United States Patent	12383129
Kind Code	B2
Date of Patent	August 12, 2025
Inventor(s)	Clark; Adrienne et al.

Medical devices with battery removal

Abstract

A battery-powered medical device comprising: an outer housing having an opening formed therein; at least one power source housed within the outer housing, the outer housing being configured to at least partially enclose the at least one power source so as to prevent contamination of the at least one power source with biohazardous materials, and the at least one power source being removable from the outer housing via the opening; a cover configured to cover the opening in the outer housing and to retain the at least one power source within the outer housing, and an actuator provided within the outer housing that directly engages with a portion of the at least one power source when the cover covers the opening in the outer housing. The cover is configured to be operated to expose the opening in the outer housing, and when the cover is operated to expose the opening, the actuator is configured to pull the at least one power source from the outer housing and the outer housing is configured to release the at least one power source via the opening without requiring physical contact between the user and the at least one power source. The outer housing comprises a handle and an operative portion coupled to the handle.

Inventors: **Clark; Adrienne (Waltham, MA), Anaya; Demetrio Donald (Somerville, MA), Murphy; Shawn P. (Bolton, MA)**

Applicant: **COOPERSURGICAL, INC.** (Trumbull, CT)

Family ID: **66170317**

Assignee: **CooperSurgical, Inc. (Trumbull, CT)**

Appl. No.: **17/212506**

Filed: **March 25, 2021**

Prior Publication Data

Document Identifier	Publication Date
US 20210204805 A1	Jul. 08, 2021

Related U.S. Application Data

continuation parent-doc US 16402580 20190503 US 11253145 child-doc US 17212506
continuation parent-doc US 16105153 20180820 US 10278572 20190507 child-doc US 16402580
us-provisional-application US 62649190 20180328
us-provisional-application US 62574969 20171020
us-provisional-application US 62574412 20171019

Publication Classification

Int. Cl.: **A61B1/32** (20060101); **A61B1/00** (20060101); **A61B1/06** (20060101); **A61B1/267** (20060101); **A61B1/303** (20060101); **A61B1/31** (20060101); **A61B17/02** (20060101); A61B17/00 (20060101)

U.S. Cl.:

CPC **A61B1/32** (20130101); **A61B1/00032** (20130101); **A61B1/00066** (20130101); **A61B1/00108** (20130101); **A61B1/0684** (20130101); **A61B1/267** (20130101); **A61B1/303** (20130101); **A61B1/31** (20130101); **A61B17/02** (20130101); A61B2017/00734 (20130101)

Field of Classification Search

CPC: A61B (1/32); A61B (1/00032); A61B (1/00066); A61B (1/00108); A61B (1/0684); A61B (1/267); A61B (1/303); A61B (1/31)

References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
559122	12/1895	Daily	N/A	N/A
659182	12/1899	Pilling	N/A	N/A
2235979	12/1940	Brown	N/A	N/A
2247458	12/1940	Wintemberg	N/A	N/A
2482971	12/1948	Golson	N/A	N/A
2592190	12/1951	Rubens et al.	N/A	N/A
3023306	12/1961	Kester	N/A	N/A
3324850	12/1966	Gunning et al.	N/A	N/A
3332414	12/1966	Gasper	N/A	N/A
3426749	12/1968	Jephcott	N/A	N/A
3532088	12/1969	Fiore	600/222	A61B 1/32
3592199	12/1970	Ostensen	N/A	N/A
3595222	12/1970	Vellacott	N/A	N/A
3598113	12/1970	Moore et al.	N/A	N/A
3638644	12/1971	Reick	N/A	N/A
3650266	12/1971	Pestka et al.	N/A	N/A
3675641	12/1971	Fiore	N/A	N/A
3716047	12/1972	Moore et al.	N/A	N/A

3729006	12/1972	Wilder et al.	N/A	N/A
3762400	12/1972	McDonald	N/A	N/A
3769968	12/1972	Blount et al.	N/A	N/A
3789835	12/1973	Whitman	N/A	N/A
3815585	12/1973	Fiore	N/A	N/A
3826248	12/1973	Gobels	600/199	A61B 1/267
3851642	12/1973	McDonald	600/223	A61M 29/02
3919541	12/1974	Chao	N/A	N/A
3934578	12/1975	Heine	N/A	N/A
3945371	12/1975	Adelman	N/A	N/A
3978850	12/1975	Moore	600/249	A61B 1/227
4067323	12/1977	Troutner	N/A	N/A
4156424	12/1978	Burgin	N/A	N/A
4210133	12/1979	Castaneda	N/A	N/A
4226228	12/1979	Shin et al.	N/A	N/A
4263899	12/1980	Burgin	N/A	N/A
4300541	12/1980	Burgin	N/A	N/A
4337763	12/1981	Petrassevich	600/245	A61B 1/0676
4432351	12/1983	Hoary	N/A	N/A
4492220	12/1984	Hayes	N/A	N/A
4502468	12/1984	Burgin	N/A	N/A
4527553	12/1984	Upsher	N/A	N/A
4546761	12/1984	McCullough	N/A	N/A
4551129	12/1984	Coleman et al.	N/A	N/A
4562832	12/1985	Wilder	N/A	N/A
4566439	12/1985	Burgin	N/A	N/A
4574784	12/1985	Soloway	600/199	A61B 1/267
4596239	12/1985	Bauman	N/A	N/A
4597383	12/1985	Van Der Bel	N/A	N/A
4607623	12/1985	Bauman	N/A	N/A
4619248	12/1985	Walsh	N/A	N/A
4638792	12/1986	Burgin	N/A	N/A
4759349	12/1987	Betz et al.	N/A	N/A
4766887	12/1987	Cecil, Jr. et al.	N/A	N/A
4807600	12/1988	Hayes	N/A	N/A
4884559	12/1988	Collins	N/A	N/A
4901708	12/1989	Lee	N/A	N/A
4905670	12/1989	Adair	N/A	N/A
4934352	12/1989	Sullivan, Jr.	N/A	N/A
4971036	12/1989	Collins	600/220	A61B 1/32
5018507	12/1990	Montaldi	N/A	N/A
5026368	12/1990	Adair	N/A	N/A
5054906	12/1990	Lyons, Jr.	N/A	N/A
5063908	12/1990	Collins	N/A	N/A
5143054	12/1991	Adair	N/A	N/A
5165387	12/1991	Woodson	N/A	N/A
5174278	12/1991	Babkow	N/A	N/A
5179937	12/1992	Lee	N/A	N/A
5179938	12/1992	Lonky	N/A	N/A
5211468	12/1992	Jeng	N/A	N/A

