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Off-road vehicle

Abstract

A utility vehicle comprising a frame, a body supported by the frame, a seating area supported by the frame, front and rear ground engaging members supporting the frame and the body, and a powertrain drivingly coupled to the front and rear ground engaging members, the powertrain including an engine having a cylinder block having a plurality of cylinders, a cylinder head removably coupled to the cylinder block, a crankcase having a first portion and a second portion, the first portion of the crankcase being removably coupled to the cylinder block, and at least one gasket positioned between the cylinder block and the first portion of the crankcase, the at least one gasket configured to individually seal each of the plurality of cylinders relative to the first portion of the crankcase.

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7117927	12/2005	Kent et al.	N/A	N/A
7124853	12/2005	Kole, Jr.	N/A	N/A
7125134	12/2005	Hedlund et al.	N/A	N/A
7136729	12/2005	Salman et al.	N/A	N/A
7137764	12/2005	Johnson	N/A	N/A
7140619	12/2005	Hrovat et al.	N/A	N/A
7147075	12/2005	Tanaka et al.	N/A	N/A
7152706	12/2005	Pichler et al.	N/A	N/A
7159557	12/2006	Yasuda et al.	N/A	N/A
7165522	12/2006	Malek et al.	N/A	N/A
7168709	12/2006	Niwa et al.	N/A	N/A
7182169	12/2006	Suzuki	N/A	N/A
7185732	12/2006	Saito et al.	N/A	N/A
7204219	12/2006	Sakurai	N/A	N/A
7208847	12/2006	Taniguchi	N/A	N/A
7213669	12/2006	Fecteau et al.	N/A	N/A
7216733	12/2006	Iwami et al.	N/A	N/A
7224132	12/2006	Cho et al.	N/A	N/A
7234707	12/2006	Green et al.	N/A	N/A
7237789	12/2006	Herman	N/A	N/A
7239032	12/2006	Wilson et al.	N/A	N/A
7243564	12/2006	Chonan et al.	N/A	N/A
7243632	12/2006	Hu	N/A	N/A
D548662	12/2006	Markefka	N/A	N/A
D549133	12/2006	LePage	N/A	N/A
7270335	12/2006	Hio et al.	N/A	N/A
7281753	12/2006	Curtis et al.	N/A	N/A
7286919	12/2006	Nordgren et al.	N/A	N/A
7287508	12/2006	Kurihara	N/A	N/A
7287619	12/2006	Tanaka et al.	N/A	N/A
D555036	12/2006	Eck	N/A	N/A
7325526	12/2007	Kawamoto	N/A	N/A
7347296	12/2007	Nakamura et al.	N/A	N/A
7359787	12/2007	Ono et al.	N/A	N/A
7363961	12/2007	Mori et al.	N/A	N/A
7367247	12/2007	Horiuchi et al.	N/A	N/A
7367417	12/2007	Inui et al.	N/A	N/A
7370724	12/2007	Saito et al.	N/A	N/A
7374012	12/2007	Inui et al.	N/A	N/A
7377351	12/2007	Smith et al.	N/A	N/A
7380622	12/2007	Shimizu	N/A	N/A
7386378	12/2007	Lauwerys et al.	N/A	N/A
7387180	12/2007	Konno et al.	N/A	N/A
7395804	12/2007	Takemoto et al.	N/A	N/A
7401794	12/2007	Laurent et al.	N/A	N/A
7407190	12/2007	Berg et al.	N/A	N/A
7412310	12/2007	Brigham et al.	N/A	N/A
7416234	12/2007	Bequette	N/A	N/A
7421954	12/2007	Bose	N/A	N/A
7427072	12/2007	Brown	N/A	N/A
7427248	12/2007	Chonan	N/A	N/A
D578433	12/2007	Kawaguchi et al.	N/A	N/A
D578934	12/2007	Tanaka et al.	N/A	N/A

7431024	12/2007	Buchwitz et al.	N/A	N/A
7438147	12/2007	Kato et al.	N/A	N/A
7438153	12/2007	Kalsnes et al.	N/A	N/A
7441789	12/2007	Geiger et al.	N/A	N/A
7449793	12/2007	Cho et al.	N/A	N/A
7451808	12/2007	Busse et al.	N/A	N/A
7455134	12/2007	Severinsky et al.	N/A	N/A
7458593	12/2007	Saito et al.	N/A	N/A
7481287	12/2008	Madson et al.	N/A	N/A
7481293	12/2008	Ogawa et al.	N/A	N/A
7483775	12/2008	Karaba et al.	N/A	N/A
D586694	12/2008	Huang et al.	N/A	N/A
7490694	12/2008	Berg et al.	N/A	N/A
7497299	12/2008	Kobayashi	N/A	N/A
7497471	12/2008	Kobayashi	N/A	N/A
7497472	12/2008	Cymbal et al.	N/A	N/A
7506712	12/2008	Kato et al.	N/A	N/A
7506714	12/2008	Davis et al.	N/A	N/A
7510060	12/2008	Izawa et al.	N/A	N/A
7510199	12/2008	Nash et al.	N/A	N/A
D592998	12/2008	Woodard et al.	N/A	N/A
7530420	12/2008	Davis et al.	N/A	N/A
7537070	12/2008	Maslov et al.	N/A	N/A
7540511	12/2008	Saito et al.	N/A	N/A
7546892	12/2008	Lan et al.	N/A	N/A
D595613	12/2008	Lai et al.	N/A	N/A
7559308	12/2008	Matsuda et al.	N/A	N/A
7565944	12/2008	Sakamoto et al.	N/A	N/A
7565945	12/2008	Okada et al.	N/A	N/A
7571039	12/2008	Chen et al.	N/A	N/A
7575211	12/2008	Andritter	N/A	N/A
7597385	12/2008	Shibata et al.	N/A	N/A
7600603	12/2008	Okada et al.	N/A	N/A
7600762	12/2008	Yasui et al.	N/A	N/A
7604084	12/2008	Okada et al.	N/A	N/A
7607368	12/2008	Takahashi et al.	N/A	N/A
7610132	12/2008	Yanai et al.	N/A	N/A
D604201	12/2008	Kawaguchi et al.	N/A	N/A
7611154	12/2008	Delaney	N/A	N/A
7621262	12/2008	Zubeck	N/A	N/A
7623327	12/2008	Ogawa	N/A	N/A
D605555	12/2008	Tanaka et al.	N/A	N/A
D606900	12/2008	Flores	N/A	N/A
7630807	12/2008	Yoshimura et al.	N/A	N/A
D607377	12/2009	Shimomura et al.	N/A	N/A
7641208	12/2009	Barron et al.	N/A	N/A
7644934	12/2009	Mizuta	N/A	N/A
7650959	12/2009	Kato et al.	N/A	N/A
D610514	12/2009	Eck	N/A	N/A
7658258	12/2009	Denney	N/A	N/A
7677646	12/2009	Nakamura	N/A	N/A
7682115	12/2009	Jay et al.	N/A	N/A
7684911	12/2009	Seifert et al.	N/A	N/A
7703566	12/2009	Wilson et al.	N/A	N/A
7703730	12/2009	Best et al.	N/A	N/A
7703826	12/2009	German	N/A	N/A
7712562	12/2009	Nozaki	N/A	N/A
7717495	12/2009	Leonard et al.	N/A	N/A
7740092	12/2009	Bender	N/A	N/A
7740103	12/2009	Sasajima	N/A	N/A
7740256	12/2009	Davis	N/A	N/A
7742851	12/2009	Hisada et al.	N/A	N/A
7751959	12/2009	Boon et al.	N/A	N/A
7753427	12/2009	Yamamura et al.	N/A	N/A
D621423	12/2009	Nakanishi et al.	N/A	N/A

