

US Patent & Trademark Office

Patent Public Search | Text View

United States Patent	12383803
Kind Code	B2
Date of Patent	August 12, 2025
Inventor(s)	Parsons; Robert R. et al.

Golf club heads and methods to manufacture golf club heads

Abstract

Embodiments of golf club heads and methods to manufacture golf club heads are generally described herein. In one example, a golf club head includes a body portion, a crown portion having a composite material, a first groove on a bottom portion extending in a heel-to-toe direction, a second groove on the bottom portion extending in a heel-to-toe direction, a first set of ports on the bottom portion between the first groove and the second groove, a second set of ports on the bottom portion between the second groove and a rear portion, and a filler material in the body portion between the first groove and the rear portion. The filler material at least partially surrounds the first set of ports and the second set of ports. Other examples and embodiments may be described and claimed.

Inventors: Parsons; Robert R. (Scottsdale, AZ), Schweigert; Bradley D. (Cave Creek, AZ), Nicolette; Michael R. (Scottsdale, AZ)

Applicant: PARSONS XTREME GOLF, LLC (Scottsdale, AZ)

Family ID: 1000008748352

Assignee: PARSONS XTREME GOLD, LLC (Scottsdale, AZ)

Appl. No.: 18/408965

Filed: January 10, 2024

Prior Publication Data

Document Identifier	Publication Date
US 20240139591 A1	May. 02, 2024

Related U.S. Application Data

continuation parent-doc US 17205887 20210318 US 11752402 20230912 child-doc US 18229760
continuation parent-doc US 16820366 20200316 US 10981037 20210420 child-doc US 17205887
continuation parent-doc US 16418691 20190521 US 10653928 20200519 child-doc US 16820366

continuation parent-doc US 15803157 20171103 US 10335645 20190702 child-doc US 16418691
continuation parent-doc US 15290859 20161011 US 9814945 20171114 child-doc US 15803157
continuation parent-doc US 15040892 20160210 US 9550096 20170124 child-doc US 15290859
continuation parent-doc US 15875416 20180119 US 10293220 20190521 child-doc US 16372009
continuation parent-doc US 15446842 20170301 US 9895582 20180220 child-doc US 15875416
continuation parent-doc US 15377120 20161213 US 9802087 20171031 child-doc US 15446842
continuation parent-doc US 14939849 20151112 US 9555295 20170131 child-doc US 15377120
continuation parent-doc US 14615606 20150206 US 9199140 20151201 child-doc US 14939849
continuation parent-doc US 15875496 20180119 US 10252123 20190409 child-doc US 16290610
continuation parent-doc US 15457627 20170313 US 9895583 20180220 child-doc US 15875496
continuation parent-doc US 15189806 20160622 US 9636554 20170502 child-doc US 15457627
continuation parent-doc US 14667546 20150324 US 9399158 20160726 child-doc US 15189806
continuation parent-doc US 15967117 20180430 US 10293221 20190521 child-doc US 16375553
continuation parent-doc US 15457618 20170313 US 9987526 20180605 child-doc US 15967117
continuation parent-doc US 15163393 20160524 US 9662547 20170530 child-doc US 15457618
continuation parent-doc US 14667541 20150324 US 9352197 20160531 child-doc US 15163393
continuation parent-doc US 17231832 20210415 US 11697050 20230711 child-doc US 18201320
continuation parent-doc US 16713942 20191213 US 11000742 20210511 child-doc US 17231832
continuation parent-doc US 16198128 20181121 US 10532257 20200114 child-doc US 16713942
continuation parent-doc US 15583756 20170501 US 10143899 20181204 child-doc US 16198128
continuation parent-doc US 15271574 20160921 US 9669270 20170606 child-doc US 15583756
continuation parent-doc US 17138797 20201230 US 11344774 20220531 child-doc US 17731402
continuation parent-doc US 16542548 20190816 US 10898766 20210126 child-doc US 17138797
continuation parent-doc US 15967098 20180430 US 10420989 20190924 child-doc US 16542548
continuation parent-doc US 15687273 20170825 US 9981160 20180529 child-doc US 15967098
continuation parent-doc US 15831148 20171204 US 10195501 20190205 child-doc US 16222580
continuation parent-doc US 15453701 20170308 US 9833667 20171205 child-doc US 15831148
continuation parent-doc US 17505851 20211020 US 11904216 child-doc US 18408965 20240110
continuation parent-doc US 15970665 20180503 US 11173356 20211116 child-doc US 17505851
continuation parent-doc US 15667343 20170802 US 10213659 20190226 child-doc US 15970665
continuation parent-doc US 15492711 20170420 US 9821201 20171121 child-doc US 15808552
continuation parent-doc US 15440968 20170223 US 9795842 20171024 child-doc US 15724035
continuation parent-doc US 15463306 20170320 US 9821200 20171121 child-doc US 15807201
continuation parent-doc US 15249857 20160829 US 9630070 20170425 child-doc US 15463306
continuation parent-doc US 15445253 20170228 US 9795843 20171024 child-doc US 15725900
continuation parent-doc US 15227281 20160803 US 9782643 20171010 child-doc US 15445253
continuation parent-doc US 15406408 20170113 US 9861867 20180109 child-doc US 15477972
continuation-in-part parent-doc US 18229760 20230803 US 12233319 child-doc US 18408965
continuation-in-part parent-doc US 16372009 20190401 US 10821334 20201103 child-doc US
16820366 20200316
continuation-in-part parent-doc US 16290610 20190301 US 10617918 20200414 child-doc US
16820366 20200316
continuation-in-part parent-doc US 14615606 20150206 US 9199140 20151201 child-doc US
14667546
continuation-in-part parent-doc US 16375553 20190404 US 10695623 20200630 child-doc US
16820366 20200316
continuation-in-part parent-doc US 14615606 20150206 US 9199140 20151201 child-doc US
14667541
continuation-in-part parent-doc US 18201320 20230524 US 12121782 child-doc US 18408965
20240110

continuation-in-part parent-doc US 17731402 20220428 US 12036451 child-doc US 18408965
20240110
continuation-in-part parent-doc US 16222580 20181217 US 10722764 20200728 child-doc US
16542548 20190816
continuation-in-part parent-doc US 15808552 20171109 US 10099093 20181016 child-doc US
15970665 20180503
continuation-in-part parent-doc US 15724035 20171003 US 9999814 20180619 child-doc US
15970665 20180503
continuation-in-part parent-doc US 15807201 20171108 US 10010770 20180703 child-doc US
15970665 20180503
continuation-in-part parent-doc US 15725900 20171005 US 10052532 20180821 child-doc US
15970665 20180503
continuation-in-part parent-doc US 15477972 20170403 US 9914029 20180313 child-doc US
15970665 20180503
us-provisional-application US 62115024 20150211
us-provisional-application US 62120760 20150225
us-provisional-application US 62138918 20150326
us-provisional-application US 62184757 20150625
us-provisional-application US 62194135 20150717
us-provisional-application US 62195211 20150721
us-provisional-application US 62042155 20140826
us-provisional-application US 62048693 20140910
us-provisional-application US 62101543 20150109
us-provisional-application US 62105123 20150119
us-provisional-application US 62109510 20150129
us-provisional-application US 62291793 20160205
us-provisional-application US 62380727 20160829
us-provisional-application US 62356539 20160630
us-provisional-application US 62360802 20160711
us-provisional-application US 62512275 20170530
us-provisional-application US 62329662 20160429
us-provisional-application US 62444671 20170110
us-provisional-application US 62445878 20170113
us-provisional-application US 62337184 20160516
us-provisional-application US 62361988 20160713
us-provisional-application US 62281639 20160121
us-provisional-application US 62296506 20160217
us-provisional-application US 62301756 20160301
us-provisional-application US 62362491 20160714
us-provisional-application US 62406856 20161011
us-provisional-application US 62412389 20161025
us-provisional-application US 62419242 20161108

Publication Classification

Int. Cl.: A63B53/04 (20150101); A63B60/02 (20150101); A63B53/06 (20150101)

U.S. Cl.:

CPC **A63B53/0466** (20130101); **A63B53/04** (20130101); **A63B60/02** (20151001);
A63B53/0408 (20200801); A63B53/0412 (20200801); A63B53/0433 (20200801);
A63B2053/0491 (20130101); A63B53/06 (20130101); A63B2209/00 (20130101)

Field of Classification Search

CPC: A63B (53/0412); A63B (53/0433); A63B (53/0466); A63B (2053/0491)

References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
1133129	12/1914	Govan	N/A	N/A
1269745	12/1917	Robertson	N/A	N/A
1306029	12/1918	Robertson	N/A	N/A
D55867	12/1919	Matters	N/A	N/A
1534800	12/1924	Malusz	N/A	N/A
1538312	12/1924	Neish	N/A	N/A
D138437	12/1943	Link	N/A	N/A
D138438	12/1943	Link	N/A	N/A
D138442	12/1943	Link	N/A	N/A
3652094	12/1971	Glover	N/A	N/A
D240748	12/1975	Bock et al.	N/A	N/A
4085934	12/1977	Churchward	N/A	N/A
D253778	12/1978	Madison	N/A	N/A
4795159	12/1988	Nagamoto	N/A	N/A
D307783	12/1989	Iinuma	N/A	N/A
5106094	12/1991	Desbiolles et al.	N/A	N/A
D326885	12/1991	Paul	N/A	N/A
5219408	12/1992	Sun	N/A	N/A
D351883	12/1993	Solheim et al.	N/A	N/A
5485997	12/1995	Schmidt et al.	N/A	N/A
5499819	12/1995	Nagamoto	N/A	N/A
5518243	12/1995	Redman	N/A	N/A
5597361	12/1996	Hope	N/A	N/A
D378111	12/1996	Parente et al.	N/A	N/A
5624331	12/1996	Lo et al.	N/A	N/A
D384120	12/1996	Cruz et al.	N/A	N/A
5788584	12/1997	Parente et al.	N/A	N/A
D400625	12/1997	Kubica et al.	N/A	N/A
D400627	12/1997	Kubica et al.	N/A	N/A
D405489	12/1998	Kubica et al.	N/A	N/A
D405492	12/1998	Kubica et al.	N/A	N/A
5997415	12/1998	Wood	N/A	N/A
D444830	12/2000	Kubica et al.	N/A	N/A
6273832	12/2000	Helmstetter et al.	N/A	N/A
6290609	12/2000	Takeda	N/A	N/A
6306048	12/2000	McCabe et al.	N/A	N/A
6409612	12/2001	Evans et al.	N/A	N/A

D478140	12/2002	Burrows	N/A	N/A
6638182	12/2002	Kosmatka	N/A	N/A
6773360	12/2003	Willett et al.	N/A	N/A
D508969	12/2004	Hasebe	N/A	N/A
6969326	12/2004	De Shiell et al.	N/A	N/A
D513051	12/2004	Barez et al.	N/A	N/A
D514179	12/2005	Chen et al.	N/A	N/A
D514185	12/2005	Barez et al.	N/A	N/A
6991560	12/2005	Tseng	N/A	N/A
D520586	12/2005	Bingman	N/A	N/A
D522077	12/2005	Schweigert et al.	N/A	N/A
D522601	12/2005	Schweigert et al.	N/A	N/A
D523498	12/2005	Chen et al.	N/A	N/A
D526694	12/2005	Schweigert et al.	N/A	N/A
7083530	12/2005	Wahl et al.	N/A	N/A
7101291	12/2005	Yamamoto	473/324	A63B 53/04
7121956	12/2005	Lo	N/A	N/A
D534599	12/2006	Barez et al.	N/A	N/A
7166040	12/2006	Hoffman et al.	N/A	N/A
D536401	12/2006	Kawami	N/A	N/A
D536403	12/2006	Kawami	N/A	N/A
7186190	12/2006	Beach et al.	N/A	N/A
7214142	12/2006	Meyer	473/332	G01N 29/045
7223180	12/2006	Willett et al.	N/A	N/A
7261645	12/2006	Oyama	N/A	N/A
7261646	12/2006	Shiell et al.	N/A	N/A
7273423	12/2006	Imamoto	473/332	A63B 53/0466
D563498	12/2007	Jertson et al.	N/A	N/A
D564054	12/2007	Jertson et al.	N/A	N/A
D564055	12/2007	Jertson et al.	N/A	N/A
7338388	12/2007	Schweigert et al.	N/A	N/A
7347794	12/2007	Schweigert	N/A	N/A
D567317	12/2007	Jertson et al.	N/A	N/A
D569933	12/2007	Jertson et al.	N/A	N/A
D569934	12/2007	Jertson et al.	N/A	N/A
D569935	12/2007	Schweigert et al.	N/A	N/A
D569936	12/2007	Schweigert et al.	N/A	N/A
D569942	12/2007	Jertson et al.	N/A	N/A
D570937	12/2007	Schweigert et al.	N/A	N/A
D570938	12/2007	Jertson et al.	N/A	N/A
7407447	12/2007	Beach et al.	N/A	N/A
7410425	12/2007	Willett et al.	N/A	N/A
7410426	12/2007	Willett et al.	N/A	N/A
7419441	12/2007	Hoffman et al.	N/A	N/A
7448963	12/2007	Beach et al.	N/A	N/A
7448964	12/2007	Schweigert et al.	N/A	N/A
7494425	12/2008	Shiell et al.	N/A	N/A
7527565	12/2008	Ehlers et al.	N/A	N/A
7530903	12/2008	Imamoto	473/335	A63B 60/02
7530904	12/2008	Beach et al.	N/A	N/A

D594520	12/2008	Schweigert et al.	N/A	N/A
D594521	12/2008	Jertson et al.	N/A	N/A
D594919	12/2008	Schweigert et al.	N/A	N/A
7540811	12/2008	Beach et al.	N/A	N/A
D597620	12/2008	Taylor et al.	N/A	N/A
7568985	12/2008	Beach et al.	N/A	N/A
7572193	12/2008	Yokota	473/328	A63B 60/02
7578753	12/2008	Beach et al.	N/A	N/A
D600297	12/2008	Jertson et al.	N/A	N/A
7584531	12/2008	Schweigert et al.	N/A	N/A
7588502	12/2008	Nishino	N/A	N/A
7591738	12/2008	Beach et al.	N/A	N/A
D603472	12/2008	Schweigert et al.	N/A	N/A
7611424	12/2008	Nagai et al.	N/A	N/A
7621823	12/2008	Beach et al.	N/A	N/A
D605715	12/2008	Barez et al.	N/A	N/A
7632194	12/2008	Beach et al.	N/A	N/A
7658686	12/2009	Soracco	N/A	N/A
7713142	12/2009	Hoffman et al.	N/A	N/A
7717804	12/2009	Beach et al.	N/A	N/A
7717805	12/2009	Beach et al.	N/A	N/A
D618746	12/2009	Jertson et al.	N/A	N/A
D618747	12/2009	Schweigert et al.	N/A	N/A
D618753	12/2009	Jertson et al.	N/A	N/A
D618754	12/2009	Schweigert et al.	N/A	N/A
7744484	12/2009	Chao	N/A	N/A
7798203	12/2009	Schweigert et al.	N/A	N/A
7806781	12/2009	Imamoto	473/332	A63B 53/0466
7846041	12/2009	Beach et al.	N/A	N/A
D635626	12/2010	Nicolette	N/A	N/A
7927229	12/2010	Jertson et al.	N/A	N/A
D638893	12/2010	Schweigert et al.	N/A	N/A
D638896	12/2010	Schweigert et al.	N/A	N/A
7963861	12/2010	Beach et al.	N/A	N/A
8007369	12/2010	Soracco	N/A	N/A
8012038	12/2010	Beach et al.	N/A	N/A
D647585	12/2010	Jertson et al.	N/A	N/A
8096896	12/2011	Schiell et al.	N/A	N/A
D661751	12/2011	Nicolette et al.	N/A	N/A
D661756	12/2011	Nicolette et al.	N/A	N/A
8197357	12/2011	Rice et al.	N/A	N/A
8202175	12/2011	Ban	N/A	N/A
8257196	12/2011	Abbott et al.	N/A	N/A
8257197	12/2011	Schweigert	N/A	N/A
8262506	12/2011	Watson et al.	N/A	N/A
8287402	12/2011	Shiell et al.	N/A	N/A
D673630	12/2012	Schweigert	N/A	N/A
D673632	12/2012	Schweigert et al.	N/A	N/A
8371957	12/2012	Schweigert et al.	N/A	N/A
D680179	12/2012	Solheim et al.	N/A	N/A

