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Robotically powered surgical device with manually-actuatable reversing system

Abstract

A surgical tool for use with a robotic system that includes a tool drive assembly that is operatively coupled to a control unit of the robotic system that is operable by inputs from an operator and is configured to robotically-generate output motions. A drive system is configured to interface with a corresponding portion of the tool drive assembly for receiving the robotically-generated output motions and applying the output motions to a drive shaft assembly which is configured to apply control motions to a surgical end effector operably coupled thereto. A manually-actuatable control system operably interfaces with the drive shaft assembly to facilitate the selective application of manually-generated control motions to the drive shaft assembly.

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4600037	12/1985	Hatten	N/A	N/A
4604786	12/1985	Howie, Jr.	N/A	N/A
4605001	12/1985	Rothfuss et al.	N/A	N/A
4605004	12/1985	Di Giovanni et al.	N/A	N/A
4606343	12/1985	Conta et al.	N/A	N/A
4607636	12/1985	Kula et al.	N/A	N/A
4607638	12/1985	Crainich	N/A	N/A
4608980	12/1985	Aihara	N/A	N/A
4608981	12/1985	Rothfuss et al.	N/A	N/A
4610250	12/1985	Green	N/A	N/A
4610383	12/1985	Rothfuss et al.	N/A	N/A
4612933	12/1985	Brinkerhoff et al.	N/A	N/A
D286180	12/1985	Korthoff	N/A	N/A
D286442	12/1985	Korthoff et al.	N/A	N/A
4617893	12/1985	Donner et al.	N/A	N/A
4617914	12/1985	Ueda	N/A	N/A
4617935	12/1985	Cartmell et al.	N/A	N/A
4619262	12/1985	Taylor	N/A	N/A
4619391	12/1985	Sharkany et al.	N/A	N/A
4624401	12/1985	Gassner et al.	N/A	N/A
D287278	12/1985	Spreckelmeier	N/A	N/A
4628459	12/1985	Shinohara et al.	N/A	N/A
4628636	12/1985	Folger	N/A	N/A
4629107	12/1985	Fedotov et al.	N/A	N/A
4632290	12/1985	Green et al.	N/A	N/A
4633861	12/1986	Chow et al.	N/A	N/A
4633874	12/1986	Chow et al.	N/A	N/A
4634419	12/1986	Kreizman et al.	N/A	N/A
4635638	12/1986	Weintraub et al.	N/A	N/A
4641076	12/1986	Linden	N/A	N/A
4642618	12/1986	Johnson et al.	N/A	N/A
4642738	12/1986	Meller	N/A	N/A
4643173	12/1986	Bell et al.	N/A	N/A
4643731	12/1986	Eckenhoff	N/A	N/A
4646722	12/1986	Silverstein et al.	N/A	N/A
4646745	12/1986	Noiles	N/A	N/A

4651734	12/1986	Doss et al.	N/A	N/A
4652820	12/1986	Maresca	N/A	N/A
4654028	12/1986	Suma	N/A	N/A
4655222	12/1986	Florez et al.	N/A	N/A
4662555	12/1986	Thornton	N/A	N/A
4663874	12/1986	Sano et al.	N/A	N/A
4664305	12/1986	Blake, III et al.	N/A	N/A
4665916	12/1986	Green	N/A	N/A
4667674	12/1986	Korthoff et al.	N/A	N/A
4669647	12/1986	Storace	N/A	N/A
4671278	12/1986	Chin	N/A	N/A
4671280	12/1986	Dorband et al.	N/A	N/A
4671445	12/1986	Barker et al.	N/A	N/A
4672964	12/1986	Dee et al.	N/A	N/A
4675944	12/1986	Wells	N/A	N/A
4676245	12/1986	Fukuda	N/A	N/A
4679460	12/1986	Yoshigai	N/A	N/A
4679719	12/1986	Kramer	N/A	N/A
4684051	12/1986	Akopov et al.	N/A	N/A
4688555	12/1986	Wardle	N/A	N/A
4691703	12/1986	Auth et al.	N/A	N/A
4693248	12/1986	Failla	N/A	N/A
4698579	12/1986	Richter et al.	N/A	N/A
4700703	12/1986	Resnick et al.	N/A	N/A
4705038	12/1986	Sjostrom et al.	N/A	N/A
4708141	12/1986	Inoue et al.	N/A	N/A
4709120	12/1986	Pearson	N/A	N/A
4715520	12/1986	Roehr, Jr. et al.	N/A	N/A
4719917	12/1987	Barrows et al.	N/A	N/A
4721099	12/1987	Chikama	N/A	N/A
4722340	12/1987	Takayama et al.	N/A	N/A
4724840	12/1987	McVay et al.	N/A	N/A
4726247	12/1987	Hormann	N/A	N/A
4727308	12/1987	Huljak et al.	N/A	N/A
4728020	12/1987	Green et al.	N/A	N/A
4728876	12/1987	Mongeon et al.	N/A	N/A
4729260	12/1987	Dudden	N/A	N/A
4730726	12/1987	Holzwarth	N/A	N/A
4741336	12/1987	Failla et al.	N/A	N/A
4743214	12/1987	Tai-Cheng	N/A	N/A
4744363	12/1987	Hasson	N/A	N/A
4747820	12/1987	Hornlein et al.	N/A	N/A
4750902	12/1987	Wuchinich et al.	N/A	N/A
4752024	12/1987	Green et al.	N/A	N/A
4754909	12/1987	Barker et al.	N/A	N/A
4755070	12/1987	Cerutti	N/A	N/A
4761326	12/1987	Barnes et al.	N/A	N/A
4763669	12/1987	Jaeger	N/A	N/A
4767044	12/1987	Green	N/A	N/A
D297764	12/1987	Hunt et al.	N/A	N/A

4773420	12/1987	Green	N/A	N/A
4777780	12/1987	Holzwarth	N/A	N/A
4781186	12/1987	Simpson et al.	N/A	N/A
4784137	12/1987	Kulik et al.	N/A	N/A
4787387	12/1987	Burbank, III et al.	N/A	N/A
4788485	12/1987	Kawagishi et al.	N/A	N/A
D298967	12/1987	Hunt	N/A	N/A
4788978	12/1987	Strekopytov et al.	N/A	N/A
4790225	12/1987	Moody et al.	N/A	N/A
4790314	12/1987	Weaver	N/A	N/A
4805617	12/1988	Bedi et al.	N/A	N/A
4805823	12/1988	Rothfuss	N/A	N/A
4807628	12/1988	Peters et al.	N/A	N/A
4809695	12/1988	Gwathmey et al.	N/A	N/A
4815460	12/1988	Porat et al.	N/A	N/A
4817643	12/1988	Olson	N/A	N/A
4817847	12/1988	Redtenbacher et al.	N/A	N/A
4819495	12/1988	Hormann	N/A	N/A
4819853	12/1988	Green	N/A	N/A
4821939	12/1988	Green	N/A	N/A
4827552	12/1988	Bojar et al.	N/A	N/A
4827911	12/1988	Broadwin et al.	N/A	N/A
4828542	12/1988	Hermann	N/A	N/A
4828944	12/1988	Yabe et al.	N/A	N/A
4830855	12/1988	Stewart	N/A	N/A
4832158	12/1988	Farrar et al.	N/A	N/A
4833937	12/1988	Nagano	N/A	N/A
4834096	12/1988	Oh et al.	N/A	N/A
4834720	12/1988	Blinkhorn	N/A	N/A
4838859	12/1988	Strassmann	N/A	N/A
4844068	12/1988	Arata et al.	N/A	N/A
4848637	12/1988	Pruitt	N/A	N/A
4856078	12/1988	Konopka	N/A	N/A
4860644	12/1988	Kohl et al.	N/A	N/A
4862891	12/1988	Smith	N/A	N/A
4863423	12/1988	Wallace	N/A	N/A
4865030	12/1988	Polyak	N/A	N/A
4868530	12/1988	Ahs	N/A	N/A
4868958	12/1988	Suzuki et al.	N/A	N/A
4869414	12/1988	Green et al.	N/A	N/A
4869415	12/1988	Fox	N/A	N/A
4873977	12/1988	Avant et al.	N/A	N/A
4875486	12/1988	Rapoport et al.	N/A	N/A
4880015	12/1988	Nierman	N/A	N/A
4890613	12/1989	Golden et al.	N/A	N/A
4892244	12/1989	Fox et al.	N/A	N/A
4893622	12/1989	Green et al.	N/A	N/A
4894051	12/1989	Shiber	N/A	N/A
4896584	12/1989	Stoll et al.	N/A	N/A
4896678	12/1989	Ogawa	N/A	N/A

4900303	12/1989	Lemelson	N/A	N/A
4903697	12/1989	Resnick et al.	N/A	N/A
4909789	12/1989	Taguchi et al.	N/A	N/A
4915100	12/1989	Green	N/A	N/A
4919039	12/1989	Nutter	N/A	N/A
4919679	12/1989	Averill et al.	N/A	N/A
4921479	12/1989	Grayzel	N/A	N/A
4925082	12/1989	Kim	N/A	N/A
4928699	12/1989	Sasai	N/A	N/A
4930503	12/1989	Pruitt	N/A	N/A
4930674	12/1989	Barak	N/A	N/A
4931047	12/1989	Broadwin et al.	N/A	N/A
4931737	12/1989	Hishiki	N/A	N/A
4932960	12/1989	Green et al.	N/A	N/A
4933800	12/1989	Yang	N/A	N/A
4933843	12/1989	Scheller et al.	N/A	N/A
D309350	12/1989	Sutherland et al.	N/A	N/A
4938408	12/1989	Bedi et al.	N/A	N/A
4941623	12/1989	Pruitt	N/A	N/A
4943182	12/1989	Hoblingre	N/A	N/A
4944443	12/1989	Oddsen et al.	N/A	N/A
4946067	12/1989	Kelsall	N/A	N/A
4948327	12/1989	Crupi, Jr.	N/A	N/A
4949707	12/1989	LeVahn et al.	N/A	N/A
4949927	12/1989	Madocks et al.	N/A	N/A
4950268	12/1989	Rink	N/A	N/A
4951860	12/1989	Peters et al.	N/A	N/A
4951861	12/1989	Schulze et al.	N/A	N/A
4954960	12/1989	Lo et al.	N/A	N/A
4955959	12/1989	Tompkins et al.	N/A	N/A
4957212	12/1989	Duck et al.	N/A	N/A
4962681	12/1989	Yang	N/A	N/A
4962877	12/1989	Hervas	N/A	N/A
4964559	12/1989	Deniega et al.	N/A	N/A
4964863	12/1989	Kanshin et al.	N/A	N/A
4965709	12/1989	Ngo	N/A	N/A
4970656	12/1989	Lo et al.	N/A	N/A
4973274	12/1989	Hirukawa	N/A	N/A
4973302	12/1989	Armour et al.	N/A	N/A
4976173	12/1989	Yang	N/A	N/A
4978049	12/1989	Green	N/A	N/A
4978333	12/1989	Broadwin et al.	N/A	N/A
4979952	12/1989	Kubota et al.	N/A	N/A
4984564	12/1990	Yuen	N/A	N/A
4986808	12/1990	Broadwin et al.	N/A	N/A
4987049	12/1990	Komamura et al.	N/A	N/A
4988334	12/1990	Hornlein et al.	N/A	N/A
4995877	12/1990	Ams et al.	N/A	N/A
4995959	12/1990	Metzner	N/A	N/A
4996975	12/1990	Nakamura	N/A	N/A

5001649	12/1990	Lo et al.	N/A	N/A
5002543	12/1990	Bradshaw et al.	N/A	N/A
5002553	12/1990	Shiber	N/A	N/A
5005754	12/1990	Van Overloop	N/A	N/A
5009222	12/1990	Her	N/A	N/A
5009661	12/1990	Michelson	N/A	N/A
5012411	12/1990	Policastro et al.	N/A	N/A
5014898	12/1990	Heidrich	N/A	N/A
5014899	12/1990	Presty et al.	N/A	N/A
5015227	12/1990	Broadwin et al.	N/A	N/A
5018515	12/1990	Gilman	N/A	N/A
5018657	12/1990	Pedlick et al.	N/A	N/A
5019077	12/1990	De Bastiani et al.	N/A	N/A
5024652	12/1990	Dumenek et al.	N/A	N/A
5024671	12/1990	Tu et al.	N/A	N/A
5025559	12/1990	McCullough	N/A	N/A
5027834	12/1990	Pruitt	N/A	N/A
5030226	12/1990	Green et al.	N/A	N/A
5031814	12/1990	Tompkins et al.	N/A	N/A
5033552	12/1990	Hu	N/A	N/A
5035040	12/1990	Kerrigan et al.	N/A	N/A
5037018	12/1990	Matsuda et al.	N/A	N/A
5038109	12/1990	Goble et al.	N/A	N/A
5038247	12/1990	Kelley et al.	N/A	N/A
5040715	12/1990	Green et al.	N/A	N/A
5042707	12/1990	Taheri	N/A	N/A
5056953	12/1990	Marot et al.	N/A	N/A
5060658	12/1990	Dejter, Jr. et al.	N/A	N/A
5061269	12/1990	Muller	N/A	N/A
5062491	12/1990	Takeshima et al.	N/A	N/A
5062563	12/1990	Green et al.	N/A	N/A
5065929	12/1990	Schulze et al.	N/A	N/A
5071052	12/1990	Rodak et al.	N/A	N/A
5071430	12/1990	de Salis et al.	N/A	N/A
5074454	12/1990	Peters	N/A	N/A
5077506	12/1990	Krause	N/A	N/A
5079006	12/1991	Urquhart	N/A	N/A
5080556	12/1991	Carreno	N/A	N/A
5083695	12/1991	Foslien et al.	N/A	N/A
5084057	12/1991	Green et al.	N/A	N/A
5088979	12/1991	Filipi et al.	N/A	N/A
5088997	12/1991	Delahuerga et al.	N/A	N/A
5089606	12/1991	Cole et al.	N/A	N/A
5094247	12/1991	Hernandez et al.	N/A	N/A
5098004	12/1991	Kerrigan	N/A	N/A
5098360	12/1991	Hirota	N/A	N/A
5100042	12/1991	Gravener et al.	N/A	N/A
5100420	12/1991	Green et al.	N/A	N/A
5100422	12/1991	Berguer et al.	N/A	N/A
5104025	12/1991	Main et al.	N/A	N/A

5104397	12/1991	Vasconcelos et al.	N/A	N/A
5104400	12/1991	Berguer et al.	N/A	N/A
5106008	12/1991	Tompkins et al.	N/A	N/A
5108368	12/1991	Hammerslag et al.	N/A	N/A
5109722	12/1991	Hufnagle et al.	N/A	N/A
5111987	12/1991	Moeinzadeh et al.	N/A	N/A
5116349	12/1991	Aranyi	N/A	N/A
D327323	12/1991	Hunt	N/A	N/A
5119009	12/1991	McCaleb et al.	N/A	N/A
5122156	12/1991	Granger et al.	N/A	N/A
5124990	12/1991	Williamson	N/A	N/A
5129570	12/1991	Schulze et al.	N/A	N/A
5135483	12/1991	Wagner et al.	N/A	N/A
5137198	12/1991	Nobis et al.	N/A	N/A
5139513	12/1991	Segato	N/A	N/A
5141144	12/1991	Foslien et al.	N/A	N/A
5142932	12/1991	Moya et al.	N/A	N/A
5151102	12/1991	Kamiyama et al.	N/A	N/A
5155941	12/1991	Takahashi et al.	N/A	N/A
5156151	12/1991	Imran	N/A	N/A
5156315	12/1991	Green et al.	N/A	N/A
5156609	12/1991	Nakao et al.	N/A	N/A
5156614	12/1991	Green et al.	N/A	N/A
5158222	12/1991	Green et al.	N/A	N/A
5158567	12/1991	Green	N/A	N/A
D330699	12/1991	Gill	N/A	N/A
5163598	12/1991	Peters et al.	N/A	N/A
5163842	12/1991	Nonomura	N/A	N/A
5164652	12/1991	Johnson et al.	N/A	N/A
5168605	12/1991	Bartlett	N/A	N/A
5170925	12/1991	Madden et al.	N/A	N/A
5171247	12/1991	Hughett et al.	N/A	N/A
5171249	12/1991	Stefanchik et al.	N/A	N/A
5171253	12/1991	Klieman	N/A	N/A
5173053	12/1991	Swanson et al.	N/A	N/A
5173133	12/1991	Morin et al.	N/A	N/A
5176677	12/1992	Wuchinich	N/A	N/A
5176688	12/1992	Narayan et al.	N/A	N/A
5180375	12/1992	Feibus	N/A	N/A
5181514	12/1992	Solomon et al.	N/A	N/A
5187422	12/1992	Izenbaard et al.	N/A	N/A
5188102	12/1992	Idemoto et al.	N/A	N/A
5188111	12/1992	Yates et al.	N/A	N/A
5188126	12/1992	Fabian et al.	N/A	N/A
5190517	12/1992	Zieve et al.	N/A	N/A
5190544	12/1992	Chapman et al.	N/A	N/A
5190560	12/1992	Woods et al.	N/A	N/A
5190657	12/1992	Heagle et al.	N/A	N/A
5192288	12/1992	Thompson et al.	N/A	N/A
5193731	12/1992	Aranyi	N/A	N/A

5195505	12/1992	Josefsen	N/A	N/A
5195968	12/1992	Lundquist et al.	N/A	N/A
5197648	12/1992	Gingold	N/A	N/A
5197649	12/1992	Bessler et al.	N/A	N/A
5197966	12/1992	Sommerkamp	N/A	N/A
5197970	12/1992	Green et al.	N/A	N/A
5200280	12/1992	Karasa	N/A	N/A
5201750	12/1992	Hocherl et al.	N/A	N/A
5205459	12/1992	Brinkerhoff et al.	N/A	N/A
5207672	12/1992	Roth et al.	N/A	N/A
5207697	12/1992	Carusillo et al.	N/A	N/A
5209747	12/1992	Knoepfler	N/A	N/A
5209756	12/1992	Seedhom et al.	N/A	N/A
5211649	12/1992	Kohler et al.	N/A	N/A
5211655	12/1992	Hasson	N/A	N/A
5217457	12/1992	Delahuerga et al.	N/A	N/A
5217478	12/1992	Rexroth	N/A	N/A
5219111	12/1992	Bilotti et al.	N/A	N/A
5220269	12/1992	Chen et al.	N/A	N/A
5221036	12/1992	Takase	N/A	N/A
5221281	12/1992	Klicek	N/A	N/A
5222945	12/1992	Basnight	N/A	N/A
5222963	12/1992	Brinkerhoff et al.	N/A	N/A
5222975	12/1992	Crainich	N/A	N/A
5222976	12/1992	Yoon	N/A	N/A
5223675	12/1992	Taft	N/A	N/A
D338729	12/1992	Sprecklemeier et al.	N/A	N/A
5234447	12/1992	Kaster et al.	N/A	N/A
5236269	12/1992	Handy	N/A	N/A
5236424	12/1992	Imran	N/A	N/A
5236440	12/1992	Hlavacek	N/A	N/A
5236629	12/1992	Mahabadi et al.	N/A	N/A
5239981	12/1992	Anapliotis	N/A	N/A
5240163	12/1992	Stein et al.	N/A	N/A
5242456	12/1992	Nash et al.	N/A	N/A
5242457	12/1992	Akopov et al.	N/A	N/A
5244462	12/1992	Delahuerga et al.	N/A	N/A
5246156	12/1992	Rothfuss et al.	N/A	N/A
5246443	12/1992	Mai	N/A	N/A
5251801	12/1992	Ruckdeschel et al.	N/A	N/A
5253793	12/1992	Green et al.	N/A	N/A
5258007	12/1992	Spetzler et al.	N/A	N/A
5258008	12/1992	Wilk	N/A	N/A
5258009	12/1992	Conners	N/A	N/A
5258010	12/1992	Green et al.	N/A	N/A
5258012	12/1992	Luscombe et al.	N/A	N/A
5259366	12/1992	Reydel et al.	N/A	N/A
5259835	12/1992	Clark et al.	N/A	N/A
5260637	12/1992	Pizzi	N/A	N/A
5261135	12/1992	Mitchell	N/A	N/A

5261877	12/1992	Fine et al.	N/A	N/A
5261922	12/1992	Hood	N/A	N/A
5263629	12/1992	Trumbull et al.	N/A	N/A
5263937	12/1992	Shipp	N/A	N/A
5263973	12/1992	Cook	N/A	N/A
5264218	12/1992	Rogozinski	N/A	N/A
5268622	12/1992	Philipp	N/A	N/A
5269794	12/1992	Rexroth	N/A	N/A
5271543	12/1992	Grant et al.	N/A	N/A
5271544	12/1992	Fox et al.	N/A	N/A
RE34519	12/1993	Fox et al.	N/A	N/A
5275322	12/1993	Brinkerhoff et al.	N/A	N/A
5275323	12/1993	Schulze et al.	N/A	N/A
5275608	12/1993	Forman et al.	N/A	N/A
5279416	12/1993	Malec et al.	N/A	N/A
5281216	12/1993	Klicek	N/A	N/A
5281400	12/1993	Berry, Jr.	N/A	N/A
5282806	12/1993	Haber et al.	N/A	N/A
5282826	12/1993	Quadri	N/A	N/A
5282829	12/1993	Hermes	N/A	N/A
5284128	12/1993	Hart	N/A	N/A
5285381	12/1993	Iskarous et al.	N/A	N/A
5285945	12/1993	Brinkerhoff et al.	N/A	N/A
5286253	12/1993	Fucci	N/A	N/A
5289963	12/1993	McGarry et al.	N/A	N/A
5290271	12/1993	Jernberg	N/A	N/A
5290310	12/1993	Makower et al.	N/A	N/A
5291133	12/1993	Gokhale et al.	N/A	N/A
5292053	12/1993	Bilotti et al.	N/A	N/A
5293024	12/1993	Sugahara et al.	N/A	N/A
5297714	12/1993	Kramer	N/A	N/A
5300087	12/1993	Knoepfler	N/A	N/A
5302148	12/1993	Heinz	N/A	N/A
5303606	12/1993	Kokinda	N/A	N/A
5304204	12/1993	Bregen	N/A	N/A
D347474	12/1993	Olson	N/A	N/A
5307976	12/1993	Olson et al.	N/A	N/A
5308353	12/1993	Beurrier	N/A	N/A
5308358	12/1993	Bond et al.	N/A	N/A
5308576	12/1993	Green et al.	N/A	N/A
5309387	12/1993	Mori et al.	N/A	N/A
5309927	12/1993	Welch	N/A	N/A
5312023	12/1993	Green et al.	N/A	N/A
5312024	12/1993	Grant et al.	N/A	N/A
5312329	12/1993	Beaty et al.	N/A	N/A
5313935	12/1993	Kortenbach et al.	N/A	N/A
5313967	12/1993	Lieber et al.	N/A	N/A
5314424	12/1993	Nicholas	N/A	N/A
5314445	12/1993	Heidmueller et al.	N/A	N/A
5314466	12/1993	Stern et al.	N/A	N/A

5318221	12/1993	Green et al.	N/A	N/A
5318589	12/1993	Lichtman	N/A	N/A
5320627	12/1993	Sorensen et al.	N/A	N/A
D348930	12/1993	Olson	N/A	N/A
5326013	12/1993	Green et al.	N/A	N/A
5329923	12/1993	Lundquist	N/A	N/A
5330486	12/1993	Wilk	N/A	N/A
5330487	12/1993	Thornton et al.	N/A	N/A
5330502	12/1993	Hassler et al.	N/A	N/A
5331971	12/1993	Bales et al.	N/A	N/A
5332142	12/1993	Robinson et al.	N/A	N/A
5333422	12/1993	Warren et al.	N/A	N/A
5333772	12/1993	Rothfuss et al.	N/A	N/A
5333773	12/1993	Main et al.	N/A	N/A
5334183	12/1993	Wuchinich	N/A	N/A
5336130	12/1993	Ray	N/A	N/A
5336229	12/1993	Noda	N/A	N/A
5336232	12/1993	Green et al.	N/A	N/A
5338317	12/1993	Hasson et al.	N/A	N/A
5339799	12/1993	Kami et al.	N/A	N/A
5341724	12/1993	Vatel	N/A	N/A
5341807	12/1993	Nardella	N/A	N/A
5341810	12/1993	Dardel	N/A	N/A
5342380	12/1993	Hood	N/A	N/A
5342381	12/1993	Tidemand	N/A	N/A
5342385	12/1993	Norelli et al.	N/A	N/A
5342395	12/1993	Jarrett et al.	N/A	N/A
5342396	12/1993	Cook	N/A	N/A
5343382	12/1993	Hale et al.	N/A	N/A
5343391	12/1993	Mushabac	N/A	N/A
5344059	12/1993	Green et al.	N/A	N/A
5344060	12/1993	Gravener et al.	N/A	N/A
5344454	12/1993	Clarke et al.	N/A	N/A
5346504	12/1993	Ortiz et al.	N/A	N/A
5348259	12/1993	Blanco et al.	N/A	N/A
5350104	12/1993	Main et al.	N/A	N/A
5350355	12/1993	Sklar	N/A	N/A
5350388	12/1993	Epstein	N/A	N/A
5350391	12/1993	Iacovelli	N/A	N/A
5350400	12/1993	Esposito et al.	N/A	N/A
5352229	12/1993	Goble et al.	N/A	N/A
5352235	12/1993	Koros et al.	N/A	N/A
5352238	12/1993	Green et al.	N/A	N/A
5353798	12/1993	Sieben	N/A	N/A
5354215	12/1993	Viracola	N/A	N/A
5354250	12/1993	Christensen	N/A	N/A
5354303	12/1993	Spaeth et al.	N/A	N/A
5355897	12/1993	Pietrafitta et al.	N/A	N/A
5356006	12/1993	Alpern et al.	N/A	N/A
5356064	12/1993	Green et al.	N/A	N/A

5358506	12/1993	Green et al.	N/A	N/A
5358510	12/1993	Luscombe et al.	N/A	N/A
5359231	12/1993	Flowers et al.	N/A	N/A
D352780	12/1993	Glaeser et al.	N/A	N/A
5359993	12/1993	Slater et al.	N/A	N/A
5360305	12/1993	Kerrigan	N/A	N/A
5360428	12/1993	Hutchinson, Jr.	N/A	N/A
5361902	12/1993	Abidin et al.	N/A	N/A
5364001	12/1993	Bryan	N/A	N/A
5364002	12/1993	Green et al.	N/A	N/A
5364003	12/1993	Williamson, IV	N/A	N/A
5366133	12/1993	Geiste	N/A	N/A
5366134	12/1993	Green et al.	N/A	N/A
5366479	12/1993	McGarry et al.	N/A	N/A
5368015	12/1993	Wilk	N/A	N/A
5368592	12/1993	Stern et al.	N/A	N/A
5368599	12/1993	Hirsch et al.	N/A	N/A
5369565	12/1993	Chen et al.	N/A	N/A
5370645	12/1993	Klicek et al.	N/A	N/A
5372124	12/1993	Takayama et al.	N/A	N/A
5372596	12/1993	Klicek et al.	N/A	N/A
5372602	12/1993	Burke	N/A	N/A
5374277	12/1993	Hassler	N/A	N/A
5375588	12/1993	Yoon	N/A	N/A
5376095	12/1993	Ortiz	N/A	N/A
5379933	12/1994	Green et al.	N/A	N/A
5381649	12/1994	Webb	N/A	N/A
5381782	12/1994	DeLaRama et al.	N/A	N/A
5381943	12/1994	Allen et al.	N/A	N/A
5382247	12/1994	Cimino et al.	N/A	N/A
5383460	12/1994	Jang et al.	N/A	N/A
5383738	12/1994	Herbermann	N/A	N/A
5383874	12/1994	Jackson et al.	N/A	N/A
5383880	12/1994	Hooven	N/A	N/A
5383881	12/1994	Green et al.	N/A	N/A
5383882	12/1994	Buess et al.	N/A	N/A
5383888	12/1994	Zvenyatsky et al.	N/A	N/A
5383895	12/1994	Holmes et al.	N/A	N/A
5388568	12/1994	van der Heide	N/A	N/A
5388748	12/1994	Davignon et al.	N/A	N/A
5389072	12/1994	Imran	N/A	N/A
5389098	12/1994	Tsuruta et al.	N/A	N/A
5389102	12/1994	Green et al.	N/A	N/A
5389104	12/1994	Hahnen et al.	N/A	N/A
5391180	12/1994	Tovey et al.	N/A	N/A
5392979	12/1994	Green et al.	N/A	N/A
5395030	12/1994	Kuramoto et al.	N/A	N/A
5395033	12/1994	Byrne et al.	N/A	N/A
5395034	12/1994	Allen et al.	N/A	N/A
5395312	12/1994	Desai	N/A	N/A

5395384	12/1994	Duthoit et al.	N/A	N/A
5397046	12/1994	Savage et al.	N/A	N/A
5397324	12/1994	Carroll et al.	N/A	N/A
5400267	12/1994	Denen et al.	N/A	N/A
5403276	12/1994	Schechter et al.	N/A	N/A
5403312	12/1994	Yates et al.	N/A	N/A
5404106	12/1994	Matsuda	N/A	N/A
5404870	12/1994	Brinkerhoff et al.	N/A	N/A
5404960	12/1994	Wada et al.	N/A	N/A
5405072	12/1994	Zlock et al.	N/A	N/A
5405073	12/1994	Porter	N/A	N/A
5405344	12/1994	Williamson et al.	N/A	N/A
5405360	12/1994	Tovey	N/A	N/A
5407293	12/1994	Crainich	N/A	N/A
5408409	12/1994	Glassman et al.	N/A	N/A
5409498	12/1994	Braddock et al.	N/A	N/A
5409703	12/1994	McAnalley et al.	N/A	N/A
D357981	12/1994	Green et al.	N/A	N/A
5411481	12/1994	Allen et al.	N/A	N/A
5411508	12/1994	Bessler et al.	N/A	N/A
5413107	12/1994	Oakley et al.	N/A	N/A
5413267	12/1994	Solyntjes et al.	N/A	N/A
5413268	12/1994	Green et al.	N/A	N/A
5413272	12/1994	Green et al.	N/A	N/A
5413573	12/1994	Koivukangas	N/A	N/A
5415334	12/1994	Williamson et al.	N/A	N/A
5415335	12/1994	Knodell, Jr.	N/A	N/A
5417203	12/1994	Tovey et al.	N/A	N/A
5417361	12/1994	Williamson, IV	N/A	N/A
5419766	12/1994	Chang et al.	N/A	N/A
5421829	12/1994	Olichney et al.	N/A	N/A
5422567	12/1994	Matsunaga	N/A	N/A
5423471	12/1994	Mastri et al.	N/A	N/A
5423809	12/1994	Klicek	N/A	N/A
5423835	12/1994	Green et al.	N/A	N/A
5425355	12/1994	Kulick	N/A	N/A
5425745	12/1994	Green et al.	N/A	N/A
5427298	12/1994	Tegtmeier	N/A	N/A
5431322	12/1994	Green et al.	N/A	N/A
5431323	12/1994	Smith et al.	N/A	N/A
5431645	12/1994	Smith et al.	N/A	N/A
5431654	12/1994	Nic	N/A	N/A
5431666	12/1994	Sauer et al.	N/A	N/A
5431668	12/1994	Burbank, III et al.	N/A	N/A
5433721	12/1994	Hooven et al.	N/A	N/A
5437681	12/1994	Meade et al.	N/A	N/A
5438302	12/1994	Goble	N/A	N/A
5438997	12/1994	Sieben et al.	N/A	N/A
5439155	12/1994	Viola	N/A	N/A
5439156	12/1994	Grant et al.	N/A	N/A

5439479	12/1994	Shichman et al.	N/A	N/A
5441191	12/1994	Linden	N/A	N/A
5441193	12/1994	Gravener	N/A	N/A
5441483	12/1994	Avitall	N/A	N/A
5441494	12/1994	Ortiz	N/A	N/A
5441499	12/1994	Fritzsch	N/A	N/A
5443197	12/1994	Malis et al.	N/A	N/A
5443198	12/1994	Viola et al.	N/A	N/A
5443463	12/1994	Stern et al.	N/A	N/A
5444113	12/1994	Sinclair et al.	N/A	N/A
5445155	12/1994	Sieben	N/A	N/A
5445304	12/1994	Plyley et al.	N/A	N/A
5445604	12/1994	Lang	N/A	N/A
5445644	12/1994	Pietrafitta et al.	N/A	N/A
5446646	12/1994	Miyazaki	N/A	N/A
5447265	12/1994	Vidal et al.	N/A	N/A
5447417	12/1994	Kuhl et al.	N/A	N/A
5447513	12/1994	Davison et al.	N/A	N/A
5449355	12/1994	Rhum et al.	N/A	N/A
5449365	12/1994	Green et al.	N/A	N/A
5449370	12/1994	Vaitekunas	N/A	N/A
5452836	12/1994	Huitema et al.	N/A	N/A
5452837	12/1994	Williamson, IV et al.	N/A	N/A
5454378	12/1994	Palmer et al.	N/A	N/A
5454822	12/1994	Schob et al.	N/A	N/A
5454824	12/1994	Fontayne et al.	N/A	N/A
5454827	12/1994	Aust et al.	N/A	N/A
5456401	12/1994	Green et al.	N/A	N/A
5456917	12/1994	Wise et al.	N/A	N/A
5458279	12/1994	Plyley	N/A	N/A
5458579	12/1994	Chodorow et al.	N/A	N/A
5462215	12/1994	Viola et al.	N/A	N/A
5464013	12/1994	Lemelson	N/A	N/A
5464144	12/1994	Guy et al.	N/A	N/A
5464300	12/1994	Crainich	N/A	N/A
5465819	12/1994	Weilant et al.	N/A	N/A
5465894	12/1994	Clark et al.	N/A	N/A
5465895	12/1994	Knodel et al.	N/A	N/A
5465896	12/1994	Allen et al.	N/A	N/A
5466020	12/1994	Page et al.	N/A	N/A
5467911	12/1994	Tsuruta et al.	N/A	N/A
5468253	12/1994	Bezwada et al.	N/A	N/A
5470006	12/1994	Rodak	N/A	N/A
5470007	12/1994	Plyley et al.	N/A	N/A
5470008	12/1994	Rodak	N/A	N/A
5470009	12/1994	Rodak	N/A	N/A
5470010	12/1994	Rothfuss et al.	N/A	N/A
5471129	12/1994	Mann	N/A	N/A
5472132	12/1994	Savage et al.	N/A	N/A

5472442	12/1994	Klicek	N/A	N/A
5473204	12/1994	Temple	N/A	N/A
5474057	12/1994	Makower et al.	N/A	N/A
5474223	12/1994	Viola et al.	N/A	N/A
5474566	12/1994	Alesi et al.	N/A	N/A
5474570	12/1994	Kockerling et al.	N/A	N/A
5474738	12/1994	Nichols et al.	N/A	N/A
5476206	12/1994	Green et al.	N/A	N/A
5476479	12/1994	Green et al.	N/A	N/A
5476481	12/1994	Schondorf	N/A	N/A
5478003	12/1994	Green et al.	N/A	N/A
5478308	12/1994	Cartmell et al.	N/A	N/A
5478354	12/1994	Tovey et al.	N/A	N/A
5480089	12/1995	Blewett	N/A	N/A
5480409	12/1995	Riza	N/A	N/A
5482197	12/1995	Green et al.	N/A	N/A
5483952	12/1995	Aranyi	N/A	N/A
5484095	12/1995	Green et al.	N/A	N/A
5484398	12/1995	Stoddard	N/A	N/A
5484451	12/1995	Akopov et al.	N/A	N/A
5485947	12/1995	Olson et al.	N/A	N/A
5485952	12/1995	Fontayne	N/A	N/A
5487377	12/1995	Smith et al.	N/A	N/A
5487499	12/1995	Sorrentino et al.	N/A	N/A
5487500	12/1995	Knodel et al.	N/A	N/A
5489058	12/1995	Plyley et al.	N/A	N/A
5489256	12/1995	Adair	N/A	N/A
5489290	12/1995	Furnish	N/A	N/A
5490819	12/1995	Nicholas et al.	N/A	N/A
5492671	12/1995	Krafft	N/A	N/A
5496312	12/1995	Klicek	N/A	N/A
5496317	12/1995	Goble et al.	N/A	N/A
5497933	12/1995	DeFonzo et al.	N/A	N/A
5498164	12/1995	Ward et al.	N/A	N/A
5498838	12/1995	Furman	N/A	N/A
5501654	12/1995	Failla et al.	N/A	N/A
5503320	12/1995	Webster et al.	N/A	N/A
5503635	12/1995	Sauer et al.	N/A	N/A
5503638	12/1995	Cooper et al.	N/A	N/A
5505363	12/1995	Green et al.	N/A	N/A
5507425	12/1995	Ziglioli	N/A	N/A
5507426	12/1995	Young et al.	N/A	N/A
5507773	12/1995	Huitema et al.	N/A	N/A
5508080	12/1995	Sorimachi et al.	N/A	N/A
5509596	12/1995	Green et al.	N/A	N/A
5509916	12/1995	Taylor	N/A	N/A
5509918	12/1995	Romano	N/A	N/A
5510138	12/1995	Sanftleben et al.	N/A	N/A
5511564	12/1995	Wilk	N/A	N/A
5514129	12/1995	Smith	N/A	N/A

5514149	12/1995	Green et al.	N/A	N/A
5514157	12/1995	Nicholas et al.	N/A	N/A
5518163	12/1995	Hooven	N/A	N/A
5518164	12/1995	Hooven	N/A	N/A
5520609	12/1995	Moll et al.	N/A	N/A
5520634	12/1995	Fox et al.	N/A	N/A
5520678	12/1995	Heckele et al.	N/A	N/A
5520700	12/1995	Beyar et al.	N/A	N/A
5522817	12/1995	Sander et al.	N/A	N/A
5522831	12/1995	Sleister et al.	N/A	N/A
5527264	12/1995	Moll et al.	N/A	N/A
5527320	12/1995	Carruthers et al.	N/A	N/A
5529235	12/1995	Boiarski et al.	N/A	N/A
D372086	12/1995	Grasso et al.	N/A	N/A
5531305	12/1995	Roberts et al.	N/A	N/A
5531744	12/1995	Nardella et al.	N/A	N/A
5531856	12/1995	Moll et al.	N/A	N/A
5533521	12/1995	Granger	N/A	N/A
5533581	12/1995	Barth et al.	N/A	N/A
5533661	12/1995	Main et al.	N/A	N/A
5535934	12/1995	Boiarski et al.	N/A	N/A
5535935	12/1995	Vidal et al.	N/A	N/A
5535937	12/1995	Boiarski et al.	N/A	N/A
5540375	12/1995	Bolanos et al.	N/A	N/A
5540705	12/1995	Meade et al.	N/A	N/A
5541376	12/1995	Ladtkow et al.	N/A	N/A
5541489	12/1995	Dunstan	N/A	N/A
5542594	12/1995	McKean et al.	N/A	N/A
5542945	12/1995	Fritzsch	N/A	N/A
5542949	12/1995	Yoon	N/A	N/A
5543119	12/1995	Sutter et al.	N/A	N/A
5543695	12/1995	Culp et al.	N/A	N/A
5544802	12/1995	Crainich	N/A	N/A
5547117	12/1995	Hamblin et al.	N/A	N/A
5549583	12/1995	Sanford et al.	N/A	N/A
5549621	12/1995	Bessler et al.	N/A	N/A
5549627	12/1995	Kieturakis	N/A	N/A
5549628	12/1995	Cooper et al.	N/A	N/A
5549637	12/1995	Crainich	N/A	N/A
5551622	12/1995	Yoon	N/A	N/A
5553624	12/1995	Francese et al.	N/A	N/A
5553675	12/1995	Pitzen et al.	N/A	N/A
5553765	12/1995	Knodel et al.	N/A	N/A
5554148	12/1995	Aebischer et al.	N/A	N/A
5554169	12/1995	Green et al.	N/A	N/A
5556020	12/1995	Hou	N/A	N/A
5556416	12/1995	Clark et al.	N/A	N/A
5558533	12/1995	Hashizawa et al.	N/A	N/A
5558665	12/1995	Kieturakis	N/A	N/A
5558671	12/1995	Yates	N/A	N/A

5560530	12/1995	Bolanos et al.	N/A	N/A
5560532	12/1995	DeFonzo et al.	N/A	N/A
5561881	12/1995	Klinger et al.	N/A	N/A
5562239	12/1995	Boiarski et al.	N/A	N/A
5562241	12/1995	Knodel et al.	N/A	N/A
5562682	12/1995	Oberlin et al.	N/A	N/A
5562690	12/1995	Green et al.	N/A	N/A
5562694	12/1995	Sauer et al.	N/A	N/A
5562701	12/1995	Huitema et al.	N/A	N/A
5562702	12/1995	Huitema et al.	N/A	N/A
5563481	12/1995	Krause	N/A	N/A
5564615	12/1995	Bishop et al.	N/A	N/A
5569161	12/1995	Ebling et al.	N/A	N/A
5569270	12/1995	Weng	N/A	N/A
5569284	12/1995	Young et al.	N/A	N/A
5571090	12/1995	Sherts	N/A	N/A
5571100	12/1995	Goble et al.	N/A	N/A
5571116	12/1995	Bolanos et al.	N/A	N/A
5571285	12/1995	Chow et al.	N/A	N/A
5571488	12/1995	Beerstecher et al.	N/A	N/A
5573169	12/1995	Green et al.	N/A	N/A
5573543	12/1995	Akopov et al.	N/A	N/A
5574431	12/1995	Mckeown et al.	N/A	N/A
5575054	12/1995	Klinzing et al.	N/A	N/A
5575789	12/1995	Bell et al.	N/A	N/A
5575799	12/1995	Bolanos et al.	N/A	N/A
5575803	12/1995	Cooper et al.	N/A	N/A
5575805	12/1995	Li	N/A	N/A
5577654	12/1995	Bishop	N/A	N/A
5578052	12/1995	Koros et al.	N/A	N/A
5579978	12/1995	Green et al.	N/A	N/A
5580067	12/1995	Hamblin et al.	N/A	N/A
5582611	12/1995	Tsuruta et al.	N/A	N/A
5582617	12/1995	Klieman et al.	N/A	N/A
5582907	12/1995	Pall	N/A	N/A
5583114	12/1995	Barrows et al.	N/A	N/A
5584425	12/1995	Savage et al.	N/A	N/A
5586711	12/1995	Plyley et al.	N/A	N/A
5588579	12/1995	Schnut et al.	N/A	N/A
5588580	12/1995	Paul et al.	N/A	N/A
5588581	12/1995	Conlon et al.	N/A	N/A
5591170	12/1996	Spievack et al.	N/A	N/A
5591187	12/1996	Dekel	N/A	N/A
5597107	12/1996	Knodel et al.	N/A	N/A
5599151	12/1996	Daum et al.	N/A	N/A
5599279	12/1996	Slotman et al.	N/A	N/A
5599344	12/1996	Paterson	N/A	N/A
5599350	12/1996	Schulze et al.	N/A	N/A
5599852	12/1996	Scopelianos et al.	N/A	N/A
5601224	12/1996	Bishop et al.	N/A	N/A

5601573	12/1996	Fogelberg et al.	N/A	N/A
5601604	12/1996	Vincent	N/A	N/A
5602449	12/1996	Krause et al.	N/A	N/A
5603443	12/1996	Clark et al.	N/A	N/A
5605272	12/1996	Witt et al.	N/A	N/A
5605273	12/1996	Hamblin et al.	N/A	N/A
5607094	12/1996	Clark et al.	N/A	N/A
5607095	12/1996	Smith et al.	N/A	N/A
5607303	12/1996	Nakamura	N/A	N/A
5607433	12/1996	Polla et al.	N/A	N/A
5607436	12/1996	Pratt et al.	N/A	N/A
5607450	12/1996	Zvenyatsky et al.	N/A	N/A
5607474	12/1996	Athanasiou et al.	N/A	N/A
5609285	12/1996	Grant et al.	N/A	N/A
5609601	12/1996	Kolesa et al.	N/A	N/A
5611709	12/1996	McAnulty	N/A	N/A
5611813	12/1996	Lichtman	N/A	N/A
5613499	12/1996	Palmer et al.	N/A	N/A
5613937	12/1996	Garrison et al.	N/A	N/A
5613966	12/1996	Makower et al.	N/A	N/A
5614887	12/1996	Buchbinder	N/A	N/A
5615820	12/1996	Viola	N/A	N/A
5618294	12/1996	Aust et al.	N/A	N/A
5618303	12/1996	Marlow et al.	N/A	N/A
5618307	12/1996	Donlon et al.	N/A	N/A
5619992	12/1996	Guthrie et al.	N/A	N/A
5620289	12/1996	Curry	N/A	N/A
5620326	12/1996	Younker	N/A	N/A
5620415	12/1996	Lucey et al.	N/A	N/A
5620452	12/1996	Yoon	N/A	N/A
5624398	12/1996	Smith et al.	N/A	N/A
5624452	12/1996	Yates	N/A	N/A
5626587	12/1996	Bishop et al.	N/A	N/A
5626595	12/1996	Sklar et al.	N/A	N/A
5626979	12/1996	Mitsui et al.	N/A	N/A
5628446	12/1996	Geiste et al.	N/A	N/A
5628743	12/1996	Cimino	N/A	N/A
5628745	12/1996	Bek	N/A	N/A
5630539	12/1996	Plyley et al.	N/A	N/A
5630540	12/1996	Blewett	N/A	N/A
5630541	12/1996	Williamson, IV et al.	N/A	N/A
5630782	12/1996	Adair	N/A	N/A
5631973	12/1996	Green	N/A	N/A
5632432	12/1996	Schulze et al.	N/A	N/A
5632433	12/1996	Grant et al.	N/A	N/A
5633374	12/1996	Humphrey et al.	N/A	N/A
5634584	12/1996	Okorocha et al.	N/A	N/A
5636779	12/1996	Palmer	N/A	N/A
5636780	12/1996	Green et al.	N/A	N/A

5637110	12/1996	Pennybacker et al.	N/A	N/A
5638582	12/1996	Klatt et al.	N/A	N/A
5639008	12/1996	Gallagher et al.	N/A	N/A
D381077	12/1996	Hunt	N/A	N/A
5643291	12/1996	Pier et al.	N/A	N/A
5643293	12/1996	Kogasaka et al.	N/A	N/A
5643294	12/1996	Tovey et al.	N/A	N/A
5643319	12/1996	Green et al.	N/A	N/A
5645209	12/1996	Green et al.	N/A	N/A
5647526	12/1996	Green et al.	N/A	N/A
5647869	12/1996	Goble et al.	N/A	N/A
5649937	12/1996	Bito et al.	N/A	N/A
5649956	12/1996	Jensen et al.	N/A	N/A
5651491	12/1996	Heaton et al.	N/A	N/A
5651762	12/1996	Bridges	N/A	N/A
5651821	12/1996	Uchida	N/A	N/A
5653373	12/1996	Green et al.	N/A	N/A
5653374	12/1996	Young et al.	N/A	N/A
5653677	12/1996	Okada et al.	N/A	N/A
5653721	12/1996	Knodel et al.	N/A	N/A
5653748	12/1996	Strecker	N/A	N/A
5655698	12/1996	Yoon	N/A	N/A
5656917	12/1996	Theobald	N/A	N/A
5657417	12/1996	Di Troia	N/A	N/A
5657429	12/1996	Wang et al.	N/A	N/A
5657921	12/1996	Young et al.	N/A	N/A
5658238	12/1996	Suzuki et al.	N/A	N/A
5658281	12/1996	Heard	N/A	N/A
5658298	12/1996	Vincent et al.	N/A	N/A
5658300	12/1996	Bito et al.	N/A	N/A
5658307	12/1996	Exconde	N/A	N/A
5662258	12/1996	Knodel et al.	N/A	N/A
5662260	12/1996	Yoon	N/A	N/A
5662662	12/1996	Bishop et al.	N/A	N/A
5662667	12/1996	Knodel	N/A	N/A
5664404	12/1996	Ivanov et al.	N/A	N/A
5665085	12/1996	Nardella	N/A	N/A
5667517	12/1996	Hooven	N/A	N/A
5667526	12/1996	Levin	N/A	N/A
5667527	12/1996	Cook	N/A	N/A
5667864	12/1996	Landoll	N/A	N/A
5669544	12/1996	Schulze et al.	N/A	N/A
5669904	12/1996	Platt, Jr. et al.	N/A	N/A
5669907	12/1996	Platt, Jr. et al.	N/A	N/A
5669918	12/1996	Balazs et al.	N/A	N/A
5672945	12/1996	Krause	N/A	N/A
5673840	12/1996	Schulze et al.	N/A	N/A
5673841	12/1996	Schulze et al.	N/A	N/A
5673842	12/1996	Bittner et al.	N/A	N/A
5674184	12/1996	Hassler, Jr.	N/A	N/A

5674286	12/1996	D'Alessio et al.	N/A	N/A
5678748	12/1996	Plyley et al.	N/A	N/A
5680981	12/1996	Mililli et al.	N/A	N/A
5680982	12/1996	Schulze et al.	N/A	N/A
5680983	12/1996	Plyley et al.	N/A	N/A
5681341	12/1996	Lunsford et al.	N/A	N/A
5683349	12/1996	Makower et al.	N/A	N/A
5683432	12/1996	Goedeke et al.	N/A	N/A
5685474	12/1996	Seeber	N/A	N/A
5686090	12/1996	Schilder et al.	N/A	N/A
5688270	12/1996	Yates et al.	N/A	N/A
5690269	12/1996	Bolanos et al.	N/A	N/A
5690675	12/1996	Sawyer et al.	N/A	N/A
5692668	12/1996	Schulze et al.	N/A	N/A
5693020	12/1996	Rauh	N/A	N/A
5693042	12/1996	Boiarski et al.	N/A	N/A
5693051	12/1996	Schulze et al.	N/A	N/A
5695494	12/1996	Becker	N/A	N/A
5695502	12/1996	Pier et al.	N/A	N/A
5695504	12/1996	Gifford, III et al.	N/A	N/A
5695524	12/1996	Kelley et al.	N/A	N/A
5697542	12/1996	Knodel et al.	N/A	N/A
5697543	12/1996	Burdorff	N/A	N/A
5697909	12/1996	Eggers et al.	N/A	N/A
5697943	12/1996	Sauer et al.	N/A	N/A
5700265	12/1996	Romano	N/A	N/A
5700270	12/1996	Peyser et al.	N/A	N/A
5700276	12/1996	Benecke	N/A	N/A
5702387	12/1996	Arts et al.	N/A	N/A
5702408	12/1996	Wales et al.	N/A	N/A
5702409	12/1996	Rayburn et al.	N/A	N/A
5704087	12/1997	Strub	N/A	N/A
5704534	12/1997	Huitema et al.	N/A	N/A
5704792	12/1997	Sobhani	N/A	N/A
5706997	12/1997	Green et al.	N/A	N/A
5706998	12/1997	Plyley et al.	N/A	N/A
5707392	12/1997	Kortenbach	N/A	N/A
5709334	12/1997	Sorrentino et al.	N/A	N/A
5709335	12/1997	Heck	N/A	N/A
5709680	12/1997	Yates et al.	N/A	N/A
5709706	12/1997	Kienzle et al.	N/A	N/A
5711472	12/1997	Bryan	N/A	N/A
5711960	12/1997	Shikinami	N/A	N/A
5712460	12/1997	Carr et al.	N/A	N/A
5713128	12/1997	Schrenk et al.	N/A	N/A
5713505	12/1997	Huitema	N/A	N/A
5713895	12/1997	Lontine et al.	N/A	N/A
5713896	12/1997	Nardella	N/A	N/A
5713920	12/1997	Bezwada et al.	N/A	N/A
5715604	12/1997	Lanzoni	N/A	N/A

5715836	12/1997	Kliegis et al.	N/A	N/A
5715987	12/1997	Kelley et al.	N/A	N/A
5715988	12/1997	Palmer	N/A	N/A
5716352	12/1997	Viola et al.	N/A	N/A
5716366	12/1997	Yates	N/A	N/A
5718359	12/1997	Palmer et al.	N/A	N/A
5718360	12/1997	Green et al.	N/A	N/A
5718548	12/1997	Cotellessa	N/A	N/A
5718714	12/1997	Livneh	N/A	N/A
5720744	12/1997	Eggleston et al.	N/A	N/A
D393067	12/1997	Geary et al.	N/A	N/A
5724025	12/1997	Tavori	N/A	N/A
5725536	12/1997	Oberlin et al.	N/A	N/A
5725554	12/1997	Simon et al.	N/A	N/A
5728110	12/1997	Vidal et al.	N/A	N/A
5728113	12/1997	Sherts	N/A	N/A
5728121	12/1997	Bimbo et al.	N/A	N/A
5730758	12/1997	Allgeyer	N/A	N/A
5732712	12/1997	Adair	N/A	N/A
5732821	12/1997	Stone et al.	N/A	N/A
5732871	12/1997	Clark et al.	N/A	N/A
5732872	12/1997	Bolduc et al.	N/A	N/A
5733308	12/1997	Daugherty et al.	N/A	N/A
5735445	12/1997	Vidal et al.	N/A	N/A
5735848	12/1997	Yates et al.	N/A	N/A
5735874	12/1997	Measamer et al.	N/A	N/A
5736271	12/1997	Cisar et al.	N/A	N/A
5738474	12/1997	Blewett	N/A	N/A
5738629	12/1997	Moll et al.	N/A	N/A
5738648	12/1997	Lands et al.	N/A	N/A
5741271	12/1997	Nakao et al.	N/A	N/A
5743456	12/1997	Jones et al.	N/A	N/A
5746770	12/1997	Zeitels et al.	N/A	N/A
5747953	12/1997	Philipp	N/A	N/A
5749889	12/1997	Bacich et al.	N/A	N/A
5749893	12/1997	Vidal et al.	N/A	N/A
5749896	12/1997	Cook	N/A	N/A
5749968	12/1997	Melanson et al.	N/A	N/A
5752644	12/1997	Bolanos et al.	N/A	N/A
5752965	12/1997	Francis et al.	N/A	N/A
5752970	12/1997	Yoon	N/A	N/A
5752973	12/1997	Kieturakis	N/A	N/A
5755717	12/1997	Yates et al.	N/A	N/A
5755726	12/1997	Pratt et al.	N/A	N/A
5758814	12/1997	Gallagher et al.	N/A	N/A
5762255	12/1997	Chrisman et al.	N/A	N/A
5762256	12/1997	Mastri et al.	N/A	N/A
5762458	12/1997	Wang et al.	N/A	N/A
5765565	12/1997	Adair	N/A	N/A
5766186	12/1997	Faraz et al.	N/A	N/A

5766188	12/1997	Igaki	N/A	N/A
5766205	12/1997	Zvenyatsky et al.	N/A	N/A
5769303	12/1997	Knodel et al.	N/A	N/A
5769640	12/1997	Jacobus et al.	N/A	N/A
5769748	12/1997	Eyerly et al.	N/A	N/A
5769791	12/1997	Benaron et al.	N/A	N/A
5769892	12/1997	Kingwell	N/A	N/A
5772099	12/1997	Gravener	N/A	N/A
5772379	12/1997	Evensen	N/A	N/A
5772578	12/1997	Heimberger et al.	N/A	N/A
5772659	12/1997	Becker et al.	N/A	N/A
5773991	12/1997	Chen	N/A	N/A
5776130	12/1997	Buysse et al.	N/A	N/A
5778939	12/1997	Hok-Yin	N/A	N/A
5779130	12/1997	Alesi et al.	N/A	N/A
5779131	12/1997	Knodel et al.	N/A	N/A
5779132	12/1997	Knodel et al.	N/A	N/A
5782396	12/1997	Mastri et al.	N/A	N/A
5782397	12/1997	Koukline	N/A	N/A
5782748	12/1997	Palmer et al.	N/A	N/A
5782749	12/1997	Riza	N/A	N/A
5782859	12/1997	Nicholas et al.	N/A	N/A
5784934	12/1997	Izumisawa	N/A	N/A
5785232	12/1997	Vidal et al.	N/A	N/A
5785647	12/1997	Tompkins et al.	N/A	N/A
5787897	12/1997	Kieturakis	N/A	N/A
5791231	12/1997	Cohn et al.	N/A	N/A
5792135	12/1997	Madhani et al.	N/A	N/A
5792162	12/1997	Jolly et al.	N/A	N/A
5792165	12/1997	Klieman et al.	N/A	N/A
5792573	12/1997	Pitzen et al.	N/A	N/A
5794834	12/1997	Hamblin et al.	N/A	N/A
5796188	12/1997	Bays	N/A	N/A
5797536	12/1997	Smith et al.	N/A	N/A
5797537	12/1997	Oberlin et al.	N/A	N/A
5797538	12/1997	Heaton et al.	N/A	N/A
5797637	12/1997	Ervin	N/A	N/A
5797900	12/1997	Madhani et al.	N/A	N/A
5797906	12/1997	Rhum et al.	N/A	N/A
5797927	12/1997	Yoon	N/A	N/A
5797941	12/1997	Schulze et al.	N/A	N/A
5797959	12/1997	Castro et al.	N/A	N/A
5798752	12/1997	Buxton et al.	N/A	N/A
5799857	12/1997	Robertson et al.	N/A	N/A
5800379	12/1997	Edwards	N/A	N/A
5800423	12/1997	Jensen	N/A	N/A
5804726	12/1997	Geib et al.	N/A	N/A
5804936	12/1997	Brodsky et al.	N/A	N/A
5806676	12/1997	Wasgien	N/A	N/A
5807241	12/1997	Heimberger	N/A	N/A

5807376	12/1997	Viola et al.	N/A	N/A
5807378	12/1997	Jensen et al.	N/A	N/A
5807393	12/1997	Williamson, IV et al.	N/A	N/A
5809441	12/1997	McKee	N/A	N/A
5810240	12/1997	Robertson	N/A	N/A
5810721	12/1997	Mueller et al.	N/A	N/A
5810811	12/1997	Yates et al.	N/A	N/A
5810846	12/1997	Virnich et al.	N/A	N/A
5810855	12/1997	Rayburn et al.	N/A	N/A
5812188	12/1997	Adair	N/A	N/A
5813813	12/1997	Daum et al.	N/A	N/A
5814055	12/1997	Knodel et al.	N/A	N/A
5814057	12/1997	Oi et al.	N/A	N/A
5816471	12/1997	Plyley et al.	N/A	N/A
5817084	12/1997	Jensen	N/A	N/A
5817091	12/1997	Nardella et al.	N/A	N/A
5817093	12/1997	Williamson, IV et al.	N/A	N/A
5817109	12/1997	McGarry et al.	N/A	N/A
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5820009	12/1997	Melling et al.	N/A	N/A
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5824333	12/1997	Scopelianos et al.	N/A	N/A
5826776	12/1997	Schulze et al.	N/A	N/A
5827271	12/1997	Buysse et al.	N/A	N/A
5827298	12/1997	Hart et al.	N/A	N/A
5827323	12/1997	Klieman et al.	N/A	N/A
5829662	12/1997	Allen et al.	N/A	N/A
5830598	12/1997	Patterson	N/A	N/A
5833690	12/1997	Yates et al.	N/A	N/A
5833695	12/1997	Yoon	N/A	N/A
5833696	12/1997	Whitfield et al.	N/A	N/A
5836503	12/1997	Ehrenfels et al.	N/A	N/A
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5841284	12/1997	Takahashi	N/A	N/A
5843021	12/1997	Edwards et al.	N/A	N/A
5843096	12/1997	Igaki et al.	N/A	N/A
5843097	12/1997	Mayenberger et al.	N/A	N/A
5843122	12/1997	Riza	N/A	N/A
5843132	12/1997	Ilvento	N/A	N/A
5843169	12/1997	Taheri	N/A	N/A
5846254	12/1997	Schulze et al.	N/A	N/A
5847566	12/1997	Marritt et al.	N/A	N/A
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5849020	12/1997	Long et al.	N/A	N/A
5849023	12/1997	Mericle	N/A	N/A
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5853366	12/1997	Dowlatshahi	N/A	N/A
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5865638	12/1998	Trafton	N/A	N/A
5868361	12/1998	Rinderer	N/A	N/A
5868664	12/1998	Speier et al.	N/A	N/A
5868760	12/1998	McGuckin, Jr.	N/A	N/A
5868790	12/1998	Vincent et al.	N/A	N/A
5871135	12/1998	Williamson IV et al.	N/A	N/A
5873885	12/1998	Weidenbenner	N/A	N/A
5876401	12/1998	Schulze et al.	N/A	N/A
5878193	12/1998	Wang et al.	N/A	N/A
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5878937	12/1998	Green et al.	N/A	N/A
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5881777	12/1998	Bassi et al.	N/A	N/A
5881943	12/1998	Heck et al.	N/A	N/A
5891094	12/1998	Masterson et al.	N/A	N/A
5891160	12/1998	Williamson, IV et al.	N/A	N/A
5891558	12/1998	Bell et al.	N/A	N/A
5893506	12/1998	Powell	N/A	N/A
5893835	12/1998	Witt et al.	N/A	N/A
5893855	12/1998	Jacobs	N/A	N/A
5893863	12/1998	Yoon	N/A	N/A
5893878	12/1998	Pierce	N/A	N/A
5894979	12/1998	Powell	N/A	N/A
5897552	12/1998	Edwards et al.	N/A	N/A
5897562	12/1998	Bolanos et al.	N/A	N/A
5899824	12/1998	Kurtz et al.	N/A	N/A
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5904702	12/1998	Ek et al.	N/A	N/A
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5909062	12/1998	Krietzman	N/A	N/A
5911353	12/1998	Bolanos et al.	N/A	N/A

5915616	12/1998	Viola et al.	N/A	N/A
5916225	12/1998	Kugel	N/A	N/A
5918791	12/1998	Sorrentino et al.	N/A	N/A
5919198	12/1998	Graves, Jr. et al.	N/A	N/A
5921956	12/1998	Grinberg et al.	N/A	N/A
5922001	12/1998	Yoon	N/A	N/A
5922003	12/1998	Anctil et al.	N/A	N/A
5924864	12/1998	Loge et al.	N/A	N/A
5928137	12/1998	Green	N/A	N/A
5928256	12/1998	Riza	N/A	N/A
5931847	12/1998	Bittner et al.	N/A	N/A
5931853	12/1998	McEwen et al.	N/A	N/A
5937951	12/1998	Izuchukwu et al.	N/A	N/A
5938667	12/1998	Peyser et al.	N/A	N/A
5941442	12/1998	Geiste et al.	N/A	N/A
5941890	12/1998	Voegele et al.	N/A	N/A
5944172	12/1998	Hannula	N/A	N/A
5944715	12/1998	Goble et al.	N/A	N/A
5946978	12/1998	Yamashita	N/A	N/A
5947984	12/1998	Whipple	N/A	N/A
5947996	12/1998	Logeman	N/A	N/A
5948030	12/1998	Miller et al.	N/A	N/A
5948429	12/1998	Bell et al.	N/A	N/A
5951301	12/1998	Younker	N/A	N/A
5951516	12/1998	Bunyan	N/A	N/A
5951552	12/1998	Long et al.	N/A	N/A
5951574	12/1998	Stefanchik et al.	N/A	N/A
5951575	12/1998	Bolduc et al.	N/A	N/A
5951581	12/1998	Saadat et al.	N/A	N/A
5954259	12/1998	Viola et al.	N/A	N/A
5957831	12/1998	Adair	N/A	N/A
5964394	12/1998	Robertson	N/A	N/A
5964774	12/1998	McKean et al.	N/A	N/A
5966126	12/1998	Szabo	N/A	N/A
5971916	12/1998	Koren	N/A	N/A
5973221	12/1998	Collyer et al.	N/A	N/A
D416089	12/1998	Barton et al.	N/A	N/A
5976122	12/1998	Madhani et al.	N/A	N/A
5977746	12/1998	Hershberger et al.	N/A	N/A
5980248	12/1998	Kusakabe et al.	N/A	N/A
5980569	12/1998	Scirica	N/A	N/A
5984949	12/1998	Levin	N/A	N/A
5988479	12/1998	Palmer	N/A	N/A
5990379	12/1998	Gregory	N/A	N/A
5993464	12/1998	Knodel	N/A	N/A
5993466	12/1998	Yoon	N/A	N/A
5997528	12/1998	Bisch et al.	N/A	N/A
5997552	12/1998	Person et al.	N/A	N/A
6001108	12/1998	Wang et al.	N/A	N/A
6003517	12/1998	Sheffield et al.	N/A	N/A

6004319	12/1998	Goble et al.	N/A	N/A
6004335	12/1998	Vaitekunas et al.	N/A	N/A
6007521	12/1998	Bidwell et al.	N/A	N/A
6010054	12/1999	Johnson et al.	N/A	N/A
6010513	12/1999	Tormala et al.	N/A	N/A
6010520	12/1999	Pattison	N/A	N/A
6012494	12/1999	Balazs	N/A	N/A
6013076	12/1999	Goble et al.	N/A	N/A
6013991	12/1999	Philipp	N/A	N/A
6015406	12/1999	Goble et al.	N/A	N/A
6015417	12/1999	Reynolds, Jr.	N/A	N/A
6017322	12/1999	Snoke et al.	N/A	N/A
6017354	12/1999	Culp et al.	N/A	N/A
6017356	12/1999	Frederick et al.	N/A	N/A
6018227	12/1999	Kumar et al.	N/A	N/A
6019745	12/1999	Gray	N/A	N/A
6019780	12/1999	Lombardo et al.	N/A	N/A
6022352	12/1999	Vandewalle	N/A	N/A
6023275	12/1999	Horvitz et al.	N/A	N/A
6023641	12/1999	Thompson	N/A	N/A
6024708	12/1999	Bales et al.	N/A	N/A
6024741	12/1999	Williamson, IV et al.	N/A	N/A
6024748	12/1999	Manzo et al.	N/A	N/A
6024750	12/1999	Mastri et al.	N/A	N/A
6024764	12/1999	Schroeppel	N/A	N/A
6027501	12/1999	Goble et al.	N/A	N/A
6030384	12/1999	Nezhat	N/A	N/A
6031148	12/1999	Hayes et al.	N/A	N/A
6032849	12/1999	Mastri et al.	N/A	N/A
6033105	12/1999	Barker et al.	N/A	N/A
6033378	12/1999	Lundquist et al.	N/A	N/A
6033399	12/1999	Gines	N/A	N/A
6033427	12/1999	Lee	N/A	N/A
6036641	12/1999	Taylor et al.	N/A	N/A
6036667	12/1999	Manna et al.	N/A	N/A
6037724	12/1999	Buss et al.	N/A	N/A
6037927	12/1999	Rosenberg	N/A	N/A
6039126	12/1999	Hsieh	N/A	N/A
6039733	12/1999	Buysse et al.	N/A	N/A
6039734	12/1999	Goble	N/A	N/A
6042601	12/1999	Smith	N/A	N/A
6042607	12/1999	Williamson, IV et al.	N/A	N/A
6043626	12/1999	Snyder et al.	N/A	N/A
6045560	12/1999	McKean et al.	N/A	N/A
6047861	12/1999	Vidal et al.	N/A	N/A
6049145	12/1999	Austin et al.	N/A	N/A
6050172	12/1999	Corves et al.	N/A	N/A
6050472	12/1999	Shibata	N/A	N/A

6050989	12/1999	Fox et al.	N/A	N/A
6050990	12/1999	Tankovich et al.	N/A	N/A
6050996	12/1999	Schmaltz et al.	N/A	N/A
6053390	12/1999	Green et al.	N/A	N/A
6053899	12/1999	Slanda et al.	N/A	N/A
6053922	12/1999	Krause et al.	N/A	N/A
6054142	12/1999	Li et al.	N/A	N/A
6055062	12/1999	Dina et al.	N/A	N/A
RE36720	12/1999	Green et al.	N/A	N/A
6056735	12/1999	Okada et al.	N/A	N/A
6056746	12/1999	Goble et al.	N/A	N/A
6059806	12/1999	Hoegerle	N/A	N/A
6062360	12/1999	Shields	N/A	N/A
6063020	12/1999	Jones et al.	N/A	N/A
6063025	12/1999	Bridges et al.	N/A	N/A
6063050	12/1999	Manna et al.	N/A	N/A
6063095	12/1999	Wang et al.	N/A	N/A
6063097	12/1999	Oi et al.	N/A	N/A
6063098	12/1999	Houser et al.	N/A	N/A
6065679	12/1999	Levie et al.	N/A	N/A
6065919	12/1999	Peck	N/A	N/A
6066132	12/1999	Chen et al.	N/A	N/A
6066144	12/1999	Wolf et al.	N/A	N/A
6066151	12/1999	Miyawaki et al.	N/A	N/A
6068627	12/1999	Orszulak et al.	N/A	N/A
6071233	12/1999	Ishikawa et al.	N/A	N/A
6072299	12/1999	Kurle et al.	N/A	N/A
6074386	12/1999	Goble et al.	N/A	N/A
6074401	12/1999	Gardiner et al.	N/A	N/A
6075441	12/1999	Maloney	N/A	N/A
6077280	12/1999	Fossum	N/A	N/A
6077286	12/1999	Cuschieri et al.	N/A	N/A
6077290	12/1999	Marini	N/A	N/A
6079606	12/1999	Milliman et al.	N/A	N/A
6080181	12/1999	Jensen et al.	N/A	N/A
6082577	12/1999	Coates et al.	N/A	N/A
6083191	12/1999	Rose	N/A	N/A
6083223	12/1999	Baker	N/A	N/A
6083234	12/1999	Nicholas et al.	N/A	N/A
6083242	12/1999	Cook	N/A	N/A
6086544	12/1999	Hibner et al.	N/A	N/A
6086600	12/1999	Kortenbach	N/A	N/A
6090106	12/1999	Goble et al.	N/A	N/A
6090123	12/1999	Culp et al.	N/A	N/A
6093186	12/1999	Goble	N/A	N/A
6094021	12/1999	Noro et al.	N/A	N/A
D429252	12/1999	Haitani et al.	N/A	N/A
6099537	12/1999	Sugai et al.	N/A	N/A
6099551	12/1999	Gabbay	N/A	N/A
6102271	12/1999	Longo et al.	N/A	N/A

6102926	12/1999	Tartaglia et al.	N/A	N/A
6104162	12/1999	Sainsbury et al.	N/A	N/A
6104304	12/1999	Clark et al.	N/A	N/A
6106511	12/1999	Jensen	N/A	N/A
6109500	12/1999	Alli et al.	N/A	N/A
6110187	12/1999	Donlon	N/A	N/A
6113618	12/1999	Nic	N/A	N/A
6117148	12/1999	Ravo et al.	N/A	N/A
6117158	12/1999	Measamer et al.	N/A	N/A
6119913	12/1999	Adams et al.	N/A	N/A
6120433	12/1999	Mizuno et al.	N/A	N/A
6120462	12/1999	Hibner et al.	N/A	N/A
6123241	12/1999	Walter et al.	N/A	N/A
6123701	12/1999	Nezhat	N/A	N/A
H1904	12/1999	Yates et al.	N/A	N/A
RE36923	12/1999	Hiroi et al.	N/A	N/A
6126058	12/1999	Adams et al.	N/A	N/A
6126359	12/1999	Dittrich et al.	N/A	N/A
6126670	12/1999	Walker et al.	N/A	N/A
6131789	12/1999	Schulze et al.	N/A	N/A
6131790	12/1999	Piraka	N/A	N/A
6132368	12/1999	Cooper	N/A	N/A
6134962	12/1999	Sugitani	N/A	N/A
6139546	12/1999	Koenig et al.	N/A	N/A
6142149	12/1999	Steen	N/A	N/A
6142933	12/1999	Longo et al.	N/A	N/A
6147135	12/1999	Yuan et al.	N/A	N/A
6148979	12/1999	Roach et al.	N/A	N/A
6149660	12/1999	Laufer et al.	N/A	N/A
6151323	12/1999	O'Connell et al.	N/A	N/A
6152935	12/1999	Kammerer et al.	N/A	N/A
6155083	12/1999	Goeser et al.	N/A	N/A
6155473	12/1999	Tompkins et al.	N/A	N/A
6156056	12/1999	Kearns et al.	N/A	N/A
6157169	12/1999	Lee	N/A	N/A
6157303	12/1999	Bodie et al.	N/A	N/A
6159146	12/1999	El Gazayerli	N/A	N/A
6159200	12/1999	Verdura et al.	N/A	N/A
6159224	12/1999	Yoon	N/A	N/A
6162208	12/1999	Hipps	N/A	N/A
6162220	12/1999	Nezhat	N/A	N/A
6162537	12/1999	Martin et al.	N/A	N/A
6165175	12/1999	Wampler et al.	N/A	N/A
6165184	12/1999	Verdura et al.	N/A	N/A
6165188	12/1999	Saadat et al.	N/A	N/A
6167185	12/1999	Smiley et al.	N/A	N/A
6168605	12/2000	Measamer et al.	N/A	N/A
6171305	12/2000	Sherman	N/A	N/A
6171316	12/2000	Kovac et al.	N/A	N/A
6171330	12/2000	Benchetrit	N/A	N/A

6173074	12/2000	Russo	N/A	N/A
6174308	12/2000	Goble et al.	N/A	N/A
6174309	12/2000	Wrublewski et al.	N/A	N/A
6174318	12/2000	Bates et al.	N/A	N/A
6175290	12/2000	Forsythe et al.	N/A	N/A
6179195	12/2000	Adams et al.	N/A	N/A
6179776	12/2000	Adams et al.	N/A	N/A
6181105	12/2000	Cutolo et al.	N/A	N/A
6182673	12/2000	Kindermann et al.	N/A	N/A
6185356	12/2000	Parker et al.	N/A	N/A
6186142	12/2000	Schmidt et al.	N/A	N/A
6186957	12/2000	Milam	N/A	N/A
6187003	12/2000	Buysse et al.	N/A	N/A
6190386	12/2000	Rydell	N/A	N/A
6193129	12/2000	Bittner et al.	N/A	N/A
6197042	12/2000	Ginn et al.	N/A	N/A
6200311	12/2000	Danek et al.	N/A	N/A
6200330	12/2000	Benderev et al.	N/A	N/A
6202914	12/2000	Geiste et al.	N/A	N/A
6206894	12/2000	Thompson et al.	N/A	N/A
6206897	12/2000	Jamiolkowski et al.	N/A	N/A
6206903	12/2000	Ramans	N/A	N/A
6206904	12/2000	Ouchi	N/A	N/A
6209414	12/2000	Uneme	N/A	N/A
6210403	12/2000	Klicek	N/A	N/A
6211626	12/2000	Lys et al.	N/A	N/A
6213999	12/2000	Platt, Jr. et al.	N/A	N/A
6214028	12/2000	Yoon et al.	N/A	N/A
6220368	12/2000	Ark et al.	N/A	N/A
6221007	12/2000	Green	N/A	N/A
6221023	12/2000	Matsuba et al.	N/A	N/A
6223100	12/2000	Green	N/A	N/A
6223835	12/2000	Habedank et al.	N/A	N/A
6224617	12/2000	Saadat et al.	N/A	N/A
6228080	12/2000	Gines	N/A	N/A
6228081	12/2000	Goble	N/A	N/A
6228083	12/2000	Lands et al.	N/A	N/A
6228084	12/2000	Kirwan, Jr.	N/A	N/A
6228089	12/2000	Wahrburg	N/A	N/A
6228098	12/2000	Kayan et al.	N/A	N/A
6231565	12/2000	Tovey	606/1	A61B 34/30
6234178	12/2000	Goble et al.	N/A	N/A
6235036	12/2000	Gardner et al.	N/A	N/A
6237604	12/2000	Burnside et al.	N/A	N/A
6238384	12/2000	Peer	N/A	N/A
6241139	12/2000	Milliman et al.	N/A	N/A
6241140	12/2000	Adams et al.	N/A	N/A
6241723	12/2000	Heim et al.	N/A	N/A
6245084	12/2000	Mark et al.	N/A	N/A
6248116	12/2000	Chevillon et al.	N/A	N/A

6248117	12/2000	Blatter	N/A	N/A
6249076	12/2000	Madden et al.	N/A	N/A
6249105	12/2000	Andrews et al.	N/A	N/A
6250532	12/2000	Green et al.	N/A	N/A
6251485	12/2000	Harris et al.	N/A	N/A
D445745	12/2000	Norman	N/A	N/A
6254534	12/2000	Butler et al.	N/A	N/A
6254619	12/2000	Garabet et al.	N/A	N/A
6254642	12/2000	Taylor	N/A	N/A
6258107	12/2000	Balazs et al.	N/A	N/A
6261246	12/2000	Pantages et al.	N/A	N/A
6261286	12/2000	Goble et al.	N/A	N/A
6261679	12/2000	Chen et al.	N/A	N/A
6264086	12/2000	McGuckin, Jr.	N/A	N/A
6264087	12/2000	Whitman	N/A	N/A
6264617	12/2000	Bales et al.	N/A	N/A
6269997	12/2000	Balazs et al.	N/A	N/A
6270508	12/2000	Klieman et al.	N/A	N/A
6270916	12/2000	Sink et al.	N/A	N/A
6273252	12/2000	Mitchell	N/A	N/A
6273876	12/2000	Klima et al.	N/A	N/A
6273897	12/2000	Dalessandro et al.	N/A	N/A
6277114	12/2000	Bullivant et al.	N/A	N/A
6280407	12/2000	Manna et al.	N/A	N/A
6283981	12/2000	Beaupre	N/A	N/A
6293927	12/2000	McGuckin, Jr.	N/A	N/A
6293942	12/2000	Goble et al.	N/A	N/A
6296640	12/2000	Wampler et al.	N/A	N/A
6302311	12/2000	Adams et al.	N/A	N/A
6302743	12/2000	Chiu et al.	N/A	N/A
6305891	12/2000	Burlingame	N/A	N/A
6306134	12/2000	Goble et al.	N/A	N/A
6306149	12/2000	Meade	N/A	N/A
6306424	12/2000	Vyakarnam et al.	N/A	N/A
6309397	12/2000	Julian et al.	N/A	N/A
6309400	12/2000	Beaupre	N/A	N/A
6309403	12/2000	Minor et al.	N/A	N/A
6312435	12/2000	Wallace et al.	N/A	N/A
6315184	12/2000	Whitman	N/A	N/A
6317616	12/2000	Glossop	N/A	N/A
6319510	12/2000	Yates	N/A	N/A
6320123	12/2000	Reimers	N/A	N/A
6322494	12/2000	Bullivant et al.	N/A	N/A
6324339	12/2000	Hudson et al.	N/A	N/A
6325799	12/2000	Goble	N/A	N/A
6325805	12/2000	Ogilvie et al.	N/A	N/A
6325810	12/2000	Hamilton et al.	N/A	N/A
6328498	12/2000	Mersch	N/A	N/A
6330965	12/2000	Milliman et al.	N/A	N/A
6331181	12/2000	Tierney et al.	N/A	N/A