D622631	12/2009	Lai et al.	N/A	N/A
7769505	12/2009	Rask et al.	N/A	N/A
7778741	12/2009	Rao et al.	N/A	N/A
7786886	12/2009	Maruyama et al.	N/A	N/A
7795602	12/2009	Leonard et al.	N/A	N/A
7802816	12/2009	McGuire	N/A	N/A
D625662	12/2009	Li	N/A	N/A
7810818	12/2009	Bushko	N/A	N/A
7819220	12/2009	Sunsdahl et al.	N/A	N/A
7828098	12/2009	Yamamoto et al.	N/A	N/A
7845452	12/2009	Bennett et al.	N/A	N/A
7857334	12/2009	Seki	N/A	N/A
D631395	12/2010	Tandrup et al.	N/A	N/A
7862061	12/2010	Jung	N/A	N/A
7874391	12/2010	Dahl et al.	N/A	N/A
D631792	12/2010	Sanschagrin	N/A	N/A
D633006	12/2010	Sanschagrin et al.	N/A	N/A
7884574	12/2010	Fukumura et al.	N/A	N/A
7885750	12/2010	Lu	N/A	N/A
7899594	12/2010	Messih et al.	N/A	N/A
7912610	12/2010	Saito et al.	N/A	N/A
7913505	12/2010	Nakamura	N/A	N/A
7913782	12/2010	Foss et al.	N/A	N/A
D636295	12/2010	Eck et al.	N/A	N/A
D636704	12/2010	Yoo et al.	N/A	N/A
D636787	12/2010	Luxon et al.	N/A	N/A
D636788	12/2010	Luxon et al.	N/A	N/A
7926822	12/2010	Ohletz et al.	N/A	N/A
7931106	12/2010	Suzuki et al.	N/A	N/A
D637623	12/2010	Luxon et al.	N/A	N/A
D638446	12/2010	Luxon et al.	N/A	N/A
7942427	12/2010	Lloyd	N/A	N/A
7942447	12/2010	Davis et al.	N/A	N/A
7950486	12/2010	Van et al.	N/A	N/A
D640598	12/2010	Zhang	N/A	N/A
7954853	12/2010	Davis et al.	N/A	N/A
7959163	12/2010	Beno et al.	N/A	N/A
7962261	12/2010	Bushko et al.	N/A	N/A
7963529	12/2010	Oteman et al.	N/A	N/A
7967100	12/2010	Cover et al.	N/A	N/A
7970512	12/2010	Lu et al.	N/A	N/A
D641288	12/2010	Sun	N/A	N/A
7984780	12/2010	Hirukawa	N/A	N/A
7984915	12/2010	Post et al.	N/A	N/A
D642493	12/2010	Goebert et al.	N/A	N/A
8002061	12/2010	Yamamura et al.	N/A	N/A
8005596	12/2010	Lu et al.	N/A	N/A
8011342	12/2010	Bluhm	N/A	N/A
8011420	12/2010	Mazzocco et al.	N/A	N/A
8027775	12/2010	Takenaka et al.	N/A	N/A
8029021	12/2010	Leonard et al.	N/A	N/A
8032281	12/2010	Bujak et al.	N/A	N/A
8037959	12/2010	Yamamura et al.	N/A	N/A
D648745	12/2010	Luxon et al.	N/A	N/A
D649162	12/2010	Luxon et al.	N/A	N/A
8047324	12/2010	Yao et al.	N/A	N/A
8047451	12/2010	McNaughton	N/A	N/A
8050818	12/2010	Mizuta	N/A	N/A
8050851	12/2010	Aoki et al.	N/A	N/A
8050857	12/2010	Lu et al.	N/A	N/A
8051842	12/2010	Hagelstein et al.	N/A	N/A
8052202	12/2010	Nakamura	N/A	N/A
8056392	12/2010	Ryan et al.	N/A	N/A
8056912	12/2010	Kawabe et al.	N/A	N/A
8065054	12/2010	Tarasinski et al.	N/A	N/A