5222271	12/1992	Eganhouse	N/A	N/A
D337384	12/1992	Schucman	N/A	N/A
5231973	12/1992	Dickie	N/A	N/A
5318009	12/1993	Robinson	N/A	N/A
5329938	12/1993	Lonky	N/A	N/A
5427152	12/1994	Weber	N/A	N/A
5438976	12/1994	Nash	N/A	N/A
5465709	12/1994	Dickie et al.	N/A	N/A
5499964	12/1995	Beck et al.	N/A	N/A
5512038	12/1995	O'Neal et al.	N/A	N/A
5553627	12/1995	Newkirk	N/A	N/A
5695492	12/1996	Brown	N/A	N/A
5716329	12/1997	Dieter	N/A	N/A
5785408	12/1997	Tseng	N/A	N/A
5785648	12/1997	Min	N/A	N/A
5840013	12/1997	Lee et al.	N/A	N/A
5846249	12/1997	Thompson	N/A	N/A
5865729	12/1998	Meehan	N/A	N/A
5873820	12/1998	Norell	N/A	N/A
5879304	12/1998	Schuchman et al.	N/A	N/A
5888195	12/1998	Schneider	N/A	N/A
5899854	12/1998	Slishman	N/A	N/A
5902315	12/1998	Dubois	N/A	N/A
5916150	12/1998	Sillman	N/A	N/A
5951142	12/1998	Wang et al.	N/A	N/A
5967971	12/1998	Bolser	N/A	N/A
6001077	12/1998	Ellman et al.	N/A	N/A
6004265	12/1998	Hsu et al.	N/A	N/A
6036638	12/1999	Nwawka	N/A	N/A
6036713	12/1999	Kieturakis	N/A	N/A
6048308	12/1999	Strong	N/A	N/A
6080105	12/1999	Spears	N/A	N/A
6116747	12/1999	Grawemeyer et al.	N/A	N/A
6130520	12/1999	Wawro et al.	N/A	N/A
6176824	12/2000	Davis	N/A	N/A
6186638	12/2000	Chang	N/A	N/A
6186944	12/2000	Tsai	N/A	N/A
6193653	12/2000	Evans et al.	N/A	N/A
6217512	12/2000	Salo et al.	N/A	N/A
6231505	12/2000	Martin	N/A	N/A
6231506	12/2000	Hu et al.	N/A	N/A
6254247	12/2000	Carson	N/A	N/A
6277067	12/2000	Blair	N/A	N/A
6319199	12/2000	Sheehan et al.	N/A	N/A
6346085	12/2001	Schiffman	N/A	N/A
6359644	12/2001	Salvati	N/A	N/A
6361489	12/2001	Tsai	N/A	N/A
6363763	12/2001	Geringer et al.	N/A	N/A
6379296	12/2001	Baggett	N/A	N/A
6379299	12/2001	Borodulin et al.	N/A	N/A

6394111	12/2001	Jacobs et al.	N/A	N/A
6394950	12/2001	Weiss	N/A	N/A
6413208	12/2001	Schöllhorn et al.	N/A	N/A
6416465	12/2001	Brau	N/A	N/A
6428180	12/2001	Karram et al.	N/A	N/A
6432045	12/2001	Lemperle et al.	N/A	N/A
6432049	12/2001	Banta	N/A	N/A
6436033	12/2001	Tan	N/A	N/A
6450952	12/2001	Rioux	N/A	N/A
6468206	12/2001	Hipps et al.	N/A	N/A
6468232	12/2001	Ashton-Miller et al.	N/A	N/A
6487440	12/2001	Deckert et al.	N/A	N/A
6504985	12/2002	Parker et al.	N/A	N/A
6523973	12/2002	Galli	N/A	N/A
6524259	12/2002	Baxter-Jones et al.	N/A	N/A
6569089	12/2002	Covington et al.	N/A	N/A
6569091	12/2002	Diokno et al.	N/A	N/A
6589168	12/2002	Thompson	N/A	N/A
6595917	12/2002	Nieto	N/A	N/A
6616603	12/2002	Fontana	N/A	N/A
6626825	12/2002	Tsai	N/A	N/A
6663576	12/2002	Gombrich et al.	N/A	N/A
6676598	12/2003	Rudischhauser et al.	N/A	N/A
6719688	12/2003	Pecherer et al.	N/A	N/A
6761687	12/2003	Doshi	N/A	N/A
6830547	12/2003	Weiss	N/A	N/A
6896653	12/2004	Vail, III et al.	N/A	N/A
7014340	12/2005	Betis	N/A	N/A
7029439	12/2005	Roberts et al.	N/A	N/A
D520464	12/2005	Strong	N/A	N/A
7066615	12/2005	Diggle, III et al.	N/A	N/A
7223223	12/2006	Lindsay	N/A	N/A
7276025	12/2006	Roberts et al.	N/A	N/A
7306559	12/2006	Williams	N/A	N/A
7474820	12/2008	Vayser et al.	N/A	N/A
7492116	12/2008	Oleynikov et al.	N/A	N/A
7510524	12/2008	Vayser et al.	N/A	N/A
7631981	12/2008	Miller et al.	N/A	N/A
7736304	12/2009	Pecherer	N/A	N/A
7758203	12/2009	McMahon et al.	N/A	N/A
7845824	12/2009	Robotham	N/A	N/A
7878973	12/2010	Yee et al.	N/A	N/A
7901353	12/2010	Vayser et al.	N/A	N/A
7909759	12/2010	Pecherer	N/A	N/A
7967809	12/2010	Jay-Robinson	N/A	N/A
8012089	12/2010	Bayat	N/A	N/A
8047987	12/2010	Grey et al.	N/A	N/A
8052702	12/2010	Hess et al.	N/A	N/A
8088066	12/2011	Grey et al.	N/A	N/A
8096945	12/2011	Buchok et al.	N/A	N/A