6331761	12/2000	Kumar et al.	N/A	N/A
6333029	12/2000	Vyakarnam et al.	N/A	N/A
6334860	12/2001	Dorn	N/A	N/A
6334861	12/2001	Chandler et al.	N/A	N/A
6336926	12/2001	Goble	N/A	N/A
6338737	12/2001	Toledano	N/A	N/A
6338738	12/2001	Bellotti et al.	N/A	N/A
6343731	12/2001	Adams et al.	N/A	N/A
6346077	12/2001	Taylor et al.	N/A	N/A
6348061	12/2001	Whitman	N/A	N/A
6349868	12/2001	Mattingly et al.	N/A	N/A
D454951	12/2001	Bon	N/A	N/A
6352503	12/2001	Matsui et al.	N/A	N/A
6352532	12/2001	Kramer et al.	N/A	N/A
6355699	12/2001	Vyakarnam et al.	N/A	N/A
6356072	12/2001	Chass	N/A	N/A
6358224	12/2001	Tims et al.	N/A	N/A
6358263	12/2001	Mark et al.	N/A	N/A
6358459	12/2001	Ziegler et al.	N/A	N/A
6361542	12/2001	Dimitriu et al.	N/A	N/A
6364828	12/2001	Yeung et al.	N/A	N/A
6364877	12/2001	Goble et al.	N/A	N/A
6364888	12/2001	Niemeyer et al.	N/A	N/A
6366441	12/2001	Ozawa et al.	N/A	N/A
6370981	12/2001	Watarai	N/A	N/A
6371114	12/2001	Schmidt et al.	N/A	N/A
6373152	12/2001	Wang et al.	N/A	N/A
6377011	12/2001	Ben-Ur	N/A	N/A
6383201	12/2001	Dong	N/A	N/A
6387092	12/2001	Burnside et al.	N/A	N/A
6387113	12/2001	Hawkins et al.	N/A	N/A
6387114	12/2001	Adams	N/A	N/A
6391038	12/2001	Vargas et al.	N/A	N/A
6392854	12/2001	O'Gorman	N/A	N/A
6394998	12/2001	Wallace et al.	N/A	N/A
6398779	12/2001	Buysse et al.	N/A	N/A
6398781	12/2001	Goble et al.	N/A	N/A
6398797	12/2001	Bombard et al.	N/A	N/A
6402766	12/2001	Bowman et al.	N/A	N/A
6402780	12/2001	Williamson, IV et al.	N/A	N/A
6406440	12/2001	Stefanchik	N/A	N/A
6406472	12/2001	Jensen	N/A	N/A
6409724	12/2001	Penny et al.	N/A	N/A
H2037	12/2001	Yates et al.	N/A	N/A
6412639	12/2001	Hickey	N/A	N/A
6413274	12/2001	Pedros	N/A	N/A
6415542	12/2001	Bates et al.	N/A	N/A
6416486	12/2001	Wampler	N/A	N/A
6416509	12/2001	Goble et al.	N/A	N/A

6419695	12/2001	Gabbay	N/A	N/A
6423079	12/2001	Blake, III	N/A	N/A
6424885	12/2001	Niemeyer et al.	N/A	N/A
RE37814	12/2001	Allgeyer	N/A	N/A
6428070	12/2001	Takanashi et al.	N/A	N/A
6428487	12/2001	Burdorff et al.	N/A	N/A
6429611	12/2001	Li	N/A	N/A
6430298	12/2001	Kettl et al.	N/A	N/A
6432065	12/2001	Burdorff et al.	N/A	N/A
6436097	12/2001	Nardella	N/A	N/A
6436107	12/2001	Wang et al.	N/A	N/A
6436110	12/2001	Bowman et al.	N/A	N/A
6436115	12/2001	Beaupre	N/A	N/A
6436122	12/2001	Frank et al.	N/A	N/A
6439439	12/2001	Rickard et al.	N/A	N/A
6439446	12/2001	Perry et al.	N/A	N/A
6440146	12/2001	Nicholas et al.	N/A	N/A
6441577	12/2001	Blumenkranz et al.	N/A	N/A
D462758	12/2001	Epstein et al.	N/A	N/A
6443973	12/2001	Whitman	N/A	N/A
6445530	12/2001	Baker	N/A	N/A
6447518	12/2001	Krause et al.	N/A	N/A
6447523	12/2001	Middleman et al.	N/A	N/A
6447799	12/2001	Ullman	N/A	N/A
6447864	12/2001	Johnson et al.	N/A	N/A
6450391	12/2001	Kayan et al.	N/A	N/A
6450989	12/2001	Dubrul et al.	N/A	N/A
6454656	12/2001	Brissette et al.	N/A	N/A
6454781	12/2001	Witt et al.	N/A	N/A
6457338	12/2001	Frenken	N/A	N/A
6457625	12/2001	Tormala et al.	N/A	N/A
6458077	12/2001	Boebel et al.	N/A	N/A
6458142	12/2001	Faller et al.	N/A	N/A
6458147	12/2001	Cruise et al.	N/A	N/A
6460627	12/2001	Below et al.	N/A	N/A
6463824	12/2001	Prell et al.	N/A	N/A
6468275	12/2001	Wampler et al.	N/A	N/A
6468286	12/2001	Mastri et al.	N/A	N/A
6471106	12/2001	Reining	N/A	N/A
6471659	12/2001	Eggers et al.	N/A	N/A
6478210	12/2001	Adams et al.	N/A	N/A
6482063	12/2001	Frigard	N/A	N/A
6482200	12/2001	Shippert	N/A	N/A
6482217	12/2001	Pintor et al.	N/A	N/A
6485490	12/2001	Wampler et al.	N/A	N/A
6485503	12/2001	Jacobs et al.	N/A	N/A
6485667	12/2001	Tan	N/A	N/A
6486286	12/2001	McGall et al.	N/A	N/A
6488196	12/2001	Fenton, Jr.	N/A	N/A
6488197	12/2001	Whitman	N/A	N/A

6488659	12/2001	Rosenman	N/A	N/A
6491201	12/2001	Whitman	N/A	N/A
6491690	12/2001	Goble et al.	N/A	N/A
6491701	12/2001	Tierney et al.	N/A	N/A
6491702	12/2001	Heilbrun et al.	N/A	N/A
6492785	12/2001	Kasten et al.	N/A	N/A
6494882	12/2001	Lebouitz et al.	N/A	N/A
6494885	12/2001	Dhindsa	N/A	N/A
6494888	12/2001	Laufer et al.	N/A	N/A
6494896	12/2001	D'Alessio et al.	N/A	N/A
6498480	12/2001	Manara	N/A	N/A
6500176	12/2001	Truckai et al.	N/A	N/A
6500189	12/2001	Lang et al.	N/A	N/A
6500194	12/2001	Benderev et al.	N/A	N/A
D468749	12/2002	Friedman	N/A	N/A
6503139	12/2002	Coral	N/A	N/A
6503257	12/2002	Grant et al.	N/A	N/A
6503259	12/2002	Huxel et al.	N/A	N/A
6505768	12/2002	Whitman	N/A	N/A
6506197	12/2002	Rollero et al.	N/A	N/A
6506399	12/2002	Donovan	N/A	N/A
6510854	12/2002	Goble	N/A	N/A
6511468	12/2002	Cragg et al.	N/A	N/A
6512360	12/2002	Goto et al.	N/A	N/A
6514252	12/2002	Nezhat et al.	N/A	N/A
6516073	12/2002	Schulz et al.	N/A	N/A
6517528	12/2002	Pantages et al.	N/A	N/A
6517535	12/2002	Edwards	N/A	N/A
6517565	12/2002	Whitman et al.	N/A	N/A
6517566	12/2002	Hovland et al.	N/A	N/A
6520971	12/2002	Perry et al.	N/A	N/A
6520972	12/2002	Peters	N/A	N/A
6522101	12/2002	Malackowski	N/A	N/A
6524180	12/2002	Simms et al.	N/A	N/A
6525499	12/2002	Naganuma	N/A	N/A
D471206	12/2002	Buzzard et al.	N/A	N/A
6527782	12/2002	Hogg et al.	N/A	N/A
6527785	12/2002	Sancoff et al.	N/A	N/A
6530942	12/2002	Fogarty et al.	N/A	N/A
6532958	12/2002	Buan et al.	N/A	N/A
6533157	12/2002	Whitman	N/A	N/A
6533723	12/2002	Lockery et al.	N/A	N/A
6533784	12/2002	Truckai et al.	N/A	N/A
6535764	12/2002	Imran et al.	N/A	N/A
6539297	12/2002	Weiberle et al.	N/A	N/A
D473239	12/2002	Cockerill	N/A	N/A
6539816	12/2002	Kogiso et al.	N/A	N/A
6540737	12/2002	Bacher et al.	N/A	N/A
6543456	12/2002	Freeman	N/A	N/A
6545384	12/2002	Pelrine et al.	N/A	N/A

6547786	12/2002	Goble	N/A	N/A
6550546	12/2002	Thurler et al.	N/A	N/A
6551333	12/2002	Kuhns et al.	N/A	N/A
6554844	12/2002	Lee et al.	N/A	N/A
6554861	12/2002	Knox et al.	N/A	N/A
6555770	12/2002	Kawase	N/A	N/A
6558378	12/2002	Sherman et al.	N/A	N/A
6558379	12/2002	Batchelor et al.	N/A	N/A
6558429	12/2002	Taylor	N/A	N/A
6561187	12/2002	Schmidt et al.	N/A	N/A
6565560	12/2002	Goble et al.	N/A	N/A
6566619	12/2002	Gillman et al.	N/A	N/A
6569085	12/2002	Kortenbach et al.	N/A	N/A
6569171	12/2002	DeGuillebon et al.	N/A	N/A
6569173	12/2002	Blatter et al.	N/A	N/A
6572629	12/2002	Kalloo et al.	N/A	N/A
6575969	12/2002	Rittman, III et al.	N/A	N/A
6578751	12/2002	Hartwick	N/A	N/A
6582364	12/2002	Butler et al.	N/A	N/A
6582427	12/2002	Goble et al.	N/A	N/A
6582441	12/2002	He et al.	N/A	N/A
6583533	12/2002	Pelrine et al.	N/A	N/A
6585144	12/2002	Adams et al.	N/A	N/A
6585664	12/2002	Burdorff et al.	N/A	N/A
6586898	12/2002	King et al.	N/A	N/A
6587750	12/2002	Gerbi et al.	N/A	N/A
6588277	12/2002	Giordano et al.	N/A	N/A
6588643	12/2002	Bolduc et al.	N/A	N/A
6588931	12/2002	Betzner et al.	N/A	N/A
6589118	12/2002	Soma et al.	N/A	N/A
6589164	12/2002	Flaherty	N/A	N/A
6592538	12/2002	Hotchkiss et al.	N/A	N/A
6592572	12/2002	Suzuta	N/A	N/A
6592597	12/2002	Grant et al.	N/A	N/A
6594552	12/2002	Nowlin et al.	N/A	N/A
6595914	12/2002	Kato	N/A	N/A
6596296	12/2002	Nelson et al.	N/A	N/A
6596304	12/2002	Bayon et al.	N/A	N/A
6596432	12/2002	Kawakami et al.	N/A	N/A
6599295	12/2002	Tornier et al.	N/A	N/A
6599323	12/2002	Melican et al.	N/A	N/A
D478665	12/2002	Isaacs et al.	N/A	N/A
D478986	12/2002	Johnston et al.	N/A	N/A
6601749	12/2002	Sullivan et al.	N/A	N/A
6602252	12/2002	Mollenauer	N/A	N/A
6602262	12/2002	Griego et al.	N/A	N/A
6603050	12/2002	Heaton	N/A	N/A
6605078	12/2002	Adams	N/A	N/A
6605669	12/2002	Awokola et al.	N/A	N/A
6605911	12/2002	Klesing	N/A	N/A

6607475	12/2002	Doyle et al.	N/A	N/A
6611793	12/2002	Burnside et al.	N/A	N/A
6613069	12/2002	Boyd et al.	N/A	N/A
6616686	12/2002	Coleman et al.	N/A	N/A
6619529	12/2002	Green et al.	N/A	N/A
6620111	12/2002	Stephens et al.	N/A	N/A
6620161	12/2002	Schulze et al.	N/A	N/A
6620166	12/2002	Wenstrom, Jr. et al.	N/A	N/A
6623482	12/2002	Pendekanti et al.	N/A	N/A
6625517	12/2002	Bogdanov et al.	N/A	N/A
6626834	12/2002	Dunne et al.	N/A	N/A
6626901	12/2002	Treat et al.	N/A	N/A
6626938	12/2002	Butaric et al.	N/A	N/A
H2086	12/2002	Amsler	N/A	N/A
6629630	12/2002	Adams	N/A	N/A
6629974	12/2002	Penny et al.	N/A	N/A
6629988	12/2002	Weadock	N/A	N/A
6635838	12/2002	Kornelson	N/A	N/A
6636412	12/2002	Smith	N/A	N/A
6638108	12/2002	Tachi	N/A	N/A
6638285	12/2002	Gabbay	N/A	N/A
6638297	12/2002	Huitema	N/A	N/A
RE38335	12/2002	Aust et al.	N/A	N/A
6641528	12/2002	Torii	N/A	N/A
6644532	12/2002	Green et al.	N/A	N/A
6645201	12/2002	Utley et al.	N/A	N/A
6646307	12/2002	Yu et al.	N/A	N/A
6648816	12/2002	Irion et al.	N/A	N/A
6648901	12/2002	Fleischman et al.	N/A	N/A
6652595	12/2002	Nicolo	N/A	N/A
D484243	12/2002	Ryan et al.	N/A	N/A
D484595	12/2002	Ryan et al.	N/A	N/A
D484596	12/2002	Ryan et al.	N/A	N/A
6656177	12/2002	Truckai et al.	N/A	N/A
6656193	12/2002	Grant et al.	N/A	N/A
6659940	12/2002	Adler	N/A	N/A
6660008	12/2002	Foerster et al.	N/A	N/A
6663623	12/2002	Oyama et al.	N/A	N/A
6663641	12/2002	Kovac et al.	N/A	N/A
6666854	12/2002	Lange	N/A	N/A
6666860	12/2002	Takahashi	N/A	N/A
6666875	12/2002	Sakurai et al.	N/A	N/A
6667825	12/2002	Lu et al.	N/A	N/A
6669073	12/2002	Milliman et al.	N/A	N/A
6670806	12/2002	Wendt et al.	N/A	N/A
6671185	12/2002	Duval	N/A	N/A
D484977	12/2003	Ryan et al.	N/A	N/A
6676660	12/2003	Wampler et al.	N/A	N/A
6677687	12/2003	Ho et al.	N/A	N/A
6679269	12/2003	Swanson	N/A	N/A

6679410	12/2003	Wursch et al.	N/A	N/A
6681978	12/2003	Geiste et al.	N/A	N/A
6681979	12/2003	Whitman	N/A	N/A
6682527	12/2003	Strul	N/A	N/A
6682528	12/2003	Frazier et al.	N/A	N/A
6682544	12/2003	Mastri et al.	N/A	N/A
6685698	12/2003	Morley et al.	N/A	N/A
6685727	12/2003	Fisher et al.	N/A	N/A
6689153	12/2003	Skiba	N/A	N/A
6692507	12/2003	Pugsley et al.	N/A	N/A
6692692	12/2003	Stetzel	N/A	N/A
6695198	12/2003	Adams et al.	N/A	N/A
6695199	12/2003	Whitman	N/A	N/A
6695774	12/2003	Hale et al.	N/A	N/A
6695849	12/2003	Michelson	N/A	N/A
6696814	12/2003	Henderson et al.	N/A	N/A
6697048	12/2003	Rosenberg et al.	N/A	N/A
6698643	12/2003	Whitman	N/A	N/A
6699177	12/2003	Wang et al.	N/A	N/A
6699214	12/2003	Gellman	N/A	N/A
6699235	12/2003	Wallace et al.	N/A	N/A
6704210	12/2003	Myers	N/A	N/A
6705503	12/2003	Pedicini et al.	N/A	N/A
6709445	12/2003	Boebel et al.	N/A	N/A
6712773	12/2003	Viola	N/A	N/A
6716215	12/2003	David et al.	N/A	N/A
6716223	12/2003	Leopold et al.	N/A	N/A
6716232	12/2003	Vidal et al.	N/A	N/A
6716233	12/2003	Whitman	N/A	N/A
6720734	12/2003	Norris	N/A	N/A
6722550	12/2003	Ricordi et al.	N/A	N/A
6722552	12/2003	Fenton, Jr.	N/A	N/A
6723087	12/2003	O'Neill et al.	N/A	N/A
6723091	12/2003	Goble et al.	N/A	N/A
6723106	12/2003	Charles et al.	N/A	N/A
6723109	12/2003	Solingen	N/A	N/A
6726651	12/2003	Robinson et al.	N/A	N/A
6726697	12/2003	Nicholas et al.	N/A	N/A
6726705	12/2003	Peterson et al.	N/A	N/A
6726706	12/2003	Dominguez	N/A	N/A
6729119	12/2003	Schnipke et al.	N/A	N/A
6731976	12/2003	Penn et al.	N/A	N/A
6736810	12/2003	Hoey et al.	N/A	N/A
6736825	12/2003	Blatter et al.	N/A	N/A
6736854	12/2003	Vadurro et al.	N/A	N/A
6740030	12/2003	Martone et al.	N/A	N/A
6743230	12/2003	Lutze et al.	N/A	N/A
6744385	12/2003	Kazuya et al.	N/A	N/A
6747121	12/2003	Gogolewski	N/A	N/A
6747300	12/2003	Nadd et al.	N/A	N/A

6749560	12/2003	Konstorum et al.	N/A	N/A
6749600	12/2003	Levy	N/A	N/A
6752768	12/2003	Burdorff et al.	N/A	N/A
6752816	12/2003	Culp et al.	N/A	N/A
6754959	12/2003	Guiette, III et al.	N/A	N/A
6755195	12/2003	Lemke et al.	N/A	N/A
6755338	12/2003	Hahnen et al.	N/A	N/A
6755825	12/2003	Shoenman et al.	N/A	N/A
6755843	12/2003	Chung et al.	N/A	N/A
6756705	12/2003	Pulford, Jr.	N/A	N/A
6758846	12/2003	Goble et al.	N/A	N/A
6761685	12/2003	Adams et al.	N/A	N/A
6762339	12/2003	Klun et al.	N/A	N/A
6763307	12/2003	Berg et al.	N/A	N/A
6764445	12/2003	Ramans et al.	N/A	N/A
6766957	12/2003	Matsuura et al.	N/A	N/A
6767352	12/2003	Field et al.	N/A	N/A
6767356	12/2003	Kanner et al.	N/A	N/A
6769590	12/2003	Vresh et al.	N/A	N/A
6769594	12/2003	Orban, III	N/A	N/A
6770027	12/2003	Banik et al.	N/A	N/A
6770070	12/2003	Balbierz	N/A	N/A
6770072	12/2003	Truckai et al.	N/A	N/A
6770078	12/2003	Bonutti	N/A	N/A
6773409	12/2003	Truckai et al.	N/A	N/A
6773437	12/2003	Ogilvie et al.	N/A	N/A
6773438	12/2003	Knodel et al.	N/A	N/A
6773458	12/2003	Brauker et al.	N/A	N/A
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6777838	12/2003	Miekka et al.	N/A	N/A
6778846	12/2003	Martinez et al.	N/A	N/A
6780151	12/2003	Grabover et al.	N/A	N/A
6780180	12/2003	Goble et al.	N/A	N/A
6783524	12/2003	Anderson et al.	N/A	N/A
6784775	12/2003	Mandell et al.	N/A	N/A
6786382	12/2003	Hoffman	N/A	N/A
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6788018	12/2003	Blumenkranz	N/A	N/A
6790173	12/2003	Saadat et al.	N/A	N/A
6793652	12/2003	Whitman et al.	N/A	N/A
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6793663	12/2003	Kneifel et al.	N/A	N/A
6793669	12/2003	Nakamura et al.	N/A	N/A
6796921	12/2003	Buck et al.	N/A	N/A
6799669	12/2003	Fukumura et al.	N/A	N/A
6801009	12/2003	Makaran et al.	N/A	N/A
6802822	12/2003	Dodge	N/A	N/A
6802843	12/2003	Truckai et al.	N/A	N/A
6802844	12/2003	Ferree	N/A	N/A

6805273	12/2003	Bilotti et al.	N/A	N/A
6806808	12/2003	Watters et al.	N/A	N/A
6806867	12/2003	Arruda et al.	N/A	N/A
6808525	12/2003	Latterell et al.	N/A	N/A
6810359	12/2003	Sakaguchi	N/A	N/A
6814154	12/2003	Chou	N/A	N/A
6814741	12/2003	Bowman et al.	N/A	N/A
6817508	12/2003	Racenet et al.	N/A	N/A
6817509	12/2003	Geiste et al.	N/A	N/A
6817974	12/2003	Cooper et al.	N/A	N/A
6818018	12/2003	Sawhney	N/A	N/A
6820791	12/2003	Adams	N/A	N/A
6821273	12/2003	Mollenauer	N/A	N/A
6821282	12/2003	Perry et al.	N/A	N/A
6821284	12/2003	Sturtz et al.	N/A	N/A
6827246	12/2003	Sullivan et al.	N/A	N/A
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6827725	12/2003	Batchelor et al.	N/A	N/A
6828902	12/2003	Casden	N/A	N/A
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6832998	12/2003	Goble	N/A	N/A
6834001	12/2003	Myono	N/A	N/A
6835173	12/2003	Couvillon, Jr.	N/A	N/A
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6841967	12/2004	Kim et al.	N/A	N/A
6843403	12/2004	Whitman	N/A	N/A
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6846308	12/2004	Whitman et al.	N/A	N/A
6846309	12/2004	Whitman et al.	N/A	N/A
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6849071	12/2004	Whitman et al.	N/A	N/A
6850817	12/2004	Green	N/A	N/A
6852122	12/2004	Rush	N/A	N/A
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RE38708	12/2004	Bolanos et al.	N/A	N/A
D502994	12/2004	Blake, III	N/A	N/A
6860169	12/2004	Shinozaki	N/A	N/A

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6863694	12/2004	Boyce et al.	N/A	N/A
6863924	12/2004	Ranganathan et al.	N/A	N/A
6866178	12/2004	Adams et al.	N/A	N/A
6866668	12/2004	Giannetti et al.	N/A	N/A
6866671	12/2004	Tierney et al.	N/A	N/A
6867248	12/2004	Martin et al.	N/A	N/A
6869430	12/2004	Balbierz et al.	N/A	N/A
6869435	12/2004	Blake, III	N/A	N/A
6872214	12/2004	Sonnenschein et al.	N/A	N/A
6874669	12/2004	Adams et al.	N/A	N/A
6876850	12/2004	Maeshima et al.	N/A	N/A
6877647	12/2004	Green et al.	N/A	N/A
6878106	12/2004	Herrmann	N/A	N/A
6882127	12/2004	Konigbauer	N/A	N/A
6883199	12/2004	Lundell et al.	N/A	N/A
6884392	12/2004	Malkin et al.	N/A	N/A
6884428	12/2004	Binette et al.	N/A	N/A
6886730	12/2004	Fujisawa et al.	N/A	N/A
6887244	12/2004	Walker et al.	N/A	N/A
6887710	12/2004	Call et al.	N/A	N/A
6889116	12/2004	Jinno	N/A	N/A
6893435	12/2004	Goble	N/A	N/A
6894140	12/2004	Roby	N/A	N/A
6895176	12/2004	Archer et al.	N/A	N/A
6899538	12/2004	Matoba	N/A	N/A
6899593	12/2004	Moeller et al.	N/A	N/A
6899705	12/2004	Niemeyer	N/A	N/A
6899915	12/2004	Yelick et al.	N/A	N/A
6905057	12/2004	Swayze et al.	N/A	N/A
6905497	12/2004	Truckai et al.	N/A	N/A
6905498	12/2004	Hooven	N/A	N/A
6908472	12/2004	Wiener et al.	N/A	N/A
6911033	12/2004	de Guillebon et al.	N/A	N/A
6911916	12/2004	Wang et al.	N/A	N/A
6913579	12/2004	Truckai et al.	N/A	N/A
6913608	12/2004	Liddicoat et al.	N/A	N/A
6913613	12/2004	Schwarz et al.	N/A	N/A
6921397	12/2004	Corcoran et al.	N/A	N/A
6921412	12/2004	Black et al.	N/A	N/A
6923093	12/2004	Ullah	N/A	N/A
6923803	12/2004	Goble	N/A	N/A
6923819	12/2004	Meade et al.	N/A	N/A
6925849	12/2004	Jairam	N/A	N/A
6926716	12/2004	Baker et al.	N/A	N/A
6927315	12/2004	Heinecke et al.	N/A	N/A
6928902	12/2004	Eyssallenne	N/A	N/A
6929641	12/2004	Goble et al.	N/A	N/A

6929644	12/2004	Truckai et al.	N/A	N/A
6931830	12/2004	Liao	N/A	N/A
6932218	12/2004	Kosann et al.	N/A	N/A
6932810	12/2004	Ryan	N/A	N/A
6936042	12/2004	Wallace et al.	N/A	N/A
6936948	12/2004	Bell et al.	N/A	N/A
D509297	12/2004	Wells	N/A	N/A
D509589	12/2004	Wells	N/A	N/A
6938706	12/2004	Ng	N/A	N/A
6939358	12/2004	Palacios et al.	N/A	N/A
6942662	12/2004	Goble et al.	N/A	N/A
6942674	12/2004	Belef et al.	N/A	N/A
6945444	12/2004	Gresham et al.	N/A	N/A
6945981	12/2004	Donofrio et al.	N/A	N/A
6949196	12/2004	Schmitz et al.	N/A	N/A
6951562	12/2004	Zwirnmann	N/A	N/A
6953138	12/2004	Dworak et al.	N/A	N/A
6953139	12/2004	Milliman et al.	N/A	N/A
6953461	12/2004	McClurken et al.	N/A	N/A
6957758	12/2004	Aranyi	N/A	N/A
6958035	12/2004	Friedman et al.	N/A	N/A
6958070	12/2004	Witt et al.	N/A	N/A
D511525	12/2004	Hernandez et al.	N/A	N/A
6959851	12/2004	Heinrich	N/A	N/A
6959852	12/2004	Shelton, IV et al.	N/A	N/A
6960107	12/2004	Schaub et al.	N/A	N/A
6960163	12/2004	Ewers et al.	N/A	N/A
6960220	12/2004	Marino et al.	N/A	N/A
6962587	12/2004	Johnson et al.	N/A	N/A
6963792	12/2004	Green	N/A	N/A
6964363	12/2004	Wales et al.	N/A	N/A
6966907	12/2004	Goble	N/A	N/A
6966909	12/2004	Marshall et al.	N/A	N/A
6968908	12/2004	Tokunaga et al.	N/A	N/A
6969385	12/2004	Moreyra	N/A	N/A
6969395	12/2004	Eskuri	N/A	N/A
6971988	12/2004	Orban, III	N/A	N/A
6972199	12/2004	Lebouitz et al.	N/A	N/A
6974435	12/2004	Daw et al.	N/A	N/A
6974462	12/2004	Sater	N/A	N/A
6978921	12/2004	Shelton, IV et al.	N/A	N/A
6978922	12/2004	Bilotti et al.	N/A	N/A
6981628	12/2005	Wales	N/A	N/A
6981941	12/2005	Whitman et al.	N/A	N/A
6981978	12/2005	Gannoe	N/A	N/A
6984203	12/2005	Tartaglia et al.	N/A	N/A
6984231	12/2005	Goble et al.	N/A	N/A
6986451	12/2005	Mastri et al.	N/A	N/A
6988649	12/2005	Shelton, IV et al.	N/A	N/A

6988650	12/2005	Schwemberger et al.	N/A	N/A
6989034	12/2005	Hammer et al.	N/A	N/A
6990731	12/2005	Haytayan	N/A	N/A
6990796	12/2005	Schnipke et al.	N/A	N/A
6991146	12/2005	Sinisi et al.	N/A	N/A
6993200	12/2005	Tastl et al.	N/A	N/A
6993413	12/2005	Sunaoshi	N/A	N/A
6994708	12/2005	Manzo	N/A	N/A
6995729	12/2005	Govari et al.	N/A	N/A
6996433	12/2005	Burbank et al.	N/A	N/A
6997931	12/2005	Sauer et al.	N/A	N/A
6997935	12/2005	Anderson et al.	N/A	N/A
6998736	12/2005	Lee et al.	N/A	N/A
6998816	12/2005	Wieck et al.	N/A	N/A
6999821	12/2005	Jenney et al.	N/A	N/A
7000818	12/2005	Shelton, IV et al.	N/A	N/A
7000819	12/2005	Swayze et al.	N/A	N/A
7000911	12/2005	McCormick et al.	N/A	N/A
7001380	12/2005	Goble	N/A	N/A
7001408	12/2005	Knodel et al.	N/A	N/A
7004174	12/2005	Eggers et al.	N/A	N/A
7005828	12/2005	Karikomi	N/A	N/A
7007176	12/2005	Goodfellow et al.	N/A	N/A
7008433	12/2005	Voellmicke et al.	N/A	N/A
7008435	12/2005	Cummins	N/A	N/A
7009039	12/2005	Yayon et al.	N/A	N/A
7011213	12/2005	Clark et al.	N/A	N/A
7011657	12/2005	Truckai et al.	N/A	N/A
7014640	12/2005	Kemppainen et al.	N/A	N/A
7018357	12/2005	Emmons	N/A	N/A
7018390	12/2005	Turovskiy et al.	N/A	N/A
7021399	12/2005	Driessen	N/A	N/A
7021669	12/2005	Lindermeir et al.	N/A	N/A
7022131	12/2005	Derowe et al.	N/A	N/A
7023159	12/2005	Gorti et al.	N/A	N/A
7025064	12/2005	Wang et al.	N/A	N/A
7025732	12/2005	Thompson et al.	N/A	N/A
7025743	12/2005	Mann et al.	N/A	N/A
7025774	12/2005	Freeman et al.	N/A	N/A
7025775	12/2005	Gadberry et al.	N/A	N/A
7028570	12/2005	Ohta et al.	N/A	N/A
7029435	12/2005	Nakao	N/A	N/A
7029439	12/2005	Roberts et al.	N/A	N/A
7030904	12/2005	Adair et al.	N/A	N/A
7032798	12/2005	Whitman et al.	N/A	N/A
7032799	12/2005	Viola et al.	N/A	N/A
7033356	12/2005	Latterell et al.	N/A	N/A
7033378	12/2005	Smith et al.	N/A	N/A
7035716	12/2005	Harris et al.	N/A	N/A

7035762	12/2005	Menard et al.	N/A	N/A
7036680	12/2005	Flannery	N/A	N/A
7037314	12/2005	Armstrong	N/A	N/A
7037344	12/2005	Kagan et al.	N/A	N/A
7038421	12/2005	Trifilo	N/A	N/A
7041088	12/2005	Nawrocki et al.	N/A	N/A
7041102	12/2005	Truckai et al.	N/A	N/A
7041868	12/2005	Greene et al.	N/A	N/A
7043852	12/2005	Hayashida et al.	N/A	N/A
7044350	12/2005	Kameyama et al.	N/A	N/A
7044352	12/2005	Shelton, IV et al.	N/A	N/A
7044353	12/2005	Mastri et al.	N/A	N/A
7046082	12/2005	Komiya et al.	N/A	N/A
7048165	12/2005	Haramiishi	N/A	N/A
7048687	12/2005	Reuss et al.	N/A	N/A
7048716	12/2005	Kucharczyk et al.	N/A	N/A
7048745	12/2005	Tierney et al.	N/A	N/A
7052454	12/2005	Taylor	N/A	N/A
7052494	12/2005	Goble et al.	N/A	N/A
7052499	12/2005	Steger et al.	N/A	N/A
7055730	12/2005	Ehrenfels et al.	N/A	N/A
7055731	12/2005	Shelton, IV et al.	N/A	N/A
7056123	12/2005	Gregorio et al.	N/A	N/A
7056284	12/2005	Martone et al.	N/A	N/A
7056330	12/2005	Gayton	N/A	N/A
7059331	12/2005	Adams et al.	N/A	N/A
7059508	12/2005	Shelton, IV et al.	N/A	N/A
7063671	12/2005	Couvillon, Jr.	N/A	N/A
7063712	12/2005	Vargas et al.	N/A	N/A
7064509	12/2005	Fu et al.	N/A	N/A
7066879	12/2005	Fowler et al.	N/A	N/A
7066944	12/2005	Laufer et al.	N/A	N/A
7067038	12/2005	Trokhan et al.	N/A	N/A
7070083	12/2005	Jankowski	N/A	N/A
7070559	12/2005	Adams et al.	N/A	N/A
7070597	12/2005	Truckai et al.	N/A	N/A
7071287	12/2005	Rhine et al.	N/A	N/A
7075412	12/2005	Reynolds et al.	N/A	N/A
7075770	12/2005	Smith	N/A	N/A
7077856	12/2005	Whitman	N/A	N/A
7080769	12/2005	Vresh et al.	N/A	N/A
7081114	12/2005	Rashidi	N/A	N/A
7081318	12/2005	Lee et al.	N/A	N/A
7083073	12/2005	Yoshie et al.	N/A	N/A
7083075	12/2005	Swayze et al.	N/A	N/A
7083571	12/2005	Wang et al.	N/A	N/A
7083615	12/2005	Peterson et al.	N/A	N/A
7083619	12/2005	Truckai et al.	N/A	N/A
7083620	12/2005	Jahns et al.	N/A	N/A
7083626	12/2005	Hart et al.	N/A	N/A

7086267	12/2005	Dworak et al.	N/A	N/A
7087049	12/2005	Nowlin et al.	N/A	N/A
7087054	12/2005	Truckai et al.	N/A	N/A
7087071	12/2005	Nicholas et al.	N/A	N/A
7090637	12/2005	Danitz et al.	N/A	N/A
7090673	12/2005	Dycus et al.	N/A	N/A
7090683	12/2005	Brock et al.	N/A	N/A
7090684	12/2005	McGuckin, Jr. et al.	N/A	N/A
7091191	12/2005	Laredo et al.	N/A	N/A
7091412	12/2005	Wang et al.	N/A	N/A
7093492	12/2005	Treiber et al.	N/A	N/A
7094202	12/2005	Nobis et al.	N/A	N/A
7094247	12/2005	Monassevitch et al.	N/A	N/A
7094916	12/2005	DeLuca et al.	N/A	N/A
7096972	12/2005	Orozco, Jr.	N/A	N/A
7097089	12/2005	Marczyk	N/A	N/A
7097644	12/2005	Long	N/A	N/A
7097650	12/2005	Weller et al.	N/A	N/A
7098794	12/2005	Lindsay et al.	N/A	N/A
7100949	12/2005	Williams et al.	N/A	N/A
7101187	12/2005	Deconinck et al.	N/A	N/A
7101363	12/2005	Nishizawa et al.	N/A	N/A
7101371	12/2005	Dycus et al.	N/A	N/A
7101394	12/2005	Hamm et al.	N/A	N/A
7104741	12/2005	Krohn	N/A	N/A
7108695	12/2005	Witt et al.	N/A	N/A
7108701	12/2005	Evens et al.	N/A	N/A
7108709	12/2005	Cummins	N/A	N/A
7111768	12/2005	Cummins et al.	N/A	N/A
7111769	12/2005	Wales et al.	N/A	N/A
7112201	12/2005	Truckai et al.	N/A	N/A
7112214	12/2005	Peterson et al.	N/A	N/A
RE39358	12/2005	Goble	N/A	N/A
D530339	12/2005	Hernandez et al.	N/A	N/A
7114642	12/2005	Whitman	N/A	N/A
7116100	12/2005	Mock et al.	N/A	N/A
7118020	12/2005	Lee et al.	N/A	N/A
7118528	12/2005	Piskun	N/A	N/A
7118563	12/2005	Weckwerth et al.	N/A	N/A
7118582	12/2005	Wang et al.	N/A	N/A
7119534	12/2005	Butzmann	N/A	N/A
7121446	12/2005	Arad et al.	N/A	N/A
7121773	12/2005	Mikiya et al.	N/A	N/A
7122028	12/2005	Looper et al.	N/A	N/A
7125403	12/2005	Julian et al.	N/A	N/A
7125409	12/2005	Truckai et al.	N/A	N/A
7126303	12/2005	Farritor et al.	N/A	N/A
7126879	12/2005	Snyder	N/A	N/A
7128253	12/2005	Mastri et al.	N/A	N/A
7128254	12/2005	Shelton, IV et al.	N/A	N/A

7128748	12/2005	Mooradian et al.	N/A	N/A
7131445	12/2005	Amoah	N/A	N/A
7133601	12/2005	Phillips et al.	N/A	N/A
7134364	12/2005	Kageler et al.	N/A	N/A
7134587	12/2005	Schwemberger et al.	N/A	N/A
7135027	12/2005	Delmotte	N/A	N/A
7137980	12/2005	Buysse et al.	N/A	N/A
7137981	12/2005	Long	N/A	N/A
7139016	12/2005	Squilla et al.	N/A	N/A
7140527	12/2005	Ehrenfels et al.	N/A	N/A
7140528	12/2005	Shelton, IV	N/A	N/A
7141055	12/2005	Abrams et al.	N/A	N/A
7143923	12/2005	Shelton, IV et al.	N/A	N/A
7143924	12/2005	Scirica et al.	N/A	N/A
7143925	12/2005	Shelton, IV et al.	N/A	N/A
7143926	12/2005	Shelton, IV et al.	N/A	N/A
7146191	12/2005	Kerner et al.	N/A	N/A
7147138	12/2005	Shelton, IV	N/A	N/A
7147139	12/2005	Schwemberger et al.	N/A	N/A
7147140	12/2005	Wukusick et al.	N/A	N/A
7147637	12/2005	Goble	N/A	N/A
7147648	12/2005	Lin	N/A	N/A
7147650	12/2005	Lee	N/A	N/A
7150748	12/2005	Ebbutt et al.	N/A	N/A
7153300	12/2005	Goble	N/A	N/A
7153314	12/2005	Laufer et al.	N/A	N/A
7155316	12/2005	Sutherland et al.	N/A	N/A
7156846	12/2006	Dycus et al.	N/A	N/A
7156863	12/2006	Sonnenschein et al.	N/A	N/A
7159750	12/2006	Racenet et al.	N/A	N/A
7160296	12/2006	Pearson et al.	N/A	N/A
7160299	12/2006	Baily	N/A	N/A
7160311	12/2006	Blatter et al.	N/A	N/A
7161036	12/2006	Oikawa et al.	N/A	N/A
7161580	12/2006	Bailey et al.	N/A	N/A
7162758	12/2006	Skinner	N/A	N/A
7163563	12/2006	Schwartz et al.	N/A	N/A
7166117	12/2006	Hellenkamp	N/A	N/A
7166133	12/2006	Evans et al.	N/A	N/A
7168604	12/2006	Milliman et al.	N/A	N/A
7169146	12/2006	Truckai et al.	N/A	N/A
7170910	12/2006	Chen et al.	N/A	N/A
7171279	12/2006	Buckingham et al.	N/A	N/A
7172104	12/2006	Scirica et al.	N/A	N/A
7172593	12/2006	Trieu et al.	N/A	N/A
7172615	12/2006	Morriss et al.	N/A	N/A
7174202	12/2006	Bladen et al.	N/A	N/A
7174636	12/2006	Lowe	N/A	N/A

7177533	12/2006	McFarlin et al.	N/A	N/A
7179223	12/2006	Motoki et al.	N/A	N/A
7179267	12/2006	Nolan et al.	N/A	N/A
7182239	12/2006	Myers	N/A	N/A
7182763	12/2006	Nardella	N/A	N/A
7183737	12/2006	Kitagawa	N/A	N/A
7187960	12/2006	Abreu	N/A	N/A
7188758	12/2006	Viola et al.	N/A	N/A
7189207	12/2006	Viola	N/A	N/A
7190147	12/2006	Gileff et al.	N/A	N/A
7193199	12/2006	Jang	N/A	N/A
7195627	12/2006	Amoah et al.	N/A	N/A
7196911	12/2006	Takano et al.	N/A	N/A
D541418	12/2006	Schechter et al.	N/A	N/A
7197965	12/2006	Anderson	N/A	N/A
7199537	12/2006	Okamura et al.	N/A	N/A
7199545	12/2006	Oleynikov et al.	N/A	N/A
7202576	12/2006	Dechene et al.	N/A	N/A
7202653	12/2006	Pai	N/A	N/A
7204404	12/2006	Nguyen et al.	N/A	N/A
7204835	12/2006	Latterell et al.	N/A	N/A
7205959	12/2006	Henriksson	N/A	N/A
7206626	12/2006	Quaid, III	N/A	N/A
7207233	12/2006	Wadge	N/A	N/A
7207471	12/2006	Heinrich et al.	N/A	N/A
7207472	12/2006	Wukusick et al.	N/A	N/A
7207556	12/2006	Saitoh et al.	N/A	N/A
7208005	12/2006	Frecker et al.	N/A	N/A
7210609	12/2006	Leiboff et al.	N/A	N/A
7211081	12/2006	Goble	N/A	N/A
7211084	12/2006	Goble et al.	N/A	N/A
7211092	12/2006	Hughett	N/A	N/A
7211979	12/2006	Khatib et al.	N/A	N/A
7213736	12/2006	Wales et al.	N/A	N/A
7214224	12/2006	Goble	N/A	N/A
7215517	12/2006	Takamatsu	N/A	N/A
7217285	12/2006	Vargas et al.	N/A	N/A
7220260	12/2006	Fleming et al.	N/A	N/A
7220272	12/2006	Weadock	N/A	N/A
7225959	12/2006	Patton et al.	N/A	N/A
7225963	12/2006	Scirica	N/A	N/A
7225964	12/2006	Mastri et al.	N/A	N/A
7226450	12/2006	Athanasiou et al.	N/A	N/A
7226467	12/2006	Lucatero et al.	N/A	N/A
7228505	12/2006	Shimazu et al.	N/A	N/A
7229408	12/2006	Douglas et al.	N/A	N/A
7234624	12/2006	Gresham et al.	N/A	N/A
7235072	12/2006	Sartor et al.	N/A	N/A
7235089	12/2006	McGuckin, Jr.	N/A	N/A
7235302	12/2006	Jing et al.	N/A	N/A

7237708	12/2006	Guy et al.	N/A	N/A
7238195	12/2006	Viola	N/A	N/A
7238901	12/2006	Kim et al.	N/A	N/A
7239657	12/2006	Gunnarsson	N/A	N/A
7241288	12/2006	Braun	N/A	N/A
7241289	12/2006	Braun	N/A	N/A
7246734	12/2006	Shelton, IV	N/A	N/A
7247161	12/2006	Johnston et al.	N/A	N/A
7249267	12/2006	Chapuis	N/A	N/A
7252641	12/2006	Thompson et al.	N/A	N/A
7252660	12/2006	Kunz	N/A	N/A
7255012	12/2006	Hedtke	N/A	N/A
7255696	12/2006	Goble et al.	N/A	N/A
7256695	12/2006	Hamel et al.	N/A	N/A
7258262	12/2006	Mastri et al.	N/A	N/A
7258546	12/2006	Beier et al.	N/A	N/A
7260431	12/2006	Libbus et al.	N/A	N/A
7265374	12/2006	Lee et al.	N/A	N/A
7267677	12/2006	Johnson et al.	N/A	N/A
7267679	12/2006	McGuckin, Jr. et al.	N/A	N/A
7272002	12/2006	Drapeau	N/A	N/A
7273483	12/2006	Wiener et al.	N/A	N/A
7273488	12/2006	Nakamura et al.	N/A	N/A
D552623	12/2006	Vong et al.	N/A	N/A
7275674	12/2006	Racenet et al.	N/A	N/A
7276044	12/2006	Ferry et al.	N/A	N/A
7276068	12/2006	Johnson et al.	N/A	N/A
7278562	12/2006	Mastri et al.	N/A	N/A
7278563	12/2006	Green	N/A	N/A
7278949	12/2006	Bader	N/A	N/A
7278994	12/2006	Goble	N/A	N/A
7282048	12/2006	Goble et al.	N/A	N/A
7283096	12/2006	Geisheimer et al.	N/A	N/A
7286850	12/2006	Frielink et al.	N/A	N/A
7287682	12/2006	Ezzat et al.	N/A	N/A
7289139	12/2006	Amling et al.	N/A	N/A
7293685	12/2006	Ehrenfels et al.	N/A	N/A
7295893	12/2006	Sunaoshi	N/A	N/A
7295907	12/2006	Lu et al.	N/A	N/A
7296722	12/2006	Ivanko	N/A	N/A
7296724	12/2006	Green et al.	N/A	N/A
7297149	12/2006	Vitali et al.	N/A	N/A
7300373	12/2006	Jinno et al.	N/A	N/A
7300431	12/2006	Dubrovsky	N/A	N/A
7300450	12/2006	Vleugels et al.	N/A	N/A
7303106	12/2006	Milliman et al.	N/A	N/A
7303107	12/2006	Milliman et al.	N/A	N/A
7303108	12/2006	Shelton, IV	N/A	N/A
7303502	12/2006	Thompson	N/A	N/A
7303556	12/2006	Metzger	N/A	N/A

7306597	12/2006	Manzo	N/A	N/A
7308998	12/2006	Mastri et al.	N/A	N/A
7311238	12/2006	Liu	N/A	N/A
7311709	12/2006	Truckai et al.	N/A	N/A
7313430	12/2006	Urquhart et al.	N/A	N/A
7314473	12/2007	Jinno et al.	N/A	N/A
7317955	12/2007	McGreevy	N/A	N/A
7320704	12/2007	Lashinski et al.	N/A	N/A
7322859	12/2007	Evans	N/A	N/A
7322975	12/2007	Goble et al.	N/A	N/A
7322994	12/2007	Nicholas et al.	N/A	N/A
7324572	12/2007	Chang	N/A	N/A
7326203	12/2007	Papineau et al.	N/A	N/A
7326213	12/2007	Benderev et al.	N/A	N/A
7328828	12/2007	Ortiz et al.	N/A	N/A
7328829	12/2007	Arad et al.	N/A	N/A
7330004	12/2007	DeJonge et al.	N/A	N/A
7331340	12/2007	Barney	N/A	N/A
7331343	12/2007	Schmidt et al.	N/A	N/A
7331403	12/2007	Berry et al.	N/A	N/A
7331406	12/2007	Wottreng, Jr. et al.	N/A	N/A
7331969	12/2007	Inganas et al.	N/A	N/A
7334717	12/2007	Rethy et al.	N/A	N/A
7334718	12/2007	McAlister et al.	N/A	N/A
7335199	12/2007	Goble et al.	N/A	N/A
7335401	12/2007	Finke et al.	N/A	N/A
7336045	12/2007	Clermonts	N/A	N/A
7336048	12/2007	Lohr	N/A	N/A
7336183	12/2007	Reddy et al.	N/A	N/A
7336184	12/2007	Smith et al.	N/A	N/A
7337774	12/2007	Webb	N/A	N/A
7338505	12/2007	Belson	N/A	N/A
7338513	12/2007	Lee et al.	N/A	N/A
7341554	12/2007	Sekine et al.	N/A	N/A
7341555	12/2007	Ootawara et al.	N/A	N/A
7341591	12/2007	Grinberg	N/A	N/A
7343920	12/2007	Toby et al.	N/A	N/A
7344532	12/2007	Goble et al.	N/A	N/A
7344533	12/2007	Pearson et al.	N/A	N/A
7346344	12/2007	Fontaine	N/A	N/A
7346406	12/2007	Brotto et al.	N/A	N/A
7348763	12/2007	Reinhart et al.	N/A	N/A
7348875	12/2007	Hughes et al.	N/A	N/A
RE40237	12/2007	Bilotti et al.	N/A	N/A
7351258	12/2007	Ricotta et al.	N/A	N/A
7354398	12/2007	Kanazawa	N/A	N/A
7354440	12/2007	Truckal et al.	N/A	N/A
7354447	12/2007	Shelton, IV et al.	N/A	N/A
7354502	12/2007	Polat et al.	N/A	N/A
7357287	12/2007	Shelton, IV et al.	N/A	N/A

7357806	12/2007	Rivera et al.	N/A	N/A
7361168	12/2007	Makower et al.	N/A	N/A
7361195	12/2007	Schwartz et al.	N/A	N/A
7362062	12/2007	Schneider et al.	N/A	N/A
7364060	12/2007	Milliman	N/A	N/A
7364061	12/2007	Swayze et al.	N/A	N/A
7367485	12/2007	Shelton, IV et al.	N/A	N/A
7367973	12/2007	Manzo et al.	N/A	N/A
7368124	12/2007	Chun et al.	N/A	N/A
7371210	12/2007	Brock et al.	N/A	N/A
7371403	12/2007	McCarthy et al.	N/A	N/A
7375493	12/2007	Calhoon et al.	N/A	N/A
7377918	12/2007	Amoah	N/A	N/A
7377928	12/2007	Zubik et al.	N/A	N/A
7378817	12/2007	Calhoon et al.	N/A	N/A
RE40388	12/2007	Gines	N/A	N/A
D570868	12/2007	Hosokawa et al.	N/A	N/A
7380695	12/2007	Doll et al.	N/A	N/A
7380696	12/2007	Shelton, IV et al.	N/A	N/A
7384403	12/2007	Sherman	N/A	N/A
7384417	12/2007	Cucin	N/A	N/A
7386365	12/2007	Nixon	N/A	N/A
7386730	12/2007	Uchikubo	N/A	N/A
7388217	12/2007	Buschbeck et al.	N/A	N/A
7388484	12/2007	Hsu	N/A	N/A
7391173	12/2007	Schena	N/A	N/A
7394190	12/2007	Huang	N/A	N/A
7396356	12/2007	Mollenauer	N/A	N/A
7397364	12/2007	Govari	N/A	N/A
7398707	12/2007	Morley et al.	N/A	N/A
7398907	12/2007	Racenet et al.	N/A	N/A
7398908	12/2007	Holsten et al.	N/A	N/A
7400107	12/2007	Schneider et al.	N/A	N/A
7400752	12/2007	Zacharias	N/A	N/A
7401000	12/2007	Nakamura	N/A	N/A
7401721	12/2007	Holsten et al.	N/A	N/A
7404449	12/2007	Bermingham et al.	N/A	N/A
7404508	12/2007	Smith et al.	N/A	N/A
7404509	12/2007	Ortiz et al.	N/A	N/A
7404822	12/2007	Viart et al.	N/A	N/A
D575793	12/2007	Ording	N/A	N/A
7407074	12/2007	Ortiz et al.	N/A	N/A
7407075	12/2007	Holsten et al.	N/A	N/A
7407076	12/2007	Racenet et al.	N/A	N/A
7407077	12/2007	Ortiz et al.	N/A	N/A
7407078	12/2007	Shelton, IV et al.	N/A	N/A
7408310	12/2007	Hong et al.	N/A	N/A
7410085	12/2007	Wolf et al.	N/A	N/A
7410086	12/2007	Ortiz et al.	N/A	N/A
7410483	12/2007	Danitz et al.	N/A	N/A

7413563	12/2007	Corcoran et al.	N/A	N/A
7416101	12/2007	Shelton, IV et al.	N/A	N/A
7418078	12/2007	Blanz et al.	N/A	N/A
RE40514	12/2007	Mastri et al.	N/A	N/A
7419080	12/2007	Smith et al.	N/A	N/A
7419081	12/2007	Ehrenfels et al.	N/A	N/A
7419321	12/2007	Tereschouk	N/A	N/A
7419495	12/2007	Menn et al.	N/A	N/A
7422136	12/2007	Marczyk	N/A	N/A
7422138	12/2007	Bilotti et al.	N/A	N/A
7422139	12/2007	Shelton, IV et al.	N/A	N/A
7422582	12/2007	Malackowski et al.	N/A	N/A
7424965	12/2007	Racenet et al.	N/A	N/A
7427607	12/2007	Suzuki	N/A	N/A
D578644	12/2007	Shumer et al.	N/A	N/A
7430772	12/2007	Van Es	N/A	N/A
7430849	12/2007	Coutts et al.	N/A	N/A
7431188	12/2007	Marczyk	N/A	N/A
7431189	12/2007	Shelton, IV et al.	N/A	N/A
7431230	12/2007	McPherson et al.	N/A	N/A
7431694	12/2007	Stefanchik et al.	N/A	N/A
7431730	12/2007	Viola	N/A	N/A
7434715	12/2007	Shelton, IV et al.	N/A	N/A
7434717	12/2007	Shelton, IV et al.	N/A	N/A
7435249	12/2007	Buysse et al.	N/A	N/A
7438209	12/2007	Hess et al.	N/A	N/A
7438718	12/2007	Milliman et al.	N/A	N/A
7439354	12/2007	Lenges et al.	N/A	N/A
7441684	12/2007	Shelton, IV et al.	N/A	N/A
7441685	12/2007	Boudreaux	N/A	N/A
7442201	12/2007	Pugsley et al.	N/A	N/A
7443547	12/2007	Moreno et al.	N/A	N/A
D580942	12/2007	Oshiro et al.	N/A	N/A
7446131	12/2007	Liu et al.	N/A	N/A
7448525	12/2007	Shelton, IV et al.	N/A	N/A
7450010	12/2007	Gravelle et al.	N/A	N/A
7450991	12/2007	Smith et al.	N/A	N/A
7451904	12/2007	Shelton, IV	N/A	N/A
7455208	12/2007	Wales et al.	N/A	N/A
7455676	12/2007	Holsten et al.	N/A	N/A
7455682	12/2007	Viola	N/A	N/A
7455687	12/2007	Saunders et al.	N/A	N/A
D582934	12/2007	Byeon	N/A	N/A
7461767	12/2007	Viola et al.	N/A	N/A
7462187	12/2007	Johnston et al.	N/A	N/A
7464845	12/2007	Chou	N/A	N/A
7464846	12/2007	Shelton, IV et al.	N/A	N/A
7464847	12/2007	Viola et al.	N/A	N/A
7464848	12/2007	Green et al.	N/A	N/A
7464849	12/2007	Shelton, IV et al.	N/A	N/A

7467740	12/2007	Shelton, IV et al.	N/A	N/A
7467849	12/2007	Silverbrook et al.	N/A	N/A
7472814	12/2008	Mastri et al.	N/A	N/A
7472815	12/2008	Shelton, IV et al.	N/A	N/A
7472816	12/2008	Holsten et al.	N/A	N/A
7473221	12/2008	Ewers et al.	N/A	N/A
7473253	12/2008	Dycus et al.	N/A	N/A
7473263	12/2008	Johnston et al.	N/A	N/A
7476237	12/2008	Taniguchi et al.	N/A	N/A
7479147	12/2008	Honeycutt et al.	N/A	N/A
7479608	12/2008	Smith	N/A	N/A
7481347	12/2008	Roy	N/A	N/A
7481348	12/2008	Marczyk	N/A	N/A
7481349	12/2008	Holsten et al.	N/A	N/A
7481824	12/2008	Boudreaux et al.	N/A	N/A
7485124	12/2008	Kuhns et al.	N/A	N/A
7485133	12/2008	Cannon et al.	N/A	N/A
7485142	12/2008	Milo	N/A	N/A
7487899	12/2008	Shelton, IV	227/176.1	A61B 17/07207
7489055	12/2008	Jeong et al.	N/A	N/A
7490749	12/2008	Schall et al.	N/A	N/A
7491232	12/2008	Bolduc et al.	N/A	N/A
7492261	12/2008	Cambre et al.	N/A	N/A
7494039	12/2008	Racenet et al.	N/A	N/A
7494460	12/2008	Haarstad et al.	N/A	N/A
7494499	12/2008	Nagase et al.	N/A	N/A
7494501	12/2008	Ahlberg et al.	N/A	N/A
7497137	12/2008	Tellenbach et al.	N/A	N/A
7500979	12/2008	Hueil et al.	N/A	N/A
7501198	12/2008	Barlev et al.	N/A	N/A
7503474	12/2008	Hillstead et al.	N/A	N/A
7506790	12/2008	Shelton, IV	N/A	N/A
7506791	12/2008	Omaits et al.	N/A	N/A
7507202	12/2008	Schoellhorn	N/A	N/A
7510107	12/2008	Timm et al.	N/A	N/A
7510534	12/2008	Burdorff et al.	N/A	N/A
7510566	12/2008	Jacobs et al.	N/A	N/A
7513407	12/2008	Chang	N/A	N/A
7513408	12/2008	Shelton, IV et al.	N/A	N/A
7517356	12/2008	Heinrich	N/A	N/A
7524320	12/2008	Tierney et al.	N/A	N/A
7527632	12/2008	Houghton et al.	N/A	N/A
7530984	12/2008	Sonnenschein et al.	N/A	N/A
7530985	12/2008	Takemoto et al.	N/A	N/A
7533790	12/2008	Knodel et al.	N/A	N/A
7533906	12/2008	Luettgen et al.	N/A	N/A
7534259	12/2008	Lashinski et al.	N/A	N/A
7540867	12/2008	Jinno et al.	N/A	N/A
7540872	12/2008	Schechter et al.	N/A	N/A

7542807	12/2008	Bertolero et al.	N/A	N/A
7543730	12/2008	Marczyk	N/A	N/A
7544197	12/2008	Kelsch et al.	N/A	N/A
7546939	12/2008	Adams et al.	N/A	N/A
7546940	12/2008	Milliman et al.	N/A	N/A
7547287	12/2008	Boecker et al.	N/A	N/A
7547312	12/2008	Bauman et al.	N/A	N/A
7549563	12/2008	Mather et al.	N/A	N/A
7549564	12/2008	Boudreaux	N/A	N/A
7549998	12/2008	Braun	N/A	N/A
7552854	12/2008	Wixey et al.	N/A	N/A
7553173	12/2008	Kowalick	N/A	N/A
7553275	12/2008	Padget et al.	N/A	N/A
7554343	12/2008	Bromfield	N/A	N/A
7556185	12/2008	Viola	N/A	N/A
7556186	12/2008	Milliman	N/A	N/A
7556647	12/2008	Drews et al.	N/A	N/A
7559449	12/2008	Viola	N/A	N/A
7559450	12/2008	Wales et al.	N/A	N/A
7559452	12/2008	Wales et al.	N/A	N/A
7559937	12/2008	de la Torre et al.	N/A	N/A
7561637	12/2008	Jonsson et al.	N/A	N/A
7562910	12/2008	Kertesz et al.	N/A	N/A
7563269	12/2008	Hashiguchi	N/A	N/A
7563862	12/2008	Sieg et al.	N/A	N/A
7565993	12/2008	Milliman et al.	N/A	N/A
7566300	12/2008	Devierre et al.	N/A	N/A
7567045	12/2008	Fristedt	N/A	N/A
7568603	12/2008	Shelton, IV et al.	N/A	N/A
7568604	12/2008	Ehrenfels et al.	N/A	N/A
7568619	12/2008	Todd et al.	N/A	N/A
7572285	12/2008	Frey et al.	N/A	N/A
7572298	12/2008	Roller et al.	N/A	N/A
7575144	12/2008	Ortiz et al.	N/A	N/A
7578825	12/2008	Huebner	N/A	N/A
D600712	12/2008	LaManna et al.	N/A	N/A
7582086	12/2008	Privitera et al.	N/A	N/A
7583063	12/2008	Dooley	N/A	N/A
7584880	12/2008	Racenet et al.	N/A	N/A
7586289	12/2008	Andruk et al.	N/A	N/A
7588174	12/2008	Holsten et al.	N/A	N/A
7588175	12/2008	Timm et al.	N/A	N/A
7588176	12/2008	Timm et al.	N/A	N/A
7588177	12/2008	Racenet	N/A	N/A
7591783	12/2008	Boulais et al.	N/A	N/A
7591818	12/2008	Bertolero et al.	N/A	N/A
7593766	12/2008	Faber et al.	N/A	N/A
7595642	12/2008	Doyle	N/A	N/A
7597229	12/2008	Boudreaux et al.	N/A	N/A
7597230	12/2008	Racenet et al.	N/A	N/A

7597693	12/2008	Garrison	N/A	N/A
7597699	12/2008	Rogers	N/A	N/A
7598972	12/2008	Tomita	N/A	N/A
7600663	12/2008	Green	N/A	N/A
7604118	12/2008	Iio et al.	N/A	N/A
7604150	12/2008	Boudreaux	N/A	N/A
7604151	12/2008	Hess et al.	N/A	N/A
7604668	12/2008	Farnsworth et al.	N/A	N/A
7605826	12/2008	Sauer	N/A	N/A
7607557	12/2008	Shelton, IV et al.	N/A	N/A
7608091	12/2008	Goldfarb et al.	N/A	N/A
D604325	12/2008	Ebeling et al.	N/A	N/A
7611038	12/2008	Racenet et al.	N/A	N/A
7611474	12/2008	Hibner et al.	N/A	N/A
7615003	12/2008	Stefanchik et al.	N/A	N/A
7615006	12/2008	Abe	N/A	N/A
7615067	12/2008	Lee et al.	N/A	N/A
7617961	12/2008	Viola	N/A	N/A
7618427	12/2008	Ortiz et al.	N/A	N/A
D605201	12/2008	Lorenz et al.	N/A	N/A
D606992	12/2008	Liu et al.	N/A	N/A
D607010	12/2008	Kocmick	N/A	N/A
7624902	12/2008	Marczyk et al.	N/A	N/A
7624903	12/2008	Green et al.	N/A	N/A
7625370	12/2008	Hart et al.	N/A	N/A
7625388	12/2008	Boukhny et al.	N/A	N/A
7625662	12/2008	Vaisnys et al.	N/A	N/A
7630841	12/2008	Comisky et al.	N/A	N/A
7631793	12/2008	Rethy et al.	N/A	N/A
7631794	12/2008	Rethy et al.	N/A	N/A
7635074	12/2008	Olson et al.	N/A	N/A
7635922	12/2008	Becker	N/A	N/A
7637409	12/2008	Marczyk	N/A	N/A
7637410	12/2008	Marczyk	N/A	N/A
7638958	12/2008	Philipp et al.	N/A	N/A
7641091	12/2009	Olson et al.	N/A	N/A
7641092	12/2009	Kruszynski et al.	N/A	N/A
7641093	12/2009	Doll et al.	N/A	N/A
7641095	12/2009	Viola	N/A	N/A
7641671	12/2009	Crainich	N/A	N/A
7644016	12/2009	Nycz et al.	N/A	N/A
7644484	12/2009	Vereschagin	N/A	N/A
7644783	12/2009	Roberts et al.	N/A	N/A
7644848	12/2009	Swayze et al.	N/A	N/A
7645230	12/2009	Mikkaichi et al.	N/A	N/A
7648055	12/2009	Marczyk	N/A	N/A
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7648519	12/2009	Lee et al.	N/A	N/A
7650185	12/2009	Maile et al.	N/A	N/A
7651017	12/2009	Ortiz et al.	N/A	N/A

7651498	12/2009	Shifrin et al.	N/A	N/A
7654431	12/2009	Hueil et al.	N/A	N/A
7655003	12/2009	Lorang et al.	N/A	N/A
7655004	12/2009	Long	N/A	N/A
7655288	12/2009	Bauman et al.	N/A	N/A
7655584	12/2009	Biran et al.	N/A	N/A
7656131	12/2009	Embrey et al.	N/A	N/A
7658311	12/2009	Boudreaux	N/A	N/A
7658312	12/2009	Vidal et al.	N/A	N/A
7658705	12/2009	Melvin et al.	N/A	N/A
7659219	12/2009	Biran et al.	N/A	N/A
7661448	12/2009	Kim et al.	N/A	N/A
7662161	12/2009	Briganti et al.	N/A	N/A
7665646	12/2009	Prommersberger	N/A	N/A
7665647	12/2009	Shelton, IV et al.	N/A	N/A
7666195	12/2009	Kelleher et al.	N/A	N/A
7669746	12/2009	Shelton, IV	N/A	N/A
7669747	12/2009	Weisenburgh, II et al.	N/A	N/A
7670334	12/2009	Hueil et al.	N/A	N/A
7670337	12/2009	Young	N/A	N/A
7673780	12/2009	Shelton, IV et al.	N/A	N/A
7673781	12/2009	Swayze et al.	N/A	N/A
7673782	12/2009	Hess et al.	N/A	N/A
7673783	12/2009	Morgan et al.	N/A	N/A
7674253	12/2009	Fisher et al.	N/A	N/A
7674255	12/2009	Braun	N/A	N/A
7674263	12/2009	Ryan	N/A	N/A
7674270	12/2009	Layer	N/A	N/A
7678121	12/2009	Knodel	N/A	N/A
7682307	12/2009	Danitz et al.	N/A	N/A
7682367	12/2009	Shah et al.	N/A	N/A
7682686	12/2009	Curro et al.	N/A	N/A
7686201	12/2009	Csiky	N/A	N/A
7686804	12/2009	Johnson et al.	N/A	N/A
7686826	12/2009	Lee et al.	N/A	N/A
7688028	12/2009	Phillips et al.	N/A	N/A
7690547	12/2009	Racenet et al.	N/A	N/A
7691098	12/2009	Wallace	606/1	A61B 34/72
7691103	12/2009	Fernandez et al.	N/A	N/A
7691106	12/2009	Schenberger et al.	N/A	N/A
7694864	12/2009	Okada et al.	N/A	N/A
7694865	12/2009	Scirica	N/A	N/A
7695485	12/2009	Whitman et al.	N/A	N/A
7695493	12/2009	Saadat et al.	N/A	N/A
7699204	12/2009	Viola	N/A	N/A
7699835	12/2009	Lee et al.	N/A	N/A
7699844	12/2009	Utley et al.	N/A	N/A
7699846	12/2009	Ryan	N/A	N/A
7699856	12/2009	Van Wyk et al.	N/A	N/A

7699859	12/2009	Bombard et al.	N/A	N/A
7699860	12/2009	Huitema et al.	N/A	N/A
7699868	12/2009	Frank et al.	N/A	N/A
7703653	12/2009	Shah et al.	N/A	N/A
7705559	12/2009	Powell et al.	N/A	N/A
7706853	12/2009	Hacker et al.	N/A	N/A
7708180	12/2009	Murray et al.	N/A	N/A
7708181	12/2009	Cole et al.	N/A	N/A
7708182	12/2009	Viola	N/A	N/A
7708758	12/2009	Lee et al.	N/A	N/A
7708768	12/2009	Danek et al.	N/A	N/A
7709136	12/2009	Touchton et al.	N/A	N/A
7712182	12/2009	Zeiler et al.	N/A	N/A
7713190	12/2009	Brock et al.	N/A	N/A
7713542	12/2009	Xu et al.	N/A	N/A
7714239	12/2009	Smith	N/A	N/A
7714334	12/2009	Lin	N/A	N/A
7717312	12/2009	Beetel	N/A	N/A
7717313	12/2009	Criscuolo et al.	N/A	N/A
7717846	12/2009	Zirps et al.	N/A	N/A
7717873	12/2009	Swick	N/A	N/A
7717915	12/2009	Miyazawa	N/A	N/A
7717926	12/2009	Whitfield et al.	N/A	N/A
7718180	12/2009	Karp	N/A	N/A
7718556	12/2009	Matsuda et al.	N/A	N/A
7721930	12/2009	McKenna et al.	N/A	N/A
7721931	12/2009	Shelton, IV et al.	N/A	N/A
7721932	12/2009	Cole et al.	N/A	N/A
7721933	12/2009	Ehrenfels et al.	N/A	N/A
7721934	12/2009	Shelton, IV et al.	N/A	N/A
7721936	12/2009	Shalton, IV et al.	N/A	N/A
7722527	12/2009	Bouchier et al.	N/A	N/A
7722607	12/2009	Dumbauld et al.	N/A	N/A
7722610	12/2009	Viola et al.	N/A	N/A
7725214	12/2009	Diolaiti	N/A	N/A
7726171	12/2009	Langlotz et al.	N/A	N/A
7726537	12/2009	Olson et al.	N/A	N/A
7726538	12/2009	Holsten et al.	N/A	N/A
7726539	12/2009	Holsten et al.	N/A	N/A
7727954	12/2009	McKay	N/A	N/A
7728553	12/2009	Carrier et al.	N/A	N/A
7729742	12/2009	Govari	N/A	N/A
7731072	12/2009	Timm et al.	N/A	N/A
7731073	12/2009	Wixey et al.	N/A	N/A
7731724	12/2009	Huitema et al.	N/A	N/A
7735703	12/2009	Morgan et al.	N/A	N/A
7735704	12/2009	Bilotti	N/A	N/A
7736254	12/2009	Schena	N/A	N/A
7736306	12/2009	Brustad et al.	N/A	N/A
7736356	12/2009	Cooper et al.	N/A	N/A

7736374	12/2009	Vaughan et al.	N/A	N/A
7738971	12/2009	Swayze et al.	N/A	N/A
7740159	12/2009	Shelton, IV et al.	N/A	N/A
7742036	12/2009	Grant et al.	N/A	N/A
7743960	12/2009	Whitman et al.	N/A	N/A
7744624	12/2009	Bettuchi	N/A	N/A
7744627	12/2009	Orban, III et al.	N/A	N/A
7744628	12/2009	Viola	N/A	N/A
7747146	12/2009	Milano et al.	N/A	N/A
7748587	12/2009	Haramiishi et al.	N/A	N/A
7748632	12/2009	Coleman et al.	N/A	N/A
7749204	12/2009	Dhanaraj et al.	N/A	N/A
7749240	12/2009	Takahashi et al.	N/A	N/A
7751870	12/2009	Whitman	N/A	N/A
7753245	12/2009	Boudreaux et al.	N/A	N/A
7753246	12/2009	Scirica	N/A	N/A
7753904	12/2009	Shelton, IV et al.	N/A	N/A
7757924	12/2009	Gerbi et al.	N/A	N/A
7758594	12/2009	Lamson et al.	N/A	N/A
7758612	12/2009	Shipp	N/A	N/A
7758613	12/2009	Whitman	N/A	N/A
7762462	12/2009	Gelbman	N/A	N/A
7762998	12/2009	Birk et al.	N/A	N/A
D622286	12/2009	Umezawa	N/A	N/A
7766207	12/2009	Mather et al.	N/A	N/A
7766209	12/2009	Baxter, III et al.	N/A	N/A
7766210	12/2009	Shelton, IV et al.	N/A	N/A
7766821	12/2009	Brunnen et al.	N/A	N/A
7766894	12/2009	Weitzner et al.	N/A	N/A
7770658	12/2009	Ito et al.	N/A	N/A
7770773	12/2009	Whitman et al.	N/A	N/A
7770774	12/2009	Mastri et al.	N/A	N/A
7770775	12/2009	Shelton, IV et al.	N/A	N/A
7770776	12/2009	Chen et al.	N/A	N/A
7771396	12/2009	Stefanchik et al.	N/A	N/A
7772720	12/2009	McGee et al.	N/A	N/A
7772725	12/2009	Siman-Tov	N/A	N/A
7775972	12/2009	Brock et al.	N/A	N/A
7776037	12/2009	Odom	N/A	N/A
7776060	12/2009	Mooradian et al.	N/A	N/A
7776065	12/2009	Griffiths et al.	N/A	N/A
7778004	12/2009	Nerheim et al.	N/A	N/A
7779614	12/2009	McGonagle et al.	N/A	N/A
7779737	12/2009	Newman, Jr. et al.	N/A	N/A
7780054	12/2009	Wales	N/A	N/A
7780055	12/2009	Scirica et al.	N/A	N/A
7780309	12/2009	McMillan et al.	N/A	N/A
7780651	12/2009	Madhani et al.	N/A	N/A
7780663	12/2009	Yates et al.	N/A	N/A
7780685	12/2009	Hunt et al.	N/A	N/A

7782382	12/2009	Fujimura	N/A	N/A
7784662	12/2009	Wales et al.	N/A	N/A
7784663	12/2009	Shelton, IV	N/A	N/A
7787256	12/2009	Chan et al.	N/A	N/A
7789283	12/2009	Shah	N/A	N/A
7789875	12/2009	Brock et al.	N/A	N/A
7789883	12/2009	Takashino et al.	N/A	N/A
7789889	12/2009	Zubik et al.	N/A	N/A
7793812	12/2009	Moore et al.	N/A	N/A
7794475	12/2009	Hess et al.	N/A	N/A
7798386	12/2009	Schall et al.	N/A	N/A
7799039	12/2009	Shelton, IV et al.	N/A	N/A
7799044	12/2009	Johnston et al.	N/A	N/A
7799965	12/2009	Patel et al.	N/A	N/A
7803151	12/2009	Whitman	N/A	N/A
7806871	12/2009	Li et al.	N/A	N/A
7806891	12/2009	Nowlin et al.	N/A	N/A
7810690	12/2009	Bilotti et al.	N/A	N/A
7810691	12/2009	Boyden et al.	N/A	N/A
7810692	12/2009	Hall et al.	N/A	N/A
7810693	12/2009	Broehl et al.	N/A	N/A
7811275	12/2009	Birk et al.	N/A	N/A
7814816	12/2009	Alberti et al.	N/A	N/A
7815092	12/2009	Whitman et al.	N/A	N/A
7815565	12/2009	Stefanchik et al.	N/A	N/A
7815662	12/2009	Spivey et al.	N/A	N/A
7819296	12/2009	Hueil et al.	N/A	N/A
7819297	12/2009	Doll et al.	N/A	N/A
7819298	12/2009	Hall et al.	N/A	N/A
7819299	12/2009	Shelton, IV et al.	N/A	N/A
7819799	12/2009	Merril et al.	N/A	N/A
7819884	12/2009	Lee et al.	N/A	N/A
7819885	12/2009	Cooper	N/A	N/A
7819886	12/2009	Whitfield et al.	N/A	N/A
7819894	12/2009	Mitsuishi et al.	N/A	N/A
7823076	12/2009	Borovsky et al.	N/A	N/A
7823592	12/2009	Bettuchi et al.	N/A	N/A
7823760	12/2009	Zemlok et al.	N/A	N/A
7824401	12/2009	Manzo et al.	N/A	N/A
7824422	12/2009	Benchetrit	N/A	N/A
7824426	12/2009	Racenet et al.	N/A	N/A
7828189	12/2009	Holsten et al.	N/A	N/A
7828794	12/2009	Sartor	N/A	N/A
7828808	12/2009	Hinman et al.	N/A	N/A
7829416	12/2009	Kudou et al.	N/A	N/A
7831292	12/2009	Quaid et al.	N/A	N/A
7832408	12/2009	Shelton, IV et al.	N/A	N/A
7832611	12/2009	Boyden et al.	N/A	N/A
7832612	12/2009	Baxter, III et al.	N/A	N/A
7833234	12/2009	Bailly et al.	N/A	N/A

7835823	12/2009	Sillman et al.	N/A	N/A
7836400	12/2009	May et al.	N/A	N/A
7837079	12/2009	Holsten et al.	N/A	N/A
7837080	12/2009	Schwemberger	N/A	N/A
7837081	12/2009	Holsten et al.	N/A	N/A
7837425	12/2009	Saeki et al.	N/A	N/A
7837685	12/2009	Weinberg et al.	N/A	N/A
7837687	12/2009	Harp	N/A	N/A
7837694	12/2009	Tethrake et al.	N/A	N/A
7838789	12/2009	Stoffers et al.	N/A	N/A
7839109	12/2009	Carmen, Jr. et al.	N/A	N/A
7840253	12/2009	Tremblay et al.	N/A	N/A
7841503	12/2009	Sonnenschein et al.	N/A	N/A
7842025	12/2009	Coleman et al.	N/A	N/A
7842028	12/2009	Lee	N/A	N/A
7843158	12/2009	Prisco	N/A	N/A
7845533	12/2009	Marczyk et al.	N/A	N/A
7845534	12/2009	Viola et al.	N/A	N/A
7845535	12/2009	Scircia	N/A	N/A
7845536	12/2009	Viola et al.	N/A	N/A
7845537	12/2009	Shelton, IV et al.	N/A	N/A
7845538	12/2009	Whitman	N/A	N/A
7845912	12/2009	Sung et al.	N/A	N/A
7846085	12/2009	Silverman et al.	N/A	N/A
7846149	12/2009	Jankowski	N/A	N/A
7846161	12/2009	Dumbauld et al.	N/A	N/A
7848066	12/2009	Yanagishima	N/A	N/A
7850623	12/2009	Griffin et al.	N/A	N/A
7850642	12/2009	Moll	604/95.04	A61B 8/4461
7850982	12/2009	Stopek et al.	N/A	N/A
7853813	12/2009	Lee	N/A	N/A
7854735	12/2009	Houser et al.	N/A	N/A
7854736	12/2009	Ryan	N/A	N/A
7857183	12/2009	Shelton, IV	N/A	N/A
7857184	12/2009	Viola	N/A	N/A
7857185	12/2009	Swayze et al.	N/A	N/A
7857186	12/2009	Baxter, III et al.	N/A	N/A
7857813	12/2009	Schmitz et al.	N/A	N/A
7861906	12/2010	Doll et al.	N/A	N/A
7862502	12/2010	Pool et al.	N/A	N/A
7862546	12/2010	Conlon et al.	N/A	N/A
7862579	12/2010	Ortiz et al.	N/A	N/A
7866525	12/2010	Scirica	N/A	N/A
7866527	12/2010	Hall et al.	N/A	N/A
7866528	12/2010	Olson et al.	N/A	N/A
7870989	12/2010	Viola et al.	N/A	N/A
7871418	12/2010	Thompson et al.	N/A	N/A
7871440	12/2010	Schwartz et al.	N/A	N/A
7875055	12/2010	Cichocki, Jr.	N/A	N/A