D650311	12/2010	Bracy	N/A	N/A
8074753	12/2010	Tahara et al.	N/A	N/A
8075002	12/2010	Pionke et al.	N/A	N/A
8086371	12/2010	Furuichi et al.	N/A	N/A
8087676	12/2011	McIntyre	N/A	N/A
8095268	12/2011	Parison et al.	N/A	N/A
8104524	12/2011	Manesh et al.	N/A	N/A
8108104	12/2011	Hrovat et al.	N/A	N/A
8116938	12/2011	Itagaki et al.	N/A	N/A
8121757	12/2011	Song et al.	N/A	N/A
8122988	12/2011	Obayashi et al.	N/A	N/A
8152880	12/2011	Matschl et al.	N/A	N/A
8157039	12/2011	Melvin et al.	N/A	N/A
8162086	12/2011	Robinson	N/A	N/A
D660746	12/2011	Bracy	N/A	N/A
8170749	12/2011	Mizuta	N/A	N/A
8176957	12/2011	Manesh et al.	N/A	N/A
8186333	12/2011	Sakuyama	N/A	N/A
8191930	12/2011	Davis et al.	N/A	N/A
8205910	12/2011	Leonard et al.	N/A	N/A
8209087	12/2011	Haegglund et al.	N/A	N/A
8214106	12/2011	Ghoneim et al.	N/A	N/A
8215427	12/2011	Rouaud et al.	N/A	N/A
8219262	12/2011	Stiller	N/A	N/A
8229642	12/2011	Post et al.	N/A	N/A
8235155	12/2011	Seegert et al.	N/A	N/A
8260496	12/2011	Gagliano	N/A	N/A
8271175	12/2011	Takenaka et al.	N/A	N/A
8272685	12/2011	Lucas et al.	N/A	N/A
8281891	12/2011	Sugiura	N/A	N/A
8296010	12/2011	Hirao et al.	N/A	N/A
D670198	12/2011	Li et al.	N/A	N/A
8308170	12/2011	Van et al.	N/A	N/A
8315764	12/2011	Chen et al.	N/A	N/A
8321088	12/2011	Brown et al.	N/A	N/A
8322497	12/2011	Marjoram et al.	N/A	N/A
8328235	12/2011	Schneider et al.	N/A	N/A
8352143	12/2012	Lu et al.	N/A	N/A
8353265	12/2012	Pursifull	N/A	N/A
8355840	12/2012	Ammon et al.	N/A	N/A
8356472	12/2012	Hiranuma et al.	N/A	N/A
8374748	12/2012	Jolly	N/A	N/A
8376373	12/2012	Conradie	N/A	N/A
8376441	12/2012	Nakamura et al.	N/A	N/A
8381855	12/2012	Suzuki et al.	N/A	N/A
8382125	12/2012	Sunsdahl et al.	N/A	N/A
8386109	12/2012	Nicholls	N/A	N/A
8396627	12/2012	Jung et al.	N/A	N/A
D679627	12/2012	Li et al.	N/A	N/A
8417417	12/2012	Chen et al.	N/A	N/A
8424832	12/2012	Robbins et al.	N/A	N/A
D682737	12/2012	Li et al.	N/A	N/A
D682739	12/2012	Patterson et al.	N/A	N/A
8434774	12/2012	Leclerc et al.	N/A	N/A
8439019	12/2012	Carlson et al.	N/A	N/A
8442720	12/2012	Lu et al.	N/A	N/A
8444161	12/2012	Leclerc et al.	N/A	N/A
8447489	12/2012	Murata et al.	N/A	N/A
8457841	12/2012	Knoll et al.	N/A	N/A
8473157	12/2012	Savaresi et al.	N/A	N/A
8479854	12/2012	Gagnon	N/A	N/A
8485303	12/2012	Yamamoto et al.	N/A	N/A
8496079	12/2012	Wenger et al.	N/A	N/A
8517395	12/2012	Knox et al.	N/A	N/A
D689396	12/2012	Wang	N/A	N/A