8414422	12/2012	Peralta et al.	N/A	N/A
8444506	12/2012	Watson et al.	N/A	N/A
8485919	12/2012	Rice et al.	N/A	N/A
D691230	12/2012	Chen et al.	N/A	N/A
8562457	12/2012	Beach et al.	N/A	N/A
8608587	12/2012	Henrikson et al.	N/A	N/A
8628431	12/2013	Schweigert et al.	N/A	N/A
8651975	12/2013	Soracco	N/A	N/A
8663026	12/2013	Blowers et al.	N/A	N/A
8777778	12/2013	Solheim et al.	N/A	N/A
8784232	12/2013	Jertson et al.	N/A	N/A
8790196	12/2013	Solheim et al.	N/A	N/A
8808108	12/2013	Schweigert	N/A	N/A
D712989	12/2013	Gillig	N/A	N/A
8826512	12/2013	Schweigert	N/A	N/A
8858362	12/2013	Leposky et al.	N/A	N/A
8961336	12/2014	Parsons et al.	N/A	N/A
D724164	12/2014	Schweigert et al.	N/A	N/A
8979671	12/2014	Demille et al.	N/A	N/A
8986133	12/2014	Bennett	473/344	A63B 60/00
D729892	12/2014	Nicolette et al.	N/A	N/A
D733234	12/2014	Nicolette	N/A	N/A
9162120	12/2014	Jertson	N/A	A63B 53/04
9199140	12/2014	Schweigert et al.	N/A	N/A
9199143	12/2014	Parsons et al.	N/A	N/A
9211448	12/2014	Bezilla	N/A	A63B 53/0466
D753251	12/2015	Schweigert et al.	N/A	N/A
9320949	12/2015	Golden	N/A	A63B 53/0466
D756471	12/2015	Nicolette et al.	N/A	N/A
9352197	12/2015	Parsons et al.	N/A	N/A
D760334	12/2015	Schweigert et al.	N/A	N/A
9399158	12/2015	Parsons et al.	N/A	N/A
9427634	12/2015	Parsons et al.	N/A	N/A
9452325	12/2015	DeShiell et al.	N/A	N/A
9630070	12/2016	Parsons et al.	N/A	N/A
9662545	12/2016	Beach	N/A	A63B 60/52
9682295	12/2016	Dawson et al.	N/A	N/A
9700765	12/2016	Frame	N/A	A63B 60/52
9821201	12/2016	Parsons et al.	N/A	N/A
9833667	12/2016	Parsons	N/A	A63B 53/04
9839821	12/2016	DeShiell et al.	N/A	N/A
9914029	12/2017	Parsons	N/A	A63B 60/02
9937390	12/2017	Luttrell	N/A	A63B 53/06
9981160	12/2017	Parsons	N/A	A63B 60/54
9999814	12/2017	Parsons	N/A	A63B 53/04
10080934	12/2017	Beach	N/A	A63B 53/02
10099093	12/2017	Parsons	N/A	A63B 53/04
10137336	12/2017	Mizutani	N/A	A63B 60/52
10159879	12/2017	Jertson	N/A	A63B 53/04
10195501	12/2018	Parsons	N/A	A63B 53/0466

10213659	12/2018	Parsons	N/A	A63B 53/06
10272299	12/2018	Mizutani	N/A	A63B 53/0466
10384102	12/2018	Parsons	N/A	A63B 53/0466
10420989	12/2018	Parsons	N/A	A63B 53/04
10441855	12/2018	Parsons	N/A	A63B 53/0466
10709942	12/2019	Parsons	N/A	A63B 53/04
10722764	12/2019	Parsons	N/A	A63B 60/52
10898766	12/2020	Parsons	N/A	A63B 60/002
11173356	12/2020	Parsons	N/A	A63B 60/54
11344774	12/2021	Parsons	N/A	A63B 60/02
11406880	12/2021	Roach et al.	N/A	N/A
12036451	12/2023	Parsons	N/A	A63B 60/02
2003/0027662	12/2002	Werner et al.	N/A	N/A
2003/0104878	12/2002	Yabu	N/A	N/A
2004/0033846	12/2003	Caldwell	N/A	N/A
2004/0087388	12/2003	Beach et al.	N/A	N/A
2004/0116207	12/2003	De Shiell et al.	N/A	N/A
2004/0192468	12/2003	Onoda et al.	N/A	N/A
2005/0049074	12/2004	Chen et al.	N/A	N/A
2005/0096154	12/2004	Chen	N/A	N/A
2005/0101408	12/2004	Sanchez et al.	N/A	N/A
2005/0181884	12/2004	Beach et al.	N/A	N/A
2005/0192116	12/2004	Imamoto	N/A	N/A
2005/0209024	12/2004	Oyama	N/A	N/A
2005/0239576	12/2004	Stites et al.	N/A	N/A
2005/0261082	12/2004	Yamamoto	N/A	N/A
2006/0105856	12/2005	Lo	N/A	N/A
2006/0111200	12/2005	Poynor	N/A	N/A
2006/0122004	12/2005	Chen et al.	N/A	N/A
2007/0004527	12/2006	Helmstetter	N/A	N/A
2007/0238551	12/2006	Yokota	473/349	A63B 60/52
2007/0293344	12/2006	Davis	N/A	N/A
2008/0004133	12/2007	Schweigert	N/A	N/A
2008/0015049	12/2007	Imamoto	N/A	N/A
2008/0188322	12/2007	Anderson et al.	N/A	N/A
2008/0261715	12/2007	Carter	N/A	N/A
2009/0029795	12/2008	Schweigert et al.	N/A	N/A
2009/0258726	12/2008	Abe	N/A	N/A
2010/0075774	12/2009	Ban	N/A	N/A
2010/0144461	12/2009	Ban	N/A	N/A
2010/0167837	12/2009	Ban	N/A	N/A
2010/0331102	12/2009	Golden et al.	N/A	N/A
2011/0143858	12/2010	Peralta et al.	N/A	N/A
2012/0083359	12/2011	Stites	N/A	N/A
2012/0142445	12/2011	Burnett et al.	N/A	N/A
2012/0190479	12/2011	Rice et al.	N/A	N/A
2012/0202615	12/2011	Beach	473/345	A63B 60/52
2012/0220387	12/2011	Beach	473/307	A63B 53/02
2013/0102410	12/2012	Stites	473/335	A63B 53/0466
2013/0109502	12/2012	Hayase et al.	N/A	N/A

2013/0130826	12/2012	Soracco	N/A	N/A
2013/0210542	12/2012	Harbert	473/338	A63B 53/06
2013/0303304	12/2012	Sato	N/A	N/A
2013/0318772	12/2012	Wahl et al.	N/A	N/A
2013/0324281	12/2012	Boyd	473/305	A63B 53/0466
2014/0080625	12/2013	Fossum	473/329	A63B 59/70
2014/0080634	12/2013	Golden	473/345	A63B 53/0466
2014/0235369	12/2013	Willet et al.	N/A	N/A
2014/0274457	12/2013	Beach	473/335	A63B 53/0412
2015/0094164	12/2014	Galvan	473/329	A63B 60/54
2015/0126304	12/2014	Cleghorn	473/338	A63B 60/52
2015/0174461	12/2014	Bennett	473/329	A63B 53/0466
2015/0182818	12/2014	James	473/349	A63B 60/52
2015/0190688	12/2014	Bennett	473/329	A63B 53/0466
2015/0217167	12/2014	Frame	473/329	A63B 60/54
2015/0231454	12/2014	Parsons et al.	N/A	N/A
2015/0290503	12/2014	Su	N/A	N/A
2015/0360098	12/2014	Parsons et al.	N/A	N/A
2016/0059088	12/2015	Parsons et al.	N/A	N/A
2016/0129319	12/2015	Bennett	473/345	A63B 53/0466
2016/0158610	12/2015	Parsons	473/346	A63B 60/54
2016/0256753	12/2015	Westrum et al.	N/A	N/A
2016/0339308	12/2015	Parsons et al.	N/A	N/A
2016/0346646	12/2015	Bennett	N/A	A63B 60/00
2017/0028284	12/2016	Galvan	N/A	A63B 60/52
2017/0151472	12/2016	Beach	N/A	A63B 60/00
2017/0203167	12/2016	de la Cruz	N/A	A63B 60/00
2017/0225050	12/2016	Cleghorn	N/A	A63B 60/54
2017/0282021	12/2016	Golden	N/A	A63B 53/06
2017/0312592	12/2016	Parsons et al.	N/A	N/A
2018/0001159	12/2017	Mizutani	N/A	A63B 53/0466
2018/0001170	12/2017	Mizutani	N/A	A63B 60/52
2018/0147459	12/2017	Martens	N/A	A63B 60/00
2018/0185719	12/2017	Johnson	N/A	A63B 53/06
2018/0345099	12/2017	Harbert	N/A	A63B 53/0433
2019/0030403	12/2018	Beach	N/A	A63B 60/00

OTHER PUBLICATIONS

Examination Report dated Dec. 2, 2019 for UK Application No. GB1911896.7. cited by applicant
Examination Report dated Sep. 12, 2019 for UK Application No. GB1911896.7. cited by applicant
International Search Report and Written Opinion Issued in Connection With Corresponding Application No. PCT/US16/17474 dated May 12, 2016 (8 Pages). cited by applicant
International Search Report and Written Opinion Issued in Connection With Corresponding Application No. PCT/US2017/013513 dated Mar. 17, 2017 (8 Pages). cited by applicant
International Search Report and Written Opinion received in connection with corresponding application No. PCT/US2015/016666, dated May 14, 2015 (8 pages). cited by applicant
International Search Report and Written Opinion received in connection with corresponding application No. PCT/US2017/055155, dated Jan. 25, 2018 (8 pages). cited by applicant
International Search Report and Written Opinion received in connection with PCT Application PCTUS2015042282 dated Oct. 13, 2015 (12 pages). cited by applicant

International Search Report and Written Opinion received in connection with PCT/US15/42484 dated Oct. 19, 2015 (12 pages). cited by applicant
Spotted: Three New PXG Drivers Appear on the USGA Conforming List (GOLFWRX). Dec. 18, 2017. Retrieved From the Internet on Jan. 16, 2019.
URL: <http://www.golfwrx.com/482592/spotted-three-new-pxg-drivers-appear-on-the-usga-conforming-list/>. cited by applicant
U.S. Appl. No. 29/512,313, Nicolette, "Golf Club Head," filed Dec. 18, 2014. cited by applicant
Wall, Jonathan, "Details: Phil's Prototype Mack Daddy PM-Grind Wedge," (<http://www.pgatour.com/equipmentreport/2015/01/21/callaway-wedge.html>), www.pgatour.com, PGA Tour, Inc., published Jan. 21, 2015. cited by applicant

Primary Examiner: Hunter; Alvin A

Background/Summary

CROSS REFERENCE (1) This application is a continuation-in-part of application Ser. No. 18/229,760, filed Aug. 3, 2023, which is a continuation of application Ser. No. 17/205,887, filed Mar. 18, 2021, now U.S. Pat. No. 11,752,402, which is a continuation of application Ser. No. 16/820,366, filed Mar. 16, 2020, now U.S. Pat. No. 10,981,037, which is a continuation of application Ser. No. 16/418,691, filed May 21, 2019, now U.S. Pat. No. 10,653,928, which is a continuation of application Ser. No. 15/803,157, filed Nov. 3, 2017, now U.S. Pat. No. 10,335,645, which is a continuation of application Ser. No. 15/290,859, filed Oct. 11, 2016, now U.S. Pat. No. 9,814,945, which is a continuation of application Ser. No. 15/040,892, filed Feb. 10, 2016, now U.S. Pat. No. 9,550,096, which claims the benefit of U.S. Provisional Application No. 62/115,024, filed Feb. 11, 2015, U.S. Provisional Application No. 62/120,760, filed Feb. 25, 2015, U.S. Provisional Application No. 62/138,918, filed Mar. 26, 2015, U.S. Provisional Application No. 62/184,757, filed Jun. 25, 2015, U.S. Provisional No. 62/194,135, filed Jul. 17, 2015, and U.S. Provisional Application No. 62/195,211, filed Jul. 21, 2015. (2) U.S. application Ser. No. 16/820,366, filed Mar. 16, 2020, is a continuation-in-part of application Ser. No. 16/372,009, filed Apr. 1, 2019, now U.S. Pat. No. 10,821,334, which is a continuation of application Ser. No. 15/875,416, filed Jan. 19, 2018, now U.S. Pat. No. 10,293,220, which is a continuation of application Ser. No. 15/446,842, filed Mar. 1, 2017, now U.S. Pat. No. 9,895,582, which is a continuation of application Ser. No. 15/377,120, filed Dec. 13, 2016, now U.S. Pat. No. 9,802,087, which is a continuation of application Ser. No. 14/939,849, filed Nov. 12, 2015, now U.S. Pat. No. 9,555,295, which is a continuation of application Ser. No. 14/615,606, filed Feb. 6, 2015, now U.S. Pat. No. 9,199,140. (3) U.S. application Ser. No. 16/820,366, filed Mar. 16, 2020, is a continuation-in-part of application Ser. No. 16/290,610, filed Mar. 1, 2019, now U.S. Pat. No. 10,617,918, which is a continuation of application Ser. No. 15/875,496, filed Jan. 19, 2018, now U.S. Pat. No. 10,252,123, which is a continuation of application Ser. No. 15/457,627, filed Mar. 13, 2017, now U.S. Pat. No. 9,895,583, which is a continuation of application Ser. No. 15/189,806, filed Jun. 22, 2016, now U.S. Pat. No. 9,636,554, which is a continuation of application Ser. No. 14/667,546, filed Mar. 24, 2015, now U.S. Pat. No. 9,399,158, which is a continuation-in-part of application Ser. No. 14/615,606, filed Feb. 6, 2015, now U.S. Pat. No. 9,199,140, which claims the benefit of U.S. Provisional Application No. 62/042,155, filed Aug. 26, 2014, U.S. Provisional Application No. 62/048,693, filed Sep. 10, 2014, U.S. Provisional Application No. 62/101,543, filed Jan. 9, 2015, U.S. Provisional Application No. 62/105,123, filed Jan. 19, 2015, and U.S. Provisional Application No. 62/109,510, filed Jan. 29, 2015. (4) U.S. application Ser. No. 16/820,366, filed Mar. 16, 2020, is a continuation-in-part of application Ser. No. 16/375,553, filed Apr. 4, 2019, now

U.S. Pat. No. 10,695,623, which is a continuation of application Ser. No. 15/967,117, filed Apr. 30, 2018, now U.S. Pat. No. 10,293,221, which is a continuation application Ser. No. 15/457,618, filed Mar. 13, 2017, now U.S. Pat. No. 9,987,526, which is a continuation of application Ser. No. 15/163,393, filed May 24, 2016, now U.S. Pat. No. 9,662,547, which is a continuation of application Ser. No. 14/667,541, filed Mar. 24, 2015, now U.S. Pat. No. 9,352,197, which is a continuation-in-part of application Ser. No. 14/615,606, filed Feb. 6, 2015, now U.S. Pat. No. 9,199,140, which claims the benefit of U.S. Provisional Application No. 62/042,155, filed Aug. 26, 2014, U.S. Provisional Application No. 62/048,693, filed Sep. 10, 2014, U.S. Provisional Application No. 62/101,543, filed Jan. 9, 2015, U.S. Provisional Application No. 62/105,123, filed Jan. 19, 2015, and U.S. Provisional Application No. 62/109,510, filed Jan. 29, 2015. (5) This application is a continuation-in-part application Ser. No. 18/201,320, filed May 24, 2023, which is a continuation of application Ser. No. 17/231,832, filed Apr. 15, 2021, now U.S. Pat. No. 11,697,050, which is a continuation of application Ser. No. 16/713,942, filed Dec. 13, 2019, now U.S. Pat. No. 11,000,742, which is a continuation of application Ser. No. 16/198,128, filed Nov. 21, 2018, now U.S. Pat. No. 10,532,257, which is a continuation of application Ser. No. 15/583,756, filed May 1, 2017, now U.S. Pat. No. 10,143,899, which is a continuation of application Ser. No. 15/271,574, filed Sep. 21, 2016, now U.S. Pat. No. 9,669,270, which claims the benefit of U.S. Provisional Application No. 62/291,793, filed Feb. 5, 2016. (6) This application is a continuation-in-part of application Ser. No. 17/731,402, filed Apr. 28, 2022, which is a continuation of application Ser. No. 17/138,797, filed Dec. 30, 2020, now U.S. Pat. No. 11,344,774, which is a continuation of application Ser. No. 16/542,548, filed Aug. 16, 2019, now U.S. Pat. No. 10,898,766, which is a continuation of application Ser. No. 15/967,098, filed Apr. 30, 2018, now U.S. Pat. No. 10,420,989, which is a continuation of application Ser. No. 15/687,273, filed Aug. 25, 2017, now U.S. Pat. No. 9,981,160, which claims the benefit of U.S. Provisional Application No. 62/380,727, filed Aug. 29, 2016. (7) U.S. patent application Ser. No. 16/542,548, filed Aug. 16, 2019 is also a continuation-in-part of application Ser. No. 16/222,580, filed Dec. 17, 2018, now U.S. Pat. No. 10,722,764, which is a continuation of application Ser. No. 15/831,148, filed Dec. 4, 2017, now U.S. Pat. No. 10,195,101, which is a continuation of application Ser. No. 15/453,701, filed Mar. 8, 2017, now U.S. Pat. No. 9,833,667, which claims the benefit of U.S. Provisional Application No. 62/356,539, filed Jun. 30, 2016, and U.S. Provisional Application No. 62/360,802, filed Jul. 11, 2016. (8) This application is a continuation of application Ser. No. 17/505,851, filed Oct. 20, 2021, which is a continuation of application Ser. No. 15/970,665, filed May 3, 2018, now U.S. Pat. No. 11,173,356, which is a continuation of application Ser. No. 15/667,343, filed Aug. 2, 2017, now U.S. Pat. No. 10,213,659, which claims the benefit of U.S. Provisional Application No. 62/512,275, filed May 30, 2017. (9) U.S. patent application Ser. No. 15/970,665, filed May 3, 2018, is also a continuation-in-part application Ser. No. 15/808,552, filed Nov. 9, 2017, now U.S. Pat. No. 10,099,093, which is a continuation of application Ser. No. 15/492,711, filed Apr. 20, 2017, now U.S. Pat. No. 9,821,201, which claims the benefit of U.S. Provisional Application No. 62/329,662, filed Apr. 29, 2016. (10) U.S. patent application Ser. No. 15/970,665, filed May 3, 2018, is also a continuation-in-part of application Ser. No. 15/724,035, filed Oct. 3, 2017, now U.S. Pat. No. 9,999,814 which is a continuation of application Ser. No. 15/440,968, filed Feb. 23, 2017, now U.S. Pat. No. 9,795,842, which claims the benefit of U.S. Provisional Application No. 62/444,671, filed Jan. 10, 2017, and U.S. Provisional Application No. 62/445,878, filed Jan. 13, 2017. (11) U.S. patent application Ser. No. 15/970,665, filed May 3, 2018, is also a continuation-in-part of application Ser. No. 15/807,201, filed Nov. 8, 2017, now U.S. Pat. No. 10,010,770, which is a continuation of application Ser. No. 15/463,306, filed Mar. 20, 2017, now U.S. Pat. No. 9,821,200, which is a continuation of application Ser. No. 15/249,857, filed Aug. 29, 2016, now U.S. Pat. No. 9,630,070, which claims the benefit of U.S. Provisional Application No. 62/337,184, filed May 16, 2016, and U.S. Provisional Application No. 62/361,988, filed Jul. 13, 2016. (12) U.S. patent application Ser. No. 15/970,665, filed May 3, 2018, is also a continuation-in-part of

application Ser. No. 15/725,900, filed Oct. 5, 2017, now U.S. Pat. No. 10,052,532, which is a continuation of application Ser. No. 15/445,253, filed Feb. 28, 2017, now U.S. Pat. No. 9,795,843, which is a continuation of application Ser. No. 15/227,281, filed Aug. 3, 2016, now U.S. Pat. No. 9,782,643, which claims the benefit of U.S. Provisional Application No. 62/281,639, filed Jan. 21, 2016, U.S. Provisional Application No. 62/296,506, filed Feb. 17, 2016, U.S. Provisional Application No. 62/301,756, filed Mar. 1, 2016, and U.S. Provisional Application No. 62/362,491, filed Jul. 14, 2016. (13) U.S. patent application Ser. No. 15/970,665, filed May 3, 2018, is also a continuation-in-part of application Ser. No. 15/477,972, filed Apr. 3, 2017, now U.S. Pat. No. 9,914,029, which is a continuation of application Ser. No. 15/406,408, filed Jan. 13, 2017, now U.S. Pat. No. 9,861,867, which claims the benefit of U.S. Provisional Application No. 62/406,856, filed Oct. 11, 2016, U.S. Provisional Application No. 62/412,389, filed Oct. 25, 2016, and U.S. Provisional Application No. 62/419,242, filed Nov. 8, 2016. (14) The disclosures of the above-referenced applications are incorporated by reference herein in their entirety.