7877869	12/2010	Mehdizadeh et al.	N/A	N/A
7879063	12/2010	Khosravi	N/A	N/A
7879070	12/2010	Ortiz et al.	N/A	N/A
7879367	12/2010	Heublein et al.	N/A	N/A
7883461	12/2010	Albrecht et al.	N/A	N/A
7883465	12/2010	Donofrio et al.	N/A	N/A
7883540	12/2010	Niwa et al.	N/A	N/A
7886951	12/2010	Hessler	N/A	N/A
7886952	12/2010	Scirica et al.	N/A	N/A
7887530	12/2010	Zemlok et al.	N/A	N/A
7887535	12/2010	Lands et al.	N/A	N/A
7887536	12/2010	Johnson et al.	N/A	N/A
7887563	12/2010	Cummins	N/A	N/A
7887755	12/2010	Mingerink et al.	N/A	N/A
7891531	12/2010	Ward	N/A	N/A
7891532	12/2010	Mastri et al.	N/A	N/A
7892200	12/2010	Birk et al.	N/A	N/A
7892245	12/2010	Liddicoat et al.	N/A	N/A
7893586	12/2010	West et al.	N/A	N/A
7896214	12/2010	Farascioni	N/A	N/A
7896215	12/2010	Adams et al.	N/A	N/A
7896671	12/2010	Kim et al.	N/A	N/A
7896869	12/2010	DiSilvestro et al.	N/A	N/A
7896877	12/2010	Hall et al.	N/A	N/A
7896895	12/2010	Boudreaux et al.	N/A	N/A
7896897	12/2010	Gresham et al.	N/A	N/A
7896900	12/2010	Frank et al.	N/A	N/A
7898198	12/2010	Murphree	N/A	N/A
7900805	12/2010	Shelton, IV et al.	N/A	N/A
7900806	12/2010	Chen et al.	N/A	N/A
7901381	12/2010	Birk et al.	N/A	N/A
7905380	12/2010	Shelton, IV et al.	N/A	N/A
7905381	12/2010	Baxter, III et al.	N/A	N/A
7905881	12/2010	Masuda et al.	N/A	N/A
7905889	12/2010	Catanese et al.	N/A	N/A
7905890	12/2010	Whitfield et al.	N/A	N/A
7905902	12/2010	Huitema et al.	N/A	N/A
7909039	12/2010	Hur	N/A	N/A
7909191	12/2010	Baker et al.	N/A	N/A
7909220	12/2010	Viola	N/A	N/A
7909221	12/2010	Viola et al.	N/A	N/A
7909224	12/2010	Prommersberger	N/A	N/A
7913891	12/2010	Doll et al.	N/A	N/A
7913893	12/2010	Mastri et al.	N/A	N/A
7914521	12/2010	Wang et al.	N/A	N/A
7914543	12/2010	Roth et al.	N/A	N/A
7914551	12/2010	Ortiz et al.	N/A	N/A
7918230	12/2010	Whitman et al.	N/A	N/A
7918376	12/2010	Knodel et al.	N/A	N/A
7918377	12/2010	Measamer et al.	N/A	N/A

7918845	12/2010	Saadat et al.	N/A	N/A
7918848	12/2010	Lau et al.	N/A	N/A
7918861	12/2010	Brock et al.	N/A	N/A
7918867	12/2010	Dana et al.	N/A	N/A
7922061	12/2010	Shelton, IV et al.	N/A	N/A
7922063	12/2010	Zemlok et al.	N/A	N/A
7922743	12/2010	Heinrich et al.	N/A	N/A
7923144	12/2010	Kohn et al.	N/A	N/A
7926691	12/2010	Viola et al.	N/A	N/A
7926692	12/2010	Racenet et al.	N/A	N/A
7927328	12/2010	Orszulak et al.	N/A	N/A
7928281	12/2010	Augustine	N/A	N/A
7930040	12/2010	Kelsch et al.	N/A	N/A
7930065	12/2010	Larkin et al.	N/A	N/A
7931660	12/2010	Aranyi et al.	N/A	N/A
7931695	12/2010	Ringeisen	N/A	N/A
7931877	12/2010	Steffens et al.	N/A	N/A
7934630	12/2010	Shelton, IV et al.	N/A	N/A
7934631	12/2010	Balbierz et al.	N/A	N/A
7934896	12/2010	Schnier	N/A	N/A
7935130	12/2010	Williams	N/A	N/A
7935773	12/2010	Hadba et al.	N/A	N/A
7936142	12/2010	Otsuka et al.	N/A	N/A
7938307	12/2010	Bettuchi	N/A	N/A
7939152	12/2010	Haskin et al.	N/A	N/A
7941865	12/2010	Seman, Jr. et al.	N/A	N/A
7942300	12/2010	Rethy et al.	N/A	N/A
7942303	12/2010	Shah	N/A	N/A
7942890	12/2010	D'Agostino et al.	N/A	N/A
7944175	12/2010	Mori et al.	N/A	N/A
7945792	12/2010	Cherpantier	N/A	N/A
7945798	12/2010	Carlson et al.	N/A	N/A
7946453	12/2010	Voegele et al.	N/A	N/A
7947011	12/2010	Birk et al.	N/A	N/A
7948381	12/2010	Lindsay et al.	N/A	N/A
7950560	12/2010	Zemlok et al.	N/A	N/A
7950561	12/2010	Aranyi	N/A	N/A
7950562	12/2010	Beardsley et al.	N/A	N/A
7951071	12/2010	Whitman et al.	N/A	N/A
7951166	12/2010	Orban, III et al.	N/A	N/A
7952464	12/2010	Nikitin et al.	N/A	N/A
7954682	12/2010	Giordano et al.	N/A	N/A
7954684	12/2010	Boudreaux	N/A	N/A
7954685	12/2010	Viola	N/A	N/A
7954686	12/2010	Baxter, III et al.	N/A	N/A
7954687	12/2010	Zemlok et al.	N/A	N/A
7954688	12/2010	Argentine et al.	N/A	N/A
7955253	12/2010	Ewers et al.	N/A	N/A
7955257	12/2010	Frasier et al.	N/A	N/A
7955322	12/2010	Devengenzo et al.	N/A	N/A

7955327	12/2010	Sartor et al.	N/A	N/A
7955380	12/2010	Chu et al.	N/A	N/A
7959050	12/2010	Smith et al.	N/A	N/A
7959051	12/2010	Smith et al.	N/A	N/A
7959052	12/2010	Sonnenschein et al.	N/A	N/A
7963432	12/2010	Knodel et al.	N/A	N/A
7963433	12/2010	Whitman et al.	N/A	N/A
7963913	12/2010	Devengenzo et al.	N/A	N/A
7963963	12/2010	Francischelli et al.	N/A	N/A
7963964	12/2010	Santilli et al.	N/A	N/A
7964206	12/2010	Suokas et al.	N/A	N/A
7966236	12/2010	Noriega et al.	N/A	N/A
7966269	12/2010	Bauer et al.	N/A	N/A
7966799	12/2010	Morgan et al.	N/A	N/A
7967178	12/2010	Scirica et al.	N/A	N/A
7967179	12/2010	Olson et al.	N/A	N/A
7967180	12/2010	Scirica	N/A	N/A
7967181	12/2010	Viola et al.	N/A	N/A
7967791	12/2010	Franer et al.	N/A	N/A
7967839	12/2010	Flock et al.	N/A	N/A
7972298	12/2010	Wallace et al.	N/A	N/A
7972315	12/2010	Birk et al.	N/A	N/A
7976213	12/2010	Bertolotti et al.	N/A	N/A
7976508	12/2010	Hoag	N/A	N/A
7976563	12/2010	Summerer	N/A	N/A
7979137	12/2010	Tracey et al.	N/A	N/A
7980443	12/2010	Scheib et al.	N/A	N/A
7981025	12/2010	Pool et al.	N/A	N/A
7981102	12/2010	Patel et al.	N/A	N/A
7981132	12/2010	Dubrul et al.	N/A	N/A
7987405	12/2010	Turner et al.	N/A	N/A
7988015	12/2010	Mason, II et al.	N/A	N/A
7988026	12/2010	Knodel et al.	N/A	N/A
7988027	12/2010	Olson et al.	N/A	N/A
7988028	12/2010	Farascioni et al.	N/A	N/A
7988779	12/2010	Disalvo et al.	N/A	N/A
7992757	12/2010	Wheeler et al.	N/A	N/A
7993360	12/2010	Hacker et al.	N/A	N/A
7994670	12/2010	Ji	N/A	N/A
7997054	12/2010	Bertsch et al.	N/A	N/A
7997468	12/2010	Farascioni	N/A	N/A
7997469	12/2010	Olson et al.	N/A	N/A
8002696	12/2010	Suzuki	N/A	N/A
8002784	12/2010	Jinno et al.	N/A	N/A
8002785	12/2010	Weiss et al.	N/A	N/A
8002795	12/2010	Beetel	N/A	N/A
8006365	12/2010	Levin et al.	N/A	N/A
8006885	12/2010	Marczyk	N/A	N/A
8006889	12/2010	Adams et al.	N/A	N/A
8007370	12/2010	Hirsch et al.	N/A	N/A

8007465	12/2010	Birk et al.	N/A	N/A
8007479	12/2010	Birk et al.	N/A	N/A
8007511	12/2010	Brock et al.	N/A	N/A
8007513	12/2010	Nalagatla et al.	N/A	N/A
8008598	12/2010	Whitman et al.	N/A	N/A
8010180	12/2010	Quaid et al.	N/A	N/A
8011550	12/2010	Aranyi et al.	N/A	N/A
8011551	12/2010	Marczyk et al.	N/A	N/A
8011553	12/2010	Mastri et al.	N/A	N/A
8011555	12/2010	Tarinelli et al.	N/A	N/A
8012170	12/2010	Whitman et al.	N/A	N/A
8016176	12/2010	Kasvikis et al.	N/A	N/A
8016177	12/2010	Bettuchi et al.	N/A	N/A
8016178	12/2010	Olson et al.	N/A	N/A
8016849	12/2010	Wenchell	N/A	N/A
8016855	12/2010	Whitman et al.	N/A	N/A
8016858	12/2010	Whitman	N/A	N/A
8016881	12/2010	Furst	N/A	N/A
8020741	12/2010	Cole et al.	N/A	N/A
8020742	12/2010	Marczyk	N/A	N/A
8020743	12/2010	Shelton, IV	N/A	N/A
8021375	12/2010	Aldrich et al.	N/A	N/A
8025199	12/2010	Whitman et al.	N/A	N/A
8025896	12/2010	Malaviya et al.	N/A	N/A
8028835	12/2010	Yasuda et al.	N/A	N/A
8028882	12/2010	Viola	N/A	N/A
8028883	12/2010	Stopek	N/A	N/A
8028884	12/2010	Sniffin et al.	N/A	N/A
8028885	12/2010	Smith et al.	N/A	N/A
8029510	12/2010	Hoegerle	N/A	N/A
8031069	12/2010	Cohn et al.	N/A	N/A
8033438	12/2010	Scirica	N/A	N/A
8033439	12/2010	Racenet et al.	N/A	N/A
8033440	12/2010	Wenchell et al.	N/A	N/A
8033442	12/2010	Racenet et al.	N/A	N/A
8034077	12/2010	Smith et al.	N/A	N/A
8034337	12/2010	Simard	N/A	N/A
8034363	12/2010	Li et al.	N/A	N/A
8035487	12/2010	Malackowski	N/A	N/A
8037591	12/2010	Spivey et al.	N/A	N/A
8038044	12/2010	Viola	N/A	N/A
8038045	12/2010	Bettuchi et al.	N/A	N/A
8038046	12/2010	Smith et al.	N/A	N/A
8038686	12/2010	Huitema et al.	N/A	N/A
8043207	12/2010	Adams	N/A	N/A
8043328	12/2010	Hahnen et al.	N/A	N/A
8044536	12/2010	Nguyen et al.	N/A	N/A
8044604	12/2010	Hagino et al.	N/A	N/A
8047236	12/2010	Perry	N/A	N/A
8048503	12/2010	Farnsworth et al.	N/A	N/A

8052636	12/2010	Moll et al.	N/A	N/A
8052697	12/2010	Phillips	N/A	N/A
8056787	12/2010	Boudreaux et al.	N/A	N/A
8056788	12/2010	Mastri et al.	N/A	N/A
8056789	12/2010	White et al.	N/A	N/A
8057508	12/2010	Shelton, IV	N/A	N/A
8058771	12/2010	Giordano et al.	N/A	N/A
8060250	12/2010	Reiland et al.	N/A	N/A
8061014	12/2010	Smith et al.	N/A	N/A
8061576	12/2010	Cappola	N/A	N/A
8062236	12/2010	Soltz	N/A	N/A
8062306	12/2010	Nobis et al.	N/A	N/A
8062330	12/2010	Prommersberger et al.	N/A	N/A
8063619	12/2010	Zhu et al.	N/A	N/A
8066158	12/2010	Vogel et al.	N/A	N/A
8066166	12/2010	Demmy et al.	N/A	N/A
8066167	12/2010	Measamer et al.	N/A	N/A
8066168	12/2010	Vidal et al.	N/A	N/A
8066720	12/2010	Knodel et al.	N/A	N/A
D650074	12/2010	Hunt et al.	N/A	N/A
D650789	12/2010	Arnold	N/A	N/A
8070033	12/2010	Milliman et al.	N/A	N/A
8070034	12/2010	Knodel	N/A	N/A
8070035	12/2010	Holsten et al.	N/A	N/A
8070743	12/2010	Kagan et al.	N/A	N/A
8074858	12/2010	Marczyk	N/A	N/A
8074859	12/2010	Kostrzewski	N/A	N/A
8074861	12/2010	Ehrenfels et al.	N/A	N/A
8075476	12/2010	Vargas	N/A	N/A
8075571	12/2010	Vitali et al.	N/A	N/A
8079950	12/2010	Stem et al.	N/A	N/A
8079989	12/2010	Birk et al.	N/A	N/A
8080004	12/2010	Downey et al.	N/A	N/A
8083118	12/2010	Milliman et al.	N/A	N/A
8083119	12/2010	Prommersberger	N/A	N/A
8083120	12/2010	Shelton, IV et al.	N/A	N/A
8084001	12/2010	Burns et al.	N/A	N/A
8084969	12/2010	David et al.	N/A	N/A
8085013	12/2010	Wei et al.	N/A	N/A
8087562	12/2011	Manoux et al.	N/A	N/A
8087563	12/2011	Milliman et al.	N/A	N/A
8089509	12/2011	Chatenever et al.	N/A	N/A
8091753	12/2011	Viola	N/A	N/A
8091756	12/2011	Viola	N/A	N/A
8092443	12/2011	Bischoff	N/A	N/A
8092932	12/2011	Phillips et al.	N/A	N/A
8093572	12/2011	Kuduvalli	N/A	N/A
8096458	12/2011	Hessler	N/A	N/A
8096459	12/2011	Ortiz et al.	N/A	N/A

8097017	12/2011	Viola	N/A	N/A
8100310	12/2011	Zemlok	N/A	N/A
8100824	12/2011	Hegeman et al.	N/A	N/A
8100872	12/2011	Patel	N/A	N/A
8102138	12/2011	Sekine et al.	N/A	N/A
8102278	12/2011	Deck et al.	N/A	N/A
8105320	12/2011	Manzo	N/A	N/A
8105350	12/2011	Lee et al.	N/A	N/A
8107925	12/2011	Natsuno et al.	N/A	N/A
8108033	12/2011	Drew et al.	N/A	N/A
8108072	12/2011	Zhao et al.	N/A	N/A
8109426	12/2011	Milliman et al.	N/A	N/A
8110208	12/2011	Hen	N/A	N/A
8113405	12/2011	Milliman	N/A	N/A
8113407	12/2011	Holsten et al.	N/A	N/A
8113408	12/2011	Wenchell et al.	N/A	N/A
8113410	12/2011	Hall et al.	N/A	N/A
8114017	12/2011	Bacher	N/A	N/A
8114100	12/2011	Smith et al.	N/A	N/A
8114345	12/2011	Dlugos, Jr. et al.	N/A	N/A
8118206	12/2011	Zand et al.	N/A	N/A
8118207	12/2011	Racenet et al.	N/A	N/A
8120301	12/2011	Goldberg et al.	N/A	N/A
8122128	12/2011	Burke, II et al.	N/A	N/A
8123103	12/2011	Milliman	N/A	N/A
8123523	12/2011	Carron et al.	N/A	N/A
8123766	12/2011	Bauman et al.	N/A	N/A
8123767	12/2011	Bauman et al.	N/A	N/A
8125168	12/2011	Johnson et al.	N/A	N/A
8127975	12/2011	Olson et al.	N/A	N/A
8127976	12/2011	Scirica et al.	N/A	N/A
8128624	12/2011	Couture et al.	N/A	N/A
8128643	12/2011	Aranyi et al.	N/A	N/A
8128645	12/2011	Sonnenschein et al.	N/A	N/A
8128662	12/2011	Altarac et al.	N/A	N/A
8132703	12/2011	Milliman et al.	N/A	N/A
8132705	12/2011	Viola et al.	N/A	N/A
8132706	12/2011	Marczyk et al.	N/A	N/A
8133500	12/2011	Ringeisen et al.	N/A	N/A
8134306	12/2011	Drader et al.	N/A	N/A
8136711	12/2011	Beardsley et al.	N/A	N/A
8136712	12/2011	Zingman	N/A	N/A
8136713	12/2011	Hathaway et al.	N/A	N/A
8137339	12/2011	Jinno et al.	N/A	N/A
8140417	12/2011	Shibata	N/A	N/A
8141762	12/2011	Bedi et al.	N/A	N/A
8141763	12/2011	Milliman	N/A	N/A
8142200	12/2011	Crunkilton et al.	N/A	N/A
8142425	12/2011	Eggers	N/A	N/A
8142461	12/2011	Houser et al.	N/A	N/A

8142515	12/2011	Therin et al.	N/A	N/A
8143520	12/2011	Cutler	N/A	N/A
8146790	12/2011	Milliman	N/A	N/A
8147421	12/2011	Farquhar et al.	N/A	N/A
8147456	12/2011	Fisher et al.	N/A	N/A
8147485	12/2011	Wham et al.	N/A	N/A
8152041	12/2011	Kostrzewski	N/A	N/A
8152756	12/2011	Webster et al.	N/A	N/A
8154239	12/2011	Katsuki et al.	N/A	N/A
8157145	12/2011	Shelton, IV et al.	N/A	N/A
8157148	12/2011	Scirica	N/A	N/A
8157151	12/2011	Ingmanson et al.	N/A	N/A
8157152	12/2011	Holsten et al.	N/A	N/A
8157153	12/2011	Shelton, IV et al.	N/A	N/A
8157793	12/2011	Omori et al.	N/A	N/A
8157834	12/2011	Conlon	N/A	N/A
8161977	12/2011	Shelton, IV et al.	N/A	N/A
8162138	12/2011	Bettenhausen et al.	N/A	N/A
8162197	12/2011	Mastri et al.	N/A	N/A
8162668	12/2011	Toly	N/A	N/A
8162933	12/2011	Francischelli et al.	N/A	N/A
8162965	12/2011	Reschke et al.	N/A	N/A
8167185	12/2011	Shelton, IV et al.	N/A	N/A
8167622	12/2011	Zhou	N/A	N/A
8167895	12/2011	D'Agostino et al.	N/A	N/A
8167898	12/2011	Schaller et al.	N/A	N/A
8170241	12/2011	Roe et al.	N/A	N/A
8172004	12/2011	Ho	N/A	N/A
8172120	12/2011	Boyden et al.	N/A	N/A
8172122	12/2011	Kasvikis et al.	N/A	N/A
8172124	12/2011	Shelton, IV et al.	N/A	N/A
8177776	12/2011	Humayun et al.	N/A	N/A
8177797	12/2011	Shimoji et al.	N/A	N/A
8179705	12/2011	Chapuis	N/A	N/A
8180458	12/2011	Kane et al.	N/A	N/A
8181839	12/2011	Beetel	N/A	N/A
8181840	12/2011	Milliman	N/A	N/A
8182422	12/2011	Bayer et al.	N/A	N/A
8182444	12/2011	Uber, III et al.	N/A	N/A
8183807	12/2011	Tsai et al.	N/A	N/A
8186555	12/2011	Shelton, IV et al.	N/A	N/A
8186556	12/2011	Viola	N/A	N/A
8186558	12/2011	Sapienza	N/A	N/A
8186560	12/2011	Hess et al.	N/A	N/A
8190238	12/2011	Moll et al.	N/A	N/A
8191752	12/2011	Scirica	N/A	N/A
8192350	12/2011	Ortiz et al.	N/A	N/A
8192460	12/2011	Orban, III et al.	N/A	N/A
8192651	12/2011	Young et al.	N/A	N/A
8193129	12/2011	Tagawa et al.	N/A	N/A

8196795	12/2011	Moore et al.	N/A	N/A
8196796	12/2011	Shelton, IV et al.	N/A	N/A
8197501	12/2011	Shadeck et al.	N/A	N/A
8197502	12/2011	Smith et al.	N/A	N/A
8197837	12/2011	Jamiolkowski et al.	N/A	N/A
8201720	12/2011	Hessler	N/A	N/A
8201721	12/2011	Zemlok et al.	N/A	N/A
8202549	12/2011	Stucky et al.	N/A	N/A
8205779	12/2011	Ma et al.	N/A	N/A
8205780	12/2011	Sorrentino et al.	N/A	N/A
8205781	12/2011	Baxter, III et al.	N/A	N/A
8207863	12/2011	Neubauer et al.	N/A	N/A
8210411	12/2011	Yates et al.	N/A	N/A
8210413	12/2011	Whitman et al.	N/A	N/A
8210414	12/2011	Bettuchi et al.	N/A	N/A
8210415	12/2011	Ward	N/A	N/A
8210416	12/2011	Milliman et al.	N/A	N/A
8210721	12/2011	Chen et al.	N/A	N/A
8211125	12/2011	Spivey	N/A	N/A
8214019	12/2011	Govari et al.	N/A	N/A
8215531	12/2011	Shelton, IV et al.	N/A	N/A
8215532	12/2011	Marczyk	N/A	N/A
8215533	12/2011	Viola et al.	N/A	N/A
8220468	12/2011	Cooper et al.	N/A	N/A
8220688	12/2011	Laurent et al.	N/A	N/A
8220690	12/2011	Hess et al.	N/A	N/A
8221402	12/2011	Francischelli et al.	N/A	N/A
8221424	12/2011	Cha	N/A	N/A
8221433	12/2011	Lozier et al.	N/A	N/A
8225799	12/2011	Bettuchi	N/A	N/A
8225979	12/2011	Farascioni et al.	N/A	N/A
8226553	12/2011	Shelton, IV et al.	N/A	N/A
8226635	12/2011	Petrie et al.	N/A	N/A
8226675	12/2011	Houser et al.	N/A	N/A
8226715	12/2011	Hwang et al.	N/A	N/A
8227946	12/2011	Kim	N/A	N/A
8228020	12/2011	Shin et al.	N/A	N/A
8228048	12/2011	Spencer	N/A	N/A
8229549	12/2011	Whitman et al.	N/A	N/A
8230235	12/2011	Goodman et al.	N/A	N/A
8231040	12/2011	Zemlok et al.	N/A	N/A
8231042	12/2011	Hessler et al.	N/A	N/A
8231043	12/2011	Tarinelli et al.	N/A	N/A
8235272	12/2011	Nicholas et al.	N/A	N/A
8235274	12/2011	Cappola	N/A	N/A
8236010	12/2011	Ortiz et al.	N/A	N/A
8236011	12/2011	Harris et al.	N/A	N/A
8236020	12/2011	Smith et al.	N/A	N/A
8237388	12/2011	Jinno et al.	N/A	N/A
8240536	12/2011	Marczyk	N/A	N/A

8240537	12/2011	Marczyk	N/A	N/A
8241271	12/2011	Millman et al.	N/A	N/A
8241284	12/2011	Dycus et al.	N/A	N/A
8241308	12/2011	Kortenbach et al.	N/A	N/A
8241322	12/2011	Whitman et al.	N/A	N/A
8245594	12/2011	Rogers et al.	N/A	N/A
8245898	12/2011	Smith et al.	N/A	N/A
8245899	12/2011	Swensgard et al.	N/A	N/A
8245900	12/2011	Scirica	N/A	N/A
8245901	12/2011	Stopek	N/A	N/A
8246608	12/2011	Omori et al.	N/A	N/A
8246637	12/2011	Viola et al.	N/A	N/A
8252009	12/2011	Weller et al.	N/A	N/A
8256654	12/2011	Bettuchi et al.	N/A	N/A
8256655	12/2011	Sniffin et al.	N/A	N/A
8256656	12/2011	Milliman et al.	N/A	N/A
8257251	12/2011	Shelton, IV et al.	N/A	N/A
8257356	12/2011	Bleich et al.	N/A	N/A
8257386	12/2011	Lee et al.	N/A	N/A
8257391	12/2011	Orban, III et al.	N/A	N/A
8257634	12/2011	Scirica	N/A	N/A
8258745	12/2011	Smith et al.	N/A	N/A
8261958	12/2011	Knodel	N/A	N/A
8262560	12/2011	Whitman	N/A	N/A
8262655	12/2011	Ghabrial et al.	N/A	N/A
8266232	12/2011	Piper et al.	N/A	N/A
8267300	12/2011	Boudreaux	N/A	N/A
8267849	12/2011	Wazer et al.	N/A	N/A
8267924	12/2011	Zemlok et al.	N/A	N/A
8267946	12/2011	Whitfield et al.	N/A	N/A
8267951	12/2011	Whayne et al.	N/A	N/A
8268344	12/2011	Ma et al.	N/A	N/A
8269121	12/2011	Smith	N/A	N/A
8272553	12/2011	Mastri et al.	N/A	N/A
8272554	12/2011	Whitman et al.	N/A	N/A
8272918	12/2011	Lam	N/A	N/A
8273404	12/2011	Dave et al.	N/A	N/A
8276594	12/2011	Shah	N/A	N/A
8276801	12/2011	Zemlok et al.	N/A	N/A
8276802	12/2011	Kostrzewski	N/A	N/A
8277473	12/2011	Sunaoshi et al.	N/A	N/A
8281446	12/2011	Moskovich	N/A	N/A
8281973	12/2011	Wenchell et al.	N/A	N/A
8281974	12/2011	Hessler et al.	N/A	N/A
8282654	12/2011	Ferrari et al.	N/A	N/A
8285367	12/2011	Hyde et al.	N/A	N/A
8286723	12/2011	Puzio et al.	N/A	N/A
8286845	12/2011	Perry et al.	N/A	N/A
8286846	12/2011	Smith et al.	N/A	N/A
8286847	12/2011	Taylor	N/A	N/A

8287487	12/2011	Estes	N/A	N/A
8287522	12/2011	Moses et al.	N/A	N/A
8287561	12/2011	Nunez et al.	N/A	N/A
8288984	12/2011	Yang	N/A	N/A
8289403	12/2011	Dobashi et al.	N/A	N/A
8290883	12/2011	Takeuchi et al.	N/A	N/A
8292147	12/2011	Viola	N/A	N/A
8292148	12/2011	Viola	N/A	N/A
8292150	12/2011	Bryant	N/A	N/A
8292151	12/2011	Viola	N/A	N/A
8292152	12/2011	Milliman et al.	N/A	N/A
8292155	12/2011	Shelton, IV et al.	N/A	N/A
8292157	12/2011	Smith et al.	N/A	N/A
8292158	12/2011	Sapienza	N/A	N/A
8292801	12/2011	Dejima et al.	N/A	N/A
8292888	12/2011	Whitman	N/A	N/A
8292906	12/2011	Taylor et al.	N/A	N/A
8294399	12/2011	Suzuki et al.	N/A	N/A
8298161	12/2011	Vargas	N/A	N/A
8298189	12/2011	Fisher et al.	N/A	N/A
8298233	12/2011	Mueller	N/A	N/A
8298677	12/2011	Wiesner et al.	N/A	N/A
8302323	12/2011	Fortier et al.	N/A	N/A
8303621	12/2011	Miyamoto et al.	N/A	N/A
8308040	12/2011	Huang et al.	N/A	N/A
8308041	12/2011	Kostrzewski	N/A	N/A
8308042	12/2011	Aranyi	N/A	N/A
8308043	12/2011	Bindra et al.	N/A	N/A
8308046	12/2011	Prommersberger	N/A	N/A
8308659	12/2011	Scheibe et al.	N/A	N/A
8308725	12/2011	Bell et al.	N/A	N/A
8310188	12/2011	Nakai	N/A	N/A
8313496	12/2011	Sauer et al.	N/A	N/A
8313499	12/2011	Magnusson et al.	N/A	N/A
8313509	12/2011	Kostrzewski	N/A	N/A
8317070	12/2011	Hueil et al.	N/A	N/A
8317071	12/2011	Knodel	N/A	N/A
8317074	12/2011	Ortiz et al.	N/A	N/A
8317437	12/2011	Merkley et al.	N/A	N/A
8317744	12/2011	Kirschenman	N/A	N/A
8317790	12/2011	Bell et al.	N/A	N/A
8319002	12/2011	Daniels et al.	N/A	N/A
D672784	12/2011	Clanton et al.	N/A	N/A
8322455	12/2011	Shelton, IV et al.	N/A	N/A
8322589	12/2011	Boudreaux	N/A	N/A
8322590	12/2011	Patel et al.	N/A	N/A
8322901	12/2011	Michelotti	N/A	N/A
8323271	12/2011	Humayun et al.	N/A	N/A
8323789	12/2011	Rozhin et al.	N/A	N/A
8324585	12/2011	McBroom et al.	N/A	N/A

8327514	12/2011	Kim	N/A	N/A
8328061	12/2011	Kasvikis	N/A	N/A
8328062	12/2011	Viola	N/A	N/A
8328063	12/2011	Milliman et al.	N/A	N/A
8328064	12/2011	Racenet et al.	N/A	N/A
8328065	12/2011	Shah	N/A	N/A
8328802	12/2011	Deville et al.	N/A	N/A
8328823	12/2011	Aranyi et al.	N/A	N/A
8333313	12/2011	Boudreaux et al.	N/A	N/A
8333691	12/2011	Schaaf	N/A	N/A
8333764	12/2011	Francischelli et al.	N/A	N/A
8333779	12/2011	Smith et al.	N/A	N/A
8334468	12/2011	Palmer et al.	N/A	N/A
8336753	12/2011	Olson et al.	N/A	N/A
8336754	12/2011	Cappola et al.	N/A	N/A
8342377	12/2012	Milliman et al.	N/A	N/A
8342378	12/2012	Marczyk et al.	N/A	N/A
8342379	12/2012	Whitman et al.	N/A	N/A
8342380	12/2012	Viola	N/A	N/A
8343150	12/2012	Artale	N/A	N/A
8347978	12/2012	Forster et al.	N/A	N/A
8348118	12/2012	Segura	N/A	N/A
8348123	12/2012	Scirica et al.	N/A	N/A
8348124	12/2012	Scirica	N/A	N/A
8348125	12/2012	Viola et al.	N/A	N/A
8348126	12/2012	Olson et al.	N/A	N/A
8348127	12/2012	Marczyk	N/A	N/A
8348129	12/2012	Bedi et al.	N/A	N/A
8348130	12/2012	Shah et al.	N/A	N/A
8348131	12/2012	Omaits et al.	N/A	N/A
8348837	12/2012	Wenchell	N/A	N/A
8348948	12/2012	Bahney	N/A	N/A
8348959	12/2012	Wolford et al.	N/A	N/A
8348972	12/2012	Soltz et al.	N/A	N/A
8349987	12/2012	Kapiamba et al.	N/A	N/A
8352004	12/2012	Mannheimer et al.	N/A	N/A
8353437	12/2012	Boudreaux	N/A	N/A
8353438	12/2012	Baxter, III et al.	N/A	N/A
8353439	12/2012	Baxter, III et al.	N/A	N/A
8356740	12/2012	Knodel	N/A	N/A
8357144	12/2012	Whitman et al.	N/A	N/A
8357158	12/2012	McKenna et al.	N/A	N/A
8357161	12/2012	Mueller	N/A	N/A
8359174	12/2012	Nakashima et al.	N/A	N/A
8360296	12/2012	Zingman	N/A	N/A
8360297	12/2012	Shelton, IV et al.	N/A	N/A
8360298	12/2012	Farascioni et al.	N/A	N/A
8360299	12/2012	Zemlok et al.	N/A	N/A
8361501	12/2012	DiTizio et al.	N/A	N/A
D676866	12/2012	Chaudhri	N/A	N/A

8365972	12/2012	Aranyi et al.	N/A	N/A
8365973	12/2012	White et al.	N/A	N/A
8365975	12/2012	Manoux et al.	N/A	N/A
8365976	12/2012	Hess et al.	N/A	N/A
8366559	12/2012	Papenfuss et al.	N/A	N/A
8366719	12/2012	Markey et al.	N/A	N/A
8366787	12/2012	Brown et al.	N/A	N/A
8368327	12/2012	Benning et al.	N/A	N/A
8369056	12/2012	Senriuchi et al.	N/A	N/A
8371393	12/2012	Higuchi et al.	N/A	N/A
8371491	12/2012	Huitema et al.	N/A	N/A
8371492	12/2012	Aranyi et al.	N/A	N/A
8371493	12/2012	Aranyi et al.	N/A	N/A
8371494	12/2012	Racenet et al.	N/A	N/A
8372094	12/2012	Bettuchi et al.	N/A	N/A
8374723	12/2012	Zhao et al.	N/A	N/A
8376865	12/2012	Forster et al.	N/A	N/A
8377029	12/2012	Nagao et al.	N/A	N/A
8377044	12/2012	Coe et al.	N/A	N/A
8377059	12/2012	Deville et al.	N/A	N/A
8381828	12/2012	Whitman et al.	N/A	N/A
8381834	12/2012	Barhitte et al.	N/A	N/A
8382773	12/2012	Whitfield et al.	N/A	N/A
8382790	12/2012	Uenohara et al.	N/A	N/A
D677273	12/2012	Randall et al.	N/A	N/A
8387848	12/2012	Johnson et al.	N/A	N/A
8388633	12/2012	Rousseau et al.	N/A	N/A
8389588	12/2012	Ringeisen et al.	N/A	N/A
8393513	12/2012	Jankowski	N/A	N/A
8393514	12/2012	Shelton, IV et al.	N/A	N/A
8393516	12/2012	Kostrzewski	N/A	N/A
8397832	12/2012	Blickle et al.	N/A	N/A
8397971	12/2012	Yates et al.	N/A	N/A
8397972	12/2012	Kostrzewski	N/A	N/A
8397973	12/2012	Hausen	N/A	N/A
8398633	12/2012	Mueller	N/A	N/A
8398669	12/2012	Kim	N/A	N/A
8398673	12/2012	Hinchliffe et al.	N/A	N/A
8398674	12/2012	Prestel	N/A	N/A
8400108	12/2012	Powell et al.	N/A	N/A
8400851	12/2012	Byun	N/A	N/A
8403138	12/2012	Weisshaupt et al.	N/A	N/A
8403195	12/2012	Beardsley et al.	N/A	N/A
8403196	12/2012	Beardsley et al.	N/A	N/A
8403198	12/2012	Sorrentino et al.	N/A	N/A
8403832	12/2012	Cunningham et al.	N/A	N/A
8403926	12/2012	Nobis et al.	N/A	N/A
8403945	12/2012	Whitfield et al.	N/A	N/A
8403946	12/2012	Whitfield et al.	N/A	N/A
8403950	12/2012	Palmer et al.	N/A	N/A

D680646	12/2012	Hunt et al.	N/A	N/A
8408439	12/2012	Huang et al.	N/A	N/A
8408442	12/2012	Racenet et al.	N/A	N/A
8409079	12/2012	Okamoto et al.	N/A	N/A
8409174	12/2012	Omori	N/A	N/A
8409175	12/2012	Lee et al.	N/A	N/A
8409211	12/2012	Baroud	N/A	N/A
8409222	12/2012	Whitfield et al.	N/A	N/A
8409223	12/2012	Sorrentino et al.	N/A	N/A
8409234	12/2012	Stahler et al.	N/A	N/A
8411500	12/2012	Gapihan et al.	N/A	N/A
8413661	12/2012	Rousseau et al.	N/A	N/A
8413870	12/2012	Pastorelli et al.	N/A	N/A
8413871	12/2012	Racenet et al.	N/A	N/A
8413872	12/2012	Patel	N/A	N/A
8414469	12/2012	Diolaiti	N/A	N/A
8414577	12/2012	Boudreaux et al.	N/A	N/A
8414598	12/2012	Brock et al.	N/A	N/A
8418073	12/2012	Mohr et al.	N/A	N/A
8418906	12/2012	Farascioni et al.	N/A	N/A
8418907	12/2012	Johnson et al.	N/A	N/A
8418908	12/2012	Beardsley	N/A	N/A
8418909	12/2012	Kostrzewski	N/A	N/A
8419635	12/2012	Shelton, IV et al.	N/A	N/A
8419717	12/2012	Diolaiti et al.	N/A	N/A
8419747	12/2012	Hinman et al.	N/A	N/A
8419754	12/2012	Laby et al.	N/A	N/A
8419755	12/2012	Deem et al.	N/A	N/A
8423182	12/2012	Robinson et al.	N/A	N/A
8424737	12/2012	Scirica	N/A	N/A
8424739	12/2012	Racenet et al.	N/A	N/A
8424740	12/2012	Shelton, IV et al.	N/A	N/A
8424741	12/2012	McGuckin, Jr. et al.	N/A	N/A
8424742	12/2012	Bettuchi	N/A	N/A
8425600	12/2012	Maxwell	N/A	N/A
8427430	12/2012	Lee et al.	N/A	N/A
8430292	12/2012	Patel et al.	N/A	N/A
8430892	12/2012	Bindra et al.	N/A	N/A
8430898	12/2012	Wiener et al.	N/A	N/A
8435257	12/2012	Smith et al.	N/A	N/A
8439246	12/2012	Knodel	N/A	N/A
8439830	12/2012	McKinley et al.	N/A	N/A
8444036	12/2012	Shelton, IV	N/A	N/A
8444037	12/2012	Nicholas et al.	N/A	N/A
8444549	12/2012	Viola et al.	N/A	N/A
8449536	12/2012	Selig	N/A	N/A
8449560	12/2012	Roth et al.	N/A	N/A
8453904	12/2012	Eskaros et al.	N/A	N/A
8453906	12/2012	Huang et al.	N/A	N/A
8453907	12/2012	Laurent et al.	N/A	N/A

8453908	12/2012	Bedi et al.	N/A	N/A
8453912	12/2012	Mastri et al.	N/A	N/A
8453914	12/2012	Laurent et al.	N/A	N/A
8454495	12/2012	Kawano et al.	N/A	N/A
8454551	12/2012	Allen et al.	N/A	N/A
8454628	12/2012	Smith et al.	N/A	N/A
8454640	12/2012	Johnston et al.	N/A	N/A
8457757	12/2012	Cauller et al.	N/A	N/A
8459520	12/2012	Giordano et al.	N/A	N/A
8459521	12/2012	Zemlok et al.	N/A	N/A
8459524	12/2012	Pribanic et al.	N/A	N/A
8459525	12/2012	Yates et al.	N/A	N/A
8464922	12/2012	Marczyk	N/A	N/A
8464923	12/2012	Shelton, IV	N/A	N/A
8464924	12/2012	Gresham et al.	N/A	N/A
8464925	12/2012	Hull et al.	N/A	N/A
8465475	12/2012	Isbell, Jr.	N/A	N/A
8465502	12/2012	Zergiebel	N/A	N/A
8465515	12/2012	Drew et al.	N/A	N/A
8469254	12/2012	Czernik et al.	N/A	N/A
8469946	12/2012	Sugita	N/A	N/A
8469973	12/2012	Meade et al.	N/A	N/A
8470355	12/2012	Skalla et al.	N/A	N/A
D686240	12/2012	Lin	N/A	N/A
D686244	12/2012	Moriya et al.	N/A	N/A
8474677	12/2012	Woodard, Jr. et al.	N/A	N/A
8475453	12/2012	Marczyk et al.	N/A	N/A
8475454	12/2012	Alshemari	N/A	N/A
8475474	12/2012	Bombard et al.	N/A	N/A
8479968	12/2012	Hodgkinson et al.	N/A	N/A
8479969	12/2012	Shelton, IV	N/A	N/A
8480703	12/2012	Nicholas et al.	N/A	N/A
8483509	12/2012	Matsuzaka	N/A	N/A
8485412	12/2012	Shelton, IV et al.	N/A	N/A
8485413	12/2012	Scheib et al.	N/A	N/A
8485970	12/2012	Widenhouse et al.	N/A	N/A
8486047	12/2012	Stopek	N/A	N/A
8487199	12/2012	Palmer et al.	N/A	N/A
8487487	12/2012	Dietz et al.	N/A	N/A
8490851	12/2012	Blier et al.	N/A	N/A
8490852	12/2012	Viola	N/A	N/A
8490853	12/2012	Criscuolo et al.	N/A	N/A
8491581	12/2012	Deville et al.	N/A	N/A
8491603	12/2012	Yeung et al.	N/A	N/A
8491624	12/2012	Kerr et al.	N/A	N/A
8496153	12/2012	Demmy et al.	N/A	N/A
8496154	12/2012	Marczyk et al.	N/A	N/A
8496156	12/2012	Sniffin et al.	N/A	N/A
8496683	12/2012	Prommersberger et al.	N/A	N/A

8498691	12/2012	Moll et al.	N/A	N/A
8499673	12/2012	Keller	N/A	N/A
8499966	12/2012	Palmer et al.	N/A	N/A
8499992	12/2012	Whitman et al.	N/A	N/A
8499993	12/2012	Shelton, IV et al.	N/A	N/A
8499994	12/2012	D'Arcangelo	N/A	N/A
8500721	12/2012	Jinno	N/A	N/A
8500762	12/2012	Sholev et al.	N/A	N/A
8502091	12/2012	Palmer et al.	N/A	N/A
8505799	12/2012	Viola et al.	N/A	N/A
8505801	12/2012	Ehrenfels et al.	N/A	N/A
8505802	12/2012	Viola et al.	N/A	N/A
8506555	12/2012	Ruiz Morales	N/A	N/A
8506557	12/2012	Zemlok et al.	N/A	N/A
8506580	12/2012	Zergiebel et al.	N/A	N/A
8506581	12/2012	Wingardner, III et al.	N/A	N/A
8511308	12/2012	Hecox et al.	N/A	N/A
8512359	12/2012	Whitman et al.	N/A	N/A
8512402	12/2012	Marczyk et al.	N/A	N/A
8517239	12/2012	Scheib et al.	N/A	N/A
8517241	12/2012	Nicholas et al.	N/A	N/A
8517243	12/2012	Giordano et al.	N/A	N/A
8517244	12/2012	Shelton, IV et al.	N/A	N/A
8517938	12/2012	Eisenhardt et al.	N/A	N/A
8518024	12/2012	Williams et al.	N/A	N/A
8521273	12/2012	Kliman	N/A	N/A
8523042	12/2012	Masiakos et al.	N/A	N/A
8523043	12/2012	Ullrich et al.	N/A	N/A
8523787	12/2012	Ludwin et al.	N/A	N/A
8523881	12/2012	Cabiri et al.	N/A	N/A
8523882	12/2012	Huitema et al.	N/A	N/A
8523900	12/2012	Jinno et al.	N/A	N/A
8529588	12/2012	Ahlberg et al.	N/A	N/A
8529599	12/2012	Holsten	N/A	N/A
8529600	12/2012	Woodard, Jr. et al.	N/A	N/A
8529819	12/2012	Ostapoff et al.	N/A	N/A
8531153	12/2012	Baarman et al.	N/A	N/A
8532747	12/2012	Nock et al.	N/A	N/A
8534527	12/2012	Brendel et al.	N/A	N/A
8534528	12/2012	Shelton, IV	N/A	N/A
8535304	12/2012	Sklar et al.	N/A	N/A
8535340	12/2012	Allen	N/A	N/A
8539866	12/2012	Nayak et al.	N/A	N/A
8540128	12/2012	Shelton, IV et al.	N/A	N/A
8540129	12/2012	Baxter, III et al.	N/A	N/A
8540130	12/2012	Moore et al.	N/A	N/A
8540131	12/2012	Swayze	N/A	N/A
8540133	12/2012	Bedi et al.	N/A	N/A
8540646	12/2012	Mendez-Coll	N/A	N/A

8540733	12/2012	Whitman et al.	N/A	N/A
8540735	12/2012	Mitelberg et al.	N/A	N/A
8550984	12/2012	Takemoto	N/A	N/A
8551076	12/2012	Duval et al.	N/A	N/A
8555660	12/2012	Takenaka et al.	N/A	N/A
8556151	12/2012	Viola	N/A	N/A
8556918	12/2012	Bauman et al.	N/A	N/A
8556935	12/2012	Knodel et al.	N/A	N/A
8560147	12/2012	Taylor et al.	N/A	N/A
8561617	12/2012	Lindh et al.	N/A	N/A
8561870	12/2012	Baxter, III et al.	N/A	N/A
8561871	12/2012	Rajappa et al.	N/A	N/A
8561873	12/2012	Ingmanson et al.	N/A	N/A
8562592	12/2012	Conlon et al.	N/A	N/A
8562598	12/2012	Falkenstein et al.	N/A	N/A
8567656	12/2012	Shelton, IV et al.	N/A	N/A
8568416	12/2012	Schmitz et al.	N/A	N/A
8568425	12/2012	Ross et al.	N/A	N/A
D692916	12/2012	Granchi et al.	N/A	N/A
8573459	12/2012	Smith et al.	N/A	N/A
8573461	12/2012	Shelton, IV et al.	N/A	N/A
8573462	12/2012	Smith et al.	N/A	N/A
8573465	12/2012	Shelton, IV	N/A	N/A
8574199	12/2012	von Bulow et al.	N/A	N/A
8574263	12/2012	Mueller	N/A	N/A
8575880	12/2012	Grantz	N/A	N/A
8575895	12/2012	Garrastacho et al.	N/A	N/A
8579176	12/2012	Smith et al.	N/A	N/A
8579178	12/2012	Holsten et al.	N/A	N/A
8579897	12/2012	Vakharia et al.	N/A	N/A
8579937	12/2012	Gresham	N/A	N/A
8584919	12/2012	Hueil et al.	N/A	N/A
8584920	12/2012	Hodgkinson	N/A	N/A
8584921	12/2012	Scirica	N/A	N/A
8585583	12/2012	Sakaguchi et al.	N/A	N/A
8585598	12/2012	Razzaque et al.	N/A	N/A
8585721	12/2012	Kirsch	N/A	N/A
8590760	12/2012	Cummins et al.	N/A	N/A
8590762	12/2012	Hess et al.	N/A	N/A
8590764	12/2012	Hartwick et al.	N/A	N/A
8591400	12/2012	Sugiyama	N/A	N/A
8596515	12/2012	Okoniewski	N/A	N/A
8597745	12/2012	Farnsworth et al.	N/A	N/A
8599450	12/2012	Kubo et al.	N/A	N/A
8602125	12/2012	King	N/A	N/A
8602287	12/2012	Yates et al.	N/A	N/A
8602288	12/2012	Shelton, IV et al.	N/A	N/A
8603077	12/2012	Cooper et al.	N/A	N/A
8603089	12/2012	Viola	N/A	N/A
8603110	12/2012	Maruyama et al.	N/A	N/A

8603135	12/2012	Mueller	N/A	N/A
8608043	12/2012	Scirica	N/A	N/A
8608044	12/2012	Hueil et al.	N/A	N/A
8608045	12/2012	Smith et al.	N/A	N/A
8608046	12/2012	Laurent et al.	N/A	N/A
8608745	12/2012	Guzman et al.	N/A	N/A
8613383	12/2012	Beckman et al.	N/A	N/A
8613384	12/2012	Pastorelli et al.	N/A	N/A
8616427	12/2012	Viola	N/A	N/A
8616431	12/2012	Timm et al.	N/A	N/A
8617155	12/2012	Johnson et al.	N/A	N/A
8620473	12/2012	Diolaiti et al.	N/A	N/A
8622274	12/2013	Yates et al.	N/A	N/A
8622275	12/2013	Baxter, III et al.	N/A	N/A
8627993	12/2013	Smith et al.	N/A	N/A
8627994	12/2013	Zemlok et al.	N/A	N/A
8627995	12/2013	Smith et al.	N/A	N/A
8628467	12/2013	Whitman et al.	N/A	N/A
8628518	12/2013	Blumenkranz et al.	N/A	N/A
8628544	12/2013	Farascioni	N/A	N/A
8628545	12/2013	Cabrera et al.	N/A	N/A
8631987	12/2013	Shelton, IV et al.	N/A	N/A
8631992	12/2013	Hausen et al.	N/A	N/A
8631993	12/2013	Kostrzewski	N/A	N/A
8632462	12/2013	Yoo et al.	N/A	N/A
8632525	12/2013	Kerr et al.	N/A	N/A
8632535	12/2013	Shelton, IV et al.	N/A	N/A
8632539	12/2013	Twomey et al.	N/A	N/A
8632563	12/2013	Nagase et al.	N/A	N/A
8636187	12/2013	Hueil et al.	N/A	N/A
8636190	12/2013	Zemlok et al.	N/A	N/A
8636191	12/2013	Meagher	N/A	N/A
8636193	12/2013	Whitman et al.	N/A	N/A
8636736	12/2013	Yates et al.	N/A	N/A
8636766	12/2013	Milliman et al.	N/A	N/A
8639936	12/2013	Hu et al.	N/A	N/A
8640788	12/2013	Dachs, II et al.	N/A	N/A
8646674	12/2013	Schulte et al.	N/A	N/A
8647258	12/2013	Aranyi et al.	N/A	N/A
8652120	12/2013	Giordano et al.	N/A	N/A
8652151	12/2013	Lehman et al.	N/A	N/A
8652155	12/2013	Houser et al.	N/A	N/A
8656929	12/2013	Miller et al.	N/A	N/A
8657174	12/2013	Yates et al.	N/A	N/A
8657175	12/2013	Sonnenschein et al.	N/A	N/A
8657176	12/2013	Shelton, IV et al.	N/A	N/A
8657177	12/2013	Scirica et al.	N/A	N/A
8657178	12/2013	Hueil et al.	N/A	N/A
8657482	12/2013	Malackowski et al.	N/A	N/A
8657808	12/2013	McPherson et al.	N/A	N/A

8657814	12/2013	Werneth et al.	N/A	N/A
8657821	12/2013	Palermo	N/A	N/A
D701238	12/2013	Lai et al.	N/A	N/A
8662370	12/2013	Takei	N/A	N/A
8663106	12/2013	Stivoric et al.	N/A	N/A
8663192	12/2013	Hester et al.	N/A	N/A
8663245	12/2013	Francischelli et al.	N/A	N/A
8663262	12/2013	Smith et al.	N/A	N/A
8663270	12/2013	Donnigan et al.	N/A	N/A
8664792	12/2013	Rebsdorf	N/A	N/A
8668129	12/2013	Olson	N/A	N/A
8668130	12/2013	Hess et al.	N/A	N/A
8672206	12/2013	Aranyi et al.	N/A	N/A
8672207	12/2013	Shelton, IV et al.	N/A	N/A
8672208	12/2013	Hess et al.	N/A	N/A
8672209	12/2013	Crainich	N/A	N/A
8672922	12/2013	Loh et al.	N/A	N/A
8672935	12/2013	Okada et al.	N/A	N/A
8672951	12/2013	Smith et al.	N/A	N/A
8673210	12/2013	Deshays	N/A	N/A
8675820	12/2013	Baic et al.	N/A	N/A
8678263	12/2013	Viola	N/A	N/A
8678994	12/2013	Sonnenschein et al.	N/A	N/A
8679093	12/2013	Farra	N/A	N/A
8679098	12/2013	Hart	N/A	N/A
8679114	12/2013	Chapman et al.	N/A	N/A
8679137	12/2013	Bauman et al.	N/A	N/A
8679154	12/2013	Smith et al.	N/A	N/A
8679156	12/2013	Smith et al.	N/A	N/A
8679454	12/2013	Guire et al.	N/A	N/A
8684248	12/2013	Milliman	N/A	N/A
8684249	12/2013	Racenet et al.	N/A	N/A
8684250	12/2013	Bettuchi et al.	N/A	N/A
8684253	12/2013	Giordano et al.	N/A	N/A
8684962	12/2013	Kirschenman et al.	N/A	N/A
8685004	12/2013	Zemlock et al.	N/A	N/A
8685020	12/2013	Weizman et al.	N/A	N/A
8690893	12/2013	Deitch et al.	N/A	N/A
8695866	12/2013	Leimbach et al.	N/A	N/A
8696665	12/2013	Hunt et al.	N/A	N/A
8701958	12/2013	Shelton, IV et al.	N/A	N/A
8701959	12/2013	Shah	N/A	N/A
8706316	12/2013	Hoevenaar	N/A	N/A
8708210	12/2013	Zemlok et al.	N/A	N/A
8708211	12/2013	Zemlok et al.	N/A	N/A
8708212	12/2013	Williams	N/A	N/A
8708213	12/2013	Shelton, IV et al.	N/A	N/A
8709012	12/2013	Muller	N/A	N/A
8712549	12/2013	Zdeblick et al.	N/A	N/A
8714352	12/2013	Farascioni et al.	N/A	N/A

8714429	12/2013	Demmy	N/A	N/A
8714430	12/2013	Natarajan et al.	N/A	N/A
8715256	12/2013	Greener	N/A	N/A
8715302	12/2013	Ibrahim et al.	N/A	N/A
8720766	12/2013	Hess et al.	N/A	N/A
8721630	12/2013	Ortiz et al.	N/A	N/A
8721666	12/2013	Schroeder et al.	N/A	N/A
8727197	12/2013	Hess et al.	N/A	N/A
8727199	12/2013	Wenchell	N/A	N/A
8727200	12/2013	Roy	N/A	N/A
8727961	12/2013	Ziv	N/A	N/A
8728099	12/2013	Cohn et al.	N/A	N/A
8728119	12/2013	Cummins	N/A	N/A
8733470	12/2013	Matthias et al.	N/A	N/A
8733611	12/2013	Milliman	N/A	N/A
8733612	12/2013	Ma	N/A	N/A
8733613	12/2013	Huitema et al.	N/A	N/A
8733614	12/2013	Ross et al.	N/A	N/A
8734336	12/2013	Bonadio et al.	N/A	N/A
8734359	12/2013	Ibanez et al.	N/A	N/A
8734478	12/2013	Widenhouse et al.	N/A	N/A
8734831	12/2013	Kim et al.	N/A	N/A
8739033	12/2013	Rosenberg	N/A	N/A
8739417	12/2013	Tokunaga et al.	N/A	N/A
8740034	12/2013	Morgan et al.	N/A	N/A
8740037	12/2013	Shelton, IV et al.	N/A	N/A
8740038	12/2013	Shelton, IV et al.	N/A	N/A
8740987	12/2013	Geremakis et al.	N/A	N/A
8746529	12/2013	Shelton, IV et al.	N/A	N/A
8746530	12/2013	Giordano et al.	N/A	N/A
8746533	12/2013	Whitman et al.	N/A	N/A
8746535	12/2013	Shelton, IV et al.	N/A	N/A
8747238	12/2013	Shelton, IV et al.	N/A	N/A
8747441	12/2013	Konieczynski et al.	N/A	N/A
8752264	12/2013	Ackley et al.	N/A	N/A
8752699	12/2013	Morgan et al.	N/A	N/A
8752747	12/2013	Shelton, IV et al.	N/A	N/A
8752748	12/2013	Whitman et al.	N/A	N/A
8752749	12/2013	Moore et al.	N/A	N/A
8753664	12/2013	Dao et al.	N/A	N/A
8757287	12/2013	Mak et al.	N/A	N/A
8757465	12/2013	Woodard, Jr. et al.	N/A	N/A
8758235	12/2013	Jaworek	N/A	N/A
8758366	12/2013	McLean et al.	N/A	N/A
8758391	12/2013	Swayze et al.	N/A	N/A
8758438	12/2013	Boyce et al.	N/A	N/A
8763875	12/2013	Morgan et al.	N/A	N/A
8763876	12/2013	Kostrzewski	N/A	N/A
8763877	12/2013	Schall et al.	N/A	N/A
8763879	12/2013	Shelton, IV et al.	N/A	N/A

8764732	12/2013	Hartwell	N/A	N/A
8765942	12/2013	Feraud et al.	N/A	N/A
8770458	12/2013	Scirica	N/A	N/A
8770459	12/2013	Racenet et al.	N/A	N/A
8770460	12/2013	Belzer	N/A	N/A
8771169	12/2013	Whitman et al.	N/A	N/A
8771260	12/2013	Conlon et al.	N/A	N/A
8777004	12/2013	Shelton, IV et al.	N/A	N/A
8777082	12/2013	Scirica	N/A	N/A
8777083	12/2013	Racenet et al.	N/A	N/A
8777898	12/2013	Suon et al.	N/A	N/A
8783541	12/2013	Shelton, IV et al.	N/A	N/A
8783542	12/2013	Riestenberg et al.	N/A	N/A
8783543	12/2013	Shelton, IV et al.	N/A	N/A
8784304	12/2013	Mikkaichi et al.	N/A	N/A
8784404	12/2013	Doyle et al.	N/A	N/A
8784415	12/2013	Malackowski et al.	N/A	N/A
8789737	12/2013	Hodgkinson et al.	N/A	N/A
8789739	12/2013	Swensgard	N/A	N/A
8789740	12/2013	Baxter, III et al.	N/A	N/A
8789741	12/2013	Baxter, III et al.	N/A	N/A
8790658	12/2013	Cigarini et al.	N/A	N/A
8790684	12/2013	Dave et al.	N/A	N/A
D711905	12/2013	Morrison et al.	N/A	N/A
8794098	12/2013	Long	N/A	N/A
8794496	12/2013	Scirica	N/A	N/A
8794497	12/2013	Zingman	N/A	N/A
8795159	12/2013	Moriyama	N/A	N/A
8795276	12/2013	Dietz et al.	N/A	N/A
8795308	12/2013	Valin	N/A	N/A
8795324	12/2013	Kawai et al.	N/A	N/A
8796995	12/2013	Cunanan et al.	N/A	N/A
8800681	12/2013	Rousson et al.	N/A	N/A
8800837	12/2013	Zemlok	N/A	N/A
8800838	12/2013	Shelton, IV	N/A	N/A
8800839	12/2013	Beetel	N/A	N/A
8800840	12/2013	Jankowski	N/A	N/A
8800841	12/2013	Ellerhorst et al.	N/A	N/A
8801710	12/2013	Ullrich et al.	N/A	N/A
8801734	12/2013	Shelton, IV et al.	N/A	N/A
8801735	12/2013	Shelton, IV et al.	N/A	N/A
8801752	12/2013	Fortier et al.	N/A	N/A
8801801	12/2013	Datta et al.	N/A	N/A
8806973	12/2013	Ross et al.	N/A	N/A
8807414	12/2013	Ross et al.	N/A	N/A
8808161	12/2013	Gregg et al.	N/A	N/A
8808164	12/2013	Hoffman et al.	N/A	N/A
8808274	12/2013	Hartwell	N/A	N/A
8808294	12/2013	Fox et al.	N/A	N/A
8808308	12/2013	Boukhny et al.	N/A	N/A

8808311	12/2013	Heinrich et al.	N/A	N/A
8808325	12/2013	Hess et al.	N/A	N/A
8810197	12/2013	Juergens	N/A	N/A
8811017	12/2013	Fujii et al.	N/A	N/A
8813866	12/2013	Suzuki	N/A	N/A
8814024	12/2013	Woodard, Jr. et al.	N/A	N/A
8814025	12/2013	Miller et al.	N/A	N/A
8814836	12/2013	Ignon et al.	N/A	N/A
8815594	12/2013	Harris et al.	N/A	N/A
8818523	12/2013	Olson et al.	N/A	N/A
8820603	12/2013	Shelton, IV et al.	N/A	N/A
8820605	12/2013	Shelton, IV	N/A	N/A
8820606	12/2013	Hodgkinson	N/A	N/A
8820607	12/2013	Marczyk	N/A	N/A
8820608	12/2013	Miyamoto	N/A	N/A
8821514	12/2013	Aranyi	N/A	N/A
8822934	12/2013	Sayeh et al.	N/A	N/A
8825164	12/2013	Tweden et al.	N/A	N/A
8827133	12/2013	Shelton, IV et al.	N/A	N/A
8827134	12/2013	Viola et al.	N/A	N/A
8827903	12/2013	Shelton, IV et al.	N/A	N/A
8828046	12/2013	Stefanchik et al.	N/A	N/A
8831779	12/2013	Ortmaier et al.	N/A	N/A
8833219	12/2013	Pierce	N/A	N/A
8833630	12/2013	Milliman	N/A	N/A
8833632	12/2013	Swensgard	N/A	N/A
8834353	12/2013	Dejima et al.	N/A	N/A
8834465	12/2013	Ramstein et al.	N/A	N/A
8834498	12/2013	Byrum et al.	N/A	N/A
8834518	12/2013	Faller et al.	N/A	N/A
8840003	12/2013	Morgan et al.	N/A	N/A
8840004	12/2013	Holsten et al.	N/A	N/A
8840603	12/2013	Shelton, IV et al.	N/A	N/A
8840609	12/2013	Stuebe	N/A	N/A
8840876	12/2013	Eemeta et al.	N/A	N/A
8844789	12/2013	Shelton, IV et al.	N/A	N/A
8844790	12/2013	Demmy et al.	N/A	N/A
8845622	12/2013	Paik et al.	N/A	N/A
8851215	12/2013	Goto	N/A	N/A
8851354	12/2013	Swensgard et al.	N/A	N/A
8851355	12/2013	Aranyi et al.	N/A	N/A
8852174	12/2013	Burbank	N/A	N/A
8852185	12/2013	Twomey	N/A	N/A
8852199	12/2013	Deslauriers et al.	N/A	N/A
8852218	12/2013	Hughett, Sr. et al.	N/A	N/A
8855822	12/2013	Bartol et al.	N/A	N/A
8857692	12/2013	Shima et al.	N/A	N/A
8857693	12/2013	Schuckmann et al.	N/A	N/A
8857694	12/2013	Shelton, IV et al.	N/A	N/A
8858538	12/2013	Belson et al.	N/A	N/A

8858547	12/2013	Brogna	N/A	N/A
8858571	12/2013	Shelton, IV et al.	N/A	N/A
8858590	12/2013	Shelton, IV et al.	N/A	N/A
8864007	12/2013	Widenhouse et al.	N/A	N/A
8864009	12/2013	Shelton, IV et al.	N/A	N/A
8864010	12/2013	Williams	N/A	N/A
8864750	12/2013	Ross et al.	N/A	N/A
8869912	12/2013	Roßkamp et al.	N/A	N/A
8869913	12/2013	Matthias et al.	N/A	N/A
8870049	12/2013	Amid et al.	N/A	N/A
8870050	12/2013	Hodgkinson	N/A	N/A
8870867	12/2013	Walberg et al.	N/A	N/A
8870912	12/2013	Brisson et al.	N/A	N/A
8871829	12/2013	Gerold et al.	N/A	N/A
8875971	12/2013	Hall et al.	N/A	N/A
8875972	12/2013	Weisenburgh, II et al.	N/A	N/A
8876698	12/2013	Sakamoto et al.	N/A	N/A
8876857	12/2013	Burbank	N/A	N/A
8876858	12/2013	Braun	N/A	N/A
8882660	12/2013	Phee et al.	N/A	N/A
8882792	12/2013	Dietz et al.	N/A	N/A
8884560	12/2013	Ito	N/A	N/A
8887979	12/2013	Mastri et al.	N/A	N/A
8888688	12/2013	Julian et al.	N/A	N/A
8888695	12/2013	Piskun et al.	N/A	N/A
8888792	12/2013	Harris et al.	N/A	N/A
8888809	12/2013	Davison et al.	N/A	N/A
8893946	12/2013	Boudreaux et al.	N/A	N/A
8893949	12/2013	Shelton, IV et al.	N/A	N/A
8894647	12/2013	Beardsley et al.	N/A	N/A
8894654	12/2013	Anderson	N/A	N/A
8899460	12/2013	Wojcicki	N/A	N/A
8899461	12/2013	Farascioni	N/A	N/A
8899462	12/2013	Kostrzewski et al.	N/A	N/A
8899463	12/2013	Schall et al.	N/A	N/A
8899464	12/2013	Hueil et al.	N/A	N/A
8899465	12/2013	Shelton, IV et al.	N/A	N/A
8899466	12/2013	Baxter, III et al.	N/A	N/A
8900267	12/2013	Woolfson et al.	N/A	N/A
8905287	12/2013	Racenet et al.	N/A	N/A
8905977	12/2013	Shelton et al.	N/A	N/A
8910846	12/2013	Viola	N/A	N/A
8910847	12/2013	Nalagatla et al.	N/A	N/A
8911426	12/2013	Coppeta et al.	N/A	N/A
8911448	12/2013	Stein	N/A	N/A
8911460	12/2013	Neurohr et al.	N/A	N/A
8911471	12/2013	Spivey et al.	N/A	N/A
8912746	12/2013	Reid et al.	N/A	N/A

8915842	12/2013	Weisenburgh, II et al.	N/A	N/A
8920368	12/2013	Sandhu et al.	N/A	N/A
8920433	12/2013	Barrier et al.	N/A	N/A
8920435	12/2013	Smith et al.	N/A	N/A
8920438	12/2013	Aranyi et al.	N/A	N/A
8920443	12/2013	Hiles et al.	N/A	N/A
8920444	12/2013	Hiles et al.	N/A	N/A
8922163	12/2013	Macdonald	N/A	N/A
8925782	12/2014	Shelton, IV	N/A	N/A
8925783	12/2014	Zemlok et al.	N/A	N/A
8925788	12/2014	Hess et al.	N/A	N/A
8926506	12/2014	Widenhouse et al.	N/A	N/A
8926598	12/2014	Mollere et al.	N/A	N/A
8931576	12/2014	Iwata	N/A	N/A
8931679	12/2014	Kostrzewski	N/A	N/A
8931680	12/2014	Milliman	N/A	N/A
8931682	12/2014	Timm et al.	N/A	N/A
8931692	12/2014	Sancak	N/A	N/A
8936614	12/2014	Allen, IV	N/A	N/A
8937408	12/2014	Ganem et al.	N/A	N/A
8939343	12/2014	Milliman et al.	N/A	N/A
8939344	12/2014	Olson et al.	N/A	N/A
8939898	12/2014	Omoto	N/A	N/A
8944069	12/2014	Miller et al.	N/A	N/A
8945095	12/2014	Blumenkranz et al.	N/A	N/A
8945098	12/2014	Seibold et al.	N/A	N/A
8945163	12/2014	Voegele et al.	N/A	N/A
8955732	12/2014	Zemlok et al.	N/A	N/A
8956342	12/2014	Russo et al.	N/A	N/A
8956390	12/2014	Shah et al.	N/A	N/A
8958860	12/2014	Banerjee et al.	N/A	N/A
8960519	12/2014	Whitman et al.	N/A	N/A
8960520	12/2014	McCuen	N/A	N/A
8960521	12/2014	Kostrzewski	N/A	N/A
8961191	12/2014	Hanshew	N/A	N/A
8961504	12/2014	Hoarau et al.	N/A	N/A
8961542	12/2014	Whitfield et al.	N/A	N/A
8963714	12/2014	Medhal et al.	N/A	N/A
D725674	12/2014	Jung et al.	N/A	N/A
8967443	12/2014	McCuen	N/A	N/A
8967444	12/2014	Beetel	N/A	N/A
8967446	12/2014	Beardsley et al.	N/A	N/A
8967448	12/2014	Carter et al.	N/A	N/A
8968276	12/2014	Zemlok et al.	N/A	N/A
8968308	12/2014	Horner et al.	N/A	N/A
8968312	12/2014	Marczyk et al.	N/A	N/A
8968337	12/2014	Whitfield et al.	N/A	N/A
8968340	12/2014	Chowaniec et al.	N/A	N/A
8968355	12/2014	Malkowski et al.	N/A	N/A

8968358	12/2014	Reschke	N/A	N/A
8970507	12/2014	Holbein et al.	N/A	N/A
8973803	12/2014	Hall et al.	N/A	N/A
8973804	12/2014	Hess et al.	N/A	N/A
8973805	12/2014	Scirica et al.	N/A	N/A
8974440	12/2014	Farritor et al.	N/A	N/A
8974542	12/2014	Fujimoto et al.	N/A	N/A
8974932	12/2014	McGahan et al.	N/A	N/A
8978954	12/2014	Shelton, IV et al.	N/A	N/A
8978955	12/2014	Aronhalt et al.	N/A	N/A
8978956	12/2014	Schall et al.	N/A	N/A
8979843	12/2014	Timm et al.	N/A	N/A
8979890	12/2014	Boudreaux	N/A	N/A
8982195	12/2014	Claus et al.	N/A	N/A
8984711	12/2014	Ota et al.	N/A	N/A
8985240	12/2014	Winnard	N/A	N/A
8985429	12/2014	Balek et al.	N/A	N/A
8986302	12/2014	Aldridge et al.	N/A	N/A
8989903	12/2014	Weir et al.	N/A	N/A
8991676	12/2014	Hess et al.	N/A	N/A
8991677	12/2014	Moore et al.	N/A	N/A
8991678	12/2014	Wellman et al.	N/A	N/A
8992042	12/2014	Eichenholz	N/A	N/A
8992422	12/2014	Spivey et al.	N/A	N/A
8992565	12/2014	Brisson et al.	N/A	N/A
8996165	12/2014	Wang et al.	N/A	N/A
8998058	12/2014	Moore et al.	N/A	N/A
8998059	12/2014	Smith et al.	N/A	N/A
8998060	12/2014	Bruewer et al.	N/A	N/A
8998061	12/2014	Williams et al.	N/A	N/A
8998939	12/2014	Price et al.	N/A	N/A
9000720	12/2014	Stulen et al.	N/A	N/A
9002518	12/2014	Manzo et al.	N/A	N/A
9004339	12/2014	Park	N/A	N/A
9004799	12/2014	Tibbits	N/A	N/A
9005230	12/2014	Yates et al.	N/A	N/A
9005238	12/2014	DeSantis et al.	N/A	N/A
9005243	12/2014	Stopek et al.	N/A	N/A
9010606	12/2014	Aranyi et al.	N/A	N/A
9010608	12/2014	Casasanta, Jr. et al.	N/A	N/A
9010611	12/2014	Ross et al.	N/A	N/A
9011437	12/2014	Woodruff et al.	N/A	N/A
9011439	12/2014	Shalaby et al.	N/A	N/A
9011471	12/2014	Timm et al.	N/A	N/A
9014856	12/2014	Manzo et al.	N/A	N/A
9016539	12/2014	Kostrzewski et al.	N/A	N/A
9016540	12/2014	Whitman et al.	N/A	N/A
9016541	12/2014	Viola et al.	N/A	N/A
9016542	12/2014	Shelton, IV et al.	N/A	N/A
9016545	12/2014	Aranyi et al.	N/A	N/A

9017331	12/2014	Fox	N/A	N/A
9017355	12/2014	Smith et al.	N/A	N/A
9017369	12/2014	Renger et al.	N/A	N/A
9017371	12/2014	Whitman et al.	N/A	N/A
9017849	12/2014	Stulen et al.	N/A	N/A
9017851	12/2014	Felder et al.	N/A	N/A
D729274	12/2014	Clement et al.	N/A	N/A
9021684	12/2014	Lenker et al.	N/A	N/A
9023014	12/2014	Chowaniec et al.	N/A	N/A
9023069	12/2014	Kasvikis et al.	N/A	N/A
9023071	12/2014	Miller et al.	N/A	N/A
9026347	12/2014	Gadh et al.	N/A	N/A
9027817	12/2014	Milliman et al.	N/A	N/A
9028468	12/2014	Scarfogliero et al.	N/A	N/A
9028494	12/2014	Shelton, IV et al.	N/A	N/A
9028495	12/2014	Mueller et al.	N/A	N/A
9028510	12/2014	Miyamoto et al.	N/A	N/A
9028511	12/2014	Weller et al.	N/A	N/A
9028519	12/2014	Yates et al.	N/A	N/A
9028529	12/2014	Fox et al.	N/A	N/A
9030166	12/2014	Kano	N/A	N/A
9030169	12/2014	Christensen et al.	N/A	N/A
9033203	12/2014	Woodard, Jr. et al.	N/A	N/A
9033204	12/2014	Shelton, IV et al.	N/A	N/A
9034505	12/2014	Detry et al.	N/A	N/A
9038881	12/2014	Schaller et al.	N/A	N/A
9039690	12/2014	Kersten et al.	N/A	N/A
9039694	12/2014	Ross et al.	N/A	N/A
9039720	12/2014	Madan	N/A	N/A
9039736	12/2014	Scirica et al.	N/A	N/A
9040062	12/2014	Maeda et al.	N/A	N/A
9043027	12/2014	Durant et al.	N/A	N/A
9044227	12/2014	Shelton, IV et al.	N/A	N/A
9044228	12/2014	Woodard, Jr. et al.	N/A	N/A
9044229	12/2014	Scheib et al.	N/A	N/A
9044230	12/2014	Morgan et al.	N/A	N/A
9044238	12/2014	Orszulak	N/A	N/A
9044241	12/2014	Barner et al.	N/A	N/A
9044261	12/2014	Houser	N/A	N/A
9044281	12/2014	Pool et al.	N/A	N/A
9050083	12/2014	Yates et al.	N/A	N/A
9050084	12/2014	Schmid et al.	N/A	N/A
9050089	12/2014	Orszulak	N/A	N/A
9050100	12/2014	Yates et al.	N/A	N/A
9050120	12/2014	Swarup et al.	N/A	N/A
9050123	12/2014	Krause et al.	N/A	N/A
9050176	12/2014	Datta et al.	N/A	N/A
9050192	12/2014	Mansmann	N/A	N/A
9055941	12/2014	Schmid et al.	N/A	N/A
9055942	12/2014	Balbierz et al.	N/A	N/A

9055943	12/2014	Zemlok et al.	N/A	N/A
9055944	12/2014	Hodgkinson et al.	N/A	N/A
9055961	12/2014	Manzo et al.	N/A	N/A
9060770	12/2014	Shelton, IV et al.	N/A	N/A
9060776	12/2014	Yates et al.	N/A	N/A
9060794	12/2014	Kang et al.	N/A	N/A
9060894	12/2014	Wubbeling	N/A	N/A
9061392	12/2014	Forgues et al.	N/A	N/A
9070068	12/2014	Coveley et al.	N/A	N/A
9072515	12/2014	Hall et al.	N/A	N/A
9072523	12/2014	Houser et al.	N/A	N/A
9072535	12/2014	Shelton, IV et al.	N/A	N/A
9072536	12/2014	Shelton, IV et al.	N/A	N/A
9078653	12/2014	Leimbach et al.	N/A	N/A
9078654	12/2014	Whitman et al.	N/A	N/A
9084586	12/2014	Hafner et al.	N/A	N/A
9084601	12/2014	Moore et al.	N/A	N/A
9084602	12/2014	Gleiman	N/A	N/A
9086875	12/2014	Harrat et al.	N/A	N/A
9089326	12/2014	Krumanaker et al.	N/A	N/A
9089330	12/2014	Widenhouse et al.	N/A	N/A
9089338	12/2014	Smith et al.	N/A	N/A
9089352	12/2014	Jeong	N/A	N/A
9089360	12/2014	Messerly et al.	N/A	N/A
9091588	12/2014	Lefler	N/A	N/A
D736792	12/2014	Brinda et al.	N/A	N/A
9095339	12/2014	Moore et al.	N/A	N/A
9095346	12/2014	Houser et al.	N/A	N/A
9095362	12/2014	Dachs, II et al.	N/A	N/A
9095367	12/2014	Olson et al.	N/A	N/A
9095642	12/2014	Harder et al.	N/A	N/A
9096033	12/2014	Holop et al.	N/A	N/A
9098153	12/2014	Shen et al.	N/A	N/A
9099863	12/2014	Smith et al.	N/A	N/A
9099877	12/2014	Banos et al.	N/A	N/A
9099922	12/2014	Toosky et al.	N/A	N/A
9101358	12/2014	Kerr et al.	N/A	N/A
9101359	12/2014	Smith et al.	N/A	N/A
9101385	12/2014	Shelton, IV et al.	N/A	N/A
9101475	12/2014	Wei et al.	N/A	N/A
9101621	12/2014	Zeldis	N/A	N/A
9107663	12/2014	Swensgard	N/A	N/A
9107667	12/2014	Hodgkinson	N/A	N/A
9107690	12/2014	Bales, Jr. et al.	N/A	N/A
9110587	12/2014	Kim et al.	N/A	N/A
9113862	12/2014	Morgan et al.	N/A	N/A
9113864	12/2014	Morgan et al.	N/A	N/A
9113865	12/2014	Shelton, IV et al.	N/A	N/A
9113866	12/2014	Felder et al.	N/A	N/A
9113868	12/2014	Felder et al.	N/A	N/A

9113873	12/2014	Marczyk et al.	N/A	N/A
9113874	12/2014	Shelton, IV et al.	N/A	N/A
9113875	12/2014	Viola et al.	N/A	N/A
9113876	12/2014	Zemlok et al.	N/A	N/A
9113877	12/2014	Whitman et al.	N/A	N/A
9113879	12/2014	Felder et al.	N/A	N/A
9113880	12/2014	Zemlok et al.	N/A	N/A
9113881	12/2014	Scirica	N/A	N/A
9113883	12/2014	Aronhalt et al.	N/A	N/A
9113884	12/2014	Shelton, IV et al.	N/A	N/A
9113887	12/2014	Behnke, II et al.	N/A	N/A
9119615	12/2014	Felder et al.	N/A	N/A
9119657	12/2014	Shelton, IV et al.	N/A	N/A
9119898	12/2014	Bayon et al.	N/A	N/A
9119957	12/2014	Gantz et al.	N/A	N/A
9123286	12/2014	Park	N/A	N/A
9124097	12/2014	Cruz	N/A	N/A
9125651	12/2014	Mandakolathur Vasudevan et al.	N/A	N/A
9125654	12/2014	Aronhalt et al.	N/A	N/A
9125662	12/2014	Shelton, IV	N/A	N/A
9126317	12/2014	Lawton et al.	N/A	N/A
9131835	12/2014	Widenhouse et al.	N/A	N/A
9131940	12/2014	Huitema et al.	N/A	N/A
9131950	12/2014	Matthew	N/A	N/A
9131957	12/2014	Skarbnik et al.	N/A	N/A
9138225	12/2014	Huang et al.	N/A	N/A
9138226	12/2014	Racenet et al.	N/A	N/A
9144455	12/2014	Kennedy et al.	N/A	N/A
D740414	12/2014	Katsura	N/A	N/A
D741882	12/2014	Shmilov et al.	N/A	N/A
9149274	12/2014	Spivey et al.	N/A	N/A
9149324	12/2014	Huang et al.	N/A	N/A
9149325	12/2014	Worrell et al.	N/A	N/A
9153994	12/2014	Wood et al.	N/A	N/A
9154189	12/2014	Von Novak et al.	N/A	N/A
9161753	12/2014	Prior	N/A	N/A
9161769	12/2014	Stoddard et al.	N/A	N/A
9161803	12/2014	Yates et al.	N/A	N/A
9161807	12/2014	Garrison	N/A	N/A
9161855	12/2014	Rousseau et al.	N/A	N/A
9164271	12/2014	Ebata et al.	N/A	N/A
9167960	12/2014	Yamaguchi et al.	N/A	N/A
9168038	12/2014	Shelton, IV et al.	N/A	N/A
9168039	12/2014	Knodel	N/A	N/A
9168042	12/2014	Milliman	N/A	N/A
9168054	12/2014	Turner et al.	N/A	N/A
9168144	12/2014	Rivin et al.	N/A	N/A
9171244	12/2014	Endou et al.	N/A	N/A
9179832	12/2014	Diolaiti	N/A	N/A