8538628	12/2012	Backman	N/A	N/A
D691924	12/2012	Smith	N/A	N/A
8548678	12/2012	Ummethala et al.	N/A	N/A
8550221	12/2012	Paulides et al.	N/A	N/A
8561403	12/2012	Vandyne et al.	N/A	N/A
8567847	12/2012	King et al.	N/A	N/A
D693370	12/2012	Randhawa	N/A	N/A
8573348	12/2012	Cantemir et al.	N/A	N/A
8573605	12/2012	Di Maria	N/A	N/A
8579060	12/2012	George et al.	N/A	N/A
8590651	12/2012	Shigematsu et al.	N/A	N/A
D694668	12/2012	Li et al.	N/A	N/A
8596405	12/2012	Sunsdahl et al.	N/A	N/A
8613335	12/2012	Deckard et al.	N/A	N/A
8613337	12/2012	Kinsman et al.	N/A	N/A
8626388	12/2013	Oikawa	N/A	N/A
8626389	12/2013	Sidlosky	N/A	N/A
D699627	12/2013	Tang	N/A	N/A
8640814	12/2013	Deckard et al.	N/A	N/A
8641052	12/2013	Kondo et al.	N/A	N/A
8645024	12/2013	Daniels	N/A	N/A
8646555	12/2013	Reed	N/A	N/A
8651557	12/2013	Suzuki	N/A	N/A
8657050	12/2013	Yamaguchi	N/A	N/A
D700869	12/2013	Sato et al.	N/A	N/A
D701469	12/2013	Lai et al.	N/A	N/A
8671919	12/2013	Nakasugi et al.	N/A	N/A
8672106	12/2013	Laird et al.	N/A	N/A
8672337	12/2013	Van et al.	N/A	N/A
D703102	12/2013	Eck et al.	N/A	N/A
8700260	12/2013	Jolly et al.	N/A	N/A
8708359	12/2013	Murray	N/A	N/A
8712599	12/2013	Westpfahl	N/A	N/A
8712639	12/2013	Lu et al.	N/A	N/A
D705127	12/2013	Patterson et al.	N/A	N/A
8718872	12/2013	Hirao et al.	N/A	N/A
8725351	12/2013	Selden et al.	N/A	N/A
8731774	12/2013	Yang	N/A	N/A
8746719	12/2013	Safranski et al.	N/A	N/A
8763739	12/2013	Belzile et al.	N/A	N/A
8783396	12/2013	Bowman	N/A	N/A
8783400	12/2013	Hirukawa	N/A	N/A
D711778	12/2013	Chun et al.	N/A	N/A
D712311	12/2013	Morgan et al.	N/A	N/A
8827019	12/2013	Deckard et al.	N/A	N/A
8834307	12/2013	Itoo et al.	N/A	N/A
8840076	12/2013	Zuber et al.	N/A	N/A
8869525	12/2013	Lingenauber et al.	N/A	N/A
D717695	12/2013	Matsumura	N/A	N/A
D719061	12/2013	Tandrup et al.	N/A	N/A
D722538	12/2014	Song et al.	N/A	N/A
8960348	12/2014	Shomura et al.	N/A	N/A
8973693	12/2014	Kinsman et al.	N/A	N/A
D727794	12/2014	Tandrup et al.	N/A	N/A
8997908	12/2014	Kinsman et al.	N/A	N/A
9016760	12/2014	Kuroda et al.	N/A	N/A
9027937	12/2014	Ryan et al.	N/A	N/A
D735077	12/2014	Sato et al.	N/A	N/A
9091468	12/2014	Colpan et al.	N/A	N/A
D737724	12/2014	Schroeder et al.	N/A	N/A
D739304	12/2014	Brown	N/A	N/A
9133730	12/2014	Joergl et al.	N/A	N/A
9146061	12/2014	Farlow et al.	N/A	N/A
9162561	12/2014	Marois et al.	N/A	N/A
9186952	12/2014	Yleva	N/A	N/A

9194278	12/2014	Fronk et al.	N/A	N/A
9194282	12/2014	Serres et al.	N/A	N/A
9221508	12/2014	De Haan	N/A	N/A
9266417	12/2015	Nadeau et al.	N/A	N/A
D756845	12/2015	Flores	N/A	N/A
9327587	12/2015	Spindler et al.	N/A	N/A
9328652	12/2015	Bruss et al.	N/A	N/A
9381803	12/2015	Galsworthy et al.	N/A	N/A
9382832	12/2015	Bowers	N/A	N/A
D762522	12/2015	Kinoshita	N/A	N/A
9421860	12/2015	Schuhmacher et al.	N/A	N/A
9428031	12/2015	Kuwabara et al.	N/A	N/A
9440671	12/2015	Schlangen et al.	N/A	N/A
9469329	12/2015	Leanza	N/A	N/A
D772755	12/2015	Tandrup et al.	N/A	N/A
9499044	12/2015	Osaki	N/A	N/A
9512809	12/2015	Tsumiyama et al.	N/A	N/A
9566858	12/2016	Hicke et al.	N/A	N/A
9592713	12/2016	Kinsman et al.	N/A	N/A
D784199	12/2016	Dunshee et al.	N/A	N/A
D785502	12/2016	Dunshee et al.	N/A	N/A
9638070	12/2016	Kaeser	N/A	N/A
9650078	12/2016	Kinsman et al.	N/A	N/A
9713976	12/2016	Miller et al.	N/A	N/A
9718351	12/2016	Ripley et al.	N/A	N/A
9719463	12/2016	Oltmans et al.	N/A	N/A
9725023	12/2016	Miller et al.	N/A	N/A
9752489	12/2016	Chu	N/A	N/A
9776481	12/2016	Deckard et al.	N/A	N/A
D804993	12/2016	Eck et al.	N/A	N/A
D805009	12/2016	Eck et al.	N/A	N/A
D805015	12/2016	Eck et al.	N/A	N/A
9856817	12/2017	Nicosia et al.	N/A	N/A
9884647	12/2017	Peterson et al.	N/A	N/A
9895946	12/2017	Schlangen et al.	N/A	N/A
9908577	12/2017	Novak et al.	N/A	N/A
10017090	12/2017	Franker et al.	N/A	N/A
10036311	12/2017	Kaeser et al.	N/A	N/A
10099547	12/2017	Bessho et al.	N/A	N/A
10124709	12/2017	Bohnsack et al.	N/A	N/A
D835545	12/2017	Hanten et al.	N/A	N/A
10183605	12/2018	Weber et al.	N/A	N/A
10189524	12/2018	Schafer et al.	N/A	N/A
10207555	12/2018	Mailhot et al.	N/A	N/A
10221727	12/2018	Walter et al.	N/A	N/A
10239571	12/2018	Kennedy et al.	N/A	N/A
10246153	12/2018	Deckard et al.	N/A	N/A
10300786	12/2018	Nugteren et al.	N/A	N/A
10323568	12/2018	Kaeser et al.	N/A	N/A
D852674	12/2018	Wilcox et al.	N/A	N/A
10369861	12/2018	Deckard et al.	N/A	N/A
10371249	12/2018	Bluhm et al.	N/A	N/A
10399401	12/2018	Schlangen et al.	N/A	N/A
10479422	12/2018	Hollman et al.	N/A	N/A
10486748	12/2018	Deckard et al.	N/A	N/A
10495120	12/2018	Fisher	N/A	F16H 61/0025
10589621	12/2019	McKoskey et al.	N/A	N/A
10655536	12/2019	Mueller et al.	N/A	N/A
10718238	12/2019	Wenger et al.	N/A	N/A
10723190	12/2019	Hu et al.	N/A	N/A
D896125	12/2019	Hashimoto et al.	N/A	N/A
D896702	12/2019	Dunshee et al.	N/A	N/A
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10766533	12/2019	Houkom et al.	N/A	N/A
10800250	12/2019	Nugteren et al.	N/A	N/A