8142352	12/2011	Vivenzio et al.	N/A	N/A
8142353	12/2011	Pecherer et al.	N/A	N/A
8157728	12/2011	Danna et al.	N/A	N/A
8162824	12/2011	Vayser et al.	N/A	N/A
8162826	12/2011	Pecherer et al.	N/A	N/A
8251898	12/2011	Pecherer	N/A	N/A
8285093	12/2011	Vayser et al.	N/A	N/A
8292805	12/2011	Vayser et al.	N/A	N/A
8317693	12/2011	Grey et al.	N/A	N/A
8376942	12/2012	Krauter et al.	N/A	N/A
8388523	12/2012	Vivenzio et al.	N/A	N/A
8394016	12/2012	Arne	N/A	N/A
8394017	12/2012	Kieffer	N/A	N/A
8435175	12/2012	McMahon et al.	N/A	N/A
8459844	12/2012	Lia et al.	N/A	N/A
8512234	12/2012	Grey et al.	N/A	N/A
8512237	12/2012	Bastia	N/A	N/A
8555892	12/2012	Traub	N/A	N/A
8594472	12/2012	Vayser et al.	N/A	N/A
8596847	12/2012	Vayser et al.	N/A	N/A
8628879	12/2013	Pecherer et al.	N/A	N/A
8651704	12/2013	Gordin et al.	N/A	N/A
8708896	12/2013	Vayser et al.	N/A	N/A
8758342	12/2013	Bales	606/51	A61B 18/1445
8786210	12/2013	Delucia	N/A	N/A
8795162	12/2013	Vayser et al.	N/A	N/A
8821385	12/2013	Naito	N/A	N/A
8870761	12/2013	Vayser et al.	N/A	N/A
8890489	12/2013	Wood	N/A	N/A
D719652	12/2013	Swift	N/A	N/A
8899809	12/2013	Vayser et al.	N/A	N/A
8979745	12/2014	Swift	N/A	N/A
9002159	12/2014	Sutherland et al.	N/A	N/A
9005115	12/2014	Vayser	N/A	N/A
9044161	12/2014	Vayser et al.	N/A	N/A
9050048	12/2014	Nadershahi	N/A	N/A
9072452	12/2014	Vayser et al.	N/A	N/A
9072455	12/2014	Vayser et al.	N/A	N/A
D745669	12/2014	Swift	N/A	N/A
9198566	12/2014	Lia et al.	N/A	N/A
9229165	12/2015	Vayser et al.	N/A	N/A
9241617	12/2015	Grey et al.	N/A	N/A
D752217	12/2015	Swift	N/A	N/A
9271709	12/2015	Grey et al.	N/A	N/A
9271710	12/2015	Grey et al.	N/A	N/A
9282878	12/2015	Grey et al.	N/A	N/A
D753295	12/2015	Vivenzio et al.	N/A	N/A
9307897	12/2015	Swift	N/A	A61B 1/32
9308054	12/2015	Vayser et al.	N/A	N/A

9326812	12/2015	Waaler	N/A	A61B 18/1442
9332898	12/2015	McMahon et al.	N/A	N/A
9386913	12/2015	Holland	N/A	A61B 1/32
9429746	12/2015	Vayser et al.	N/A	N/A
9468366	12/2015	Grey et al.	N/A	N/A
9504373	12/2015	Vayser et al.	N/A	N/A
9510737	12/2015	Vayser et al.	N/A	N/A
9532706	12/2016	McMahon et al.	N/A	N/A
9574742	12/2016	Vayser et al.	N/A	N/A
9629529	12/2016	Indovina et al.	N/A	N/A
9636004	12/2016	Lia et al.	N/A	N/A
9636182	12/2016	Vayser et al.	N/A	N/A
9718130	12/2016	Vayser et al.	N/A	N/A
9763743	12/2016	Lin et al.	N/A	N/A
9808231	12/2016	Miraki et al.	N/A	N/A
9814377	12/2016	Lia et al.	N/A	N/A
9820638	12/2016	Cheng	N/A	N/A
9820729	12/2016	Miles et al.	N/A	N/A
9826892	12/2016	Dresher et al.	N/A	N/A
9833295	12/2016	Vayser et al.	N/A	N/A
9833308	12/2016	Dye	N/A	N/A
9844364	12/2016	Grey et al.	N/A	N/A
9861349	12/2017	Nadershahi et al.	N/A	N/A
9867531	12/2017	Pacey et al.	N/A	N/A
9867602	12/2017	Swift	N/A	N/A
9877639	12/2017	Grey et al.	N/A	N/A
9877644	12/2017	Greenstein et al.	N/A	N/A
D809660	12/2017	Nguyen et al.	N/A	N/A
9883792	12/2017	McMahon et al.	N/A	N/A
9888957	12/2017	Wolf et al.	N/A	N/A
9907544	12/2017	Nadershahi et al.	N/A	N/A
9913682	12/2017	Wolf et al.	N/A	N/A
9914202	12/2017	Portaro	N/A	N/A
9918618	12/2017	Molnar	N/A	N/A
9918802	12/2017	Coppersmith et al.	N/A	N/A
9931028	12/2017	Lia et al.	N/A	N/A
9943295	12/2017	King	N/A	N/A
9949814	12/2017	Alexander et al.	N/A	N/A
9955858	12/2017	Pamnani et al.	N/A	N/A
9968262	12/2017	Greenstein et al.	N/A	N/A
9968346	12/2017	Alexander et al.	N/A	N/A
9980710	12/2017	Seifert et al.	N/A	N/A
9986901	12/2017	Grey et al.	N/A	N/A
9986903	12/2017	Nadershahi et al.	N/A	N/A
9986988	12/2017	Ferro et al.	N/A	N/A
9999345	12/2017	Vayser et al.	N/A	N/A
10004392	12/2017	Millard et al.	N/A	N/A
10004393	12/2017	Kucklick	N/A	N/A
10028648	12/2017	Goldfain et al.	N/A	N/A