COPYRIGHT AUTHORIZATION

(1) The present disclosure may be subject to copyright protection. The copyright owner has no objection to the facsimile reproduction by anyone of the present disclosure and its related documents, as they appear in the Patent and Trademark Office patent files or records, but otherwise reserves all applicable copyrights.

FIELD

(2) The present disclosure generally relates to sports equipment, and more particularly, to golf club heads and methods to manufacture golf club heads.

BACKGROUND

(3) In golf, various factors may affect the distance and direction that a golf ball may travel. In particular, the center of gravity (CG) and/or the moment of inertia (MOI) of a golf club head may affect the launch angle, the spin rate, and the direction of the golf ball at impact. Such factors may vary significantly based the type of golf swing.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

- (1) FIG. 1 is top perspective view of an example golf club head according to an embodiment of the apparatus, methods, and articles of manufacture described herein.
- (2) FIG. 2 depicts a bottom perspective view of the example golf club head of FIG. 1.
- (3) FIG. 3 depicts a top view of the example golf club head of FIG. 1.
- (4) FIG. 4 depicts a bottom view of the example golf club head of FIG. 1.
- (5) FIG. 5 depicts a front view of the example golf club head of FIG. 1.
- (6) FIG. 6 depicts a rear view of the example golf club head of FIG. 1.
- (7) FIG. 7 depicts a toe view of the example golf club head of FIG. 1.
- (8) FIG. 8 depicts a heel view of the example golf club head of FIG. 1.
- (9) FIG. 9 depicts a bottom view of an example body portion of the example golf club head of FIG. 1.
- (10) FIG. 10 depicts a cross-sectional view of the example body portion of the example golf club head of FIG. 1.
- (11) FIG. 11 depicts two weight ports of the example golf club head of FIG. 1.
- (12) FIG. 12 depicts a top view of an example weight portion of the example golf club head of FIG. 1.
- (13) FIG. 13 depicts a side view of the example weight portion of FIG. 10.
- (14) FIG. 14 depicts example launch trajectory profiles of the example golf club head of FIG. 1.
- (15) FIG. 15 depicts a first weight configuration of the example weight portions.

- (16) FIG. 16 depicts a second weight configuration of the example weight portions.
- (17) FIG. 17 depicts a third weight configuration of the example weight portions.
- (18) FIG. 18 depicts a fourth weight configuration of the example weight portions.
- (19) FIG. 19 depicts an example launch trajectory profile of the example golf club head of FIG. 18.
- (20) FIG. 20 depicts one manner in which the example golf club heads described herein may be manufactured.
- (21) FIG. 21 depicts a bottom view of another example golf club head.
- (22) FIG. 22 depicts a bottom view of yet another example golf club head.
- (23) FIG. 23 is top perspective view of an example golf club head according to an embodiment of the apparatus, methods, and articles of manufacture described herein.
- (24) FIG. 24 depicts a bottom perspective view of the example golf club head of FIG. 23.
- (25) FIG. 25 depicts a front view of the example golf club head of FIG. 23.
- (26) FIG. 26 depicts a rear view of the example golf club head of FIG. 23.
- (27) FIG. 27 depicts a top view of the example golf club head of FIG. 23.
- (28) FIG. 28 depicts a bottom view of the example golf club head of FIG. 23.
- (29) FIG. 29 depicts a toe view of the example golf club head of FIG. 23.
- (30) FIG. 30 depicts a heel view of the example golf club head of FIG. 23.
- (31) FIG. 31 depicts a cross-sectional view of the example golf club head of FIG. 23 taken at section line 31-31 of FIG. 29
- (32) FIG. 32 depicts a cross-sectional view of the example golf club head of FIG. 23 taken at section line 32-32 of FIG. 25.
- (33) FIG. 33 depicts a cross-sectional view of an example golf club head of FIG. 23 taken at section line 31-31 of FIG. 29 according to an embodiment of the apparatus, methods, and articles of manufacture described herein.
- (34) FIG. 34 depicts a cross-sectional view of the golf club head of FIG. 33 taken at section line 32-32 of FIG. 25.
- (35) FIG. 35 depicts a cross-sectional view of an example golf club head of FIG. 23 taken at section line 31-31 of FIG. 29 according to an embodiment of the apparatus, methods, and articles of manufacture described herein.
- (36) FIG. 36 depicts a cross-sectional view of an example golf club head of FIG. 23 taken at section line 31-31 of FIG. 29 according to an embodiment of the apparatus, methods, and articles of manufacture described herein.
- (37) FIG. 37 depicts a cross-sectional view of an example golf club head of FIG. 23 taken at section line 31-31 of FIG. 29 according to an embodiment of the apparatus, methods, and articles of manufacture described herein.
- (38) FIG. 38 depicts a cross-sectional view of an example golf club head of FIG. 23 taken at section line 31-31 of FIG. 29 according to an embodiment of the apparatus, methods, and articles of manufacture described herein.
- (39) FIG. 39 depicts a cross-sectional view of an example golf club head of FIG. 23 taken at section line 31-31 of FIG. 29 according to an embodiment of the apparatus, methods, and articles of manufacture described herein.
- (40) FIG. 40 depicts a perspective view of an elastic polymer insert according to an embodiment of the apparatus, methods, and articles of manufacture described herein.
- (41) FIG. 41 is top perspective view of an example golf club head according to an embodiment of the apparatus, methods, and articles of manufacture described herein.
- (42) FIG. 42 depicts a bottom view of the example golf club head of FIG. 41.
- (43) FIG. 43 depicts a toe view of the example golf club head of FIG. 41.
- (44) FIG. 44 depicts a top perspective cross-sectional view of the golf club head of FIG. 41 taken at section line 44-44 of FIG. 43.
- (45) FIG. 45 depicts a top perspective cross-sectional view of an example of the golf club head of

FIG. **41** taken at section line **44-44** of FIG. **43** according to an embodiment of the apparatus, methods, and articles of manufacture described herein.

(46) FIG. **46** depicts a top perspective cross-sectional view an example of the golf club head of FIG. **41** taken at section line **44-44** of FIG. **43** according to an embodiment of the apparatus, methods, and articles of manufacture described herein.

(47) FIG. **47** depicts a perspective view of an elastic polymer insert according to an embodiment of the apparatus, methods, and articles of manufacture described herein.

(48) FIG. **48** depicts a perspective view of an elastic polymer insert according to an embodiment of the apparatus, methods, and articles of manufacture described herein.

(49) FIG. **49** is top perspective view of an example golf club head according to an embodiment of the apparatus, methods, and articles of manufacture described herein.

(50) FIG. **50** depicts a rear perspective view of the example golf club head of FIG. **49**.

(51) FIG. **51** depicts a toe perspective view of the example golf club head of FIG. **49**.

(52) FIG. **52** depicts a heel perspective view of the example golf club head of FIG. **49**.

(53) FIG. **53** depicts a bottom perspective view of the example golf club head of FIG. **49**.

(54) FIG. **54** depicts a cross-sectional view of the example golf club head of FIG. **48** taken at section line **54-54** of FIG. **51**.

(55) FIG. **55** is top perspective view of an example golf club head according to an embodiment of the apparatus, methods, and articles of manufacture described herein.

(56) FIG. **56** depicts a top view of the example golf club head of FIG. **55**.

(57) FIG. **57** depicts a perspective exploded view of the example golf club head of FIG. **55**.

(58) FIG. **58** depicts a perspective exploded view of another example golf club head of FIG. **55**.

(59) FIG. **59** depicts a perspective exploded view of another example golf club head of FIG. **55**.

(60) FIG. **60** depicts a side perspective cross-sectional view of an example golf club head according to an embodiment of the apparatus, methods, and articles of manufacture described herein.

(61) FIG. **61** depicts another side perspective cross-sectional view of the golf club head of FIG. **60**.

(62) For simplicity and clarity of illustration, the drawing figures illustrate the general manner of construction, and descriptions and details of well-known features and techniques may be omitted to avoid unnecessarily obscuring the present disclosure. Additionally, elements in the drawing figures are not necessarily drawn to scale. For example, the dimensions of some of the elements in the figures may be exaggerated relative to other elements to help improve understanding of embodiments of the present disclosure.

DESCRIPTION

(63) In general, golf club heads and methods to manufacture golf club heads are described herein. The apparatus, methods, and articles of manufacture described herein are not limited in this regard. In the example of FIGS. **1-13**, a golf club head **100** may include a body portion **110**, and a plurality of weight portions **120**, generally, shown as a first set of weight portions **210** (FIG. **2**) and a second set of weight portions **220** (FIG. **2**). The body portion **110** may include a top portion **130**, a bottom portion **140**, a toe portion **150**, a heel portion **160**, a front portion **170**, and a rear portion **180**. The bottom portion **140** may include a skirt portion **190** defined as a side portion of the golf club head **100** between the top portion **130** and the bottom portion **140** excluding the front portion **170** and extending across a periphery of the golf club head **100** from the toe portion **150**, around the rear portion **180**, and to the heel portion **160**. The bottom portion **140** may include a transition region **230** and a weight port region **240**. For example, the weight port region **240** may be a D-shape region. The weight port region **240** may include a plurality of weight ports **900** (FIG. **9**) to receive the plurality of weight portions **120**. The front portion **170** may include a face portion **175** to engage a golf ball (not shown). The body portion **110** may also include a hosel portion **165** to receive a shaft (not shown). Alternatively, the body portion **110** may include a bore instead of the hosel portion **165**. For example, the body portion **110** may be made partially or entirely of an aluminum-based material, a magnesium-type material, a steel-based material, a titanium-based

material, any combination thereof, or any other suitable material. In another example the body portion **110** may be made partially or entirely of a non-metal material such as a ceramic material, a composite material, any combination thereof, or any other suitable material.

(64) The golf club head **100** may have a club head volume greater than or equal to 300 cubic centimeters (cm³ or cc). In one example, the golf club head **100** may be about 460 cc.

Alternatively, the golf club head **100** may have a club head volume less than or equal to 300 cc. In particular, the golf club head **100** may have a club head volume between 100 cc and 200 cc. The club head volume of the golf club head **100** may be determined by using the weighted water displacement method (i.e., Archimedes Principle). For example, procedures defined by golf standard organizations and/or governing bodies such as the United States Golf Association (USGA) and/or the Royal and Ancient Golf Club of St. Andrews (R&A) may be used for measuring the club head volume of the golf club head **100**. Although FIG. **1** may depict a particular type of club head (e.g., a driver-type club head), the apparatus, methods, and articles of manufacture described herein may be applicable to other types of club head (e.g., a fairway wood-type club head, a hybrid-type club head, an iron-type club head, a putter-type club head, etc.). The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(65) Each of the first set of weight portions **210**, generally shown as **405, 410, 415, 420, 425, 430, and 435** (FIG. **4**), may be associated with a first mass. Each of the second set of weight portions **220**, generally shown as **440, 445, 450, 455, 460, 465, 470, 475, and 480** (FIG. **4**), may be associated with a second mass. The first mass may be greater than the second mass or vice versa. In one example, the first set of weight portions **210** may be made of a tungsten-based material whereas the second set of weight portions **220** may be made of an aluminum-based material. As described in detail below, the first and second set of weight portions **210** and **220**, respectively, may provide various weight configurations (e.g., FIGS. **15-18**).

(66) Referring to FIGS. **9-11**, for example, the bottom portion **140** of the body portion **110** may include a plurality of weight ports **900**. The plurality of weight ports **900**, generally shown as **905, 910, 915, 920, 925, 930, 935, 940, 945, 950, 955, 960, 965, 970, 975, and 980**, may be located along a periphery of the weight port region **240** of the bottom portion **140**. The plurality of weight ports **900** may extend across the bottom portion **140**. In particular, the plurality of weight ports **900** may extend between the toe and heel portions **150** and **160**, respectively, across the bottom portion **140**. The plurality of weight ports **900** may also extend between the front and rear portions **170** and **180**, respectively, across the bottom portion **140**. The plurality of weight ports **900** may be arranged across the bottom portion **140** along a path that defines a generally D-shaped loop. In one example, the plurality of weight ports **900** may extend more than 50% of a maximum toe-to-heel distance **500** between of the toe and heel portions **150** and **160**, respectively, across the bottom portion **140**. The maximum toe-to-heel distance **500** of the golf club head **100** may be measured from transition regions between the top and bottom portions **130** and **140**, respectively, at the toe and heel portions **150** and **160**, respectively. Alternatively, the maximum toe-to-heel distance **500** may be a horizontal distance between vertical projections of the outermost points of the toe and heel portions **150** and **160**, respectively. For example, the maximum toe-to-heel distance **500** may be measured when the golf club head **100** is at a lie angle **510** of about 60 degrees. If the outermost point of the heel portion **160** is not readily defined, the outermost point of the heel portion **160** may be located at a height **520** of about 0.875 inches (22.23 millimeters) above a ground plane **530** (i.e., a horizontal plane on which the golf club head **100** is lying on). The plurality of weight ports **900** may extend more than 50% of a maximum toe-to-heel club head distance **500** of the golf club head **100**. In particular, the plurality of weight ports **900** may extend between the toe portion **150** and the heel portion **160** at a maximum toe-to-heel weight port distance **995**, which may be more than 50% of the maximum toe-to-heel club head distance **500** of the golf club head **100**. In one example, the maximum toe-to-heel club head distance **500** of the golf club head **100** may be no more than 5 inches (127 millimeters). Accordingly, the plurality of weight ports **900** may extend a weight port

maximum toe-to-heel weight port distance of at least 2.5 inches between the toe and heel portions **150** and **160**, respectively. A maximum toe-to-heel weight port distance **995** may be the maximum distance between the heel-side boundary of the weight port farthest from the toe portion **150** and the toe-side boundary of the weight port farthest from the heel portion **160**. In the example of FIG. **9**, the weight port maximum toe-to-heel weight port distance **995** may be the maximum distance between the heel-side boundary of the weight port **940** and toe-side boundary of the weight port **980**. For example, the maximum toe-to-heel weight port distance **995** may be about 3.7 inches. As the rules of golf may change from time to time (e.g., new regulations may be adopted or old rules may be eliminated or modified by golf standard organizations and/or governing bodies), the lie angle **510** and/or the height **520** for measuring the maximum toe-to-heel club head distance **500** may also change. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(67) Each of the plurality of weight ports **900** may be associated with a port diameter (D.sub.port) (e.g., two shown as **1105** and **1110** in FIG. **11**). For example, the port diameter of each weight port of the plurality of weight ports **900** may be about 0.3 inch (7.65 millimeters). Alternatively, the port diameters of adjacent weight ports may be different. In one example, the weight port **905** may be associated with a port diameter **1105**, and the weight port **910** may be associated with a port diameter **1110**. In particular, the port diameter **1105** of the weight port **905** may be larger than the port diameter **1110** of the weight port **910** or vice versa. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(68) The bottom portion **140** may also include an outer surface **990**. As illustrated in FIG. **10**, for example, the plurality of weight ports **900** may be formed on the bottom portion **140** relative to an outer surface curve **1090** formed by the outer surface **990**. In particular, each of the plurality of weight ports **900** may be associated with a port axis generally shown as **1005**, **1010**, and **1015**. A center of a weight port may define the port axis of the weight port. Each port axis may be perpendicular or substantially perpendicular to a plane that is tangent to the outer surface curve **1090** at the point of intersection of the port axis and the outer surface curve **1090**. In one example, substantially perpendicular may refer to a deviation of $\pm 5^\circ$ from perpendicular. In another example, substantially perpendicular may refer to a deviation of $\pm 3^\circ$ from perpendicular. The deviation from perpendicular may depend on manufacturing tolerances.