10837329	12/2019	Parrish	N/A	F01M 11/0004
10876462	12/2019	Draisey et al.	N/A	N/A
10926799	12/2020	Houkom et al.	N/A	N/A
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10933932	12/2020	Spindler et al.	N/A	N/A
10946736	12/2020	Fischer et al.	N/A	N/A
11104194	12/2020	Schlangen et al.	N/A	N/A
11173808	12/2020	Swain et al.	N/A	N/A
11220147	12/2021	Hu et al.	N/A	N/A
11235814	12/2021	Schlangen et al.	N/A	N/A
11285807	12/2021	Galsworthy et al.	N/A	N/A
11293540	12/2021	Leclair et al.	N/A	N/A
11370266	12/2021	Borud et al.	N/A	N/A
11607920	12/2022	Schlangen et al.	N/A	N/A
11691674	12/2022	Schleif et al.	N/A	N/A
11780326	12/2022	Schlangen et al.	N/A	N/A
11787251	12/2022	Schlangen et al.	N/A	N/A
11884148	12/2023	Nelson et al.	N/A	N/A
11926190	12/2023	Schlangen et al.	N/A	N/A
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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION (1) The present application is a continuation of U.S. patent application Ser. No. 16/875,494, filed May 15, 2020, the enclosure of which is disclosed herein by reference.

FIELD OF THE INVENTION

(1) The present invention relates to off-road vehicles including all-terrain vehicles (“ATVs”) or utility vehicles (“UTVs”).

BACKGROUND OF THE INVENTION

(2) Generally, UTVs or ATVs are used to carry one or more passengers and a small amount of cargo over a variety of terrains. Current ATVs and UTVs are typically provided with engines having a unitary engine block housing a plurality of cylinders and a portion of a crankcase. However, for engine modularity purposes, a need exists for an engine in a UTV or ATV that has a cylinder block separate from but sealingly engaged with the portion of the crankcase.

SUMMARY OF THE INVENTION

(3) In one embodiment of the disclosure, a utility vehicle comprises a frame, a body supported by the frame, a seating area supported by the frame, front and rear ground engaging members supporting the frame and the body, and a powertrain drivingly coupled to the front and rear ground engaging members. The powertrain includes an engine having a cylinder block having a plurality of cylinders, a cylinder head removably coupled to the cylinder block, and a crankcase having a first portion and a second portion. The first portion of the crankcase is removably coupled to the cylinder block, and at least one gasket is positioned between the cylinder block and the first portion of the crankcase. The at least one gasket is configured to individually seal each of the plurality of cylinders relative to the first portion of the crankcase.

(4) In another embodiment of the disclosure, an engine for a utility vehicle comprises a cylinder block having a plurality of cylinders, a cylinder head removably coupled to the cylinder block, and a crankcase having a first portion and a second portion. The first portion of the crankcase is removably coupled to the cylinder block. Each of the plurality of cylinders is individually sealed with the first portion of the crankcase via at least one sealing member.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1** shows a front left perspective view of a vehicle of the present disclosure;
(2) FIG. **2** shows a right rear perspective view of the vehicle of FIG. **1**;
(3) FIG. **3** shows a left elevational side view of the vehicle of FIG. **1**;
(4) FIG. **4** shows a right elevational side view of the vehicle of FIG. **1**;
(5) FIG. **5** shows a top plan view of the vehicle of FIG. **1**;
(6) FIG. **6** shows a front elevational view of the vehicle of FIG. **1**;
(7) FIG. **7** shows a rear elevational view of the vehicle of FIG. **1**;
(8) FIG. **8** shows a schematic view of a powertrain of the vehicle of FIG. **1**;
(9) FIG. **9** shows a first perspective view of an engine of the vehicle of FIG. **1**;
(10) FIG. **10** shows a second perspective view of the engine of FIG. **9**;
(11) FIG. **11** shows a side plan view of a fuel injection assembly of the vehicle of FIG. **1** coupled to an air intake and an engine of a powertrain of the vehicle of FIG. **1**;
(12) FIG. **12** shows a cross-sectional view of the fuel injection assembly, air intake, and engine of FIG. **11** taken along line **12-12** of FIG. **11**;
(13) FIG. **13** shows a perspective view of the engine of FIG. **9** with a cam cover, a cylinder head, and a coolant assembly of the engine removed;
(14) FIG. **14** shows an exploded view of a portion of the engine of FIG. **13**;
(15) FIG. **15** shows a cross-sectional view of a portion of the engine of FIG. **13** taken along line **15-15** of FIG. **13**;
(16) FIG. **16** shows a perspective view of a starter motor, a balance shaft, an oil pump, a water pump, a crankshaft and an oil pan of the engine of FIG. **9**;
(17) FIG. **17** shows a side plan view of the starter motor, the balance shaft, and the crankshaft of FIG. **16**;
(18) FIG. **18** shows an exploded view of the starter motor, the balance shaft, and the crankshaft of FIG. **17**;
(19) FIG. **19** shows an exploded view of the water pump and the oil pump of FIG. **16**;
(20) FIG. **20** shows a perspective view of a lubrication system of the engine of FIG. **9**;
(21) FIG. **21** shows an exploded view of the lubrication system of FIG. **20**;
(22) FIG. **22** shows a cross-sectional view of lubrication system of FIG. **20** taken along line **22-22** of FIG. **20**;
(23) FIG. **23**A is a detailed cross-sectional view of a scavenge pump of the lubrication system of FIG. **22** when the vehicle of FIG. **1** is tilted in a first direction; and
(24) FIG. **23**B shows a detailed cross-sectional view of the scavenge pump of the lubrication system of FIG. **22** when the vehicle of FIG. **1** is tilted in a second direction.