10028649	12/2017	Salvati et al.	N/A	N/A
10028780	12/2017	Wolf et al.	N/A	N/A
10045686	12/2017	Yang et al.	N/A	N/A
10045731	12/2017	Prasad et al.	N/A	N/A
10052432	12/2017	Dexter et al.	N/A	N/A
10064611	12/2017	Ross et al.	N/A	N/A
10064613	12/2017	Davis et al.	N/A	N/A
10068173	12/2017	Vayser et al.	N/A	N/A
10092176	12/2017	Kienzle et al.	N/A	N/A
10092281	12/2017	Perler et al.	N/A	N/A
10098530	12/2017	McMahon et al.	N/A	N/A
10105043	12/2017	George	N/A	N/A
10117646	12/2017	Friedrich et al.	N/A	N/A
10130441	12/2017	Martinez	N/A	N/A
10166016	12/2018	Shimizu et al.	N/A	N/A
10172601	12/2018	Ahn	N/A	N/A
10174933	12/2018	Phillips, Jr. et al.	N/A	N/A
10188298	12/2018	Greenstein et al.	N/A	N/A
10213271	12/2018	Duggal et al.	N/A	N/A
10219800	12/2018	Tsubouchi	N/A	N/A
10220445	12/2018	Vayser et al.	N/A	N/A
10226555	12/2018	Vayser et al.	N/A	N/A
10238462	12/2018	Wood et al.	N/A	N/A
D846119	12/2018	Greeley et al.	N/A	N/A
10278571	12/2018	Poormand	N/A	N/A
10292782	12/2018	Haverich et al.	N/A	N/A
10292784	12/2018	Duggal et al.	N/A	N/A
10321969	12/2018	Wayne et al.	N/A	N/A
10342525	12/2018	Wilson	N/A	N/A
10456190	12/2018	Vayser et al.	N/A	N/A
10499974	12/2018	Heim et al.	N/A	N/A
10500010	12/2018	Vayser et al.	N/A	N/A
10512518	12/2018	Vayser et al.	N/A	N/A
10512520	12/2018	Wayne et al.	N/A	N/A
10531933	12/2019	Vayser et al.	N/A	N/A
10548682	12/2019	Vayser et al.	N/A	N/A
10568712	12/2019	Vayser et al.	N/A	N/A
10601004	12/2019	Lindemann	N/A	H01M 50/247
10675115	12/2019	Vayser et al.	N/A	N/A
10729511	12/2019	Vayser et al.	N/A	N/A
10729512	12/2019	Wayne et al.	N/A	N/A
2001/0029044	12/2000	Gombrich et al.	N/A	N/A
2002/0009275	12/2001	Williams et al.	N/A	N/A
2002/0016528	12/2001	Tan	N/A	N/A
2002/0022769	12/2001	Smith et al.	N/A	N/A
2002/0038075	12/2001	Tsai	N/A	N/A
2002/0038076	12/2001	Sheehan et al.	N/A	N/A
2002/0055670	12/2001	Weiss	N/A	N/A
2002/0076607	12/2001	Chang	429/97	H01M 50/00

2002/0115909	12/2001	Bolser	N/A	N/A
2002/0156350	12/2001	Nieto	N/A	N/A
2002/0165435	12/2001	Weiss	N/A	N/A
2002/0198471	12/2001	Baxter-Jones et al.	N/A	N/A
2003/0095781	12/2002	Willaims	N/A	N/A
2003/0105387	12/2002	Frumovitz et al.	N/A	N/A
2003/0139673	12/2002	Vivenzio et al.	N/A	N/A
2003/0158502	12/2002	Baxter-Jones et al.	N/A	N/A
2003/0176772	12/2002	Yang	600/220	A61B 1/32
2003/0187331	12/2002	Faludi et al.	N/A	N/A
2004/0026829	12/2003	Van Der Weegen	N/A	N/A
2004/0054260	12/2003	Klaassen et al.	N/A	N/A
2004/0141175	12/2003	Baldwin et al.	N/A	N/A
2004/0183482	12/2003	Roberts et al.	N/A	N/A
2004/0184288	12/2003	Bettis	N/A	N/A
2004/0186355	12/2003	Strong	N/A	N/A
2004/0254428	12/2003	Ritland	N/A	N/A
2005/0065496	12/2004	Simon et al.	N/A	N/A
2005/0085699	12/2004	Weiss	N/A	N/A
2005/0085723	12/2004	Huebner	N/A	N/A
2005/0093718	12/2004	Martin	N/A	N/A
2005/0125015	12/2004	McNally-Heintzelman et al.	N/A	N/A
2005/0159649	12/2004	Patel	N/A	N/A
2005/0182301	12/2004	Acker et al.	N/A	N/A
2005/0192482	12/2004	Carpenter	N/A	N/A
2005/0215858	12/2004	Vail, III	N/A	N/A
2005/0240081	12/2004	Eliachar	N/A	N/A
2005/0277811	12/2004	Richards et al.	N/A	N/A
2006/0084843	12/2005	Sommerich et al.	N/A	N/A
2006/0122463	12/2005	Klassen et al.	N/A	N/A
2006/0155276	12/2005	Walulik et al.	N/A	N/A
2006/0189847	12/2005	Yee et al.	N/A	N/A
2006/0200186	12/2005	Marchek et al.	N/A	N/A
2006/0291195	12/2005	Horrell et al.	N/A	N/A
2007/0043264	12/2006	Gillis et al.	N/A	N/A
2007/0060795	12/2006	Vayser et al.	N/A	N/A
2007/0060938	12/2006	Dziadik et al.	N/A	N/A
2007/0066872	12/2006	Morrison et al.	N/A	N/A
2007/0093693	12/2006	Geist et al.	N/A	N/A
2007/0100212	12/2006	Pimenta et al.	N/A	N/A
2007/0179342	12/2006	Miller et al.	N/A	N/A
2007/0208226	12/2006	Grey et al.	N/A	N/A
2007/0230164	12/2006	Vivenzio et al.	N/A	N/A
2007/0230167	12/2006	McMahon et al.	N/A	N/A
2007/0255110	12/2006	Wax et al.	N/A	N/A
2007/0270866	12/2006	Von Jako	N/A	N/A
2007/0287888	12/2006	Lovell et al.	N/A	N/A
2008/0002426	12/2007	Vayser et al.	N/A	N/A
2008/0027461	12/2007	Vaquero et al.	N/A	N/A

2008/0108877	12/2007	Bayat	N/A	N/A
2008/0113312	12/2007	Ortega	N/A	N/A
2008/0221569	12/2007	Moore et al.	N/A	N/A
2008/0228038	12/2007	McMahon et al.	N/A	N/A
2008/0269564	12/2007	Gelnett	N/A	N/A
2008/0269565	12/2007	McMahon et al.	N/A	N/A
2008/0278936	12/2007	Kurth et al.	N/A	N/A
2009/0018400	12/2008	Raymond et al.	N/A	N/A
2009/0069634	12/2008	Larkin	N/A	N/A
2009/0097236	12/2008	Miller et al.	N/A	N/A
2009/0112068	12/2008	Grey et al.	N/A	N/A
2009/0209816	12/2008	Gunther et al.	N/A	N/A
2009/0240245	12/2008	Deville	606/33	A61B 18/1445
2009/0275803	12/2008	Krauter et al.	N/A	N/A
2009/0287192	12/2008	Vivenzio et al.	N/A	N/A
2009/0312610	12/2008	Buchok et al.	N/A	N/A
2010/0036382	12/2009	Bonnadier	N/A	N/A
2010/0041955	12/2009	Grey et al.	N/A	N/A
2010/0097794	12/2009	Teng et al.	N/A	N/A
2010/0190129	12/2009	Paz	N/A	N/A
2010/0191062	12/2009	Kieffer	N/A	N/A
2010/0249513	12/2009	Tydlaska	N/A	N/A
2010/0261967	12/2009	Pacey et al.	N/A	N/A
2010/0292533	12/2009	Kasahara et al.	N/A	N/A
2011/0022032	12/2010	Zemlok et al.	N/A	N/A
2011/0130632	12/2010	McGrail et al.	N/A	N/A
2011/0257650	12/2010	Deville et al.	N/A	N/A
2011/0275894	12/2010	Mackin	N/A	N/A
2012/0055470	12/2011	Pecherer et al.	N/A	N/A
2012/0059226	12/2011	Funt	N/A	N/A
2012/0078060	12/2011	Swift	N/A	N/A
2012/0116170	12/2011	Vayser et al.	N/A	N/A
2012/0232352	12/2011	Lin et al.	N/A	N/A
2012/0243212	12/2011	Smith et al.	N/A	N/A
2012/0277780	12/2011	Smith et al.	N/A	N/A
2012/0330103	12/2011	Tenger et al.	N/A	N/A
2013/0018230	12/2012	Su et al.	N/A	N/A
2013/0021798	12/2012	Chen et al.	N/A	N/A
2013/0041229	12/2012	Hahn et al.	N/A	N/A
2013/0046290	12/2012	Palmer et al.	N/A	N/A
2013/0092421	12/2012	Kajiya	N/A	N/A
2013/0102850	12/2012	Fiorella	N/A	N/A
2013/0102887	12/2012	Thompson et al.	N/A	N/A
2013/0109910	12/2012	Alexander et al.	N/A	N/A
2013/0158345	12/2012	Majlessi	N/A	N/A
2013/0197313	12/2012	Wan	600/245	A61B 90/36
2013/0226198	12/2012	Kamler	N/A	N/A
2013/0245381	12/2012	Dang et al.	N/A	N/A
2013/0245657	12/2012	Deville et al.	N/A	N/A