9179911	12/2014	Morgan et al.	N/A	N/A
9179912	12/2014	Yates et al.	N/A	N/A
9180223	12/2014	Yu et al.	N/A	N/A
9182244	12/2014	Luke et al.	N/A	N/A
9186046	12/2014	Ramamurthy et al.	N/A	N/A
9186137	12/2014	Farascioni et al.	N/A	N/A
9186140	12/2014	Hiles et al.	N/A	N/A
9186142	12/2014	Fanelli et al.	N/A	N/A
9186143	12/2014	Timm et al.	N/A	N/A
9186148	12/2014	Felder et al.	N/A	N/A
9186221	12/2014	Burbank	N/A	N/A
9192376	12/2014	Almodovar	N/A	N/A
9192380	12/2014	(Tarinelli) Racenet et al.	N/A	N/A
9192384	12/2014	Bettuchi	N/A	N/A
9192430	12/2014	Rachlin et al.	N/A	N/A
9192434	12/2014	Twomey et al.	N/A	N/A
9193045	12/2014	Saur et al.	N/A	N/A
9197079	12/2014	Yip et al.	N/A	N/A
D744528	12/2014	Agrawal	N/A	N/A
D746459	12/2014	Kaercher et al.	N/A	N/A
9198642	12/2014	Storz	N/A	N/A
9198644	12/2014	Balek et al.	N/A	N/A
9198661	12/2014	Swensgard	N/A	N/A
9198662	12/2014	Barton et al.	N/A	N/A
9198683	12/2014	Friedman et al.	N/A	N/A
9204830	12/2014	Zand et al.	N/A	N/A
9204877	12/2014	Whitman et al.	N/A	N/A
9204878	12/2014	Hall et al.	N/A	N/A
9204879	12/2014	Shelton, IV	N/A	N/A
9204880	12/2014	Baxter, III et al.	N/A	N/A
9204881	12/2014	Penna	N/A	N/A
9204923	12/2014	Manzo et al.	N/A	N/A
9204924	12/2014	Marczyk et al.	N/A	N/A
9211120	12/2014	Scheib et al.	N/A	N/A
9211121	12/2014	Hall et al.	N/A	N/A
9211122	12/2014	Hagerty et al.	N/A	N/A
9216013	12/2014	Scirica et al.	N/A	N/A
9216019	12/2014	Schmid et al.	N/A	N/A
9216020	12/2014	Zhang et al.	N/A	N/A
9216030	12/2014	Fan et al.	N/A	N/A
9216062	12/2014	Duque et al.	N/A	N/A
9220500	12/2014	Swayze et al.	N/A	N/A
9220501	12/2014	Baxter, III et al.	N/A	N/A
9220502	12/2014	Zemlok et al.	N/A	N/A
9220504	12/2014	Viola et al.	N/A	N/A
9220508	12/2014	Dannaher	N/A	N/A
9220559	12/2014	Worrell et al.	N/A	N/A
9220570	12/2014	Kim et al.	N/A	N/A
D746854	12/2015	Shardlow et al.	N/A	N/A

9226686	12/2015	Blair	N/A	N/A
9226750	12/2015	Weir et al.	N/A	N/A
9226751	12/2015	Shelton, IV et al.	N/A	N/A
9226754	12/2015	D'Agostino et al.	N/A	N/A
9226760	12/2015	Shelton, IV	N/A	N/A
9226761	12/2015	Burbank	N/A	N/A
9226767	12/2015	Stulen et al.	N/A	N/A
9226799	12/2015	Lightcap et al.	N/A	N/A
9232941	12/2015	Mandakolathur Vasudevan et al.	N/A	N/A
9232945	12/2015	Zingman	N/A	N/A
9232979	12/2015	Parihar et al.	N/A	N/A
9233610	12/2015	Kim et al.	N/A	N/A
9237891	12/2015	Shelton, IV	N/A	N/A
9237892	12/2015	Hodgkinson	N/A	N/A
9237895	12/2015	McCarthy et al.	N/A	N/A
9237900	12/2015	Boudreaux et al.	N/A	N/A
9237921	12/2015	Messerly et al.	N/A	N/A
9239064	12/2015	Helbig et al.	N/A	N/A
9240740	12/2015	Zeng et al.	N/A	N/A
9241711	12/2015	Ivanko	N/A	N/A
9241712	12/2015	Zemlok et al.	N/A	N/A
9241714	12/2015	Timm et al.	N/A	N/A
9241716	12/2015	Whitman	N/A	N/A
9241731	12/2015	Boudreaux et al.	N/A	N/A
9241758	12/2015	Franer et al.	N/A	N/A
9244524	12/2015	Inoue et al.	N/A	N/A
D748668	12/2015	Kim et al.	N/A	N/A
D749128	12/2015	Perez et al.	N/A	N/A
D749623	12/2015	Gray et al.	N/A	N/A
D750122	12/2015	Shardlow et al.	N/A	N/A
D750129	12/2015	Kwon	N/A	N/A
9254131	12/2015	Soltz et al.	N/A	N/A
9254170	12/2015	Parihar et al.	N/A	N/A
9259265	12/2015	Harris et al.	N/A	N/A
9259268	12/2015	Behnke, II et al.	N/A	N/A
9259274	12/2015	Prisco	N/A	N/A
9259275	12/2015	Burbank	N/A	N/A
9261172	12/2015	Solomon et al.	N/A	N/A
9265500	12/2015	Sorrentino et al.	N/A	N/A
9265510	12/2015	Dietzel et al.	N/A	N/A
9265516	12/2015	Casey et al.	N/A	N/A
9265585	12/2015	Wingardner et al.	N/A	N/A
9271718	12/2015	Milad et al.	N/A	N/A
9271727	12/2015	McGuckin, Jr. et al.	N/A	N/A
9271753	12/2015	Butler et al.	N/A	N/A
9271799	12/2015	Shelton, IV et al.	N/A	N/A
9272406	12/2015	Aronhalt et al.	N/A	N/A
9274095	12/2015	Humayun et al.	N/A	N/A
9277919	12/2015	Timmer et al.	N/A	N/A

9277922	12/2015	Carter et al.	N/A	N/A
9277969	12/2015	Brannan et al.	N/A	N/A
9282962	12/2015	Schmid et al.	N/A	N/A
9282963	12/2015	Bryant	N/A	N/A
9282966	12/2015	Shelton, IV et al.	N/A	N/A
9282974	12/2015	Shelton, IV	N/A	N/A
9283028	12/2015	Johnson	N/A	N/A
9283045	12/2015	Rhee et al.	N/A	N/A
9283054	12/2015	Morgan et al.	N/A	N/A
9283334	12/2015	Mantell et al.	N/A	N/A
9289206	12/2015	Hess et al.	N/A	N/A
9289207	12/2015	Shelton, IV	N/A	N/A
9289210	12/2015	Baxter, III et al.	N/A	N/A
9289211	12/2015	Williams et al.	N/A	N/A
9289212	12/2015	Shelton, IV et al.	N/A	N/A
9289225	12/2015	Shelton, IV et al.	N/A	N/A
9289256	12/2015	Shelton, IV et al.	N/A	N/A
9293757	12/2015	Toussaint et al.	N/A	N/A
9295464	12/2015	Shelton, IV et al.	N/A	N/A
9295465	12/2015	Farascioni	N/A	N/A
9295466	12/2015	Hodgkinson et al.	N/A	N/A
9295467	12/2015	Scirica	N/A	N/A
9295468	12/2015	Heinrich et al.	N/A	N/A
9295514	12/2015	Shelton, IV et al.	N/A	N/A
9295522	12/2015	Kostrzewski	N/A	N/A
9295565	12/2015	McLean	N/A	N/A
9295784	12/2015	Eggert et al.	N/A	N/A
D753167	12/2015	Yu et al.	N/A	N/A
9301691	12/2015	Hufnagel et al.	N/A	N/A
9301752	12/2015	Mandakolathur Vasudevan et al.	N/A	N/A
9301753	12/2015	Aldridge et al.	N/A	N/A
9301755	12/2015	Shelton, IV et al.	N/A	N/A
9301759	12/2015	Spivey et al.	N/A	N/A
9301811	12/2015	Goldberg et al.	N/A	N/A
9307965	12/2015	Ming et al.	N/A	N/A
9307986	12/2015	Hall et al.	N/A	N/A
9307987	12/2015	Swensgard et al.	N/A	N/A
9307988	12/2015	Shelton, IV	N/A	N/A
9307989	12/2015	Shelton, IV et al.	N/A	N/A
9307994	12/2015	Gresham et al.	N/A	N/A
9308009	12/2015	Madan et al.	N/A	N/A
9308011	12/2015	Chao et al.	N/A	N/A
9308646	12/2015	Lim et al.	N/A	N/A
9313915	12/2015	Niu et al.	N/A	N/A
9314246	12/2015	Shelton, IV et al.	N/A	N/A
9314247	12/2015	Shelton, IV et al.	N/A	N/A
9314261	12/2015	Bales, Jr. et al.	N/A	N/A
9314291	12/2015	Schall et al.	N/A	N/A
9314339	12/2015	Mansmann	N/A	N/A

9314908	12/2015	Tanimoto et al.	N/A	N/A
9320518	12/2015	Henderson et al.	N/A	N/A
9320520	12/2015	Shelton, IV et al.	N/A	N/A
9320521	12/2015	Shelton, IV et al.	N/A	N/A
9320523	12/2015	Shelton, IV et al.	N/A	N/A
9325516	12/2015	Pera et al.	N/A	N/A
D755196	12/2015	Meyers et al.	N/A	N/A
D756373	12/2015	Raskin et al.	N/A	N/A
D756377	12/2015	Connolly et al.	N/A	N/A
D757028	12/2015	Goldenberg et al.	N/A	N/A
9326767	12/2015	Koch, Jr. et al.	N/A	N/A
9326768	12/2015	Shelton, IV	N/A	N/A
9326769	12/2015	Shelton, IV et al.	N/A	N/A
9326770	12/2015	Shelton, IV et al.	N/A	N/A
9326771	12/2015	Baxter, III et al.	N/A	N/A
9326788	12/2015	Batross et al.	N/A	N/A
9326812	12/2015	Waaler et al.	N/A	N/A
9326824	12/2015	Inoue et al.	N/A	N/A
9327061	12/2015	Govil et al.	N/A	N/A
9331721	12/2015	Martinez Nuevo et al.	N/A	N/A
9332890	12/2015	Ozawa	N/A	N/A
9332974	12/2015	Henderson et al.	N/A	N/A
9332984	12/2015	Weaner et al.	N/A	N/A
9332987	12/2015	Leimbach et al.	N/A	N/A
9333040	12/2015	Shellenberger et al.	N/A	N/A
9333082	12/2015	Wei et al.	N/A	N/A
9337668	12/2015	Yip	N/A	N/A
9339226	12/2015	van der Walt et al.	N/A	N/A
9339342	12/2015	Prisco et al.	N/A	N/A
9345477	12/2015	Anim et al.	N/A	N/A
9345479	12/2015	(Tarinelli) Racenet et al.	N/A	N/A
9345480	12/2015	Hessler et al.	N/A	N/A
9345481	12/2015	Hall et al.	N/A	N/A
9345503	12/2015	Ishida et al.	N/A	N/A
9351726	12/2015	Leimbach et al.	N/A	N/A
9351727	12/2015	Leimbach et al.	N/A	N/A
9351728	12/2015	Sniffin et al.	N/A	N/A
9351730	12/2015	Schmid et al.	N/A	N/A
9351731	12/2015	Carter et al.	N/A	N/A
9351732	12/2015	Hodgkinson	N/A	N/A
9352071	12/2015	Landgrebe et al.	N/A	N/A
D758433	12/2015	Lee et al.	N/A	N/A
D759063	12/2015	Chen	N/A	N/A
9358003	12/2015	Hall et al.	N/A	N/A
9358004	12/2015	Sniffin et al.	N/A	N/A
9358005	12/2015	Shelton, IV et al.	N/A	N/A
9358015	12/2015	Sorrentino et al.	N/A	N/A
9358031	12/2015	Manzo	N/A	N/A

9358065	12/2015	Ladtkow et al.	N/A	N/A
9364217	12/2015	Kostrzewski et al.	N/A	N/A
9364219	12/2015	Olson et al.	N/A	N/A
9364220	12/2015	Williams	N/A	N/A
9364223	12/2015	Scirica	N/A	N/A
9364226	12/2015	Zemlok et al.	N/A	N/A
9364228	12/2015	Straehnz et al.	N/A	N/A
9364229	12/2015	D'Agostino et al.	N/A	N/A
9364230	12/2015	Shelton, IV et al.	N/A	N/A
9364231	12/2015	Wenchell	N/A	N/A
9364233	12/2015	Alexander, III et al.	N/A	N/A
9364279	12/2015	Houser et al.	N/A	N/A
9368991	12/2015	Qahouq	N/A	N/A
9370341	12/2015	Ceniccola et al.	N/A	N/A
9370358	12/2015	Shelton, IV et al.	N/A	N/A
9370361	12/2015	Viola et al.	N/A	N/A
9370362	12/2015	Petty et al.	N/A	N/A
9370364	12/2015	Smith et al.	N/A	N/A
9370400	12/2015	Parihar	N/A	N/A
9375206	12/2015	Vidal et al.	N/A	N/A
9375218	12/2015	Wheeler et al.	N/A	N/A
9375230	12/2015	Ross et al.	N/A	N/A
9375232	12/2015	Hunt et al.	N/A	N/A
9375255	12/2015	Houser et al.	N/A	N/A
D761309	12/2015	Lee et al.	N/A	N/A
9381058	12/2015	Houser et al.	N/A	N/A
9383881	12/2015	Day et al.	N/A	N/A
9385640	12/2015	Sun et al.	N/A	N/A
9386983	12/2015	Swensgard et al.	N/A	N/A
9386984	12/2015	Aronhalt et al.	N/A	N/A
9386985	12/2015	Koch, Jr. et al.	N/A	N/A
9386988	12/2015	Baxter, III et al.	N/A	N/A
9387003	12/2015	Kaercher et al.	N/A	N/A
9392885	12/2015	Vogler et al.	N/A	N/A
9393015	12/2015	Laurent et al.	N/A	N/A
9393017	12/2015	Flanagan et al.	N/A	N/A
9393018	12/2015	Wang et al.	N/A	N/A
9393354	12/2015	Freedman et al.	N/A	N/A
9396369	12/2015	Whitehurst et al.	N/A	N/A
9396669	12/2015	Karkanias et al.	N/A	N/A
9398905	12/2015	Martin	N/A	N/A
9398911	12/2015	Auld	N/A	N/A
D763277	12/2015	Ahmed et al.	N/A	N/A
D764498	12/2015	Capela et al.	N/A	N/A
9402604	12/2015	Williams et al.	N/A	N/A
9402625	12/2015	Coleman et al.	N/A	N/A
9402626	12/2015	Ortiz et al.	N/A	N/A
9402627	12/2015	Stevenson et al.	N/A	N/A
9402629	12/2015	Ehrenfels et al.	N/A	N/A
9402679	12/2015	Ginnebaugh et al.	N/A	N/A

9402682	12/2015	Worrell et al.	N/A	N/A
9402688	12/2015	Min et al.	N/A	N/A
9408604	12/2015	Shelton, IV et al.	N/A	N/A
9408605	12/2015	Knodel et al.	N/A	N/A
9408606	12/2015	Shelton, IV	N/A	N/A
9408622	12/2015	Stulen et al.	N/A	N/A
9411370	12/2015	Benni et al.	N/A	N/A
9413128	12/2015	Tien et al.	N/A	N/A
9414838	12/2015	Shelton, IV et al.	N/A	N/A
9414849	12/2015	Nagashimada	N/A	N/A
9414880	12/2015	Monson et al.	N/A	N/A
9420967	12/2015	Zand et al.	N/A	N/A
9421003	12/2015	Williams et al.	N/A	N/A
9421014	12/2015	Ingmanson et al.	N/A	N/A
9421030	12/2015	Cole et al.	N/A	N/A
9421060	12/2015	Monson et al.	N/A	N/A
9421062	12/2015	Houser et al.	N/A	N/A
9421682	12/2015	McClaskey et al.	N/A	N/A
9427223	12/2015	Park et al.	N/A	N/A
9427231	12/2015	Racenet et al.	N/A	N/A
9429204	12/2015	Stefan et al.	N/A	N/A
D767624	12/2015	Lee et al.	N/A	N/A
9433411	12/2015	Racenet et al.	N/A	N/A
9433414	12/2015	Chen et al.	N/A	N/A
9433418	12/2015	Whitman et al.	N/A	N/A
9433419	12/2015	Gonzalez et al.	N/A	N/A
9433420	12/2015	Hodgkinson	N/A	N/A
9439649	12/2015	Shelton, IV et al.	N/A	N/A
9439650	12/2015	McGuckin, Jr. et al.	N/A	N/A
9439651	12/2015	Smith et al.	N/A	N/A
9439668	12/2015	Timm et al.	N/A	N/A
9445808	12/2015	Woodard, Jr. et al.	N/A	N/A
9445813	12/2015	Shelton, IV et al.	N/A	N/A
9445816	12/2015	Swayze et al.	N/A	N/A
9445817	12/2015	Bettuchi	N/A	N/A
9446226	12/2015	Zilberman	N/A	N/A
9451938	12/2015	Overes et al.	N/A	N/A
9451958	12/2015	Shelton, IV et al.	N/A	N/A
9452020	12/2015	Griffiths et al.	N/A	N/A
D768152	12/2015	Gutierrez et al.	N/A	N/A
D768156	12/2015	Frincke	N/A	N/A
D768167	12/2015	Jones et al.	N/A	N/A
D769315	12/2015	Scotti	N/A	N/A
D769930	12/2015	Agrawal	N/A	N/A
9461340	12/2015	Li et al.	N/A	N/A
9463012	12/2015	Bonutti et al.	N/A	N/A
9463040	12/2015	Jeong et al.	N/A	N/A
9463260	12/2015	Stopek	N/A	N/A
9468438	12/2015	Baber et al.	N/A	N/A
9468447	12/2015	Aman et al.	N/A	N/A

9470297	12/2015	Aranyi et al.	N/A	N/A
9471969	12/2015	Zeng et al.	N/A	N/A
9474506	12/2015	Magnin et al.	N/A	N/A
9474513	12/2015	Ishida et al.	N/A	N/A
9474523	12/2015	Meade et al.	N/A	N/A
9474528	12/2015	Marczyk	N/A	N/A
9474540	12/2015	Stokes et al.	N/A	N/A
9475180	12/2015	Eshleman et al.	N/A	N/A
9477649	12/2015	Davidson et al.	N/A	N/A
D770476	12/2015	Jitkoff et al.	N/A	N/A
D770515	12/2015	Cho et al.	N/A	N/A
D771116	12/2015	Dellinger et al.	N/A	N/A
D772905	12/2015	Ingenlath	N/A	N/A
9480476	12/2015	Aldridge et al.	N/A	N/A
9480492	12/2015	Aranyi et al.	N/A	N/A
9483095	12/2015	Tran et al.	N/A	N/A
9486186	12/2015	Fiebig et al.	N/A	N/A
9486213	12/2015	Altman et al.	N/A	N/A
9486214	12/2015	Shelton, IV	N/A	N/A
9486215	12/2015	Olson et al.	N/A	N/A
9486302	12/2015	Boey et al.	N/A	N/A
9488197	12/2015	Wi	N/A	N/A
9492146	12/2015	Kostrzewski et al.	N/A	N/A
9492167	12/2015	Shelton, IV et al.	N/A	N/A
9492170	12/2015	Bear et al.	N/A	N/A
9492172	12/2015	Weisshaupt et al.	N/A	N/A
9492189	12/2015	Williams et al.	N/A	N/A
9492192	12/2015	To et al.	N/A	N/A
9492237	12/2015	Kang et al.	N/A	N/A
9498213	12/2015	Marczyk et al.	N/A	N/A
9498219	12/2015	Moore et al.	N/A	N/A
9498231	12/2015	Haider et al.	N/A	N/A
9504455	12/2015	Whitman et al.	N/A	N/A
9504483	12/2015	Houser et al.	N/A	N/A
9504520	12/2015	Worrell et al.	N/A	N/A
9504521	12/2015	Deutmeyer et al.	N/A	N/A
9504528	12/2015	Ivinson et al.	N/A	N/A
9507399	12/2015	Chien	N/A	N/A
D774547	12/2015	Capela et al.	N/A	N/A
D775336	12/2015	Shelton, IV et al.	N/A	N/A
9510827	12/2015	Kostrzewski	N/A	N/A
9510828	12/2015	Yates et al.	N/A	N/A
9510830	12/2015	Shelton, IV et al.	N/A	N/A
9510846	12/2015	Sholev et al.	N/A	N/A
9510895	12/2015	Houser et al.	N/A	N/A
9510925	12/2015	Hotter et al.	N/A	N/A
9515366	12/2015	Herbsommer et al.	N/A	N/A
9517063	12/2015	Swayze et al.	N/A	N/A
9517065	12/2015	Simms et al.	N/A	N/A
9517068	12/2015	Shelton, IV et al.	N/A	N/A

9517326	12/2015	Hinman et al.	N/A	N/A
9521996	12/2015	Armstrong	N/A	N/A
9522003	12/2015	Weir et al.	N/A	N/A
9522005	12/2015	Williams et al.	N/A	N/A
9522014	12/2015	Nishizawa et al.	N/A	N/A
9522029	12/2015	Yates et al.	N/A	N/A
9526481	12/2015	Storz et al.	N/A	N/A
9526499	12/2015	Kostrzewski et al.	N/A	N/A
9526563	12/2015	Twomey	N/A	N/A
9526564	12/2015	Rusin	N/A	N/A
9526921	12/2015	Kimball et al.	N/A	N/A
D776683	12/2016	Gobinski et al.	N/A	N/A
D777773	12/2016	Shi	N/A	N/A
9532783	12/2016	Swayze et al.	N/A	N/A
9539060	12/2016	Lightcap et al.	N/A	N/A
9539726	12/2016	Simaan et al.	N/A	N/A
9545253	12/2016	Worrell et al.	N/A	N/A
9545258	12/2016	Smith et al.	N/A	N/A
9549732	12/2016	Yates et al.	N/A	N/A
9549733	12/2016	Knodel	N/A	N/A
9549735	12/2016	Shelton, IV et al.	N/A	N/A
9549750	12/2016	Shelton, IV et al.	N/A	N/A
9554794	12/2016	Baber et al.	N/A	N/A
9554796	12/2016	Kostrzewski	N/A	N/A
9554803	12/2016	Smith et al.	N/A	N/A
9554812	12/2016	Inkpen et al.	N/A	N/A
9554854	12/2016	Yates et al.	N/A	N/A
9559624	12/2016	Philipp	N/A	N/A
9561013	12/2016	Tsuchiya	N/A	N/A
9561029	12/2016	Scheib et al.	N/A	N/A
9561030	12/2016	Zhang et al.	N/A	N/A
9561031	12/2016	Heinrich et al.	N/A	N/A
9561032	12/2016	Shelton, IV et al.	N/A	N/A
9561038	12/2016	Shelton, IV et al.	N/A	N/A
9561045	12/2016	Hinman et al.	N/A	N/A
9561072	12/2016	Ko	N/A	N/A
9561082	12/2016	Yen et al.	N/A	N/A
9566061	12/2016	Aronhalt et al.	N/A	N/A
9566062	12/2016	Boudreaux	N/A	N/A
9566064	12/2016	Williams et al.	N/A	N/A
9566065	12/2016	Knodel	N/A	N/A
9566067	12/2016	Milliman et al.	N/A	N/A
9572552	12/2016	Bodor et al.	N/A	N/A
9572574	12/2016	Shelton, IV et al.	N/A	N/A
9572576	12/2016	Hodgkinson et al.	N/A	N/A
9572577	12/2016	Lloyd et al.	N/A	N/A
9572592	12/2016	Price et al.	N/A	N/A
9574644	12/2016	Parihar	N/A	N/A
9579088	12/2016	Farritor et al.	N/A	N/A
9579143	12/2016	Ullrich et al.	N/A	N/A

9579158	12/2016	Brianza et al.	N/A	N/A
D780803	12/2016	Gill et al.	N/A	N/A
D781879	12/2016	Butcher et al.	N/A	N/A
D782530	12/2016	Paek et al.	N/A	N/A
9585550	12/2016	Abel et al.	N/A	N/A
9585657	12/2016	Shelton, IV et al.	N/A	N/A
9585658	12/2016	Shelton, IV	N/A	N/A
9585659	12/2016	Viola et al.	N/A	N/A
9585660	12/2016	Laurent et al.	N/A	N/A
9585662	12/2016	Shelton, IV et al.	N/A	N/A
9585663	12/2016	Shelton, IV et al.	N/A	N/A
9585672	12/2016	Bastia	N/A	N/A
9590433	12/2016	Li	N/A	N/A
9592050	12/2016	Schmid et al.	N/A	N/A
9592052	12/2016	Shelton, IV	N/A	N/A
9592053	12/2016	Shelton, IV et al.	N/A	N/A
9592054	12/2016	Schmid et al.	N/A	N/A
9597073	12/2016	Sorrentino et al.	N/A	N/A
9597075	12/2016	Shelton, IV et al.	N/A	N/A
9597078	12/2016	Scirica et al.	N/A	N/A
9597080	12/2016	Milliman et al.	N/A	N/A
9597104	12/2016	Nicholas et al.	N/A	N/A
9597143	12/2016	Madan et al.	N/A	N/A
9603595	12/2016	Shelton, IV et al.	N/A	N/A
9603598	12/2016	Shelton, IV et al.	N/A	N/A
9603599	12/2016	Miller et al.	N/A	N/A
9603991	12/2016	Shelton, IV et al.	N/A	N/A
D783658	12/2016	Hurst et al.	N/A	N/A
9610068	12/2016	Kappel et al.	N/A	N/A
9610079	12/2016	Kamei et al.	N/A	N/A
9610080	12/2016	Whitfield et al.	N/A	N/A
9610412	12/2016	Zemlok et al.	N/A	N/A
9614258	12/2016	Takahashi et al.	N/A	N/A
9615826	12/2016	Shelton, IV et al.	N/A	N/A
9622745	12/2016	Ingmanson et al.	N/A	N/A
9622746	12/2016	Simms et al.	N/A	N/A
9629623	12/2016	Lytle, IV et al.	N/A	N/A
9629626	12/2016	Soltz et al.	N/A	N/A
9629627	12/2016	Kostrzewski et al.	N/A	N/A
9629628	12/2016	Aranyi	N/A	N/A
9629629	12/2016	Leimbach et al.	N/A	N/A
9629631	12/2016	Nicholas et al.	N/A	N/A
9629632	12/2016	Linder et al.	N/A	N/A
9629652	12/2016	Mumaw et al.	N/A	N/A
9629814	12/2016	Widenhouse et al.	N/A	N/A
D785794	12/2016	Magno, Jr.	N/A	N/A
D786280	12/2016	Ma	N/A	N/A
D786896	12/2016	Kim et al.	N/A	N/A
D787547	12/2016	Basargin et al.	N/A	N/A
D788123	12/2016	Shan et al.	N/A	N/A

D788140	12/2016	Hemsley et al.	N/A	N/A
9636091	12/2016	Beardsley et al.	N/A	N/A
9636111	12/2016	Wenchell	N/A	N/A
9636112	12/2016	Penna et al.	N/A	N/A
9636113	12/2016	Wenchell	N/A	N/A
9636850	12/2016	Stopek et al.	N/A	N/A
9641122	12/2016	Romanowich et al.	N/A	N/A
9642620	12/2016	Baxter, III et al.	N/A	N/A
9642642	12/2016	Lim	N/A	N/A
9649096	12/2016	Sholev	N/A	N/A
9649110	12/2016	Parihar et al.	N/A	N/A
9649111	12/2016	Shelton, IV et al.	N/A	N/A
9649190	12/2016	Mathies	N/A	N/A
9651032	12/2016	Weaver et al.	N/A	N/A
9655613	12/2016	Schaller	N/A	N/A
9655614	12/2016	Swensgard et al.	N/A	N/A
9655615	12/2016	Knodel et al.	N/A	N/A
9655616	12/2016	Aranyi	N/A	N/A
9655624	12/2016	Shelton, IV et al.	N/A	N/A
9661991	12/2016	Glossop	N/A	N/A
9662108	12/2016	Williams	N/A	N/A
9662110	12/2016	Huang et al.	N/A	N/A
9662111	12/2016	Holsten et al.	N/A	N/A
9662116	12/2016	Smith et al.	N/A	N/A
9662130	12/2016	Bartels et al.	N/A	N/A
9662131	12/2016	Omori et al.	N/A	N/A
D788792	12/2016	Alessandri et al.	N/A	N/A
D789384	12/2016	Lin et al.	N/A	N/A
D790570	12/2016	Butcher et al.	N/A	N/A
9668728	12/2016	Williams et al.	N/A	N/A
9668729	12/2016	Williams et al.	N/A	N/A
9668732	12/2016	Patel et al.	N/A	N/A
9668733	12/2016	Williams	N/A	N/A
9668734	12/2016	Kostrzewski et al.	N/A	N/A
9668735	12/2016	Beetel	N/A	N/A
9675344	12/2016	Combrowski et al.	N/A	N/A
9675348	12/2016	Smith et al.	N/A	N/A
9675351	12/2016	Hodgkinson et al.	N/A	N/A
9675354	12/2016	Weir et al.	N/A	N/A
9675355	12/2016	Shelton, IV et al.	N/A	N/A
9675368	12/2016	Guo et al.	N/A	N/A
9675372	12/2016	Laurent et al.	N/A	N/A
9675375	12/2016	Houser et al.	N/A	N/A
9675405	12/2016	Trees et al.	N/A	N/A
9675819	12/2016	Dunbar et al.	N/A	N/A
9681870	12/2016	Baxter, III et al.	N/A	N/A
9681873	12/2016	Smith et al.	N/A	N/A
9681884	12/2016	Clem et al.	N/A	N/A
9687230	12/2016	Leimbach et al.	N/A	N/A
9687231	12/2016	Baxter et al.	N/A	N/A

9687232	12/2016	Shelton, IV et al.	N/A	N/A
9687233	12/2016	Fernandez et al.	N/A	N/A
9687236	12/2016	Leimbach et al.	N/A	N/A
9687237	12/2016	Schmid et al.	N/A	N/A
9687253	12/2016	Detry et al.	N/A	N/A
9689466	12/2016	Kanai et al.	N/A	N/A
9690362	12/2016	Leimbach et al.	N/A	N/A
9693772	12/2016	Ingmanson et al.	N/A	N/A
9693774	12/2016	Gettinger et al.	N/A	N/A
9693775	12/2016	Agarwal et al.	N/A	N/A
9693777	12/2016	Schellin et al.	N/A	N/A
9700309	12/2016	Jaworek et al.	N/A	N/A
9700310	12/2016	Morgan et al.	N/A	N/A
9700312	12/2016	Kostrzewski et al.	N/A	N/A
9700314	12/2016	Marczyk	N/A	N/A
9700315	12/2016	Chen et al.	N/A	N/A
9700317	12/2016	Aronhalt et al.	N/A	N/A
9700318	12/2016	Scirica et al.	N/A	N/A
9700319	12/2016	Motooka et al.	N/A	N/A
9700320	12/2016	Dinardo et al.	N/A	N/A
9700321	12/2016	Shelton, IV et al.	N/A	N/A
9700334	12/2016	Hinman et al.	N/A	N/A
9700381	12/2016	Amat Girbau	N/A	N/A
9702823	12/2016	Maher et al.	N/A	N/A
9706674	12/2016	Collins et al.	N/A	N/A
9706981	12/2016	Nicholas et al.	N/A	N/A
9706991	12/2016	Hess et al.	N/A	N/A
9706993	12/2016	Hessler et al.	N/A	N/A
9707003	12/2016	Hoell, Jr. et al.	N/A	N/A
9707005	12/2016	Strobl et al.	N/A	N/A
9707026	12/2016	Malackowski et al.	N/A	N/A
9707033	12/2016	Parihar et al.	N/A	N/A
9707043	12/2016	Bozung	N/A	N/A
9707684	12/2016	Ruiz Morales et al.	N/A	N/A
9713466	12/2016	Kostrzewski	N/A	N/A
9713468	12/2016	Harris et al.	N/A	N/A
9713470	12/2016	Scirica et al.	N/A	N/A
9713474	12/2016	Lorenz	N/A	N/A
D795919	12/2016	Bischoff et al.	N/A	N/A
9717497	12/2016	Zerkle et al.	N/A	N/A
9717498	12/2016	Aranyi et al.	N/A	N/A
9718190	12/2016	Larkin et al.	N/A	N/A
9722236	12/2016	Sathrum	N/A	N/A
9724091	12/2016	Shelton, IV et al.	N/A	N/A
9724092	12/2016	Baxter, III et al.	N/A	N/A
9724094	12/2016	Baber et al.	N/A	N/A
9724095	12/2016	Gupta et al.	N/A	N/A
9724096	12/2016	Thompson et al.	N/A	N/A
9724098	12/2016	Baxter, III et al.	N/A	N/A
9724118	12/2016	Schulte et al.	N/A	N/A

9724163	12/2016	Orban	N/A	N/A
9730692	12/2016	Shelton, IV et al.	N/A	N/A
9730695	12/2016	Leimbach et al.	N/A	N/A
9730697	12/2016	Morgan et al.	N/A	N/A
9730717	12/2016	Katsuki et al.	N/A	N/A
9730757	12/2016	Brudniok	N/A	N/A
9731410	12/2016	Hirabayashi et al.	N/A	N/A
9733663	12/2016	Leimbach et al.	N/A	N/A
9737297	12/2016	Racenet et al.	N/A	N/A
9737298	12/2016	Isbell, Jr.	N/A	N/A
9737299	12/2016	Yan	N/A	N/A
9737301	12/2016	Baber et al.	N/A	N/A
9737302	12/2016	Shelton, IV et al.	N/A	N/A
9737303	12/2016	Shelton, IV et al.	N/A	N/A
9737323	12/2016	Thapliyal et al.	N/A	N/A
9737365	12/2016	Hegeman et al.	N/A	N/A
9743927	12/2016	Whitman	N/A	N/A
9743928	12/2016	Shelton, IV et al.	N/A	N/A
9743929	12/2016	Leimbach et al.	N/A	N/A
D798319	12/2016	Bergstrand et al.	N/A	N/A
9750498	12/2016	Timm et al.	N/A	N/A
9750499	12/2016	Leimbach et al.	N/A	N/A
9750501	12/2016	Shelton, IV et al.	N/A	N/A
9750502	12/2016	Scirica et al.	N/A	N/A
9750503	12/2016	Milliman	N/A	N/A
9750639	12/2016	Barnes et al.	N/A	N/A
9751176	12/2016	McRoberts et al.	N/A	N/A
9757123	12/2016	Giordano et al.	N/A	N/A
9757124	12/2016	Schellin et al.	N/A	N/A
9757126	12/2016	Cappola	N/A	N/A
9757128	12/2016	Baber et al.	N/A	N/A
9757129	12/2016	Williams	N/A	N/A
9757130	12/2016	Shelton, IV	N/A	N/A
9763662	12/2016	Shelton, IV et al.	N/A	N/A
9763668	12/2016	Whitfield et al.	N/A	N/A
9770245	12/2016	Swayze et al.	N/A	N/A
9770274	12/2016	Pool et al.	N/A	N/A
D798886	12/2016	Prophete et al.	N/A	N/A
D800742	12/2016	Rhodes	N/A	N/A
D800744	12/2016	Jitkoff et al.	N/A	N/A
D800766	12/2016	Park et al.	N/A	N/A
D800904	12/2016	Leimbach et al.	N/A	N/A
9775608	12/2016	Aronhalt et al.	N/A	N/A
9775609	12/2016	Shelton, IV et al.	N/A	N/A
9775610	12/2016	Nicholas et al.	N/A	N/A
9775611	12/2016	Kostrzewski	N/A	N/A
9775613	12/2016	Shelton, IV et al.	N/A	N/A
9775614	12/2016	Shelton, IV et al.	N/A	N/A
9775618	12/2016	Bettuchi et al.	N/A	N/A
9775635	12/2016	Takei	N/A	N/A

9775678	12/2016	Lohmeier	N/A	N/A
9782169	12/2016	Kimsey et al.	N/A	N/A
9782170	12/2016	Zemlok et al.	N/A	N/A
9782180	12/2016	Smith et al.	N/A	N/A
9782187	12/2016	Zergiebel et al.	N/A	N/A
9782193	12/2016	Thistle	N/A	N/A
9782214	12/2016	Houser et al.	N/A	N/A
9788834	12/2016	Schmid et al.	N/A	N/A
9788835	12/2016	Morgan et al.	N/A	N/A
9788836	12/2016	Overmyer et al.	N/A	N/A
9788847	12/2016	Jinno	N/A	N/A
9788851	12/2016	Dannaher et al.	N/A	N/A
9788902	12/2016	Inoue et al.	N/A	N/A
9795379	12/2016	Leimbach et al.	N/A	N/A
9795380	12/2016	Shelton, IV et al.	N/A	N/A
9795381	12/2016	Shelton, IV	N/A	N/A
9795382	12/2016	Shelton, IV	N/A	N/A
9795383	12/2016	Aldridge et al.	N/A	N/A
9795384	12/2016	Weaner et al.	N/A	N/A
9797486	12/2016	Zergiebel et al.	N/A	N/A
9801626	12/2016	Parihar et al.	N/A	N/A
9801627	12/2016	Harris et al.	N/A	N/A
9801628	12/2016	Harris et al.	N/A	N/A
9801634	12/2016	Shelton, IV et al.	N/A	N/A
9801679	12/2016	Trees et al.	N/A	N/A
9802033	12/2016	Hibner et al.	N/A	N/A
9804618	12/2016	Leimbach et al.	N/A	N/A
D803234	12/2016	Day et al.	N/A	N/A
D803235	12/2016	Markson et al.	N/A	N/A
D803850	12/2016	Chang et al.	N/A	N/A
9808244	12/2016	Leimbach et al.	N/A	N/A
9808246	12/2016	Shelton, IV et al.	N/A	N/A
9808247	12/2016	Shelton, IV et al.	N/A	N/A
9808248	12/2016	Hoffman	N/A	N/A
9808249	12/2016	Shelton, IV	N/A	N/A
9814460	12/2016	Kimsey et al.	N/A	N/A
9814462	12/2016	Woodard, Jr. et al.	N/A	N/A
9814463	12/2016	Williams et al.	N/A	N/A
9814530	12/2016	Weir et al.	N/A	N/A
9814561	12/2016	Forsell	N/A	N/A
9815118	12/2016	Schmitt et al.	N/A	N/A
9820445	12/2016	Simpson et al.	N/A	N/A
9820737	12/2016	Beardsley et al.	N/A	N/A
9820738	12/2016	Lytle, IV et al.	N/A	N/A
9820741	12/2016	Kostrzewski	N/A	N/A
9820768	12/2016	Gee et al.	N/A	N/A
9825455	12/2016	Sandhu et al.	N/A	N/A
9826976	12/2016	Parihar et al.	N/A	N/A
9826977	12/2016	Leimbach et al.	N/A	N/A
9826978	12/2016	Shelton, IV et al.	N/A	N/A

9829698	12/2016	Haraguchi et al.	N/A	N/A
D806108	12/2016	Day	N/A	N/A
9833235	12/2016	Penna et al.	N/A	N/A
9833236	12/2016	Shelton, IV et al.	N/A	N/A
9833238	12/2016	Baxter, III et al.	N/A	N/A
9833239	12/2016	Yates et al.	N/A	N/A
9833241	12/2016	Huitema et al.	N/A	N/A
9833242	12/2016	Baxter, III et al.	N/A	N/A
9839420	12/2016	Shelton, IV et al.	N/A	N/A
9839421	12/2016	Zerkle et al.	N/A	N/A
9839422	12/2016	Schellin et al.	N/A	N/A
9839423	12/2016	Vendely et al.	N/A	N/A
9839427	12/2016	Swayze et al.	N/A	N/A
9839428	12/2016	Baxter, III et al.	N/A	N/A
9839429	12/2016	Weisenburgh, II et al.	N/A	N/A
9839480	12/2016	Pribanic et al.	N/A	N/A
9839481	12/2016	Blumenkranz et al.	N/A	N/A
9844313	12/2016	DiCarlo et al.	N/A	N/A
9844368	12/2016	Boudreaux et al.	N/A	N/A
9844369	12/2016	Huitema et al.	N/A	N/A
9844372	12/2016	Shelton, IV et al.	N/A	N/A
9844373	12/2016	Swayze et al.	N/A	N/A
9844374	12/2016	Lytle, IV et al.	N/A	N/A
9844375	12/2016	Overmyer et al.	N/A	N/A
9844376	12/2016	Baxter, III et al.	N/A	N/A
9844379	12/2016	Shelton, IV et al.	N/A	N/A
9848871	12/2016	Harris et al.	N/A	N/A
9848873	12/2016	Shelton, IV	N/A	N/A
9848875	12/2016	Aronhalt et al.	N/A	N/A
9848877	12/2016	Shelton, IV et al.	N/A	N/A
9850499	12/2016	Baylink et al.	N/A	N/A
9850994	12/2016	Schena	N/A	N/A
D808989	12/2017	Ayvazian et al.	N/A	N/A
9855039	12/2017	Racenet et al.	N/A	N/A
9855040	12/2017	Kostrzewski	N/A	N/A
9855662	12/2017	Ruiz Morales et al.	N/A	N/A
9861261	12/2017	Shahinian	N/A	N/A
9861359	12/2017	Shelton, IV et al.	N/A	N/A
9861361	12/2017	Aronhalt et al.	N/A	N/A
9861362	12/2017	Whitman et al.	N/A	N/A
9861366	12/2017	Aranyi	N/A	N/A
9861382	12/2017	Smith et al.	N/A	N/A
9861446	12/2017	Lang	N/A	N/A
9867612	12/2017	Parihar et al.	N/A	N/A
9867613	12/2017	Marczyk et al.	N/A	N/A
9867615	12/2017	Fanelli et al.	N/A	N/A
9867617	12/2017	Ma	N/A	N/A
9867618	12/2017	Hall et al.	N/A	N/A
9867620	12/2017	Fischvogt et al.	N/A	N/A

9868198	12/2017	Nicholas et al.	N/A	N/A
9872682	12/2017	Hess et al.	N/A	N/A
9872683	12/2017	Hopkins et al.	N/A	N/A
9872684	12/2017	Hall et al.	N/A	N/A
9872722	12/2017	Lech	N/A	N/A
9877721	12/2017	Schellin et al.	N/A	N/A
9877722	12/2017	Schellin et al.	N/A	N/A
9877723	12/2017	Hall et al.	N/A	N/A
9877776	12/2017	Boudreaux	N/A	N/A
D810099	12/2017	Riedel	N/A	N/A
9883843	12/2017	Garlow	N/A	N/A
9883860	12/2017	Leimbach et al.	N/A	N/A
9883861	12/2017	Shelton, IV et al.	N/A	N/A
9884456	12/2017	Schellin et al.	N/A	N/A
9888914	12/2017	Martin et al.	N/A	N/A
9888919	12/2017	Leimbach et al.	N/A	N/A
9888921	12/2017	Williams et al.	N/A	N/A
9888924	12/2017	Ebersole et al.	N/A	N/A
9889230	12/2017	Bennett et al.	N/A	N/A
9895147	12/2017	Shelton, IV	N/A	N/A
9895148	12/2017	Shelton, IV et al.	N/A	N/A
9895813	12/2017	Blumenkranz et al.	N/A	N/A
9901339	12/2017	Farascioni	N/A	N/A
9901341	12/2017	Kostrzewski	N/A	N/A
9901342	12/2017	Shelton, IV et al.	N/A	N/A
9901344	12/2017	Moore et al.	N/A	N/A
9901345	12/2017	Moore et al.	N/A	N/A
9901346	12/2017	Moore et al.	N/A	N/A
9901358	12/2017	Faller et al.	N/A	N/A
9901406	12/2017	State et al.	N/A	N/A
9901412	12/2017	Lathrop et al.	N/A	N/A
D813899	12/2017	Erant et al.	N/A	N/A
9907456	12/2017	Miyoshi	N/A	N/A
9907552	12/2017	Measamer et al.	N/A	N/A
9907553	12/2017	Cole et al.	N/A	N/A
9907600	12/2017	Stulen et al.	N/A	N/A
9907620	12/2017	Shelton, IV et al.	N/A	N/A
9913641	12/2017	Takemoto et al.	N/A	N/A
9913642	12/2017	Leimbach et al.	N/A	N/A
9913644	12/2017	McCuen	N/A	N/A
9913646	12/2017	Shelton, IV	N/A	N/A
9913647	12/2017	Weisenburgh et al.	N/A	N/A
9913648	12/2017	Shelton, IV et al.	N/A	N/A
9913694	12/2017	Brisson	N/A	N/A
9913733	12/2017	Piron et al.	N/A	N/A
9918704	12/2017	Shelton, IV et al.	N/A	N/A
9918714	12/2017	Gibbons, Jr.	N/A	N/A
9918715	12/2017	Menn	N/A	N/A
9918716	12/2017	Baxter, III et al.	N/A	N/A
9918717	12/2017	Czernik	N/A	N/A

9918730	12/2017	Trees et al.	N/A	N/A
9924941	12/2017	Burbank	N/A	N/A
9924942	12/2017	Swayze et al.	N/A	N/A
9924943	12/2017	Mohan Pinjala et al.	N/A	N/A
9924944	12/2017	Shelton, IV et al.	N/A	N/A
9924945	12/2017	Zheng et al.	N/A	N/A
9924946	12/2017	Vendely et al.	N/A	N/A
9924947	12/2017	Shelton, IV et al.	N/A	N/A
9924961	12/2017	Shelton, IV et al.	N/A	N/A
9931106	12/2017	Au et al.	N/A	N/A
9931116	12/2017	Racenet et al.	N/A	N/A
9931117	12/2017	Hathaway et al.	N/A	N/A
9931118	12/2017	Shelton, IV et al.	N/A	N/A
9931120	12/2017	Chen et al.	N/A	N/A
9936949	12/2017	Measamer et al.	N/A	N/A
9936950	12/2017	Shelton, IV et al.	N/A	N/A
9936951	12/2017	Hufnagel et al.	N/A	N/A
9936952	12/2017	Demmy	N/A	N/A
9936954	12/2017	Shelton, IV et al.	N/A	N/A
9937626	12/2017	Rockrohr	N/A	N/A
9943309	12/2017	Shelton, IV et al.	N/A	N/A
9943310	12/2017	Harris et al.	N/A	N/A
9943312	12/2017	Posada et al.	N/A	N/A
9949754	12/2017	Newhauser et al.	N/A	N/A
9953193	12/2017	Butler et al.	N/A	N/A
D819072	12/2017	Clediere	N/A	N/A
9955954	12/2017	Destoumieux et al.	N/A	N/A
9955965	12/2017	Chen et al.	N/A	N/A
9955966	12/2017	Zergiebel	N/A	N/A
9956677	12/2017	Baskar et al.	N/A	N/A
9962129	12/2017	Jerebko et al.	N/A	N/A
9962157	12/2017	Sapre	N/A	N/A
9962158	12/2017	Hall et al.	N/A	N/A
9962159	12/2017	Heinrich et al.	N/A	N/A
9962161	12/2017	Scheib et al.	N/A	N/A
9968354	12/2017	Shelton, IV et al.	N/A	N/A
9968355	12/2017	Shelton, IV et al.	N/A	N/A
9968356	12/2017	Shelton, IV et al.	N/A	N/A
9968397	12/2017	Taylor et al.	N/A	N/A
9974529	12/2017	Shelton, IV et al.	N/A	N/A
9974538	12/2017	Baxter, III et al.	N/A	N/A
9974539	12/2017	Yates et al.	N/A	N/A
9974541	12/2017	Calderoni	N/A	N/A
9974542	12/2017	Hodgkinson	N/A	N/A
9980713	12/2017	Aronhalt et al.	N/A	N/A
9980724	12/2017	Farascioni et al.	N/A	N/A
9980729	12/2017	Moore et al.	N/A	N/A
9980740	12/2017	Krause et al.	N/A	N/A
9980769	12/2017	Trees et al.	N/A	N/A
D819680	12/2017	Nguyen	N/A	N/A

D819682	12/2017	Howard et al.	N/A	N/A
D819684	12/2017	Dart	N/A	N/A
D820307	12/2017	Jian et al.	N/A	N/A
D820867	12/2017	Dickens et al.	N/A	N/A
9987000	12/2017	Shelton, IV et al.	N/A	N/A
9987003	12/2017	Timm et al.	N/A	N/A
9987006	12/2017	Morgan et al.	N/A	N/A
9987008	12/2017	Scirica et al.	N/A	N/A
9987095	12/2017	Chowaniec et al.	N/A	N/A
9987097	12/2017	van der Weide et al.	N/A	N/A
9987099	12/2017	Chen et al.	N/A	N/A
9993248	12/2017	Shelton, IV et al.	N/A	N/A
9993258	12/2017	Shelton, IV et al.	N/A	N/A
9993284	12/2017	Boudreaux	N/A	N/A
9999408	12/2017	Boudreaux et al.	N/A	N/A
9999423	12/2017	Schuckmann et al.	N/A	N/A
9999426	12/2017	Moore et al.	N/A	N/A
9999431	12/2017	Shelton, IV et al.	N/A	N/A
9999472	12/2017	Weir et al.	N/A	N/A
10004497	12/2017	Overmyer et al.	N/A	N/A
10004498	12/2017	Morgan et al.	N/A	N/A
10004500	12/2017	Shelton, IV et al.	N/A	N/A
10004501	12/2017	Shelton, IV et al.	N/A	N/A
10004505	12/2017	Moore et al.	N/A	N/A
10004506	12/2017	Shelton, IV et al.	N/A	N/A
10004552	12/2017	Kleyman et al.	N/A	N/A
D822206	12/2017	Shelton, IV et al.	N/A	N/A
10010322	12/2017	Shelton, IV et al.	N/A	N/A
10010324	12/2017	Huitema et al.	N/A	N/A
10010395	12/2017	Puckett et al.	N/A	N/A
10013049	12/2017	Leimbach et al.	N/A	N/A
10016199	12/2017	Baber et al.	N/A	N/A
10016656	12/2017	Devor et al.	N/A	N/A
10022120	12/2017	Martin et al.	N/A	N/A
10022123	12/2017	Williams et al.	N/A	N/A
10022125	12/2017	Stopek et al.	N/A	N/A
10024407	12/2017	Aranyi et al.	N/A	N/A
10028742	12/2017	Shelton, IV et al.	N/A	N/A
10028743	12/2017	Shelton, IV et al.	N/A	N/A
10028744	12/2017	Shelton, IV et al.	N/A	N/A
10028761	12/2017	Leimbach et al.	N/A	N/A
10029108	12/2017	Powers et al.	N/A	N/A
10029125	12/2017	Shapiro et al.	N/A	N/A
10034344	12/2017	Yoshida	N/A	N/A
10034668	12/2017	Ebner	N/A	N/A
D826405	12/2017	Shelton, IV et al.	N/A	N/A
10039440	12/2017	Fenech et al.	N/A	N/A
10039529	12/2017	Kerr et al.	N/A	N/A
10039532	12/2017	Srinivas et al.	N/A	N/A
10039545	12/2017	Sadowski et al.	N/A	N/A

10041822	12/2017	Zemlok	N/A	N/A
10045769	12/2017	Aronhalt et al.	N/A	N/A
10045776	12/2017	Shelton, IV et al.	N/A	N/A
10045778	12/2017	Yates et al.	N/A	N/A
10045779	12/2017	Savage et al.	N/A	N/A
10045781	12/2017	Cropper et al.	N/A	N/A
10045782	12/2017	Murthy Aravalli	N/A	N/A
10045869	12/2017	Forsell	N/A	N/A
10046904	12/2017	Evans et al.	N/A	N/A
10052044	12/2017	Shelton, IV et al.	N/A	N/A
10052099	12/2017	Morgan et al.	N/A	N/A
10052100	12/2017	Morgan et al.	N/A	N/A
10052102	12/2017	Baxter, III et al.	N/A	N/A
10052104	12/2017	Shelton, IV et al.	N/A	N/A
10052164	12/2017	Overmyer	N/A	N/A
10058317	12/2017	Fan et al.	N/A	N/A
10058327	12/2017	Weisenburgh, II et al.	N/A	N/A
10058373	12/2017	Takashino et al.	N/A	N/A
10058395	12/2017	Devengenzo et al.	N/A	N/A
10058963	12/2017	Shelton, IV et al.	N/A	N/A
10064620	12/2017	Gettinger et al.	N/A	N/A
10064621	12/2017	Kerr et al.	N/A	N/A
10064622	12/2017	Murthy Aravalli	N/A	N/A
10064624	12/2017	Shelton, IV et al.	N/A	N/A
10064639	12/2017	Ishida et al.	N/A	N/A
10064642	12/2017	Marczyk et al.	N/A	N/A
10064649	12/2017	Golebieski et al.	N/A	N/A
10064688	12/2017	Shelton, IV et al.	N/A	N/A
10070861	12/2017	Spivey et al.	N/A	N/A
10070863	12/2017	Swayze et al.	N/A	N/A
10071452	12/2017	Shelton, IV et al.	N/A	N/A
10076325	12/2017	Huang et al.	N/A	N/A
10076326	12/2017	Yates et al.	N/A	N/A
10076340	12/2017	Belagali et al.	N/A	N/A
10080552	12/2017	Nicholas et al.	N/A	N/A
D830550	12/2017	Miller et al.	N/A	N/A
D831209	12/2017	Huitema et al.	N/A	N/A
D831676	12/2017	Park et al.	N/A	N/A
D832301	12/2017	Smith	N/A	N/A
10085624	12/2017	Isoda et al.	N/A	N/A
10085643	12/2017	Bandic et al.	N/A	N/A
10085728	12/2017	Jogasaki et al.	N/A	N/A
10085746	12/2017	Fischvogt	N/A	N/A
10085748	12/2017	Morgan et al.	N/A	N/A
10085749	12/2017	Cappola et al.	N/A	N/A
10085750	12/2017	Zergiebel et al.	N/A	N/A
10085751	12/2017	Overmyer et al.	N/A	N/A
10085754	12/2017	Sniffin et al.	N/A	N/A
10085806	12/2017	Hagn et al.	N/A	N/A

10092290	12/2017	Yigit et al.	N/A	N/A
10092292	12/2017	Boudreaux et al.	N/A	N/A
10098635	12/2017	Burbank	N/A	N/A
10098636	12/2017	Shelton, IV et al.	N/A	N/A
10098640	12/2017	Bertolero et al.	N/A	N/A
10098642	12/2017	Baxter, III et al.	N/A	N/A
10099303	12/2017	Yoshida et al.	N/A	N/A
10101861	12/2017	Kiyoto	N/A	N/A
10105126	12/2017	Sauer	N/A	N/A
10105128	12/2017	Cooper et al.	N/A	N/A
10105136	12/2017	Yates et al.	N/A	N/A
10105139	12/2017	Yates et al.	N/A	N/A
10105140	12/2017	Malinouskas et al.	N/A	N/A
10105142	12/2017	Baxter, III et al.	N/A	N/A
10105149	12/2017	Haider et al.	N/A	N/A
10106932	12/2017	Anderson et al.	N/A	N/A
10111657	12/2017	McCuen	N/A	N/A
10111658	12/2017	Chowaniec et al.	N/A	N/A
10111660	12/2017	Hemmann	N/A	N/A
10111665	12/2017	Aranyi et al.	N/A	N/A
10111679	12/2017	Baber et al.	N/A	N/A
10111698	12/2017	Scheib et al.	N/A	N/A
10111702	12/2017	Kostrzewski	N/A	N/A
D833608	12/2017	Miller et al.	N/A	N/A
10117649	12/2017	Baxter, III et al.	N/A	N/A
10117650	12/2017	Nicholas et al.	N/A	N/A
10117652	12/2017	Schmid et al.	N/A	N/A
10117653	12/2017	Leimbach et al.	N/A	N/A
10117654	12/2017	Ingmanson et al.	N/A	N/A
10123798	12/2017	Baxter, III et al.	N/A	N/A
10123845	12/2017	Yeung	N/A	N/A
10124493	12/2017	Rothfuss et al.	N/A	N/A
10130352	12/2017	Widenhouse et al.	N/A	N/A
10130359	12/2017	Hess et al.	N/A	N/A
10130360	12/2017	Olson et al.	N/A	N/A
10130361	12/2017	Yates et al.	N/A	N/A
10130363	12/2017	Huitema et al.	N/A	N/A
10130366	12/2017	Shelton, IV et al.	N/A	N/A
10130367	12/2017	Cappola et al.	N/A	N/A
10130382	12/2017	Gladstone	N/A	N/A
10130738	12/2017	Shelton, IV et al.	N/A	N/A
10130830	12/2017	Miret Carceller et al.	N/A	N/A
10133248	12/2017	Fitzsimmons et al.	N/A	N/A
10135242	12/2017	Baber et al.	N/A	N/A
10136879	12/2017	Ross et al.	N/A	N/A
10136887	12/2017	Shelton, IV et al.	N/A	N/A
10136889	12/2017	Shelton, IV et al.	N/A	N/A
10136890	12/2017	Shelton, IV et al.	N/A	N/A
10136891	12/2017	Shelton, IV et al.	N/A	N/A

10136949	12/2017	Felder et al.	N/A	N/A
D835659	12/2017	Anzures et al.	N/A	N/A
D836124	12/2017	Fan	N/A	N/A
10143474	12/2017	Bucciaglia et al.	N/A	N/A
10146423	12/2017	Reed et al.	N/A	N/A
10149679	12/2017	Shelton, IV et al.	N/A	N/A
10149680	12/2017	Parihar et al.	N/A	N/A
10149682	12/2017	Shelton, IV et al.	N/A	N/A
10149683	12/2017	Smith et al.	N/A	N/A
10149712	12/2017	Manwaring et al.	N/A	N/A
10152789	12/2017	Carnes et al.	N/A	N/A
10154841	12/2017	Weaner et al.	N/A	N/A
10159481	12/2017	Whitman et al.	N/A	N/A
10159482	12/2017	Swayze et al.	N/A	N/A
10159483	12/2017	Beckman et al.	N/A	N/A
10159506	12/2017	Boudreaux et al.	N/A	N/A
10161816	12/2017	Jackson et al.	N/A	N/A
10163065	12/2017	Koski et al.	N/A	N/A
10163589	12/2017	Zergiebel et al.	N/A	N/A
10164466	12/2017	Calderoni	N/A	N/A
D837244	12/2018	Kuo et al.	N/A	N/A
D837245	12/2018	Kuo et al.	N/A	N/A
10166023	12/2018	Vendely et al.	N/A	N/A
10166025	12/2018	Leimbach et al.	N/A	N/A
10166026	12/2018	Shelton, IV et al.	N/A	N/A
10172611	12/2018	Shelton, IV et al.	N/A	N/A
10172615	12/2018	Marczyk et al.	N/A	N/A
10172616	12/2018	Murray et al.	N/A	N/A
10172617	12/2018	Shelton, IV et al.	N/A	N/A
10172618	12/2018	Shelton, IV et al.	N/A	N/A
10172619	12/2018	Harris et al.	N/A	N/A
10172620	12/2018	Harris et al.	N/A	N/A
10172636	12/2018	Stulen et al.	N/A	N/A
10172669	12/2018	Felder et al.	N/A	N/A
10175127	12/2018	Collins et al.	N/A	N/A
10178992	12/2018	Wise et al.	N/A	N/A
10180463	12/2018	Beckman et al.	N/A	N/A
10182813	12/2018	Leimbach et al.	N/A	N/A
10182815	12/2018	Williams et al.	N/A	N/A
10182816	12/2018	Shelton, IV et al.	N/A	N/A
10182818	12/2018	Hensel et al.	N/A	N/A
10182819	12/2018	Shelton, IV	N/A	N/A
10182868	12/2018	Meier et al.	N/A	N/A
10188385	12/2018	Kerr et al.	N/A	N/A
10188389	12/2018	Vendely et al.	N/A	N/A
10188393	12/2018	Smith et al.	N/A	N/A
10188394	12/2018	Shelton, IV et al.	N/A	N/A
10190888	12/2018	Hryb et al.	N/A	N/A
D839900	12/2018	Gan	N/A	N/A
D841667	12/2018	Coren	N/A	N/A

10194801	12/2018	Elhawary et al.	N/A	N/A
10194904	12/2018	Viola et al.	N/A	N/A
10194907	12/2018	Marczyk et al.	N/A	N/A
10194908	12/2018	Duque et al.	N/A	N/A
10194910	12/2018	Shelton, IV et al.	N/A	N/A
10194911	12/2018	Miller et al.	N/A	N/A
10194912	12/2018	Scheib et al.	N/A	N/A
10194913	12/2018	Nalagatla et al.	N/A	N/A
10194976	12/2018	Boudreaux	N/A	N/A
10194992	12/2018	Robinson	N/A	N/A
10201348	12/2018	Scheib et al.	N/A	N/A
10201349	12/2018	Leimbach et al.	N/A	N/A
10201363	12/2018	Shelton, IV	N/A	N/A
10201364	12/2018	Leimbach et al.	N/A	N/A
10201365	12/2018	Boudreaux et al.	N/A	N/A
10201381	12/2018	Zergiebel et al.	N/A	N/A
10206605	12/2018	Shelton, IV et al.	N/A	N/A
10206676	12/2018	Shelton, IV	N/A	N/A
10206677	12/2018	Harris et al.	N/A	N/A
10206678	12/2018	Shelton, IV et al.	N/A	N/A
10206748	12/2018	Burbank	N/A	N/A
10210244	12/2018	Branavan et al.	N/A	N/A
10211586	12/2018	Adams et al.	N/A	N/A
10213198	12/2018	Aronhalt et al.	N/A	N/A
10213201	12/2018	Shelton, IV et al.	N/A	N/A
10213202	12/2018	Flanagan et al.	N/A	N/A
10213203	12/2018	Swayze et al.	N/A	N/A
10213204	12/2018	Aranyi et al.	N/A	N/A
10213262	12/2018	Shelton, IV et al.	N/A	N/A
D842328	12/2018	Jian et al.	N/A	N/A
10219811	12/2018	Haider et al.	N/A	N/A
10219832	12/2018	Bagwell et al.	N/A	N/A
10220522	12/2018	Rockrohr	N/A	N/A
10226239	12/2018	Nicholas et al.	N/A	N/A
10226249	12/2018	Jaworek et al.	N/A	N/A
10226250	12/2018	Beckman et al.	N/A	N/A
10226251	12/2018	Scheib et al.	N/A	N/A
10226274	12/2018	Worrell et al.	N/A	N/A
10231634	12/2018	Zand et al.	N/A	N/A
10231653	12/2018	Bohm et al.	N/A	N/A
10231734	12/2018	Thompson et al.	N/A	N/A
10231794	12/2018	Shelton, IV et al.	N/A	N/A
10238385	12/2018	Yates et al.	N/A	N/A
10238386	12/2018	Overmyer et al.	N/A	N/A
10238387	12/2018	Yates et al.	N/A	N/A
10238389	12/2018	Yates et al.	N/A	N/A
10238390	12/2018	Harris et al.	N/A	N/A
10238391	12/2018	Leimbach et al.	N/A	N/A
D844666	12/2018	Espeleta et al.	N/A	N/A
D844667	12/2018	Espeleta et al.	N/A	N/A

D845342	12/2018	Espeleta et al.	N/A	N/A
D847199	12/2018	Whitmore	N/A	N/A
10244991	12/2018	Shademan et al.	N/A	N/A
10245027	12/2018	Shelton, IV et al.	N/A	N/A
10245028	12/2018	Shelton, IV et al.	N/A	N/A
10245029	12/2018	Hunter et al.	N/A	N/A
10245030	12/2018	Hunter et al.	N/A	N/A
10245032	12/2018	Shelton, IV	N/A	N/A
10245033	12/2018	Overmyer et al.	N/A	N/A
10245034	12/2018	Shelton, IV et al.	N/A	N/A
10245035	12/2018	Swayze et al.	N/A	N/A
10245038	12/2018	Hopkins et al.	N/A	N/A
10245058	12/2018	Omori et al.	N/A	N/A
10251645	12/2018	Kostrzewski	N/A	N/A
10251648	12/2018	Harris et al.	N/A	N/A
10251649	12/2018	Schellin et al.	N/A	N/A
10251725	12/2018	Valentine et al.	N/A	N/A
10258322	12/2018	Fanton et al.	N/A	N/A
10258330	12/2018	Shelton, IV et al.	N/A	N/A
10258331	12/2018	Shelton, IV et al.	N/A	N/A
10258332	12/2018	Schmid et al.	N/A	N/A
10258333	12/2018	Shelton, IV et al.	N/A	N/A
10258336	12/2018	Baxter, III et al.	N/A	N/A
10258363	12/2018	Worrell et al.	N/A	N/A
10258418	12/2018	Shelton, IV et al.	N/A	N/A
10264797	12/2018	Zhang et al.	N/A	N/A
10265065	12/2018	Shelton, IV et al.	N/A	N/A
10265067	12/2018	Yates et al.	N/A	N/A
10265068	12/2018	Harris et al.	N/A	N/A
10265072	12/2018	Shelton, IV et al.	N/A	N/A
10265073	12/2018	Scheib et al.	N/A	N/A
10265074	12/2018	Shelton, IV et al.	N/A	N/A
10265090	12/2018	Ingmanson et al.	N/A	N/A
10271840	12/2018	Sapre	N/A	N/A
10271844	12/2018	Valentine et al.	N/A	N/A
10271845	12/2018	Shelton, IV	N/A	N/A
10271846	12/2018	Shelton, IV et al.	N/A	N/A
10271847	12/2018	Racenet et al.	N/A	N/A
10271849	12/2018	Vendely et al.	N/A	N/A
10271851	12/2018	Shelton, IV et al.	N/A	N/A
D847989	12/2018	Shelton, IV et al.	N/A	N/A
D848473	12/2018	Zhu et al.	N/A	N/A
D849046	12/2018	Kuo et al.	N/A	N/A
10278696	12/2018	Gurumurthy et al.	N/A	N/A
10278697	12/2018	Shelton, IV et al.	N/A	N/A
10278702	12/2018	Shelton, IV et al.	N/A	N/A
10278703	12/2018	Nativ et al.	N/A	N/A
10278707	12/2018	Thompson et al.	N/A	N/A
10278722	12/2018	Shelton, IV et al.	N/A	N/A
10278780	12/2018	Shelton, IV	N/A	N/A

10285694	12/2018	Viola et al.	N/A	N/A
10285695	12/2018	Jaworek et al.	N/A	N/A
10285699	12/2018	Vendely et al.	N/A	N/A
10285700	12/2018	Scheib	N/A	N/A
10285705	12/2018	Shelton, IV et al.	N/A	N/A
10285724	12/2018	Faller et al.	N/A	N/A
10285750	12/2018	Coulson et al.	N/A	N/A
10292701	12/2018	Scheib et al.	N/A	N/A
10292704	12/2018	Harris et al.	N/A	N/A
10292707	12/2018	Shelton, IV et al.	N/A	N/A
10293100	12/2018	Shelton, IV et al.	N/A	N/A
10293553	12/2018	Racenet et al.	N/A	N/A
10299787	12/2018	Shelton, IV	N/A	N/A
10299788	12/2018	Heinrich et al.	N/A	N/A
10299789	12/2018	Marczyk et al.	N/A	N/A
10299790	12/2018	Beardsley	N/A	N/A
10299792	12/2018	Huitema et al.	N/A	N/A
10299817	12/2018	Shelton, IV et al.	N/A	N/A
10299818	12/2018	Riva	N/A	N/A
10299878	12/2018	Shelton, IV et al.	N/A	N/A
10303851	12/2018	Nguyen et al.	N/A	N/A
D850617	12/2018	Shelton, IV et al.	N/A	N/A
D851676	12/2018	Foss et al.	N/A	N/A
D851762	12/2018	Shelton, IV et al.	N/A	N/A
10307159	12/2018	Harris et al.	N/A	N/A
10307160	12/2018	Vendely et al.	N/A	N/A
10307161	12/2018	Jankowski	N/A	N/A
10307163	12/2018	Moore et al.	N/A	N/A
10307170	12/2018	Parfett et al.	N/A	N/A
10307202	12/2018	Smith et al.	N/A	N/A
10314559	12/2018	Razzaque et al.	N/A	N/A
10314577	12/2018	Laurent et al.	N/A	N/A
10314578	12/2018	Leimbach et al.	N/A	N/A
10314579	12/2018	Chowaniec et al.	N/A	N/A
10314580	12/2018	Scheib et al.	N/A	N/A
10314582	12/2018	Shelton, IV et al.	N/A	N/A
10314584	12/2018	Scirica et al.	N/A	N/A
10314587	12/2018	Harris et al.	N/A	N/A
10314588	12/2018	Turner et al.	N/A	N/A
10314589	12/2018	Shelton, IV et al.	N/A	N/A
10314590	12/2018	Shelton, IV et al.	N/A	N/A
10315566	12/2018	Choi et al.	N/A	N/A
10321907	12/2018	Shelton, IV et al.	N/A	N/A
10321909	12/2018	Shelton, IV et al.	N/A	N/A
10321927	12/2018	Hinman	N/A	N/A
10327743	12/2018	St. Goar et al.	N/A	N/A
10327764	12/2018	Harris et al.	N/A	N/A
10327765	12/2018	Timm et al.	N/A	N/A
10327767	12/2018	Shelton, IV et al.	N/A	N/A
10327769	12/2018	Overmyer et al.	N/A	N/A

10327776	12/2018	Harris et al.	N/A	N/A
10327777	12/2018	Harris et al.	N/A	N/A
D854032	12/2018	Jones et al.	N/A	N/A
D854151	12/2018	Shelton, IV et al.	N/A	N/A
10335144	12/2018	Shelton, IV et al.	N/A	N/A
10335145	12/2018	Harris et al.	N/A	N/A
10335147	12/2018	Rector et al.	N/A	N/A
10335148	12/2018	Shelton, IV et al.	N/A	N/A
10335149	12/2018	Baxter, III et al.	N/A	N/A
10335150	12/2018	Shelton, IV	N/A	N/A
10335151	12/2018	Shelton, IV et al.	N/A	N/A
10337148	12/2018	Rouse et al.	N/A	N/A
10342533	12/2018	Shelton, IV et al.	N/A	N/A
10342535	12/2018	Scheib et al.	N/A	N/A
10342541	12/2018	Shelton, IV et al.	N/A	N/A
10342543	12/2018	Shelton, IV et al.	N/A	N/A
10342623	12/2018	Huelman et al.	N/A	N/A
10349937	12/2018	Williams	N/A	N/A
10349939	12/2018	Shelton, IV et al.	N/A	N/A
10349941	12/2018	Marczyk et al.	N/A	N/A
10349963	12/2018	Fiksen et al.	N/A	N/A
10350016	12/2018	Burbank et al.	N/A	N/A
10357246	12/2018	Shelton, IV et al.	N/A	N/A
10357247	12/2018	Shelton, IV et al.	N/A	N/A
10357248	12/2018	Dalessandro et al.	N/A	N/A
10357252	12/2018	Harris et al.	N/A	N/A
10363031	12/2018	Alexander, III et al.	N/A	N/A
10363033	12/2018	Timm et al.	N/A	N/A
10363036	12/2018	Yates et al.	N/A	N/A
10363037	12/2018	Aronhalt et al.	N/A	N/A
D855634	12/2018	Kim	N/A	N/A
D856359	12/2018	Huang et al.	N/A	N/A
10368838	12/2018	Williams et al.	N/A	N/A
10368861	12/2018	Baxter, III et al.	N/A	N/A
10368863	12/2018	Timm et al.	N/A	N/A
10368864	12/2018	Harris et al.	N/A	N/A
10368865	12/2018	Harris et al.	N/A	N/A
10368866	12/2018	Wang et al.	N/A	N/A
10368867	12/2018	Harris et al.	N/A	N/A
10368892	12/2018	Stulen et al.	N/A	N/A
10374544	12/2018	Yokoyama et al.	N/A	N/A
10376263	12/2018	Morgan et al.	N/A	N/A
10383626	12/2018	Soltz	N/A	N/A
10383628	12/2018	Kang et al.	N/A	N/A
10383629	12/2018	Ross et al.	N/A	N/A
10383630	12/2018	Shelton, IV et al.	N/A	N/A
10383631	12/2018	Collings et al.	N/A	N/A
10383633	12/2018	Shelton, IV et al.	N/A	N/A
10383634	12/2018	Shelton, IV et al.	N/A	N/A
10390823	12/2018	Shelton, IV et al.	N/A	N/A

10390825	12/2018	Shelton, IV et al.	N/A	N/A
10390828	12/2018	Vendely et al.	N/A	N/A
10390829	12/2018	Eckert et al.	N/A	N/A
10390830	12/2018	Schulz	N/A	N/A
10390841	12/2018	Shelton, IV et al.	N/A	N/A
10390897	12/2018	Kostrzewski	N/A	N/A
D859466	12/2018	Okada et al.	N/A	N/A
D860219	12/2018	Rasmussen et al.	N/A	N/A
D861035	12/2018	Park et al.	N/A	N/A
10398433	12/2018	Boudreaux et al.	N/A	N/A
10398434	12/2018	Shelton, IV et al.	N/A	N/A
10398436	12/2018	Shelton, IV et al.	N/A	N/A
10398460	12/2018	Overmyer	N/A	N/A
10404136	12/2018	Oktavec et al.	N/A	N/A
10405854	12/2018	Schmid et al.	N/A	N/A
10405857	12/2018	Shelton, IV et al.	N/A	N/A
10405859	12/2018	Harris et al.	N/A	N/A
10405863	12/2018	Wise et al.	N/A	N/A
10405914	12/2018	Manwaring et al.	N/A	N/A
10405932	12/2018	Overmyer	N/A	N/A
10405937	12/2018	Black et al.	N/A	N/A
10413155	12/2018	Inoue	N/A	N/A
10413291	12/2018	Worthington et al.	N/A	N/A
10413293	12/2018	Shelton, IV et al.	N/A	N/A
10413294	12/2018	Shelton, IV et al.	N/A	N/A
10413297	12/2018	Harris et al.	N/A	N/A
10413370	12/2018	Yates et al.	N/A	N/A
10413373	12/2018	Yates et al.	N/A	N/A
10420548	12/2018	Whitman et al.	N/A	N/A
10420549	12/2018	Yates et al.	N/A	N/A
10420550	12/2018	Shelton, IV	N/A	N/A
10420551	12/2018	Calderoni	N/A	N/A
10420552	12/2018	Shelton, IV et al.	N/A	N/A
10420553	12/2018	Shelton, IV et al.	N/A	N/A
10420554	12/2018	Collings et al.	N/A	N/A
10420555	12/2018	Shelton, IV et al.	N/A	N/A
10420558	12/2018	Nalagatla et al.	N/A	N/A
10420559	12/2018	Marczyk et al.	N/A	N/A
10420560	12/2018	Shelton, IV et al.	N/A	N/A
10420561	12/2018	Shelton, IV et al.	N/A	N/A
10420577	12/2018	Chowaniec et al.	N/A	N/A
D861707	12/2018	Yang	N/A	N/A
D862518	12/2018	Niven et al.	N/A	N/A
D863343	12/2018	Mazlish et al.	N/A	N/A
D864388	12/2018	Barber	N/A	N/A
D865174	12/2018	Auld et al.	N/A	N/A
D865175	12/2018	Widenhouse et al.	N/A	N/A
10426463	12/2018	Shelton, IV et al.	N/A	N/A
10426466	12/2018	Contini et al.	N/A	N/A
10426467	12/2018	Miller et al.	N/A	N/A

10426468	12/2018	Contini et al.	N/A	N/A
10426469	12/2018	Shelton, IV et al.	N/A	N/A
10426471	12/2018	Shelton, IV et al.	N/A	N/A
10426476	12/2018	Harris et al.	N/A	N/A
10426477	12/2018	Harris et al.	N/A	N/A
10426478	12/2018	Shelton, IV et al.	N/A	N/A
10426481	12/2018	Aronhalt et al.	N/A	N/A
10426555	12/2018	Crowley et al.	N/A	N/A
10433837	12/2018	Worthington et al.	N/A	N/A
10433839	12/2018	Scheib et al.	N/A	N/A
10433840	12/2018	Shelton, IV et al.	N/A	N/A
10433842	12/2018	Amariglio et al.	N/A	N/A
10433844	12/2018	Shelton, IV et al.	N/A	N/A
10433845	12/2018	Baxter, III et al.	N/A	N/A
10433846	12/2018	Vendely et al.	N/A	N/A
10433849	12/2018	Shelton, IV et al.	N/A	N/A
10433918	12/2018	Shelton, IV et al.	N/A	N/A
10441279	12/2018	Shelton, IV et al.	N/A	N/A
10441280	12/2018	Timm et al.	N/A	N/A
10441281	12/2018	Shelton, IV et al.	N/A	N/A
10441285	12/2018	Shelton, IV et al.	N/A	N/A
10441286	12/2018	Shelton, IV et al.	N/A	N/A
10441345	12/2018	Aldridge et al.	N/A	N/A
10441369	12/2018	Shelton, IV et al.	N/A	N/A
10448948	12/2018	Shelton, IV et al.	N/A	N/A
10448950	12/2018	Shelton, IV et al.	N/A	N/A
10448952	12/2018	Shelton, IV et al.	N/A	N/A
10456122	12/2018	Koltz et al.	N/A	N/A
10456132	12/2018	Gettinger et al.	N/A	N/A
10456133	12/2018	Yates et al.	N/A	N/A
10456137	12/2018	Vendely et al.	N/A	N/A
10456140	12/2018	Shelton, IV et al.	N/A	N/A
D865796	12/2018	Xu et al.	N/A	N/A
10463367	12/2018	Kostrzewski et al.	N/A	N/A
10463369	12/2018	Shelton, IV et al.	N/A	N/A
10463370	12/2018	Yates et al.	N/A	N/A
10463371	12/2018	Kostrzewski	N/A	N/A
10463372	12/2018	Shelton, IV et al.	N/A	N/A
10463373	12/2018	Mozdzierz et al.	N/A	N/A
10463382	12/2018	Ingmanson et al.	N/A	N/A
10463383	12/2018	Shelton, IV et al.	N/A	N/A
10463384	12/2018	Shelton, IV et al.	N/A	N/A
10470762	12/2018	Leimbach et al.	N/A	N/A
10470763	12/2018	Yates et al.	N/A	N/A
10470764	12/2018	Baxter, III et al.	N/A	N/A
10470767	12/2018	Gleiman et al.	N/A	N/A
10470768	12/2018	Harris et al.	N/A	N/A
10470769	12/2018	Shelton, IV et al.	N/A	N/A
10471282	12/2018	Kirk et al.	N/A	N/A
10471576	12/2018	Totsu	N/A	N/A