DETAILED DESCRIPTION OF THE DRAWINGS

(25) With reference to FIGS. **1-7**, the vehicle of the present invention will be described. As shown, the vehicle is generally depicted as reference number **2** which includes front ground engaging members **4** and rear ground engaging members **6**. Front ground engaging members **4** are comprised of wheels **8** and tires **10**, and rear ground engaging members **6** are comprised of wheels **12** and tires **14**. Ground engaging members **4** and **6** support a vehicle frame, which is shown generally at **20**, through front and rear suspension assemblies **16** and **18**.

(26) Vehicle frame **20** supports a seating area **22** comprised of a driver's seat **24** and a passenger seat **26**. Vehicle **2** further includes a steering assembly for steering front ground engaging members **4** whereby the steering assembly includes a steering wheel **28**. Frame **20** of vehicle **2** is comprised of a cab frame **30** that generally extends over the seating area **22**, and a lower frame portion **32** positioned below and supporting cab frame **30**. Frame **20** is configured to support a plurality of body panels **34** and/or doors **36**.

(27) With reference now to FIG. **8**, vehicle **2** further includes a powertrain assembly **70** for providing power to ground engaging members **4** and **6** of vehicle **2**. Powertrain assembly **70** generally comprises an engine **72**, an air intake assembly **74** providing air

to engine **72**, an exhaust assembly **76** routing exhaust from engine **72** out of vehicle **2**, a transmission **78** coupled to engine **72**, and a drivetrain (not shown) coupled to transmission **78**. Additional details relating to vehicle **2** including powertrain **70** may be found in U.S. patent application Ser. No. 16/875,448 (now U.S. Pat. No.12,187,127) the subject matter of which is incorporated herein by reference.

(28) Still referring to FIG. **8**, in various embodiments, powertrain assembly **70** may further include a starter clutch **80** removably coupled between engine **72** and transmission **78** to allow a starter motor, which may be in constant meshed engagement with starter clutch **80**, to crank or start engine **72**. Starter clutch **80** is generally sealingly coupled to engine **72** such that starter clutch **80** may receive lubricant from engine **72**. Decoupling starter clutch **80** from engine **72** and transmission **78** allows for a more modular engine in that various components of powertrain assembly **70** may be used in different embodiments and orientations due to ability to couple and decouple components from each other, depending on the application on vehicle **2** and the requirements of powertrain assembly **70**. Furthermore, in various embodiments, powertrain assembly **70** may include a turbocharger **82** at least fluidly coupled with exhaust assembly **76**.

(29) Referring now to FIGS. **9-15**, engine **72** of powertrain assembly **70** generally includes a cylinder block **90**, a cylinder head which includes an intake port **92** and is coupled to cylinder block **90**, a first crankcase portion **94** coupled to cylinder block **90**, a second crankcase portion **96** coupled to first crankcase portion **94**, an oil pan **98** coupled to second crankcase portion **96**, a valve or cam cover **100** depending on the location of valves and cams within engine **72** coupled over intake port **92**, and a coolant assembly **102**. Coolant assembly **102** may be configured to extend along a side of engine **72** from intake port **92** to second crankcase portion **94**. In various embodiments, intake port **92** is positioned above cylinder block **90** and cylinder block **90** itself is positioned above first crankcase portion **94**. First crankcase portion **94** is positioned above second crankcase portion **96** and second crankcase portion **96** is positioned above oil pan **98**.

(30) With reference to FIGS. **9** and **10**, coolant assembly **102** generally includes a coolant manifold **104**, a water pump **106** (FIG. **10**), a water pump inlet conduit **108** coupling coolant manifold **104** to water pump **106**, a water pump outlet conduit **110** (FIG. **10**) coupling water pump **106** to engine **72**, an oil cooler **112**, an oil cooler outlet conduit **114** coupling oil cooler **112** to coolant manifold **104**, and an oil cooler inlet conduit **116** coupling engine **72** to oil cooler **112**. Coolant manifold **104** generally includes a first inlet **120** configured to receive coolant from a radiator (not shown), a first outlet **122** configured to provide heated coolant to the radiator, a second inlet **124** configured to receive heated coolant from oil cooler **112**, a second outlet **126** configured to provide coolant to water pump **106**, and a bleed outlet **128**. In various embodiments, a thermostat (not shown) may be controlled with return, heated coolant from the radiator.

(31) Referring now to FIGS. **11** and **12**, powertrain assembly **70** further includes a fuel injection assembly **120**. Fuel injection assembly **120** generally includes a fuel rail **122** and at least one fuel injector **124**. In general, fuel injector assembly **120** includes one fuel injector **124** for each cylinder **130** (FIG. **13**) of engine **72**. Fuel injector(s) **124** are positioned along intake assembly **74** to direct a fuel stream **126** downward such that fuel stream **126** contacts an opposing interior wall **128** of intake assembly **74** and bounces at an angle α into intake port **92**. More particularly, opposing interior wall **128** is generally opposite the location of fuel injector **124** such that fuel injector **124** is positioned at one portion of an intake manifold **75** of intake assembly **74** and opposing interior wall **128** is positioned approximately 180° from the location of fuel injector **124**. In various embodiments, angle α may be between 30 degrees and 70 degrees. In the illustrative embodiment, angle α is approximately 45 degrees. By hitting wall **128** substantially straight on such that fuel stream **126** defines a linear stream that first contacts wall **128** before contacting any other portion of intake manifold **75**, fuel stream **126** hits wall **128** and increases the atomization of fuel stream **126**. Fuel stream **126** atomizes better since the entire fuel stream **126** hits wall **128** ensuring full stream **126** atomizes rather than only a portion of fuel stream **126**. In general, fuel injector assembly **120** is positioned below a top of engine **72** for protection.