2013/0267786	12/2012	Vayser et al.	N/A	N/A
2013/0281784	12/2012	Ray	N/A	N/A
2013/0324801	12/2012	Grey et al.	N/A	N/A
2014/0088371	12/2013	Vayser et al.	N/A	N/A
2014/0179998	12/2013	Pacey	N/A	N/A
2014/0202459	12/2013	Iqbal	N/A	N/A
2014/0228875	12/2013	Saadat	N/A	N/A
2014/0257039	12/2013	Feldman	N/A	N/A
2014/0275790	12/2013	Vivenzio et al.	N/A	N/A
2014/0309499	12/2013	Swift	N/A	N/A
2014/0316211	12/2013	Hermle	N/A	N/A
2014/0323800	12/2013	Dye	N/A	N/A
2014/0323811	12/2013	DeSantis et al.	N/A	N/A
2014/0364695	12/2013	Nadershahi et al.	N/A	N/A
2014/0371536	12/2013	Miller et al.	N/A	N/A
2015/0018625	12/2014	Miraki et al.	N/A	N/A
2015/0141866	12/2014	Mayse et al.	N/A	N/A
2015/0157387	12/2014	Ouyang et al.	N/A	N/A
2015/0157469	12/2014	Prado et al.	N/A	N/A
2015/0238070	12/2014	Lia et al.	N/A	N/A
2015/0285382	12/2014	Kienreich et al.	N/A	N/A
2015/0289757	12/2014	Swift	N/A	N/A
2015/0297217	12/2014	Huitema et al.	N/A	N/A
2016/0000305	12/2015	Elbaz et al.	N/A	N/A
2016/0030128	12/2015	Duggal et al.	N/A	N/A
2016/0038032	12/2015	Dan	N/A	N/A
2016/0066915	12/2015	Baber et al.	N/A	N/A
2016/0081833	12/2015	Leblanc et al.	N/A	N/A
2016/0095506	12/2015	Dan et al.	N/A	N/A
2016/0100751	12/2015	Davis et al.	N/A	N/A
2016/0151058	12/2015	Ferro et al.	N/A	N/A
2016/0242637	12/2015	Tydlaska et al.	N/A	N/A
2016/0302657	12/2015	Hussey et al.	N/A	N/A
2016/0310121	12/2015	Swift	N/A	N/A
2017/0007228	12/2016	Costabile	N/A	N/A
2017/0020621	12/2016	Huldin et al.	N/A	N/A
2017/0059400	12/2016	Murphy et al.	N/A	N/A
2017/0065282	12/2016	Mathis et al.	N/A	N/A
2017/0079518	12/2016	Elbaz et al.	N/A	N/A
2017/0172404	12/2016	McMahon et al.	N/A	N/A
2017/0172555	12/2016	Shimizu et al.	N/A	N/A
2017/0181605	12/2016	Lalli et al.	N/A	N/A
2017/0181607	12/2016	Lalli et al.	N/A	N/A
2017/0181615	12/2016	Vella et al.	N/A	N/A
2017/0181616	12/2016	Vella et al.	N/A	N/A
2017/0224206	12/2016	Vayser	N/A	N/A
2017/0231712	12/2016	Vayser	N/A	N/A
2017/0296162	12/2016	Wan	N/A	N/A
2017/0300623	12/2016	Rosenblatt et al.	N/A	N/A
2017/0303903	12/2016	De Koning et al.	N/A	N/A