(69) In one example, the port axis **1010** may be perpendicular or substantially perpendicular (i.e., normal) to a tangent plane **1012** of the outer surface curve **1090**. Multiple fixtures may be used to manufacture the plurality of weight ports **900** by positioning the golf club head **100** in various positions. Alternatively, the weight ports may be manufactured by multiple-axis machining processes, which may be able to rotate the golf club head around multiple axes to mill away excess material (e.g., by water jet cutting and/or laser cutting) to form the plurality of weight ports **900**. Further, multiple-axis machining processes may provide a suitable surface finish because the milling tool may be moved tangentially about a surface. Accordingly, the apparatus, methods, and articles of manufacture described herein may use a multiple-axis machining process to form each of the plurality of weight ports **900** on the bottom portion **140**. For example, a five-axis milling machine may form the plurality of weight ports **900** so that the port axis **1000** of each of the plurality weight ports **900** may be perpendicular or substantially perpendicular to the outer surface curve **1090**. The tool of the five-axis milling machine may be moved tangentially about the outer surface curve **1090** of the outer surface **990**.

(70) Turning to FIG. **11**, for example, two adjacent weight ports may be separated by a port distance **1100**, which may be the shortest distance between two adjacent weight ports on the outer surface **990**. In particular, the port distance **1100** may be less than or equal to the port diameter of any of the two adjacent weight ports. In one example, the port distance **1100** between the weight ports **905** and **910** may be less than or equal to either the port diameter **1105** or the port diameter **1110**. The apparatus, methods, and articles of manufacture described herein are not limited in this

regard.

(71) The plurality of weight portions **120** may have similar or different physical properties (e.g., density, shape, mass, volume, size, color, etc.). In one example, the first set of weight portions **210** may be a black color whereas the second set of weight portions **220** may be a gray color or a steel color. Some or all of the plurality of weight portions **120** may be partially or entirely made of a metal material such as a steel-based material, a tungsten-based material, an aluminum-based material, any combination thereof or suitable types of materials. Alternatively, some or all of the plurality of weight portions **120** may be partially or entirely made of a non-metal material (e.g., composite, plastic, etc.).

(72) In the illustrated example as shown in FIGS. **12** and **13**, each weight portion of the plurality of weight portions **120** may have a cylindrical shape (e.g., a circular cross section). Although the above examples may describe weight portions having a particular shape, the apparatus, methods, and articles of manufacture described herein may include weight portions of other suitable shapes (e.g., a portion of or a whole sphere, cube, cone, cylinder, pyramid, cuboidal, prism, frustum, or other suitable geometric shape). Each weight portion of the plurality of weight portions **120** may be associated with a diameter **1200** and a height **1300**. In one example, each weight portion of the plurality of weight portions **120** may have a diameter of about 0.3 inch (7.62 millimeters) and a height of about 0.2 inch (5.08 millimeters). Alternatively, the first and second sets of weight portions **210** and **220**, respectively, may be different in width and/or height.

(73) Instead of a rear-to-front direction as in other golf club heads, each weight portion of the plurality of weight portions **120** may engage one of the plurality of weight ports **400** in a bottom-to-top direction. The plurality of weight portions **120** may include threads to secure in the weight ports. For example, each weight portion of the plurality of weight portions **120** may be a screw. The plurality of weight portions **120** may not be readily removable from the body portion **110** with or without a tool. Alternatively, the plurality of weight portions **120** may be readily removable (e.g., with a tool) so that a relatively heavier or lighter weight portion may replace one or more of the plurality of weight portions **120**. In another example, the plurality of weight portions **120** may be secured in the weight ports of the body portion **110** with epoxy or adhesive so that the plurality of weight portions **120** may not be readily removable. In yet another example, the plurality of weight portions **120** may be secured in the weight ports of the body portion **110** with both epoxy and threads so that the plurality of weight portions **120** may not be readily removable. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(74) In contrast to other golf club heads, the golf club head **100** may accommodate at least four different types of golf swings. As illustrated in FIG. **14**, for example, each weight configuration may be associated with one of the plurality of launch trajectory profiles **1400**, generally shown as **1410**, **1420**, and **1430**. Referring to FIG. **15**, for example, in a first weight configuration **1500**, a first set of weight portions, which may be defined by the weight portions **405**, **410**, **415**, **120**, **425**, **430** and **435**, may be disposed toward the front portion **170**, whereas a second set of weight portions, which may be defined by the weight portions **440**, **445**, **450**, **455**, **460**, **465**, **470**, **475**, may be disposed toward the rear portion **180** according to the configuration of the first set of weight ports **1510**. The first weight configuration **1500** may be associated with the first launch trajectory profile **1410** (FIG. **14**). In particular, the first weight configuration **1500** may decrease spin rate of a golf ball. By placing relatively heavier weight portions (i.e., the first set of weight portions) towards the front portion **170** of the golf club head **100** according to the configuration of the first set of weight ports **1510**, the center of gravity (GC) of the golf club head **100** may move relatively forward and lower to produce a relatively lower launch and spin trajectory. As a result, the first launch trajectory profile **1410** may be associated with a relatively greater roll distance (i.e., distance after impact with the ground). While the above example may describe the weight portions being disposed in certain weight ports, any weight portion of the first set of weight portions **210** may be disposed in any weight port of the first set of weight ports **1510**.

(75) Turning to FIG. 16, for example, in a second weight configuration **1600**, a first set of weight portions, which may be defined by the weight portions **405, 410, 415, 120, 425, 430** and **435**, may be disposed toward the rear portion **180** whereas a second set of weight portions, which may be defined by the weight portions **440, 445, 450, 455, 460, 465, 470, 475**, may be disposed toward the front portion **170** according to the configuration of the second set of weight ports **1610**. The second weight configuration **1600** may be associated with the second launch trajectory profile **1420** (FIG. 14). In particular, the second weight configuration **1600** may increase launch angle of a golf ball and maximize forgiveness. By placing the relatively heavier weight portion (i.e., the first set of weight portions) towards the rear portion **180** of the golf club head **100** according to the configuration of the second set of weight ports **1610**, the center of gravity (GC) of the golf club head **100** may move relatively back and up to produce a relatively higher launch and spin trajectory. Further, the moment of inertia (MOI) of the golf club head **100** may increase in both the horizontal (front-to-back axis) and vertical axes (top-to-bottom axis), which in turn, provides relatively more forgiveness on off-center hits. As a result, the second launch trajectory profile **1420** may be associated with a relatively greater carry distance (i.e., in-the-air distance).

(76) Turning to FIG. 17, for example, in a third weight configuration, a first set of weight portions, which may be defined by the weight portions **405, 410, 415, 120, 425, 430** and **435**, may be disposed toward the heel portion **160** whereas a second set of weight portions, which may be defined by the weight portions **440, 445, 450, 455, 460, 465, 470, 475**, may be disposed toward the toe portion **150** according to the configuration of the third set of weight ports **1710**. The third weight configuration **1700** may be associated with a third launch trajectory profile **1430** (FIG. 14). In particular, the third weight configuration **1700** may allow an individual to turn over the golf club head **100** relatively easier (i.e., square up the face portion **175** to impact a golf ball). By placing the relatively heavier weight portions (i.e., the first set of weight portions) towards the heel portion **160** of the golf club head **100**, the center of gravity (GC) of the golf club head **100** may move relatively closer to the axis of the shaft.

(77) Turning to FIG. 18, for example, in a fourth weight configuration **1800**, a first set of weight portions, which may be defined by the weight portions **405, 410, 415, 120, 425, 430** and **435**, may be disposed toward the toe portion **150** whereas a second set of weight portions, which may be defined by the weight portions **440, 445, 450, 455, 460, 465, 470, 475**, may be disposed toward the heel portion **160** according to the configuration of the fourth set of weight ports **1810**. The fourth weight configuration **1800** may be associated with the third launch trajectory profile **1430** (FIG. 14). In particular, the fourth weight configuration **1800** may prevent an individual from turning over the golf club head **100** (i.e., the face portion **175** may be more open to impact a golf ball). By placing the relatively heavier weight portions (i.e., the first set of weight portions) towards the toe portion **150** of the golf club head **100**, the center of gravity (GC) of the golf club head **100** may move relatively farther away from the axis of the shaft. The fourth weight configuration **1800** may result in a fade golf shot (as shown in FIG. 19, for example, a trajectory or ball flight in which a golf ball travels to the left of a target **1910** and curving back to the right of the target for a right-handed individual). The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(78) FIG. 20 depicts one manner in which the golf club head **100** may be manufactured. In the example of FIG. 20, the process **2000** may begin with providing a plurality of weight portions (block **2010**). The plurality of weight portions may include a first set of weight portions and a second set of weight portions. Each weight portion of the first set of weight portions may be associated with a first mass whereas each weight portion of the second set of weight portions may be associated with a second mass. The first mass may be greater than the second mass. In one example, each weight portion of the first set of weight portions may be made of a tungsten-based material with a mass 2.6 grams whereas each weight portion of the second set of weight portions may be made of an aluminum-based material with a mass of 0.4 grams. The first set of weight

portions may have a gray color or a steel color whereas the second set of weight portions may have a black color. The process **2000** may provide a body portion of a golf club head (block **2020**). The body portion may include a front portion, a rear portion, a toe portion, a heel portion, a top portion, a bottom portion having an outer surface associated with outer surface curve, and a skirt portion between the top and bottom portion. The process **2000** may form a weight port region located at or proximate to the bottom and skirts portions (block **2030**). A transition region may surround the weight port region. The process **2000** may form a plurality of weight ports along a periphery of the weight port region (block **2040**). Each weight port of the plurality of weight ports may be associated with a port diameter and configured to receive at least one weight portion of the plurality of weight portions. Two adjacent weight ports may be separated by less than or equal to the port diameter. Further, each weight port of the plurality of weight ports may be associated with a port axis. The port axis may be perpendicular or substantially perpendicular relative to a tangent plane of the outer surface curve of the bottom portion of the golf club head. The example process **2000** of FIG. **20** is merely provided and described in conjunction with FIGS. **1-19** as an example of one way to manufacture the golf club head **100**. While a particular order of actions is illustrated in FIG. **20**, these actions may be performed in other temporal sequences. For example, two or more actions depicted in FIG. **20** may be performed sequentially, concurrently, or simultaneously. Although FIG. **20** depicts a particular number of blocks, the process may not perform one or more blocks. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(79) As shown in the above examples, the plurality of weight portions **120** and the plurality of weight ports **900** may be located on a periphery of the weight port region **240** along a path that defines a generally D-shaped loop formed with two arcs, generally shown as **490** and **495** in FIG. **4**. For example, the weight portions **405**, **410**, **415**, **420**, **425**, **430**, and **435** (FIG. **4**), and the weight ports **905**, **910**, **915**, **920**, **925**, **930**, and **935** (FIG. **9**) may form the first arc **490**. In particular, the first arc **490** may extend between the toe and heel portions **150** and **160**, respectively, across the bottom portion **140**. The weight portions **440**, **445**, **450**, **455**, **460**, **465**, **470**, **475**, and **480** (FIG. **4**), the weight ports **940**, **945**, **950**, **955**, **960**, **965**, **970**, **975**, and **980** (FIG. **9**) may form the second arc **495**. The second arc **495** may generally follow the contour of the rear portion **180** of the body portion **110**. Alternatively, the first and second arcs **490** and **495** may define loops with other shapes that extend across the bottom portion **140** (e.g., a generally O-shaped loop). The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(80) Although the above examples may depict the plurality of weight portions **120** and the plurality of weight ports **900** forming a particular geometric shape, the apparatus, methods, and articles of manufacture described herein may have weight portions and weight ports located along a periphery of a weight portion region to form other geometric shapes. Turning to FIG. **21**, for example, a golf club head **2100** may include a bottom portion **2110**, and a plurality of weight portions **2120** disposed in a plurality of weight ports **2130**. The plurality of weight ports **2130** may be located along a periphery of a weight port region **2140** of the bottom portion **2110** (i.e., the plurality of weight ports **2130** may extend between the toe and heel portions **2112** and **2114**, respectively, across the bottom portion **2110**). In contrast to the plurality of weight portions **120** and the plurality of weight ports **900** (e.g., FIGS. **4** and **9**), the plurality of weight ports **2130** may form two discrete arcs, generally shown as **2150** and **2155**, extending across the bottom portion **2110**.

(81) The first arc **2150** may extend between the toe portion **2112** and the heel portion **2114**. The first arc **2150** may curve toward the front portion **2170** of the golf club head **2100** (i.e., concave relative to the front portion **2170**). According to the example of FIG. **21**, the first arc **2150** may extend from a region proximate the toe portion **2112** to a region proximate to the front portion **2170** and from the region proximate to the front portion **2170** to a region proximate to the heel portion **2114** (i.e., concave relative to the front portion **2170**). Accordingly, the first arc **2150** may appear as a C-shaped arc facing the rear portion **2180** of the golf club head **2100** that extends between the toe portion **2112** and the heel portion **2114**. The second arc **2155** may also extend between the toe

portion **2112** and the heel portion **2114**. The second arc **2155** may curve toward the rear portion **2180** of the golf club head **2100** (i.e., concave relative to the rear portion **2180**). Accordingly, the second arc **2155** may appear as a C-shaped arc facing the front portion **2170** of the golf club head **2100** that extends between the toe portion **2112** and the heel portion **2114**. Further, the first arc **2150** may be closer to the front portion **2170** than the second arc **2155**. The first arc **2150** and the second arc **2155** may be discrete so that the first and second arcs **2150** and **2155**, respectively, may be spaced apart along the periphery of the bottom portion **2110**. Accordingly, the bottom portion **2110** may include gaps **2190** and **2192** along the periphery of the bottom portion **2110** between the weight ports **2130** of the first arc **2150** and the weight ports **2130** of the second arc **2155**. The gaps **2190** and/or **2192** may be greater than or equal to the port diameter of any of the weight ports **2130** such as the weight ports **2130** that are adjacent to the gaps **2190** and/or **2192**. According to one example as shown in FIG. **21**, the gaps **2190** and **2192** may be several orders or magnitude larger than the diameters of the weight ports **2130** that are adjacent to the gaps **2190** and **2192**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard. (82) Referring to FIG. **21**, for example, the first arc **2150** may include a greater number of weight ports **2130** than the second arc **2155**, which may be suitable for certain golf club heads (e.g., a fairway wood-type golf club head and/or a hybrid-type golf club head). Alternatively, the second arc **2155** may include the same or a greater number of weight ports **2130** than the first arc **2150**. The number of weight ports **2130** in each of the first and second arcs **2150** and **2155**, respectively, the weight portions **2120** associated with each weight port **2130** and the spacing between adjacent weight ports **2130** may be determined based on the type of golf club, a preferred weight distribution of the golf club head **2100**, and/or a center of gravity location of the golf club head **2100**.

(83) The weight ports **2130** of the first arc **2150** and/or the second arc **2155** may be spaced from each other at the same or approximately the same distance along the first arc **2150** and/or the second arc **2155**, respectively. Any variation in the spacing between the weight ports **2130** of the first arc **2150** or the second arc **2155** or any of the weight ports described herein may be due to different manufacturing considerations, such as manufacturing tolerances and/or cost effectiveness associated with manufacturing precision. For example, the variation in the spacing between the weight ports **2130** of the first arc **2150** and/or the second arc **2155** may be between 1/16 of an inch to 0.001 inch. As described herein, the distance between adjacent weight ports **2130** (i.e., port distance) may be less than or equal to the port diameter of any of the two adjacent weight ports. The plurality of weight ports **2130** may extend between the toe portion **2112** and the heel portion **2114** at a maximum toe-to-heel weight port distance that is more than 50% of a maximum toe-to-heel club head distance **2195** of the golf club head **2100**. The maximum toe-to-heel weight port distance may be the maximum distance between the heel-side boundary of the weight port farthest from the toe portion **2112** and the toe-side boundary of the weight port farthest from the heel portion **2114**.

(84) In particular, the golf club head **2100** may have a volume of less than 430 cc. In example, the golf club head **2100** may have a volume ranging from 100 cc to 400 cc. In another example, the golf club head **2100** may have a volume ranging from 150 cc to 350 cc. In yet another example, the golf club head **2100** may have a volume ranging from 200 cc to 300 cc. The golf club head **2100** may have a mass ranging from 100 grams to 350 grams. In another example, the golf club head **2100** may have a mass ranging from 150 grams to 300 grams. In yet another example, the golf club head **2100** may have a mass ranging from 200 grams to 250 grams. The golf club head **2100** may have a loft angle ranging from 10° to 30°. In another example, the golf club head **2100** may have a loft angle ranging from 13° to 27°. For example, the golf club head **2100** may be a fairway wood-type golf club head. Alternatively, the golf club head **2100** may be a smaller driver-type golf club head (i.e., larger than a fairway wood-type golf club head but smaller than a driver-type golf club head). The apparatus, methods, and articles of manufacture described herein are not limited in this

regard.

(85) As illustrated in FIG. 22, for example, a golf club head **2200** may include a bottom portion **2200**, and a plurality of weight portions **2220** disposed in a plurality of weight ports **2230**. The plurality of weight ports **2230** located along a periphery of a weight port region **2240** may be arranged along a path that defines an arc, generally shown as **2250**, extending across the bottom portion **2210** (i.e., the plurality of weight ports **2230** may extend between the toe and heel portions **2212** and **2214**, respectively, across the bottom portion **2210**). The arc **2250** may curve toward the rear portion **2280** of the golf club head **2200** (i.e., concave relative to the rear portion **2280**). According to the example of FIG. 22, the arc **2250** may extend from a region proximate the toe portion **2212** to a region proximate to the rear portion **2280** and from the region proximate to the rear portion **2280** to a region proximate to the heel portion **2214** (i.e., concave relative to the rear portion **2280**). Accordingly, the arc **2250** may appear as a C-shaped arc facing the front portion **2270** of the golf club head **2200** that extends from near the heel portion **2214** to near the toe portion **2212**. Further, the curvature of the arc **2250** is substantially similar to or generally follows the contour of the rear portion **2280** of the golf club head **2200**. The number of weight ports **2230** in the arc **2250**, the weight portions **2220** associated with each weight port **2230** and the spacing between adjacent weight ports **2230** may be determined based on the type of golf club, a preferred weight distribution of the golf club head **2200**, and/or a center of gravity location of the golf club head **2200**.