(32) With reference now to FIGS. **13-15**, engine **72** generally includes a plurality of cylinders **130**, illustratively three but any number of cylinders **130** may be provided, a piston **132** positioned within each cylinder **130**, and a connecting rod **134** coupling each piston **132** to a crankshaft **136**. Cylinders **130** are generally positioned within cylinder block **90** which is sealingly coupled to and positioned above first crankcase portion **94** with a gasket **138**. In various embodiments, gasket **138** is configured such that each cylinder **130** is individually sealed with first crankcase portion **94** at a lowermost end of cylinder block **90**. In various embodiments, cylinder block **90** may be sealingly coupled above first crankcase portion **94** with an additional gasket **137** positioned above gasket **138** and between an uppermost end of first crankcase portion **94** and a lip **139** of cylinder block **90**. In this way, each cylinder **130** is sealed from each other such that fluid does not flow between cylinders **130**.

(33) Crankshaft **136** is generally positioned within first and second crankcase portions **94** and **96**, and connecting rods **134** reciprocate within crank bays **140** within first and second crankcase portions **94** and **96** and cylinders **130**. Gasket **138** seals individual crank bays **140** to prevent windage created by the reciprocation of connecting rods **134** within crank bays **140** from passing between crank bays **140**.

(34) Referring now to FIGS. **16-19**, engine **72** may further include a balance shaft **150** and a starter motor **152** for cranking or starting engine **72**. In various embodiments, starter motor **152** and balance shaft **150** are coupled to crankshaft **136** such that crankshaft **136** is started by balance shaft **150**. For example, and as shown in FIGS. **16-19**, crankshaft **136** may be started by balance shaft **150** via a gear assembly **153**. Gear assembly **153** generally includes a starter gear **156** coupled to a first end **151** of starter motor **152** which is meshed with a first transfer gear **158** coupled to a shaft **157**, which extends between first crankcase portion **94** and a cover **159** (FIG. **13**) coupled to first crankcase portion **94**. First transfer gear **158** in turn is fixedly coupled to a second transfer gear **160** (FIGS. **18** and **19**) which may also be coupled to shaft **157** and positioned between first crankcase portion **94** and cover **159**. In this way, gears **158**, **160** may rotate together on shaft **157** such that when starter motor **152** drives gear **158**, gear **160** drives rotation of a gear **162**, as disclosed further herein. In various embodiments, first transfer gear **150** is a torque limiting gear that limits any backfire torque engine **72** sees. Second transfer gear **160** in turn is meshed with an outer gear **162** of balance shaft **150** which is coupled to an inner gear **164** of balance shaft **150** via a one-way or sprag clutch such that outer gear **162** is fixedly coupled to inner gear **164** in a first direction and rotatably coupled to inner gear **164** in a second direction. Inner gear **164** of balance shaft **150**, which is fixedly coupled to balance shaft **150**, in turn is meshed with a gear **166** of crankshaft **136**.

In this way, crankshaft **136** may be started by balance shaft **150** via gear assembly **153**.
(35) With reference to FIGS. **16** and **19**, engine **72** generally further includes a lubrication assembly **154** coupled to balance shaft **150** such that balance shaft **150** drives an oil pump **170** of lubrication assembly **154**. For example, and as shown in FIG. **16**, a second end **155** of balance shaft **150** may be coupled to a gear **172** of oil pump **170** via a chain **174** such that rotation of balance shaft **150** drives oil pump **170**. In various embodiments, oil pump **170** is coupled directly to water pump **106** such that rotation of gear **172** of oil pump **170** drives water pump **106**. For example, and as shown in FIG. **19**, oil pump **170** may include a protrusion or key **176** fixedly coupled to gear **172** which is received within an indentation or opening **178** in water pump **106** such that rotation of protrusion **176** is transferred to water pump **106** through indentation **178**.
(36) Referring to FIGS. **19**-**23**B, lubrication system **154** generally further includes a pressure pick-up **180** fluidly coupled to oil pump **170** via a transfer conduit **182**, and a scavenge pump **184** fluidly coupled to oil pump **170** via a pickup conduit **186**, where pressure pick-up **180** and scavenge pump **184** are positioned within oil pan **98**. Oil pan **98** generally includes a pressure pick-up volume **188** (FIG. **21**) within which pressure pick-up **180** is positioned and into which oil from oil pump **170** may be released through oil pump outlet conduit **183**, a scavenge pump volume **190** within which scavenge pump **184** is positioned, and an outlet **192** through which oil within oil pan **98** may be drained. In various embodiments, outlet **192** may be positioned such that oil from pressure pick-up volume **188** and scavenge pump volume **190** may be drained simultaneously. For example, outlet **192** may be positioned below a wall **194** of pressure pick-up volume **188** such that a portion of outlet **192** is in fluid communication with pressure pick-up volume **188** and a portion of outlet **192** is in fluid communication with scavenge pump volume **190**.
(37) Referring to FIGS. **22**, **23**A, and **23**B, in various embodiments, scavenge pump **184** is a shuttle valve scavenge pump **184**. Shuttle valve scavenge pump **184** generally includes a housing **196**, a shuttle valve assembly **198** positioned with housing **196**, and a strainer assembly **200** coupled to housing **196**. Housing **196** includes an outlet **202** fluidly coupled to oil pump **170** via pick up conduit **186**, a first inlet **204** fluidly coupled to strainer assembly **200**, a second inlet **206** fluidly coupled to strainer assembly **200**, a first shoulder **208**, and a second shoulder **210**. Shuttle valve assembly **198** generally includes at least one ball **212** and/or **214** positioned within housing **196**. In various embodiments, and as shown in the illustrative embodiments, shuttle valve assembly **198** may include a first ball **212**, a second ball **214**, and a spring **216** positioned between first ball **212** and second ball **214**. Strainer assembly **200** generally includes a first inlet **215** in fluid communication with first inlet **204** of housing **196** and a second inlet **217** in fluid communication with second inlet **206** of housing **196**.
(38) Shuttle valve assembly **198** is configured to shift within housing **196** such that when vehicle **2** is tilted in a first direction (e.g., to one side), gravity causes the at least one ball **212** and/or **214** to prevent first inlet **215** of strainer assembly **200** and first inlet **204** of housing **196** from fluidly communicating with outlet **202** and/or oil pump **170** such that oil is received through second inlet **206** of housing **196** and second inlet **217** of strainer assembly **200**. Additionally, when vehicle **2** is tilted in a second direction opposite to the first direction (e.g., to the other side), gravity causes the at least one ball **212** and/or **214** to prevent second inlet **206** of housing **196** and second inlet **217** of strainer assembly **200** from fluidly communication with outlet **202** and/or oil pump **170** such that oil is received through first inlet **215** of strainer assembly **200** and first inlet **204** of housing **196**. With reference to the illustrative embodiments, when vehicle **2** is tilted in the first direction, gravity causes first ball **212** to abut first shoulder **208** such that first inlet **204** of housing **196** and first inlet **215** of strainer assembly **200** are no longer in fluid communication with outlet **202** and oil pump **170** and oil is received through second inlet **206** of housing **196** and second inlet **217** of strainer assembly **200** (FIG. **23**A), while when vehicle **2** is tilted in the second direction opposite to the first direction, gravity causes second ball **214** to abut second shoulder **210** such that second inlet **206** of housing **196** and second inlet **217** of strainer assembly **200** are no longer in fluid communication with outlet **170** and oil pump **170** and oil is received through first inlet **204** of housing **196** and first inlet **215** of strainer assembly **200** (FIG. **23**B). When vehicle **2** is not tilted in either direction, the at least one ball, illustratively first ball **212** and second ball **214**, may be spaced apart from first and second shoulders **208** and **210** such that oil may be received through both first and second inlets **204** and **206** of housing **196** and first and second inlets **215** and **217** of strainer assembly **200** simultaneously. However, spring **216** prevents first ball **212** and second ball **214** from being simultaneously engaged with first and second shoulder **208** and **210**, respectively, such that oil is being received through one of inlets **204** and **215** or inlets **206** and **217** at any given time. As such, shuttle valve assembly **198** prevents air from being received within scavenge pump **184** when vehicle **2** is tilted.
(39) While this invention has been described as having an exemplary design, the present invention may be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains.