2017/0347871	12/2016	Wallace et al.	N/A	N/A
2017/0360423	12/2016	Stevenson et al.	N/A	N/A
2018/0000469	12/2017	Wood et al.	N/A	N/A
2018/0008137	12/2017	Poormand	N/A	N/A
2018/0008138	12/2017	Thommen et al.	N/A	N/A
2018/0008368	12/2017	Duggal et al.	N/A	N/A
2018/0014721	12/2017	Rullo et al.	N/A	N/A
2018/0014842	12/2017	Shener-Irmakoglu	N/A	N/A
2018/0014900	12/2017	Vayser et al.	N/A	N/A
2018/0021100	12/2017	Swift	N/A	N/A
2018/0036031	12/2017	Smith et al.	N/A	N/A
2018/0036095	12/2017	Vayser et al.	N/A	N/A
2018/0042596	12/2017	Tsubouchi	N/A	N/A
2018/0064316	12/2017	Charles et al.	N/A	N/A
2018/0064317	12/2017	Tesar	N/A	N/A
2018/0078301	12/2017	Vayser	N/A	N/A
2018/0116581	12/2017	Prasad et al.	N/A	N/A
2018/0125336	12/2017	Goldfarb et al.	N/A	N/A
2018/0125347	12/2017	Czyzewski et al.	N/A	N/A
2018/0132710	12/2017	Pacey et al.	N/A	N/A
2018/0132970	12/2017	Ritter	N/A	N/A
2018/0153391	12/2017	McMahon et al.	N/A	N/A
2018/0156448	12/2017	Phillips, Jr. et al.	N/A	N/A
2018/0206832	12/2017	Greeley et al.	N/A	N/A
2018/0228376	12/2017	Greenstein et al.	N/A	N/A
2018/0228483	12/2017	Duggal et al.	N/A	N/A
2018/0235444	12/2017	Tsai	N/A	N/A
2018/0235592	12/2017	Kass et al.	N/A	N/A
2018/0249902	12/2017	Grey et al.	N/A	N/A
2018/0263480	12/2017	Lalli et al.	N/A	N/A
2018/0263481	12/2017	Muratori et al.	N/A	N/A
2018/0271581	12/2017	Yang et al.	N/A	N/A
2018/0280011	12/2017	Ferro et al.	N/A	N/A
2018/0296082	12/2017	Salvati et al.	N/A	N/A
2018/0296204	12/2017	Davis	N/A	N/A
2018/0317746	12/2017	Lalli et al.	N/A	N/A
2018/0317752	12/2017	Cybulski et al.	N/A	N/A
2018/0317902	12/2017	Green et al.	N/A	N/A
2018/0328572	12/2017	Kennedy et al.	N/A	N/A
2019/0038273	12/2018	Perler et al.	N/A	N/A
2019/0049655	12/2018	Zagatsky et al.	N/A	N/A
2019/0076138	12/2018	Opperman	N/A	N/A
2019/0083079	12/2018	Shimizu et al.	N/A	N/A
2019/0133432	12/2018	Tsai	N/A	N/A
2019/0143006	12/2018	Vayser et al.	N/A	N/A
2019/0143414	12/2018	Vayser et al.	N/A	N/A
2019/0150422	12/2018	Welch	N/A	N/A
2019/0150725	12/2018	Ramanujam et al.	N/A	N/A
2019/0150739	12/2018	Wawro et al.	N/A	N/A
2019/0150786	12/2018	Vassallo et al.	N/A	N/A

2019/0167111	12/2018	Greenstein et al.	N/A	N/A
2019/0167378	12/2018	Wood et al.	N/A	N/A
2019/0190293	12/2018	Wawro et al.	N/A	N/A
2019/0223708	12/2018	Recanati et al.	N/A	N/A
2019/0254512	12/2018	Spiertz	N/A	N/A
2019/0254771	12/2018	Swift et al.	N/A	N/A
2019/0335988	12/2018	Lia et al.	N/A	N/A
2019/0343379	12/2018	Altamura	N/A	N/A
2019/0365217	12/2018	Hegenberger	N/A	N/A
2020/0008694	12/2019	Karla et al.	N/A	N/A
2020/0046216	12/2019	Moein	N/A	N/A
2020/0069171	12/2019	Miller et al.	N/A	N/A
2020/0107714	12/2019	Bar-Or et al.	N/A	N/A
2020/0253467	12/2019	Lees, Jr. et al.	N/A	N/A
2020/0337541	12/2019	Vivenzio et al.	N/A	N/A
2021/0145270	12/2020	Altamura	N/A	N/A

FOREIGN PATENT DOCUMENTS

Patent No.	Application Date	Country	CPC
2239235	12/1995	CN	N/A
2265156	12/1996	CN	N/A
2516109	12/2001	CN	N/A
2629738	12/2003	CN	N/A
1565664	12/2004	CN	N/A
2668152	12/2004	CN	N/A
2668152	12/2004	CN	N/A
1717195	12/2005	CN	N/A
101179982	12/2007	CN	N/A
201055387	12/2007	CN	N/A
203591245	12/2007	CN	N/A
201139589	12/2007	CN	N/A
102415869	12/2011	CN	N/A
103154793	12/2012	CN	N/A
302536685	12/2012	CN	N/A
103925266	12/2013	CN	N/A
203898367	12/2013	CN	N/A
102573700	12/2013	CN	N/A
2128855	12/1971	DE	N/A
10216618	12/2002	DE	N/A
202004002963	12/2003	DE	N/A
102005002220	12/2004	DE	N/A
202005019780	12/2005	DE	N/A
600 33 612	12/2006	DE	N/A
202010017638	12/2011	DE	N/A
0190014	12/1985	EP	N/A
1074224	12/2000	EP	N/A
2490478	12/1981	FR	N/A
2505463	12/2013	GB	N/A
2187972	12/2001	RU	N/A

2308873	12/2006	RU	N/A
9825512	12/1997	WO	N/A
0137739	12/2000	WO	N/A
01/62137	12/2000	WO	N/A
03082123	12/2002	WO	N/A
2004064624	12/2003	WO	N/A
2006107877	12/2005	WO	N/A
2006107878	12/2005	WO	N/A
2007/084641	12/2006	WO	N/A
2009/090383	12/2008	WO	N/A
2009137017	12/2008	WO	N/A
2013-044151	12/2012	WO	N/A
2014-041172	12/2013	WO	N/A
2015/164881	12/2014	WO	N/A
2006121530	12/2015	WO	N/A
2016196788	12/2015	WO	N/A

OTHER PUBLICATIONS

International Search Report for International application No. PCT/US2021/017768 issued May 27, 2021, a copy of which is enclosed. cited by applicant

International Search Report for International application No. PCT/US2021/014076 issued Apr. 15, 2021, a copy of which is enclosed. cited by applicant

International Search Report for International application No. PCT/US2016/016154 issued May 19, 2016 for corresponding U.S. application, U.S. Appl. No. 14/614,413, a copy of which is enclosed. cited by applicant

International Search Report, for International application No. PCT/US2016/035508 issued Sep. 15, 2016 for corresponding U.S. application, U.S. Appl. No. 15/171,581, a copy of which is enclosed. cited by applicant

International Search Report for International application No. PCT/US2016/036833 issued Jan. 19, 2017. cited by applicant

U.S. Patent references 121-125 and U.S. Published Patent Application references 48 and 50 were cited in an Office Action issued in U.S. Appl. No. 15/171,581, a copy of which is enclosed. cited by applicant

U.S. Published Patent Application references 47, 49 and 51 were cited in a PCT Search Report issued in PCT Application No. PCT/US2017/042617, a copy of which is enclosed. cited by applicant

The above foreign patent documents 18, 21, 22, 23 and 24 were cited in a Nov. 1, 2017 Chinese Office Action, a copy of which is enclosed without an English Translation, that issued in Chinese Patent Application No. 201510543086.7. cited by applicant

The above foreign patent documents 21, 22 and 26 was cited in the Jul. 16, 2018 Chinese Office Action, a copy of which is enclosed without an English Translation, that issued in Chinese Patent Application No. 201510543086.7. cited by applicant