10471607	12/2018	Butt et al.	N/A	N/A
10478181	12/2018	Shelton, IV et al.	N/A	N/A
10478182	12/2018	Taylor	N/A	N/A
10478185	12/2018	Nicholas	N/A	N/A
10478187	12/2018	Shelton, IV et al.	N/A	N/A
10478188	12/2018	Harris et al.	N/A	N/A
10478189	12/2018	Bear et al.	N/A	N/A
10478190	12/2018	Miller et al.	N/A	N/A
10478207	12/2018	Lathrop	N/A	N/A
10482292	12/2018	Clouser et al.	N/A	N/A
10485536	12/2018	Ming et al.	N/A	N/A
10485537	12/2018	Yates et al.	N/A	N/A
10485539	12/2018	Shelton, IV et al.	N/A	N/A
10485541	12/2018	Shelton, IV et al.	N/A	N/A
10485542	12/2018	Shelton, IV et al.	N/A	N/A
10485543	12/2018	Shelton, IV et al.	N/A	N/A
10485546	12/2018	Shelton, IV et al.	N/A	N/A
10485547	12/2018	Shelton, IV et al.	N/A	N/A
D869655	12/2018	Shelton, IV et al.	N/A	N/A
D870742	12/2018	Cornell	N/A	N/A
10492783	12/2018	Shelton, IV et al.	N/A	N/A
10492785	12/2018	Overmyer et al.	N/A	N/A
10492787	12/2018	Smith et al.	N/A	N/A
10492814	12/2018	Snow et al.	N/A	N/A
10492847	12/2018	Godara et al.	N/A	N/A
10492851	12/2018	Hughett, Sr. et al.	N/A	N/A
10498269	12/2018	Zemlok et al.	N/A	N/A
10499890	12/2018	Shelton, IV et al.	N/A	N/A
10499914	12/2018	Huang et al.	N/A	N/A
10499917	12/2018	Scheib et al.	N/A	N/A
10499918	12/2018	Schellin et al.	N/A	N/A
10500000	12/2018	Swayze et al.	N/A	N/A
10500004	12/2018	Hanuschik et al.	N/A	N/A
10500309	12/2018	Shah et al.	N/A	N/A
10507034	12/2018	Timm	N/A	N/A
10508720	12/2018	Nicholas	N/A	N/A
10512461	12/2018	Gupta et al.	N/A	N/A
10512462	12/2018	Felder et al.	N/A	N/A
10512464	12/2018	Park et al.	N/A	N/A
10517590	12/2018	Giordano et al.	N/A	N/A
10517592	12/2018	Shelton, IV et al.	N/A	N/A
10517594	12/2018	Shelton, IV et al.	N/A	N/A
10517595	12/2018	Hunter et al.	N/A	N/A
10517596	12/2018	Hunter et al.	N/A	N/A
10517599	12/2018	Baxter, III et al.	N/A	N/A
10517682	12/2018	Giordano et al.	N/A	N/A
10524784	12/2019	Kostrzewski	N/A	N/A
10524787	12/2019	Shelton, IV et al.	N/A	N/A
10524788	12/2019	Vendely et al.	N/A	N/A
10524789	12/2019	Swayze et al.	N/A	N/A

10524790	12/2019	Shelton, IV et al.	N/A	N/A
10524795	12/2019	Nalagatla et al.	N/A	N/A
10524870	12/2019	Saraliev et al.	N/A	N/A
10531874	12/2019	Morgan et al.	N/A	N/A
10531887	12/2019	Shelton, IV et al.	N/A	N/A
10537324	12/2019	Shelton, IV et al.	N/A	N/A
10537325	12/2019	Bakos et al.	N/A	N/A
10537351	12/2019	Shelton, IV et al.	N/A	N/A
10542908	12/2019	Mei et al.	N/A	N/A
10542974	12/2019	Yates et al.	N/A	N/A
10542976	12/2019	Calderoni et al.	N/A	N/A
10542978	12/2019	Chowaniec et al.	N/A	N/A
10542979	12/2019	Shelton, IV et al.	N/A	N/A
10542982	12/2019	Beckman et al.	N/A	N/A
10542985	12/2019	Zhan et al.	N/A	N/A
10542988	12/2019	Schellin et al.	N/A	N/A
10542991	12/2019	Shelton, IV et al.	N/A	N/A
10548504	12/2019	Shelton, IV et al.	N/A	N/A
10548593	12/2019	Shelton, IV et al.	N/A	N/A
10548600	12/2019	Shelton, IV et al.	N/A	N/A
10548673	12/2019	Harris et al.	N/A	N/A
10561412	12/2019	Bookbinder et al.	N/A	N/A
10561418	12/2019	Richard et al.	N/A	N/A
10561419	12/2019	Beardsley	N/A	N/A
10561420	12/2019	Harris et al.	N/A	N/A
10561422	12/2019	Schellin et al.	N/A	N/A
10561432	12/2019	Estrella et al.	N/A	N/A
10561474	12/2019	Adams et al.	N/A	N/A
10562160	12/2019	Iwata et al.	N/A	N/A
10568493	12/2019	Blase et al.	N/A	N/A
10568621	12/2019	Shelton, IV et al.	N/A	N/A
10568624	12/2019	Shelton, IV et al.	N/A	N/A
10568625	12/2019	Harris et al.	N/A	N/A
10568626	12/2019	Shelton, IV et al.	N/A	N/A
10568629	12/2019	Shelton, IV et al.	N/A	N/A
10568632	12/2019	Miller et al.	N/A	N/A
10568652	12/2019	Hess et al.	N/A	N/A
10569071	12/2019	Harris et al.	N/A	N/A
D879808	12/2019	Harris et al.	N/A	N/A
D879809	12/2019	Harris et al.	N/A	N/A
10575868	12/2019	Hall et al.	N/A	N/A
10580320	12/2019	Kamiguchi et al.	N/A	N/A
10582928	12/2019	Hunter et al.	N/A	N/A
10588231	12/2019	Sgroi, Jr. et al.	N/A	N/A
10588623	12/2019	Schmid et al.	N/A	N/A
10588625	12/2019	Weaner et al.	N/A	N/A
10588626	12/2019	Overmyer et al.	N/A	N/A
10588629	12/2019	Malinouskas et al.	N/A	N/A
10588630	12/2019	Shelton, IV et al.	N/A	N/A
10588631	12/2019	Shelton, IV et al.	N/A	N/A

10588632	12/2019	Shelton, IV et al.	N/A	N/A
10588633	12/2019	Shelton, IV et al.	N/A	N/A
10589410	12/2019	Aho	N/A	N/A
10595835	12/2019	Kerr et al.	N/A	N/A
10595862	12/2019	Shelton, IV et al.	N/A	N/A
10595882	12/2019	Parfett et al.	N/A	N/A
10595887	12/2019	Shelton, IV et al.	N/A	N/A
10595929	12/2019	Boudreaux et al.	N/A	N/A
10603036	12/2019	Hunter et al.	N/A	N/A
10603039	12/2019	Vendely et al.	N/A	N/A
10603041	12/2019	Miller et al.	N/A	N/A
10603117	12/2019	Schings et al.	N/A	N/A
10603128	12/2019	Zergiebel et al.	N/A	N/A
D882783	12/2019	Shelton, IV et al.	N/A	N/A
10610224	12/2019	Shelton, IV et al.	N/A	N/A
10610225	12/2019	Reed et al.	N/A	N/A
10610236	12/2019	Baril	N/A	N/A
10610313	12/2019	Bailey et al.	N/A	N/A
10610346	12/2019	Schwartz	N/A	N/A
10614184	12/2019	Solki	N/A	N/A
10617411	12/2019	Williams	N/A	N/A
10617412	12/2019	Shelton, IV et al.	N/A	N/A
10617413	12/2019	Shelton, IV et al.	N/A	N/A
10617414	12/2019	Shelton, IV et al.	N/A	N/A
10617416	12/2019	Leimbach et al.	N/A	N/A
10617417	12/2019	Baxter, III et al.	N/A	N/A
10617418	12/2019	Barton et al.	N/A	N/A
10617420	12/2019	Shelton, IV et al.	N/A	N/A
10617438	12/2019	O'Keefe et al.	N/A	N/A
10624616	12/2019	Mukherjee et al.	N/A	N/A
10624630	12/2019	Deville et al.	N/A	N/A
10624633	12/2019	Shelton, IV et al.	N/A	N/A
10624634	12/2019	Shelton, IV et al.	N/A	N/A
10624635	12/2019	Harris et al.	N/A	N/A
10624709	12/2019	Remm	N/A	N/A
10624861	12/2019	Widenhouse et al.	N/A	N/A
10625062	12/2019	Matlock et al.	N/A	N/A
10631857	12/2019	Kostrzewski	N/A	N/A
10631858	12/2019	Burbank	N/A	N/A
10631859	12/2019	Shelton, IV et al.	N/A	N/A
10631860	12/2019	Bakos et al.	N/A	N/A
10636104	12/2019	Mazar et al.	N/A	N/A
10639018	12/2019	Shelton, IV et al.	N/A	N/A
10639034	12/2019	Harris et al.	N/A	N/A
10639035	12/2019	Shelton, IV et al.	N/A	N/A
10639036	12/2019	Yates et al.	N/A	N/A
10639037	12/2019	Shelton, IV et al.	N/A	N/A
10639089	12/2019	Manwaring et al.	N/A	N/A
10639115	12/2019	Shelton, IV et al.	N/A	N/A
10642633	12/2019	Chopra et al.	N/A	N/A

10645905	12/2019	Gandola et al.	N/A	N/A
10646220	12/2019	Shelton, IV et al.	N/A	N/A
10646292	12/2019	Solomon et al.	N/A	N/A
10653413	12/2019	Worthington et al.	N/A	N/A
10653417	12/2019	Shelton, IV et al.	N/A	N/A
10653435	12/2019	Shelton, IV et al.	N/A	N/A
10660640	12/2019	Yates et al.	N/A	N/A
10667408	12/2019	Sgroi, Jr. et al.	N/A	N/A
D888953	12/2019	Baxter, III et al.	N/A	N/A
10667808	12/2019	Baxter, III et al.	N/A	N/A
10667809	12/2019	Bakos et al.	N/A	N/A
10667810	12/2019	Shelton, IV et al.	N/A	N/A
10667811	12/2019	Harris et al.	N/A	N/A
10667818	12/2019	McLain et al.	N/A	N/A
10674895	12/2019	Yeung et al.	N/A	N/A
10675021	12/2019	Harris et al.	N/A	N/A
10675024	12/2019	Shelton, IV et al.	N/A	N/A
10675025	12/2019	Swayze et al.	N/A	N/A
10675026	12/2019	Harris et al.	N/A	N/A
10675028	12/2019	Shelton, IV et al.	N/A	N/A
10675035	12/2019	Zingman	N/A	N/A
10675080	12/2019	Woloszko et al.	N/A	N/A
10675102	12/2019	Forgione et al.	N/A	N/A
10677035	12/2019	Balan et al.	N/A	N/A
10682134	12/2019	Shelton, IV et al.	N/A	N/A
10682136	12/2019	Harris et al.	N/A	N/A
10682137	12/2019	Stokes et al.	N/A	N/A
10682138	12/2019	Shelton, IV et al.	N/A	N/A
10682141	12/2019	Moore et al.	N/A	N/A
10682142	12/2019	Shelton, IV et al.	N/A	N/A
10687806	12/2019	Shelton, IV et al.	N/A	N/A
10687809	12/2019	Shelton, IV et al.	N/A	N/A
10687810	12/2019	Shelton, IV et al.	N/A	N/A
10687812	12/2019	Shelton, IV et al.	N/A	N/A
10687813	12/2019	Shelton, IV et al.	N/A	N/A
10687817	12/2019	Shelton, IV et al.	N/A	N/A
10687819	12/2019	Stokes et al.	N/A	N/A
10687904	12/2019	Harris et al.	N/A	N/A
10695053	12/2019	Hess et al.	N/A	N/A
10695055	12/2019	Shelton, IV et al.	N/A	N/A
10695057	12/2019	Shelton, IV et al.	N/A	N/A
10695058	12/2019	Lytle, IV et al.	N/A	N/A
10695062	12/2019	Leimbach et al.	N/A	N/A
10695063	12/2019	Morgan et al.	N/A	N/A
10695074	12/2019	Carusillo	N/A	N/A
10695081	12/2019	Shelton, IV et al.	N/A	N/A
10695119	12/2019	Smith	N/A	N/A
10695123	12/2019	Allen, IV	N/A	N/A
10695187	12/2019	Moskowitz et al.	N/A	N/A
D890784	12/2019	Shelton, IV et al.	N/A	N/A

10702266	12/2019	Parihar et al.	N/A	N/A
10702267	12/2019	Hess et al.	N/A	N/A
10702270	12/2019	Shelton, IV et al.	N/A	N/A
10702271	12/2019	Aranyi et al.	N/A	N/A
10705660	12/2019	Xiao	N/A	N/A
10709446	12/2019	Harris et al.	N/A	N/A
10709468	12/2019	Shelton, IV et al.	N/A	N/A
10709469	12/2019	Shelton, IV et al.	N/A	N/A
10709495	12/2019	Broderick et al.	N/A	N/A
10709496	12/2019	Moua et al.	N/A	N/A
10716563	12/2019	Shelton, IV et al.	N/A	N/A
10716565	12/2019	Shelton, IV et al.	N/A	N/A
10716568	12/2019	Hall et al.	N/A	N/A
10716614	12/2019	Yates et al.	N/A	N/A
10717179	12/2019	Koenig et al.	N/A	N/A
10722232	12/2019	Yates et al.	N/A	N/A
10722233	12/2019	Wellman	N/A	N/A
10722292	12/2019	Arya et al.	N/A	N/A
10722293	12/2019	Arya et al.	N/A	N/A
10722317	12/2019	Ward et al.	N/A	N/A
D893717	12/2019	Messerly et al.	N/A	N/A
10729432	12/2019	Shelton, IV et al.	N/A	N/A
10729434	12/2019	Harris et al.	N/A	N/A
10729435	12/2019	Richard	N/A	N/A
10729436	12/2019	Shelton, IV et al.	N/A	N/A
10729443	12/2019	Cabrera et al.	N/A	N/A
10729458	12/2019	Stoddard et al.	N/A	N/A
10729501	12/2019	Leimbach et al.	N/A	N/A
10729509	12/2019	Shelton, IV et al.	N/A	N/A
10736616	12/2019	Scheib et al.	N/A	N/A
10736628	12/2019	Yates et al.	N/A	N/A
10736629	12/2019	Shelton, IV et al.	N/A	N/A
10736630	12/2019	Huang et al.	N/A	N/A
10736633	12/2019	Vendely et al.	N/A	N/A
10736634	12/2019	Shelton, IV et al.	N/A	N/A
10736636	12/2019	Baxter, III et al.	N/A	N/A
10736644	12/2019	Windolf et al.	N/A	N/A
10736702	12/2019	Harris et al.	N/A	N/A
10737398	12/2019	Remirez et al.	N/A	N/A
10743849	12/2019	Shelton, IV et al.	N/A	N/A
10743850	12/2019	Hibner et al.	N/A	N/A
10743851	12/2019	Swayze et al.	N/A	N/A
10743868	12/2019	Shelton, IV et al.	N/A	N/A
10743870	12/2019	Hall et al.	N/A	N/A
10743872	12/2019	Leimbach et al.	N/A	N/A
10743873	12/2019	Overmyer et al.	N/A	N/A
10743874	12/2019	Shelton, IV et al.	N/A	N/A
10743875	12/2019	Shelton, IV et al.	N/A	N/A
10743877	12/2019	Shelton, IV et al.	N/A	N/A
10743930	12/2019	Nagtegaal	N/A	N/A

10751048	12/2019	Whitman et al.	N/A	N/A
10751051	12/2019	Weir et al.	N/A	N/A
10751053	12/2019	Harris et al.	N/A	N/A
10751076	12/2019	Laurent et al.	N/A	N/A
10751138	12/2019	Giordano et al.	N/A	N/A
10758226	12/2019	Weir et al.	N/A	N/A
10758229	12/2019	Shelton, IV et al.	N/A	N/A
10758230	12/2019	Shelton, IV et al.	N/A	N/A
10758232	12/2019	Shelton, IV et al.	N/A	N/A
10758233	12/2019	Scheib et al.	N/A	N/A
10758259	12/2019	Demmy et al.	N/A	N/A
10765425	12/2019	Yates et al.	N/A	N/A
10765427	12/2019	Shelton, IV et al.	N/A	N/A
10765429	12/2019	Leimbach et al.	N/A	N/A
10765430	12/2019	Wixey	N/A	N/A
10765432	12/2019	Moore et al.	N/A	N/A
10765442	12/2019	Strobl	N/A	N/A
10772625	12/2019	Shelton, IV et al.	N/A	N/A
10772628	12/2019	Chen et al.	N/A	N/A
10772629	12/2019	Shelton, IV et al.	N/A	N/A
10772630	12/2019	Wixey	N/A	N/A
10772631	12/2019	Zergiebel et al.	N/A	N/A
10772632	12/2019	Kostrzewski	N/A	N/A
10772651	12/2019	Shelton, IV et al.	N/A	N/A
10779818	12/2019	Zemlok et al.	N/A	N/A
10779820	12/2019	Harris et al.	N/A	N/A
10779821	12/2019	Harris et al.	N/A	N/A
10779822	12/2019	Yates et al.	N/A	N/A
10779823	12/2019	Shelton, IV et al.	N/A	N/A
10779824	12/2019	Shelton, IV et al.	N/A	N/A
10779825	12/2019	Shelton, IV et al.	N/A	N/A
10779826	12/2019	Shelton, IV et al.	N/A	N/A
10779903	12/2019	Wise et al.	N/A	N/A
10780539	12/2019	Shelton, IV et al.	N/A	N/A
10786248	12/2019	Rousseau et al.	N/A	N/A
10786253	12/2019	Shelton, IV et al.	N/A	N/A
10786255	12/2019	Hodgkinson et al.	N/A	N/A
10792038	12/2019	Becerra et al.	N/A	N/A
10796471	12/2019	Leimbach et al.	N/A	N/A
10799240	12/2019	Shelton, IV et al.	N/A	N/A
10799306	12/2019	Robinson et al.	N/A	N/A
10806448	12/2019	Shelton, IV et al.	N/A	N/A
10806449	12/2019	Shelton, IV et al.	N/A	N/A
10806450	12/2019	Yates et al.	N/A	N/A
10806451	12/2019	Harris et al.	N/A	N/A
10806453	12/2019	Chen et al.	N/A	N/A
10806479	12/2019	Shelton, IV et al.	N/A	N/A
10813638	12/2019	Shelton, IV et al.	N/A	N/A
10813639	12/2019	Shelton, IV et al.	N/A	N/A
10813640	12/2019	Adams et al.	N/A	N/A

10813641	12/2019	Setser et al.	N/A	N/A
10813683	12/2019	Baxter, III et al.	N/A	N/A
10813705	12/2019	Hares et al.	N/A	N/A
10813710	12/2019	Grubbs	N/A	N/A
10820939	12/2019	Sartor	N/A	N/A
10828028	12/2019	Harris et al.	N/A	N/A
10828030	12/2019	Weir et al.	N/A	N/A
10828032	12/2019	Leimbach et al.	N/A	N/A
10828033	12/2019	Shelton, IV et al.	N/A	N/A
10828089	12/2019	Clark et al.	N/A	N/A
10835245	12/2019	Swayze et al.	N/A	N/A
10835246	12/2019	Shelton, IV et al.	N/A	N/A
10835247	12/2019	Shelton, IV et al.	N/A	N/A
10835249	12/2019	Schellin et al.	N/A	N/A
10835251	12/2019	Shelton, IV et al.	N/A	N/A
10835330	12/2019	Shelton, IV et al.	N/A	N/A
10842357	12/2019	Moskowitz et al.	N/A	N/A
10842473	12/2019	Scheib et al.	N/A	N/A
10842488	12/2019	Swayze et al.	N/A	N/A
10842489	12/2019	Shelton, IV	N/A	N/A
10842490	12/2019	DiNardo et al.	N/A	N/A
10842491	12/2019	Shelton, IV et al.	N/A	N/A
10842492	12/2019	Shelton, IV et al.	N/A	N/A
10842523	12/2019	Shelton, IV et al.	N/A	N/A
D904612	12/2019	Wynn et al.	N/A	N/A
D904613	12/2019	Wynn et al.	N/A	N/A
D906355	12/2019	Messerly et al.	N/A	N/A
10849621	12/2019	Whitfield et al.	N/A	N/A
10849623	12/2019	Dunki-Jacobs et al.	N/A	N/A
10849697	12/2019	Yates et al.	N/A	N/A
10856866	12/2019	Shelton, IV et al.	N/A	N/A
10856867	12/2019	Shelton, IV et al.	N/A	N/A
10856868	12/2019	Shelton, IV et al.	N/A	N/A
10856869	12/2019	Shelton, IV et al.	N/A	N/A
10856870	12/2019	Harris et al.	N/A	N/A
10863981	12/2019	Overmyer et al.	N/A	N/A
10863984	12/2019	Shelton, IV et al.	N/A	N/A
10863986	12/2019	Yates et al.	N/A	N/A
10869663	12/2019	Shelton, IV et al.	N/A	N/A
10869664	12/2019	Shelton, IV	N/A	N/A
10869665	12/2019	Shelton, IV et al.	N/A	N/A
10869666	12/2019	Shelton, IV et al.	N/A	N/A
10869669	12/2019	Shelton, IV et al.	N/A	N/A
10874290	12/2019	Walen et al.	N/A	N/A
10874391	12/2019	Shelton, IV et al.	N/A	N/A
10874392	12/2019	Scirica et al.	N/A	N/A
10874393	12/2019	Satti, III et al.	N/A	N/A
10874396	12/2019	Moore et al.	N/A	N/A
10874399	12/2019	Zhang	N/A	N/A
10874474	12/2019	Wu et al.	N/A	N/A

10879275	12/2019	Li et al.	N/A	N/A
D907647	12/2020	Siebel et al.	N/A	N/A
D907648	12/2020	Siebel et al.	N/A	N/A
D908216	12/2020	Messerly et al.	N/A	N/A
10881339	12/2020	Peyser et al.	N/A	N/A
10881395	12/2020	Merchant et al.	N/A	N/A
10881396	12/2020	Shelton, IV et al.	N/A	N/A
10881398	12/2020	Whitman et al.	N/A	N/A
10881399	12/2020	Shelton, IV et al.	N/A	N/A
10881401	12/2020	Baber et al.	N/A	N/A
10881446	12/2020	Strobl	N/A	N/A
10888318	12/2020	Parihar et al.	N/A	N/A
10888321	12/2020	Shelton, IV et al.	N/A	N/A
10888322	12/2020	Morgan et al.	N/A	N/A
10888323	12/2020	Chen et al.	N/A	N/A
10888325	12/2020	Harris et al.	N/A	N/A
10888328	12/2020	Shelton, IV et al.	N/A	N/A
10888329	12/2020	Moore et al.	N/A	N/A
10888330	12/2020	Moore et al.	N/A	N/A
10888369	12/2020	Messerly et al.	N/A	N/A
10892899	12/2020	Shelton, IV et al.	N/A	N/A
10893853	12/2020	Shelton, IV et al.	N/A	N/A
10893863	12/2020	Shelton, IV et al.	N/A	N/A
10893864	12/2020	Harris et al.	N/A	N/A
10893867	12/2020	Leimbach et al.	N/A	N/A
10898183	12/2020	Shelton, IV et al.	N/A	N/A
10898184	12/2020	Yates et al.	N/A	N/A
10898185	12/2020	Overmyer et al.	N/A	N/A
10898186	12/2020	Bakos et al.	N/A	N/A
10898190	12/2020	Yates et al.	N/A	N/A
10898193	12/2020	Shelton, IV et al.	N/A	N/A
10898194	12/2020	Moore et al.	N/A	N/A
10898195	12/2020	Moore et al.	N/A	N/A
10903685	12/2020	Yates et al.	N/A	N/A
D910847	12/2020	Shelton, IV et al.	N/A	N/A
10905415	12/2020	DiNardo et al.	N/A	N/A
10905418	12/2020	Shelton, IV et al.	N/A	N/A
10905420	12/2020	Jasemian et al.	N/A	N/A
10905422	12/2020	Bakos et al.	N/A	N/A
10905423	12/2020	Baber et al.	N/A	N/A
10905426	12/2020	Moore et al.	N/A	N/A
10905427	12/2020	Moore et al.	N/A	N/A
10911515	12/2020	Biasi et al.	N/A	N/A
10912559	12/2020	Harris et al.	N/A	N/A
10912562	12/2020	Dunki-Jacobs et al.	N/A	N/A
10912575	12/2020	Shelton, IV et al.	N/A	N/A
10918364	12/2020	Applegate et al.	N/A	N/A
10918380	12/2020	Morgan et al.	N/A	N/A
10918385	12/2020	Overmyer et al.	N/A	N/A
10918386	12/2020	Shelton, IV et al.	N/A	N/A

10919156	12/2020	Roberts et al.	N/A	N/A
10925600	12/2020	McCuen	N/A	N/A
10925605	12/2020	Moore et al.	N/A	N/A
D914878	12/2020	Shelton, IV et al.	N/A	N/A
10932772	12/2020	Shelton, IV et al.	N/A	N/A
10932774	12/2020	Shelton, IV	N/A	N/A
10932775	12/2020	Shelton, IV et al.	N/A	N/A
10932778	12/2020	Smith et al.	N/A	N/A
10932779	12/2020	Vendely et al.	N/A	N/A
10932784	12/2020	Mozdzierz et al.	N/A	N/A
10932804	12/2020	Scheib et al.	N/A	N/A
10932806	12/2020	Shelton, IV et al.	N/A	N/A
10932872	12/2020	Shelton, IV et al.	N/A	N/A
10944728	12/2020	Wiener et al.	N/A	N/A
10945727	12/2020	Shelton, IV et al.	N/A	N/A
10945728	12/2020	Morgan et al.	N/A	N/A
10945729	12/2020	Shelton, IV et al.	N/A	N/A
10945731	12/2020	Baxter, III et al.	N/A	N/A
10952708	12/2020	Scheib et al.	N/A	N/A
10952726	12/2020	Chowaniec	N/A	N/A
10952727	12/2020	Giordano et al.	N/A	N/A
10952728	12/2020	Shelton, IV et al.	N/A	N/A
10952759	12/2020	Messerly et al.	N/A	N/A
10952767	12/2020	Kostrzewski et al.	N/A	N/A
10959722	12/2020	Morgan et al.	N/A	N/A
10959725	12/2020	Kerr et al.	N/A	N/A
10959726	12/2020	Williams et al.	N/A	N/A
10959727	12/2020	Hunter et al.	N/A	N/A
10959731	12/2020	Casasanta, Jr. et al.	N/A	N/A
10959744	12/2020	Shelton, IV et al.	N/A	N/A
10959797	12/2020	Licht et al.	N/A	N/A
D917500	12/2020	Siebel et al.	N/A	N/A
10966627	12/2020	Shelton, IV et al.	N/A	N/A
10966717	12/2020	Shah et al.	N/A	N/A
10966718	12/2020	Shelton, IV et al.	N/A	N/A
10966791	12/2020	Harris et al.	N/A	N/A
10973515	12/2020	Harris et al.	N/A	N/A
10973516	12/2020	Shelton, IV et al.	N/A	N/A
10973517	12/2020	Wixey	N/A	N/A
10973519	12/2020	Weir et al.	N/A	N/A
10973520	12/2020	Shelton, IV et al.	N/A	N/A
10980534	12/2020	Yates et al.	N/A	N/A
10980535	12/2020	Yates et al.	N/A	N/A
10980536	12/2020	Weaner et al.	N/A	N/A
10980537	12/2020	Shelton, IV et al.	N/A	N/A
10980538	12/2020	Nalagatla et al.	N/A	N/A
10980539	12/2020	Harris et al.	N/A	N/A
10980560	12/2020	Shelton, IV et al.	N/A	N/A
10983646	12/2020	Yoon et al.	N/A	N/A
10987102	12/2020	Gonzalez et al.	N/A	N/A

10987178	12/2020	Shelton, IV et al.	N/A	N/A
10993713	12/2020	Shelton, IV et al.	N/A	N/A
10993715	12/2020	Shelton, IV et al.	N/A	N/A
10993716	12/2020	Shelton, IV et al.	N/A	N/A
10993717	12/2020	Shelton, IV et al.	N/A	N/A
11000274	12/2020	Shelton, IV et al.	N/A	N/A
11000275	12/2020	Shelton, IV et al.	N/A	N/A
11000277	12/2020	Giordano et al.	N/A	N/A
11000278	12/2020	Shelton, IV et al.	N/A	N/A
11000279	12/2020	Shelton, IV et al.	N/A	N/A
11005291	12/2020	Calderoni	N/A	N/A
11006951	12/2020	Giordano et al.	N/A	N/A
11006955	12/2020	Shelton, IV et al.	N/A	N/A
11007004	12/2020	Shelton, IV et al.	N/A	N/A
11007022	12/2020	Shelton, IV et al.	N/A	N/A
11013511	12/2020	Huang et al.	N/A	N/A
11013552	12/2020	Widenhouse et al.	N/A	N/A
11013563	12/2020	Shelton, IV et al.	N/A	N/A
11020016	12/2020	Wallace et al.	N/A	N/A
11020112	12/2020	Shelton, IV et al.	N/A	N/A
11020113	12/2020	Shelton, IV et al.	N/A	N/A
11020114	12/2020	Shelton, IV et al.	N/A	N/A
11020115	12/2020	Scheib et al.	N/A	N/A
11020172	12/2020	Garrison	N/A	N/A
11026678	12/2020	Overmyer et al.	N/A	N/A
11026680	12/2020	Shelton, IV et al.	N/A	N/A
11026684	12/2020	Shelton, IV et al.	N/A	N/A
11026687	12/2020	Shelton, IV et al.	N/A	N/A
11026712	12/2020	Shelton, IV et al.	N/A	N/A
11026713	12/2020	Stokes et al.	N/A	N/A
11026751	12/2020	Shelton, IV et al.	N/A	N/A
11033267	12/2020	Shelton, IV et al.	N/A	N/A
11039834	12/2020	Harris et al.	N/A	N/A
11039836	12/2020	Shelton, IV et al.	N/A	N/A
11039837	12/2020	Shelton, IV et al.	N/A	N/A
11039849	12/2020	Bucciaglia et al.	N/A	N/A
11045189	12/2020	Yates et al.	N/A	N/A
11045191	12/2020	Shelton, IV et al.	N/A	N/A
11045192	12/2020	Harris et al.	N/A	N/A
11045196	12/2020	Olson et al.	N/A	N/A
11045197	12/2020	Shelton, IV et al.	N/A	N/A
11045199	12/2020	Mozdzierz et al.	N/A	N/A
11045270	12/2020	Shelton, IV et al.	N/A	N/A
11051807	12/2020	Shelton, IV et al.	N/A	N/A
11051810	12/2020	Harris et al.	N/A	N/A
11051811	12/2020	Shelton, IV et al.	N/A	N/A
11051813	12/2020	Shelton, IV et al.	N/A	N/A
11051836	12/2020	Shelton, IV et al.	N/A	N/A
11051840	12/2020	Shelton, IV et al.	N/A	N/A
11051873	12/2020	Wiener et al.	N/A	N/A

11058418	12/2020	Shelton, IV et al.	N/A	N/A
11058420	12/2020	Shelton, IV et al.	N/A	N/A
11058422	12/2020	Harris et al.	N/A	N/A
11058423	12/2020	Shelton, IV et al.	N/A	N/A
11058424	12/2020	Shelton, IV et al.	N/A	N/A
11058425	12/2020	Widenhouse et al.	N/A	N/A
11058426	12/2020	Nalagatla et al.	N/A	N/A
11058498	12/2020	Shelton, IV et al.	N/A	N/A
11064997	12/2020	Shelton, IV et al.	N/A	N/A
11064998	12/2020	Shelton, IV	N/A	N/A
11065000	12/2020	Shankarsetty et al.	N/A	N/A
11065048	12/2020	Messerly et al.	N/A	N/A
11069012	12/2020	Shelton, IV et al.	N/A	N/A
11071542	12/2020	Chen et al.	N/A	N/A
11071543	12/2020	Shelton, IV et al.	N/A	N/A
11071545	12/2020	Baber et al.	N/A	N/A
11071554	12/2020	Parfett et al.	N/A	N/A
11071560	12/2020	Deck et al.	N/A	N/A
11076853	12/2020	Parfett et al.	N/A	N/A
11076854	12/2020	Baber et al.	N/A	N/A
11076921	12/2020	Shelton, IV et al.	N/A	N/A
11076929	12/2020	Shelton, IV et al.	N/A	N/A
11083452	12/2020	Schmid et al.	N/A	N/A
11083453	12/2020	Shelton, IV et al.	N/A	N/A
11083454	12/2020	Harris et al.	N/A	N/A
11083455	12/2020	Shelton, IV et al.	N/A	N/A
11083456	12/2020	Shelton, IV et al.	N/A	N/A
11083457	12/2020	Shelton, IV et al.	N/A	N/A
11083458	12/2020	Harris et al.	N/A	N/A
11090045	12/2020	Shelton, IV	N/A	N/A
11090046	12/2020	Shelton, IV et al.	N/A	N/A
11090047	12/2020	Shelton, IV et al.	N/A	N/A
11090048	12/2020	Fanelli et al.	N/A	N/A
11090049	12/2020	Bakos et al.	N/A	N/A
11090075	12/2020	Hunter et al.	N/A	N/A
11096687	12/2020	Flanagan et al.	N/A	N/A
11096688	12/2020	Shelton, IV et al.	N/A	N/A
11096689	12/2020	Overmyer et al.	N/A	N/A
11100631	12/2020	Yates et al.	N/A	N/A
11103241	12/2020	Yates et al.	N/A	N/A
11103248	12/2020	Shelton, IV et al.	N/A	N/A
11103268	12/2020	Shelton, IV et al.	N/A	N/A
11103269	12/2020	Shelton, IV et al.	N/A	N/A
11103301	12/2020	Messerly et al.	N/A	N/A
11109858	12/2020	Shelton, IV et al.	N/A	N/A
11109859	12/2020	Overmyer et al.	N/A	N/A
11109860	12/2020	Shelton, IV et al.	N/A	N/A
11109866	12/2020	Shelton, IV et al.	N/A	N/A
11109878	12/2020	Shelton, IV et al.	N/A	N/A
11109925	12/2020	Cooper et al.	N/A	N/A

11116485	12/2020	Scheib et al.	N/A	N/A
11116502	12/2020	Shelton, IV et al.	N/A	N/A
11116594	12/2020	Beardsley	N/A	N/A
11123069	12/2020	Baxter, III et al.	N/A	N/A
11123070	12/2020	Shelton, IV et al.	N/A	N/A
11129611	12/2020	Shelton, IV et al.	N/A	N/A
11129613	12/2020	Harris et al.	N/A	N/A
11129615	12/2020	Scheib et al.	N/A	N/A
11129616	12/2020	Shelton, IV et al.	N/A	N/A
11129634	12/2020	Scheib et al.	N/A	N/A
11129636	12/2020	Shelton, IV et al.	N/A	N/A
11129666	12/2020	Messerly et al.	N/A	N/A
11129680	12/2020	Shelton, IV et al.	N/A	N/A
11132462	12/2020	Shelton, IV et al.	N/A	N/A
11133106	12/2020	Shelton, IV et al.	N/A	N/A
11134938	12/2020	Timm et al.	N/A	N/A
11134940	12/2020	Shelton, IV et al.	N/A	N/A
11134942	12/2020	Harris et al.	N/A	N/A
11134943	12/2020	Giordano et al.	N/A	N/A
11134944	12/2020	Wise et al.	N/A	N/A
11134947	12/2020	Shelton, IV et al.	N/A	N/A
11135352	12/2020	Shelton, IV et al.	N/A	N/A
11141153	12/2020	Shelton, IV et al.	N/A	N/A
11141154	12/2020	Shelton, IV et al.	N/A	N/A
11141155	12/2020	Shelton, IV	N/A	N/A
11141156	12/2020	Shelton, IV	N/A	N/A
11141159	12/2020	Scheib et al.	N/A	N/A
11141160	12/2020	Shelton, IV et al.	N/A	N/A
11147547	12/2020	Shelton, IV et al.	N/A	N/A
11147549	12/2020	Timm et al.	N/A	N/A
11147551	12/2020	Shelton, IV	N/A	N/A
11147553	12/2020	Shelton, IV	N/A	N/A
11147554	12/2020	Aronhalt et al.	N/A	N/A
11154296	12/2020	Aronhalt et al.	N/A	N/A
11154297	12/2020	Swayze et al.	N/A	N/A
11154298	12/2020	Timm et al.	N/A	N/A
11154299	12/2020	Shelton, IV et al.	N/A	N/A
11154300	12/2020	Nalagatla et al.	N/A	N/A
11154301	12/2020	Beckman et al.	N/A	N/A
11160551	12/2020	Shelton, IV et al.	N/A	N/A
11160553	12/2020	Simms et al.	N/A	N/A
11160601	12/2020	Worrell et al.	N/A	N/A
11166716	12/2020	Shelton, IV et al.	N/A	N/A
11166717	12/2020	Shelton, IV et al.	N/A	N/A
11166720	12/2020	Giordano et al.	N/A	N/A
11166772	12/2020	Shelton, IV et al.	N/A	N/A
11166773	12/2020	Ragosta et al.	N/A	N/A
11172580	12/2020	Gaertner, II	N/A	N/A
11172927	12/2020	Shelton, IV	N/A	N/A
11172929	12/2020	Shelton, IV	N/A	N/A

11179150	12/2020	Yates et al.	N/A	N/A
11179151	12/2020	Shelton, IV et al.	N/A	N/A
11179152	12/2020	Morgan et al.	N/A	N/A
11179153	12/2020	Shelton, IV	N/A	N/A
11179155	12/2020	Shelton, IV et al.	N/A	N/A
11179208	12/2020	Yates et al.	N/A	N/A
11185325	12/2020	Shelton, IV et al.	N/A	N/A
11185330	12/2020	Huitema et al.	N/A	N/A
11191539	12/2020	Overmyer et al.	N/A	N/A
11191540	12/2020	Aronhalt et al.	N/A	N/A
11191543	12/2020	Overmyer et al.	N/A	N/A
11191545	12/2020	Vendely et al.	N/A	N/A
11197668	12/2020	Shelton, IV et al.	N/A	N/A
11197670	12/2020	Shelton, IV et al.	N/A	N/A
11197671	12/2020	Shelton, IV et al.	N/A	N/A
11197672	12/2020	Dunki-Jacobs et al.	N/A	N/A
11202570	12/2020	Shelton, IV et al.	N/A	N/A
11202631	12/2020	Shelton, IV et al.	N/A	N/A
11202633	12/2020	Harris et al.	N/A	N/A
11207064	12/2020	Shelton, IV et al.	N/A	N/A
11207065	12/2020	Harris et al.	N/A	N/A
11207067	12/2020	Shelton, IV et al.	N/A	N/A
11207089	12/2020	Kostrzewski et al.	N/A	N/A
11207090	12/2020	Shelton, IV et al.	N/A	N/A
11207146	12/2020	Shelton, IV et al.	N/A	N/A
11213293	12/2021	Worthington et al.	N/A	N/A
11213294	12/2021	Shelton, IV et al.	N/A	N/A
11213302	12/2021	Parfett et al.	N/A	N/A
11213359	12/2021	Shelton, IV et al.	N/A	N/A
11219453	12/2021	Shelton, IV et al.	N/A	N/A
11219455	12/2021	Shelton, IV et al.	N/A	N/A
11224423	12/2021	Shelton, IV et al.	N/A	N/A
11224426	12/2021	Shelton, IV et al.	N/A	N/A
11224427	12/2021	Shelton, IV et al.	N/A	N/A
11224428	12/2021	Scott et al.	N/A	N/A
11224454	12/2021	Shelton, IV et al.	N/A	N/A
11224497	12/2021	Shelton, IV et al.	N/A	N/A
11229436	12/2021	Shelton, IV et al.	N/A	N/A
11229437	12/2021	Shelton, IV et al.	N/A	N/A
11234698	12/2021	Shelton, IV et al.	N/A	N/A
11234700	12/2021	Ragosta et al.	N/A	N/A
11241229	12/2021	Shelton, IV et al.	N/A	N/A
11241230	12/2021	Shelton, IV et al.	N/A	N/A
11241235	12/2021	Shelton, IV et al.	N/A	N/A
11246590	12/2021	Swayze et al.	N/A	N/A
11246592	12/2021	Shelton, IV et al.	N/A	N/A
11246616	12/2021	Shelton, IV et al.	N/A	N/A
11246618	12/2021	Hall et al.	N/A	N/A
11246678	12/2021	Shelton, IV et al.	N/A	N/A
11253254	12/2021	Kimball et al.	N/A	N/A

11253256	12/2021	Harris et al.	N/A	N/A
11259799	12/2021	Overmyer et al.	N/A	N/A
11259803	12/2021	Shelton, IV et al.	N/A	N/A
11259805	12/2021	Shelton, IV et al.	N/A	N/A
11259806	12/2021	Shelton, IV et al.	N/A	N/A
11259807	12/2021	Shelton, IV et al.	N/A	N/A
11266405	12/2021	Shelton, IV et al.	N/A	N/A
11266406	12/2021	Leimbach et al.	N/A	N/A
11266409	12/2021	Huitema et al.	N/A	N/A
11266410	12/2021	Shelton, IV et al.	N/A	N/A
11266468	12/2021	Shelton, IV et al.	N/A	N/A
11272927	12/2021	Swayze et al.	N/A	N/A
11272928	12/2021	Shelton, IV	N/A	N/A
11272931	12/2021	Boudreaux et al.	N/A	N/A
11272938	12/2021	Shelton, IV et al.	N/A	N/A
11278279	12/2021	Morgan et al.	N/A	N/A
11278280	12/2021	Shelton, IV et al.	N/A	N/A
11278284	12/2021	Shelton, IV et al.	N/A	N/A
11284890	12/2021	Nalagatla et al.	N/A	N/A
11284891	12/2021	Shelton, IV et al.	N/A	N/A
11284898	12/2021	Baxter, III et al.	N/A	N/A
11284953	12/2021	Shelton, IV et al.	N/A	N/A
11291440	12/2021	Harris et al.	N/A	N/A
11291441	12/2021	Giordano et al.	N/A	N/A
11291442	12/2021	Wixey et al.	N/A	N/A
11291443	12/2021	Viola et al.	N/A	N/A
11291444	12/2021	Boudreaux et al.	N/A	N/A
11291445	12/2021	Shelton, IV et al.	N/A	N/A
11291447	12/2021	Shelton, IV et al.	N/A	N/A
11291449	12/2021	Swensgard et al.	N/A	N/A
11291451	12/2021	Shelton, IV	N/A	N/A
11291465	12/2021	Parihar et al.	N/A	N/A
11291510	12/2021	Shelton, IV et al.	N/A	N/A
11298125	12/2021	Ming et al.	N/A	N/A
11298127	12/2021	Shelton, IV	N/A	N/A
11298128	12/2021	Messerly et al.	N/A	N/A
11298129	12/2021	Bakos et al.	N/A	N/A
11298130	12/2021	Bakos et al.	N/A	N/A
11298132	12/2021	Shelton, IV et al.	N/A	N/A
11298134	12/2021	Huitema et al.	N/A	N/A
11304695	12/2021	Shelton, IV et al.	N/A	N/A
11304696	12/2021	Shelton, IV et al.	N/A	N/A
11304697	12/2021	Fanelli et al.	N/A	N/A
11304699	12/2021	Shelton, IV et al.	N/A	N/A
11304704	12/2021	Thomas et al.	N/A	N/A
11311290	12/2021	Shelton, IV et al.	N/A	N/A
11311292	12/2021	Shelton, IV et al.	N/A	N/A
11311294	12/2021	Swayze et al.	N/A	N/A
11311295	12/2021	Wingardner et al.	N/A	N/A
11311342	12/2021	Parihar et al.	N/A	N/A

D950728	12/2021	Bakos et al.	N/A	N/A
D952144	12/2021	Boudreaux	N/A	N/A
11317910	12/2021	Miller et al.	N/A	N/A
11317912	12/2021	Jenkins et al.	N/A	N/A
11317913	12/2021	Shelton, IV et al.	N/A	N/A
11317915	12/2021	Boudreaux et al.	N/A	N/A
11317917	12/2021	Shelton, IV et al.	N/A	N/A
11317919	12/2021	Shelton, IV et al.	N/A	N/A
11317978	12/2021	Cameron et al.	N/A	N/A
11324501	12/2021	Shelton, IV et al.	N/A	N/A
11324503	12/2021	Shelton, IV et al.	N/A	N/A
11324506	12/2021	Beckman et al.	N/A	N/A
11324557	12/2021	Shelton, IV et al.	N/A	N/A
11331100	12/2021	Boudreaux et al.	N/A	N/A
11331101	12/2021	Harris et al.	N/A	N/A
11337691	12/2021	Widenhouse et al.	N/A	N/A
11337693	12/2021	Hess et al.	N/A	N/A
11337698	12/2021	Baxter, III et al.	N/A	N/A
11344299	12/2021	Yates et al.	N/A	N/A
11344303	12/2021	Shelton, IV et al.	N/A	N/A
11350843	12/2021	Shelton, IV et al.	N/A	N/A
11350916	12/2021	Shelton, IV et al.	N/A	N/A
11350928	12/2021	Shelton, IV et al.	N/A	N/A
11350929	12/2021	Giordano et al.	N/A	N/A
11350932	12/2021	Shelton, IV et al.	N/A	N/A
11350934	12/2021	Bakos et al.	N/A	N/A
11350935	12/2021	Shelton, IV et al.	N/A	N/A
11350938	12/2021	Shelton, IV et al.	N/A	N/A
11357503	12/2021	Bakos et al.	N/A	N/A
11361176	12/2021	Shelton, IV et al.	N/A	N/A
11364027	12/2021	Harris et al.	N/A	N/A
11364046	12/2021	Shelton, IV et al.	N/A	N/A
11369366	12/2021	Scheib et al.	N/A	N/A
11369368	12/2021	Shelton, IV et al.	N/A	N/A
11369376	12/2021	Simms et al.	N/A	N/A
11369377	12/2021	Boudreaux et al.	N/A	N/A
11373755	12/2021	Shelton, IV et al.	N/A	N/A
11376001	12/2021	Shelton, IV et al.	N/A	N/A
11376002	12/2021	Shelton, IV et al.	N/A	N/A
11376082	12/2021	Shelton, IV et al.	N/A	N/A
11376098	12/2021	Shelton, IV et al.	N/A	N/A
11382625	12/2021	Huitema et al.	N/A	N/A
11382626	12/2021	Shelton, IV et al.	N/A	N/A
11382627	12/2021	Huitema et al.	N/A	N/A
11382628	12/2021	Baxter, III et al.	N/A	N/A
11382638	12/2021	Harris et al.	N/A	N/A
11382697	12/2021	Shelton, IV et al.	N/A	N/A
11382704	12/2021	Overmyer et al.	N/A	N/A
11389160	12/2021	Shelton, IV et al.	N/A	N/A
11389161	12/2021	Shelton, IV et al.	N/A	N/A

11389162	12/2021	Baber et al.	N/A	N/A
11389164	12/2021	Yates et al.	N/A	N/A
11395651	12/2021	Shelton, IV et al.	N/A	N/A
11395652	12/2021	Parihar et al.	N/A	N/A
11399828	12/2021	Swayze et al.	N/A	N/A
11399829	12/2021	Leimbach et al.	N/A	N/A
11399831	12/2021	Overmyer et al.	N/A	N/A
11399837	12/2021	Shelton, IV et al.	N/A	N/A
11406377	12/2021	Schmid et al.	N/A	N/A
11406378	12/2021	Baxter, III et al.	N/A	N/A
11406380	12/2021	Yates et al.	N/A	N/A
11406381	12/2021	Parihar et al.	N/A	N/A
11406382	12/2021	Shelton, IV et al.	N/A	N/A
11406386	12/2021	Baber et al.	N/A	N/A
11406390	12/2021	Shelton, IV et al.	N/A	N/A
11406442	12/2021	Davison et al.	N/A	N/A
11410259	12/2021	Harris et al.	N/A	N/A
11413041	12/2021	Viola et al.	N/A	N/A
11413042	12/2021	Shelton, IV et al.	N/A	N/A
11413102	12/2021	Shelton, IV et al.	N/A	N/A
11419606	12/2021	Overmyer et al.	N/A	N/A
11419630	12/2021	Yates et al.	N/A	N/A
11424027	12/2021	Shelton, IV	N/A	N/A
11426160	12/2021	Shelton, IV et al.	N/A	N/A
11426167	12/2021	Shelton, IV et al.	N/A	N/A
11426251	12/2021	Kimball et al.	N/A	N/A
D964564	12/2021	Boudreaux	N/A	N/A
11432816	12/2021	Leimbach et al.	N/A	N/A
11432885	12/2021	Shelton, IV et al.	N/A	N/A
11439391	12/2021	Bruns et al.	N/A	N/A
11439470	12/2021	Spivey et al.	N/A	N/A
11446029	12/2021	Shelton, IV et al.	N/A	N/A
11446034	12/2021	Shelton, IV et al.	N/A	N/A
11452526	12/2021	Ross et al.	N/A	N/A
11452528	12/2021	Leimbach et al.	N/A	N/A
D966512	12/2021	Shelton, IV et al.	N/A	N/A
D967421	12/2021	Shelton, IV et al.	N/A	N/A
11457918	12/2021	Shelton, IV et al.	N/A	N/A
11464511	12/2021	Timm et al.	N/A	N/A
11464512	12/2021	Shelton, IV et al.	N/A	N/A
11464513	12/2021	Shelton, IV et al.	N/A	N/A
11464514	12/2021	Yates et al.	N/A	N/A
11464601	12/2021	Shelton, IV et al.	N/A	N/A
11471155	12/2021	Shelton, IV et al.	N/A	N/A
11471156	12/2021	Shelton, IV et al.	N/A	N/A
11471157	12/2021	Baxter, III et al.	N/A	N/A
11478241	12/2021	Shelton, IV et al.	N/A	N/A
11478242	12/2021	Shelton, IV et al.	N/A	N/A
11478244	12/2021	DiNardo et al.	N/A	N/A
D971232	12/2021	Siebel et al.	N/A	N/A

11484307	12/2021	Hall et al.	N/A	N/A
11484309	12/2021	Harris et al.	N/A	N/A
11484310	12/2021	Shelton, IV et al.	N/A	N/A
11484311	12/2021	Shelton, IV et al.	N/A	N/A
11484312	12/2021	Shelton, IV et al.	N/A	N/A
11490889	12/2021	Overmyer et al.	N/A	N/A
11497488	12/2021	Leimbach et al.	N/A	N/A
11497489	12/2021	Baxter, III et al.	N/A	N/A
11497492	12/2021	Shelton, IV	N/A	N/A
11497499	12/2021	Shelton, IV et al.	N/A	N/A
11504116	12/2021	Schmid et al.	N/A	N/A
11504119	12/2021	Shelton, IV et al.	N/A	N/A
11504122	12/2021	Shelton, IV et al.	N/A	N/A
11504192	12/2021	Shelton, IV et al.	N/A	N/A
11510671	12/2021	Shelton, IV et al.	N/A	N/A
11510673	12/2021	Chen et al.	N/A	N/A
11510741	12/2021	Shelton, IV et al.	N/A	N/A
11517304	12/2021	Yates et al.	N/A	N/A
11517306	12/2021	Miller et al.	N/A	N/A
11517309	12/2021	Bakos et al.	N/A	N/A
11517311	12/2021	Lytle, IV et al.	N/A	N/A
11517315	12/2021	Huitema et al.	N/A	N/A
11517325	12/2021	Shelton, IV et al.	N/A	N/A
11517390	12/2021	Baxter, III	N/A	N/A
11523821	12/2021	Harris et al.	N/A	N/A
11523822	12/2021	Shelton, IV et al.	N/A	N/A
11523823	12/2021	Hunter et al.	N/A	N/A
11523824	12/2021	Williams	N/A	N/A
11523859	12/2021	Shelton, IV et al.	N/A	N/A
11529137	12/2021	Shelton, IV et al.	N/A	N/A
11529138	12/2021	Jaworek et al.	N/A	N/A
11529139	12/2021	Shelton, IV et al.	N/A	N/A
11529140	12/2021	Shelton, IV et al.	N/A	N/A
11529142	12/2021	Leimbach et al.	N/A	N/A
11534162	12/2021	Shelton, IV	N/A	N/A
11534259	12/2021	Leimbach et al.	N/A	N/A
D974560	12/2022	Shelton, IV et al.	N/A	N/A
D975278	12/2022	Shelton, IV et al.	N/A	N/A
D975850	12/2022	Shelton, IV et al.	N/A	N/A
D975851	12/2022	Shelton, IV et al.	N/A	N/A
D976401	12/2022	Shelton, IV et al.	N/A	N/A
11540824	12/2022	Shelton, IV et al.	N/A	N/A
11540829	12/2022	Shelton, IV et al.	N/A	N/A
11547403	12/2022	Shelton, IV et al.	N/A	N/A
11547404	12/2022	Shelton, IV et al.	N/A	N/A
11553911	12/2022	Shelton, IV et al.	N/A	N/A
11553916	12/2022	Vendely et al.	N/A	N/A
11553919	12/2022	Shelton, IV et al.	N/A	N/A
11553971	12/2022	Shelton, IV et al.	N/A	N/A
11559302	12/2022	Timm et al.	N/A	N/A

11559303	12/2022	Shelton, IV et al.	N/A	N/A
11559304	12/2022	Boudreaux et al.	N/A	N/A
11559307	12/2022	Shelton, IV et al.	N/A	N/A
11559308	12/2022	Yates et al.	N/A	N/A
11559496	12/2022	Widenhouse et al.	N/A	N/A
11564679	12/2022	Parihar et al.	N/A	N/A
11564682	12/2022	Timm et al.	N/A	N/A
11564686	12/2022	Yates et al.	N/A	N/A
11564688	12/2022	Swayze et al.	N/A	N/A
11564703	12/2022	Shelton, IV et al.	N/A	N/A
11564756	12/2022	Shelton, IV et al.	N/A	N/A
11571207	12/2022	Shelton, IV et al.	N/A	N/A
11571210	12/2022	Shelton, IV et al.	N/A	N/A
11571212	12/2022	Yates et al.	N/A	N/A
11571215	12/2022	Shelton, IV et al.	N/A	N/A
11571231	12/2022	Hess et al.	N/A	N/A
11576668	12/2022	Shelton, IV et al.	N/A	N/A
11576672	12/2022	Shelton, IV et al.	N/A	N/A
11576673	12/2022	Shelton, IV	N/A	N/A
11576677	12/2022	Shelton, IV et al.	N/A	N/A
11583274	12/2022	Widenhouse et al.	N/A	N/A
11583277	12/2022	Shelton, IV et al.	N/A	N/A
11583278	12/2022	Shelton, IV et al.	N/A	N/A
11583279	12/2022	Smith et al.	N/A	N/A
11589863	12/2022	Weir et al.	N/A	N/A
11589865	12/2022	Shelton, IV et al.	N/A	N/A
11589888	12/2022	Shelton, IV et al.	N/A	N/A
D980425	12/2022	Baxter, III	N/A	N/A
11596406	12/2022	Huitema et al.	N/A	N/A
11602340	12/2022	Schmid et al.	N/A	N/A
11602346	12/2022	Shelton, IV	N/A	N/A
11602366	12/2022	Shelton, IV et al.	N/A	N/A
11607219	12/2022	Shelton, IV et al.	N/A	N/A
11607239	12/2022	Swensgard et al.	N/A	N/A
11607278	12/2022	Shelton, IV et al.	N/A	N/A
11612393	12/2022	Morgan et al.	N/A	N/A
11612394	12/2022	Morgan et al.	N/A	N/A
11612395	12/2022	Yates et al.	N/A	N/A
11617575	12/2022	Yates et al.	N/A	N/A
11617576	12/2022	Yates et al.	N/A	N/A
11617577	12/2022	Huang	N/A	N/A
11622763	12/2022	Parihar et al.	N/A	N/A
11622766	12/2022	Shelton, IV	N/A	N/A
11622785	12/2022	Hess et al.	N/A	N/A
11627959	12/2022	Shelton, IV et al.	N/A	N/A
11627960	12/2022	Shelton, IV et al.	N/A	N/A
11628006	12/2022	Henderson et al.	N/A	N/A
11633183	12/2022	Parihar et al.	N/A	N/A
11633185	12/2022	Wilson et al.	N/A	N/A
11638581	12/2022	Parihar et al.	N/A	N/A

11638582	12/2022	Bakos et al.	N/A	N/A
11638583	12/2022	Yates et al.	N/A	N/A
11638587	12/2022	Shelton, IV et al.	N/A	N/A
11642125	12/2022	Harris et al.	N/A	N/A
11642128	12/2022	Shelton, IV et al.	N/A	N/A
11648005	12/2022	Yates et al.	N/A	N/A
11648006	12/2022	Timm et al.	N/A	N/A
11648008	12/2022	Shelton, IV et al.	N/A	N/A
11648009	12/2022	Jenkins	N/A	N/A
11648022	12/2022	Shelton, IV	N/A	N/A
11648024	12/2022	Shelton, IV et al.	N/A	N/A
11653914	12/2022	Shelton, IV et al.	N/A	N/A
11653915	12/2022	Shelton, IV et al.	N/A	N/A
11653917	12/2022	Scott et al.	N/A	N/A
11653918	12/2022	Swayze et al.	N/A	N/A
11653920	12/2022	Shelton, IV et al.	N/A	N/A
11659023	12/2022	Shelton, IV et al.	N/A	N/A
11660090	12/2022	Bakos et al.	N/A	N/A
11660110	12/2022	Shelton, IV et al.	N/A	N/A
11660163	12/2022	Shelton, IV et al.	N/A	N/A
11666327	12/2022	Whitman et al.	N/A	N/A
11666332	12/2022	Giordano et al.	N/A	N/A
11672531	12/2022	Timm et al.	N/A	N/A
11672532	12/2022	Shelton, IV et al.	N/A	N/A
11672536	12/2022	Shelton, IV et al.	N/A	N/A
11672605	12/2022	Messerly et al.	N/A	N/A
11678877	12/2022	Shelton, IV et al.	N/A	N/A
11678880	12/2022	Shelton, IV et al.	N/A	N/A
11678881	12/2022	Yates et al.	N/A	N/A
11678882	12/2022	Shelton, IV et al.	N/A	N/A
11684360	12/2022	Shelton, IV et al.	N/A	N/A
11684361	12/2022	Yates et al.	N/A	N/A
11684365	12/2022	Shelton, IV et al.	N/A	N/A
11684369	12/2022	Shelton, IV et al.	N/A	N/A
11684434	12/2022	Shelton, IV	N/A	N/A
11690615	12/2022	Parihar et al.	N/A	N/A
11690623	12/2022	Shelton, IV et al.	N/A	N/A
11696757	12/2022	Shelton, IV et al.	N/A	N/A
11696759	12/2022	Shelton, IV et al.	N/A	N/A
11696761	12/2022	Shelton, IV	N/A	N/A
11696778	12/2022	Shelton, IV et al.	N/A	N/A
11701110	12/2022	Yates et al.	N/A	N/A
11701111	12/2022	Shelton, IV et al.	N/A	N/A
11701113	12/2022	Shelton, IV et al.	N/A	N/A
11701114	12/2022	Shelton, IV et al.	N/A	N/A
11701115	12/2022	Harris et al.	N/A	N/A
11707273	12/2022	Kerr et al.	N/A	N/A
11712244	12/2022	Vendely et al.	N/A	N/A
11712303	12/2022	Shelton, IV et al.	N/A	N/A
11717285	12/2022	Yates et al.	N/A	N/A

11717289	12/2022	Leimbach	N/A	N/A
11717291	12/2022	Morgan et al.	N/A	N/A
11717294	12/2022	Huitema et al.	N/A	N/A
11717297	12/2022	Baber et al.	N/A	N/A
11723657	12/2022	Shelton, IV et al.	N/A	N/A
11723658	12/2022	Bakos et al.	N/A	N/A
11723662	12/2022	Leimbach et al.	N/A	N/A
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2006/0064086	12/2005	Odom	N/A	N/A
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2006/0086032	12/2005	Valencic et al.	N/A	N/A
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2010/0005035	12/2009	Carpenter et al.	N/A	N/A
2010/0012702	12/2009	Marczyk	227/175.1	A61B 17/07207
2010/0012703	12/2009	Calabrese et al.	N/A	N/A
2010/0015104	12/2009	Fraser et al.	N/A	N/A
2010/0016853	12/2009	Burbank	N/A	N/A
2010/0016888	12/2009	Calabrese et al.	N/A	N/A
2010/0017715	12/2009	Balassanian	N/A	N/A
2010/0023024	12/2009	Zeiner et al.	N/A	N/A
2010/0030233	12/2009	Whitman	606/130	A61B 34/30
2010/0030239	12/2009	Viola et al.	N/A	N/A
2010/0032179	12/2009	Hanspers et al.	N/A	N/A
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2010/0036441	12/2009	Procter	N/A	N/A
2010/0051668	12/2009	Milliman et al.	N/A	N/A
2010/0057118	12/2009	Dietz et al.	N/A	N/A
2010/0065604	12/2009	Weng	N/A	N/A
2010/0069833	12/2009	Wenderow et al.	N/A	N/A
2010/0069942	12/2009	Shelton, IV	N/A	N/A
2010/0076433	12/2009	Taylor et al.	N/A	N/A
2010/0076483	12/2009	Imuta	N/A	N/A
2010/0076489	12/2009	Stopek et al.	N/A	N/A
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2010/0094312	12/2009	Ruiz Morales et al.	N/A	N/A
2010/0094340	12/2009	Stopek et al.	N/A	N/A
2010/0094400	12/2009	Bolduc et al.	N/A	N/A
2010/0100123	12/2009	Bennett	N/A	N/A
2010/0100124	12/2009	Calabrese et al.	N/A	N/A
2010/0106167	12/2009	Boulnois et al.	N/A	N/A
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2010/0122339	12/2009	Boccacci	N/A	N/A
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2010/0145146	12/2009	Melder	N/A	N/A
2010/0147921	12/2009	Olson	N/A	N/A
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2010/0245102	12/2009	Yokoi	N/A	N/A
2010/0249497	12/2009	Peine et al.	N/A	N/A
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2010/0256675	12/2009	Romans	N/A	N/A
2010/0258327	12/2009	Esenwein et al.	N/A	N/A
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2012/0241494	12/2011	Marczyk	N/A	N/A
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2013/0172878	12/2012	Smith	N/A	N/A
2013/0175315	12/2012	Milliman	N/A	N/A
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2014/0135832	12/2013	Park et al.	N/A	N/A
2014/0148803	12/2013	Taylor	N/A	N/A
2014/0151433	12/2013	Shelton, IV et al.	N/A	N/A
2014/0155916	12/2013	Hodgkinson et al.	N/A	N/A
2014/0158747	12/2013	Measamer et al.	N/A	N/A
2014/0166718	12/2013	Swayze et al.	N/A	N/A
2014/0166723	12/2013	Beardsley et al.	N/A	N/A
2014/0166724	12/2013	Schellin et al.	N/A	N/A
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2014/0175147	12/2013	Manoux et al.	N/A	N/A
2014/0175150	12/2013	Shelton, IV et al.	N/A	N/A
2014/0175152	12/2013	Hess et al.	N/A	N/A
2014/0181710	12/2013	Baalu et al.	N/A	N/A

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2014/0215242	12/2013	Jung	N/A	N/A
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2014/0249557	12/2013	Koch, Jr. et al.	N/A	N/A
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2014/0263535	12/2013	Rajani et al.	N/A	N/A
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2014/0263558	12/2013	Hausen et al.	N/A	N/A
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2014/0284371	12/2013	Morgan et al.	N/A	N/A
2014/0287703	12/2013	Herbsommer et al.	N/A	N/A
2014/0288460	12/2013	Ouyang et al.	N/A	N/A
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2015/0022012	12/2014	Kim et al.	N/A	N/A
2015/0025549	12/2014	Kilroy et al.	N/A	N/A
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2016/0183944	12/2015	Swensgard et al.	N/A	N/A
2016/0192927	12/2015	Kostrzewski	N/A	N/A
2016/0192960	12/2015	Bueno et al.	N/A	N/A
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2016/0242855	12/2015	Fichtinger et al.	N/A	N/A
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2016/0249922	12/2015	Morgan et al.	N/A	N/A
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2016/0256159	12/2015	Pinjala et al.	N/A	N/A
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2016/0310143	12/2015	Bettuchi	N/A	N/A
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2017/0020616	12/2016	Vale et al.	N/A	N/A
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2017/0172549	12/2016	Smaby et al.	N/A	N/A
2017/0172662	12/2016	Panescu et al.	N/A	N/A
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2018/0310995	12/2017	Gliner et al.	N/A	N/A
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Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS (1) This application is a continuation application claiming priority under 35 U.S.C. § 120 to U.S. patent application Ser. No. 16/367,899, entitled ROBOTICALLY POWERED SURGICAL DEVICE WITH MANUALLY-ACTUATABLE REVERSING SYSTEM, filed on Mar. 28, 2019, which issued on Mar. 14, 2023 as U.S. Pat. No. 11,602,346, which is a continuation application claiming priority under 35 U.S.C. § 120 to U.S. patent application Ser. No. 15/079,526, entitled ROBOTICALLY POWERED SURGICAL DEVICE WITH MANUALLY-ACTUATABLE REVERSING SYSTEM, filed on Mar. 24, 2016, which issued on Nov. 26, 2019 as U.S. Pat. No. 10,485,541, which is a continuation application claiming priority under 35 U.S.C. § 120 to U.S. patent application Ser. No. 13/536,323, entitled ROBOTICALLY POWERED SURGICAL DEVICE WITH MANUALLY-ACTUATABLE REVERSING SYSTEM, filed on Jun. 28, 2012, which issued on Aug. 9, 2016 as U.S. Pat. No. 9,408,606, the entire disclosures of which are hereby incorporated by reference herein.

BACKGROUND
(1) Over the years a variety of minimally invasive robotic (or “telesurgical”) systems have been developed to increase surgical dexterity as well as to permit a surgeon to operate on a patient in an intuitive manner. Many of such systems are disclosed in the following U.S. patents which are each herein incorporated by reference in their respective entirety: U.S. Pat. No. 5,792,135, entitled ARTICULATED SURGICAL INSTRUMENT FOR PERFORMING MINIMALLY INVASIVE SURGERY WITH ENHANCED DEXTERITY AND SENSITIVITY, U.S. Pat. No. 6,231,565, entitled ROBOTIC ARM PLUS FOR PERFORMING SURGICAL TASKS, U.S. Pat. No. 6,783,524, entitled ROBOTIC SURGICAL TOOL WITH ULTRASOUND CAUTERIZING AND CUTTING INSTRUMENT, U.S. Pat. No. 6,364,888, entitled ALIGNMENT OF MASTER AND SLAVE IN A MINIMALLY INVASIVE SURGICAL APPARATUS, U.S. Pat. No. 7,524,320, entitled MECHANICAL ACTUATOR INTERFACE SYSTEM FOR ROBOTIC SURGICAL TOOLS, U.S. Pat. No. 7,691,098, entitled PLATFORM LINK WRIST MECHANISM, U.S. Pat. No. 7,806,891, entitled REPOSITIONING AND REORIENTATION OF MASTER/SLAVE RELATIONSHIP IN MINIMALLY INVASIVE TELESURGERY, and U.S. Pat. No. 7,824,401, entitled SURGICAL TOOL WITH WRISTED MONOPOLAR ELECTROSURGICAL END EFFECTORS. Many of such systems, however, have in the past been unable to generate the magnitude of forces required to effectively cut and fasten tissue. In addition, existing robotic surgical systems are limited in the number of different types of surgical devices that they may operate.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) The features and advantages of this invention, and the manner of attaining them, will become

more apparent and the invention itself will be better understood by reference to the following description of exemplary embodiments of the invention taken in conjunction with the accompanying drawings, wherein:
(2) Various exemplary embodiments are described herein by way of example in conjunction with the following Figures wherein:
(3) FIG. **1** is a perspective view of one robotic controller embodiment;
(4) FIG. **2** is a perspective view of one robotic surgical arm cart/manipulator of a robotic system operably supporting a plurality of surgical tool embodiments;
(5) FIG. **3** is a side view of the robotic surgical arm cart/manipulator depicted in FIG. **2**;
(6) FIG. **4** is a perspective view of a cart structure with positioning linkages for operably supporting robotic manipulators that may be used with surgical tool embodiments;
(7) FIG. **5** is a perspective view of a surgical tool embodiment and a surgical end effector embodiment;
(8) FIG. **6** is an exploded assembly view of an adapter and tool holder arrangement for attaching various surgical tool embodiments to a robotic system;
(9) FIG. **7** is a side view of the adapter shown in FIG. **6**;
(10) FIG. **8** is a bottom view of the adapter shown in FIG. **6**;
(11) FIG. **9** is a top view of the adapter of FIGS. **6** and **7**;
(12) FIG. **10** is a partial bottom perspective view of a surgical tool embodiment;
(13) FIG. **11** is a front perspective view of a portion of a surgical tool embodiment with some elements thereof omitted for clarity;
(14) FIG. **12** is a rear perspective view of the surgical tool embodiment of FIG. **11**;
(15) FIG. **13** is a top view of the surgical tool embodiment of FIGS. **11** and **12**;
(16) FIG. **14** is a partial top view of the surgical tool embodiment of FIGS. **11-13** with the manually actuatable drive gear in an unactuated position;
(17) FIG. **15** is another partial top view of the surgical tool embodiment of FIGS. **11-14** with the manually actuatable drive gear in an initially actuated position;
(18) FIG. **16** is another partial top view of the surgical tool embodiment of FIGS. **11-15** with the manually actuatable drive gear in an actuated position;
(19) FIG. **17** is a rear perspective view of another surgical tool embodiment;
(20) FIG. **18** is a side elevational view of the surgical tool embodiment of FIG. **17**;
(21) FIG. **19** is a cross-sectional view of the surgical tool embodiment of FIG. **5** with the end effector detached from the proximal shaft portion of the surgical tool;
(22) FIG. **20** is a side perspective view showing a portion of a interconnected quick disconnect joint embodiment;
(23) FIG. **21** is a cross-sectional view of a quick disconnect joint embodiment with the distal shaft portion of the end effector detached from the proximal shaft portion;
(24) FIG. **22** is another cross-sectional view of the quick disconnect joint embodiment of FIGS. **19-21** wherein the distal shaft portion has been initially engaged with the proximal shaft portion;
(25) FIG. **22**A is a cross-sectional view of a quick disconnect joint embodiment wherein the distal shaft portion has been initially engaged with the proximal shaft portion;
(26) FIG. **23** is another cross-sectional view of the quick disconnect joint embodiment of FIGS. **19-22** wherein the distal shaft portion has been attached to the proximal shaft portion;
(27) FIG. **23**A is another cross-sectional view of the quick disconnect joint embodiment of FIG. **22**A wherein the distal shaft portion has been attached to the proximal shaft portion;
(28) FIG. **23**B is another cross-sectional view of the quick disconnect joint embodiment of FIGS. **22**A, **22**B wherein the distal shaft portion has been disengaged from the proximal shaft portion;
(29) FIG. **24** is a cross-sectional view of the distal shaft portion of FIGS. **19-23** taken along line **24-24** in FIG. **21**;
(30) FIG. **25** is a cross-sectional view of a portion of an articulation joint and end effector

embodiment;
(31) FIG. **26** is an exploded assembly view of a portion of the articulation joint and end effector of FIG. **25**;
(32) FIG. **27** is a partial cross-sectional perspective view of the articulation joint and end effector portions depicted in FIG. **26**;
(33) FIG. **28** is a partial perspective view of an end effector and drive shaft assembly embodiment;
(34) FIG. **29** is a partial side view of a drive shaft assembly embodiment;
(35) FIG. **30** is a perspective view of a drive shaft assembly embodiment;
(36) FIG. **31** is a side view of the drive shaft assembly of FIG. **31**;
(37) FIG. **32** is a perspective view of a composite drive shaft assembly embodiment;
(38) FIG. **33** is a side view of the composite drive shaft assembly of FIG. **33**;
(39) FIG. **34** is another view of the drive shaft assembly of FIGS. **30** and **31** assuming an arcuate or "flexed" configuration;
(40) FIG. **34**A is a side view of a drive shaft assembly embodiment assuming an arcuate or "flexed" configuration;
(41) FIG. **34**B is a side view of another drive shaft assembly embodiment assuming an arcuate or "flexed" configuration;
(42) FIG. **35** is a perspective view of a portion of another drive shaft assembly embodiment;
(43) FIG. **36** is a top view of the drive shaft assembly embodiment of FIG. **35**;
(44) FIG. **37** is another perspective view of the drive shaft assembly embodiment of FIGS. **35** and **36** in an arcuate configuration;
(45) FIG. **38** is a top view of the drive shaft assembly embodiment depicted in FIG. **37**;
(46) FIG. **39** is a perspective view of another drive shaft assembly embodiment;
(47) FIG. **40** is another perspective view of the drive shaft assembly embodiment of FIG. **39** in an arcuate configuration;
(48) FIG. **41** is a top view of the drive shaft assembly embodiment of FIGS. **39** and **40**;
(49) FIG. **42** is a cross-sectional view of the drive shaft assembly embodiment of FIG. **41**;
(50) FIG. **43** is a partial cross-sectional view of another drive shaft assembly embodiment;
(51) FIG. **44** is another cross-sectional view of the drive shaft assembly embodiment of FIG. **43**;
(52) FIG. **45** is another cross-sectional view of a portion of another drive shaft assembly embodiment;
(53) FIG. **46** is another cross-sectional view of the drive shaft assembly of FIG. **45**;
(54) FIG. **47** is a partial cross-sectional perspective view of an end effector embodiment with the anvil thereof in an open position;
(55) FIG. **48** is another partial cross-sectional perspective view of the end effector embodiment of FIG. **47**;
(56) FIG. **49** is a side cross-sectional view of the end effector embodiment of FIGS. **47** and **48**;
(57) FIG. **50** is another side cross-sectional view of the end effector embodiment of FIGS. **47-49**;
(58) FIG. **51** is a partial cross-sectional perspective view of the end effector embodiment of FIGS. **47-50** with the anvil thereof in a closed position;
(59) FIG. **52** is another partial cross-sectional perspective view of the end effector embodiment of FIG. **51**;
(60) FIG. **53** is a side cross-sectional view of the end effector embodiment of FIGS. **51** and **52** with the anvil thereof in a partially closed position;
(61) FIG. **54** is another side cross-sectional view of the end effector embodiment of FIGS. **51-53** with the anvil in a closed position;
(62) FIG. **55** is a cross-sectional perspective view of another end effector embodiment and portion of another elongate shaft assembly embodiment;
(63) FIG. **56** is an exploded perspective view of a closure system embodiment;
(64) FIG. **57** is a side view of the closure system embodiment of FIG. **56** with the anvil in an open

position;
(65) FIG. **58** is a side cross-sectional view of the closure system embodiment of FIGS. **57** and **57** within an end effector embodiment wherein the anvil thereof is in an open position;
(66) FIG. **59** is another cross-sectional view of the closure system and end effector embodiment of FIG. **58** with the anvil thereof in a closed position;
(67) FIG. **59**A is a front perspective view of a portion of another surgical tool embodiment that employs the closure system embodiment of FIGS. **56-59** with the actuation solenoid omitted for clarity;
(68) FIG. **60** is an exploded assembly view of another end effector embodiment;
(69) FIG. **61** is a partial perspective view of a drive system embodiment;
(70) FIG. **62** is a partial front perspective view of a portion of the drive system embodiment of FIG. **61**;
(71) FIG. **63** is a partial rear perspective view of a portion of the drive system embodiment of FIGS. **61** and **62**;
(72) FIG. **64** is a partial cross-sectional side view of the drive system embodiment of FIGS. **61-63** in a first axial drive position;
(73) FIG. **65** is another partial cross-sectional side view of the drive system embodiment of FIGS. **61-64** in a second axial drive position;
(74) FIG. **66** is a cross-sectional view of an end effector and drive system embodiment wherein the drive system is configured to fire the firing member;
(75) FIG. **67** is another cross-sectional view of the end effector and drive system embodiment wherein the drive system is configured to rotate the entire end effector;
(76) FIG. **68** is a cross-sectional perspective view of a portion of an end effector embodiment and articulation joint embodiment;
(77) FIG. **69** is a cross-sectional side view of the end effector and articulation joint embodiment depicted in FIG. **68**;
(78) FIG. **70** is a cross-sectional view of another end effector and drive system embodiment wherein the drive system is configured to rotate the entire end effector;
(79) FIG. **71** is another cross-sectional view of the end effector and drive system embodiment of FIG. **70** wherein the drive system is configured to fire the firing member of the end effector;
(80) FIG. **72** is a cross-sectional side view of an end effector embodiment;
(81) FIG. **73** is an enlarged cross-sectional view of a portion of the end effector embodiment of FIG. **72**;
(82) FIG. **74** is a cross-sectional side view of another end effector embodiment wherein the firing member thereof has been partially driven through the firing stroke;
(83) FIG. **75** is another cross-sectional side view of the end effector embodiment of FIG. **74** wherein the firing member has been driven to the end of its firing stroke;
(84) FIG. **76** is another cross-sectional side view of the end effector embodiment of FIGS. **74** and **75** wherein the firing member thereof is being retracted;
(85) FIG. **77** is a cross-sectional side view of another end effector embodiment wherein the firing member thereof has been partially driven through its firing stroke;
(86) FIG. **78** is an exploded assembly view of a portion of an implement drive shaft embodiment;
(87) FIG. **79** is another cross-sectional side view of the end effector of FIG. **77** with the firing member thereof at the end of its firing stroke;
(88) FIG. **80** is another cross-sectional side view of the end effector of FIGS. **77** and **78** wherein the firing member is being retracted;
(89) FIG. **81** is a cross-sectional side view of another end effector embodiment wherein the firing member is at the end of its firing stroke;
(90) FIG. **81**A is an exploded assembly view of an implement drive shaft and bearing segment embodiment;

(91) FIG. **81**B is an exploded assembly view of another implement drive shaft and bearing segment embodiment;
(92) FIG. **82** is an exploded assembly view of a firing member embodiment;
(93) FIG. **83** is a perspective view of the firing member of FIG. **82**;
(94) FIG. **84** is a cross-sectional view of the firing member of FIGS. **82** and **83** installed on a portion of an exemplary implement drive shaft embodiment;
(95) FIG. **85** is an exploded assembly view of another firing member embodiment;
(96) FIG. **86** is a rear perspective view of another firing member embodiment;
(97) FIG. **87** is a front perspective view of the firing member embodiment of FIG. **86**;
(98) FIG. **88** is a perspective view of a firing member, implement drive shaft, wedge sled assembly and alignment portion for a surgical end effector;
(99) FIG. **89** is a side elevational view of the firing member, implement drive shaft, wedge sled assembly and alignment portion of FIG. **88**;
(100) FIG. **90** is a cross-sectional elevational view of the surgical end effector of FIG. **60** in a closed configuration without a staple cartridge installed therein;
(101) FIG. **91** is a bottom view of a surgical end effector having a firing lockout according to various exemplary embodiments of the present disclosure;
(102) FIG. **92** is a perspective view of a portion of the bottom of the surgical end effector of FIG. **91** in a closed and inoperable configuration;
(103) FIG. **93** is a cross-sectional elevational view of the surgical end effector of FIG. **91** in a closed and inoperable configuration;
(104) FIG. **94** is an end elevational view of the surgical end effector of FIG. **91** in an open and inoperable configuration;
(105) FIG. **95** is an end elevational view of the surgical end effector of FIG. **91** in a closed and inoperable configuration;
(106) FIG. **96** is an elevational, cross-sectional view of the surgical end effector of FIG. **91** in a closed and operable configuration having a wedge sled assembly and an alignment portion in a first set of positions therein;
(107) FIG. **97** is another end elevational view of the surgical end effector of FIG. **91** in a closed and operable configuration;
(108) FIG. **98** is an exploded perspective view of a surgical end effector with some components thereof shown in cross section and other components thereof omitted for clarity;
(109) FIG. **99** is a perspective view of the biasing element depicted in FIG. **98**;
(110) FIG. **100** is a perspective view of the end effector drive housing depicted in FIG. **98**;
(111) FIG. **101** is a cross-sectional elevational view of the surgical end effector of FIG. **98** illustrating the biasing element in a second set of positions;
(112) FIG. **102** is a cross-sectional view of a portion of the surgical end effector of FIG. **98** illustrating the implement drive shaft in an inoperable position;
(113) FIG. **103** is a cross-sectional view of a portion of the surgical end effector of FIG. **98** illustrating the biasing element in a first set of positions;
(114) FIG. **104** is a cross-sectional view of a portion of the surgical end effector of FIG. **98** illustrating the biasing element in a first set of positions and the implement drive shaft in an operable position;
(115) FIG. **105** is a cross-sectional perspective view of an end effector for a surgical instrument comprising a drive screw configured to drive a firing member of the end effector;
(116) FIG. **106**A is a side view of a portion of a first drive screw for an end effector comprising a first length, wherein the first drive screw includes a single thread;
(117) FIG. **106**B is a cross-sectional end view of the first drive screw of FIG. **106**A;
(118) FIG. **107**A is a side view of a portion of a second drive screw for an end effector comprising a second length, wherein the second drive screw includes two threads;

(119) FIG. **107**B is a cross-sectional end view of the second drive screw of FIG. **107**A;
(120) FIG. **108**A is a side view of a portion of a third drive screw for an end effector comprising a third length, wherein the third drive screw includes three threads;
(121) FIG. **108**B is a cross-sectional end view of the third drive screw of FIG. **108**A;
(122) FIG. **109**A is a side view of a portion of a fourth drive screw for an end effector comprising a fourth length, wherein the fourth drive screw includes four threads;
(123) FIG. **109**B is a cross-sectional end view of the fourth drive screw of FIG. **109**A;
(124) FIG. **110** is a exploded perspective view of a cutting blade for use with an end effector having a drive screw;
(125) FIG. **111** is a perspective view of a gearing arrangement for transmitting rotation from a drive shaft to a drive screw of an end effector, wherein the gearing arrangement is shown with portions thereof removed for the purposes of illustration;
(126) FIG. **112** is a perspective view of another surgical tool embodiment;
(127) FIG. **112**A is a perspective view of the end effector arrangement of the surgical tool of FIG. **112**;
(128) FIG. **113** is an exploded assembly view of a portion of the elongate shaft assembly and quick disconnect coupler arrangement depicted in FIG. **112**;
(129) FIG. **114** is a perspective view of a portion of the elongate shaft assembly of FIGS. **112** and **113**;
(130) FIG. **115** is an enlarged exploded perspective view of the exemplary quick disconnect coupler arrangement depicted in FIGS. **112-114**;
(131) FIG. **116** is a side elevational view of the quick disconnect coupler arrangement of FIGS. **112-115** with the locking collar thereof in an unlocked position;
(132) FIG. **117** is another side elevational view of the quick disconnect coupler arrangement of FIGS. **112-116** with the locking collar thereof in a locked position;
(133) FIG. **118** is a perspective view of another surgical tool embodiment;
(134) FIG. **119** is another perspective view of the surgical tool embodiment of FIG. **118**;
(135) FIG. **120** is a cross-sectional perspective view of the surgical tool embodiment of FIGS. **118** and **119**;
(136) FIG. **121** is a cross-sectional perspective view of a portion of an articulation system;
(137) FIG. **122** is a cross-sectional view of the articulation system of FIG. **121** in a neutral position;
(138) FIG. **123** is another cross-sectional view of the articulation system of FIGS. **121** and **122** in an articulated position;
(139) FIG. **124** is a side elevational view of a portion of the surgical instrument embodiment of FIGS. **118-120** with portions thereof omitted for clarity;
(140) FIG. **125** is a rear perspective view of a portion of the surgical instrument embodiment of FIGS. **118-120** with portions thereof omitted for clarity;
(141) FIG. **126** is a rear elevational view of a portion of the surgical instrument embodiment of FIGS. **118-120** with portions thereof omitted for clarity;
(142) FIG. **127** is a front perspective view of a portion of the surgical instrument embodiment of FIGS. **118-120** with portions thereof omitted for clarity;
(143) FIG. **128** is a side elevational view of a portion of the surgical instrument embodiment of FIGS. **118-120** with portions thereof omitted for clarity;
(144) FIG. **129** is an exploded assembly view of an exemplary reversing system embodiment of the surgical instrument embodiment of FIGS. **118-120**;
(145) FIG. **130** is a perspective view of a lever arm embodiment of the reversing system of FIG. **129**;
(146) FIG. **131** is a perspective view of a knife retractor button of the reversing system of FIG. **129**;
(147) FIG. **132** is a perspective view of a portion of the surgical instrument embodiment of FIGS.