(86) The weight ports **2230** of the arc **2250** may be spaced from each other at the same or approximately the same distance along the arc **2250** (e.g., the weight ports **2230** may be substantially similarly spaced apart from each other). Any variation in the spacing between the weight ports **2230** of the arc **2250** or any of the weight ports described herein may be due to different manufacturing considerations, such as manufacturing tolerances and/or cost effectiveness associated with manufacturing precision. For example, the variation in the spacing between the weight ports **2130** of the arc **2250** may be between 1/16 of an inch to 0.001 inch. As described herein, the distance between adjacent weight ports **2230** (i.e., port distance) may be less than or equal to the port diameter of any of the two adjacent weight ports. The plurality of weight ports **2230** may extend between the toe portion **2212** and the heel portion **2214** at a maximum toe-to-heel weight port distance that is more than 50% of a maximum toe-to-heel club head distance of **2290** the golf club head **2200**. The maximum toe-to-heel weight port distance may be the maximum distance between the heel-side boundary of the weight port farthest from the toe portion **2212** and the toe-side boundary of the weight port farthest from the heel portion **2214**.

(87) In particular, the golf club head **2200** may have a volume of less than 200 cc. In example, the golf club head **2200** may have a volume ranging from 50 cc to 150 cc. In another example, the golf club head **2200** may have a volume ranging from 60 cc to 120 cc. In yet another example, the golf club head **2200** may have a volume ranging from 70 cc to 100 cc. The golf club head **2200** may have a mass ranging from 180 grams to 275 grams. In another example, the golf club head **2200** may have a mass ranging from 200 grams to 250 grams. The golf club head **2200** may have a loft angle ranging from 15° to 35°. In another example, the golf club head **2200** may have a loft angle ranging from 17° to 33°. For example, the golf club head **2200** may be a hybrid-type golf club head. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(88) In the example of FIGS. 23-32, a golf club head **2300** may include a body portion **2310**, and a plurality of weight portions **2320**, generally, shown as a first set of weight portions **2410** and a second set of weight portions **2420** (FIG. 24). The body portion **2310** may include a top portion **2330**, a bottom portion **2340**, a toe portion **2350**, a heel portion **2360**, a front portion **2370** with a face portion **2375**, and a rear portion **2380**. The bottom portion **2340** may include a skirt portion **2390** defined as a side portion of the golf club head **2300** between the top portion **2330** and the bottom portion **2340** excluding the front portion **2370** and extending across a periphery of the golf

club head **2300** from the toe portion **2350**, around the rear portion **2380**, and to the heel portion **2360**. The bottom portion **2340** may include a transition region **2430** and a weight port region **2440**. For example, the weight port region **2440** may be a D-shape region. The weight port region **2440** may include a plurality of weight ports **2800** (FIG. **28**) to receive the plurality of weight portions **2320**. The body portion **2310** may also include a hosel portion **2365** to receive a shaft (not shown). The hosel portion **2365** may be an integral portion or a separate portion of the body portion **2310**. For example, the hosel portion **2365** may include a hosel sleeve with one end to receive a shaft and an opposite end that may be inserted into the body portion **2310**. Alternatively, the body portion **2310** may include a bore instead of the hosel portion **2365**. The golf club head **2300** may be constructed from similar material, may have a similar volume and be the same type of golf club head as the golf club head **100** or any of the golf club heads described herein. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(89) Each of the first set of weight portions **2410**, generally shown as **2605**, **2610**, **2615**, and **2620** may be associated with a first mass. Each of the second set of weight portions **2420**, generally shown as **2640**, **2645**, **2650**, **2655**, **2660**, **2665**, and **2670** may be associated with a second mass. The first mass may be greater than the second mass or vice versa. The first and second set of weight portions **2410** and **2420**, respectively, may provide various weight configurations for the golf club head **2300** that may be similar to the various weight configurations for the golf club head **100** or any of the golf club heads described herein. Alternatively, all of the weight portions of the first and second set of weight portions **2410** and **2420**, respectively, may have the same mass. That is, the first and second masses may be equal to each other. The plurality of weight portions **2320** may have similar or different physical properties (e.g., density, shape, mass, volume, size, color, etc.). The weight portions **2320** may be similar in many respects to the weight portions **120** of the golf club head **100** or any of the golf club heads described herein. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(90) Referring to FIG. **28**, for example, the bottom portion **2340** of the body portion **2310** may include a plurality of weight ports **2800**. The plurality of weight ports **2800**, generally shown as **2805**, **2810**, **2815**, **2820**, **2840**, **2845**, **2850**, **2855**, **2860**, **2865**, and **2870** may be located on and/or along a periphery of the weight port region **2440** of the bottom portion **2340**. Each of the plurality of weight ports **2800** may be similar in many respects (e.g., port diameter) to any of the weight ports of the golf club head **100** or any of the golf club heads described herein. Further, each of the plurality of weight ports **2800** may be formed on the bottom portion **2340** similar to the formation of the weight ports **900** of the golf club head **100** or any of the golf club heads described herein. Further yet, the plurality of weight ports **2800** may extend across the bottom portion **2340** similar to the configuration of the weight ports **900** of the golf club head **100** or any of the golf club heads described herein. However, the configuration of the weight ports **2800** on the bottom portion **2340** may be different than the configuration of the weight ports **900** of the golf club head **100** or any of the golf club heads described herein. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(91) In one example shown in FIGS. **23-32**, the bottom portion **2340** may include an outer surface **2342** and an inner surface **2344**. Each of the outer surface **2342** and the inner surface **2344** may include one or a plurality of support portions, generally shown as **3110**, **3120**, and **3140**. The outer surface **2342** may include at least one outer support portion **3110** and the inner surface **2344** may include a first set of inner support portions **3120** (generally shown as inner support portions **3121**, **3122**, **3123**, **3124**, **3125**, **3126**, **3127**, **3128**, **3129**, **3130**, **3131**, **3132** and **3133**), and a second set of inner support portions **3140** (generally shown as inner support portions **3141**, **3142**, **3143**, **3144**, **3145**, and **3146**). The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(92) The outer support portion **3110** may be positioned on the bottom portion **2340** and/or the skirt portion **2390** between any of the weight ports **2800** and/or a periphery of the body portion **2310** as

defined by the toe portion **2350**, the heel portion **2360**, the front portion **2370**, and the rear portion **2380**. However, the outer support portion **3110** may be positioned at any location on the golf club head **2300** for structural support of the golf club head **2300**. As an example shown in FIGS. **23-32**, the outer support portion **3110** may be defined by a groove or indentation that extends on the bottom portion **2340** and/or the skirt portion **2390** from the rear portion **2380** toward and/or to the toe portion **2350** proximate to a periphery of the body portion **2310**. The outer support portion **3110** may have any configuration. As illustrated in FIG. **31**, a width of the outer support portion **3110** may increase from the rear portion **2380** toward the toe portion **2350** while the outer support portion **3110** may follow a contour of the periphery of the body portion **2310** between the rear portion **2380** and the toe portion **2350**. Accordingly, the outer support portion **3110** may resemble a curved triangular groove on the bottom portion **2340**. The depth of the outer support portion **3110** may also vary. Alternatively, the depth of the outer support portion **3110** may be constant. Further, the depth of the outer support portion **3110** may be determined based on the thickness of the bottom portion **2340** and the material from which the bottom portion **2340** is formed. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(93) Each inner support portion of the first set of inner support portions **3120** may include walls, ribs and/or any projection from the inner surface **2344** of the bottom portion **2340**. Each inner support portion of the first set of inner support portions **3120** may extend from and connect each weight port **2800** to an adjacent weight port or to one or more other non-adjacent weight ports **2800**. As shown in FIG. **31**, for example, the inner support portion **3121** may include a wall projecting from the inner surface **2344** of the bottom portion **2340** and connecting the weight ports **2805** and **2810**. Similarly, as shown in FIG. **31**, each pair of adjacent weight ports **2810** and **2815**, **2815** and **2820**, **2820** and **2840**, **2840** and **2845**, **2845** and **2850**, **2850** and **2855**, **2855** and **2860**, **2860** and **2865**, **2865** and **2870**, **2870** and **2805** may be connected by inner support portions **3122**, **3123**, **3124**, **3125**, **3126**, **3127**, **3128**, **3129**, **3130**, **3131**, respectively. Accordingly, the inner support portions **3121** through **3131** of the first set of inner support portions **3120** may define a loop-shaped support region **3150** on the inner surface **2344** of the bottom portion **2340**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(94) Further, the inner support portion **3132** may include a wall projecting from the inner surface **2344** of the bottom portion **2340** and connecting two non-adjacent weight ports such as the weight ports **2805** and **2855**. The inner support portion **3133** may include a wall projecting from the inner surface **2344** of the bottom portion **2340** and connecting two non-adjacent weight ports such as the weight ports **2820** and **2855**. Accordingly, the inner support portions **3121**, **3122**, **3123**, **3132** and **3133** may define a triangular support region **3160** on the inner surface **2344** of the bottom portion **2340** partially within the loop-shaped support region **3150** and partially overlapping the loop-shaped support region **3150**. The weight ports **2805**, **2820** and **2855** may define the vertices of the triangular support region **3160**. The first set of inner support portions **3120** may have any configuration, connect any two or more of the weight ports, and/or define any shape. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(95) Each inner support portion of the second set of inner support portions **3140** may include walls, ribs and/or any projections on the inner surface **2344** of the bottom portion **2340**. Each inner support portion of the second set of inner support portions **3140** (generally shown as inner support portions **3141**, **3142**, **3143**, **3144**, **3145**, and **3146**) may extend from one or more of the weight ports **2800** toward the periphery and/or the skirt portion **2390** of the body portion **2310**. In one example shown in FIG. **31**, each inner support portion of the second set of inner support portions **3140** is shown to extend from a corresponding weight port of the weight ports **2800** to the toe portion, the toe and rear portion, the rear portion, the heel and rear portion and the heel portion, respectively. The length, height, thickness, orientation angle, and/or cross-sectional configuration of each of the inner support portions **3141**, **3142**, **3143**, **3144**, **3145** and/or **3146** may be configured such that the inner support portions **3141**, **3142**, **3143**, **3144**, **3145** and/or **3146** may provide or

substantially provide structural support to the bottom portion **2340**, the skirt portion **2390**, the toe portion **2350**, the heel portion **2360**, the front portion **2370** and/or the rear portion **2380**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(96) The first set of inner support portions **3120** may structurally support the bottom portion **2340** by distributing the impact loads exerted on the bottom portion **2340** throughout the bottom portion **2340** when the golf club head **2300** strikes a golf ball (not shown). The second set of inner support portions **3140** may further distribute the impact loads throughout the bottom portion **2340**, the skirt portion **2390**, toe portion **2350**, the heel portion **2360**, the front portion **2370**, and/or the rear portion **2380**. In one example, the second set of inner support portions **3140** may include additional walls, ribs and/or projections (not shown) that connect to any of the weight ports such as weight ports **2840**, **2850** and **2860** to further distribute impact loads throughout the body portion **2310**. While the above examples may depict a particular number of inner support portions, the bottom portion **2340** may include additional inner support portions (not shown). For example, the bottom portion **2340** may include a plurality of inner support portions (not shown) that connect non-adjacent weight ports **2800** (e.g., weight ports **2815** and **2860**) and/or the second set of inner support portions **3140**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(97) The width (i.e., thickness), length, height, orientation angle, and/or cross-sectional shape of the inner support portions of the first set of inner support portions **3120** and/or the second set of inner support portions **3140** may be similar or vary and be configured to provide structural support to the golf club head **2300**. For example, the materials from which the bottom portion **2340** and/or the body portion **2310** may be constructed may determine the width, length, height, orientation angle, and/or cross-sectional shape of the inner support portions of the first set of inner support portions **3120** and/or the second set of inner support portions **3140**. For example, the inner support portions of the first set of inner support portions **3120** and/or the second set of inner support portions **3140** may be defined by walls with rectangular cross sections having heights that are similar to the depths of the weight portions **2800**. The length of each inner support portion of the second set of inner support portions **3140** may be configured such that one or more inner support portions of the second set of inner support portions **3140** extend from the bottom portion **2340** to the skirt portion **2390**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(98) Any of the golf club heads described herein may have different configurations of outer support portions and/or inner support portions to provide structural support for the golf club head during impact with a golf ball depending on the size, thickness, materials of construction and/or other characteristics of any portions and/or parts of the golf club head. The different configurations of the outer support portions and/or inner support portions may affect vibration, dampening, and/or noise characteristics of the golf club head when striking a golf ball. Further, the different configurations of the outer support portions and/or the inner support portions may provide structural support to portions of the golf club head that may require additional structural support. For example, a golf club head as described herein may include more inner support portions in addition to the first set of inner support portions and the second set of inner support portions as described herein. For example, a golf club head as described herein may include fewer inner support portions than the first set of inner support portions and the second set of inner support portions as described herein.

(99) FIGS. **33** and **34** show another example of the golf club head **2300** with a different configuration of inner support portions. The inner surface **2344** of the bottom portion **2340** may include a first set of inner support portions **3320** (generally shown as inner support portions **3323**, **3324**, **3325**, **3326**, and **3327**), and a second set of inner support portions **3340** (generally shown as inner support portions **3344**, **3345**, **3346**, **3347** and **3348**). The first set of inner support portions **3320** and the second set of inner support portions **3340** are closer to the heel portion **2360** than to

the toe portion **2350**. For example, the first set of inner support portions **3320** and the second set of inner support portions **3340** may be located on the bottom portion **2340** between a midpoint (not shown) of the body portion **2310** and the heel portion **2360**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(100) The first set of inner support portions **3320** may be similar in many respects to any of the inner support portions described herein such as the inner support portions of the first set of inner support portions **3120** shown in FIG. **31**. The inner support portions **3323** through **3327** of the first set of inner support portions **3320** may define a loop-shaped support region **3350** on the inner surface **2344** of the bottom portion **2340**. The loop-shaped support region **3350** may be closer to the heel portion **2360** than to the toe portion **2350**. The loop-shaped support region **3350** may be located between a midpoint (not shown) of the body portion **2310** and the heel portion **2360**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(101) The second set of inner support portions **3340** may be similar in many respects to any of the inner support portions described herein such as the second set of inner support portions **3140** shown in FIG. **31**. As shown in FIGS. **33** and **34**, for example, each of the inner support portion **3344**, **3345**, **3346**, **3347**, and **3348** may include a wall connected to the weight port **2850**, **2845**, **2840**, **2820** and **2815**, respectively, and extend outward from the corresponding weight port toward and/or to the periphery of the bottom portion **2340**. The length, height, thickness, orientation angle, and/or cross-sectional configuration of each of the inner support portions **3344**, **3345**, **3346**, **3347** and **3348** may be configured such that the inner support portions **3344**, **3345**, **3346**, **3347** and **3348** may provide or substantially provide structural support to the bottom portion **2340**, the skirt portion **2390**, the heel portion **2360**, the front portion **2370** and/or the rear portion **2380**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(102) FIG. **35** shows another example of the golf club head **2300** with a different configuration of the inner support portions. The inner surface **2344** may include a first set of inner support portions **3120** (generally shown as inner support portions **3121**, **3122**, **3123**, **3124**, **3125**, **3126**, **3127**, **3128**, **3129**, **3130** and **3131**), and a second set of inner support portions **3140** (generally shown as inner support portions **3141**, **3142**, **3143**, **3144**, **3145**, and **3146**). Accordingly, the golf club head **2300** of FIG. **43** may be similar to the golf club head **2300** of FIG. **31**, except that the golf club head **2300** of FIG. **43** does not include the inner support portions **3132** and **3133**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(103) In addition to any of the golf club heads described herein having different configurations of outer support portions and/or inner support portions, any of the golf club heads described herein may have different configurations of weight ports in combination with different configurations of the outer support portions and/or the inner support portions. The different configurations of the weight ports may affect the weight distribution of the golf club head. The different configurations of the outer support portions and/or inner support portions may affect stiffness, vibration, dampening, and/or noise characteristics of the golf club head when striking a golf ball. Further, the different configurations of the outer support portions and/or the inner support portions may provide structural support to portions of the golf club head that may require additional structural support. For example, a golf club head as described herein may include more or less weight ports than some of the example golf club heads described herein. For example, a golf club head as described herein may include more inner support portions in addition to the first set of inner support portions and the second set of inner support portions as described herein. For example, a golf club head as described herein may include fewer inner support portions than the first set of inner support portions and the second set of inner support portions as described herein. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(104) FIG. **36** shows another example of the golf club head **2300** with a different configuration of the weight ports and different configuration of inner support portions. The bottom portion **2340** may include a plurality of weight ports **2800**, which are generally shown as **2805**, **2810**, **2815**,

2820, 2845, 2850, 2855, 2860, and 2865. Accordingly, the golf club head **2300** of FIG. **36** is similar to the golf club head **2300** of FIG. **31**, except that the golf club head **2300** of FIG. **36** does not include weight ports **2840** and **2870**. Also, in the example of FIG. **36**, the inner surface **2344** of the bottom portion **2340** may include a first set of inner support portions **3120** (generally shown as inner support portions **3121, 3122, 3123, 3126, 3127, 3128, and 3129**), and a second set of inner support portions **3140** (generally shown as inner support portions **3141, 3143, 3144, 3145, and 3146**). Accordingly, the golf club head **2300** of FIG. **36** may be similar to the golf club head **2300** of FIG. **31**, except that the golf club head **2300** of FIG. **36** does not include the inner support portions **3124, 3125, 3130, 3131, 3132, 3133 and 3142**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(105) In one example shown in FIG. **37**, certain regions of the interior of the body portion **2310** of the golf club head **2300** may include an elastic polymer material or an elastomer material, which may be referred to herein as the filler material. The filler material may dampen vibration, dampen noise, lower the center of gravity and/or provide a better feel and sound for the golf club head **2300** when striking a golf ball (not shown). According to one example, the triangular support region **3160** may be filled with the filler material. According to another example, a support region **3161** defined by the inner support portions **3128, 3129, 3130, 3131 and 3132**; and a support region **3162** defined by the inner support portions **3124, 3125, 3136, 3137 and 3133** may be filled with the filler material. The filler material may extend from the inner surface **2344** of the bottom portion **2340** up to a height of any of the inner support portions that may define the support regions **3160, 3161 and/or 3162**. However, the filler material may extend below or above the height of any of the inner support portions. Further, the thickness of the filler material, which may be defined as the distance the filler material extends from the inner surface **2344** of the bottom portion **2340**, may be constant or vary for the support regions **3160, 3161 and/or 3162**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(106) In one example shown in FIG. **38**, which is similar to many respects to the golf club head **2300** shown in FIG. **33**, the support region **3350** may be filled with the filler material. The filler material, which may be an elastic polymer material or an elastomer material as described herein, may extend from the inner surface **2344** of the bottom portion **2340** up to a height of any of the inner support portions **3323, 3324, 3325, 3326 and/or 3327**. The filler material may dampen vibration, dampen noise, lower the center of gravity and/or provide a better feel and sound for the golf club head **2300** when striking a golf ball (not shown). The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(107) Any of the golf club heads described herein may have one or more interior regions that may include a filler material as described. In one example, the filler material may be injected into a region of the golf club head from one or more ports on the golf club head to cover or fill the region. The one or more ports that may be used to inject the filler material may be one or more of the weight ports described herein. Accordingly, the filler material may be molded to the shape of the region in which the filler material is injected to cover or fill the region. Alternatively, one or more inserts may be formed from elastic polymer material or an elastomer material (i.e., filler material) and placed in one or more regions of the interior of golf club head. FIG. **39** shows an example of the golf club head **2300** of FIG. **36** with an insert **3950**, which may be constructed from an elastic polymer material or an elastomer material. The insert **3950** may be manufactured to have a similar shape as the shape of a region **3954** on the inner surface **2344** of the bottom portion **2340**.