Solvey, Techinical Data Sheet, Ixef 1022 polyarylamide, Feb. 13, 2015, pp. 1-5. cited by applicant

http://www.makeitfrom.com/material-properties/Polyetheretheketone-PEEK, printed on Oct. 9, 2016, pp. 1-9. cited by applicant

https://web.archive.org/web/20160618175418/http://bihlermed.com:80/scintillant/; Home—Scintillant® Surgical Light : Scintillant® Surgical Light; printed Oct. 19, 2022 (One Page). cited by applicant

European Search Report issued on Nov. 23, 2018, a copy of which is enclosed, that issued in the corresponding European Patent Application No. 16747107.7. cited by applicant

Oct. 29, 2018 Chinese Office Action, a copy of which is enclosed without an English Translation, that issued in Chinese Patent Application No. 201711159829.6. cited by applicant
International Search Report of PCT/US2018/054925, Oct. 9, 2018, a copy of which is enclosed. cited by applicant
Pankaj Saxena, et al., Hydrodissection Technique of Harvesting Left Internal Thoracic Artery, Department of Cardiac Surgery, The Prince Charles Hospital, Chermside, Brisbane, Queensland, Australia, Thoracic Artery, Ann Thorac Surg., 2005; 80:335-6. cited by applicant
The above U.S. Publications documents #1 and #2 were cited in a Supplementary European Search Report issued on Apr. 24, 2019, a copy of which is enclosed, that issued in European Patent Application No. 16804432.9. cited by applicant
OBP Medical—OfficeSPEC, Premier Speculum for In-Office Procedures published Nov. 30, 2009 (1 page). cited by applicant
OBP Medical—ER-SPEC OBGYN Brochure published Nov. 19, 2014 (2 pages). cited by applicant
OBP Medical—ER-SPEC Brochure, Light Source Now 10× Brighter published Oct. 30, 2012 (1 page). cited by applicant
OBP Medical—ER-SPEC Product Presentation published Apr. 16, 2014 (12 pages). cited by applicant
OBP Medical—ER-SPEC Brochure published Apr. 11, 2013 (2 pages). cited by applicant
OBP Medical—ER-SPEC Brochure published Feb. 4, 2013 (2 pages). cited by applicant
OBP Medical—ER-SPEC Brochure, Light Source Now 10× Brighter published Jan. 23, 2013 (1 page). cited by applicant
Redefining illumination, Eikon LT Adapt SE For optimal precision and protection (2019), Stryker, www.stryker.com/surgical (3 pages). cited by applicant
The US Publications (# 1, 2) and WO references were cited in the Supplementary European Search Report dated Oct. 6, 2021 issued in European Application No. 19757432.0 , a copy of which is enclosed. cited by applicant

---

Primary Examiner: Summitt; Lynnsy M

Attorney, Agent or Firm: Fish & Richardson P.C.

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) This application is a continuation application of application Ser. No. 16/402,580, which is a continuation application of application Ser. No. 16/105,153 filed Aug. 20, 2018, now issued as U.S. Pat. No. 10,278,572, and claiming benefit of provisional patent application Nos. 62/574,412 filed on Oct. 19, 2017, 62/574,969 filed on Oct. 20, 2019 and 62/649,190 filed on Mar. 28, 2018, the entire disclosures of which are incorporated herein by reference.

INTRODUCTION
(1) The present invention relates to medical devices, such as speculums, retractors and suction devices, typically used for examination of a patient or during surgery. Conventional medical devices, including specula, may use an illumination means for illuminating the subject area for examination. For example, U.S. patent application Ser. Nos. 13/241,136 and 14/316,787 describe specula that include an illumination assembly for illuminating the subject area. These applications are incorporated herein by reference. Illumination assemblies or means typically use a light, such as an LED, and one or more power sources, such as batteries. For example, button batteries are used in the illumination assemblies described in the '136 and '787 applications.

(2) After a disposable speculum is used on a patient, the speculum is disposed as biohazardous waste in accordance with medical waste disposal requirements. Biomedical waste is often incinerated by an appropriate entity. However, batteries usually contain metals, such as mercury, cadmium, zinc, nickel, chromium, lead and others. As a result, when batteries are incinerated along with the biomedical waste, heavy metals may contaminate the ash released by the incinerator, thus polluting the air. Moreover, metals in the batteries can leach out of landfills and pollute water sources. Therefore, proper disposal and recycling of batteries from used specula, without contaminating the batteries with biohazardous materials, is desired.

SUMMARY OF THE INVENTION

(3) It is an objective of the present invention to provide a battery removal mechanism which allows for easy removal of batteries without risking contamination of the batteries with biohazardous materials.

(4) In accordance with the present invention, a battery-powered medical device comprising: an outer housing having an opening formed therein, at least one power source housed within the outer housing, the outer housing being configured to at least partially enclose the at least one power source so as to prevent contamination of the at least one power source with biohazardous materials, and the at least one power source being removable from the outer housing via the opening, a cover configured to cover the opening in the outer housing and to retain the at least one power source within the outer housing, and an actuator provided within the outer housing that directly engages with a portion of the at least one power source when the cover covers the opening in the outer housing, wherein the cover is configured to be operated to expose the opening in the outer housing, and when the cover is operated to expose the opening, the actuator is configured to pull the at least one power source from the outer housing and the outer housing is configured to release the at least one power source via the opening without requiring physical contact between the user and the at least one power source, and wherein the outer housing comprises a handle and an operative portion coupled to the handle.

(5) In certain embodiments, the actuator loops around a portion of the at least one power source. The actuator may be a band that loops around the power source. In some embodiments, the medical device is one of a retractor and a suction device.

(6) In certain embodiments, the medical device further comprises an illumination assembly including at least one light source, and the at least one power source is configured to power the at least one light source. In some embodiments, the at least one light source is provided on the operative portion and the at least one power source is housed in the handle.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) The above and other features and aspects of the present invention will become more apparent upon reading the following detailed description in conjunction with the accompanying drawings, in which:

(2) FIG. **1** shows a conventional illumination assembly for use with a disposable speculum;

(3) FIGS. **2**A-**2**C show a medical device with a first embodiment of an illumination assembly of the present invention that allows for battery removal;

(4) FIGS. **3**A-**3**D show a medical device with a second embodiment of an illumination assembly of the present invention that allows for battery removal;

(5) FIG. **4** shows a medical device with a third embodiment of a portion of an illumination assembly of the present invention that allows for battery removal;

(6) FIG. **5** shows a portion of a medical device with a fourth embodiment of a portion of an illumination assembly of the present invention that allows for battery removal;