118-120 with portions thereof omitted for clarity and with the lever arm in actuatable engagement with the reversing gear;
(148) FIG. **133** is a perspective view of a portion of the surgical instrument embodiment of FIGS. **118-120** with portions thereof omitted for clarity and with the lever arm in an unactuated position;
(149) FIG. **134** is another perspective view of a portion of the surgical instrument embodiment of FIGS. **118-120** with portions thereof omitted for clarity and with the lever arm in actuatable engagement with the reversing gear;
(150) FIG. **135** is a side elevational view of a portion of a handle assembly portion of the surgical instrument embodiment of FIGS. **118-20** with the a shifter button assembly moved into a position which will result in the rotation of the end effector when the drive shaft assembly is actuated;
(151) FIG. **136** is another side elevational view of a portion of a handle assembly portion of the surgical instrument embodiment of FIGS. **118-120** with the a shifter button assembly moved into another position which will result in the firing of the firing member in the end effector when the drive shaft assembly is actuated;
(152) FIG. **137** is a cross-sectional view of a portion of another surgical tool embodiment with a lockable articulation joint embodiment;
(153) FIG. **138** is another cross-sectional view of the portion of surgical tool of FIG. **137** articulated in one configuration;
(154) FIG. **139** is another cross-sectional view of the portion of surgical tool of FIGS. **137** and **138** articulated in another configuration;
(155) FIG. **140** is a cross-sectional of an articulation locking system embodiment depicted in FIG. **137** taken along line **140-140** in FIG. **137**;
(156) FIG. **141** is a cross-sectional view of the articulation locking system of FIG. **140** taken along line **141-141** in FIG. **140**;
(157) FIG. **142** is a cross-sectional view of a portion of the surgical tool of FIG. **137** taken along line **142-142** in FIG. **137**;
(158) FIG. **143** illustrates the position of the locking wire when the first and second locking rings are in a clamped or locked configuration when the end effector has been articulated into a first articulation position illustrated in FIG. **138**;
(159) FIG. **144** illustrates a position of the locking wire when the first and second locking rings have been sprung to their respective unclamped or unlocked positions when the end effector has been articulated to the first articulation position illustrated in FIG. **138**;
(160) FIG. **145** illustrates a position of the locking wire when the first and second locking rings are in a clamped or locked configuration when the end effector has been articulated into a second articulation position illustrated in FIG. **139**;
(161) FIG. **146** illustrates the position of the locking wire when the first and second locking rings have been sprung to their respective unclamped or unlocked positions when the end effector has been articulated to the first articulation position illustrated in FIG. **139**;
(162) FIG. **147** is another view of the locking wire when the end effector has been articulated relative to the elongate shaft assembly;
(163) FIG. **148** is a cross-sectional view of another end effector embodiment with the anvil assembly thereof in the closed position;
(164) FIG. **149** is another cross-sectional view of the end effector embodiment of FIG. **148**;
(165) FIG. **150** is another cross-sectional view of the end effector embodiment of FIGS. **148** and **149** with the anvil assembly in the closed position;
(166) FIG. **151** is another cross-sectional view of the end effector embodiment of FIGS. **148-150** illustrating the drive transmission configured to drive the firing member;
(167) FIG. **152** is another cross-sectional view of the end effector embodiment of FIGS. **148-151** with the drive transmission configured to rotate the entire end effector about the longitudinal tool axis;

(168) FIG. **153** is a cross-sectional view of the end effector of FIGS. **148-152** taken along line **153-153** in FIG. **148** with the drive transmission configured to actuate the anvil assembly;
(169) FIG. **154** is a cross-sectional view of the end effector of FIGS. **148-153** taken along line **154-154** in FIG. **148** with the drive transmission configured to fire the firing member;
(170) FIG. **155** is a cross-sectional view of the end effector of FIGS. **148-154** taken along line **155-155** in FIG. **148** with the drive transmission configured to actuate the anvil assembly;
(171) FIG. **156** is a cross-sectional view of the end effector of FIGS. **148-155** taken along line **156-156** in FIG. **148**;
(172) FIG. **157** is a cross-sectional perspective view of another end effector embodiment;
(173) FIG. **158** is a perspective view of an elongate channel of the end effector of FIG. **157**;
(174) FIG. **159** is a perspective view of an anvil spring embodiment;
(175) FIG. **160** is a side cross-sectional view of the end effector of FIG. **157** with the anvil in a closed position after the firing member has been driven to its distal-most position;
(176) FIG. **161** is a cross-sectional view of a portion of the end effector of FIG. **160** taken along line **161-161** in FIG. **160**;
(177) FIG. **162** is another side cross-sectional view of the end effector of FIGS. **157**, **160** and **161** with the firing member being retracted;
(178) FIG. **163** is a cross-sectional view of a portion of the end effector of FIG. **162** taken along line **163-163**;
(179) FIG. **164** is another side cross-sectional view of the end effector of FIGS. **157** and **160-163** with the firing member in its proximal-most position;
(180) FIG. **165** is a cross-sectional view of the end effector of FIGS. **157** and **160-164** taken along line **165-165** in FIG. **164**;
(181) FIG. **166** is another side cross-sectional view of the end effector of FIGS. **157** and **160-165** after the solenoid has pulled the closure tube to its proximal-most position;
(182) FIG. **167** is a cross-sectional view of the end effector of FIGS. **157** and **160-166** taken along line **167-167** in FIG. **166**;
(183) FIG. **168** is another side cross-sectional view of the end effector of FIGS. **157** and **160-167** with the anvil in an open position and the after the solenoid has pulled the closure tube to its proximal-most position;
(184) FIG. **169** is another side cross-sectional view of the end effector of FIGS. **157** and **160-168** after the firing member has moved to its starting position;
(185) FIG. **170** is another side cross-sectional view of the end effector of FIGS. **157** and **160-169** with the anvil assembly closed and the firing member ready to fire;
(186) FIG. **171** is a partial cross-sectional view of another quick disconnect arrangement for coupling a distal shaft portion that may be attached to an end effector to a proximal shaft portion that may be coupled to a tool mounting portion for a robotic system or to a handle assembly;
(187) FIG. **172** is another partial cross-sectional view of the quick disconnect arrangement of FIG. **171**;
(188) FIG. **173** is an end view of the proximal shaft portion of the quick disconnect arrangement of FIGS. **171** and **172**;
(189) FIG. **174** is cross-sectional view of an axially movable lock collar embodiment of the quick disconnect arrangement of FIGS. **171** and **172**;
(190) FIG. **174**A is a perspective view of the lock collar embodiment of FIG. **174**;
(191) FIG. **175** is another cross-sectional view of the quick disconnect arrangement of FIGS. **171** and **172** illustrating the initial coupling of the distal and proximal drive shaft portions;
(192) FIG. **176** is another cross-sectional view of the quick disconnect arrangement of FIGS. **171**, **172** and **175** illustrating the initial coupling of the corresponding articulation cable segments;
(193) FIG. **177** is another cross-sectional view of the quick disconnect arrangement of FIG. **175** after the distal drive shaft portion has been locked to the proximal drive shaft portion; and

(194) FIG. **178** is another cross-sectional view of the quick disconnect arrangement of FIG. **176** after the corresponding articulation cable segments have been locked together.

DETAILED DESCRIPTION

(195) Applicant of the present application also owns the following patent applications that have been filed on Jun. 28, 2012 herewith and which are each herein incorporated by reference in their respective entireties: 1. U.S. patent application Ser. No. 13/536,271, entitled FLEXIBLE DRIVE MEMBER, now U.S. Pat. No. 9,204,879. 2. U.S. patent application Ser. No. 13/536,288, entitled MULTI-FUNCTIONAL POWERED SURGICAL DEVICE WITH EXTERNAL DISSECTION FEATURES, now U.S. Patent Application Publication No. 2014/0005718. 3. U.S. patent application Ser. No. 13/536,277, entitled COUPLING ARRANGEMENTS FOR ATTACHING SURGICAL END EFFECTORS TO DRIVE SYSTEMS THEREFOR, now U.S. Patent Application Publication No. 2014/0001234. 4. U.S. patent application Ser. No. 13/536,295, entitled ROTARY ACTUATABLE CLOSURE ARRANGEMENT FOR SURGICAL END EFFECTOR, now U.S. Pat. No. 9,119,657. 5. U.S. patent application Ser. No. 13/536,326, entitled SURGICAL END EFFECTORS HAVING ANGLED TISSUE-CONTACTING SURFACES, now U.S. Pat. No. 9,289,256. 6. U.S. patent application Ser. No. 13/536,303 entitled INTERCHANGEABLE END EFFECTOR COUPLING ARRANGEMENT, now U.S. Pat. No. 9,028,494. 7. U.S. patent application Ser. No. 13/536,393, entitled SURGICAL END EFFECTOR JAW AND ELECTRODE CONFIGURATIONS, now U.S. Patent Application Publication No. 2014/0005640. 8. U.S. patent application Ser. No. 13/536,362, entitled MULTI-AXIS ARTICULATING AND ROTATING SURGICAL TOOLS, now U.S. Pat. No. 9,125,662. 9. U.S. patent application Ser. No. 13/536,284, entitled DIFFERENTIAL LOCKING ARRANGEMENTS FOR ROTARY POWERED SURGICAL INSTRUMENTS, now U.S. Pat. No. 9,072,536. 10. U.S. patent application Ser. No. 13/536,374, entitled INTERCHANGEABLE CLIP APPLIER, now U.S. Pat. No. 9,561,038. 11. U.S. patent application Ser. No. 13/536,292, entitled FIRING SYSTEM LOCKOUT ARRANGEMENTS FOR SURGICAL INSTRUMENTS, now U.S. Patent Application Publication No. 2014/0001231. 12. U.S. patent application Ser. No. 13/536,301 entitled ROTARY DRIVE SHAFT ASSEMBLIES FOR SURGICAL INSTRUMENTS WITH ARTICULATABLE END EFFECTORS, now U.S. Pat. No. 8,747,238. 13. U.S. patent application Ser. No. 13/536,313, entitled ROTARY DRIVE ARRANGEMENTS FOR SURGICAL INSTRUMENTS, now U.S. Patent Application Publication No. 2014/0005678. 14. U.S. patent application Ser. No. 13/536,379, entitled REPLACEABLE CLIP CARTRIDGE FOR A CLIP APPLIER, now U.S. Pat. No. 9,649,111. 15. U.S. patent application Ser. No. 13/536,386 entitled EMPTY CLIP CARTRIDGE LOCKOUT, now U.S. Pat. No. 9,282,974. 16. U.S. patent application Ser. No. 13/536,360, entitled SURGICAL INSTRUMENT SYSTEM INCLUDING REPLACEABLE END EFFECTORS, now U.S. Pat. No. 9,226,751. 17. U.S. patent application Ser. No. 13/536,335, entitled SURGERY STAPLING INSTRUMENTS WITH ROTARY JOINT ASSEMBLIES, now U.S. Pat. No. 9,364,230. 18. U.S. patent application Ser. No. 13/536,417, entitled ELECTRODE CONNECTIONS FOR ROTARY DRIVEN SURGICAL TOOLS, now U.S. Pat. No. 9,101,385.

(196) Applicant also owns the following patent applications that are each incorporated by reference in their respective entireties: U.S. patent application Ser. No. 13/118,259, entitled SURGICAL INSTRUMENT WITH WIRELESS COMMUNICATION BETWEEN A CONTROL UNIT OF A ROBOTIC SYSTEM AND REMOTE SENSOR, now U.S. Pat. No. 8,684,253. U.S. patent application Ser. No. 13/118,210, entitled ROBOTICALLY-CONTROLLED DISPOSABLE MOTOR DRIVEN LOADING UNIT, now U.S. Pat. No. 8,752,749. U.S. patent application Ser. No. 13/118,194, entitled ROBOTICALLY-CONTROLLED ENDOSCOPIC ACCESSORY CHANNEL, now U.S. Pat. No. 8,992,422. U.S. patent application Ser. No. 13/118,253, entitled ROBOTICALLY-CONTROLLED MOTORIZED SURGICAL INSTRUMENT, now U.S. Pat. No. 9,386,983. U.S. patent application Ser. No. 13/118,278, entitled ROBOTICALLY-CONTROLLED SURGICAL STAPLING DEVICES THAT PRODUCE FORMED STAPLES HAVING

DIFFERENT LENGTHS, now U.S. Pat. No. 9,237,891. U.S. patent application Ser. No. 13/118,190, entitled ROBOTICALLY-CONTROLLED MOTORIZED CUTTING AND FASTENING INSTRUMENT, now U.S. Pat. No. 9,179,912. U.S. patent application Ser. No. 13/118,223, entitled ROBOTICALLY-CONTROLLED SHAFT BASED ROTARY DRIVE SYSTEMS FOR SURGICAL INSTRUMENTS, now U.S. Pat. No. 8,931,682. U.S. patent application Ser. No. 13/118,263, entitled ROBOTICALLY-CONTROLLED SURGICAL INSTRUMENT HAVING RECORDING CAPABILITIES, now U.S. Patent Application Publication No. 2011-0295295. U.S. patent application Ser. No. 13/118,272, entitled ROBOTICALLY-CONTROLLED SURGICAL INSTRUMENT WITH FORCE FEEDBACK CAPABILITIES, now U.S. Patent Application Publication No. 2011-0290856. U.S. patent application Ser. No. 13/118,246, entitled ROBOTICALLY-DRIVEN SURGICAL INSTRUMENT WITH E-BEAM DRIVER, U.S. Pat. No. 9,060,770. U.S. patent application Ser. No. 13/118,241, entitled SURGICAL STAPLING INSTRUMENTS WITH ROTATABLE STAPLE DEPLOYMENT ARRANGEMENTS, now U.S. Pat. No. 9,072,535.

(197) Certain exemplary embodiments will now be described to provide an overall understanding of the principles of the structure, function, manufacture, and use of the devices and methods disclosed herein. One or more examples of these exemplary embodiments are illustrated in the accompanying drawings. Those of ordinary skill in the art will understand that the devices and methods specifically described herein and illustrated in the accompanying drawings are non-limiting exemplary embodiments and that the scope of the various exemplary embodiments of the present invention is defined solely by the claims. The features illustrated or described in connection with one exemplary embodiment may be combined with the features of other exemplary embodiments. Such modifications and variations are intended to be included within the scope of the present invention.

(198) FIG. **1** depicts a master controller **12** that is used in connection with a robotic arm slave cart **20** of the type depicted in FIG. **2**. Master controller **12** and robotic arm slave cart **20**, as well as their respective components and control systems are collectively referred to herein as a robotic system **10**. Examples of such systems and devices are disclosed in U.S. Pat. No. 7,524,320 which has been herein incorporated by reference. Thus, various details of such devices will not be described in detail herein beyond that which may be necessary to understand various exemplary embodiments disclosed herein. As is known, the master controller **12** generally includes master controllers (generally represented as **14** in FIG. **1**) which are grasped by the surgeon and manipulated in space while the surgeon views the procedure via a stereo display **16**. The master controllers **12** generally comprise manual input devices which preferably move with multiple degrees of freedom, and which often further have an actuatable handle for actuating tools (for example, for closing grasping jaws, applying an electrical potential to an electrode, or the like).

(199) As can be seen in FIG. **2**, the robotic arm cart **20** is configured to actuate a plurality of surgical tools, generally designated as **30**. Various robotic surgery systems and methods employing master controller and robotic arm cart arrangements are disclosed in U.S. Pat. No. 6,132,368, entitled MULTI-COMPONENT TELEPRESENCE SYSTEM AND METHOD, the full disclosure of which is incorporated herein by reference. As shown, the robotic arm cart **20** includes a base **22** from which, in the illustrated embodiment, three surgical tools **30** are supported. The surgical tools **30** are each supported by a series of manually articulatable linkages, generally referred to as set-up joints **32**, and a robotic manipulator **34**. These structures are herein illustrated with protective covers extending over much of the robotic linkage. These protective covers may be optional, and may be limited in size or entirely eliminated to minimize the inertia that is encountered by the servo mechanisms used to manipulate such devices, to limit the volume of moving components so as to avoid collisions, and to limit the overall weight of the cart **20**. The cart **20** generally has dimensions suitable for transporting the cart **20** between operating rooms. The cart **20** is configured to typically fit through standard operating room doors and onto standard hospital elevators. The

cart **20** would preferably have a weight and include a wheel (or other transportation) system that allows the cart **20** to be positioned adjacent an operating table by a single attendant.

(200) Referring now to FIG. **3**, robotic manipulators **34** as shown include a linkage **38** that constrains movement of the surgical tool **30**. Linkage **38** includes rigid links coupled together by rotational joints in a parallelogram arrangement so that the surgical tool **30** rotates around a point in space **40**, as more fully described in U.S. Pat. No. 5,817,084, the full disclosure of which is herein incorporated by reference. The parallelogram arrangement constrains rotation to pivoting about an axis **40***a*, sometimes called the pitch axis. The links supporting the parallelogram linkage are pivotally mounted to set-up joints **32** (FIG. **2**) so that the surgical tool **30** further rotates about an axis **40***b*, sometimes called the yaw axis. The pitch and yaw axes **40***a*, **40***b* intersect at the remote center **42**, which is aligned along a shaft **44** of the surgical tool **30**. The surgical tool **30** may have further degrees of driven freedom as supported by manipulator **50**, including sliding motion of the surgical tool **30** along the longitudinal tool axis “LT-LT”. As the surgical tool **30** slides along the tool axis LT-LT relative to manipulator **50** (arrow **40***c*), remote center **42** remains fixed relative to base **52** of manipulator **50**. Hence, the entire manipulator is generally moved to re-position remote center **42**. Linkage **54** of manipulator **50** is driven by a series of motors **56**. These motors actively move linkage **54** in response to commands from a processor of a control system. Motors **56** are also employed to manipulate the surgical tool **30**. An alternative set-up joint structure is illustrated in FIG. **4**. In this embodiment, a surgical tool **30** is supported by an alternative manipulator structure **50′** between two tissue manipulation tools.

(201) Other embodiments may incorporate a wide variety of alternative robotic structures, including those described in U.S. Pat. No. 5,878,193, entitled AUTOMATED ENDOSCOPE SYSTEM FOR OPTIMAL POSITIONING, the full disclosure of which is incorporated herein by reference. Additionally, while the data communication between a robotic component and the processor of the robotic surgical system is described with reference to communication between the surgical tool **30** and the master controller **12**, similar communication may take place between circuitry of a manipulator, a set-up joint, an endoscope or other image capture device, or the like, and the processor of the robotic surgical system for component compatibility verification, component-type identification, component calibration (such as off-set or the like) communication, confirmation of coupling of the component to the robotic surgical system, or the like.

(202) A surgical tool **100** that is well-adapted for use with a robotic system **10** is depicted in FIG. **5**. As can be seen in that Figure, the surgical tool **100** includes a surgical end effector **1000** that comprises an endocutter. The surgical tool **100** generally includes an elongate shaft assembly **200** that is operably coupled to the manipulator **50** by a tool mounting portion, generally designated as **300**. The surgical tool **100** further includes an interface **302** which mechanically and electrically couples the tool mounting portion **300** to the manipulator. One interface **302** is illustrated in FIGS. **6-10**. In the embodiment depicted in FIGS. **6-10**, the tool mounting portion **300** includes a tool mounting plate **304** that operably supports a plurality of (four are shown in FIG. **10**) rotatable body portions, driven discs or elements **306**, that each include a pair of pins **308** that extend from a surface of the driven element **306**. One pin **308** is closer to an axis of rotation of each driven elements **306** than the other pin **308** on the same driven element **306**, which helps to ensure positive angular alignment of the driven element **306**. Interface **302** may include an adaptor portion **310** that is configured to mountingly engage a mounting plate **304** as will be further discussed below. The illustrated adaptor portion **310** includes an array of electrical connecting pins **312** (FIG. **8**) which may be coupled to a memory structure by a circuit board within the tool mounting portion **300**. While interface **302** is described herein with reference to mechanical, electrical, and magnetic coupling elements, it should be understood that a wide variety of telemetry modalities might be used, including infrared, inductive coupling, or the like in other embodiments.

(203) As can be seen in FIGS. **6-9**, the adapter portion **310** generally includes a tool side **314** and a holder side **316**. A plurality of rotatable bodies **320** are mounted to a floating plate **318** which has a

limited range of movement relative to the surrounding adaptor structure normal to the major surfaces of the adaptor **310**. Axial movement of the floating plate **318** helps decouple the rotatable bodies **320** from the tool mounting portion **300** when levers or other latch formations along the sides of the tool mounting portion housing (not shown) are actuated. Other embodiments may employ other mechanisms/arrangements for releasably coupling the tool mounting portion **300** to the adaptor **310**. In the embodiment of FIGS. **6-10**, rotatable bodies **320** are resiliently mounted to floating plate **318** by resilient radial members which extend into a circumferential indentation about the rotatable bodies **320**. The rotatable bodies **320** can move axially relative to plate **318** by deflection of these resilient structures. When disposed in a first axial position (toward tool side **314**) the rotatable bodies **320** are free to rotate without angular limitation. However, as the rotatable bodies **320** move axially toward tool side **314**, tabs **322** (extending radially from the rotatable bodies **320**) laterally engage detents on the floating plates so as to limit angular rotation of the rotatable bodies **320** about their axes. This limited rotation can be used to help drivingly engage the rotatable bodies **320** with drive pins **332** of a corresponding tool holder portion **330** of the robotic system **10**, as the drive pins **332** will push the rotatable bodies **320** into the limited rotation position until the pins **332** are aligned with (and slide into) openings **334′**. Openings **334** on the tool side **314** and openings **334′** on the holder side **316** of rotatable bodies **320** are configured to accurately align the driven elements **306** (FIG. **10**) of the tool mounting portion **300** with the drive elements **336** of the tool holder **330**. As described above regarding inner and outer pins **308** of driven elements **306**, the openings **334**, **334′** are at differing distances from the axis of rotation on their respective rotatable bodies **306** so as to ensure that the alignment is not 180 degrees from its intended position. Additionally, each of the openings **334** may be slightly radially elongate so as to fittingly receive the pins **308** in the circumferential orientation. This allows the pins **308** to slide radially within the openings **334** and accommodate some axial misalignment between the tool **100** and tool holder **330**, while minimizing any angular misalignment and backlash between the drive and driven elements. Openings **334** on the tool side **314** may be offset by about 90 degrees from the openings **334′** (shown in broken lines) on the holder side **316**, as can be seen most clearly in FIG. **9**.

(204) In the embodiment of FIGS. **6-10**, an array of electrical connector pins **340** are located on holder side **316** of adaptor **310** and the tool side **314** of the adaptor **310** includes slots **342** (FIG. **9**) for receiving a pin array (not shown) from the tool mounting portion **300**. In addition to transmitting electrical signals between the surgical tool **100** and the tool holder **330**, at least some of these electrical connections may be coupled to an adaptor memory device **344** (FIG. **8**) by a circuit board of the adaptor **310**.

(205) In the embodiment of FIGS. **6-10**, a detachable latch arrangement **346** is employed to releasably affix the adaptor **310** to the tool holder **330**. As used herein, the term “tool drive assembly” when used in the context of the robotic system **10**, at least encompasses the adapter **310** and tool holder **330** and which have been collectively generally designated as **110** in FIG. **6**. As can be seen in FIG. **6**, the tool holder **330** includes a first latch pin arrangement **337** that is sized to be received in corresponding clevis slots **311** provided in the adaptor **310**. In addition, the tool holder **330** further has second latch pins **338** that are sized to be retained in corresponding latch clevises **313** in the adaptor **310**. See FIG. **8**. A latch assembly **315** is movably supported on the adapter **310** and has a pair of latch clevises **317** formed therein that is biasable from a first latched position wherein the latch pins **338** are retained within their respective latch clevis **313** and an unlatched position wherein the clevises **317** are aligned with clevises **313** to enable the second latch pins **338** may be inserted into or removed from the latch clevises **313**. A spring or springs (not shown) are employed to bias the latch assembly into the latched position. A lip on the tool side **314** of adaptor **310** slidably receives laterally extending tabs of the tool mounting housing (not shown).

(206) Referring now to FIGS. **5** and **11-16**, the tool mounting portion **300** operably supports a plurality of drive systems for generating various forms of control motions necessary to operate a

particular type of end effector that is coupled to the distal end of the elongate shaft assembly **200**. As shown in FIGS. **5** and **11-13**, the tool mounting portion **300** includes a first drive system generally designated as **350** that is configured to receive a corresponding "first" rotary output motion from the tool drive assembly **110** of the robotic system **10** and convert that first rotary output motion to a first rotary control motion to be applied to the surgical end effector. In the illustrated embodiment, the first rotary control motion is employed to rotate the elongate shaft assembly **200** (and surgical end effector **1000**) about a longitudinal tool axis LT-LT.

(207) In the embodiment of FIGS. **5** and **11-13**, the first drive system **350** includes a tube gear segment **354** that is formed on (or attached to) the proximal end **208** of a proximal closure tube segment **202** of the elongate shaft assembly **200**. The proximal end **208** of the proximal tube segment **202** is rotatably supported on the tool mounting plate **304** of the tool mounting portion **300** by a forward support cradle **352** that is mounted on the tool mounting plate **304**. See FIG. **11**. The tube gear segment **354** is supported in meshing engagement with a first rotational gear assembly **360** that is operably supported on the tool mounting plate **304**. As can be seen in FIG. **11**, the rotational gear assembly **360** comprises a first rotation drive gear **362** that is coupled to a corresponding first one of the driven discs or elements **306** on the holder side **316** of the tool mounting plate **304** when the tool mounting portion **300** is coupled to the tool drive assembly **110**. See FIG. **10**. The rotational gear assembly **360** further comprises a first rotary driven gear **364** that is rotatably supported on the tool mounting plate **304**. The first rotary driven gear **364** is in meshing engagement with a second rotary driven gear **366** which, in turn, is in meshing engagement with the tube gear segment **354**. Application of a first rotary output motion from the tool drive assembly **110** of the robotic system **10** to the corresponding driven element **306** will thereby cause rotation of the rotation drive gear **362**. Rotation of the rotation drive gear **362** ultimately results in the rotation of the elongate shaft assembly **200** (and the surgical end effector **1000**) about the longitudinal tool axis LT-LT (represented by arrow "R" in FIG. **5**). It will be appreciated that the application of a rotary output motion from the tool drive assembly **110** in one direction will result in the rotation of the elongate shaft assembly **200** and surgical end effector **1000** about the longitudinal tool axis LT-LT in a first rotary direction and an application of the rotary output motion in an opposite direction will result in the rotation of the elongate shaft assembly **200** and surgical end effector **1000** in a second rotary direction that is opposite to the first rotary direction.

(208) In embodiment of FIGS. **5** and **11-16**, the tool mounting portion **300** further includes a second drive system generally designated as **370** that is configured to receive a corresponding "second" rotary output motion from the tool drive assembly **110** of the robotic system **10** and convert that second rotary output motion to a second rotary control motion for application to the surgical end effector. The second drive system **370** includes a second rotation drive gear **372** that is coupled to a corresponding second one of the driven discs or elements **306** on the holder side **316** of the tool mounting plate **304** when the tool mounting portion **300** is coupled to the tool drive assembly **110**. See FIG. **10**. The second drive system **370** further comprises a first rotary driven gear **374** that is rotatably supported on the tool mounting plate **304**. The first rotary driven gear **374** is in meshing engagement with a shaft gear **376** that is movably and non-rotatably mounted onto a proximal drive shaft segment, or movable element, **380**. In this illustrated embodiment, the shaft gear **376** is non-rotatably mounted onto the proximal drive shaft segment **380** by a series of axial keyways **384** that enable the shaft gear **376** to axially move on the proximal drive shaft segment **380** while being non-rotatably affixed thereto. Rotation of the proximal drive shaft segment **380** results in the transmission of a second rotary control motion to the surgical end effector **1000**.

(209) The second drive system **370** in the embodiment of FIGS. **5** and **11-16** includes a shifting system **390** for selectively axially shifting the proximal drive shaft segment **380** which moves the shaft gear **376** into and out of meshing engagement with the first rotary driven gear **374**. For example, as can be seen in FIGS. **11-13**, the proximal drive shaft segment **380** is supported within a second support cradle **382** that is attached to the tool mounting plate **304** such that the proximal

drive shaft segment **380** may move axially and rotate relative to the second support cradle **382**. In at least one form, the shifting system **390** further includes a shifter yoke **392** that is slidably supported on the tool mounting plate **304**. The proximal drive shaft segment **380** is supported in the shifter yoke **392** and has a pair of collars **386** thereon such that shifting of the shifter yoke **392** on the tool mounting plate **304** results in the axial movement of the proximal drive shaft segment, or movable element, **380**. In at least one form, the shifting system **390** further includes a shifter solenoid **394** that operably interfaces with the shifter yoke **392**. The shifter solenoid **394** receives control power from the robotic controller **12** such that when the shifter solenoid **394** is activated, the shifter yoke **392** is moved in the distal direction "DD".

(210) In this illustrated embodiment, a shaft spring, or rotational resistance member, **396** is journaled on the proximal drive shaft segment **380** between the shaft gear **376** and the second support cradle **382** to bias the shaft gear **376** in the proximal direction "PD" and into meshing engagement with the first rotary driven gear **374**. See FIGS. **11**, **13** and **14**. Rotation of the second rotation drive gear **372** in response to rotary output motions generated by the robotic system **10** ultimately results in the rotation of the proximal drive shaft segment **380** and other drive shaft components coupled thereto (drive shaft assembly **388**) about the longitudinal tool axis LT-LT. It will be appreciated that the application of a rotary output motion from the tool drive assembly **110** in one direction will result in the rotation of the proximal drive shaft segment **380** and ultimately of the other drive shaft components attached thereto in a first direction and an application of the rotary output motion in an opposite direction will result in the rotation of the proximal drive shaft segment **380** in a second direction that is opposite to the first direction. When it is desirable to shift the proximal drive shaft segment **380** in the distal direction "DD" as will be discussed in further detail below, the robotic controller **12** activates the shifter solenoid **390** to shift the shifter yoke **392** in the distal direction "DD".

(211) FIGS. **17** and **18** illustrate another embodiment that employs the same components of the embodiment depicted in FIGS. **5** and **11-16** except that this embodiment employs a battery-powered drive motor **400** for supplying rotary drive motions to the proximal drive shaft segment **380**. Such arrangement enables the tool mounting portion to generate higher rotary output motions and torque which may be advantageous when different forms of end effectors are employed. As can be seen in those Figures, the motor **400** is attached to the tool mounting plate **304** by a support structure **402** such that a driver gear **404** that is coupled to the motor **400** is retained in meshing engagement with the shaft gear **376**. In the embodiment of FIGS. **17** and **18**, the support structure **402** is configured to removably engage latch notches **303** formed in the tool mounting plate **304** that are designed to facilitate attachment of a housing member (not shown) to the mounting plate **304** when the motor **400** is not employed. Thus, to employ the motor **400**, the clinician removes the housing from the tool mounting plate **304** and then inserts the legs **403** of the support structure into the latch notches **303** in the tool mounting plate **304**. The proximal drive shaft segment **380** and the other drive shaft components attached thereto are rotated about the longitudinal tool axis LT-LT by powering the motor **400**. As illustrated, the motor **400** is battery powered. In such arrangement, however, the motor **400** interface with the robotic controller **12** such that the robotic system **10** controls the activation of the motor **400**. In alternative embodiments, the motor **400** is manually actuatable by an on/off switch (not shown) mounted on the motor **400** itself or on the tool mounting portion **300**. In still other embodiments, the motor **400** may receive power and control signals from the robotic system.

(212) The embodiment illustrated in FIGS. **5** and **11-16** includes a manually-actuatable reversing system, generally designated as **410**, for manually applying a reverse rotary motion to the proximal drive shaft segment **380** in the event that the motor fails or power to the robotic system is lost or interrupted. Such manually-actuatable reversing system **410** may also be particularly useful, for example, when the drive shaft assembly **388** becomes jammed or otherwise bound in such a way that would prevent reverse rotation of the drive shaft components under the motor power alone. In

the illustrated embodiment, the mechanically-actuatable reversing system **410** includes a drive gear assembly **412** that is selectively engageable with the second rotary driven gear **376** and is manually actuatable to apply a reversing rotary motion to the proximal drive shaft segment **380**. The drive gear assembly **412** includes a reversing gear **414** that is movably mounted to the tool mounting plate **304**. The reversing gear **414** is rotatably journaled on a pivot shaft **416** that is movably mounted to the tool mounting plate **304** through a slot **418**. See FIG. **12**. In the embodiment of FIGS. **5** and **11-16**, the manually-actuatable reversing system **410** further includes a manually actuatable drive gear **420** that includes a body portion **422** that has an arcuate gear segment, or coupling member, **424** formed thereon. The body portion **422** is pivotally coupled to the tool mounting plate **304** for selective pivotal travel about an actuator axis A-A (FIG. **11**) that is substantially normal to the tool mounting plate **304**.
(213) FIGS. **11-14** depict the manually-actuatable reversing system **410** in a first unactuated position. In one exemplary form, an actuator handle portion, or manual rotational input, **426** is formed on or otherwise attached to the body portion **422**. The actuator handle portion **426** is sized relative to the tool mounting plate **304** such that a small amount of interference is established between the handle portion **426** and the tool mounting plate **304** to retain the handle portion **426** in the first unactuated position. However, when the clinician desires to manually actuate the drive gear assembly **412**, the clinician can easily overcome the interference fit by applying a pivoting motion to the handle portion **426**. As can also be seen in FIGS. **11-14**, when the drive gear assembly **412** is in the first unactuated position, the arcuate gear segment **424** is out of meshing engagement with the reversing gear **414**. When the clinician desires to apply a reverse rotary drive motion to the proximal drive shaft segment **380**, the clinician begins to apply a pivotal ratcheting motion to drive gear **420**. As the drive gear **420** begins to pivot about the actuation axis A-A, a portion of the body **422** contacts a portion of the reversing gear **414** and axially moves the reversing gear **414** in the distal direction DD taking the drive shaft gear **376** out of meshing engagement with the first rotary driven gear **374** of the second drive system **370**. See FIG. **15**. As the drive gear **420** is pivoted, the arcuate gear segment **424** is brought into meshing engagement with the reversing gear **414**. Continued ratcheting of the drive gear **420** results in the application of a reverse rotary drive motion to the drive shaft gear **376** and ultimately to the proximal drive shaft segment **380**. The clinician may continue to ratchet the drive gear assembly **412** for as many times as are necessary to fully release or reverse the associated end effector component(s). Once a desired amount of reverse rotary motion has been applied to the proximal drive shaft segment **380**, the clinician returns the drive gear **420** to the starting or unactuated position wherein the arcuate gear segment **416** is out of meshing engagement with the drive shaft gear **376**. When in that position, the shaft spring **396** once again biases the shaft gear **376** into meshing engagement with first rotary driven gear **374** of the second drive system **370**.
(214) In use, the clinician may input control commands to the controller or control unit of the robotic system **10** which “robotically-generates” output motions that are ultimately transferred to the various components of the second drive system **370**. As used herein, the terms “robotically-generates” or “robotically-generated” refer to motions that are created by powering and controlling the robotic system motors and other powered drive components. These terms are distinguishable from the terms “manually-actuatable” or “manually generated” which refer to actions taken by the clinician which result in control motions that are generated independent from those motions that are generated by powering the robotic system motors. Application of robotically-generated control motions to the second drive system in a first direction results in the application of a first rotary drive motion to the drive shaft assembly **388**. When the drive shaft assembly **388** is rotated in a first rotary direction, the firing member **1200** is driven in the distal direction “DD” from its starting position toward its ending position in the end effector **1000**. Application of robotically-generated control motions to the second drive system in a second direction results in the application of a second rotary drive motion to the drive shaft assembly **388**. When the drive shaft assembly **388** is

rotated in a second rotary direction, the firing member **1200** is driven in the proximal direction "PD" from its ending position toward its starting position in the end effector **1000**. When the clinician desires to manually-apply rotary control motion to the drive shaft assembly **388**, the drive shaft assembly **388** is rotated in the second rotary direction which causes the firing member **1200** to move in the proximal direction "PD" in the end effector. Other embodiments containing the same components are configured such that the manual-application of a rotary control motion to the drive shaft assembly could cause the drive shaft assembly to rotate in the first rotary direction which could be used to assist the robotically-generated control motions to drive the firing member **1200** in the distal direction.

(215) The drive shaft assembly that is used to fire, close and rotate the end effector can be actuated and shifted manually allowing the end effector to release and be extracted from the surgical site as well as the abdomen even in the event that the motor(s) fail, the robotic system loses power or other electronic failure occurs. Actuation of the handle portion **426** results in the manual generation of actuation or control forces that are applied to the drive shaft assembly **388**′ by the various components of the manually-actuatable reversing system **410**. If the handle portion **426** is in its unactuated state, it is biased out of actuatable engagement with the reversing gear **414**. The beginning of the actuation of the handle portion **426** shifts the bias. The handle **426** is configured for repeated actuation for as many times as are necessary to fully release the firing member **1200** and the end effector **1000**.

(216) As illustrated in FIGS. **5** and **11-16**, the tool mounting portion **300** includes a third drive system **430** that is configured to receive a corresponding "third" rotary output motion from the tool drive assembly **110** of the robotic system **10** and convert that third rotary output motion to a third rotary control motion. The third drive system **430** includes a third drive pulley **432** that is coupled to a corresponding third one of the driven discs or elements **306** on the holder side **316** of the tool mounting plate **304** when the tool mounting portion **300** is coupled to the tool drive assembly **110**. See FIG. **10**. The third drive pulley **432** is configured to apply a third rotary control motion (in response to corresponding rotary output motions applied thereto by the robotic system **10**) to a corresponding third drive cable **434** that may be used to apply various control or manipulation motions to the end effector that is operably coupled to the shaft assembly **200**. As can be most particularly seen in FIGS. **11** and **12**, the third drive cable **434** extends around a third drive spindle assembly **436**. The third drive spindle assembly **436** is pivotally mounted to the tool mounting plate **304** and a third tension spring **438** is attached between the third drive spindle assembly **436** and the tool mounting plate **304** to maintain a desired amount of tension in the third drive cable **434**. As can be seen in the Figures, cable end portion **434**A of the third drive cable **434** extends around an upper portion of a pulley block **440** that is attached to the tool mounting plate **304** and cable end portion **434**B extends around a sheave pulley or standoff **442** on the pulley block **440**. It will be appreciated that the application of a third rotary output motion from the tool drive assembly **110** in one direction will result in the rotation of the third drive pulley **432** in a first direction and cause the cable end portions **434**A and **434**B to move in opposite directions to apply control motions to the end effector **1000** or elongate shaft assembly **200** as will be discussed in further detail below. That is, when the third drive pulley **432** is rotated in a first rotary direction, the cable end portion **434**A moves in a distal direction "DD" and cable end portion **434**B moves in a proximal direction "PD". Rotation of the third drive pulley **432** in an opposite rotary direction result in the cable end portion **434**A moving in a proximal direction "PD" and cable end portion **434**B moving in a distal direction "DD".

(217) The tool mounting portion **300** illustrated in FIGS. **5** and **11-16** includes a fourth drive system **450** that is configured to receive a corresponding "fourth" rotary output motion from the tool drive assembly **110** of the robotic system **10** and convert that fourth rotary output motion to a fourth rotary control motion. The fourth drive system **450** includes a fourth drive pulley **452** that is coupled to a corresponding fourth one of the driven discs or elements **306** on the holder side **316** of

the tool mounting plate **304** when the tool mounting portion **300** is coupled to the tool drive assembly **110**. See FIG. **10**. The fourth drive pulley **452** is configured to apply a fourth rotary control motion (in response to corresponding rotary output motions applied thereto by the robotic system **10**) to a corresponding fourth drive cable **454** that may be used to apply various control or manipulation motions to the end effector that is operably coupled to the shaft assembly **200**. As can be most particularly seen in FIGS. **11** and **12**, the fourth drive cable **454** extends around a fourth drive spindle assembly **456**. The fourth drive spindle assembly **456** is pivotally mounted to the tool mounting plate **304** and a fourth tension spring **458** is attached between the fourth drive spindle assembly **456** and the tool mounting plate **304** to maintain a desired amount of tension in the fourth drive cable **454**. Cable end portion **454**A of the fourth drive cable **454** extends around a bottom portion of the pulley block **440** that is attached to the tool mounting plate **304** and cable end portion **454**B extends around a sheave pulley or fourth standoff **462** on the pulley block **440**. It will be appreciated that the application of a rotary output motion from the tool drive assembly **110** in one direction will result in the rotation of the fourth drive pulley **452** in a first direction and cause the cable end portions **454**A and **454**B to move in opposite directions to apply control motions to the end effector or elongate shaft assembly **200** as will be discussed in further detail below. That is, when the fourth drive pulley **434** is rotated in a first rotary direction, the cable end portion **454**A moves in a distal direction “DD” and cable end portion **454**B moves in a proximal direction “PD”. Rotation of the fourth drive pulley **452** in an opposite rotary direction result in the cable end portion **454**A moving in a proximal direction “PD” and cable end portion **454**B to move in a distal direction “DD”.

(218) The surgical tool **100** as depicted in FIG. **5** includes an articulation joint **700**. In such embodiment, the third drive system **430** may also be referred to as a “first articulation drive system” and the fourth drive system **450** may be referred to herein as a “second articulation drive system”. Likewise, the third drive cable **434** may be referred to as a “first proximal articulation cable” and the fourth drive cable **454** may be referred to herein as a “second proximal articulation cable”.

(219) The tool mounting portion **300** of the embodiment illustrated in FIGS. **5** and **11-16** includes a fifth drive system generally designated as **470** that is configured to axially displace a drive rod assembly **490**. The drive rod assembly **490** includes a proximal drive rod segment **492** that extends through the proximal drive shaft segment **380** and the drive shaft assembly **388**. See FIG. **13**. The fifth drive system **470** includes a movable drive yoke **472** that is slidably supported on the tool mounting plate **304**. The proximal drive rod segment **492** is supported in the drive yoke **472** and has a pair of retainer balls **394** thereon such that shifting of the drive yoke **472** on the tool mounting plate **304** results in the axial movement of the proximal drive rod segment **492**. In at least one exemplary form, the fifth drive system **470** further includes a drive solenoid **474** that operably interfaces with the drive yoke **472**. The drive solenoid **474** receives control power from the robotic controller **12**. Actuation of the drive solenoid **474** in a first direction will cause the drive rod assembly **490** to move in the distal direction “DD” and actuation of the drive solenoid **474** in a second direction will cause the drive rod assembly **490** to move in the proximal direction “PD”. As can be seen in FIG. **5**, the end effector **1000** includes an anvil portion that is movable between open and closed positions upon application of axial closure motions to a closure system. In the illustrated embodiment of FIGS. **5** and **11-16**, the fifth drive system **470** is employed to generate such closure motions. Thus, the fifth drive system **470** may also be referred to as a “closure drive”.

(220) The embodiment depicted in FIG. **5**, includes a surgical end effector **1000** that is attached to the tool mounting portion **300** by the elongate shaft assembly **200**. In that illustrated embodiment, the elongate shaft assembly includes a coupling arrangement in the form of a quick disconnect arrangement or joint **210** that facilitates quick attachment of a distal portion **230** of the shaft assembly **200** to a proximal shaft portion **201** of the shaft assembly **200**. The quick disconnect joint **210** serves to facilitate the quick attachment and detachment of a plurality of drive train

components used to provide control motions from a source of drive motions to an end effector that is operably coupled thereto. In the embodiment illustrated in FIGS. **5** and **19**, for example, the quick disconnect joint **210** is employed to couple a distal shaft portion **230** of end effector **1000** to a proximal shaft portion **201**.

(221) Referring now to FIGS. **19-23**, the coupling arrangement or quick disconnect joint **210** includes a proximal coupler member **212** that is configured to operably support proximal drive train assemblies and a distal coupler member **232** that is configured to operably support at least one and preferably a plurality of distal drive train assemblies. In the embodiment of FIGS. **5** and **19**, the third drive system **430** (i.e., a first articulation drive system) and the fourth drive system **450** (i.e., a second articulation drive system) are employed to apply articulation motions to the articulation joint **700**. For example, the third drive system **430** serves to apply control motions to the first proximal articulation cable **434** that has cable end portions **434**A, **434**B to articulate the end effector **1000** in first and second articulation directions about the articulation joint **700**. Likewise, the fourth drive system **450** serves to apply control motions to the second proximal articulation cable **454** that has cable end portions **454**A, **454**B to articulate the end effector **1000** in the third and fourth articulation directions.

(222) Referring to FIG. **20**, the proximal coupler member **212** has a first pair of diametrically-opposed first slots **214** therein and a second pair of diametrically-opposed second slots **218** therein (only one slot **218** can be seen in FIG. **20**). A first proximal articulation formation or link **222** is supported in each of the opposed first slots **214**. A second proximal articulation formation or link **226** is supported in each of the second slots **218**. The cable end portion **434**A extends through a slot in one of the proximal articulation links **222** and is attached thereto. Likewise, the cable end portion **434**B extends through a slot in the other proximal articulation link **222** and is attached thereto. Cable end portion **434**A and its corresponding proximal articulation formation or link **222** and cable end portion **434**B and its corresponding proximal articulation formation or link **222** are collectively referred to as a “first proximal articulation drive train assembly” **217**. The end cable portion **454**A extends through a slot in one of the proximal articulation links **226** and is attached thereto. The cable end portion **454**B extends through a slot in the other proximal articulation link **226** and is attached thereto. Cable end portion **454**A and its corresponding proximal articulation formation or link **226** and the cable end portion **454**B and its corresponding proximal articulation formation or link **226** are collectively referred to as a “second proximal articulation drive train assembly” **221**.

(223) As can be seen in FIG. **21**, the distal shaft portion **230** includes a distal outer tube portion **231** that supports the distal coupler member **232**. The distal coupler member **232** has a first pair of diametrically opposed first slots **234** therein and a second pair of diametrically opposed second slots **238** therein. See FIG. **20**. A first pair of distal articulation formations or links **242** are supported in the opposed first slots **234**. A second pair of distal articulation formations or links **246** are supported in the second pair of slots **238**. A first distal cable segment **444** extends through one of the first slots **234** and a slot in one of the distal articulation links **242** to be attached thereto. A primary distal cable segment **445** extends through the other one of the first slots **234** and through a slot in the other distal articulation link **242** and to be attached thereto. The first distal cable segment **444** and its corresponding distal articulation link **242** and the primary distal cable segment **445** and its corresponding distal articulation link **242** are collectively referred to as a “first distal articulation drive train assembly” **237**. A second distal cable segment **446** extends through one of the second slots **238** and a slot in one of the distal articulation links **246** and to be attached thereto. A secondary distal cable segment **447** extends through the other second slot **238** and through a slot in the other distal articulation link **246** to be attached thereto. The second distal cable segment **446** and its corresponding distal articulation link **246** and the secondary distal cable segment **447** and its corresponding distal articulation link **246** are collectively referred to as a “second distal articulation drive train assembly” **241**.

(224) Each of the proximal articulation links **222** has a toothed end **224** formed on a spring portion **223** thereof. Each proximal articulation link **226** has a toothed end **227′** formed on a spring arm portion **227**. Each distal articulation link **242** has a toothed end **243** that is configured to be meshingly coupled with the toothed end **224** of a corresponding one of the proximal articulation links **222**. Each distal articulation link **246** has a toothed end **247** that is configured to be meshingly coupled with the toothed end **228** of a corresponding proximal articulation link **226**. When the proximal articulation formations or links **222**, **226** are meshingly linked with the distal articulation links **242**, **246**, respectively, the first and second proximal articulation drive train assemblies **217** and **221** are operably coupled to the first and second distal articulation drive train assemblies **237** and **241**, respectively. Thus, actuation of the third and fourth drive systems **430**, **450** will apply actuation motions to the distal cable segments **444**, **445**, **446**, **447** as will be discussed in further detail below.
(225) In the embodiment of FIGS. **19-23**, a distal end **250** of proximal outer tube segment **202** has a series of spring fingers **252** therein that extend distally into slots **254** configured to receive corresponding spring arm portions **223**, **227** therein. See FIG. **21** (spring arm portion **227** is not depicted in FIG. **21** but can be seen in FIG. **20**). Each spring finger **252** has a detent **256** therein that is adapted to engage corresponding dimples **258** formed in the proximal articulation links **222**, **226** when the proximal articulation links **222**, **226** are in the neutral position (FIG. **23**). When the clinician desires to remove or attach an end effector **1000** to the proximal shaft portion **201**, the third and fourth drive systems **430**, **450** are parked in their neutral unactuated positions.
(226) The proximal coupler member **212** and the distal coupler member **232** of the quick disconnect joint **210** operably support corresponding portions of a drive member coupling assembly **500** for releasably coupling the proximal drive rod segment **492** to a distal drive rod segment **520**. The proximal drive rod segment **492** comprises a proximal axial drive train assembly **496** and the distal drive rod segment **520** comprises a distal axial drive train assembly **528**. The drive member coupling assembly **500** comprises a drive rod coupler or formation **502** that comprises a receiving formation or first magnet **504** such as, for example, a rare earth magnet, etc. that is attached to the distal end **493** of the distal drive rod segment **520**. The first magnet **504** has a receiving cavity **506** formed therein for receiving a second formation or distal magnet **510**. As can be seen in FIG. **21**, the distal magnet **510** is attached to a tapered mounting member **512** that is attached to a proximal end **522** of the distal drive rod **520**.
(227) The proximal coupler member **212** and the distal coupler member **232** of the quick disconnect joint **210** operably support other corresponding portions of a drive member coupling assembly **500** for releasably coupling the proximal drive shaft segment **380** with a distal drive shaft segment **540**. The proximal drive shaft segment **380**, in at least one exemplary form, comprises a proximal rotary drive train assembly **387** and the distal drive shaft segment **540** comprises a distal rotary drive train assembly **548**. When the proximal rotary drive train assembly **387** is operably coupled to the distal rotary drive train assembly **548**, the drive shaft assembly **388** is formed to transmit rotary control motions to the end effector **1000**. In the illustrated exemplary embodiment, a proximal end **542** of the distal drive shaft segment **540** has a plurality (e.g., four—only two can be seen in FIG. **21**) formations or cleated fingers **544** formed thereon. Each cleated finger **544** has an attachment cleat **546** formed thereon that are sized to be received in corresponding lock formations or holes or slots **383** in a distal end **381** of the proximal drive shaft segment **380**. The fingers **544** extend through a reinforcing ring **545** journaled onto the proximal end **542** of the distal drive shaft segment **540**.
(228) In the embodiment depicted in FIGS. **19-23**, the drive member coupling assembly **500** further includes an unlocking tube **514** for assisting in the disengagement of the first and second magnets **504**, **510** when the clinician detaches the end effector **1000** from the proximal shaft portion **201** of the surgical tool **100**. The unlocking tube **514** extends through the proximal drive shaft segment **380** and its proximal end **517** protrudes out of the proximal end **385** of the proximal drive shaft

segment **380** as shown in FIG. **19**. The unlocking tube **514** is sized relative to the proximal drive shaft segment **380** so as to be axially movable therein upon application of an unlocking motion "UL" applied to the proximal end **517** thereof. A handle (not shown) is attached to the proximal end **517** of the unlocking tube to facilitate the manual application of the unlocking motion "UL" to the unlocking tube **514** or the unlocking motion "UL". Other embodiments that are otherwise identical to the embodiment of FIGS. **19-23** employ an unlocking solenoid (not shown) that is attached to the tool mounting plate **304** and powered by the robotic controller **12** or a separate battery attached thereto is employed to apply the unlocking motion.

(229) In the illustrated exemplary embodiment, the coupling arrangement or quick disconnect joint **210** also includes an outer lock collar **260** that is slidably journaled on the distal end **204** of the proximal outer tube portion **202**. The outer lock collar **260** has four inwardly extending detents **262** that extend into a corresponding one of the slots **254** in the proximal outer tube portion **202**. Use of the quick disconnect joint **210** can be understood from reference to FIGS. **21-23**. FIG. **21** illustrates the conditions of the proximal shaft portion **201** and the distal shaft portion **230** prior to being coupled together. As can be seen in that Figure, the spring arm portions **223**, **227** of the proximal articulation links **224**, **226**, respectively are naturally radially sprung outward. The locking collar **260** is moved to its proximal-most position on the proximal outer tube **202** wherein the detents **262** are at the proximal end of the slots **254** therein. When the clinician desires to attach the end effector **1000** to the proximal shaft portion **201** of the surgical tool **100**, the clinician brings the distal shaft portion **230** into axial alignment and coupling engagement with the proximal shaft portion **201** as shown in FIG. **22**. As can be seen in that Figure, the distal magnet **510** is seated within the cavity **506** in the drive rod coupler **502** and is magnetically attached to the proximal magnet **504** to thereby couple the distal drive rod segment **520** to the proximal drive rod segment **492**. Such action thereby operably couples the distal axial drive train assembly **528** to the proximal axial drive train assembly **496**. In addition, as the shaft portions **201**, **230** are joined together, the cleated fingers **544** flex inward until the cleats **546** formed thereon enter the lock openings **383** in the distal end portion **381** of the proximal drive shaft segment **380**. When the cleats **546** are seated within their respective locking holes **383**, the distal drive shaft segment **540** is coupled to the proximal drive shaft segment **380**. Thus, such action thereby operably couples the distal rotary drive train assembly **548** to the proximal rotary drive train assembly **387**. As such, when distal coupler member **232** and the proximal coupler member **212** are brought into axial alignment and engagement in the manner described above and the locking collar **260** is moved to its proximal-most position on the proximal outer tube **202**, the distal drive train assemblies are operably coupled to the proximal drive train assemblies.

(230) When the clinician desires to detach the end effector **1000** from the proximal shaft portion **201** of the surgical tool **100**, the clinician returns the third and fourth drive systems **430**, **450** into their neutral positions. The clinician may then slide the locking collar **260** proximally on the proximal outer tube segment **202** into the starting position shown in FIG. **22**. When in that position, the spring arm portions of the proximal articulation links **222**, **226** cause the toothed portions thereof to disengage the toothed portions of the distal articulation links **242**, **246**. The clinician may then apply an unlocking motion UL to the proximal end **517** of the unlocking tube **514** to move the unlocking tube **514** and the unlocking collar **516** attached thereto in the distal direction "DD". As the unlocking collar **516** moves distally, it biases the cleated fingers **544** out of engagement with their respective holes **383** in the distal end portion **381** of the proximal drive shaft segment **380** and contacts the tapered mounting portion **512** to force the distal magnet **510** out of magnetic engagement with the proximal magnet **504**.

(231) FIGS. **22**A, **23**A and **23**B depict an alternative coupling arrangement or quick disconnect joint assembly **210**″ that is similar to the quick disconnect joint **210** described above except that an electromagnet **504**′ is employed to couple the distal drive rod segment **520** to the proximal drive rod segment **492**′. As can be seen in these Figures, the proximal drive rod segment **492**′ is hollow to

accommodate conductors **505** that extend from a source of electrical power in the robotic system **10**. The conductors **505** are wound around a piece of iron **508**. When the clinician brings the distal shaft portion **230** into engagement with the proximal shaft portion **201** as shown in FIG. **22**A, electrical current may be passed through the conductors **505** in a first direction to cause the magnet **504′** to attract the magnet **510** into coupling engagement as shown in FIG. **23**A. When the clinician desires to detach the end effector **1000** from the proximal shaft portion **201** of the surgical tool **100**, the clinician returns the third and fourth drive systems **430**, **450** into their neutral positions. The clinician may then slide the locking collar **260** proximally on the proximal outer tube segment **202** into the starting position shown in FIG. **22**A. When in that position, the spring arm portions of the proximal articulation links **222**, **226** cause the toothed portions thereof to disengage the toothed portions of the distal articulation links **242**, **246**. The clinician may then apply an unlocking motion UL to the proximal end **517** of the unlocking tube **514** to move the unlocking tube **514** and the unlocking collar **516** attached thereto in the distal direction “DD”. In addition, the electrical current may be passed through the conductors **505** in an opposite direction to cause the electromagnet **504′** to repel magnet **510** to assist in separating the shaft segments. As the clinician moves the unlocking tube distally, the unlocking collar **516** biases the cleated fingers **544** out of engagement with their respective holes **383** in the distal end portion **381** of the proximal drive shaft segment **380** and contacts the tapered mounting portion **512** to further separate the shaft segments.
(232) The coupling arrangements or quick detach joint assemblies described above may offer many advantages. For example, such arrangements may employ a single release/engagement motions that cannot be left semi-engaged. Such engagement motions can be employed to simultaneously operably couple several drive train assemblies wherein at least some drive train assemblies provide control motions that differ from the control motions provided by other drive train assemblies. For example, some drive trains may provide rotary control motions and be longitudinally shiftable to provide axial control motions and some may just provide rotary or axial control motions. Other drive train assemblies may provide push/pull motions for operating various end effector systems/components. The unique and novel locking collar arrangement ensures that either the distal drive train assemblies are locked to their respective proximal drive train assemblies or they are unlocked and may be detached therefrom. When locked together, all of the drive train assemblies are radially supported by the locking collar which prevents any uncoupling.
(233) The surgical tool **100** depicted in FIGS. **5** and **11-16** includes an articulation joint **700** that cooperates with the third and fourth drive systems **430**, **450**, respectively for articulating the end effector **1000** about the longitudinal tool axis “LT”. The articulation joint **700** includes a proximal socket tube **702** that is attached to the distal end **233** of the distal outer tube portion **231** and defines a proximal ball socket **704** therein. See FIG. **25**. A proximal ball member **706** is movably seated within the proximal ball socket **704**. As can be seen in FIG. **25**, the proximal ball member **706** has a central drive passage **708** that enables the distal drive shaft segment **540** to extend therethrough. In addition, the proximal ball member **706** has four articulation passages **710** therein which facilitate the passage of distal cable segments **444**, **445**, **446**, **447** therethrough. As can be further seen in FIG. **25**, the articulation joint **700** further includes an intermediate articulation tube segment **712** that has an intermediate ball socket **714** formed therein. The intermediate ball socket **714** is configured to movably support therein an end effector ball **722** formed on an end effector connector tube **720**. The distal cable segments **444**, **445**, **446**, **447** extend through cable passages **724** formed in the end effector ball **722** and are attached thereto by lugs **726** received within corresponding passages **728** in the end effector ball **722**. Other attachment arrangements may be employed for attaching distal cable segments **444**, **445**, **446**, **447** to the end effector ball **722**.
(234) A unique and novel rotary support joint assembly, generally designated as **740**, is depicted in FIGS. **26** and **27**. The illustrated rotary support joint assembly **740** includes a connector portion **1012** of the end effector drive housing **1010** that is substantially cylindrical in shape. A first annular race **1014** is formed in the perimeter of the cylindrically-shaped connector portion **1012**. The rotary

support joint assembly **740** further comprises a distal socket portion **730** that is formed in the end effector connector tube **720** as shown in FIGS. **26** and **27**. The distal socket portion **730** is sized relative to the cylindrical connector portion **1012** such that the connector portion **1012** can freely rotate within the socket portion **730**. A second annular race **732** is formed in an inner wall **731** of the distal socket portion **730**. A window **733** is provided through the distal socket **730** that communicates with the second annular race **732** therein. As can also be seen in FIGS. **26** and **27**, the rotary support joint assembly **740** further includes a ring-like bearing **734**. In various exemplary embodiments, the ring-like bearing **734** comprises a plastic deformable substantially-circular ring that has a cut **735** therein. The cut forms free ends **736**, **737** in the ring-like bearing **734**. As can be seen in FIG. **26**, the ring-like bearing **734** has a substantially annular shape in its natural unbiased state.

(235) To couple a surgical end effector **1000** (e.g., a first portion of a surgical instrument) to the articulation joint **700** (e.g., a second portion of a surgical instrument), the cylindrically shaped connector position **1012** is inserted into the distal socket portion **730** to bring the second annular race **732** into substantial registry with the first annular race **1014**. One of the free ends **736**, **737** of the ring-like bearing is then inserted into the registered annular races **1014**, **732** through the window **733** in the distal socket portion **730** of the end effector connector tube **720**. To facilitate easy insertion, the window or opening **733** has a tapered surface **738** formed thereon. See FIG. **26**. The ring-like bearing **734** is essentially rotated into place and, because it tends to form a circle or ring, it does not tend to back out through the window **733** once installed. Once the ring-like bearing **734** has been inserted into the registered annular races **1014**, **732**, the end effector connector tube **720** will be rotatably affixed to the connector portion **1012** of the end effector drive housing **1010**. Such arrangement enables the end effector drive housing **1010** to rotate about the longitudinal tool axis LT-LT relative to the end effector connector tube **720**. The ring-like bearing **734** becomes the bearing surface that the end effector drive housing **1010** then rotates on. Any side loading tries to deform the ring-like bearing **734** which is supported and contained by the two interlocking races **1014**, **732** preventing damage to the ring-like bearing **734**. It will be understood that such simple and effective joint assembly employing the ring-like bearing **734** forms a highly lubricious interface between the rotatable portions **1010**, **730**. If during assembly, one of the free ends **736**, **737** is permitted to protrude out through the window **733** (see e.g., FIG. **27**), the rotary support joint assembly **740** may be disassembled by withdrawing the ring-like bearing member **732** out through the window **733**. The rotary support joint assembly **740** allows for easy assembly and manufacturing while also providing for good end effector support while facilitating rotary manipulation thereof.

(236) The articulation joint **700** facilitates articulation of the end effector **1000** about the longitudinal tool axis LT. For example, when it is desirable to articulate the end effector **1000** in a first direction “FD” as shown in FIG. **5**, the robotic system **10** may power the third drive system **430** such that the third drive spindle assembly **436** (FIGS. **11-13**) is rotated in a first direction thereby drawing the proximal cable end portion **434**A and ultimately distal cable segment **444** in the proximal direction “PD” and releasing the proximal cable end portion **434**B and distal cable segment **445** to thereby cause the end effector ball **722** to rotate within the socket **714**. Likewise, to articulate the end effector **1000** in a second direction “SD” opposite to the first direction FD, the robotic system **10** may power the third drive system **430** such that the third drive spindle assembly **436** is rotated in a second direction thereby drawing the proximal cable end portion **434**B and ultimately distal cable segment **445** in the proximal direction “PD” and releasing the proximal cable end portion **434**A and distal cable segment **444** to thereby cause the end effector ball **722** to rotate within the socket **714**. When it is desirable to articulate the end effector **1000** in a third direction “TD” as shown in FIG. **5**, the robotic system **10** may power the fourth drive system **450** such that the fourth drive spindle assembly **456** is rotated in a third direction thereby drawing the proximal cable end portion **454**A and ultimately distal cable segment **446** in the proximal direction

"PD" and releasing the proximal cable end portion **454**B and distal cable segment **447** to thereby cause the end effector ball **722** to rotate within the socket **714**. Likewise, to articulate the end effector **1000** in a fourth direction "FTH" opposite to the third direction TD, the robotic system **10** may power the fourth drive system **450** such that the fourth drive spindle assembly **456** is rotated in a fourth direction thereby drawing the proximal cable end portion **454**B and ultimately distal cable segment **447** in the proximal direction "PD" and releasing the proximal cable end portion **454**A and distal cable segment **446** to thereby cause the end effector ball **722** to rotate within the socket **714**.

(237) The end effector embodiment depicted in FIGS. **5** and **11-16** employs rotary and longitudinal motions that are transmitted from the tool mounting portion **300** through the elongate shaft assembly for actuation. The drive shaft assembly employed to transmit such rotary and longitudinal motions (e.g., torsion, tension and compression motions) to the end effector is relatively flexible to facilitate articulation of the end effector about the articulation joint. FIGS. **28** and **29** illustrate an alternative drive shaft assembly **600** that may be employed in connection with the embodiment illustrated in FIGS. **5** and **11-16** or in other embodiments. In the embodiment depicted in FIG. **5** which employs the quick disconnect joint **210**, the proximal drive shaft segment **380** comprises a segment of drive shaft assembly **600** and the distal drive shaft segment **540** similarly comprises another segment of drive shaft assembly **600**. The drive shaft assembly **600** includes a drive tube **602** that has a series of annular joint segments **604** cut therein. In that illustrated embodiment, the drive tube **602** comprises a distal portion of the proximal drive shaft segment **380**.

(238) The drive tube **602** comprises a hollow metal tube (stainless steel, titanium, etc.) that has a series of annular joint segments **604** formed therein. The annular joint segments **604** comprise a plurality of loosely interlocking dovetail shapes **606** that are, for example, cut into the drive tube **602** by a laser and serve to facilitate flexible movement between the adjoining joint segments **604**. See FIG. **29**. Such laser cutting of a tube stock creates a flexible hollow drive tube that can be used in compression, tension and torsion. Such arrangement employs a full diametric cut that is interlocked with the adjacent part via a "puzzle piece" configuration. These cuts are then duplicated along the length of the hollow drive tube in an array and are sometimes "clocked" or rotated to change the tension or torsion performance.

(239) FIGS. **30-34** illustrate alternative exemplary micro-annular joint segments **604**′ that comprise plurality of laser cut shapes **606**′ that roughly resemble loosely interlocking, opposed "T" shapes and T-shapes with a notched portion therein. The annular joint segments **604**, **604**′ essentially comprise multiple micro-articulating torsion joints. That is, each joint segment **604**, **604**′ can transmit torque while facilitating relative articulation between each annular joint segment. As shown in FIGS. **30** and **31**, the joint segment **604**D′ on the distal end **603** of the drive tube **602** has a distal mounting collar portion **608**D that facilitates attachment to other drive components for actuating the end effector or portions of the quick disconnect joint, etc. and the joint segment **604**P′ on the proximal end **605** of the drive tube **602** has a proximal mounting collar portion **608**P′ that facilitates attachment to other proximal drive components or portions of the quick disconnect joint.

(240) The joint-to-joint range of motion for each particular drive shaft assembly **600** can be increased by increasing the spacing in the laser cuts. For example, to ensure that the joint segments **604**′ remain coupled together without significantly diminishing the drive tube's ability to articulate through desired ranges of motion, a secondary constraining member **610** is employed. In the embodiment depicted in FIGS. **32** and **33**, the secondary constraining member **610** comprises a spring **612** or other helically-wound member. In various exemplary embodiments, the distal end **614** of the spring **612** corresponds to the distal mounting collar portion **608**D and is wound tighter than the central portion **616** of the spring **612**. Similarly, the proximal end **618** of the spring **612** is wound tighter than the central portion **616** of the spring **612**. In other embodiments, the constraining member **610** is installed on the drive tube **602** with a desired pitch such that the constraining member also functions, for example, as a flexible drive thread for threadably engaging other threaded control components on the end effector and/or the control system. It will also be

appreciated that the constraining member may be installed in such a manner as to have a variable pitch to accomplish the transmission of the desired rotary control motions as the drive shaft assembly is rotated. For example, the variable pitch arrangement of the constraining member may be used to enhance open/close and firing motions which would benefit from differing linear strokes from the same rotation motion. In other embodiments, for example, the drive shaft assembly comprises a variable pitch thread on a hollow flexible drive shaft that can be pushed and pulled around a ninety degree bend. In still other embodiments, the secondary constraining member comprises an elastomeric tube or coating **611** applied around the exterior or perimeter of the drive tube **602** as illustrated in FIG. **34**A. In still another embodiment, for example, the elastomeric tube or coating **611**′ is installed in the hollow passageway **613** formed within the drive tube **602** as shown in FIG. **34**B.

(241) Such drive shaft arrangements comprise a composite torsional drive axle which allows superior load transmission while facilitating a desirable axial range of articulation. See, e.g., FIGS. **34** and **34**A-B. That is, these composite drive shaft assemblies allow a large range of motion while maintaining the ability to transmit torsion in both directions as well as facilitating the transmission of tension and compression control motions therethrough. In addition, the hollow nature of such drive shaft arrangements facilitate passage of other control components therethrough while affording improved tension loading. For example, some other embodiments include a flexible internal cable that extends through the drive shaft assembly which can assist in the alignment of the joint segments while facilitating the ability to apply tension motions through the drive shaft assembly. Moreover, such drive shaft arrangements are relatively easily to manufacture and assemble.

(242) FIGS. **35-38** depict a segment **620** of a drive shaft assembly **600**′. This embodiment includes joint segments **622**, **624** that are laser cut out of tube stock material (e.g., stainless steel, titanium, polymer, etc.). The joint segments **622**, **624** remain loosely attached together because the cuts **626** are radial and are somewhat tapered. For example, each of the lug portions **628** has a tapered outer perimeter portion **629** that is received within a socket **630** that has a tapered inner wall portion. See, e.g., FIGS. **36** and **38**. Thus, there is no assembly required to attach the joint segments **622**, **624** together. As can be seen in the Figures, joint segment **622** has opposing pivot lug portions **628** cut on each end thereof that are pivotally received in corresponding sockets **630** formed in adjacent joint segments **624**.

(243) FIGS. **35-38** illustrate a small segment of the drive shaft assembly **600**′. Those of ordinary skill in the art will appreciate that the lugs/sockets may be cut throughout the entire length of the drive shaft assembly. That is, the joint segments **624** may have opposing sockets **630** cut therein to facilitate linkage with adjoining joint segments **622** to complete the length of the drive shaft assembly **600**′. In addition, the joint segments **624** have an angled end portion **632** cut therein to facilitate articulation of the joint segments **624** relative to the joint segments **622** as illustrated in FIGS. **37** and **38**. In the illustrated embodiment, each lug **628** has an articulation stop portion **634** that is adapted to contact a corresponding articulation stop **636** formed in the joint segment **622**. See FIGS. **37** and **38**. Other embodiments, which may otherwise be identical to the segment **620**, are not provided with the articulation stop portions **634** and stops **636**.

(244) As indicated above, the joint-to-joint range of motion for each particular drive shaft assembly can be increased by increasing the spacing in the laser cuts. In such embodiments, to ensure that the joint segments **622**, **624** remain coupled together without significantly diminishing the drive tube's ability to articulate through desired ranges of motion, a secondary constraining member in the form of an elastomeric sleeve or coating **640** is employed. Other embodiments employ other forms of constraining members disclosed herein and their equivalent structures. As can be seen in FIG. **35**, the joint segments **622**, **624** are capable of pivoting about pivot axes “PA-PA” defined by the pivot lugs **628** and corresponding sockets **630**. To obtain an expanded range of articulation, the drive shaft assembly **600**′ may be rotated about the tool axis TL-TL while pivoting about the pivot axes

PA-PA.