Accordingly, the insert **3950** may have a curvature similar to the curvature of the bottom portion **2340** at the region **3954** to lay generally flat and in contact with the inner surface **2344** of the bottom portion **2340**, have a shape that may be similar to the shape of the region **3954** to be inserted in the region **3954** and generally fit within the region **3954**, and/or have a plurality of cutout portions **3956** to generally match the shape and/or contour of sidewall portions of each of the weight ports **2800**. The apparatus, methods, and articles of manufacture described herein are

not limited in this regard.

(108) The insert **3950** may have a thickness that may be similar to the height of any of the weight ports **2800**. Accordingly, when the insert **3950** is in the region **3954**, the top portion of the insert **3950** at or proximate to the weight ports **2800** may be at the same height or substantially the same height as the weight ports **2800**. However, the thickness of the insert **3950** may be constant or vary such that the thickness of the insert **3950** at any location of the insert **3950** may be more or less than the height of any of the weight ports **2800**. The insert **3950** may dampen vibration, dampen noise, lower the center of gravity and/or provide a better feel and sound for the golf club head **2300** of FIG. **39** when striking a golf ball (not shown). The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(109) The insert **3950** may be manufactured for use with any of the golf club heads described herein. As shown in FIG. **39**, the insert **3950** may include a plurality of cutout portions **3956** that may generally match the shape of the outer wall portions of the weight ports **2800**. The insert **3950** shown in FIG. **39** further includes cutout portions **3958** and **3959**. Referring back to FIG. **35**, when the insert **3950** is used with the golf club head **2300** of FIG. **35**, the cut out portions **3958** and **3959** may generally match the shape of the outer wall portions of the weight ports **2870** and **2840**, respectively. Accordingly, the insert **3950** can be used in both the golf club head **2300** of FIG. **35** and the golf club head **2300** of FIG. **36**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(110) Referring back to FIG. **31**, the insert **3950** may include channels, grooves or slots (not shown) that may be sized and shaped to receive the inner support portions **3132** and **3133** therein. Accordingly, an insert **3950** may be manufactured with the described channels, grooves or slot for use with the golf club heads **2300** of FIGS. **31**, **33**, **35** and **36**. Alternatively, one or more inserts may be manufactured that may only fit one of the golf club heads described herein. For example, each of the golf club heads described herein may include one or more inserts that may have a certain shape for fitting only within one or more regions in the golf club head. Referring back to FIG. **31**, for example, the golf club head **2300** may include a first insert (not shown) for fitting in the support region **3161**, a second insert (not shown) for fitting in the triangular support region **3160**, and a third insert (not shown) for fitting in the support region **3162**. Referring back to FIG. **33**, for example, the golf club head **3300** may include an insert (not shown) for fitting in the support region **3350**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(111) Any of the inserts described herein may be manufactured from an elastic polymer material as a one-piece continuous part. In the example of FIG. **39**, the insert **3950** may be a one-piece continuous part without any recesses and/or holes. FIG. **40** illustrates an insert **4050** that is similar in many respects to the insert **3950**. Accordingly, in one example, the insert **4050** may be manufactured to have a similar shape as the shape of the region **3954** on the inner surface **2344** of the bottom portion **2340** of the golf club head **23** of FIG. **39** and further include a plurality of cutout portions **4056** similar to the cutout portions **3956**, **3958** and **3959** as described herein. The insert **4050** further includes a plurality of holes **4062** that may reduce the weight of the insert **4050** and/or the amount of material used for the construction of the insert **4050**. The insert **4050** may include any number of holes **4062** arranged in any configuration on the insert **4050**. In the example of FIG. **40**, the insert **4050** includes a plurality of hexagonal holes **4062** that extend through the thickness of the insert **4050** and are arranged on the insert **4050** to define a pattern similar to a honeycomb pattern. The holes **4062** may have any shape or spacing. Although the above example may describe holes having a particular shape, the apparatus, methods, and articles of manufacture described herein may include holes of other suitable shapes (e.g., circular, triangular, octagonal, or other suitable geometric shape). Further, the holes **4062** may be similar or different in shape, size and/or arrangement on the insert **4050**. In one example, the insert **4050** may include a plurality of round holes (not shown). In another example, the insert **4050** may include a plurality of slots,

grooves and/or slits (not shown). In yet another example, the insert **4050** may include recesses (not shown) that do not extend through the insert **4050**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(112) Any of the filler materials and or inserts described herein may be a polymer material, an elastic polymer or elastomer material (e.g., a viscoelastic urethane polymer material such as Sorbothane® material manufactured by Sorbothane, Inc., Kent, Ohio), a thermoplastic elastomer material (TPE), a thermoplastic polyurethane material (TPU), and/or other suitable types of materials to absorb shock, isolate vibration, and/or dampen noise. In another example, the filler material may be a high density ethylene copolymer ionomer, a fatty acid modified ethylene copolymer ionomer, a highly amorphous ethylene copolymer ionomer, an ionomer of ethylene acid acrylate terpolymer, an ethylene copolymer comprising a magnesium ionomer, an injection moldable ethylene copolymer that may be used in conventional injection molding equipment to create various shapes, an ethylene copolymer that can be used in conventional extrusion equipment to create various shapes, and/or an ethylene copolymer having high compression and low resilience similar to thermoset polybutadiene rubbers. For example, the ethylene copolymer may include any of the ethylene copolymers associated with DuPont™ High-Performance Resin (HPF) family of materials (e.g., DuPont™ HPF AD1172, DuPont™ HPF AD1035, DuPont® HPF 1000 and DuPont™ HPF 2000), which are manufactured by E.I. du Pont de Nemours and Company of Wilmington, Delaware. The DuPont™ HPF family of ethylene copolymers may be injection moldable and may be used with conventional injection molding equipment and molds, provide low compression, and provide high resilience. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(113) The filler material including any of the inserts that may be manufactured from the filler material as described herein may be bonded, attached and/or connected to any of the golf club heads described herein by a bonding portion (not shown) to improve adhesion and/or mitigate delamination between the body portion of any of the golf club heads described herein and the filler material. The bonding portion may be a bonding agent, an epoxy, a combination of bonding agents, a bonding structure or attachment device, a combination of bonding structures and/or attachment devices, and/or a combination of one or more bonding agents, one or more bonding structures and/or one or more attachment devices. In one example, the bonding portion may be low-viscosity, organic, solvent-based solutions and/or dispersions of polymers and other reactive chemicals such as MEGUM™, ROBOND™, and/or THIXON™ materials manufactured by the Dow Chemical Company, Auburn Hills, Michigan. In another example, the bonding portion may be LOCTITE® materials manufactured by Henkel Corporation, Rocky Hill, Connecticut. The apparatus, methods, and articles of manufacture are not limited in this regard.

(114) In the example of FIGS. **41-47**, a golf club head **4100** may include a body portion **4110** with a top portion **4130**, a bottom portion **4140**, a toe portion **4150**, a heel portion **4160**, a front portion **4170**, and a rear portion **4180**. The bottom portion **4140** may include a skirt portion (not shown) defined as a side portion of the golf club head **4100** between the top portion **4130** and the bottom portion **4140** excluding the front portion **4170** and extending across a periphery of the golf club head **4100** from the toe portion **4150**, around the rear portion **4180**, and to the heel portion **4160**. The bottom portion **4140** may include a transition region **4230** and a weight port region **4240**. The transition region **4230** may be defined by a groove or a channel on the bottom portion **4140**. Further, the transition region **4230** may define the boundary of the weight port region **4240**. The front portion **4170** may include a face portion **4175** to engage a golf ball (not shown). The body portion **4110** may also include a hosel portion **4165** that may be similar in many respects to any of the hosel portions described herein. Alternatively, the body portion **4110** may include a bore (not shown) instead of the hosel portion **4165**. The body portion **4110** may be made partially or entirely from any of the materials described herein. Further, the golf club head **4100** may be any type of golf club head having a club head volume similar to the club head volume of any of the golf club

heads described herein. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(115) The body portion **4110** may include a plurality of weight portions **4120** (FIG. 42), generally, shown as a first set of weight portions **4210** (generally shown as weight portions **4405**, **4410**, **4415**, **4420** and **4425**) and a second set of weight portions **4220** (generally shown as weight portions **4445**, **4450**, **4455**, **4460** and **4465**). The weight port region **4240** may have a shape similar to the weight port regions of any of the golf club heads described herein. The weight port region **4240** may include a plurality of weight ports **4600** (generally shown as weight ports **4605**, **4610**, **4615**, **4620**, **4625**, **4645**, **4650**, **4655**, **4660** and **4665**) to receive the plurality of weight portions **4120**. The characteristics (e.g., density, shape, volume, size, color, dimensions, depth, diameter, materials of construction, mass, method of formation, etc.), location on the golf club head (e.g., location relative to the periphery of the golf club head and/or location relative to other weight portions and/or weight ports), and/or any other properties of each weight portion of the plurality of weight portions **4120** and each weight port of the plurality of weight ports **4600** may be similar in many respects to each weight portion and weight port, respectively, of any of the golf club heads described herein. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(116) The outer surface **4142** and/or the inner surface **4144** of the bottom portion **4140** may include one or a plurality of support portions similar to any of the inner or outer support portions described herein. The outer surface **4142** may include at least one outer support portion **4310**. The outer support portion **4310** may be similar in many respects including the function thereof to the outer support portion **3110** of the golf club head **2300**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(117) The inner surface **4144** may include an inner support portion **4320**, which may be also referred to herein as the inner wall portion **4320**. The inner support portion **4320** may include a wall, a rib and/or any projection extending from the inner surface **4144** of the bottom portion **4140**. The inner support portion **4320** may extend around some or all of the weight ports **4600** to partially or fully surround the weight ports **4600**. In the example of FIGS. 41-46, the inner support portion **4320** fully surrounds the weight ports **4600**. Accordingly, the inner support portion **4320** may define an inner port region **4325** on the inner surface **4144** of the bottom portion **4140**. The inner support portion **4320** may structurally support the bottom portion **4140** by distributing the impact loads exerted on the bottom portion **4140** throughout the bottom portion **4140** when the golf club head **100** strikes a golf ball (not shown). While the above examples may depict a particular inner support portion, the bottom portion **4140** may include additional inner support portions and/or any type of support portions (not shown). The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(118) The width (i.e., thickness), length, height, orientation angle, and/or cross-sectional shape of the inner support portion **4320** may be similar or vary along the length of the inner support portion **4320** and be configured to provide structural support to the golf club head **4100**. For example, characteristics of the body portion **4110** and/or the bottom portion **4140** including the materials from which the bottom portion **4140** and/or the body portion **4110** is constructed may determine the width, length, height, orientation angle, and/or cross-sectional shape of the inner support portion **4320** along the length of the inner support portion **4320**. In one example, the inner support portion **4320** may be defined by a wall having a height that may be similar to the depths of the weight portions **4600**. In another example, the inner support portion **4320** may be defined by a wall having a height that may be greater than the depths of the weight portions **4600**. In yet another example, the inner support portion **4320** may be defined by a wall having a height that may be smaller than the depths of the weight portions **4600**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(119) In one example shown in FIG. 45, certain regions of the interior of the body portion **4110** of the golf club head **4100** may include a polymer material, an elastic polymer material or an

elastomer material, which may be referred to herein as the filler material **4510**. The filler material **4510** may dampen vibration, dampen noise, lower the center of gravity and/or provide a better feel and sound for the golf club head **4100** when striking a golf ball (not shown). According to one example, the inner port region **4325**, which may be defined by the inner surface **4144** of the bottom portion **4140** and the inner support portion **4320**, may partially or fully include the filler material **4510**. The filler material **4510** may extend from the inner surface **4144** of the bottom portion **4140** up to the height of the inner support portion **4320** at any location on the inner support portion **4320**. However, the filler material **4510** may extend below or above the inner support portion **4320** at any location on the inner support portion **4320**. Accordingly, if the height of the inner support portion **4320** is greater than or equal to the depth of the weight ports **4600**, the weight ports **4600** may be surrounded and/or covered by the filler material **4510**, respectively, which may provide vibration dampening, noise dampening, and/or a better feel and sound for the golf club head **4100** when striking a golf ball (not shown). The height or thickness of the filler material **4510** in the inner port region **4325** may be constant or may vary. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(120) Any of the golf club heads described herein, including the golf club head **4100**, may have one or more interior regions that may include a filler material as described herein. In one example, the filler material **4510** may be injected into the inner port region **4325** of the body portion **4110** from one or more of the weight ports **4600**. In the example of FIGS. **41-46**, each of the weight ports **4615** and **4655** may include an opening **4616** and **4656**, respectively, into the inner port region **4325** or the interior of the body portion **4110**. Accordingly, the openings **4616** and **4656** may be used to inject the filler material **4510** into the inner port region **4325**. In one example, one of the openings **4616** or **4656** may be used to inject filler material into inner port region **4325**, while the other opening **4656** or **4616**, respectively, may be used for the air that is displaced by the filler material injected into the body portion **4110** to escape. The inner support portion **4320** may provide a boundary or a holding perimeter for the filler material **4510** when the filler material **4510** is injected into the body portion **4110**. The filler material **4510** may be injected into the inner port region **4325** until the height of the filler material **4510** is similar, substantially similar, or greater than to the height of the inner support portion **4320**. Accordingly, the filler material may be molded to the shape of the inner port region **4325**. Alternatively, the inner port region **4325** may be partially filled with the filler material **4510**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(121) Alternatively, one or more inserts may be formed from an elastic polymer material or an elastomer material (e.g., filler material) and placed in one or more regions of the interior of golf club head. FIG. **46** shows an example of the golf club head **4100** of FIG. **41** with an insert **4750**, which may be constructed from an elastic polymer material or an elastomer material. The insert **4750** may be manufactured to have a similar shape as the shape of the inner port region **4325**. Accordingly, the insert **4750** may have a curvature similar to the curvature of the bottom portion **4140** at the inner port region **4325** to lie generally flat and in contact with the inner surface **4144** of the bottom portion **4140**. The insert **4750** may have a shape that may be similar to the shape of the inner port region **4325** to be inserted in the inner port region **4325** and generally fit within the inner port region **4325**. Further, the insert **4750** may be surrounded and/or in contact with the inner support portion **4320**. The inner support portion **4320** may engage all or portions of the perimeter of the insert **4750** to assist in maintaining the insert in the inner port region **4325** or maintain the insert in the inner port region **4325**. The insert **4750** may have a plurality of cutout portions **4756** to generally match the shape and/or contour of the sidewall portions of each of the weight ports **4600**. Accordingly, when the insert **4750** is placed in the inner port region **4325**, each port of the plurality of weight ports **4600** is received in a corresponding cutout portion **4756**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(122) The insert **4750** may have a thickness that may be similar or substantially similar to the