Claims

1. A vehicle, comprising: a plurality of ground engaging members; a frame supported by the plurality of ground engaging members; an engine supported by the frame, the engine operably coupled to at least one ground engaging member of the plurality of ground engaging members, the engine includes: an oil pan; and a lubrication system positioned within the oil pan, the lubrication system includes: an oil pump; a housing statically positioned in the oil pan; a shuttle valve having first and second movable shuttles positioned within the housing, wherein the first and second movable shuttles are configured to move interconnectedly relative to the housing according to vehicle tilting; and a conduit coupled between the oil pump and the housing.
2. The vehicle of claim 1, wherein the first movable shuttle is coupled with the second movable shuttle.
3. The vehicle of claim 2, wherein the housing comprises a first inlet and a second inlet.
4. The vehicle of claim 3, wherein when the engine is positioned in a first titled orientation, the first movable shuttle is configured to close the first inlet, and when the engine is positioned in a second titled orientation, the second movable shuttle is configured to close the second inlet.
5. The vehicle of claim 4, wherein the first movable shuttle is a first ball and the second movable shuttle is a second ball.

6. The vehicle of claim 5, wherein a spring is positioned between the first ball and the second ball.
7. An engine, comprising: a cylinder head; a crankcase coupled to the cylinder head; a crankshaft positioned within the crankcase; an oil pan coupled to the crankcase; and a lubrication system includes: an oil pump positioned within the oil pan, the oil pump operably coupled to the crankcase; a shuttle valve scavenge pump fluidly coupled with the oil pan, the shuttle valve scavenge pump including: a housing having a first inlet and a second inlet, a strainer coupled to the housing, a first movable shuttle positioned within the housing and a second movable shuttle positioned within the housing, each of the first and second movable shuttles are interconnected and interdependently movable relative to the housing; a conduit coupled between the oil pump and the housing; and wherein the oil pan includes a first tilted configuration and a second tilted configuration: in the first tilted configuration the second movable shuttle is moved within the housing to open the second inlet to the conduit and the first movable shuttle is moved within the housing to close the first inlet to the conduit according to tilting of the oil pan in a first direction; and in the second tilted configuration the first movable shuttle is moved within the housing to open the first inlet to the conduit and the second movable shuttle is moved within the housing to close the second inlet to the conduit according to tilting of the oil pan in a second direction.
8. The engine of claim 7, wherein the strainer includes a first strainer inlet fluidly coupled to the first inlet and a second strainer inlet fluidly coupled to the second inlet.
9. The engine of claim 8, wherein the strainer is positioned vertically lower than the housing.
10. The engine of claim 7, wherein when the engine is in a first orientation, the first movable shuttle is configured to close the first inlet, and when the engine is in a second orientation, the second movable shuttle is configured to close the second inlet.
11. The engine of claim 10, wherein the first orientation is angled relative to a ground level and the second orientation is angled relative to the second orientation.
12. The engine of claim 11, wherein in a third orientation, each of the first movable shuttle and second movable shuttle are separated from each other to allow access to each of the first inlet and the second inlet.
13. The engine of claim 12, wherein the third orientation is generally parallel to the ground level.
14. The engine of claim 7, wherein the housing includes: a first shoulder; a second shoulder, the first and second shoulders between the first and second movable shuttles; wherein in the first tilted configuration the second movable shuttle is spaced from the second shoulder and the first movable shuttle is seated against the first shoulder; and in the second tilted configuration the first movable shuttle is spaced from the first shoulder and the second movable shuttle is seated against the second shoulder.
15. The engine of claim 7, wherein the housing of the shuttle valve scavenge pump is static relative to the oil pan.