(245) FIGS. **39-44** depict a segment **640** of another drive shaft assembly **600**″. The drive shaft assembly **600**″ comprises a multi-segment drive system that includes a plurality of interconnected joint segments **642** that form a flexible hollow drive tube **602**″. A joint segment **642** includes a ball connector portion **644** and a socket portion **648**. Each joint segment **642** may be fabricated by, for example, metal injection molding "MIM" and be fabricated from 17-4, 17-7, 420 stainless steel. Other embodiments may be machined from 300 or 400 series stainless steel, 6065 Or 7071 aluminum or titanium. Still other embodiments could be molded out of plastic infilled or unfilled Nylon, Ultem, ABS, Polycarbonate or Polyethylene, for example. As can be seen in the Figures, the ball connector **644** is hexagonal in shape. That is, the ball connector **644** has six arcuate surfaces **646** formed thereon and is adapted to be rotatably received in like-shaped sockets **650**. Each socket **650** has a hexagonally-shaped outer portion **652** formed from six flat surfaces **654** and a radially-shaped inner portion **656**. See FIG. **42**. Each joint segment **642** is identical in construction, except that the socket portions of the last joint segments forming the distal and proximal ends of the drive shaft assembly **600** may be configured to operably mate with corresponding control components. Each ball connector **644** has a hollow passage **645** therein that cooperate to form a hollow passageway **603** through the hollow flexible drive tube **602**″.

(246) As can be seen in FIGS. **43** and **44**, the interconnected joint segments **642** are contained within a constraining member **660** which comprises a tube or sleeve fabricated from a flexible polymer material, for example. FIG. **45** illustrates a flexible inner core member **662** extending through the interconnected joint segments **642**. The inner core member **662** comprises a solid member fabricated from a polymer material or a hollow tube or sleeve fabricated from a flexible polymer material. FIG. **46** illustrates another embodiment wherein a constraining member **660** and an inner core member **662** are both employed.

(247) Drive shaft assembly **600**″ facilitates transmission of rotational and translational motion through a variable radius articulation joint. The hollow nature of the drive shaft assembly **600**″ provides room for additional control components or a tensile element (e.g., a flexible cable) to facilitate tensile and compressive load transmission. In other embodiments, however, the joint segments **624** do not afford a hollow passage through the drive shaft assembly. In such embodiments, for example, the ball connector portion is solid. Rotary motion is translated via the edges of the hexagonal surfaces. Tighter tolerances may allow greater load capacity. Using a cable or other tensile element through the centerline of the drive shaft assembly **600**″, the entire drive shaft assembly **600**″ can be rotated bent, pushed and pulled without limiting range of motion. For example, the drive shaft assembly **600**″ may form an arcuate drive path, a straight drive path, a serpentine drive path, etc.

(248) FIGS. **5** and **47-54** illustrate one surgical end effector **1000** that may be effectively employed with the robotic system **10**. The end effector **1000** comprises an endocutter **1002** that has a first jaw **1004** and a second jaw **1006** that is selectively movable relative to the first jaw **1004**. In the embodiment illustrated in FIGS. **5** and **47-54**, the first jaw **1004** comprises a support member **1019** in the form of an elongate channel **1020** that is configured to operably support a staple cartridge **1030** therein. The second jaw **1006** comprises an anvil assembly **1100**. As can be seen in FIGS. **47**, **49**, **53** and **55**, the anvil assembly **1100** comprises an anvil body **1102** that has a staple forming surface **1104** thereon. The anvil body **1102** has a passage **1106** that is adapted to register with mounting holes **1022** in the elongate channel **1020**. A pivot or trunnion pin (not shown) is inserted through the holes **1022** and passage **1104** to pivotally couple the anvil **1100** to the elongate channel **1020**. Such arrangement permits the anvil assembly **1100** to be selectively pivoted about a closure axis "CA-CA" that is substantially transverse to the longitudinal tool axis "LT-LT" (FIG. **48**) between an open position wherein the staple forming surface **1104** is spaced away from the cartridge deck **1044** of the staple cartridge **1040** (FIGS. **47-50**) and closed positions (FIGS. **51-54**) wherein the staple forming surface **1104** on the anvil body **1102** is in confronting relationship

relative to the cartridge deck **1042**.

(249) The embodiment of FIGS. **5** and **47-54** employs a closure assembly **1110** that is configured to receive opening and closing motions from the fifth drive system **470**. The fifth drive system **470** serves to axially advance and retract a drive rod assembly **490**. As described above, the drive rod assembly **490** includes a proximal drive rod segment **492** that operably interfaces with the drive solenoid **474** to receive axial control motions therefrom. The proximal drive rod segment **492** is coupled to a distal drive rod segment **520** through the drive rod coupler **502**. The distal drive rod segment **520** is somewhat flexible to facilitate articulation of the end effector **1000** about articulation joint **700** yet facilitate the axial transmission of closing and opening motions therethrough. For example, the distal drive rod segment **520** may comprise a cable or laminate structure of titanium, stainless spring steel or Nitinol.

(250) The closure assembly **1110** includes a closure linkage **1112** that is pivotally attached to the elongate channel **1020**. As can be seen in FIGS. **48**, **51** and **52**, the closure linkage **1112** has an opening **1114** therein through which the distal end **524** of the distal drive rod segment **520** extends. A ball **526** or other formation is attached to the distal drive rod segment **520** to thereby attach the distal end **524** of the distal drive rod segment **520** to the closure linkage **1112**. The closure assembly **1110** further includes a pair of cam discs **1120** that are rotatably mounted on the lateral sides of the elongate channel **1020**. One cam disc **1120** is rotatably supported on one lateral side of the elongate channel **1020** and the other cam disc **1120** is rotatably supported to the other lateral side of the elongate channel **1020**. See FIG. **60**. A pair of pivot links **1122** are attached between each cam disc **1120** and the closure linkage **1112**. Thus, pivotal travel of the closure linkage **1112** by the drive rod assembly **490** will result in the rotation of the cam discs **1120**. Each cam disc **1120** further has an actuator pin **1124** protruding therefrom that is slidably received in a corresponding cam slot **1108** in the anvil body **1102**.

(251) Actuation of the second jaw **1006** or anvil assembly **1100** will now be described. FIGS. **47-50** illustrate the anvil assembly **1100** in the open position. After the end effector **1000** has been positioned relative to the tissue to be cut and stapled, the robotic controller **12** may activate the drive solenoid **474** in the first or distal direction “DD” which ultimately results in the distal movement of the drive yoke **472** which causes the drive rod assembly **490** to move in the distal direction “DD”. Such movement of the drive rod assembly **490** results in the distal movement of the distal drive rod segment **520** which causes the closure linkage **1112** to pivot from the open position to the closed position (FIGS. **51-54**). Such movement of the closure linkage **1112** causes the cam discs **1120** to rotate in the “CCW” direction. As the cam discs rotate in the “CCW” direction, interaction between the actuator pins **1124** and their respective cam slot **1108** causes the anvil assembly **1100** to pivot closed onto the target tissue. To release the target tissue, the drive solenoid **474** is activated to pull the drive rod assembly **490** in the proximal direction “PD” which results in the reverse pivotal travel of the closure linkage **1112** to the open position which ultimately causes the anvil assembly **1100** to pivot back to the open position.

(252) FIGS. **55-59** illustrate another closure system **670** for applying opening and closing motions to the anvil **1100**. As can be seen in FIG. **56**, for example, the closure system **670** includes a first mounting block or member **672** that rotatably supports a first closure rod segment **680**. The first closure rod segment **680** has a substantially semi-circular, cross-sectional shape. A proximal end **682** of the first closure rod segment **680** has a first ball connector **684** thereon that is rotatably supported within a first mounting socket **673** formed in the mounting block **672**. To facilitate articulation of the end effector **1000** by the articulation joint **700**, the first closure rod segment **680** also has a first serrated portion **686** that coincides with the articulation joint **700** as illustrated in FIGS. **58** and **59**. The closure system **670** further includes a second mounting block or member **674** that rotatably supports a second closure rod segment **690**. The second closure rod segment **690** has a substantially semi-circular, cross-sectional shape. A proximal end **692** of the second closure rod segment **690** has a second ball connector **694** thereon that is rotatably supported within a second

mounting socket **675** formed in the second mounting block **674**. To facilitate articulation of the end effector **1000** by the articulation joint **700**, the second closure rod segment **690** also has a second serrated portion **696** that coincides with the articulation joint **700** as illustrated in FIGS. **58** and **59**.
(253) As can also be seen in FIG. **56**, the closure system **670** further has a first pivot link **676** that is attached to a distal end **682** of the first closure rod segment **680**. The first pivot link **676** has a first pivot lug **677** formed thereon that is configured to be rotatably supported within a first socket **683** formed in the distal end **682** of the first closure rod segment **680**. Such arrangement permits the first pivot link **676** to rotate relative to the first closure rod segment **680**. Likewise, a second pivot link **678** is attached to a distal end **691** of the second closure rod segment **690** such that it can rotate relative thereto. The second pivot link **678** has a second pivot lug **1679** formed thereon that is configured to extend through an opening in the first pivot lug **677** to be rotatably supported within a second socket **692** in a distal end **1691** of the second closure rod segment **690**. In addition, as can be seen in FIG. **56**, the first and second pivot links **676**, **678** are movably keyed to each other by a key **716** on the second pivot link **678** that is slidably received within a slot **717** in the first pivot link **676**. In at least one embodiment, the first pivot link **676** is attached to each of the cam discs **1120** by first linkage arms **687** and the second pivot link **678** is attached to each of the cam discs **1120** by second linkage arms **688**.
(254) In the illustrated embodiment, the closure system **670** is actuated by the drive solenoid **474**. The drive solenoid **474** is configured to operably interface with one of the first and second mounting blocks **672**, **674** to apply axial closing and opening motions thereto. As can be seen in FIGS. **56-59**, such drive arrangement may further comprise a first pivot link and gear assembly **695** that is movably attached to the first mounting block **672** by a pin **685** that extends into a slot **696** in the first pivot link and gear assembly **695**. Similarly, a second pivot link and gear assembly **697** is movably attached to the second mounting block **674** by a pin **685** that extends into a slot **698** in the second pivot link and gear assembly **697**. The first pivot link and gear assembly **695** has a first bevel gear **699**A rotatably mounted thereto and the second pivot link and gear assembly **697** has a second bevel gear **699**B rotatably attached thereto. Both first and second bevel gears **699**A, **699**B are mounted in meshing engagement with an idler gear **689** rotatably mounted on the tool mounting plate **304**. See FIG. **59**A. Thus, when the first mounting block **672** is advanced in the distal direction “DD” which also results in the movement of the first closure rod segment **680** and first pivot link **676** in the distal direction DD, the bevel gears **689**, **699**A, **699**B will result in the movement of the second closure rod **690** and second pivot link **678** in the proximal direction “PD”. Likewise, when the first mounting block **672** is advanced in the proximal direction “PD” which also results in the movement of the first closure rod segment **680** and first pivot link **676** in the proximal direction PD, the bevel gears **689**, **699**A, **699**B will result in the movement of the second closure rod **690** and second pivot link **678** in the distal direction “DD”.
(255) FIG. **58** illustrates the anvil **1100** in the open position. As can be seen in that Figure, the first closure rod **680** is slightly proximal to the second closure rod **690**. To close the anvil, the drive solenoid **474** is powered to axially advance the first closure rod **680** in the distal direction “DD”. Such action causes the first pivot link **676** and first linkage arms **687** to rotate the cam discs **1120** in the counter-clockwise “CCW” direction as shown in FIG. **59**. Such motion also results in the movement of the second closure rod **690** is the proximal direction causing the second pivot link **678** and second linkage arms **688** to also pull the cam discs **1120** in the counter-clockwise “CCW” direction. To open the anvil, the drive solenoid **474** applies an axial control motion to the first mounting block **672** to return the first and second control rod segments **680**, **690** to the positions shown in FIG. **58**.
(256) The end effector embodiment **1000** illustrated in FIG. **60** includes a drive arrangement generally designated as **748** that facilitates the selective application of rotary control motions to the end effector **1000**. The end effector **1000** includes a firing member **1200** that is threadably journaled on an implement drive shaft **1300**. As can be seen in FIG. **61**, the implement drive shaft

1300 has a bearing segment **1304** formed thereon that is rotatably supported in a bearing sleeve **1011**. The implement drive shaft **1300** has an implement drive gear **1302** that operably meshes with a rotary transmission generally designated as **750** that operably interfaces with the elongate channel **1020** and is operably supported by a portion of the elongate shaft assembly **200**. In one exemplary form, the rotary transmission **750** includes a differential interlock assembly **760**. As can be seen in FIGS. **64** and **65**, the differential interlock assembly **760** includes a differential housing **762** that is configured to selectively rotate relative to the end effector drive housing **1010** and to rotate with the end effector housing **1010**.

(257) The distal drive shaft segment **540** is attached to a sun gear shaft **752** that has a sun gear **754** attached thereto. Thus, sun gear **754** will rotate when the distal drive shaft segment **540** is rotated. Sun gear **754** will also move axially with the distal drive shaft segment **540**. The differential interlock assembly **760** further includes a plurality of planet gears **764** that are rotatably attached to the differential housing **762**. In at least one embodiment, for example, three planet gears **764** are employed. Each planet gear **764** is in meshing engagement with a first end effector ring gear **1016** formed within the end effector drive housing **1010**. In the illustrated exemplary embodiment shown in FIG. **60**, the end effector drive housing **1010** is non-rotatably attached to the elongate channel **1020** by a pair of opposing attachment lugs **1018** (only one attachment lug **1018** can be seen in FIG. **60**) into corresponding attachment slots **1024** (only one attachment slot **1024** can be seen in FIG. **60**) formed in the proximal end **1021** of the elongate channel **1020**. Other methods of non-movably attaching the end effector drive housing **1010** to the elongate channel **1020** may be employed or the end effector drive housing **1010** may be integrally formed with the elongate channel **1020**. Thus, rotation of the end effector drive housing **1010** will result in the rotation of the elongate channel **1020** of the end effector **1000**.

(258) In the embodiment depicted in FIGS. **61-65**, the differential interlock assembly **760** further includes a second ring gear **766** that is formed within the differential housing **762** for meshing engagement with the sun gear **754**. The differential interlock assembly **760** also includes a third ring gear **768** formed in the differential housing **762** that is in meshing engagement with the implement drive gear **1302**. Rotation of the differential housing **762** within the end effector drive housing **1010** will ultimately result in the rotation of the implement drive gear **1302** and the implement drive shaft **1300** attached thereto.

(259) When the clinician desires to rotate the end effector **1000** about the longitudinal tool axis LT-LT distal to the articulation joint **700** to position the end effector in a desired orientation relative to the target tissue, the robotic controller **12** may activate the shifter solenoid **394** to axially move the proximal drive shaft segment **380** such that the sun gear **754** is moved to a “first axial” position shown in FIGS. **65**, **67** and **70**. As described in detail above, the distal drive shaft segment **540** is operably coupled to the proximal drive shaft segment **380** by the quick disconnect joint **210**. Thus, axial movement of the proximal drive shaft segment **380** may result in the axial movement of the distal drive shaft segment **540** and the sun gear shaft **752** and sun gear **754**. As was further described above, the shifting system **390** controls the axial movement of the proximal drive shaft segment **380**. When in the first axial position, the sun gear **754** is in meshing engagement with the planetary gears **764** and the second ring gear **766** to thereby cause the planetary gears **764** and the differential housing **762** to rotate as a unit as the sun gear **754** is rotated.

(260) Rotation of the proximal drive shaft segment **380** is controlled by the second drive system **370**. Rotation of the proximal drive shaft segment **380** results in rotation of the distal drive shaft segment **540**, the sun gear shaft **752** and sun gear **754**. Such rotation of the differential housing **762** and planetary gears **764** as a unit applies a rotary motion to the end effector drive housing **1010** of sufficient magnitude to overcome a first amount of friction F**1** between the end effector drive housing **1010** and the distal socket portion **730** of the intermediate articulation tube **712** to thereby cause the end effector drive housing **1010** and end effector **1000** attached thereto to rotate about the longitudinal tool axis “LT-LT” relative to the distal socket tube **730**. Thus, when in such position,

the end effector drive housing **1010**, the differential housing **762** and the planetary gears **764** all rotate together as a unit. Because the implement shaft **1300** is supported by the bearing sleeve **1011** in the end effector drive housing, the implement shaft **1300** also rotates with the end effector drive housing **1010**. See FIG. **61**. Thus, rotation of the end effector drive housing **1010** and the end effector **1000** does not result in relative rotation of the implement drive shaft **1300** which would result in displacement of the firing member **1200**. In the illustrated exemplary embodiment, such rotation of the end effector **1000** distal of the articulation joint **700** does not result in rotation of the entire elongate shaft assembly **200**.
(261) When it is desired to apply a rotary drive motion to the implement drive shaft **1300** for driving the firing member **1200** within the end effector **1000**, the sun gear **754** is axially positioned in a “second axial” position to disengage the second ring gear **766** while meshingly engaging the planetary gears **764** as shown in FIGS. **61**, **62**, **64** and **66**. Thus, when it is desired to rotate the implement drive shaft **1300**, the robotic controller **12** activates the shifter solenoid **394** to axially position the sun gear **754** into meshing engagement with the planetary gears **764**. When in that second axial or “firing position”, the sun gear **754** only meshingly engages the planetary gears **764**.
(262) Rotation of the proximal drive shaft segment **380** may be controlled by the second drive system **370**. Rotation of the proximal drive shaft segment **380** results in rotation of the distal drive shaft segment **540**, the sun gear shaft **752** and sun gear **754**. As the sun gear **754** is rotated in a first firing direction, the planetary gears **764** are also rotated. As the planetary gears **764** rotate, they also cause the differential housing **762** to rotate. Rotation of the differential housing **762** causes the implement shaft **1300** to rotate due to the meshing engagement of the implement drive gear **1302** with the third ring gear **768**. Because of the amount of friction F**1** existing between the end effector drive housing **1010** and the distal socket portion **730** of the intermediate articulation tube **712**, rotation of the planetary gears **764** does not result in the rotation of the end effector housing **1010** relative to the intermediate articulation tube **712**. Thus, rotation of the drive shaft assembly results in rotation of the implement drive shaft **1300** without rotating the entire end effector **1000**.
(263) Such unique and novel rotary transmission **750** comprises a single drive system that can selectively rotate the end effector **1000** or fire the firing member **1200** depending upon the axial position of the rotary drive shaft. One advantage that may be afforded by such arrangement is that it simplifies the drives that must transverse the articulation joint **700**. It also translates the central drive to the base of the elongate channel **1020** so that the implement drive shaft **1300** can exist under the staple cartridge **1040** to the drive the firing member **1200**. The ability for an end effector to be rotatable distal to the articulation joint may vastly improve the ability to position the end effector relative to the target tissue.
(264) As indicated above, when the drive shaft assembly is positioned in a first axial position, rotation of the drive shaft assembly may result in rotation of the entire end effector **1000** distal of the articulation joint **700**. When the drive shaft assembly is positioned in a second axial position (in one example—proximal to the first axial position), rotation of the drive shaft assembly may result in the rotation of the implement drive shaft **1300**.
(265) The rotary transmission embodiment depicted in FIGS. **64** and **65** includes a differential locking system **780** which is configured to retain the drive shaft assembly in the first and second axial positions. As can be seen in FIGS. **64** and **65**, the differential locking system **780** comprises a first retention formation **756** in the sun gear shaft **752** that corresponds to the first axial position of the drive shaft assembly and a second retention formation **758** in the sun gear shaft **752** that correspond to the second axial position of the drive shaft assembly. In the illustrated exemplary embodiment, the first retention formation comprises a first radial locking groove **757** in the sun gear shaft **752** and the second retention formation **758** comprises a second radial locking groove **759** formed in the sun gear shaft **752**. The first and second locking grooves **757**, **759** cooperate with at least one spring-biased locking member **784** that is adapted to retainingly engage the locking grooves **757**, **759** when the drive shaft assembly is in the first and second axial positions,

respectively. The locking members **784** have a tapered tip **786** and are movably supported within the differential housing **762**. A radial wave spring **782** may be employed to apply a biasing force to the locking members **784** as shown in FIG. **63**. When the drive shaft assembly is axially moved into the first position, the locking members **784** snap into engagement with the first radial locking groove **7576**. See FIG. **65**. When the drive shaft assembly is axially moved into the second axial position, the locking members **784** snap into engagement with the second radial locking groove **759**. See FIG. **64**. In alternative embodiments, the first and second retention formations may comprise, for example, dimples that correspond to each of the locking members **784**. Also in alternative embodiments wherein the drive shaft assembly is axially positionable in more than two axial positions, addition retention formations may be employed which correspond to each of those axial positions.
(266) FIGS. **70** and **71** illustrate an alternative differential locking system **790** that is configured to ensure that the drive shaft assembly is locked into one of a plurality of predetermined axial positions. The differential locking system **790** is configured to ensure that the drive shaft assembly is positionable in one of the first and second axial positions and is not inadvertently positioned in another axial position wherein the drive system is not properly operable. In the embodiment depicted in FIGS. **70** and **71**, the differential locking system **790** includes a plurality of locking springs **792** that are attached to the drive shaft assembly. Each locking spring **792** is formed with first and second locking valleys **794**, **796** that are separated by a pointed peak portion **798**. The locking springs **792** are located to cooperate with a pointed locking members **763** formed on the differential housing **762**. Thus, when the pointed locking members **763** are seated in the first locking valley **794**, the drive shaft assembly is retained in the first axial position and when the pointed locking members **763** are seated in the second locking valleys **796**, the drive shaft assembly is retained in the second axial position. The pointed peak portion **798** between the first and second locking valleys **794**, **796** ensure that the drive shaft assembly is in one of the first and second axial positions and does not get stopped in an axial position between those two axial positions. If additional axial positions are desired, the locking springs may be provided with additional locking valleys that correspond to the desired axial positions.
(267) Referring to FIGS. **60**, **72** and **73**, a thrust bearing **1030** is supported within a cradle **1026** in the elongate channel **1020**. The distal end portion **1306** of the implement drive shaft **1300** is rotatably received within the thrust bearing **1030** and protrudes therethrough. A retaining collar **1032** is pinned or otherwise affixed to the distal end **1030** as shown in FIG. **73** to complete the installation. Use of the thrust bearing **1030** in this manner may enable the firing member **1200** to be “pulled” as it is fired from a starting position to an ending position within the elongate channel **1020**. Such arrangement may minimize the risk of buckling of the implement drive shaft **1300** under high load conditions. The unique and novel mounting arrangement and location of the thrust bearing **1030** may result in a seating load that increases with the anvil load which further increases the end effector stability. Such mounting arrangement may essentially serve to place the implement drive shaft **1300** in tension during the high load firing cycle. This may avoid the need for the drive system gears to both rotate the implement drive shaft **1300** and resist the buckling of the shaft **1300**. Use of the retaining collar **1032** may also make the arrangement easy to manufacture and assemble. The firing member **1200** is configured to engage the anvil and retain the anvil at a desired distance from the cartridge deck as the firing member **1200** is driven from the starting to ending position. In this arrangement for example, as the firing member **1200** assembly moves distally down the elongate channel **1020**, the length of the portion of the anvil that resembles a cantilever beam becomes shorter and stiffer thereby increasing the magnitude of downward loading occurring at the distal end of the elongate channel **1020** further increasing the bearing seating load.
(268) One of the advantages of utilizing rotary drive members for firing, closing, rotating, etc. may include the ability to use the high mechanical advantage of the drive shaft to accommodate the high loads needed to accomplish those instrument tasks. However, when employing such rotary drive

systems, it may be desirable to track the number of rotations that the drive shaft is driven to avoid catastrophic failure or damage to the drive screw and other instrument components in the event that the drive shaft or movable end effector component is driven too far in the distal direction. Thus, some systems that include rotary drive shafts have, in the past, employed encoders to track the motor rotations or sensors to monitor the axial position of the movable component. The use of encoders and/or sensors require the need for additional wiring, electronics and processing power to accommodate such a system which can lead to increased instrument costs. Also, the system's reliability may be somewhat difficult to predict and its reliability depends upon software and processors.
(269) FIGS. **74-76** depict a mechanical stroke limiting system **1310** for limiting the linear stroke of the firing member **1200** as the firing member **1200** is driven from a starting to an ending position. The stroke limiting system **1310** employs an implement drive shaft **1300**′ wherein the screw threads **1308** on the implement drive shaft **1300**′ do not extend to the distal end **1306** of the drive shaft **1300**′. For example, as can be seen in FIGS. **74-76**, the implement drive shaft **1300**′ includes an un-threaded section **1309**. The firing member **1200** has a body portion **1202** that has a series of internal threads **1204** that are adapted to threadably interface with the screw threads **1308** on the implement drive shaft **1300**′ such that, as the implement drive shaft **1300**′ is rotated in a first firing direction, the firing member **1200** is driven in the distal direction “DD” until it contacts the unthreaded section **1309** at which point the firing member **1200** stops its distal advancement. That is, the firing member **1200** will advance distally until the internal threads **1204** in the firing member **1200** disengage the threads **1308** in the implement drive shaft **1300**′. Any further rotation of the implement drive shaft **1300**′ in the first direction will not result in further distal advancement of the firing member **1200**. See, e.g., FIG. **75**.
(270) The illustrated exemplary mechanical stroke limiting system **1310** further includes a distal biasing member **1312** that is configured to be contacted by the firing member **1200** when the firing member **1200** has been advanced to the end of its distal stroke (i.e., the firing member will no longer advance distally with the rotation of the implement drive shaft in the first rotary direction). In the embodiment depicted in FIGS. **74-76**, for example, the biasing member **1312** comprises a leaf spring **1314** that is positioned within the elongate channel **1020** as shown. FIG. **74** illustrates the leaf spring **1314** prior to contact by the firing member **1200** and FIG. **75** illustrates the leaf spring **1314** in a compressed state after it has been contacted by the firing member **1200**. When in that position, the leaf spring **1314** serves to bias the firing member **1200** in the proximal direction “PD” to enable the internal threads **1204** in the firing member **1200** to re-engage the implement drive shaft **1300**′ when the implement drive shaft **1300**′ is rotated in a second retraction direction. As the implement drive shaft **1300**′ is rotated in the second retraction direction, the firing member **1200** is retracted in the proximal direction. See FIG. **76**.
(271) FIGS. **77-80** illustrate another stroke limiting system **1310**′. The stroke limiting system **1310**′ employs a two-part implement drive shaft **1300**″. In at least one form, for example, the implement drive shaft **1300**″ includes a proximal implement drive shaft segment **1320** that has a socket **1324** in a distal end **1322** thereof and a distal drive shaft segment **1330** that has a lug **1334** protruding from a proximal end **1332** thereof. The lug **1334** is sized and shaped to be received within the socket **1324** such that threads **1326** on the proximal drive shaft segment **1320** cooperate with threads **1336** on the distal drive shaft segment **1330** to form one continuous drive thread **1340**. As can be seen in FIGS. **77**, **79** and **80**, a distal end **1338** of the distal drive shaft segment **1330** extends through a thrust bearing **1032** that is movably supported in the distal end **1023** of the elongate channel **1020**. That is, the thrust bearing **1032** is axially movable within the elongate channel **1020**. A distal biasing member **1342** is supported within the elongate channel **1020** for contact with the thrust bearing **1032**. FIG. **78** illustrates the firing member **1200** being driven in the distal direction “DD” as the implement drive shaft **1300**″ is driven in a first rotary direction. FIG. **79** illustrates the firing member **1200** at the distal end of its stroke. Further rotation of the implement drive shaft

1300″ in the first rotary direction causes the thrust bearing **1032** to compress the biasing member **1342** and also allows the distal shaft segment **1330** to slip if the proximal segment **1320** continues to turn. Such slippage between the proximal and distal implement drive shaft segments **1320**, **1330** prevent the firing member **1200** from being further advanced distally which could ultimately damage the instrument. However, after the first rotary motion has been discontinued, the biasing member **1342** serves to bias the distal shaft segment **1320** in the proximal direction such that the lug **1334** is seated in the socket **1324**. Thereafter, rotation of the implement shaft **1300**″ in a second rotary direction results in the movement of the firing member **1200** in the proximal direction “PD” as shown in FIG. **80**.

(272) FIG. **81** illustrates another stroke limiting system **1310**″. In this embodiment, the implement drive shaft **1300** has a lug **1350** formed thereon that is sized and shaped to be received within a socket **1352** in the bearing segment **1304** that has the implement drive gear **1302** formed thereon or otherwise attached thereto. FIGS. **81**A and **81**B illustrate different lugs **1350**′ (FIG. **81**A) and **1350**″ (FIG. **81**B) that are configured to releasably engage corresponding sockets **1352**′ and **1352**″, respectively. The leaf spring **1314** is positioned to be contacted by the firing member **1200** when the firing member **1200** has reached the end of its stroke. Further rotation of the implement drive shaft **1300** will result in the lug **1350**, **1350**′, **1350**″ slipping out of the socket **1352**, **1352**′, **1352**″, respectively to thereby prevent further rotation of the implement shaft **1300**. Once the application of rotational motion to the implement drive shaft **1300** is discontinued, the leaf spring **1314** will apply a biasing motion to the firing member **1200** to ultimately bias the implement drive shaft **1300** in the proximal direction “PD” to seat the lug **1350** in the socket **1352**. Rotation of the implement drive shaft **1300** in the second rotary direction will result in the retraction of the firing member **1200** in the proximal direction “PD” to the starting position. Once the firing member **1200** has returned to the starting position, the anvil **1100** may then be opened.

(273) In the illustrated exemplary embodiment, the firing member **1200** is configured to engage the anvil **1100** as the firing member **1200** is driven distally through the end effector to affirmatively space the anvil from the staple cartridge to assure properly formed closed staples, especially when an amount of tissue is clamped that is inadequate to do so. Other forms of firing members that are configured to engage and space the anvil from the staple cartridge or elongate channel and which may be employed in this embodiment and others are disclosed in U.S. Pat. No. 6,978,921, entitled SURGICAL STAPLING INSTRUMENT INCORPORATING AN E-BEAM FIRING MECHANISM, the disclosure of which is herein incorporated by reference in its entirety. As can be seen in FIGS. **82** and **83**, the body portion **1202** of the firing member **1200** includes a foot portion **1206** that upwardly engages a channel slot **1028** in the elongate channel **1020**. See FIG. **60**. Similarly, the knife body includes a pair of laterally-protruding upper fins **1208**. When fired with the anvil **1100** closed, the upper fins **1208** advance distally within a longitudinal anvil slot **1103** extending distally through anvil **1100**. Any minor upward deflection in the anvil **1100** is overcome by a downward force imparted by the upper fins **1208**.

(274) In general, the loads necessary to close and advance the firing member i.e., “fire” the firing member could conceivably exceed 200 lbs. Such force requirements, however, may require the internal threads **1204** in the firing member to comprise relative fine threads of a power-type thread configuration such as Acme threads. Further, to provide sufficient support to the upper fins **1208** to avoid the firing member **1200** from binding as it is driven distally through the end effector, it may be desirable for at least 5-15 threads in the firing member to be engaged with the threads on the implement drive shaft at any given time. However, conventional manufacturing methods may be unsuitable for forming sufficient threads in the firing member body **1202** within an 0.08 inch-0.150 inch diameter opening and which have sufficient thread depth.

(275) FIGS. **82-84** illustrate a firing member **1200**′ that may address at least some of the aforementioned challenges. As can be seen in those Figures, the body portion **1202**′ of the firing member has a hollow shaft socket **1210** extending therethrough that is sized to receive the

implement shaft therethrough. The internal threads in this embodiment are formed by a series of rods **1214** that extend transversely through holes **1212** in the shaft socket **1210** as shown. As can be seen in FIG. **84**, the pins **1214** rest on the minor diameter of the pitch of the threads **1308** on the implement drive shaft **1300**.

(276) FIG. **85** illustrates another firing member **1200**″ that may also address at least some of the above-discussed manufacturing challenges. As can be seen in that Figure, the body portion **1202**″ of the firing member **100**″ has a hollow shaft socket **1210** extending therethrough that is sized to receive the implement shaft therethrough. A pair of windows **1216** are formed in the body portion **1202**″ as shown. The internal threads **1220** in this embodiment are formed on plugs **1218** that are inserted into the windows **1216** and are attached therein by welding, adhesive, etc. FIGS. **86** and **87** illustrate another firing member **1200**″ wherein access into the socket **1210** is gained through access windows **1230**A, **1230**B formed in the body portion **1202**″. For example, a pair of access windows **1230**A are provided through one side of the socket portion **1210** to enable internal thread segments **1232** to be formed within the opposite wall of the socket **1210**. Another access window **1230**B is provided through the opposite side of the socket portion **1210** so that a central internal thread segment **1234** can be formed in the opposite wall between the internal thread segments **1232**. The thread segments **1232**, **1234** cooperate to threadably engage the threads **1308** on the implement drive shaft **1300**.

(277) End effector **1000** is configured to removably support a staple cartridge **1040** therein. See FIG. **60**. The staple cartridge **1040** includes a cartridge body **1042** that is configured to be operably seated with the elongate channel **1020**. The cartridge body **1042** has an elongate slot **1046** therein for accommodating the firing member **1200**. The cartridge body **1042** further defines an upper surface referred to herein as the cartridge deck **1044**. In addition, two lines of staggered staple apertures **1048** are provided on each side of the elongate slot **1046**. The staple apertures **1048** operably support corresponding staple drivers **1050** that support one or two surgical staples (not shown) thereon. A variety of such staple driver arrangements are known and may be employed without departing from the spirit and scope of the various exemplary embodiments of the invention.

(278) The firing member embodiments also employ a wedge sled assembly **1250** for driving contact with the staple drivers operably supported within the staple cartridge **1040**. As can be seen in FIG. **60**, the wedge sled assembly **1250** includes at least two wedges **1252** that are oriented for driving contact with the lines of staple drivers operably supported within the staple cartridge **1040**. As the firing member **1200** is driven distally, the wedge sled assembly **1250** travels with the firing member **1220** and the wedges **1252** thereon force the drivers **1050** upward towards the closed anvil **1100**. As the drivers **1050** are driven upwardly, the surgical staples supported thereon are driven out of their respective apertures **1048** into forming contact with the staple forming surface **1104** of the closed anvil **1100**.

(279) Various exemplary end effector embodiments disclosed herein may also employ a unique and novel firing lockout arrangement that will prevent the clinician from inadvertently advancing or “firing” the firing member when a cartridge is not present, a cartridge has not been properly seated within the end effector and/or when a spent cartridge remains installed in the end effector. For example, as will be discussed in further detail below, the firing lockout arrangement may interact with the implement drive shaft **1300** and/or the firing member **1200** to prevent inadvertent advancement of the firing member **1200** when one of the aforementioned conditions exist.

(280) In the illustrated exemplary embodiment, rotation of the implement drive shaft **1300** in a first rotary or “firing” direction will cause the firing member **1200** to be driven distally through the staple cartridge **1040** if the firing member **1200** is properly aligned with the elongate slot **1046** in the cartridge body **1042** (FIG. **60**), the channel slot **1028** in the elongate channel **1020** and the anvil slot **1103** in the anvil **1100**, for example. Referring primarily to FIG. **90**, the elongate slot **1046**, the channel slot **1028** and/or the anvil slot **1103** can guide the firing member **1200** as it moves along

the path through the surgical end effector **1000**, for example, during a firing stroke. When the firing member **1200** is in the operable configuration, the channel slot **1028** is configured to receive the foot portion **1206** of the firing member **1200** and the anvil slot **1103** is configured to receive the upper fins **1208** of the firing member **1200**, for example. When a portion of the firing member **1200** is positioned in the channel slot **1028** and/or the anvil slot **1103**, the firing member **1200** can be aligned or substantially aligned with the axis A. The channel slot **1028** and/or the anvil slot **1103** can guide the firing member **1200** and maintain the alignment of the firing member **1200** with the axis A as the firing member **1200** moves from the initial position to the secondary position relative to the cartridge body **1042**, for example.

(281) As was briefly discussed above, in various surgical staple cartridge examples, the surgical staples are supported on movable staple drivers supported in the cartridge body. Various exemplary end effector embodiments employ a wedge sled assembly **1250** that is configured to contact the staple drivers as the wedge sled assembly is driven distally through the staple cartridge to drive the staples out of their respective cavities in the cartridge body and into forming contact with the closed anvil. In at least one exemplary embodiment, the wedge sled **1250** is positioned within the staple cartridge **1040**. Thus, each new staple cartridge **1040** has its own wedge sled operably supported therein. When the clinician properly seats a new staple cartridge **1040** into the elongate channel, the wedge sled **1250** is configured to straddle the implement drive shaft **1300** and engage the firing member **1200** in the manner illustrated in FIGS. **60**, **88** and **89**, for example. As can be seen in those Figures, the exemplary wedge sled assembly **1250** can comprise a sled body **1414**, a flange **1410**, and wedges **1252**. The sled body **1414** can be positioned around a portion of the implement drive shaft **1300** when the wedge sled assembly **1250** is positioned in the elongate channel **1020**. The sled body **1414** can be structured such that the sled body **1414** avoids contact with the implement drive shaft **1300** when the sled body **1414** is positioned around the implement drive shaft **1300**. The sled body **1414** can comprise a contour **1412**, for example, that curves over and/or around the implement drive shaft **1300**. In such embodiment, for example, a flange **1410** extends between the sled body **1414** and each of the wedges **1252**. In addition, the sled body **1414** has a notch **1415** therein that is configured to receive therein a portion of the firing member body **1203**. Referring primarily to FIG. **89**, the flange **1410** can extend substantially parallel to the foot portion **1206** of the firing member **1200** when the firing member **1200** engages the wedge sled assembly **1250**.

(282) When a new staple cartridge **1040** has been properly installed in the elongate channel **1020**, initial actuation of the firing member **1200** (e.g., by rotating the implement drive shaft **1300**) causes a portion of the firing member body **1203** to enter the notch **1415** in the wedge sled **1250** which thereby results in the alignment of the firing member **1200** with the elongate slot **1046** in the cartridge body **1042** (FIG. **60**), the channel slot **1028** in the elongate channel **1020** and the anvil slot **1103** in the anvil **1100** to enable the firing member **1250** to be distally advanced through the staple cartridge **1040**. Hence, the wedge sled may also be referred to herein as an “alignment member”. If the staple cartridge **1040** has been improperly installed in the elongate channel, activation of the firing member **1200** will not result in the aligning engagement with the notch **1415** in the wedge sled **1250** and the firing member **1200** will remain out of alignment with the channel slot **1028** in the elongate channel **1020** and the anvil slot **1103** in the anvil **1100** to thereby prevent the firing member **1250** from being fired.

(283) After a new staple cartridge **1040** has been properly installed in the elongate channel **1020**, the clinician fires the firing member by applying a first rotary motion to the implement drive shaft **1300**. Once the firing member **1250** has been distally driven through the staple cartridge **1250** to its distal-most position, a reverse rotary motion is applied to the implement drive shaft **1300** to return the firing member **1250** to its starting position external to the surgical staple cartridge **1040** to enable the spent cartridge to be removed from the elongate channel **1020** and a new staple cartridge to be installed therein. As the firing member **1250** is returned to its starting position, the wedge sled

1250 remains in the distal end of the staple cartridge and does not return with the firing member **1200**. Thus, as the firing member **1200** moves proximally out of the staple cartridge **1040** and the anvil slot **1103** in the anvil, the rotary motion of the implement drive shaft **1300** causes the firing member **1200** to pivot slightly into an inoperable position. That is, when the firing member **1200** is in the inoperable position (outside of the cartridge), should the clinician remove the spent cartridge **1040** and fail to replace it with a fresh cartridge containing a new wedge sled **1250** and then close the anvil **1110** and attempt to fire the firing member **1200**, because there is no wedge sled present to align the firing member **1200**, the firing member **1200** will be unable to advance distally through the elongate channel **1020**. Thus, such arrangement prevents the clinician from inadvertently firing the firing member **1200** when no cartridge is present.

(284) In such exemplary embodiment, the firing member **1200** can be substantially aligned with an axis A when the firing member **1200** is oriented in an operable configuration such that the firing member **1200** can move along a path established through the end effector **1000**. The axis A can be substantially perpendicular to the staple forming surface **1104** of the anvil **1100** and/or the cartridge deck **1044** of the staple cartridge **1040** (FIG. **60**). In other exemplary embodiments, the axis A can be angularly oriented relative to the staple forming surface **1104** of the anvil **1100** and/or the cartridge deck **1044** of the staple cartridge **1040**. Further, in at least one exemplary embodiment, the axis A can extend through the center of the surgical end effector **1000** and, in other exemplary embodiments, the axis A can be positioned on either side of the center of the surgical end effector **1000**.

(285) FIGS. **91-97** illustrate one exemplary form of a surgical end effector **1400** that employs a unique and novel firing lockout arrangement. As can be seen in FIGS. **91-95**, when the firing member **1200** is in the initial position, the firing member **1200** is in an inoperable configuration which prevents its distal advancement through the end effector due to the misalignment of the firing member **1200** with the channel slot **1028** and the anvil slot **1103**. The firing member **1200** may be retained in the inoperable configuration by a firing lockout generally designated as **1418**. Referring primarily to FIGS. **91-93**, in at least one form, for example, the firing lockout **1418** includes a first lockout groove or notch **1402** that is formed in the elongate channel **1020**. In other exemplary embodiments, however, the first lockout notch **1402** can form an opening in the first jaw **1004**, the second jaw **1006**, the elongate channel **1020** and/or the anvil **1100**, for example. In various exemplary embodiments, the first lockout notch **1402** is located in the surgical end effector **1400** such that the first lockout notch **1402** retainingly engages a portion of the firing member **1200** when the firing member **1200** is in the inoperable configuration. The first lockout notch **1402** can be near, adjacent to, and/or connected to the channel slot **1028** in the elongate channel **1020**, for example. Referring primarily to FIG. **91**, the channel slot **1028** can have a slot width along the length thereof. In at least one exemplary embodiment, the first lockout notch **1402** can extend from the channel slot **1028** such that the combined width of the channel slot **1028** and the first lockout notch **1402** exceeds the slot width of the channel slot **1028**. As can be seen in FIG. **91**, when the firing member **1200** is in the inoperable configuration, the foot portion **1206** of the firing member **1200** extends into the first lockout notch **1402** to thereby prevent its inadvertent distal advancement through the elongate channel **1020**.

(286) When a new staple cartridge **1040** has been properly installed in the elongate channel **1020**, initiation of the firing stroke causes the firing member to engage the wedge sled **1250** positioned within the staple cartridge **1040** which moves the firing member **1200** into driving alignment with the elongate slot **1046** in the cartridge body **1042**, the channel slot **1028** in the elongate channel **1020** and the anvil slot **1103** in the anvil **1100** to enable the firing member **1250** to be distally advanced therethrough. As the firing member **1200** moves from the initial position to the secondary position relative to the staple cartridge **1040**, the firing member **1200** can move past the first lockout notch **1402**, for example. The first lockout notch **1402** can have a length of approximately 0.25 inches, for example. In some other exemplary embodiments, the first lockout notch **1402** can

have a length of approximately 0.15 inches to approximately 0.25 inches, for example, or of approximately 0.25 inches to approximately 1.0 inch, for example.

(287) Referring primarily to FIGS. **93** and **94**, the surgical end effector **1400** can be structured to accommodate the upper fins **1208** of the firing member **1200** when the firing member **1200** is in the inoperable configuration. For example, the firing lockout **1418** can include a second lockout groove or notch **1404** in the anvil **1100**. In the illustrated exemplary embodiment, for example, the second lockout notch **1404** can be near, adjacent to, and/or connected to the anvil slot **1103** in the anvil **1100**, for example. The anvil slot **1103** can have a slot width along the length thereof. In at least one exemplary embodiment, the second lockout notch **1404** can extend from the anvil slot **1103** such that the combined width of the anvil slot **1103** and the second lockout notch **1404** exceeds the slot width of the anvil slot **1103**. The second lockout notch **1404** can extend a length or distance in the surgical end effector **1400**. The firing member **1200** can be structured to engage the second lockout notch **1404** along the length thereof when the firing member **1200** is in the inoperable configuration. As the firing member **1200** moves from the initial position to the secondary position relative to the staple cartridge **1040**, the firing member **1200** can move past the second lockout notch **1404**, for example. The second lockout notch **1404** can have a length of approximately 0.25 inches, for example. In some other exemplary embodiments, the second lockout notch **1404** can have a length of approximately 0.15 inches to approximately 0.25 inches, for example, or of approximately 0.25 inches to approximately 1.0 inch, for example. Referring primarily to FIG. **93**, the first lockout notch **1402** can extend from the channel slot **1028** in a first direction X and the second lockout notch **1404** can extend from the anvil slot **1103** in a second direction Y. In at least one exemplary embodiment, the first direction X can be substantially laterally opposite to the second direction Y. In such exemplary embodiments, the foot portion **1206** of the firing member **1200** can pivot into the first lockout notch **1402** and the upper fins **1208** of the firing member **1200** can pivot into the second lockout notch **1404** when the firing member **1200** moves to the inoperable configuration.

(288) Referring primarily to FIGS. **92-94**, when the firing member **1200** is oriented in the inoperable configuration, corresponding portions of the firing member **1200** engage the first and second lockout notches **1402**, **1404**. The firing member **1200** can be positioned at least partially within the first and second lockout notches **1402**, **1404** when the firing member **1200** is in the inoperable configuration. The firing member **1200** can shift into the first and second lockout notches **1402**, **1404** when the firing member **1200** moves to the inoperable configuration. Further, when the firing member **1200** is oriented in the operable configuration, the firing member **1200** can disengage the first and second lockout notches **1402**, **1404**.

(289) A portion or portions of the surgical end effector **1400** can block the firing member **1200** and limit or prevent movement of the firing member **1200** through the surgical end effector **1400** when the firing member **1200** is oriented in the inoperable configuration (see, e.g., FIG. **95**). For example, the first jaw **1004**, the second jaw **1006**, the elongate channel **1020** and/or the anvil **1100** can be configured to block the firing member **1200** when it is in the operable configuration. In some exemplary embodiments, the first lockout notch **1402** has a first blocking surface or edge **1406** (FIGS. **91** and **92**) formed thereon and the second lockout notch **1404** has a second blocking surface or edge **1408** formed thereon (FIG. **94**). Attempts to fire the firing member **1200** while the firing member **1200** is in the inoperable configuration will result in corresponding portions of the firing member **1200** contacting one or both of the first and second blocking surfaces **1406**, **1408** to prevent the firing member **1200** from moving from the initial position towards the secondary positions. In at least one exemplary embodiment, the surgical end effector **1400** need not have both the first blocking edge **1406** and the second blocking edge **1408**.

(290) FIGS. **97-104** illustrate another exemplary surgical end effector embodiment **1500** that employs another exemplary firing lockout arrangement. For example, as can be seen in those Figures, a surgical end effector **1500** can comprise the elongate channel **1020**, the implement drive

shaft **1300**, and the firing member **1200**. The surgical end effector **1500** can also comprise an end effector drive housing **1510** (see, e.g. FIG. **100**). Similar to the end effector drive housing **1010** described herein, the end effector drive housing **1510** can comprise a bearing sleeve **1511** and the third ring gear or housing drive member **768**. The bearing sleeve **1511** can be structured such that the bearing segment **1304** of the implement drive shaft **1300** can be moveably positioned in the bearing sleeve **1511**. The bearing segment **1304** can move in the bearing sleeve **1511** as the implement drive shaft **1300** moves between an inoperable position and an operable position, as described herein. The bearing sleeve **1511** can comprise a bore **1512** having an elongated cross-section such as, for example, a cross-sectional shape comprising an oval, an ellipse and/or semicircles having longitudinal and/or parallel sides therebetween. In such exemplary embodiments, the bearing segment **1304** can be positioned against or near a first side of the bore **1512** such as, for example, a first semicircle, when the implement drive shaft **1300** is in the inoperable position. Further, the bearing segment **1304** can be positioned against or near a second side of the bore **1512** such as, for example, a second semicircle, when the implement drive shaft **1300** is in the operable position.

(291) The implement drive shaft **1300** can be moveable between the inoperable position and the operable position. As described herein, a biasing member **1520** and/or a portion of the staple cartridge **1040** can move the implement drive shaft **1300** between the inoperable position and the operable position, for example. In the illustrated embodiment and others, the implement drive gear **1302** of the implement drive shaft **1300** can be engaged with the third ring gear **768** of the end effector drive housing **1510** when the implement drive shaft **1300** is in the operable position. The implement drive gear **1302** can be an external gear, for example, and the third ring gear **768** can be an internal gear, for example. The implement drive gear **1302** can move into engagement with the third ring gear **768** when the implement drive shaft **1300** moves from the inoperable position to the operable position. Further, the implement drive gear **1302** can be disengaged from the third ring gear **768** when the implement drive shaft **1300** is in the inoperable position. In at least one exemplary embodiment, the implement drive gear **1302** can move out of engagement with the third ring gear **768** when the implement drive shaft **1300** moves from the operable position to the inoperable position. Similar to other exemplary embodiments described herein, when the implement drive shaft **1300** is engaged with the third ring gear **768** in the end effector drive housing **1510**, the drive system **750** (FIG. **61**) can drive the firing member **1200** through the elongate channel **1020** of the surgical end effector **1500**, for example, during a firing stroke.

(292) Referring primarily to FIGS. **101** and **102**, the bearing segment **1304** can be positioned against the first side of the bore **1512** of the bearing sleeve **1511** when the implement drive shaft **1300** is in the inoperable position. A retaining pin **1514** (FIGS. **98**, **100**, **101** and **103**) can be structured to bias the bearing segment **1304** against the first side of the bore **1512** such that the implement drive shaft **1300** is held in the inoperable position, for example, and the implement drive gear **1302** is held out of engagement with the third ring gear **768**, for example. In some exemplary embodiments, the retaining pin **1514** can be spring-loaded such that retaining pin **1514** exerts a force on the bearing segment **1304** to move the implement drive shaft **1300** towards the inoperable position. The implement drive shaft **1300** can remain in the inoperable position until another force overcomes the force exerted by the retaining pin **1514** to move the implement drive shaft **1300** towards the operable position, for example, and the implement drive gear **1302** into engagement with the third ring gear **768**, for example.

(293) Referring primarily to FIGS. **103** and **104**, the bearing segment **1304** can be positioned against the second side of the bore **1512** of the bearing sleeve **1511** when the implement drive shaft **1300** is in the operable position. In various exemplary embodiments, the force exerted by the retaining pin **1514** (FIGS. **98**, **100**, **101** and **103**) can be overcome to move the bearing segment **1304** against the second side of the bore **1512** such that the implement drive shaft **1300** is in the operable position, for example, and the implement drive gear **1302** is engaged with the third ring

gear **768**, for example. As described herein, the biasing element **1520** can exert a force on the bearing segment **1304** that overcomes the force exerted by the retaining pin **1515**, for example.

(294) The surgical end effector **1500** can comprise the biasing element **1520**, which can be moveable between a first set of positions (see, e.g., FIG. **103**) and a second set of positions (see, e.g., FIG. **101**). The second set of positions can be distal to the first set of positions relative to the end effector drive housing **1510**. When the biasing element **1520** is in the first set of positions, the biasing element **1520** can be structured to move the implement drive shaft **1300** to the operable position, for example. When the biasing element **1520** is in the second set of positions, the biasing element **1520** can release the implement drive shaft **1300** such that the implement drive shaft can return to the inoperable position, for example.

(295) The biasing element **1520** can be an independent element positionable in the surgical end effector **1500**. The biasing element **1520** can be moveably retained in the surgical end effector **1500**, for example, and can be operably engageable with the staple cartridge **1040**, for example. The staple cartridge **1040** can comprise the biasing element **1520**. In some exemplary embodiments, the biasing element **1520** can be integrally formed with the wedge sled assembly **1250** of the staple cartridge **1040**, for example, and the biasing element **1520** can be moveably retained in the staple cartridge **1040**, for example. In such exemplary embodiments, the biasing element **1520** can move through the elongate channel **1020** as the wedge sled assembly **1250** and/or the firing member **1200** moves through the elongate channel **1020**, for example, during a firing stroke.

(296) Referring primarily to FIG. **99**, the biasing element **1520** can comprise a biasing body **1522** and legs **1526** extending from the biasing body **1522**. The biasing body **1522** can be positioned around a portion of the implement drive shaft **1300** in the surgical end effector **1500**. In some exemplary embodiments, the biasing body **1522** can be structured such that the biasing body **1522** avoids contact with the implement drive shaft **1300** when the biasing body **1522** is positioned around the implement drive shaft **1300**. The biasing body **1522** can comprise a contour **1524**, for example, that curves over and/or around the implement drive shaft **1300**. The legs **1526** can extend along a portion of the elongate channel **1020** and/or on either side of the implement drive shaft **1300**. The biasing element **1520** can also comprise at least one extension or wedge **1528**. As described herein, the wedge **1528** can moveably engage the bearing sleeve **1511** and/or the bearing segment **1304** to move the implement drive shaft into the operable position. The biasing element **1520** can also comprise at least one spring **1530**. The spring **1530** can be deformable between an initial configuration (FIG. **101**) and deformed configurations (FIG. **103**), for example. The spring **1530** can hold the biasing element **1520** in the first set of positions relative to the end effector drive housing **1510** until a force deforms the spring **1530** from the initial configuration to a deformed configuration. When the spring **1530** moves from the initial configuration to the deformed configuration, the biasing element **1520** can move from the second set of positions to the first set of positions relative to the end effector drive housing **1510**.

(297) Referring primarily to FIG. **101**, before the insertion of the staple cartridge **1040** (FIG. **103**) into the elongate channel **1020**, the spring **1530** can be in the initial configuration, for example, and the biasing element **1520** can be in the second set of positions, for example. The retaining pin **1514** can hold the bearing segment **1304** against the first side of the bore **1512**, for example. In such exemplary embodiments, the implement drive shaft **1300** can be held in the inoperable position by the retaining pin **1514**.

(298) Referring now to FIG. **103**, installation of the staple cartridge **1040** in the elongate channel **1020** moves the biasing element **1520** proximally against the force of springs **1530** into a first set of positions wherein the wedge **1528** moveably engages the bearing sleeve **1511** and the bearing segment **1304** to bias the bearing segment **1304** and the implement drive gear **1302** of the implement drive shaft **1300** into meshing engagement with the third ring gear **768**. Thereafter, actuation of the firing drive system as described herein will result in the firing of the firing member

1200. In some exemplary embodiments, a portion of the staple cartridge **1040** is configured to directly contact the biasing element **1520** to move the biasing element **1520** to the first set of positions. In other exemplary embodiments, a portion of the staple cartridge **1040** is configured to contact another element in the surgical end effector **1500** such as, for example, the firing member **1200**, to operable move the biasing element **1520** to the first set of positions. In still other exemplary embodiments, the staple cartridge **1040** has the biasing element **1520** integrally formed therewith.

(299) In various exemplary embodiments, the biasing element **1520** can move through the elongate channel **1020** of the surgical end effector **1500** as the firing member **1200** and/or the wedge sled assembly **1250** are driven through the elongate channel **1020** by the implement drive shaft **1300**, for example, during a firing stroke, as described herein. The biasing element **1520** can be integrally formed with and/or fixed to the wedge sled assembly **1250** of the staple cartridge **1040**. In such exemplary embodiments, when the staple cartridge **1040** is initially seated in the elongate channel **1020**, the wedge sled assembly **1250** and the biasing element **1520** can be positioned in an initial position relative to the staple cartridge **1040** and/or the elongate channel **1020**. The initial position of the biasing element **1520** can correspond to the first set of positions such that the biasing element **1520** moveably engages the bearing sleeve **1511** of the end effector drive housing **1510** to move the implement drive shaft **1300** into the operable position, as described herein. During the firing stroke, the wedge sled assembly **1250** and the biasing element **1520** can be moved away from the initial or first set of positions, for example. The biasing element **1520** can move to the second set of positions, for example. When the biasing element **1520** moves past the first set of positions and into the second set of positions, the biasing element **1520** may no longer engage the bearing sleeve **1511** of the end effector drive housing **1510** to hold the implement drive shaft **1300** in the operable configuration. Though the biasing element **1520** may not bias the implement drive gear **1302** of the implement drive shaft **1300** into engagement with the third ring gear **768** when the biasing element **1520** moves into the second set of positions, the channel slot **1028**, the anvil slot **1103**, and/or the elongate slot **1046** in the staple cartridge **1040** serve to guide the firing member **1200** in a firing orientation that retains the implement drive gear **1302** of the implement drive shaft **1300** in meshing engagement with the third ring gear **768** and thereby prevents the implement drive shaft **1300** from returning to the inoperable position during the firing stroke.

(300) In at least one exemplary embodiment, the firing member **1200** and/or the implement drive shaft **1300** can drive the wedge sled assembly **1250** and/or the biasing element **1520** to the second set of positions during the firing stroke. In various exemplary embodiments, upon completion of the firing stroke, the firing member **1200** can return to the initial position, however, the wedge sled assembly **1250**, including the biasing element **1520**, can remain in the second set of positions, for example. The firing member **1200** can return to a proximal position in the surgical end effector **1500**, for example, and the biasing element **1520** can remain in a distal position in the surgical end effector **1500**, for example. When the firing member **1200** is in the initial position and the biasing element **1520** is in the second set of positions, the bearing segment **1304** of the implement drive shaft **1300** can shift in the bearing sleeve **1511** such that the implement drive shaft **1300** moves into the inoperable position, for example, and the implement drive gear **1302** moves out of engagement with the third ring gear **768**, for example. In various exemplary embodiments, the implement drive shaft **1300** can remain in the inoperable position until the biasing element **1520** is drawn back into the first set of positions and/or until a replacement biasing element **1520** is positioned in the first set of positions, for example. For example, the spent staple cartridge **1040** is removed from the elongate channel **1020** and replaced with a replacement staple cartridge **1040**, which can comprise a biasing element **1520** located in its first positions. When the replacement staple cartridge **1040** is positioned in the elongate channel **1020**, the biasing element **1520** thereof shifts the implement drive gear **1302** into engagement with the third ring gear **768**, for example, and into the operable position, for example. In such exemplary embodiments, the surgical end effector **1500** can be

prevented from being re-fired when no cartridge **1040** or a spent cartridge **1040** is seated in the elongate channel **1020**. In addition, if the staple cartridge has not been properly seated in the elongate channel **1020** such that the biasing element **1520** has not moved the implement drive shaft **1300** into meshing engagement with the third ring gear **768**, the firing member **1200** cannot be fired.

(301) As described above, a surgical instrument system can include a surgical housing, replaceable end effector assemblies that can be connected to the surgical housing for use during a surgical technique and then disconnected from the housing after they have been used, and a motor and/or an actuator configured to fire the end effectors. In various circumstances, a surgeon can choose from several different replaceable end effectors for use during a surgical procedure. For example, a surgeon may first select a first replaceable end effector configured to staple and/or incise a patient's tissue that includes a staple cartridge length of approximately 15 millimeters (“mm”), for example, to make a first cut in the patient tissue. In such an embodiment, a cutting blade and/or a staple-driving sled can be advanced along the approximately 15 mm length of the staple cartridge by a drive screw in order to cut and staple approximately 15 mm of patient tissue. The surgeon may then select a second replaceable end effector, also configured to staple and/or incise patient tissue, which can include a staple cartridge length of approximately 30 mm to make a second cut in the patient's tissue. In such an embodiment, a cutting blade and/or a staple-driving sled can be advanced along the approximately 30 mm length of the staple cartridge by a drive screw to cut and staple approximately 30 mm of the patient's tissue. The surgeon may also select a replaceable end effector configured to staple and/or incise patient tissue that includes a staple cartridge length of approximately 45 mm to make a cut in the patient's tissue, for example. In such an embodiment, a cutting blade and/or a staple driving sled can be advanced along the approximately 45 mm length of the staple cartridge by a drive screw to cut and staple approximately 45 mm of the patient's tissue. The surgeon may also select a replaceable end effector, which can also be configured to staple and/or incise patient tissue, which includes a staple cartridge length of approximately 60 mm to make a cut in the patient's tissue, for example. In such an embodiment, a cutting blade and/or a staple driving sled can be advanced along the approximately 60 mm length of the staple cartridge by a drive screw to cut and staple approximately 60 mm of the patient's tissue. The 15 mm, 30 mm, 45 mm, and/or 60 mm lengths of the end effectors discussed above are exemplary. Other lengths can be used. In certain embodiments, a first end effector can include a staple cartridge having a length of x, a second end effector can include a staple cartridge having a length of approximately 2*x, a third end effector can include a staple cartridge having a length of approximately 3*x, and a fourth end effector can include a staple cartridge having a length of approximately 4*x, for example.

(302) In some surgical instrument systems utilizing replaceable end effectors having different lengths, the drive screws in each of the different replaceable end effectors may be identical except that the length of each drive screw may be different in order to accommodate the different length of the associated replaceable end effector. For example, a replaceable end effector comprising a 30 mm staple cartridge may require a drive screw which is longer than the drive screw of a replaceable end effector comprising a 15 mm staple cartridge. In each instance of such surgical instrument systems, however, each drive screw which utilizes the same thread pitch and/or thread lead, described in greater detail below, may require the motor to rotate the drive shaft a different number or revolutions depending on the length of the end effector being used in order for each end effector to be fully fired. For instance, a drive screw providing a 30 mm firing stroke may require twice as many revolutions in order to be fully actuated as compared to a drive screw providing a 15 mm firing stroke. In such surgical instrument systems, electronic communication between the surgical housing and the replaceable end effector can be utilized to ensure that the electric motor in the surgical housing turns a correct number of revolutions for the length of the attached replaceable end effector. For example, a replaceable end effector may include an electronic circuit that can be

identified by the surgical instrument system so that surgical instrument system can turn the motor a correct number of revolutions for the attached end effector. In addition to or in lieu of the above, the replaceable end effector may include a sensor that senses when an end effector has been completely actuated. In such an embodiment, the sensor can be in signal communication with a controller in the housing configured to stop the motor when the appropriate signal is received. While suitable for their intended purposes, such electronic communication between the surgical housing and the replaceable end effector may increase the complexity and/or cost of such surgical instrument systems.

(303) As outlined above, end effectors having different lengths can be used on the same surgical instrument system. In the surgical instrument systems described above, replaceable end effectors having different firing lengths include drive screws that revolve a different number of times to accommodate the different firing lengths. In order to accommodate the different number of revolutions required for different drive screws, the motor driving the drive screw is operated for a longer duration or a shorter duration, and/or a larger number of revolutions or a smaller number of revolutions, depending on whether a longer firing length or a shorter firing length is needed. Embodiments of replaceable end effectors described below enable a surgical instrument system comprising a motor configured to turn a fixed or set number of revolutions to actuate end effectors having different firing lengths. By operating the motor a fixed number of revolutions, the need for the surgical instrument system to identify the length of the end effector may not be necessary. Each end effector in the embodiments described below includes a drive screw with a thread pitch and/or thread lead that enables an actuating portion of an end effector, such as a cutting blade, for example, to travel the full length of a particular end effector in the fixed number of revolutions of the motor.

(304) Referring to FIG. **105**, a drive screw **1700** can be rotated in a first direction to move a cutting blade **1730** of an end effector **1740** in a distal direction indicated by arrow E. In use, the drive screw **1700** can be rotated a fixed or set number of times to advance the cutting blade **1730** a full firing length, indicated by length L in FIG. **105**. For each revolution of the drive screw **1700**, in certain embodiments, the cutting blade **1730** can be moved in the direction of arrow E by an amount equal to the thread pitch, thread lead, and/or distance between adjacent windings of thread **1708** on the drive screw **1700**, described below in greater detail. In various embodiments, a first drive screw can include a first set of characteristics that defines a first firing length while a second drive screw can include a second set of characteristics that defines a second firing length wherein the first set of characteristics can be different than the second set of characteristics.

(305) Now referring to FIGS. **106**A, **107**, **108**A, and **109**A, further to the above, the distance between thread windings on a drive screw can be proportional to the angle of threads on the drive screw. Put differently, the angle at which threads are arranged on a drive screw can be a characteristic of a drive screw that defines the thread pitch and/or thread lead of the drive screw. A longer drive screw for use in a longer end effector can utilize a larger thread pitch and/or thread lead than a shorter drive screw for use in a shorter end effector in embodiments where the drive screws, and a motor driving the drive screws, turn a fixed number of revolutions. The drive screw **1700** in FIG. **106**A includes a single thread A arranged at an angle α relative to the longitudinal axis **1701** on the drive screw **1700** wherein the thread A defines a thread pitch and/or thread lead having a length X. FIG. **106**B shows a cross-sectional view of the drive screw **1700** and the single thread A. In certain embodiments, the drive screw **1700** may include more than one thread, as described in greater detail below.

(306) FIG. **107**A shows a drive screw **1700**′ which can include a first thread A′ and a second thread B′. FIG. **107**B shows a cross-sectional view of the drive screw **1700**′ wherein the first thread A′ and the second thread B′ are positioned approximately 180° out of phase with each other on the drive screw **1700**′. In various embodiments, a drive screw with a first thread A′ and a second thread B′ can increase the number of threads per unit length compared to a drive screw using a single thread

A′ or B′. Where a drive screw includes more than one thread, the distance from a winding of a first thread to an adjacent winding of a second thread is referred to as "thread pitch." The distance from one winding of a thread to the next winding of the same thread is referred to as "thread lead." For a drive screw with a single thread, the thread pitch and the thread lead are the same. For example, and with reference to FIG. **107**A, the distance from a winding of thread A′ to an adjacent winding of thread B′ defines the thread pitch of the drive screw **1700′**. The distance from a winding of thread A′ to the next winding of thread A′ defines the thread lead of the drive screw **1700′**. Thus, the thread lead of the drive screw **1700′** in FIG. **107**A is equal to X′ and the thread pitch is equal to X′/2. The drive screw **1700** shown in FIGS. **106**A and **106**B has a single thread and therefore the thread pitch and thread lead are both equal to X. The thread lead of a drive screw determines the length that a firing member, such as a cutting blade **1730** and/or a staple driver, for example, will travel for a single revolution of the drive screw.

(307) Returning to FIG. **107**A, the first thread A′ and the second thread B′ each are arranged at an angle β, relative to the longitudinal axis **1701** of the drive screw **1700′**. Angle β, is less than angle α and the thread lead X′ of the drive screw **1700′** in FIG. **107**A is greater than the thread lead X of the drive screw **1700** shown in FIG. **106**A. For a single rotation of the drive screw **1700′**, a cutting blade will move a length X′ along the drive screw **1700′**. For example, the thread lead X′ can be double the thread pitch or thread lead X of the drive screw **1700** shown in FIG. **106**A wherein, as a result, a cutting blade engaged with the drive screw **1700′** of FIG. **107**A will move twice the distance for a single revolution of drive screw **1700′** as would a cutting blade engaged with the drive screw **1700** of FIG. **106**A.

(308) FIG. **108**A shows a drive screw **1700″** which can include a first thread A″, a second thread B″, and a third thread C″ each extending at an angle γ relative to the longitudinal axis **1701** of the drive screw **1700″**. FIG. **108**B is a cross-sectional view of the drive screw **1700″** and shows the threads A″, B″, and C″ arranged approximately 120° out of phase. The angle γ is smaller than the angle β in FIG. **107**A and the thread lead X″ of the drive screw **1700″** in FIG. **108**A is greater than the thread lead X′ of the drive screw **1700′** shown in FIG. **107**A. Similarly, FIG. **109**A shows a drive screw **1700‴** which can include a first thread A‴, a second thread B‴, a third thread C‴, and a fourth thread D‴, each of which extends at an angle δ relative to the longitudinal axis Z of the drive screw **1700‴**. FIG. **109**B is a cross-sectional view of the drive screw **1700‴** and shows the threads arranged approximately 90° out of phase. The angle δ is smaller than angle γ and the thread lead X‴ of the drive screw **1700‴** is larger than that of drive screw **1700″** in FIG. **108**A.

(309) An exemplary surgical instrument system may include a housing and a motor in the housing configured to turn a fixed number of revolutions that results in a drive screw of a connected replaceable end effector turning 30 revolutions, for example. The surgical instrument system can further include a plurality of replaceable surgical stapler end effectors, wherein each of the end effectors can include a cutting blade and/or staple driver driven by the drive screw, for example. In at least one such embodiment, a first replaceable end effector can include a staple cartridge having a length of 15 mm, for example. The drive screw **1700** shown in FIGS. **2**A and **2**B can be used in the first replaceable end effector. The thread lead X can be set to 0.5 mm, for example, so that the cutting blade and/or staple driver can travel the 15 mm length of the staple cartridge in the 30 revolutions of the drive screw **1700**. A second replaceable end effector can include a staple cartridge having a length of 30 mm, for example, and a drive screw, such as drive screw **1700″** illustrated in FIGS. **107**A and **107**B, for example. The thread lead X′ of the drive screw **1700′** can be set to 1.0 mm, for example, so that the cutting blade and/or staple drive can travel the 30 mm length of the staple cartridge in the 30 revolutions of the drive screw **1700′**. Similarly, a third replaceable end effector with a staple cartridge having a length of 45 mm, for example, can include a drive screw, such as drive screw **1700″** in FIGS. **108**A and **108**B, having a thread lead X″ of 1.5 mm, for example, so that the cutting blade and/or staple drive travels the 45 mm length of the staple deck in the 30 revolutions of the drive screw **1700″**. A fourth replaceable end effector with a staple

cartridge having a length of 60 mm, for example can include a drive screw, such as drive screw **1700‴** in FIGS. **109**A and **109**B, having a thread lead X‴ of 2.0 mm, for example, so that the cutting blade and/or staple drive travels the 60 mm length of the staple deck in the 30 revolutions of the drive screw **1700‴**.

(310) FIG. **110** shows the cutting blade **1730** of FIG. **105** removed from the remainder of the end effector **1740**. The cutting blade **1730** includes a passage **1732** though which the drive screw **1700** passes. Side portions **1736** form interior walls of the passage **1732** and can include recesses, such a grooves **1734**, for example, which are configured to receive threads **1708** on the drive screw **1700**. The grooves **1734** are oriented at an angle ε that corresponds to the angle of the threads **1708** on the drive screw **1700**. For example, if the threads **1708** are set to the angle α, shown in FIG. **106**A, then the angle ε of the grooves **1734** can also be set to the angle α. Correspondingly, the angle ε of the grooves **1734** can be set to the angles β, δ and/or γ, for example, of the corresponding drive screw used therewith.

(311) In various embodiments, as illustrated in the exploded view of FIG. **110**, the side portions **1736** can be assembled into windows **1738** defined in a shaft portion **1746** of the cutting blade **1730**. In certain embodiments, a cutting blade **1730** can comprise integral side portions. In at least one embodiment, the side portions can comprise an appropriate groove angle ε matching an angle of the threads **1708** on a drive screw **1700** which can be formed in the passage **1732** defined therein. Providing a cutting blade **1730** with an appropriate groove angle ε for a particular drive screw can be accomplished in numerous ways. In certain embodiments, a generic cutting blade **1730** can be provided that does not include side portions **1736** assembled into the windows **1738** of the shaft portion **1746** thereof wherein various sets of side portions **1736** can be provided such that a desired set of side portions **1736** can be selected from the various sets of side portions **1736** and then assembled to the generic cutting blade **1730** so that such an assembly can be used with a specific drive screw. For instance, a first set of side portions **1736**, when assembled to the cutting blade **1730**, can configure the cutting blade **1730** to be used with a first drive screw and a second set of side portions **1736**, when assembled to the cutting blade **1730**, can configure the cutting blade **1730** to be used with a second drive screw, and so forth. In certain other embodiments, a cutting blade **1730** can be provided with side portions formed integrally therewith. In at least one such embodiment, the grooves **1734** can be formed, e.g., with a tap, at the angle ε that matches the angle of threads **1708** of a particular drive screw **1700**.

(312) FIG. **111** illustrates the drive screw **1700** coupled to a drive shaft **1750** via an intermediate gear **1720** disposed therebetween. The drive shaft **1750** is turned by a motor. As described above, the motor can complete a fixed or set number of revolutions and, as a result, the drive shaft **1750** can turn a fixed number of revolutions R. In certain embodiments, the number of revolutions R turned by the drive shaft **1750** may be equal to the fixed number of revolutions turned by the motor. In alternative embodiments, the number of revolutions R turned by the drive shaft **1750** may be greater than or less than the fixed number revolutions turned by the motor. In various embodiments, one or more gears arranged between the motor and the drive shaft **1750** can cause the drive shaft **1750** to complete more revolutions or fewer revolutions than the motor. In certain embodiments, the drive shaft **1750** can include an external spline gear **1752** surrounding and/or attached to the distal end **1754** of the drive shaft **1750**. The external spline gear **1752** can engage an internal spline gear **1724** defined in the intermediate gear **1720** in order to transmit rotation of the drive shaft **1750** to the intermediate gear **1720**. As a result, in at least one embodiment, the intermediate gear **1720** can complete the same revolutions R as the drive shaft **1750**.

(313) The intermediate gear **1720** can include a second gear **1722** that is engaged to a gear **1712** surrounding and/or attached to a proximal end **1702** of the drive screw **1700**. The second gear **1722** of the intermediate gear **1720** defines a first diameter D**1** and the gear **1712** on the proximal end **1702** of the drive screw **1700** defines a second diameter D**2**. The second diameter D**2** can be different than the first diameter D**1**. When the first diameter D**1** and the second diameter D**2** are

different, they can define a gear ratio that is different than 1:1. As shown in FIG. **111**, in certain embodiments, diameter D**1** can be larger than diameter D**2** such that the drive screw **1700** will complete more revolutions R′ than the revolutions R turned by the drive shaft **1750** and the intermediate gear **1720**. In alternative embodiments, diameter D**1** can be smaller than diameter D**2** such that the drive screw **1700** will turn fewer revolutions R′ than the revolutions R turned by the drive shaft **1750** and the intermediate gear **1720**.

(314) The gear ratio between the second gear **1722** of the intermediate gear **1720** and the gear **1712** of the drive screw **1700** can be set so that the drive screw **1700** completes a certain number of revolutions when the drive shaft **1750** completes its fixed number of revolutions. If the intermediate gear **1722** is part of the replaceable end effector assembly, then the gear ratio between the intermediate gear **1722** and the drive screw **1700** in each replaceable end effector assembly can be set so that the motor in the surgical housing can turn a fixed number of revolutions. For example, referring to FIG. **111**, assuming that the drive shaft **1750** turns a fixed 30 revolutions and that the replaceable surgical stapler includes a 15 mm staple cartridge and if the end effector includes a drive screw with a thread lead of 0.25 mm, then the drive screw will complete 60 revolutions to advance a cutting blade and/or a staple driver the 15 mm length of the staple cartridge. In at least one embodiment, the intermediate gear **1720** can be sized so that the second interior gear **1722** has a diameter D**1** that is double the diameter D**2** of the external gear **1712** of the drive screw **1700**. As a result, the drive screw **1700** will complete 60 revolutions when the drive shaft **1750** completes 30 revolutions. If a second replaceable surgical stapler includes a 30 mm staple cartridge, then a drive screw with a thread lead of 0.25 mm will complete 120 revolutions to advance a cutting blade and/or staple driver the 30 mm length. The intermediate gear **1720** of the replaceable surgical stapler can be sized so that the second interior gear **1722** has a diameter D**1** that is four times the diameter D**2** of the external gear **1712** of the drive screw **1700**. As a result, the drive screw **1700** will complete 120 revolutions when the drive shaft **1750** completes 30 revolutions.

(315) Returning to FIG. **105**, in certain embodiments, a firing path of the firing member, e.g., cutting blade **1730**, can be linear. In certain embodiments, the firing patch can be curved and/or curvilinear. In certain embodiments, the drive screw **1708** can be flexible to enable the drive screw **1708** to follow lateral motions of the firing member along a curved and/or curvilinear path, for example. In certain embodiments, the firing member can be flexible or can include at least one flexible portion to enable portions of the firing member to displace laterally relative to the drive screw **1708**, for example, along a curved and/or curvilinear path while remaining portions of the firing member are not laterally displaced relative to the drive screw **1708**. In certain embodiments, the firing length may be defined by the distance moved by the firing member along the firing path regardless of the overall net displacement. In various other embodiments, the firing length may be defined by the overall net displacement of the firing member regardless of the firing path.

(316) In various embodiments, a kit for use with a surgical instrument system may be provided that includes various replaceable end effectors having different lengths. In certain embodiments, the kit may include a selection of replaceable end effectors having different lengths from which a surgeon may choose for use in a surgical operation on a patient. The kit can also include several replaceable end effectors of each length. In certain embodiments, the kit may include a sequence of replaceable end effectors of different lengths wherein the sequence is predetermined for a particular surgical procedure. For example, a certain surgical procedure first may call for a 15 mm incision, then a second 15 mm incision, and finally a 30 mm incision. A surgical kit for this surgical procedure can include three replaceable end effectors configured to incise and staple a patient's tissue. The first two replaceable end effectors can include an approximately 15 mm length and the third replaceable end effector can include an approximately 30 mm length.