height of any of the weight ports **4600**. Accordingly, when the insert **4750** is in the inner port region **4325**, the top portion of the insert **4750** at or proximate to the weight ports **4600** may be at the same or substantially the same height as the weight ports **4600**. However, the thickness of the insert **4750** may vary such that the thickness of the insert **4750** at any location of the insert **4750** may be more or less than the height of any of the weight ports **4600**. The insert **4750** may dampen vibration, dampen noise, lower the center of gravity and/or provide a better feel and sound for the golf club head **4100** when striking a golf ball (not shown). The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(123) Any of the inserts described herein may be manufactured from an elastic polymer material as a one-piece continuous part. The insert **4750** may be a one-piece continuous part without any recesses and/or holes. According to the example shown in FIG. **47**, the insert **4750** may include a plurality of holes **4762** that may reduce the weight of the insert **4750**. The insert **4750** may include any number of holes arranged in any configuration on the insert **4750**. In the example of FIG. **47**, the insert **4750** includes a plurality of hexagonal holes **4762** that extend through the thickness of the insert **4750** and are arranged on the insert **4750** to define a pattern that is similar to a honeycomb pattern. The holes **4762** may have any shape or spacing. In the example of FIG. **48**, the insert **4750** also includes a plurality of holes, which may be the hexagonal holes **4762** similar to the example of FIG. **47**, and a center hole **4862** that may larger than the hexagonal holes **4762** or the cut-out portions **4756**. The center hole **4862** may have any size, shape or configuration. In the example of FIG. **48**, the center hole **4862** has a shape that may generally resemble the perimeter shape of the insert **4750**. The insert **4750** may include any number of larger or smaller holes than the center hole **4862**, the hexagonal holes **4762** and/or the cut-out portions **4756**. Although the above example may describe holes having a particular shape, the apparatus, methods, and articles of manufacture described herein may include holes of other suitable shapes (e.g., circular, triangular, octagonal, or other suitable geometric shape). Further, the openings may be similar or different in shape, size and or arrangement on the insert **4750**. In one example, the insert **4750** may include a plurality of round holes (not shown). In another example, the insert **4750** may include a plurality of slots, grooves and/or slits (not shown). In yet another example, the insert **4750** may include recesses (not shown) instead of holes that do not extend through the insert **4750**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(124) The filler material **4510** and or the insert **4750** may be manufactured from any of the materials described herein. The filler material **4510** or the insert **4750** may be bonded, attached and/or connected to the body portion **4110** of the golf club head **4100** by a bonding portion (not shown) to improve adhesion and/or mitigate delamination between the body portion **4110** and the filler material **4510** or the insert **4750**. Further, as described herein, the inner support portion **4320** may engage the insert **4750** to partially or fully maintain the insert **4750** in the inner port region **4325**. In one example, the insert **4750** may be maintained in the inner port region **4325** by frictionally engaging the inner support portion **4320** and/or a bonding portion bonding the insert **4750** to the inner support portion **4320** and/or the inner surface **4144** of the bottom portion **4140**. The bonding portion may be any of the bonding portions described herein such as a bonding agent, an epoxy, a combination of bonding agents, a bonding structure or attachment device, a combination of bonding structures and/or attachment devices, and/or a combination of one or more bonding agents, one or more bonding structures and/or one or more attachment devices. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(125) In the example of FIGS. **50-54**, a golf club head **4900** may include a body portion **4910** with a top portion **4930**, a bottom portion **4940**, a toe portion **4950**, a heel portion **4960**, a front portion **4970**, and a rear portion **4980**. The bottom portion **4940** may include a skirt portion (not shown) defined as a side portion of the golf club head **4900** between the top portion **4930** and the bottom portion **4940** excluding the front portion **4970** and extending across a periphery of the golf club head **4900** from the toe portion **4950**, around the rear portion **4980**, and to the heel portion **4960**.

The bottom portion **4940** may include one or more weight port regions. For example, the bottom portion **4940** may include a first weight port region **5040** and a second weight port region **5050**. The front portion **4970** may include a face portion **4975** to engage a golf ball (not shown). The body portion **4910** may also include a hosel portion **4965** that may be similar in many respects to any of the hosel portions described herein. Alternatively, the body portion **4910** may include a bore (not shown) instead of the hosel portion **4965**. The body portion **4910** may be made partially or entirely from any of the materials described herein. Further, the golf club head **4900** may be any type of golf club head having a club head volume similar to the club head volume of any of the golf club heads described herein. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(126) The body portion **4910** may include a plurality of weight portions, generally shown as a first set of weight portions **5010** (generally shown as weight portions **5205**, **5210**, and **5215**) and a second set of weight portions **5020** (generally shown as weight portions **5245**, **5250**, and **5255**). The first weight port region **5040** may include a plurality of weight ports (generally shown **5405**, **5410** and **5415**) and the second weight port region **5050** may include a plurality of weight ports (generally shown as **5445**, **5450** and **5455**). Each weight port of the first weight port region **5040** and the second weight port region **5050** may receive a weight portion of the first of weight portions **5010** or the second set of weight portions **5020**. The characteristics (e.g., density, shape, volume, size, color, dimensions, depth, diameter, materials of construction, mass, method of formation, etc.), and/or any other properties of each weight portion of the plurality of weight portions may be similar in many respects to each weight portion of any of the golf club heads described herein. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(127) The first weight port region **5040** may be located on the bottom portion **4940** at or near the rear portion **4980**. All or portions of the first weight port region **5040** may have a greater thickness than the thickness of the bottom portion **4940** to project into the body portion **4910** as shown in FIG. **54** and/or project from the outer surface **4942** of the bottom portion **4940** as shown in FIG. **52**. Accordingly, a portion of the first weight port region **5040** extending into the body portion **4910** may define a first inner support portion **5120** on the inner surface **4944** of the bottom portion **4940**. The first inner support portion **5120** may include an inner wall **5121** projecting into the body portion **4910** from the inner surface of **4944** of the bottom portion **4940**. Accordingly, the inner wall **5121** may define a boundary of the first inner support portion **5120** inside the body portion **4910**. The first inner support portion **5120** may have a shape corresponding to the shape of the portion of the first weight port region **5040** extending into the body portion **4910**. In one example, as shown in FIG. **54**, portions of the first inner support portion **5120** such as the inner wall **5121** may define the boundaries of the weight ports **5405**, **5410** and **5415**. Accordingly, portions of the first inner support portion **5120** may partially define walls of the weight ports **5405**, **5410** and **5415**. In one example, only the weight ports **5405**, **5410** and **5415** of the first weight port region **5040** may project into the body portion **4910** similar to the weight ports of any of the golf club heads described herein. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(128) The second weight port region **5050** may be located on the bottom portion **4940** at or near the heel portion **4960**. All or portions of the second weight port region **5050** may have a greater thickness than the thickness of the bottom portion **4940** to project into the body portion **4910** as shown in FIG. **54** and/or project from the outer surface **4942** of the bottom portion **4940** (not shown). Accordingly, a portion of the second weight port region **5050** extending into the body portion **4910** may define a second inner support portion **5122** on the inner surface **4944** of the bottom portion. The second inner support portion **5122** may include an inner wall **5123** projecting into the body portion **4910** from the inner surface of **4944** of the bottom portion **4940**. Accordingly, the inner wall **5123** may define a boundary of the second inner support portion **5122** inside the body portion **4910**. The second inner support portion **5122** may have a shape corresponding to the

shape of the portion of the second weight port region **5050** extending into the body portion **4910**. In one example, as shown in FIG. **54**, portions of the second inner support portion **5122** may define the boundaries of the weight ports **5445**, **5450** and **5455**. Accordingly, portions of the second inner support portion **5122** may partially define walls of the weight ports **5445**, **5450** and **5455**. In one example, only the weight ports **5445**, **5450** and **5455** of the second weight port region **5050** may project into the body portion **4910** similar to the weight ports of any of the golf club heads described herein. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(129) The body portion **4910** includes a third inner support portion **5124** that extends from the heel portion **4960** to a region of the bottom portion **4940** or the skirt portion (not shown) between the rear portion **4980** and the toe portion **4950**. The third inner support portion **5124** may be defined by a wall projecting into the body portion **4910** from the inner surface **4944** of the bottom portion **4940**. The third inner support portion **5124** may have any shape and have any path on the inner surface **4944** of the bottom portion **4940**. In one example, as shown in FIG. **54**, the third inner support portion **5124** extends from a location at or near the heel portion **4960** between the second weight port region **5050** and the face portion **4975** generally toward the toe portion **4950** past the second weight port region **5050**. The third inner support portion **5124** then extends toward the rear portion **4980** to a location between the first weight port region **5040** and the second weight port region **5050** while maintaining a certain distance with the second weight port region **5050**. The third inner support portion **5124** then extends generally toward the toe portion **4950** and past the first weight port region **5040** while maintaining a certain distance with the first weight port region **5040**. The third inner support portion **5124** may then terminate at or proximate to a location on the body portion **4910** between the rear portion **4980** and the toe portion **4950**. The distance between the third inner support portion **5124**, the inner wall **5123** of the second inner support portion **5122**, the inner wall **5121** of the first inner support portion **5120** and the rear portion **4980** may define a support region **5160**. As shown in FIG. **54**, the support region **5160** partially surrounds the first weight port region **5040** and the second weight port region **5050**. The inner walls **5121**, **5123** and **5124** may have any shape and/or configuration such as the configurations of any of the inner support portions described herein. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(130) The bottom portion **4940** may include one or more outer support portions. In one example, as shown in FIG. **53**, the bottom portion **4940** may include a first outer support portion **5170** and a second outer support portion **5180**. Each of the first outer support portion **5170** and the second outer support portion **5180** may be defined by a channel or a groove on the outer surface **4942** of the bottom portion **4940**. The first outer support portion **5170** may be closer to the face portion **4975** than the rear portion **4980**. The second outer support portion **5180** may be closer to the rear portion **4980** than the face portion **4975**. The first outer support portion **5170** may include a center portion **5172** that may extend in generally a similar direction as the face portion **4975**. The first outer support portion **5170** may also include a first wing portion **5174** that may extend from the center portion **5172** toward the toe portion **4950** and/or the rear portion **4980**, and a second wing portion **5176** that may extend from the center portion **5172** toward the heel portion **4960** and/or the rear portion **4980**. The second outer support portion **5180** may include a center portion **5182** that may extend in generally a similar direction as the face portion **4975**. The second outer support portion **5180** may also include a first wing portion **5184** that may extend from the center portion **5182** toward the toe portion **4950** and/or the rear portion **4980**, and a second wing portion **5186** that may extend from the center portion **5182** toward the heel portion **4960** and/or the rear portion **4980**. The outer support portions of the body portion **4910** may have any shape and/or configuration such as the configurations of any of the outer support portions described herein. The outer support portions **5170** and **5180** may have any configuration, such as the configurations described herein to provide structural support to the bottom portion **4940** when the face portion **4975** strikes a golf ball.

Further, the outer support portions **5170** and **5180** may provide vibration and noise dampening and better feel and sound for the golf club head **4900**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(131) The width (i.e., thickness), length, height, orientation angle, and/or cross-sectional shape of the inner support portions **5120**, **5122** and/or **5124** including the inner walls **5121** and **5123** may be similar or vary along any dimension thereof and/or be configured to provide structural support to the golf club head **4900**. For example, characteristics of the body portion **4910** and/or the bottom portion **4940** including the materials from which the bottom portion **4940** and/or the body portion **4910** may be constructed may determine the width, length, height, orientation angle, and/or cross-sectional shape of the inner support portions **5120**, **5122** and/or **5124** including the inner walls **5121** and **5123** along the any dimension thereof. In one example, any one or more of the inner support portions **5120**, **5122** and **5124** may be defined by a wall having a height that may be similar to, greater than or less than the depths of the weight portions **5405**, **5410**, **5415**, **5445**, **5450** and/or **5455**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(132) Certain regions of the interior of the body portion **4910** of the golf club head **4900** may include a polymer material, an elastic polymer material or an elastomer material, which may be referred to herein as the filler material. The filler material may dampen vibration, dampen noise, lower the center of gravity and/or provide a better feel and sound for the golf club head **4900** when striking a golf ball (not shown). According to one example, the support region **5160** may partially or fully include the filler material. The filler material may extend from the inner surface **4944** of the bottom portion **4940** up to the height of any one or more of the inner support portions **5120**, **5122** and **5124**. However, the filler material may extend below or above any one or more of the inner support portions **5120**, **5122** and **5124**. The height or thickness of the filler material in the support region **5160** may be constant or may vary similar to the filler material for any of the golf club heads described herein. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(133) Any of the golf club heads described herein, including the golf club head **4900**, may have one or more interior regions that may include a filler material as described herein. In one example, the filler material may be injected into the support region **5160** of the body portion **4910** from one or more of the weight ports. In the example of FIGS. **49-54**, each of the weight ports **5410** and **5450** may include an opening **5411** and **5451**, respectively, into the interior of the body portion **4910**. Accordingly, the openings **5411** and **5451** may be used to inject the filler material into the support region **5160**. In one example, one of the openings **5411** or **5451** may be used to inject filler material into the support region **5160**, while the other opening **5451** or **5411**, respectively, may be used for the air that is displaced by the filler material injected into the body portion **4910** to escape. The first inner support portion **5120**, the second inner support portion **5122** and the third inner support portion **5124** may provide a boundary or a holding perimeter of the support region **5160** for the filler material when the filler material is injected into the body portion **4910**. The filler material may be injected into the support region **5160** until the height of all or portions of the filler material is similar, less than, or greater than to the height of any one or more of the inner support portions **5120**, **5122** and **5124**. The support region **5160** may be partially filled with the filler material. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(134) Alternatively, one or more inserts may be formed from an elastic polymer material or an elastomer material (e.g., filler material) and placed in one or more regions of the interior of golf club head. FIG. **54** shows an example of the golf club head **4900** with an insert **5350**, which may be constructed from an elastic polymer material or an elastomer material. The insert **5350** may be manufactured to have a similar shape as the shape of the support region **5160**. Accordingly, the insert **5350** may have a curvature similar to the curvature of the bottom portion **4940** at the support region **5160** to lie generally flat and in contact with the inner surface **4944** of the bottom portion

4940. The insert **5350** may have a shape that may be similar to the shape of the support region **5160** to be inserted in the support region **5160** and generally fit within the support region **5160**. Further, the insert **5350** may be surrounded and/or in contact with the inner support portions **5120**, **5122** and/or **5124**. The inner support portions **5120**, **5122** and/or **5124** may engage all or portions of the perimeter of the insert **5350** to assist in maintaining the insert in the support region **5160** or maintain the insert in the support region **5160**. The insert **5350** may have a plurality of cutout portions **5356** to generally match the shape and/or contour of the inner walls **5121** and **5123** and/or sidewall portions of each of the weight ports **5405**, **5410**, **5415**, **5445**, **5450** and **5455**. Accordingly, when the insert **5350** is placed in the support region **5160**, a portion of each port of the plurality of weight ports is received in a corresponding cutout portion **5356**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(135) The insert **5350** may have a thickness that may be similar to the thickness of any of the inserts described herein. Further, the insert **5350** may be manufactured from an elastic polymer material as a one-piece continuous part similar to any of the inserts described herein. Additionally, the insert **5350** may have any type of holes or apertures such as the holes or apertures of any of the inserts described herein. For example, as shown in FIG. **54**, the insert may include hexagonal holes in honeycomb pattern. The insert **5350** may dampen vibration, dampen noise, lower the center of gravity and/or provide a better feel and sound for the golf club head **4900** when striking a golf ball (not shown). The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(136) The filler material and or the insert **5350** may be manufactured from any of the materials described herein. The filler material or the insert **5350** may be bonded, attached and/or connected to the body portion **4910** of the golf club head **4900** by any of the methods described herein such as by a bonding portion (not shown) to improve adhesion and/or mitigate delamination between the body portion **4910** and the filler material or the insert **5350**. Additionally, the filler material and the insert may be maintained in the support region **5160** by the inner support portions **5120**, **5122** and **5124** as described herein. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(137) In the example of FIGS. **55-59**, a golf club head **5500** may include a body portion **5510** with a top portion **5530**, a bottom portion **5540**, a toe portion **5550**, a heel portion **5560**, a front portion **5570** with a face portion **5575**, a rear portion **5580**, and a hosel portion **5565**. Alternatively, the body portion **5510** may include a bore instead of the hosel portion **5565**. The golf club head **5500** may be any type of golf club head described herein. The body portion **5510** may be made from any of the materials described herein. The golf club head **5500** may or may not include a plurality weight portions, weight ports configured to receive the weight portions, outer support portions and/or inner support portions, elastic polymer filler materials, and/or elastic polymer inserts similar to any of the golf club heads described herein. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(138) The top portion **5530** may include a crown portion **5630** with one or more openings extending into the body portion **5510**. In the examples of FIGS. **55-58** the crown portion **5630** includes a first opening **5632** and a second opening **5634**. In the example of FIG. **59**, the crown portion **5630** includes one opening **5832**. However, the crown portion may include any number of openings. In the examples of FIGS. **57** and **58**, a portion of the crown portion **5630** defines a reinforcement portion **5636** that may separate the first opening **5632** and the second opening **5634**. The reinforcement portion **5636** may be proximate to a center portion of the body portion **5510** and extend from a location at or proximate to the front portion **5570** to a location at or proximate to the rear portion **5580**. The width of the reinforcement portion **5636** may be between approximately 3% and 15% of the distance between toe portion **5550** and heel portion **5560**. The thickness of reinforcement portion may be between approximately 2% and 30% of the width of the reinforcement portion **5636**. The reinforcement portion **5636** may be integral with the body portion