(317) FIGS. **112-117** illustrate another exemplary elongate shaft assembly **2200** that has another exemplary quick disconnect coupler arrangement **2210** therein. In at least one form, for example,

the quick disconnect coupler arrangement **2210** includes a proximal coupler member **2212** in the form of a proximal outer tube segment **2214** that has tube gear segment **354** thereon that is configured to interface with the first drive system **350** in the above-described manner. As discussed above, the first drive system **350** serves to rotate the elongate shaft assembly **2200** and the end effector **1000** operably coupled thereto about the longitudinal tool axis “LT-LT”. The proximal outer tube segment **2214** has a “necked-down” distal end portion **2216** that is configured to receive a locking tube segment **2220** thereon. The quick disconnect arrangement **2210** further includes a distal coupler member **2217** in the form of a distal outer tube portion **2218** that is substantially similar to the distal outer tube portion **231** described above except that the distal outer tube portion **2218** includes a necked down proximal end portion **2219**. A distal outer formation or dovetail joint **2226** is formed on the end of the proximal end portion **2219** of the distal outer tube segment **2218** that is configured to drivingly engage a proximal outer formation or dovetail joint **2228** that is formed on the distal end portion **2216** of the proximal outer tube segment **2214**.
(318) The exemplary embodiment depicted in FIGS. **112-117** employs an exemplary embodiment of the closure system **670** described above. The quick disconnect coupler arrangement **2210** is configured to facilitate operable coupling of proximal closure drive train assemblies to corresponding distal drive train assemblies. For example, as can be seen in FIG. **113**, the elongate shaft assembly **2200** may include a first proximal closure drive train assembly in the form of a first proximal closure rod segment **2230** and a first distal closure drive train assembly in the form of a first distal closure rod segment **2240** that are configured to be linked together through the quick disconnect coupler arrangement **2210**. That is, in at least one exemplary form, the first proximal closure rod segment **2230** has a first closure joint formation or dovetail joint segment **2234** formed on a distal end **2232** thereof. Likewise, the first distal closure rod segment **2240** has a second closure joint formation or a dovetail joint segment **2244** formed on a proximal end **2242** thereof that is adapted to laterally slidably engage the first dovetail joint segment **2234**. Still referring to FIG. **113**, the elongate shaft assembly **2200** may include a second proximal closure drive train assembly in the form of a second proximal closure rod segment **2250** and a second distal closure drive train assembly in the form of a second distal closure rod segment **2260** that are configured to be linked together through the quick disconnect coupler arrangement **2210**. That is, in at least one exemplary form, the second proximal closure rod segment **2250** has a third closure joint formation or dovetail closure joint segment **2254** formed on a distal end **2252** thereof. Likewise, the distal second distal closure rod segment **2260** may have a fourth closure joint formation or dovetail closure joint segment **2264** formed on a proximal end **2262** of the distal second closure rod segment **2260** that is adapted to laterally engage the third dovetail joint segment **2254**.
(319) In the illustrated embodiment and others, the first proximal closure rod segment **2230** and the second proximal closure rod segment **2250** extend through the proximal drive shaft segment **380′**. The proximal drive shaft segment **380′** comprises a proximal rotary drive train assembly **387′** and the distal drive shaft segment **540′** comprises a distal rotary drive train assembly **548′**. When the proximal rotary drive train assembly **387′** is operably coupled to the distal rotary drive train assembly **548′**, the drive shaft assembly **388′** is formed to transmit rotary control motions to the end effector **1000**. In at least one exemplary embodiment, the proximal drive shaft segment **380′** is substantially similar to the proximal drive shaft segment **380** described above, except that the distal end **381′** of the proximal drive shaft segment **380′** has a distal formation or dovetail drive joint **2270** formed thereon. Similarly, the distal drive shaft segment **540′** may be substantially similar to the distal drive shaft segment **540** described above, except that a proximal formation dovetail drive joint **2280** is formed on the proximal end **542′** thereof that is adapted to drivingly engage the distal dovetail drive joint **2270** through the quick disconnect coupler arrangement **2210**. The first distal closure rod segment **2240** and the distal second closure rod segment **2260** may also extend through the distal drive shaft segment **540′**.
(320) This exemplary embodiment may also include an articulation coupling joint **2300** that

interfaces with the third and fourth drive cables **434**, **454**. As can be seen in FIG. **113**, the articulation coupling joint **2300** comprises a proximal articulation tube **2302** that has a proximal ball joint segment **2306** formed on a distal end **2304** thereof. The proximal articulation tube **2302** includes passages **2308** for receiving the cable end portions **434**A′, **434**B′, **454**A′, **454**B′ therethrough. A proximal ball joint segment **2310** is movably supported on the proximal ball segment **2306**. Proximal cable segments **434**A′, **434**B′, **454**A′, **454**B′ extend through passages **2308** to be attached to the proximal ball joint segment **2310**. The proximal articulation tube **2302**, the proximal ball joint segment **2310** and the proximal cable segments **434**A′, **434**B′, **454**A′, **454**B′ may be collectively referred to as a proximal articulation drive train portion **2314**.
(321) The exemplary articulation coupling joint **2300** may also comprise a distal articulation tube **2320** that has a distal ball joint segment **2324** formed on a proximal end **2322** thereof. The distal ball joint segment **2324** has a first distal formation or dovetail joint **2325** formed thereon that is adapted to drivingly engage a first proximal formation or dovetail joint **2307** formed on the proximal ball joint segment **2306** such that when the first distal dovetail joint **2325** drivingly engages the first proximal dovetail joint **2307**, the distal ball joint segment **2324** and the proximal ball joint segment **2306** form an internal articulation ball assembly. In addition, the articulation coupling joint **2300** further comprises a distal ball segment **2330** that is supported on the distal ball joint segment **2324** and has a second distal formation or dovetail joint **2332** formed thereon that is adapted to drivingly engage a second proximal formation or dovetail joint **2312** on the proximal ball joint segment **2310**. The distal cable segments **444**, **445**, **446**, **447** are attached to the distal ball segment **2340** and extend through passages **2328** in the distal articulation tube **2320**. When joined together, the proximal ball joint segment **2310** and the distal ball joint segment **2324** form an articulation ball **2340** that is movably journaled on the internal articulation ball. The distal articulation tube **2320**, the distal ball segment **2340** and the distal cable segments **444**, **445**, **446**, **4447** may be collectively referred to as a proximal articulation drive train assembly **2316**.
(322) As can be seen in FIG. **115**, the distal portions of the elongate shaft assembly **2200** may be assembled such that the following joint segments are retained in registration with each other by the distal coupler **2217** or distal outer tube portion **2218** to form a distal dovetail joint assembly generally referred to as **2290**: **2226**, **2332**, **2325**, **2280**, **2244** and **2264**. Likewise, the elongate shaft assembly **2200** may be assembled such that the proximal coupler member **2212** or proximal outer tube segment **2214** retains the following joint segments in registration with each other to form a proximal dovetail joint assembly generally designated as **2292**: **2228**, **2312**, **2307**, **2270**, **2234** and **2254**.
(323) The end effector **1000** may be operably coupled to the elongate shaft assembly **2200** as follows. To commence the attachment, the clinician moves the locking tube segment **2220** to a first unlocked position shown in FIGS. **115** and **116**. As can be seen in those Figures, the locking tube segment has an abutment segment **2224** formed on its distal end **2222**. When in the unlocked position, the abutment segment **2224** protrudes distally beyond the proximal dovetail joint assembly **2292** to form an abutment surface for laterally joining the distal dovetail joint assembly **2290** with the proximal dovetail joint assembly **2292**. That is, the clinician may laterally align the distal dovetail joint assembly **2290** with the proximal dovetail joint assembly **2292** and then slide the distal dovetail joint assembly **2290** into lateral engagement with the proximal dovetail joint assembly **2292** until the distal dovetail joint assembly **2290** contacts the abutment segment **2224** at which point all of the corresponding proximal and distal joint segments are simultaneously interconnected. Thereafter, the clinician may move the locking tube segment **2220** distally to a second locked position as shown in FIG. **117**. When in that position, the locking tube segment **2220** covers the quick disconnect joint **2210** and prevents any relative lateral movement between the distal dovetail assembly **2290** and the proximal dovetail assembly **2292**.
(324) While the various exemplary embodiments described above are configured to operably interface with and be at least partially actuated by a robotic system, the end effector and elongate

shaft components may be effectively employed in connection with handheld instruments. For example, FIGS. **118-120** depict a handheld surgical instrument **2400** that may employ various components and systems described above to operably actuate an end effector **1000** coupled thereto. In the exemplary embodiment depicted in FIGS. **118-120**, a quick disconnect joint **2210** is employed to couple the end effector **1000** to the elongate shaft assembly **2402**. To facilitate articulation of the end effector **1000** about the articulation joint **700**, the proximal portion of the elongate shaft assembly **2402** includes an exemplary manually actuatable articulation drive **2410**.
(325) Referring now to FIGS. **121-123**, in at least one exemplary form, the articulation drive **2410** includes four axially movable articulation slides that are movably journaled on the proximal drive shaft segment **380**′ between the proximal outer tube segment **2214** and the proximal drive shaft segment **380**′. For example, the articulation cable segment **434**A′ is attached to a first articulation slide **2420** that has a first articulation actuator rod **2422** protruding therefrom. Articulation cable segment **434**B′ is attached to a second articulation slide **2430** that is diametrically opposite from the first articulation slide **2420**. The second articulation slide **2430** has a second articulation actuator rod **2432** protruding therefrom. Articulation cable segment **454**A′ is attached to a third articulation slide **2440** that has a third articulation actuator rod **2442** protruding therefrom. Articulation cable segment **454**B′ is attached to a fourth articulation slide **2450** that is diametrically opposite to the third articulation slide **2440**. A fourth articulation actuator rod **2452** protrudes from the fourth articulation slide **2450**. Articulation actuator rods **2422**, **2432**, **2442**, **2452** facilitate the application of articulation control motions to the articulation slides **2420**, **2430**, **2440**, **2450**, respectively by an articulation ring assembly **2460**.
(326) As can be seen in FIG. **121**, the articulation actuator rods **2422**, **2432**, **2442**, **2452** movably pass through a mounting ball **2470** that is journaled on a proximal outer tube segment **2404**. In at least one embodiment, the mounting ball **2470** may be manufactured in segments that are attached together by appropriate fastener arrangements (e.g., welding, adhesive, screws, etc.). As shown in FIG. **109**, the articulation actuator rods **2422** and **2432** extend through slots **2472** in the proximal outer tube segment **2404** and slots **2474** in the mounting ball **2470** to enable the articulation slides **2420**, **2430** to axially move relative thereto. Although not shown, the articulation actuator rods **2442**, **2452** extend through similar slots **2472**, **2474** in the proximal outer tube segment **2404** and the mounting ball **2470**. Each of the articulation actuator rods **2422**, **2432**, **2442**, **2452** protrude out of the corresponding slots **2474** in the mounting ball **2470** to be operably received within corresponding mounting sockets **2466** in the articulation ring assembly **2460**. See FIG. **122**.
(327) In at least one exemplary form, the articulation ring assembly **2460** is fabricated from a pair of ring segments **2480**, **2490** that are joined together by, for example, welding, adhesive, snap features, screws, etc. to form the articulation ring assembly **2460**. The ring segments **2480**, **2490** cooperate to form the mounting sockets **2466**. Each of the articulation actuator rods has a mounting ball **2468** formed thereon that are each adapted to be movably received within a corresponding mounting socket **2466** in the articulation ring assembly **2460**.
(328) Various exemplary embodiments of the articulation drive **2410** may further include an exemplary locking system **2486** configured to retain the articulation ring assembly **2460** in an actuated position. In at least one exemplary form, the locking system **2486** comprises a plurality of locking flaps formed on the articulation ring assembly **2460**. For example, the ring segments **2480**, **2490** may be fabricated from a somewhat flexible polymer or rubber material. Ring segment **2480** has a series of flexible proximal locking flaps **2488** formed therein and ring segment **2490** has a series of flexible distal locking flaps **2498** formed therein. Each locking flap **2388** has at least one locking detent **2389** formed thereon and each locking flap **2398** has at least one locking detent **2399** thereon. Locking detents **2389**, **2399** may serve to establish a desired amount of locking friction with the articulation ball so as to retain the articulation ball in position. In other exemplary embodiments, the locking detents **2389**, **2390** are configured to matingly engage various locking dimples formed in the outer perimeter of the mounting ball **2470**.

(329) Operation of the articulation drive **2410** can be understood from reference to FIGS. **122** and **123**. FIG. **122** illustrates the articulation drive **2410** in an unarticulated position. In FIG. **123**, the clinician has manually tilted the articulation ring assembly **2460** to cause the articulation slide **2420** to move axially in the distal direction “DD” thereby advancing the articulation cable segment **434**A′ distally. Such movement of the articulation ring assembly **2460** also results in the axial movement of the articulation slide **2430** in the proximal direction which ultimately pulls the articulation cable **434**B in the proximal direction. Such pushing and pulling of the articulation cable segments **434**A′, **434**B′ will result in articulation of the end effector **1000** relative to the longitudinal tool axis “LT-LT” in the manner described above. To reverse the direction of articulation, the clinician simply reverses the orientation of the articulation ring assembly **2460** to thereby cause the articulation slide **2430** to move in the distal direction “DD” and the articulation slide **2420** to move in the proximal direction “PD”. The articulation ring assembly **2460** may be similarly actuated to apply desired pushing and pulling motions to the articulation cable segments **454**A′, **454**B′. The friction created between the locking detents **2389**, **2399** and the outer perimeter of the mounting ball serves to retain the articulation drive **2410** in position after the end effector **1000** has been articulated to the desired position. In alternative exemplary embodiments, when the locking detents **2389**, **2399** are positioned so as to be received in corresponding locking dimples in the mounting ball, the mounting ball will be retained in position.
(330) In the illustrated exemplary embodiments and others, the elongate shaft assembly **2402** operably interfaces with a handle assembly **2500**. An exemplary embodiment of handle assembly **2500** comprises a pair of handle housing segments **2502**, **2504** that are coupled together to form a housing for various drive components and systems as will be discussed in further detail below. See, e.g., FIGS. **118** and **119**. The handle housing segments **2502**, **2504** may be coupled together by screws, snap features, adhesive, etc. When coupled together, the handle segments **2502**, **2504** may form a handle assembly **2500** that includes a pistol grip portion **2506**.
(331) To facilitate selective rotation of the end effector **1000** about the longitudinal tool axis “LT=LT”, the elongate shaft assembly **2402** may interface with a first drive system, generally designated as **2510**. The drive system **2510** includes a manually-actuatable rotation nozzle **2512** that is rotatably supported on the handle assembly **2500** such that it can be rotated relative thereto as well as be axially moved between a locked position and an unlocked position.
(332) The surgical instrument **2400** may include a closure system **670** as was described above for applying opening and closing motions to the anvil **1100** of the end effector **1000**. In this exemplary embodiment, however, the closure system **670** is actuated by a closure trigger **2530** that is pivotally mounted to the handle frame assembly **2520** that is supported within the handle housing segments **2502**, **2504**. The closure trigger **2530** includes an actuation portion **2532** that is pivotally mounted on a pivot pin **2531** that is supported within the handle frame assembly **2520**. See FIG. **124**. Such exemplary arrangement facilitates pivotal travel toward and away from the pistol grip portion **2506** of the handle assembly **2500**. As can be seen in FIG. **124**, the closure trigger **2530** includes a closure link **2534** that is linked to the first pivot link and gear assembly **695** by a closure wire **2535**. Thus, by pivoting the closure trigger **2530** toward the pistol grip portion **2506** of the handle assembly **2500** into an actuated position, the closure link **2534** and closure wire **2535** causes the first pivot link and gear assembly **695** to move the first closure rod segment **680** in the distal direction “DD” to close the anvil.
(333) The surgical instrument **2400** may further include a closure trigger locking system **2536** to retain the closure trigger in the actuated position. In at least one exemplary form, the closure trigger locking system **2536** includes a closure lock member **2538** that is pivotally coupled to the handle frame assembly **2520**. As can be seen in FIGS. **125** and **126**, the closure lock member **2538** has a lock arm **2539** formed thereon that is configured to ride upon an arcuate portion **2537** of the closure link **2532** as the closure trigger **2530** is actuated toward the pistol grip portion **2506**. When the closure trigger **2530** has been pivoted to the fully actuated position, the lock arm **2539** drops behind

the end of the closure link **2532** and prevents the closure trigger **2530** from returning to its unactuated position. Thus, the anvil **1100** will be locked in its closed position. To enable the closure trigger **2530** to return to its unactuated position and thereby result in the movement of the anvil from the closed position to the open position, the clinician simply pivots the closure lock member **2538** until the lock arm **2539** thereof disengages the end of the closure link **2532** to thereby permit the closure link **2532** to move to the unactuated position.

(334) The closure trigger **2532** is returned to the unactuated position by a closure return system **2540**. For example, as can be seen in FIG. **124**, one exemplary form of the closure trigger return system **2540** includes a closure trigger slide member **2542** that is linked to the closure link **2534** by a closure trigger yoke **2544**. The closure trigger slide member **2542** is slidably supported within a slide cavity **2522** in the handle frame assembly **2520**. A closure trigger return spring **2546** is positioned within the slide cavity **2520** to apply a biasing force to the closure trigger slide member **2542**. Thus, when the clinician actuates the closure trigger **2530**, the closure trigger yoke **2544** moves the closure trigger slide member **2542** in the distal direction "DD" compressing the closure trigger return spring **2546**. When the closure trigger locking system **2536** is disengaged and the closure trigger is released **2530**, the closure trigger return spring **2546** moves the closure trigger slide member **2542** in the proximal direction "PD" to thereby pivot the closure trigger **2530** into the starting unactuated position.

(335) The surgical instrument **2400** can also employ any of the various exemplary drive shaft assemblies described above. In at least one exemplary form, the surgical instrument **2400** employs a second drive system **2550** for applying rotary control motions to a proximal drive shaft assembly **380′**. See FIG. **128**. The second drive system **2550** may include a motor assembly **2552** that is operably supported in the pistol grip portion **2506**. The motor assembly **2552** may be powered by a battery pack **2554** that is removably attached to the handle assembly **2500** or it may be powered by a source of alternating current. A second drive gear **2556** is operably coupled to the drive shaft **2555** of the motor assembly **2552**. The second drive gear **2556** is supported for meshing engagement with a second rotary driven gear **2558** that is attached to the proximal drive shaft segment **380′** of the drive shaft assembly. In at least one form, for example, the second drive gear **2556** is also axially movable on the motor drive shaft **2555** relative to the motor assembly **2552** in the directions represented by arrow "U" in FIG. **128**. A biasing member, e.g., a coil spring **2560** or similar member, is positioned between the second drive gear **2556** and the motor housing **2553** and serves to bias the second drive gear **2556** on the motor drive shaft **2555** into meshing engagement with a first gear segment **2559** on the second driven gear **2558**.

(336) The second drive system **2550** may further include a firing trigger assembly **2570** that is movably, e.g., pivotally attached to the handle frame assembly **2520**. In at least one exemplary form, for example, the firing trigger assembly **2570** includes a first rotary drive trigger **2572** that cooperates with a corresponding switch/contact (not shown) that electrically communicates with the motor assembly **2552** and which, upon activation, causes the motor assembly **2552** to apply a first rotary drive motion to the second driven gear **2558**. In addition, the firing trigger assembly **2570** further includes a retraction drive trigger **2574** that is pivotal relative to the first rotary drive trigger. The retraction drive trigger **2574** operably interfaces with a switch/contact (not shown) that is in electrical communication with the motor assembly **2552** and which, upon activation, causes the motor assembly **2552** to apply a second rotary drive motion to the second driven gear **2558**. The first rotary drive motion results in the rotation of the drive shaft assembly and the implement drive shaft in the end effector to cause the firing member to move distally in the end effector **1000**. Conversely, the second rotary drive motion is opposite to the first rotary drive motion and will ultimately result in rotation of the drive shaft assembly and the implement drive shaft in a rotary direction which results in the proximal movement or retraction of the firing member in the end effector **1000**.

(337) The illustrated embodiment also includes a manually actuatable safety member **2580** that is

pivotally attached to the closure trigger actuation portion **2532** and is selectively pivotable between a first "safe" position wherein the safety member **2580** physically prevents pivotal travel of the firing trigger assembly **2570** and a second "off" position, wherein the clinician can freely pivot the firing trigger assembly **2570**. As can be seen in FIG. **124**, a first dimple **2582** is provided in the closure trigger actuation portion **2532** that corresponds to the first position of the safety member **2580**. When the safety member **2580** is in the first position, a detent (not shown) on the safety member **2580** is received within the first dimple **2582**. A second dimple **2584** is also provided in the closure trigger actuation portion **2532** that corresponds to the second position of the safety member **2580**. When the safety member **2580** is in the second position, the detent on the safety member **2580** is received within the second dimple **2582**.

(338) In at least some exemplary forms, the surgical instrument **2400** may include a mechanically actuatable reversing system, generally designated as **2590**, for mechanically applying a reverse rotary motion to the proximal drive shaft segment **380′** in the event that the motor assembly **2552** fails or battery power is lost or interrupted. Such mechanical reversing system **2590** may also be particularly useful, for example, when the drive shaft system components operably coupled to the proximal drive shaft segment **380′** become jammed or otherwise bound in such a way that would prevent reverse rotation of the drive shaft components under the motor power alone. In at least one exemplary form, the mechanically actuatable reversing system **2590** includes a reversing gear **2592** that is rotatably mounted on a shaft **2524**A formed on the handle frame assembly **2520** in meshing engagement with a second gear segment **2562** on the second driven gear **2558**. See FIG. **126**. Thus, the reversing gear **2592** freely rotates on shaft **2524**A when the second driven gear **2558** rotates the proximal drive shaft segment **380′** of the drive shaft assembly.

(339) In various exemplary forms, the mechanical reversing system **2590** further includes a manually actuatable driver **2594** in the form of a lever arm **2596**. As can be seen in FIGS. **129** and **130**, the lever arm **2596** includes a yoke portion **2597** that has elongate slots **2598** therethrough. The shaft **2524**A extends through slot **2598**A and a second opposing shaft **2598**B formed on the handle housing assembly **2520** extends through the other elongate slot to movably affix the lever arm **2596** thereto. In addition, the lever arm **2596** has an actuator fin **2597** formed thereon that can meshingly engage the reversing gear **2592**. There is a detent or interference that keeps the lever arm **2596** in the unactuated state until the clinician exerts a substantial force to actuate it. This keeps it from accidentally initiating if inverted. Other embodiments may employ a spring to bias the lever arm into the unactuated state. Various exemplary embodiments of the mechanical reversing system **2590** further includes a knife retractor button **2600** that is movably journaled in the handle frame assembly **2520**. As can be seen in FIGS. **129** and **130**, the knife retractor button **2600** includes a disengagement flap **2602** that is configured to engage the top of the second drive gear **2556**. The knife retractor button **2600** is biased to a disengaged position by a knife retractor spring **2604**. When in the disengaged position, the disengagement flap **2602** is biased out of engagement with the second drive gear **2556**. Thus, until the clinician desires to activate the mechanical reversing system **2590** by depressing the knife retractor button **2600**, the second drive gear **2556** is in meshing engagement with the first gear segment **2559** of the second driven gear **2558**.

(340) When the clinician desires to apply a reverse rotary drive motion to the proximal drive shaft segment **380′**, the clinician depresses the knife retractor button **2600** to disengage the first gear segment **2559** on the second driven gear **2558** from the second drive gear **2556**. Thereafter, the clinician begins to apply a pivotal ratcheting motion to the manually actuatable driver **2594** which causes the gear fin **2597** thereon to drive the reversing gear **2592**. The reversing gear **2592** is in meshing engagement with the second gear segment **2562** on the second driven gear **2558**. Continued ratcheting of the manually actuatable driver **2594** results in the application of a reverse rotary drive motion to the second gear segment **2562** and ultimately to the proximal drive shaft segment **380′**. The clinician may continue to ratchet the driver **2594** for as many times as are

necessary to fully release or reverse the associated end effector component(s). Once a desired amount of reverse rotary motion has been applied to the proximal drive shaft segment **380′**, the clinician releases the knife retractor button **2600** and the driver **2594** to their respective starting or unactuated positions wherein the fin **2597** is out of engagement with the reversing gear **2592** and the second drive gear **2556** is once again in meshing engagement with the first gear segment **2559** on the second driven gear **2558**.

(341) The surgical instrument **2400** can also be employed with an end effector **1000** that includes a rotary transmission **750** as was described in detail above. As discussed above, when the drive shaft assembly is in a first axial position, rotary motion applied thereto results in the rotation of the entire end effector **1000** about the longitudinal tool axis “LT-LT” distal to the articulation joint **700**. When the drive shaft assembly is in the second position, rotary motion applied thereto results in the rotation of the implement drive shaft which ultimately causes the actuation of the firing member within the end effector **1000**.

(342) The surgical instrument **2400** may employ a shifting system **2610** for selectively axially shifting the proximal drive shaft segment **380′** which moves the shaft gear **376** into and out of meshing engagement with the first rotary driven gear **374**. For example, the proximal drive shaft segment **380′** is movably supported within the handle frame assembly **2520** such that the proximal drive shaft segment **380′** may move axially and rotate therein. In at least one exemplary form, the shifting system **2610** further includes a shifter yoke **2612** that is slidably supported by the handle frame assembly **2520**. See FIGS. **124** and **127**. The proximal drive shaft segment **380′** has a pair of collars **386** (shown in FIGS. **124** and **128**) thereon such that shifting of the shifter yoke **2612** on the handle frame assembly **2520** results in the axial movement of the proximal drive shaft segment **380′**. In at least one form, the shifting system **2610** further includes a shifter button assembly **2614** operably interfaces with the shifter yoke **2612** and extends through a slot **2505** in the handle housing segment **2504** of the handle assembly **2500**. See FIGS. **135** and **136**. A shifter spring **2616** is mounted with the handle frame assembly **2520** such that it engages the proximal drive shaft segment **380′**. See FIGS. **127** and **134**. The spring **2616** serves to provide the clinician with an audible click and tactile feedback as the shifter button assembly **2614** is slidably positioned between the first axial position depicted in FIG. **135** wherein rotation of the drive shaft assembly results in rotation of the end effector **1000** about the longitudinal tool axis “LT-LT” relative to the articulation joint **700** (illustrated in FIG. **67**) and the second axial position depicted in FIG. **136** wherein rotation of the drive shaft assembly results in the axial movement of the firing member in the end effector (illustrated in FIG. **66**). Thus, such arrangement enables the clinician to easily slidably position the shifter button assembly **2614** while holding the handle assembly **2500**.

(343) FIGS. **137-147** illustrate a lockable articulation joint **2700** that, in one exemplary embodiment, is substantially identical to the articulation joint **700** described above except for the differences discussed below. In one exemplary embodiment, the articulation joint **2700** is locked and unlocked by an articulation lock system **2710**. The articulation joint **2700** includes a proximal socket tube **702** that is attached to the distal end **233** of the distal outer tube portion **231** and defines a proximal ball socket **704** therein. See FIG. **137**. A proximal ball member **706** that is attached to an intermediate articulation tube segment **712** is movably seated within the proximal ball socket **704** within the proximal socket tube **702**. As can be seen in FIG. **137**, the proximal ball member **706** has a central drive passage **708** that enables the distal drive shaft segment **540** to extend therethrough. In addition, the proximal ball member **706** has four articulation passages **710** therein which facilitate the passage of distal cable segments **444**, **445**, **446**, **447** therethrough. As can be further seen in FIG. **137**, the intermediate articulation tube segment **712** has an intermediate ball socket **714** formed therein. The intermediate ball socket **714** is configured to movably support therein an end effector ball **722** formed on an end effector connector tube **720**. The distal cable segments **444**, **445**, **446**, **447** extend through cable passages **724** formed in the end effector ball **722** and are attached thereto by lugs **726** received within corresponding passages **728** in the end effector ball

722. Other attachment arrangements may be employed for attaching distal cable segments **444**, **445**, **446**, **447** to the end effector ball **722**.

(344) As can be seen in FIG. **137**, one exemplary form of the articulation lock system **2710** includes a lock wire or member **2712** that extends through the distal outer tube portion **231** of elongate shaft assembly and the proximal socket tube **702**. The lock wire **2712** has a proximal end **2720** that is attached to a transfer disc **2722** that is operably supported in the handle portion **2500** (generally represented in broken lines in FIG. **137**). For example, the transfer disc **2722** is mounted on a spindle shaft **2724** that is coupled to a boss **2726** formed in the handle **2500**. An actuator cable or wire **2730** is attached to the transfer disc **2722** and may be manually actuated (i.e., pushed or pulled) by the clinician. In other embodiments wherein the surgical instrument is attached to the robotic system, the actuator cable **2730** may be configured to receive control motions from the robotic system to actuate the transfer disc **2722**.

(345) As can be seen in FIGS. **143-146**, the lock wire **2712** has a pair of unlocking wedges **2714**, **2716** formed on its distal end **2715**. The first unlocking wedge **2714** is configured to operably interface with the ends **2742**, **2744** of a distal locking ring **2740** that is journaled on the intermediate articulation tube **712**. In its normal “locked” state as shown in FIG. **143**, the distal locking ring **2740** applies a circumferentially-extending locking or squeezing force to the intermediate articulation tube **712** to squeeze the intermediate articulation tube **712** onto the end effector ball **722** to prevent its movement within the socket **714**. As can be seen in FIGS. **143-146**, the ends **2742**, **2744** of the distal locking ring **2740** are tapered to define a conical or V-shaped opening **2746** therebetween configured to receive the first unlocking wedge **2714** therebetween.

(346) As can be further seen in FIGS. **143-146**, the second locking wedge **2716** is configured to interface with the ends **2752**, **2754** of a proximal locking ring **2750** that is journaled on the proximal socket tube **702**. In its normal “locked” state as shown in FIG. **143**, the proximal locking ring **27450** applies a circumferentially-extending locking or squeezing force to the proximal socket tube **702** to squeeze the proximal socket tube **702** onto the proximal ball member **706** to prevent its movement within the proximal ball socket **704**. As can be seen in FIGS. **143-146**, the ends **2752**, **2754** of the proximal locking ring **2750** are tapered to define a conical or V-shaped opening **2756** therebetween configured to receive the second unlocking wedge **2716** therebetween.

(347) When the articulation joint **2700** is unlocked by actuation the articulation lock system **2710**, the end effector **1000** may be selectively articulated in the various manners described above by actuating the distal cable segments **444**, **445**, **446**, **447**. Actuation of the articulation lock system **2710** may be understood from reference to FIGS. **138**, **139** and **143-146**. FIG. **143** depicts the positions of the first and second unlocking wedges **2714**, **2716** with respect to the distal and proximal locking rings **2740**, **2750**. When in that state, locking ring **2740** prevents movement of the end effector ball **722** within the socket **714** and the locking ring **2750** prevents the proximal ball member **706** from moving within socket **704**. To unlock the articulation joint **2700**, the actuation cable **2726** is pulled in the proximal direction “PD” which ultimately results in the locking wire **2712** being pushed in the distal direction “DD” to the position shown in FIG. **144**. As can be seen in FIG. **144**, the first unlocking wedge **2714** has moved distally between the ends **2742**, **2744** of the distal locking ring **2740** to spread the ring **2740** to relieve the squeezing force applied to the intermediate articulation tube **712** to permit the end effector ball **722** to move within the socket **714**. Likewise, the second unlocking wedge **2716** has moved distally between the ends **2752**, **2754** of the proximal locking ring **2750** to spread the ring **2750** to relieve the squeezing force on the proximal socket tube **702** to permit the proximal ball member **706** to move within the socket **704**. When in that unlocked position, the articulation system may be actuated to apply actuation motions to the distal cable segments **444**, **445**, **446**, **447** in the above described manners to articulate the end effector **1000** as illustrated in FIGS. **138** and **139**. For example, FIGS. **143** and **144** illustrate the position of the first and second locking wedges **2714**, **2716** when the end effector **1000** has been articulated into the position illustrated in FIG. **138**. Likewise, FIGS. **145**, **146** illustrate the position

of the first and second locking wedges **2714**, **2716** when the end effector **1000** has been articulated into the position illustrated in FIG. **139**. Once the clinician has articulated the end effector to the desired position, the clinician (or robotic system) applies a pushing motion to the actuation cable to rotate the transfer disc **2722** and move the locking wire **2712** to the position shown in FIGS. **143**, **145** to thereby permit the locking rings **2740**, **2750** to spring to their clamped or locked positions to retain the end effector **1000** in that locked position.
(348) FIGS. **148-156** illustrate another end effector embodiment **2800** that, in one exemplary form, is substantially identical to the end effector **1000** except for the differences discussed below. The end effector **2800** includes an anvil assembly **2810** that is opened and closed by applying a rotary closure motion thereto. The anvil assembly **2810** is pivotally supported on an elongate channel **2830** for selective movement between an open position (FIGS. **148** and **149**) and a closed position (FIGS. **150-153**). The elongate channel **2830** may be substantially identical to elongate channel **1020** described above, except for the differences discussed below. For example, in the illustrated embodiment, the elongate channel **2830** has an end effector connector housing **2832** formed thereon that may be coupled to an end effector connector tube **720** by the ring-like bearing **734** as described above. As can be seen in FIG. **148**, the end effector connector housing **2832** operably supports a rotary transmission assembly **2860** therein.
(349) As can be seen in FIGS. **148** and **149**, the anvil assembly **2810** includes a pair of anvil trunnions **2812** (only one trunnion can be seen in FIG. **148**) that are movably received within corresponding trunnion slots **2814** formed in the elongate channel **2830**. The underside of the anvil assembly **2810** further has an anvil open ramp **2816** formed thereon for pivotal engagement with an anvil pivot pin **1201′** on the firing member **1200′**. Firing member **1200′** may be substantially identical to firing member **1200** described above except for the noted differences. In addition, the anvil assembly **2810** further includes a closure pin **2818** that is configured for operable engagement with a rotary closure shaft **2910** that receives rotary closure motions from the rotary transmission assembly **2860** as will be discussed in further detail below. The firing member **1200′** is rotatably journaled on an implement drive shaft **1300** that is rotatably supported within an elongate channel **2830** that is configured to support a surgical staple cartridge therein (not shown). The implement drive shaft **1300** has a bearing segment **1304** formed thereon that is rotatably supported in a bearing sleeve **2834** formed in the end effector connector housing **2832**.
(350) In the exemplary illustrated embodiment, the rotary transmission assembly **2860** includes a rotary drive shaft **2870** that extends longitudinally through the elongate shaft assembly to operably interface with the tool mounting portion (if the end effector **2800** is powered by a robotic system) or with the firing trigger of a handle assembly (if the end effector **2800** is to be manually operated). For those embodiments employing an articulation joint, the portion of the rotary drive shaft **2870** that extends through the articulation joint **700** may comprise any of the flexible drive shaft assemblies disclosed herein. If no articulation joint is employed, the rotary drive shaft may be rigid. As can be most particularly seen in FIGS. **148** and **149** the rotary drive shaft **2870** has a rotary drive head **2872** formed thereon or attached thereto that has a first ring gear **2874** formed thereon. In addition, the rotary drive head **2872** further has a second ring gear **2876** formed thereon for selective meshing engagement with a shifter gear **2882** attached to a rotary shifter shaft **2880**.
(351) The shifter shaft **2880** may comprise any one of the rotary drive shaft assemblies described above and extends through the elongate shaft assembly to operably interface with a tool mounting portion **300** (if the end effector **2800** is driven by a robotic system) or the handle assembly (if the end effector is to be manually operated). In either case, the shifter shaft **2800** is configured to receive longitudinally shifting motions to longitudinally shift the shifter gear **2882** within the rotary drive head **2872** and rotary drive motions to rotate the shifter gear **2882** as will be discussed in further detail below.
(352) As can be further seen in FIGS. **148** and **149**, the rotary transmission assembly **2860** further includes a transfer gear assembly **2890** that has a body **2892**, a portion of which is rotatably

supported within a cavity **2873** in the rotary drive head **2872**. The body **2892** has a spindle **2894** that rotatably extends through a spindle mounting hole **2838** formed in a bulkhead **2836** in the end effector connector housing **2832**. The body **2892** further has a shifter ring gear **2896** formed therein for selective meshing engagement with the shifter gear **2882** on the rotary shifter shaft **2880**. A transfer gear **2900** is mounted to a transfer gear spindle **2902** that protrudes from the body **2892** and is slidably received within the arcuate slot **2840** in the bulkhead **2836**. See FIGS. **155** and **156**. The transfer gear **2900** is in meshing engagement with the first ring gear **2874** formed in the rotary drive head **2872**. As can be seen in FIGS. **153-156**, the arcuate slot **2840** that has a centrally disposed flexible detent **2842** protruding therein. The detent **2842** is formed on a web **2844** formed by a detent relief slot **2846** formed adjacent to the arcuate slot **2840** as shown in FIG. **155**.

(353) The rotary closure shaft **2910** has a bearing portion **2912** that is rotatably supported through a corresponding opening in the bulkhead **2836**. The rotary closure shaft **2910** further has a closure drive gear **2914** that is configured for selective meshing engagement with the transfer gear **2900**. The implement drive shaft **1300** also has an implement drive gear **1302** that is configured for selective meshing engagement with the transfer gear **2900**.

(354) Operation of the end effector **2800** will now be explained with reference to FIGS. **148-155**. FIGS. **148** and **149** illustrate the end effector **2800** with the anvil assembly **2810** in the open position. To move the anvil assembly **2810** to the closed position shown in FIG. **150**, the shifter shaft **2880** is located such that the shifter gear **2882** is in meshing engagement with the shifter ring gear **2896** in the body **2892**. The shifter shaft **2880** may be rotated to cause the body **2892** to rotate to bring the transfer gear **2900** into meshing engagement with the closure drive gear **2914** on the closure shaft **2910**. See FIG. **153**. When in that position, the locking detent **2842** retains the transfer gear spindle **2902** in that position. Thereafter, the rotary drive shaft **2870** is rotated to apply rotary motion to the transfer gear **2900** which ultimately rotates the closure shaft **2910**. As the closure shaft **2910** is rotated, a rotary spindle portion **2916** which is in engagement with the closure pin **2818** on the anvil assembly **2810** results in the anvil assembly **2810** moving proximally causing the anvil assembly **2810** to pivot on the anvil pivot pin **1201′** on the firing member **1200′**. Such action causes the anvil assembly **2810** to pivot to the closed position shown in FIG. **150**. When the clinician desires to drive the firing member **1200′** distally down the elongate channel **2830**, the shifter shaft **2880** is once again rotated to pivot the transfer gear spindle **2902** to the position shown in FIG. **154**. Again, the locking detent **2842** retains the transfer gear spindle **2902** in that position. Thereafter, the rotary drive shaft **2870** is rotated to apply rotary motion to the drive gear **1302** on the implement drive shaft **1300**. Rotation of the implement drive shaft **1300** in one direction causes the firing member **1200′** to be driven in the distal direction “DD”. Rotation of the implement drive shaft **1300** in an opposite direction will cause the firing member **1200′** to be retracted in the proximal direction “PD”. Thus, in those applications wherein the firing member **1200′** is configured to cut and fire staples within a staple cartridge mounted in the elongate channel **2830**, after the firing member **1200′** has been driven to its distal-most position within the elongate channel **2830**, the rotary drive motion applied to the implement drive shaft **1300** by the rotary drive shaft assembly **2870** is reversed to retract the firing member **1200′** back to its starting position shown in FIG. **150**. To release the target tissue from the end effector **2800**, the clinician again rotates the shifter shaft **2800** to once again bring the transfer gear **2900** into meshing engagement with the drive gear **2914** on the closure drive shaft **2910**. Thereafter, a reverse rotary motion is applied to the transfer gear **2900** by the rotary drive shaft **2870** to cause the closure drive shaft **2910** to rotate the drive spindle **2916** and thereby cause the anvil assembly **2810** to move distally and pivot to the open position shown in FIGS. **148** and **149**. When the clinician desires to rotate the entire end effector **2800** about the longitudinal tool axis “LT-LT”, the shifter shaft is longitudinally shifted to bring the shifter gear **2882** into simultaneously meshing engagement with the second ring gear **2876** on the rotary drive head **2872** and the shifter ring gear **2896** on the transfer gear body **2892** as shown in FIG. **152**. Thereafter, rotating the rotary drive shaft **2880** causes the entire end

effector **2800** to rotate about the longitudinal tool axis "LT-LT" relative to the end effector connector tube **720**.

(355) FIGS. **157-170** illustrate another end effector embodiment **3000** that employs a pull-type motions to open and close the anvil assembly **3010**. The anvil assembly **3010** is movably supported on an elongate channel **3030** for selective movement between an open position (FIGS. **168** and **169**) and a closed position (FIGS. **157**, **160** and **170**). The elongate channel **3030** may be substantially identical to elongate channel **1020** described above, except for the differences discussed below. The elongate channel **3030** may be coupled to an end effector drive housing **1010** in the manner described above. The end effector drive housing **1010** may also be coupled to an end effector connector tube **720** by the ring-like bearing **734** as described above. As can be seen in FIG. **157**, the end effector drive housing **1010** may support a drive arrangement **748** and rotary transmission **750** as described above.

(356) As can be seen in FIG. **160**, the anvil assembly **3010** includes a pair of anvil trunnions **3012** (only one trunnion can be seen in FIG. **160**) that are movably received within corresponding trunnion slots **3032** formed in the elongate channel **3030**. The underside of the anvil assembly **2810** further has an anvil open notches **3016** formed thereon for pivotal engagement with the upper fins **1208** on the firing member **3100**. See FIG. **168**. Firing member **3100** may be substantially identical to firing member **1200** described above except for the noted differences. In the illustrated embodiment, the end effector **3000** further includes an anvil spring **3050** that is configured to apply a biasing force on the anvil trunnions **3012**. One form of anvil spring **3050** is illustrated in FIG. **159**. As can be seen in that Figure, the anvil spring **3050** may be fabricated from a metal wire and have two opposing spring arms **3052** that are configured to bear upon the anvil trunnions **3012** when the anvil trunnions are received within their respective trunnion slots **3032**. in addition, as can be further seen in FIG. **159**, the anvil spring **3050** has two mounting loops **3054** formed therein that are adapted to be movably supported on corresponding spring pins **3034** formed on the elongate channel **3030**. See FIG. **158**. As will be discussed in further detail below, the anvil spring **3050** is configured to pivot on the spring pins **3034** within the elongate channel **3030**. As can be most particularly seen in FIG. **158**, a portion **3035** of each side wall of the elongate channel is recessed to provide clearance for the movement of the anvil spring **3050**.

(357) As can be seen in FIGS. **157** and **160-170**, the end effector **3000** further includes a closure tube **3060** that is movably supported on the elongate channel **3030** for selective longitudinal movement thereon. To facilitate longitudinal movement of the closure tube **3060**, the embodiment depicted in FIGS. **157** and **160-170** includes a closure solenoid **3070** that is linked to the closure tube **3060** by a linkage arm **3072** that is pivotally pinned or otherwise attached to the closure tube **3030**. When the solenoid is actuated, the linkage arm **3072** is driven in the distal direction which drives the closure tube **3060** distally on the end of the elongate channel **3030**. As the closure tube **3060** moves distally, it causes the anvil assembly **3010** to pivot to a closed position. In an alternative embodiment, the solenoid may comprise an annular solenoid mounted on the distal end of the end effector drive housing **1010**. The closure tube would be fabricated from a metal material that could be magnetically attracted and repelled by the annular solenoid to result in the longitudinal movement of the closure tube.

(358) In at least one form, the end effector **3060** further includes a unique anvil locking system **3080** to retain the anvil assembly **3010** locked in position when it is closed onto the target tissue. In one form, as can be seen in FIG. **157**, the anvil locking system **3080** includes an anvil lock bar **3082** that extends transversely across the elongate channel **3030** such that the ends thereof are received within corresponding lock bar windows **3036** formed in the elongate channel **3030**. See FIG. **158**. Referring to FIG. **161**, when the closure tube **3060** is in its distal-most "closed" position, the ends of the lock bar **3082** protrude laterally out through the lock bar windows **3036** and extend beyond the proximal end of the closure tube **3060** to prevent it from moving proximally out of position. The lock bar **3082** is configured to engage a solenoid contact **3076** supported in the end

effector drive housing **1010**. The solenoid contact **3076** is wired to a control system for controlling the solenoid **3070**. The control system includes a source of electrical power either supplied by a battery or other source of electrical power in the robotic system or handle assembly, whichever the case may be.

(359) The firing member **3100** is rotatably journaled on an implement drive shaft **1300** that is rotatably supported within an elongate channel **2830** that is configured to support a surgical staple cartridge therein (not shown). The implement drive shaft **1300** has a bearing segment **1304** formed thereon that is rotatably supported in a bearing sleeve **2834** formed in the end effector connector housing **2832** and operably interfaces with the rotary transmission **750** in the manner described above. Rotation of the implement drive shaft **1300** in one direction causes the firing member **3100** to be driven distally through the elongate channel **3030** and rotation of the implement drive shaft **1300** in an opposite rotary direction will cause the firing member **1200**″ to be retracted in the proximal direction “PD”. As can be seen in FIGS. **157** and **160-170**, the firing member **3100** has an actuation bar **3102** configured to engage the lock bar **3082** as will be discussed in further detail below.

(360) The anvil locking system **3080** further includes an anvil pulling assembly **3090** for selectively pulling the anvil into wedging locking engagement with the closure tube **3060** when the closure tube **3060** has been moved into its distal-most position wherein the distal end of the closure tube **3060** is in contact with an anvil ledge **3013** formed on the anvil assembly **3010**. In one form, the anvil pulling assembly **3090** includes a pair of anvil pull cables **3092** that are attached to the proximal end of the anvil assembly **3010** and protrude proximally through the elongate shaft assembly to the tool mounting portion or handle assembly, whichever the case may be. The pull cables **3092** may be attached to an actuator mechanism on the handle assembly or be coupled to one of the drive systems on the tool mounting portion that is configured to apply tension to the cables **3092**.

(361) Operation of the end effector **3000** will now be described. FIGS. **168** and **169** illustrate the anvil assembly **3010** in an open position. FIG. **168** illustrates the firing member **3100** in proximal-most position wherein a new staple cartridge (not shown) may be mounted in the elongate channel **3030**. The closure tube **3060** is also in its proximal-most unactuated position. Also, as can be seen in FIG. **167**, when the firing member **3100** is in its proximal-most position, the actuation bar **3102** has biased the lock bar into engagement with the solenoid contact **3076** which enables the solenoid to be activated for the next closure sequence. Thus, to commence the closure process, the rotary drive shaft **752** is actuated to move the firing member **3100** to its starting position illustrated in FIG. **169**. When in that position, the actuation bar **3102** has moved in the proximal direction sufficiently to enable the lock bar **3082** to move out of engagement with the solenoid contact **3076** such that when power is supplied to the solenoid control circuit, the solenoid link **3072** is extended. Control power is then applied—either automatically or through a switch or other control mechanism in the handle assembly to the solenoid **3070** which moves the closure tube **3060** distally until the distal end of the closure tube **3060** contacts the ledge **3013** on the anvil assembly **3010** to cause the anvil assembly to pivot closed on the firing member **1200**″ as shown in FIG. **162**. As can be seen in that Figure, the lock bar **3082** is positioned to prevent movement of the closure tube **3060** in the proximal direction. When in that position, the clinician then applies tension to the pull cables **3092** to pull the proximal end of the anvil assembly **3010** into wedging engagement with the closure tube **3060** to lock the anvil assembly **3010** in the closed position. Thereafter, the firing member **1200**″ may be driven in the distal direction through the tissue clamped in the end effector **3000**. Once the firing process has been completed. The implement drive shaft is rotated in an opposite direction to return the firing member **3100** to its starting position wherein the actuation bar **3102** has once again contacted the lock bar **3082** to flex it into contact with the solenoid contact **3076** and to pull the ends of the lock bar **3082** into the windows **3036** in the elongate channel **3030**. When in that position, when power is supplied to the solenoid control system, the solenoid **3070**

retracts the closure tube **3060** in the proximal direction to its starting or open position shown in FIGS. **167** and **168**. As the closure tube **3060** moves proximally out of engagement with the anvil assembly **3010**, the anvil spring **3050** applies a biasing force to the anvil trunnions **3012** to bias the anvil assembly to the open position shown in FIG. **168**.

(362) FIGS. **171-178** illustrate another exemplary elongate shaft assembly **3200** that has another exemplary quick disconnect coupler arrangement **3210** therein. In at least one form, for example, the quick disconnect coupler arrangement **3210** includes a proximal coupler member **3212** in the form of a proximal outer tube segment **3214** that, in one arrangement, may have a tube gear segment **354** thereon that is configured to interface with the first drive system **350** in the above-described manner when the device is to be robotically controlled. In another embodiment, however, the proximal outer tube segment **3214** may interface with a manually-actuatable rotation nozzle **2512** mounted to a handle assembly in the above-described manner. As discussed above, the first drive system **350** in a robotically-controlled application or the rotation nozzle **2512** in a handheld arrangement serve to rotate the elongate shaft assembly **3200** and the end effector operably coupled thereto about the longitudinal tool axis “LT-LT”. See FIG. **171**. The proximal outer tube segment **3214** has a “necked-down” distal end portion **3216** that is configured to receive a locking collar thereon.

(363) In the exemplary embodiment depicted in FIGS. **171-178**, the elongate shaft assembly **3200** includes a proximal drive shaft segment **380**″ that may be substantially identical to the proximal drive shaft segment **380** described above except for the differences discussed below and be configured to receive rotary and axial control motions from the robotic system or handle assembly in the various manners disclosed herein. The illustrated embodiment may be used with an articulation joint **700** as described above and include articulation cables **434** and **454** that may be coupled to the articulation control drives in the various manners described herein. A proximal filler material **3220** is provided within the proximal outer tube segment **3214** to provide axial support for the articulation cable end portions **434**A, **434**B, **454**A, **454**B. Each articulation cable end portion **434**A, **434**B, **454**A, **454**B extends through a corresponding proximal articulation passage **3222** provided through the proximal filler material **3220**. Each articulation cable end portion **434**A, **434**B, **454**A, **454**B further has a proximal articulation clip **3224** attached thereto that is configured to slide within the corresponding articulation passage **3222**. The proximal articulation clips **3224** may be fabricated from metal or polymer material and each have a pair of flexible clip arms **3226** that each have a fastener cleat **3228** formed thereon. Likewise, the proximal drive shaft segment **380**″ is movable received in a shaft passage **3230** in the proximal filler material **3220**. A drive shaft connection clip **3240** thereon. In one exemplary form, the drive shaft connection clip **3240** is formed with a central tubular connector portion **3242** and two flexible clip arms **3244** thereon that each have a fastener cleat **3248** thereon.

(364) As can be further seen in FIGS. **171**, **172** and **176-178**, the quick disconnect arrangement **3210** further includes a distal coupler member **3250** in the form of a distal outer tube segment **3252** that is substantially similar to the distal outer tube portion **231** described above except that the distal outer tube segment **3252** includes a necked down proximal end portion **3254**. The distal outer tube segment **3252** is operably coupled to an end effector **1000** of the various types disclosed herein and includes a distal drive shaft segment **540**″ that may be substantially similar to distal drive shaft segment **540** described above except for the differences noted below. A distal filler material **3260** is provided within the distal outer tube segment **3252** to provide axial support for the distal articulation cable segments **444**, **445**, **446**, **447**. Each distal articulation cable segment **444**, **445**, **446**, **447** extends through a corresponding distal articulation passage **3262** provided through the distal filler material **3260**. Each distal articulation cable segment **444**, **445**, **446**, **447** further has a distal articulation bayonet post **3270** attached thereto that is configured to slide between the clip arms **3226** of the corresponding proximal articulation clip **3224**. Each distal articulation bayonet post **3270** is configured to be retainingly engaged by the fastener cleats **3228** on the corresponding

clip arms **3226**. Likewise, the distal drive shaft segment **540**″ is movably received in a distal shaft passage **3264** in the distal filler material **3260**. A distal drive shaft bayonet post **3280** is attached to the proximal end of the distal drive shaft segment **540**″ such that it may protrude proximally beyond the distal articulation bayonet posts **3270**. FIG. **172** illustrates the position of the distal drive shaft bayonet post **3280** (in broken lines) relative to the distal articulation bayonet posts **3270**. The distal drive shaft bayonet post **3280** is configured to be retainingly engaged by the fastener cleats **3248** on the corresponding clip arms **3244** on the drive shaft connection clip **3240**.

(365) As can be seen in FIGS. **171-178**, the exemplary quick disconnect coupler arrangement **3210** further includes an axially movable lock collar **3290** that is movably journaled on the necked down proximal end portion **3254** of the distal outer tube segment **3252**. As can be most particularly seen in FIG. **174**, one form of the lock collar **3290** includes an outer lock sleeve **3292** that is sized to be slidably received on the necked down portions **3216**, **3254** of the proximal outer tube segment **3214** and distal outer tube segment **3254**, respectively. The outer lock sleeve **3292** is coupled to central lock body **3294** by a bridge **3295**. The bridge **3295** is configured to slide through a distal slot **3255** in the necked down portion **3254** of the distal outer tube segment **3254** as well as a proximal slot **3217** in the necked down portion **3216** of the proximal outer tube segment **3214** that is slidably received within the necked down proximal end portion **3254** of the distal outer tube segment **3252** and may also slidably extend into the necked down portion **3216** of the proximal outer tube segment **3214**. As can be further seen in FIG. **174**, the central lock body **3294** has a plurality of passages **3296** for receiving the articulation posts and clips therethrough. Likewise, the central lock body **3294** has a central drive shaft passage **3298** for movably receiving the distal drive shaft segment **540**″ therein.

(366) Use of the exemplary quick disconnect coupler arrangement **3210** will now be described. Referring first to FIGS. **171** and **172**, the distal coupler member **3250** is axially aligned with the proximal coupler member **3212** such that the bridge **3295** is aligned with the slot **3217** in the necked down portion **3216** of the proximal outer tube segment **3214** and the distal drive shaft bayonet post **3280** is aligned with the central tubular connector portion **3242** on the proximal drive shaft connector clip **3240**. Thereafter, the distal coupler member **3250** is brought into abutting engagement with the proximal coupler member **3212** to cause the distal drive shaft bayonet post **3280** to slide into the central tubular segment **3214** an ultimately into retaining engagement with the fastener cleats **3248** on the proximal drive shaft connector clip **3240**. Such action also causes each distal articulation bayonet connector post **3270** to be retainingly engaged by the fastener cleats **3228** on the proximal articulation connector clips **3224** as shown in FIG. **176**. It will be appreciated that as the distal drive shaft bayonet post **3280** is inserted between the clip arms **3244**, the clip arms **3244** flex outward until the fastener cleats **3248** engage a shoulder **3281** on the post **3280**. Likewise, as each of the distal articulation bayonet posts **3270** are inserted between their corresponding connector arms **3226**, the connector arms **3226** flex outward until the fastener cleats **3228** engage a shoulder **3271** on the post **3270**. Once the distal drive shaft segment **540**″ has been connected to the proximal drive shaft segment **380**″ and the distal articulation cable segments **444**, **445**, **446**, **447** have been connected to the articulation cable end portions **434**A, **434**B, **454**A, **454**B, respectively, the user may then slide the outer lock sleeve **3292** proximally to the position shown in FIGS. **177** and **178**. When in that position, the central lock body **3294** prevents the clip arms **3244**, **3226** from flexing outward to thereby lock the distal coupler member **3250** to the proximal coupler member **3212**. To disconnect the distal coupler member **3250** from the proximal coupler member **3212**, the user moves the outer lock sleeve **392** to the position shown in FIGS. **175** and **176** and thereafter pulls the coupler members **3250**, **3212** apart. As opposing axial separation motions are applied to the coupler members **3250**, **3212**, the clip arms **3244** and **3226** are permitted to flex out of engagement with the distal drive shaft bayonet post and the distal articulation bayonet posts, respectively.

Non-Limiting Examples

(367) One exemplary form comprises a surgical tool for use with a robotic system that includes a tool drive assembly that is operatively coupled to a control unit of the robotic system that is operable by inputs from an operator and is configured to robotically-generate output motions. In at least one exemplary form, the surgical tool includes a drive system that is configured to interface with a corresponding portion of the tool drive assembly of the robotic system for receiving the robotically-generated output motions therefrom. A drive shaft assembly operably interfaces with the drive system and is configured to receive the robotically-generated output motions from the drive system and apply control motions to a surgical end effector that operably interfaces with the drive shaft assembly. A manually-actuatable control system operably interfaces with the drive shaft assembly to selectively apply manually-generated control motions to the drive shaft assembly.

(368) In connection with another general exemplary form, there is provided a surgical tool for use with a robotic system that includes a tool drive assembly that is operatively coupled to a control unit of the robotic system that is operable by inputs from an operator and is configured to provide at least one rotary output motion to at least one rotatable body portion supported on the tool drive assembly. In at least one exemplary form, the surgical tool includes a surgical end effector that comprises at least one component portion that is selectively movable between first and second positions relative to at least one other component portion thereof in response to control motions applied thereto. An elongate shaft assembly is operably coupled to the surgical end effector and comprises at least one gear-driven portion that is in operable communication with the at least one selectively movable component portion. A tool mounting portion is operably coupled to the elongate shaft assembly and is configured to operably interface with the tool drive assembly when coupled thereto. At least one exemplary form further comprises a tool mounting portion that comprises a driven element that is rotatably supported on the tool mounting portion and is configured for driving engagement with a corresponding one of the at least one rotatable body portions of the tool drive assembly to receive corresponding rotary output motions therefrom. A drive system is in operable engagement with the driven element to apply robotically-generated actuation motions thereto to cause the corresponding one of the at least one gear driven portions to apply at least one control motion to the selectively movable component. A manually-actuatable reversing system operably interfaces with the elongate shaft assembly to selectively apply manually-generated control motions thereto.

(369) In accordance with another exemplary general form, there is provided a surgical tool for use with a robotic system that includes a tool drive assembly that is operatively coupled to a control unit of the robotic system that is operable by inputs from an operator and is configured to robotically-generate rotary output motions. In at least one exemplary form, the surgical tool comprises a rotary drive system that is configured to interface with a corresponding portion of the tool drive assembly of the robotic system for receiving the robotically-generated rotary output motions therefrom. A rotary drive shaft assembly operably interfaces with the rotary drive system and is configured to receive the robotically-generated rotary output motions from the rotary drive system and apply rotary drive motions to a surgical end effector operably that interfaces with the rotary drive shaft assembly. A manually-actuatable reversing system operably interfaces with the rotary drive shaft assembly to selectively apply manually-generated rotary drive motions to the rotary drive shaft assembly.

(370) Another exemplary form comprises a surgical stapling device that includes an elongate shaft assembly that has a distal end and defines a longitudinal tool axis. The device further includes an end effector that comprises an elongate channel assembly that includes a portion that is configured to operably support a surgical staple cartridge therein. An anvil is movably supported relative to the elongate channel assembly. The surgical stapling device further comprises a rotary joint that couples the elongate channel assembly to the distal end of the elongate shaft assembly to facilitate selective rotation of the elongate channel assembly about the longitudinal tool axis relative to the distal end of the elongate shaft assembly.

(371) Another exemplary form comprises a rotary support joint assembly for coupling a first portion of a surgical instrument to a second portion of a surgical instrument. In at least one exemplary form, the rotary support joint assembly comprises a first annular race in the first portion and a second annular race in the second portion and which is configured for substantial registration with the first annular race when the second portion is joined with the first portion. A ring-like bearing is supported within the registered first and second annular races.
(372) In connection with another exemplary general form, there is provided a rotary support joint assembly for coupling a surgical end effector to an elongate shaft assembly of a surgical instrument. In at least one exemplary form, the rotary support joint assembly comprises a cylindrically-shaped connector portion on the surgical end effector. A first annular race is provided in the perimeter of the connector portion. A socket is provided on the elongate shaft and is sized to receive the cylindrically-shaped connector portion therein such that the cylindrically-shaped connector portion may freely rotate relative to the socket. A second annular race is provided in an inner wall of the socket and is configured for substantial registration with the first annular race when the cylindrically-shaped connector portion is received within the socket. A window is provided in the socket in communication with the second annular race. A ring-like bearing member that has a free end is insertable through the window into the first and second registered annular races.
(373) In connection with another exemplary general form, there is provided a method for rotatably coupling a first portion of a surgical instrument to a second portion of a surgical instrument. In various exemplary forms, the method comprises forming a first annular race in the first portion and forming a second annular race in the second portion. The method further includes inserting the first portion into the second portion such that the first and second annular races are in substantial registration and inserting a ring-like bearing within the registered first and second annular races.
(374) Another exemplary form comprises a drive shaft assembly for a surgical instrument that includes a plurality of movably interlocking joint segments that are interconnected to form a flexible hollow tube. A flexible secondary constraining member is installed in flexible constraining engagement with the plurality of movably interlocking joint segments to retain the interlocking joint segments in movable interlocking engagement while facilitating flexing of the drive shaft assembly.
(375) In accordance with another general exemplary form, there is provided a composite drive shaft assembly for a surgical instrument that includes a plurality of movably interlocking joint segments that are cut into a hollow tube by a laser and which has a distal end and a proximal end. A flexible secondary constraining member is in flexible constraining engagement with the plurality of movably interlocking joint segments to retain the interlocking joint segments in movable interlocking engagement while facilitating flexing of the drive shaft assembly.
(376) In accordance with yet another exemplary general form, there is provided a drive shaft assembly for a surgical instrument that includes a plurality of movably interconnected joint segments wherein at least some joint segments comprise a ball connector portion that is formed from six substantially arcuate surfaces. A socket portion is sized to movably receive the ball connector portion of an adjoining joint segment therein. A hollow passage extends through each ball connector portion to form a passageway through the drive shaft assembly. The drive shaft assembly may further include a flexible secondary constraining member installed in flexible constraining engagement with the plurality of movably interconnected joint segments to retain the joint segments in movable interconnected engagement while facilitating flexing of the drive shaft assembly.
(377) Another exemplary form comprises a method of forming a flexible drive shaft assembly for a surgical instrument. In various exemplary embodiments, the method comprises providing a hollow shaft and cutting a plurality of movably interconnected joint segments into the hollow shaft with a laser. The method further comprises installing a secondary constraining member on the hollow

shaft to retain the movably interconnected joint segments in movable interconnected engagement while facilitating flexing of the drive shaft assembly.

(378) In connection with another exemplary form, there is provided a method of forming a flexible drive shaft assembly for a surgical instrument. In at least one exemplary embodiment, the method comprises providing a hollow shaft and cutting a plurality of movably interconnected joint segments into the hollow shaft with a laser. Each joint segment comprises a pair of opposing lugs wherein each lug has a tapered outer perimeter portion that is received within a corresponding socket that has a tapered inner wall portion which cooperates with the tapered outer perimeter portion of the corresponding lug to movably retain the corresponding lug therein.

(379) Another exemplary general form comprises a rotary drive arrangement for a surgical instrument that has a surgical end effector operably coupled thereto. In one exemplary form, the rotary drive arrangement includes a rotary drive system that is configured to generate rotary drive motions. A drive shaft assembly operably interfaces with the rotary drive system and is selectively axially movable between a first position and a second position. A rotary transmission operably interfaces with the drive shaft assembly and the surgical end effector such that when the drive shaft assembly is in the first axial position, application of one of the rotary drive motions to the drive shaft assembly by the rotary drive system causes the rotary transmission to apply a first rotary control motion to the surgical end effector and when the drive shaft assembly is in the second axial position, application of the rotary drive motion to the drive shaft assembly by the rotary drive system causes the rotary transmission to apply a second rotary control motion to the surgical end effector.

(380) In connection with another exemplary general form, there is provided a surgical tool for use with a robotic system that includes a tool drive assembly that is operatively coupled to a control unit of the robotic system that is operable by inputs from an operator and is configured to generate output motions. In at least one exemplary form the surgical tool comprises a tool mounting portion that is configured operably interface with a portion of the robotic system. A rotary drive system is operably supported by the tool mounting portion and interfaces with the tool drive assembly to receive corresponding output motions therefrom. An elongate shaft assembly operably extends from the tool mounting portion and includes a drive shaft assembly that operably interfaces with the rotary drive system. The drive shaft assembly is selectively axially movable between a first position and a second position. The surgical tool further comprises a surgical end effector that is rotatably coupled to the elongate shaft assembly for selective rotation relative thereto. A rotary transmission operably interfaces with the drive shaft assembly and the surgical end effector such that when the drive shaft assembly is in the first axial position, application of one of the rotary drive motions to the drive shaft assembly by the rotary drive system causes the rotary transmission to apply a first rotary control motion to the surgical end effector and when the drive shaft assembly is in the second axial position, application of the rotary drive motion to the drive shaft assembly by the rotary drive system causes the rotary transmission to apply a second rotary control motion to the surgical end effector.

(381) In connection with yet another exemplary general form, there is provided a surgical instrument that comprises a handle assembly and a drive motor that is operably supported by the handle assembly. An elongate shaft assembly operably extends from the handle assembly and includes a drive shaft assembly that operably interfaces with the drive motor and is selectively axially movable between a first position and a second position. A surgical end effector is rotatably coupled to the elongate shaft assembly for selective rotation relative thereto. A rotary transmission operably interfaces with the drive shaft assembly and the surgical end effector such that when the drive shaft assembly is in the first axial position, application of a rotary drive motion to the drive shaft assembly by the drive motor causes the rotary transmission to apply a first rotary control motion to the surgical end effector and when the drive shaft assembly is in the second axial position, application of the rotary drive motion to the drive shaft assembly by the drive motor

causes the rotary transmission to apply a second rotary control motion to the surgical end effector.

(382) Various exemplary embodiments also comprise a differential locking system for a surgical instrument that includes a surgical end effector that is powered by a rotary drive shaft assembly that is movable between a plurality of discrete axial positions. In at least one form, the differential locking system comprises at least one retention formation on the rotary drive shaft assembly that corresponds to each one of the discrete axial positions. At least one lock member is operably supported relative to rotary drive shaft assembly for retaining engagement with the at least one retention formation when the rotary drive shaft assembly is moved to the discrete axial positions associated therewith.

(383) In connection with another exemplary general form, there is provided a differential locking system for a surgical instrument that includes a surgical end effector powered by a rotary drive shaft assembly that is movable between a first axial position and a second axial position. In at least one exemplary form, the differential locking system comprises a differential housing that operably interfaces with the rotary drive shaft assembly and the surgical end effector. At least one spring-biased lock member operably supported by the differential housing for retaining engagement with a first portion of the rotary drive shaft assembly when the rotary drive shaft assembly is in the first axial position and the at least one spring-biased lock member further configured to retainingly engage a second portion of the rotary drive shaft assembly when the rotary drive shaft assembly is in the second axial position.

(384) In connection with yet another exemplary general form, there is provided a differential locking system for a surgical instrument that includes a surgical end effector that is powered by a rotary drive shaft assembly that is movable between a first axial position and a second axial position. In at least one exemplary form, the differential locking system comprises a differential housing that operably interfaces with the rotary drive shaft assembly and the surgical end effector. At least one spring member is provided on a portion of the rotary drive shaft assembly wherein each spring member defines a first retaining position that corresponds to the first axial position of the rotary drive shaft assembly and a second retaining position that corresponds to the second axial position of the rotary drive shaft assembly. A lock member is operably supported by the differential housing and corresponds to each of the at least one spring members for retaining engagement therewith such that the lock member retainingly engages the corresponding spring member in the first retaining position when the rotary drive shaft assembly is in the first axial position and the lock member retainingly engages the corresponding spring member in the second retaining position when the rotary drive shaft assembly is in the second axial position.

(385) Various other exemplary embodiments comprise a surgical instrument that includes an end effector and a proximal rotary drive train assembly that is operably coupled to a source of rotary and axial control motions. The proximal rotary drive train assembly is longitudinally shiftable in response to applications of the axial control motions thereto. The surgical instrument further includes a distal rotary drive train assembly that is operably coupled to the end effector to apply the rotary control motions thereto. A proximal axial drive train assembly is operably coupled to another source of axial control motions. A distal axial drive train assembly is operably coupled to the end effector to apply the axial control motions thereto. The instrument further comprises a coupling arrangement for simultaneously attaching and detaching the proximal rotary drive train assembly to the distal rotary drive train assembly and the proximal axial drive train assembly to the distal axial drive train assembly.

(386) In connection with another general aspect, there is provided a coupling arrangement for attaching an end effector including a plurality of distal drive train assemblies that are configured to apply a plurality of control motions to the end effector to corresponding proximal drive train assemblies communicating with a source of drive motions. In one exemplary form, the coupling arrangement comprises a proximal attachment formation on a distal end of each proximal drive train assembly and a proximal coupler member that is configured to operably support each

proximal drive train assembly therein such that the proximal attachment formations thereon are retained in substantial coupling alignment. A distal attachment formation is provided on a proximal end of each distal drive train assembly. Each distal attachment formation is configured to operably engage a proximal attachment formation on the distal end of a corresponding proximal drive train when brought into coupling engagement therewith. A distal coupler member is operably coupled to the end effector and is configured to operably support each distal drive train therein to retain the distal attachment formations thereon in substantial coupling alignment. A locking collar is movable from an unlocked position wherein the distal drive train assemblies may be decoupled from the corresponding proximal drive train assemblies and a locked position wherein the distal drive train assemblies are retained in coupled engagement with their corresponding proximal drive train assemblies.

(387) In connection with another general aspect, there is provided a surgical instrument that includes an end effector that is configured to perform surgical activities in response to drive motions applied thereto. An exemplary form of the instrument further includes a source of drive motions and a first proximal drive train assembly that operably interfaces with the source of drive motions for receiving corresponding first drive motions therefrom. A second proximal drive train assembly operably interfaces with the source of drive motions for receiving corresponding second drive motions therefrom. A first distal drive train assembly operably interfaces with the end effector and is configured to receive the corresponding first drive motions from the first proximal drive train assembly when it is operably coupled thereto. A second distal drive train assembly operably interfaces with the end effector and is configured to receive the corresponding second drive motions from the second proximal drive train assembly when it is operably coupled thereto. The instrument further comprises a coupling arrangement that includes a first coupling member that operably supports the first and second proximal drive train assemblies therein. The coupling arrangement further includes a second coupling member that operably supports the first and second distal drive train assemblies therein and is configured for axial alignment with the first coupling member such that when the second coupling member is axially aligned with the first coupling member, the first distal drive train assembly is in axial alignment with the first proximal drive train assembly for operable engagement therewith and the second distal drive train assembly is in axial alignment with the second proximal drive train assembly for operable engagement therewith. A locking collar is movably journaled on one of the first and second coupling members and is configured to move between an unlocked position wherein the first and second distal drive train assemblies are detachable from the first and second proximal drive train assemblies, respectively and a locked position wherein the first and second distal drive train assemblies are retained in operable engagement with the first and second proximal drive train assemblies, respectively.

(388) In accordance with another general aspect, there is provided a surgical cartridge that includes a cartridge body that defines a path therethrough for operably receiving a firing member of a surgical instrument. The surgical cartridge further includes an alignment member that is operably supported in the cartridge body and is configured to move the firing member from an inoperable configuration wherein firing member is misaligned with the path to an operable configuration wherein the firing member is in alignment with the path when the firing member is driven into contact therewith.

(389) In accordance with yet another general aspect, there is provided an end effector for a surgical instrument. In at least one form, the end effector comprises a support member that has a slot and a lockout notch that is adjacent to the slot. The end effector further comprises a firing member that is movable between an inoperable configuration and an operable configuration, wherein the firing member is aligned with the slot and is structured to translate in the slot when it is in the operable configuration and wherein the firing member is engaged with the lockout notch and misaligned with the slot when it is in the inoperable configuration.

(390) Another exemplary embodiment comprises a surgical instrument that includes an elongate

channel that is configured to removably support a cartridge therein. In at least one form, the cartridge comprises a cartridge body and an alignment member that is movably supported within the cartridge body for movement from a first position to a second position therein. The surgical instrument also comprises a firing member that is operably supported relative to the elongate channel for movement between a starting position and an ending position upon application of actuation motions thereto. The firing member is incapable from moving from the starting position to the ending position unless the firing member is in operable engagement with the alignment member in the cartridge body.

(391) Another exemplary embodiment comprises an end effector for a surgical instrument. In at least one form, the end effector comprises an elongate channel that is configured to removably support a cartridge therein. A firing member is operably supported relative to the elongate channel for movement between a starting and ending position. An implement drive shaft is in operable engagement with the firing member for moving the firing member between the starting and ending positions upon applications of actuation motions thereto from a drive arrangement. The implement drive shaft is moveable from an inoperable position wherein the implement drive shaft is out of operable engagement with the drive arrangement to an operable position wherein the implement drive shaft is in operable engagement with the drive arrangement. The end effector further comprises an alignment member that is movably supported for contact with the implement drive shaft to move the implement drive shaft from the inoperable position to the operable position upon installation of a cartridge in the elongate channel.

(392) Another exemplary embodiment includes a surgical instrument that comprises an elongate channel and a cartridge that is removably supported in the elongate channel. A firing member is operably supported relative to the elongate channel for movement between a starting and ending position. An implement drive shaft is in operable engagement with the firing member for moving the firing member between the starting and ending positions upon applications of actuation motions thereto from a drive arrangement. The implement drive shaft is moveable from an inoperable position wherein the implement drive shaft is out of operable engagement with the drive arrangement to an operable position wherein the implement drive shaft is in operable engagement with the drive arrangement. The surgical instrument further comprises an alignment member movably supported for contact with the implement drive shaft to move the implement drive shaft from the inoperable position to the operable position upon installation of a cartridge in the elongate channel.

(393) The devices disclosed herein can be designed to be disposed of after a single use, or they can be designed to be used multiple times. In either case, however, the device can be reconditioned for reuse after at least one use. Reconditioning can include any combination of the steps of disassembly of the device, followed by cleaning or replacement of particular pieces, and subsequent reassembly. In particular, the device can be disassembled, and any number of the particular pieces or parts of the device can be selectively replaced or removed in any combination. Upon cleaning and/or replacement of particular parts, the device can be reassembled for subsequent use either at a reconditioning facility, or by a surgical team immediately prior to a surgical procedure. Those skilled in the art will appreciate that reconditioning of a device can utilize a variety of techniques for disassembly, cleaning/replacement, and reassembly. Use of such techniques, and the resulting reconditioned device, are all within the scope of the present application.

(394) Although the present invention has been described herein in connection with certain disclosed exemplary embodiments, many modifications and variations to those exemplary embodiments may be implemented. For example, different types of end effectors may be employed. Also, where materials are disclosed for certain components, other materials may be used. The foregoing description and following claims are intended to cover all such modification and variations.

(395) Any patent, publication, or other disclosure material, in whole or in part, that is said to be incorporated by reference herein is incorporated herein only to the extent that the incorporated materials does not conflict with existing definitions, statements, or other disclosure material set forth in this disclosure. As such, and to the extent necessary, the disclosure as explicitly set forth herein supersedes any conflicting material incorporated herein by reference. Any material, or portion thereof, that is said to be incorporated by reference herein, but which conflicts with existing definitions, statements, or other disclosure material set forth herein will only be incorporated to the extent that no conflict arises between that incorporated material and the existing disclosure material.

Claims

1. A surgical device for use with a robotic system and a loading unit, wherein the robotic system comprises a plurality of rotary drivers, wherein the loading unit comprises an end effector including a first jaw and a second jaw, and wherein the surgical device comprises: an elongate shaft, wherein the loading unit is operably couplable to the elongate shaft; a firing driver rotatable in a first direction and a second direction opposite the first direction, wherein the firing driver is configured to provide a firing stroke to the loading unit based on the firing driver rotating in the first direction; an enclosure extending proximally from the elongate shaft, wherein the enclosure is removably coupleable to the robotic system; a first rotary actuator configured to be driven by a first rotary driver of the plurality of rotary drivers, wherein the first rotary actuator is configured to rotate the firing driver in the first direction and the second direction; a firing gear operably coupling the first rotary actuator and the firing driver; a second rotary actuator configured to be driven by a second rotary driver of the plurality of rotary drivers, wherein the elongate shaft is rotatable based on rotation of the second rotary actuator; and a manually-operable bailout configured to rotate the firing driver in the second direction, wherein the manually-operable bailout comprises a ratchet gear configured to engage and rotate the firing gear.
2. The surgical device of claim 1, further comprising a third rotary actuator configured to be driven by a third rotary driver of the plurality of rotary drivers.
3. The surgical device of claim 1, wherein the manually-operable bailout comprises a lever, wherein the ratchet gear extends from the lever, and wherein the ratchet gear is configured to engage and rotate the firing gear based on rotation of the lever.
4. The surgical device of claim 3, wherein the lever is pivotably coupled to the enclosure.
5. The surgical device of claim 1, wherein the end effector comprises a staple cartridge including staples, and wherein the staples are deployable from the staple cartridge based on the firing driver rotating in the first direction.
6. The surgical device of claim 1, wherein the firing driver comprises a firing shaft.
7. A surgical device for use with a robotic system including a plurality of rotary drivers, wherein the surgical device comprises: an elongate shaft; a loading unit removably coupleable to the elongate shaft, wherein the loading unit comprises an end effector including a first jaw and a second jaw; a rotatable driver rotatable in a first direction and a second direction opposite the first direction, wherein the rotatable driver is configured to effect a firing motion at the loading unit based on the rotatable driver rotating in the first direction; a housing extending proximally from the elongate shaft, wherein the housing is removably coupleable to the robotic system; a first rotary actuator configured to be driven by a first rotary driver of the plurality of rotary drivers, wherein the first rotary actuator is configured to rotate the rotatable driver in the first direction and the second direction; a firing gear operably coupling the first rotary actuator and the rotatable driver; a second rotary actuator configured to be driven by a second rotary driver of the plurality of rotary driver, wherein the elongate shaft is rotatable based on rotation of the second rotary actuator; and a manually-operable bailout configured to rotate the rotatable driver in the second direction, wherein

the manually-operable bailout comprises a ratchet gear configured to engage and rotate the firing gear.
8. The surgical device of claim 7, further comprising a third rotary actuator configured to be driven by a third rotary driver of the plurality of rotary drivers.
9. The surgical device of claim 7, wherein the manually-operable bailout comprises a lever, wherein the ratchet gear extends from the lever, and wherein the ratchet gear is configured to engage and rotate the firing gear based on rotation of the lever.
10. The surgical device of claim 9, wherein the lever is pivotably coupled to the housing.
11. The surgical device of claim 7, wherein the end effector comprises a staple cartridge including staples, and wherein the staples are deployable from the staple cartridge based on the rotatable driver rotating in the first direction.
12. The surgical device of claim 7, wherein the loading unit comprises a translatable driver, comprising: a first fin configured to engage the first jaw; and a second fin configured to engage the second jaw, wherein the first fin and the second fin are configured to maintain a spacing between the first jaw and the second jaw.
13. The surgical device of claim 7, wherein the rotatable driver comprises a rotatable shaft.
14. A surgical device for use with a robotic system and a loading unit, wherein the robotic system comprises a plurality of rotary drivers, wherein the loading unit comprises an end effector including a first jaw and a second jaw, and wherein the surgical device comprises: an elongate shaft, wherein the loading unit is operably couplable to the elongate shaft; a firing driver movable in an advancing direction and a reversing direction, wherein the firing driver is configured to effect a firing motion at the loading unit based on the firing driver moving in the advancing direction; an enclosure extending proximally from the elongate shaft, wherein the enclosure is removably coupleable to the robotic system; a first rotary actuator configured to be driven by a first rotary driver of the plurality of rotary drivers, wherein the first rotary actuator is configured to move the firing driver in the advancing direction and the reversing direction; a firing gear operably coupling the first rotary actuator and the firing driver; a second rotary actuator configured to be driven by a second rotary driver of the plurality of rotary drivers, wherein the elongate shaft is rotatable relative to the elongate shaft based on rotation of the second rotary actuator; and a manually-operable bailout configured to move the firing driver in the reversing direction, wherein the manually-operable bailout comprises a ratchet gear configured to engage and rotate the firing gear.
15. The surgical device of claim 14, wherein the manually-operable bailout comprises a lever pivotably coupled to the enclosure, and wherein the ratchet gear extends from the lever.
16. The surgical device of claim 15, wherein the ratchet gear is configured to engage and rotate the firing gear based on rotation of the lever.
17. The surgical device of claim 14, further comprising a translatable articulation driver configured to rotate the end effector based on rotation of the second rotary actuator.