5510 and constructed from the same materials as the body portion **5510**. The reinforcement portion **5636** may be a separate piece from the body portion **5510** and/or constructed from a different material than the body portion **5520**. The reinforcement portion **5636** may provide a reinforcing or bracing effect on the crown portion **5630**. Accordingly, the reinforcement portion **5636** may reduce flexure of the face portion **5575** and/or the crown portion **5630** when the golf club head **5500** strikes a golf ball via the face portion **5575**. The crown portion **5630** may include a plurality of reinforcement portions when the crown portion **5630** includes more than two openings. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(139) The first opening **5632** may extend from a location proximate to the front portion **5570** to a location proximate to the rear portion **5580**. The first opening **5632** may also extend from the reinforcement portion **5636** to a location proximate to the toe portion **5550** and follow the contour of the body portion **5510** proximate to the toe portion **5550**. The second opening **5634** may extend from a location proximate to the front portion **5570** to a location proximate to the rear portion **5580**. The second opening **5634** may also extend from the reinforcement portion **5636** to a location proximate to the heel portion **5560** and follow the contour of the body portion **5510** proximate to the heel portion **5560**. In one example as shown in FIGS. 55-57, the first opening **5632**, the second opening **5634** and the reinforcement portion **5636** may collectively define a shape resembling the general shape of the crown portion **5630** and located within the boundaries crown portion **5630**. Accordingly, the crown portion **5630** may include a crown perimeter portion **5638** that surrounds the first opening **5632**, the second opening **5634** and the reinforcement portion **5636**. The width **5640** of the crown perimeter portion **5638** at any location around the crown perimeter portion **5638** may be configured based on at least one of the thickness, size, shape and materials of construction of the crown portion **5630** and the impact forces experienced by the body portion **5510** when striking a golf ball (not shown). The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(140) The golf club head **5500** may include one or more cover portions to cover any one or more openings on the crown portion **5630**. In the example of FIG. 57, the golf club head **5500** includes a first cover portion **5650** that is configured to be attached to the crown portion **5630** and cover the first opening **5632** and a second cover portion **5750** that is configured to be attached to the crown portion **5630** to cover the second opening **5634**. The first cover portion **5650** and the second cover portion **5750** may also provide structural support for the crown portion **5630**. Accordingly, the thickness and materials of construction of the first cover portion **5650** and the second cover portion **5750** may be configured to provide structural support for the crown portion **5630** and to absorb shock, isolate vibration, and/or dampen noise when the golf club head **5500** strikes a golf ball via the face portion **5575**. The first opening **5632** may include one or more ridges, shoulders or protrusions (not shown) below the outer surface of the crown portion **5630** configured to support the first cover portion **5650** so that the first cover portion **5650** may be flush with the outer surface of the crown portion **5630** when the first cover portion **5650** is attached to the crown portion **5630** to cover the first opening **5632**. The second opening **5634** may include one or more ridges, shoulders or protrusions (not shown) below the outer surface of the crown portion **5630** configured to support the second cover portion **5750** so that the second cover portion **5750** may be flush with the outer surface of the crown portion **5630** when the second cover portion **5750** is attached to the crown portion **5630** to cover the second opening **5634**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(141) The first cover portion **5650** and/or the second cover portion **5750** may be made partially or entirely of an aluminum-based material, a magnesium-type material, a steel-based material, a titanium-based material, a non-metal material such as a polymer material, a ceramic material, a composite material, any combination thereof, or any other suitable material. In the example of FIGS. 55-57, the first cover portion **5650** includes a top layer **5652**, a bottom layer **5654**, and a middle layer **5656**. The second cover portion **5750** includes a top layer **5752**, a bottom layer **5754**,

and a middle layer **5756**. The top layer **5652**, the top layer **5752**, the bottom layer **5654** and/or the bottom layer **5754** may be constructed from a composite material. In one example, the top layer **5652**, the top layer **5752**, the bottom layer **5654** and/or the bottom layer **5754** may be constructed from graphite-epoxy composite or other suitable fiber composite materials. The thickness of the top layer **5652**, the top layer **5752**, the bottom layer **5654** and/or the bottom layer **5754** may depend on the characteristics and a certain weight distribution of the golf club head **5500**. The top layer **5652**, the top layer **5752**, the bottom layer **5654** and/or the bottom layer **5754** may provide structural support for the crown portion **5630** when the golf club head **5500** strikes a golf ball via the face portion **5575**. The middle layer **5656** and/or the middle layer **5756** may be constructed from any polymer material and/or elastomer material with a thickness to absorb shock, isolate vibration, and/or dampen noise when the golf club head **5500** strikes a golf ball via the face portion **5575**. Accordingly, the middle layer **5656** and/or the middle later **5756** may be constructed from a material that has less rigidity or more elasticity than the material of the top layers **5652** and **5752** and/or the bottom layers **5654** and **5754**. For example, the middle layer **5656** and/or the middle layer **5756** may be constructed form a material that is similar to any of the polymer, elastomer and/or elastic polymer materials described herein. The top layer **5652**, the bottom layer **5654** and the middle layer **5656** may be attached or bonded together by adhesives such as epoxy. The top layer **5752**, the bottom layer **5754** and the middle layer **5756** may be attached or bonded together by adhesives such as epoxy. The first cover portion **5650** may be attached to the crown portion **5630** to cover the first opening **5632** by any methods or materials. For example, the first cover portion **5650** may be attached to the crown portion **5630** with one or more adhesives described herein such as epoxy. The second cover portion **5750** may be attached to the crown portion **5630** to cover the second opening **5634** by any methods or materials. For example, the second cover portion **5750** may be attached to the crown portion **5630** with one or more adhesives described herein such as epoxy. Any of the cover portions described herein may be co-manufactured with the body portion **5510** such that the one or more cover portions as described herein define continuous one-piece portions of the crown portion **5630**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(142) The first cover portion **5660** and the second cover portion **5750** may be a single cover portion that may be configured to cover both the first opening **5632** and the second opening **5634**. For example, as shown in FIG. **58**, the golf club head **5500** may include a single cover portion **5850** that is configured to be attached to the crown portion **5630** to cover both the first opening **5632** and the second opening **5634**. Accordingly, the reinforcement portion **5636** may be recessed so that the cover portion **5850** can remain flush with the outer surfaces of the crown portion **5630** when the cover portion **5850** is attached to the crown portion **5630**. The golf club head **5500** may not include a reinforcement portion. For example, as shown in FIG. **59**, the golf club head **5500** may include a single opening **5832** on the crown portion **5630**. Accordingly, the cover portion **5850** may be configured to be attached to the crown portion **5630** to cover the opening **5832**. The opening **5832** may include one or more ridges, shoulders or protrusions (not shown) below the outer surface of the crown portion **5630** configured to support the cover portion **5850** so that the cover portion **5850** may be flush with the outer surface of the crown portion **5630** when the cover portion **5850** is attached to the crown portion **5630** to cover the opening **5832**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(143) In the example of FIG. **58**, the cover portion **5850** may include a top layer **5852**, a bottom layer **5854**, and a middle layer **5856**. The cover portion **5850** including the top layer **5852**, the bottom layer **5854**, and the middle layer **5856** may be similar in many respects including methods and materials of construction to the cover portion **5650** (including the layers **5652**, **5654** and **5656**) and/or the cover portion **5750** (including the layers **5752**, **5754** and **5756**) as described herein. The cover portion **5850** may be attached to the crown portion **5630** to cover the first opening **5632** and the second opening **5634** as in the example of FIG. **58**, or to cover the opening **5832** as in the

example of FIG. 59 by any methods or materials described herein. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(144) The first cover portion **5660** and the second cover portion **5750** of the examples of FIG. 57, and the cover portion **5850** of the examples of FIGS. 58 and 59 may contribute to a reduction in weight of the crown portion **5630** while maintaining or increasing the structural strength of the crown portion **4430**. Accordingly, the golf club head **5500** may have a lower center of gravity than a golf club head having a crown portion that is constructed from the same material as the body portion **5510** and may be in one piece with the body portion **5510**. The lower center of gravity may promote a higher ball trajectory. Additionally, the middle layers **5656**, **5756**, and **5856** of the cover portions **5650**, **5750** and **5850**, respectively, may absorb and distribute shock, isolate vibration, and/or dampen noise when the golf club head **5500** strikes a golf ball via the face portion **5575**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(145) The crown portion **5630** may include one or more recesses (not shown) instead of one or more openings that may be configured to receive one or more cover portions as described herein. Accordingly, the one or more recesses may not be open to the interior of the body portion **5510**. The depth of the one or more recesses (not shown) may be similar or substantially similar to the thickness of the one or more cover portions, respectively, that are configured to cover the one or more recesses so that the one or more cover portions remain flush with the top surface of the crown portion **5630**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(146) Turning to FIGS. 60 and 61, for example, the golf club head **5500** may include a hosel assembly **6000** with a hosel **6002**, a hosel sleeve **6004**, and a fastener **6008**. In one example, the hosel **6002** may extend outward from the top portion **5530** and does not extend into the body portion **5510**. The hosel **6002** may be configured to receive the hosel sleeve **6004** such that a portion of the hosel sleeve **6004** may be located inside the body portion **5510** as shown in FIG. 60. The hosel sleeve **6004** may include an outer wall **6005** and a ferrule portion **6006**. The outer wall **6005** of the portion of the hosel sleeve **6004** inside the body portion **5510** may be exposed to the interior space or the hollow space of the body portion **5510**. In other words, as shown in FIG. 61, the hosel **6002** does not extend into the body portion **5510** and the body portion **5510** does not include any structure to surround or cover the hosel sleeve **6004**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(147) The hosel sleeve **6004** may be attached to the hosel **6002** and/or the body portion **5510** by one or more fasteners, one or more adhesives, welding, one or more mechanical locking mechanisms, and/or a combination thereof. In one example shown in FIG. 60, the hosel sleeve **6004** may be fixed to the body portion by the fastener **6008**, which may be a threaded fastener such as a bolt. The hosel sleeve **6004** may include a first end configured to receive a shaft (not shown) and a second end **6012** having a threaded bore **6014**. The bottom portion **5540** may include an opening **6016** configured to receive the fastener **6008**. The opening **6016** may be generally axially aligned with the threaded bore **6014** at the second end **6012** of the hosel sleeve **6004** when the hosel sleeve **6004** is inserted into the hollow body portion **5510** through the hosel **6002** as shown in FIG. 60. The fastener **6008** may be inserted into the opening **6016** and threaded into the threaded bore **6014** of the hosel sleeve **6004** to fasten the hosel sleeve **6004** to the hosel **6002** and/or to the body portion **5510**. A shaft (not shown) may then be inserted and affixed in the hosel sleeve **6004**. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(148) The terms “and” and “or” may have both conjunctive and disjunctive meanings. The terms “a” and “an” are defined as one or more unless this disclosure indicates otherwise. The term “coupled” and any variation thereof refer to directly or indirectly connecting two or more elements chemically, mechanically, and/or otherwise. The phrase “removably connected” is defined such that two elements that are “removably connected” may be separated from each other without breaking or destroying the utility of either element.

(149) The term “substantially” when used to describe a characteristic, parameter, property, or value of an element may represent deviations or variations that do not diminish the characteristic, parameter, property, or value that the element may be intended to provide. Deviations or variations in a characteristic, parameter, property, or value of an element may be based on, for example, tolerances, measurement errors, measurement accuracy limitations and other factors. The term “proximate” is synonymous with terms such as “adjacent,” “close,” “immediate,” “nearby”, “neighboring”, etc., and such terms may be used interchangeably as appearing in this disclosure.

(150) The apparatus, methods, and articles of manufacture described herein may be implemented in a variety of embodiments, and the foregoing description of some of these embodiments does not necessarily represent a complete description of all possible embodiments. Instead, the description of the drawings, and the drawings themselves, disclose at least one embodiment, and may disclose alternative embodiments.

(151) As the rules of golf may change from time to time (e.g., new regulations may be adopted or old rules may be eliminated or modified by golf standard organizations and/or governing bodies such as the USGA, the R&A, etc.), golf equipment related to the apparatus, methods, and articles of manufacture described herein may be conforming or non-conforming to the rules of golf at any particular time. Accordingly, golf equipment related to the apparatus, methods, and articles of manufacture described herein may be advertised, offered for sale, and/or sold as conforming or non-conforming golf equipment. Further, while the above examples may be described with respect to golf clubs, the apparatus, methods and articles of manufacture described herein may be applicable to other suitable types of sports equipment such as a fishing pole, a hockey stick, a ski pole, a tennis racket, etc. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

(152) The scope of coverage of this disclosure is not limited to the example apparatus, methods, and articles of manufacture described herein. On the contrary, this disclosure covers all apparatus, methods, and articles of articles of manufacture fairly falling within the scope of the appended claims either literally or under the doctrine of equivalents.

Claims

1. A golf club head comprising: a hollow body portion having a volume of greater than or equal to 300 cubic centimeters, the hollow body portion comprising a bottom portion, a top portion, a toe portion, a heel portion, a front portion, and a rear portion; a crown portion on the top portion, the crown portion comprising a composite material; a first groove on the bottom portion extending in a heel-to-toe direction, a distance between the first groove and the front portion being less than a distance between the first groove and the rear portion; a second groove on the bottom portion extending in a heel-to-toe direction, a distance between the second groove and the front portion being greater than a distance between the second groove and the rear portion; a first set of ports on the bottom portion between the first groove and the second groove, a distance between the first set of ports and the heel portion being less than a distance between the first set of ports and the toe portion; a second set of ports on the bottom portion between the second groove and the rear portion; and a filler material in the hollow body portion between the first groove and the rear portion, wherein the filler material at least partially surrounds the first set of ports and the second set of ports, and wherein the filler material comprises a polymer mesh.
2. A golf club head according to claim 1, wherein the first set of ports comprises at least two ports with each port having a port diameter, and wherein the at least two ports are separated by a distance of less than or equal to the port diameter.
3. A golf club head according to claim 1, wherein the second set of ports comprises at least two ports with each port having a port diameter, and wherein the at least two ports are separated by a distance of less than or equal to the port diameter.

4. A golf club head according to claim 1, wherein the first groove comprises a center portion and opposing end portions, wherein the opposing end portions extend rearward relative to the center portion.
5. A golf club head according to claim 1, wherein the second groove comprises a center portion and opposing end portions, wherein the opposing end portions extend rearward relative to the center portion.
6. A golf club head according to claim 1, wherein a length of the first groove is greater than a length of the second groove.
7. A golf club head comprising: a body portion having a volume of greater than or equal to 300 cubic centimeters, the body portion comprising an interior cavity, a bottom portion, a top portion, a toe portion, a heel portion, a front portion, and a rear portion; a crown portion on the top portion, the crown portion comprising a composite material; a first groove on the bottom portion, the first groove comprising a first groove center portion extending in a heel-to-toe direction and two opposing first groove end portions extending toward the top portion from the first groove center portion, a distance between the first groove and the front portion being less than a distance between the first groove and the rear portion; a second groove on the bottom portion, the second groove comprising a second groove center portion extending in a heel-to-toe direction and two opposing second groove end portions extending toward the top portion from the second groove center portion, a distance between the second groove and the front portion being greater than a distance between the second groove and the rear portion; a first set of ports on the bottom portion between the first groove and the second groove and extending into the interior cavity from the bottom portion, a distance between the first set of ports and the heel portion being less than a distance between the first set of ports and the toe portion; a second set of ports on the bottom portion between the second groove and the rear portion and extending into the interior cavity from the bottom portion; and a filler material coupled to an inner surface of the bottom portion inside the interior cavity between the first groove and the rear portion, wherein the filler material comprises a plurality of cutout portions with each cutout portion configured to at least partially surrounds a port of the first set of ports or a port of the second set of ports.
8. A golf club head according to claim 7, wherein ports of the first set of ports and the second set of ports are configured to interchangeably receive weight portions, and wherein each weight portion comprises a material having a greater density than a material of the body portion.
9. A golf club head according to claim 7, wherein the first set of ports comprises at least two ports and the second set of ports comprises at least two ports with each port of the first set of ports and the second set of ports having a port diameter, and wherein the at least two ports of the first set of ports are separated by a distance of less than or equal to the port diameter, and wherein at least two ports of the second set of ports are separated by a distance of less than or equal to the port diameter.
10. A golf club head according to claim 7, wherein the two opposing first groove end portions extend rearward relative to the first groove center portion.
11. A golf club head according to claim 7, wherein the two opposing second groove end portions extend rearward relative to the second groove center portion.
12. A golf club head according to claim 7, wherein a length of the first groove is greater than a length of the second groove.
13. A golf club head according to claim 7, wherein the filler material comprises a plurality of holes.
14. A golf club head comprising: a body portion having a volume of greater than or equal to 300 cubic centimeters, the body portion comprising an interior cavity, a bottom portion, a top portion, a toe portion, a heel portion, a front portion, and a rear portion; a first groove on the bottom portion, the first groove comprising a first groove center portion extending in a heel-to-toe direction and two opposing first groove end portions extending toward the top portion and toward the rear portion from the first groove center portion, a distance between the first groove and the front portion being less than a distance between the first groove and the rear portion; a second groove on

the bottom portion, the second groove comprising a second groove center portion extending in a heel-to-toe direction and two opposing second groove end portions extending toward the top portion and toward the rear portion from the second groove center portion, a distance between the second groove and the front portion being greater than a distance between the second groove and the rear portion; a plurality of weight portions comprising a material having a greater density than a material of the body portion; at least two ports on the bottom portion extending into the interior cavity from the bottom portion, each port of the at least two ports configured to receive a weight portion of the plurality of weight portions; and a filler material coupled to an inner surface of the bottom portion inside the interior cavity between the first groove and the rear portion, wherein the filler material is coupled to each port of the at least two ports, and wherein the filler material comprises a plurality of holes and a plurality of cutout portions with each cutout port configured to at least partially surround a port of the at least two ports.

15. A golf club head according to claim 14, wherein a length of the first groove center portion is greater than a length of each first groove end portion.

16. A golf club head according to claim 14, wherein a length of the second groove center portion is greater than a length of each second groove end portion.

17. A golf club head according to claim 14, wherein a length of the first groove center portion is greater than a length of the second groove center portion.

18. A golf club head according to claim 14, wherein each port of the at least two ports includes a port diameter, and wherein the at least two ports are separated by a distance of less than or equal to the port diameter.