(7) FIGS. **6**A-**6**D show a medical device with a fifth embodiment of an illumination assembly of the present invention that allows for battery removal;
(8) FIGS. **7**A-**7**G show a portion of a medical device with a sixth embodiment of an illumination assembly of the present invention that allows for battery removal;
(9) FIGS. **8**A-**8**B show a portion of a medical device with a seventh embodiment of an illumination assembly portion of the present invention that allows for battery removal;
(10) FIGS. **9**A-**9**B show a portion of a medical device with an eighth embodiment of an illumination assembly portion of the present invention that allows for battery removal;
(11) FIGS. **10**A-**10**B show a speculum with a ninth embodiment of an illumination assembly of the present invention that allows for battery removal;
(12) FIGS. **11**A-**11**B show the ninth embodiment of the illumination assembly of FIGS. **10**A-**10**B in more detail with a battery compartment in a retained state;
(13) FIGS. **11**C and **11**D show cross-sectional view of the illumination assembly of FIGS. **11**A-**11**B;
(14) FIGS. **12**A-**12**C show the illumination assembly of FIGS. **11**A-**11**D with the battery compartment in an ejected state;
(15) FIG. **13** shows a rear faceplate portion of the illumination assembly of FIGS. **11**A-**11**D without the battery compartment;
(16) FIG. **14**A shows an exploded view of the speculum of FIGS. **10**A-**13**; and
(17) FIGS. **14**B-**14**G show an illustrative sequence of assembling the speculum of FIGS. **10**A-**13**.

DETAILED DESCRIPTION

(18) The present invention provides a medical device, such as a speculum, which includes an illumination assembly or the like with batteries, and in which the batteries can be easily removed by the doctor and recycled after the medical device is used on a patient. In particular, the medical device of the present invention enables a doctor to remove the batteries, while wearing gloves, without having the batteries come into contact with the doctor's gloves or other parts of the medical device.

(19) Examples of illumination assemblies and specula with illumination assemblies are described in U.S. Pat. No. 9,307,897 and application Ser. No. 14/316,787 (US Pub. No. 2014/0309499) and Ser. No. 14/748,435 (US Pub. No. 2015/0289757), all of which are incorporated herein by reference. An illumination assembly of a cordless disposable speculum uses batteries, and it is preferable to separately dispose of or recycle these batteries. Conventional illumination assemblies do not provide for safe removal of the batteries from the speculum. As shown in FIGS. **1**-**14** and described below, the present invention contemplates several embodiments of battery removal mechanisms, which can be used in illuminated specula.

(20) In accordance with various embodiments of the present invention as set forth herein, an illumination assembly is defined by a structure (e.g., a housing or a casing) that retains at least a light source and a power supply. The illumination assembly in some instances may further contain one or more conducting/non-conducting circuit elements, one or more energization/de-energization switch elements, engagement/retention elements, etc. FIG. **1** shows an exemplary prior art illumination assembly. Further structural and operational details regarding these types of illumination assemblies are described in at least U.S. patent application Ser. No. 14/316,787 (US Pub. No. 2014/0309499) and Ser. No. 15/178,744 (US Pub. No. 2016/0310121), both of which are incorporated herein by reference in their entireties.

(21) As shown in FIG. **1**, the housing that defines the illumination assembly is a semi-enclosed (or partially enclosing) structure having at least one open side allowing access to or removal of its constituents. For example, the illumination assembly is configured to fully retain and securely hold the batteries and the contained light source upon placement of the illumination assembly onto a surface of a blade. Typically, the surface upon which the illumination assembly is placed (e.g., the speculum blade) provides the final, missing support for a full and complete retention.

(22) As further shown in FIG. **1**, the illumination assembly is configured to attach to a speculum blade via suitable engagement means (e.g., clips, adhesives, slots and tabs, etc.). The position of attachment of the illumination assembly along the blade varies from anywhere between a distal end of the blade and a proximal end of the blade, or within or extending along a curved portion (transition into handle portion) of the blade. In some prior art devices, the illumination assembly is contained entirely within the handle portion of the speculum and the light is directed to a desired area, e.g., the distal end of the speculum blade, via use of light guiding means such as a light pipe. In other prior art devices, at least of a portion of the illumination assembly is external to the device or positioned on an exterior surface thereof, e.g., on the exterior surface of the speculum blade.
(23) The various embodiments of the present invention incorporate a similar illumination assembly but are not necessarily limited to use of the illumination assembly as shown in FIG. **1**. In particular, the embodiments of the present invention as described herein, as well as their respective variants, are compatible with illuminating means of any size, shape or structure. Furthermore, although the embodiments described below are used in a speculum, it is also contemplated that the embodiments of the present invention are applicable to any medical or surgical device in which one or more of the entire medical or surgical device, the illuminating means, or the batteries are configured to be discarded after use.
(24) Referring now to an exemplary embodiment of the present invention, a speculum apparatus having at least one blade and at least one an illumination assembly is provided, the illumination assembly being attached to the blade or handle and further having a bottomless battery compartment. The phrase “bottomless battery compartment” as used herein refers to a compartment within an illumination assembly for retaining one or more batteries in which the compartment does not completely permanently enclose the retained batteries. It is understood that the embodiments described below may be adapted for use with other medical and surgical devices, including but not limited to laryngoscopes, anoscopes, suction devices, electrocautery devices, and any other medical or surgical devices which use portable power sources, such as batteries or power packs.
(25) As shown in FIG. **2**A, a speculum apparatus **1200** comprises a blade **1210**, a handle, and an illumination assembly **1220** attached to the blade **1210**. Only the lower member of the speculum is shown in the figures. In this embodiment, the illumination assembly **1220** includes a bottomless battery compartment that retains one or more batteries **1230**. As described herein, the bottomless battery compartment does not provide any retaining support for the batteries along at least one of its sides, e.g., the bottom side of the compartment that comes in contact with the surface of the blade **1210**.
(26) In one version, the illumination assembly **1220** is a self-contained and standalone illumination assembly in which all of the batteries are at least loosely retained within the battery compartment by a small force (e.g., adhesive, spring, electromagnetic, etc.). In this version, a small outside force (e.g., shake, turbulence, push, jerk, etc.) applied to the illumination assembly or the apparatus causes the batteries to break loose via the open side of the battery compartment. In another version, the illumination assembly **1220** firmly retains the batteries within the battery compartment and requires a force exceeding a certain threshold to cause the batteries to break loose via the open side of the battery compartment.
(27) In accordance with this embodiment, the blade **1210** comprises an opening **1240** that is aligned with the attachment position of the illumination assembly **1220**. The opening **1240** of the blade **1210** is typically defined by a size or a hole that is sufficiently large to allow at least the batteries **1230** contained in the battery compartment to pass through and to be disposed. In one version, the opening **1240** may permit the entire illumination assembly to pass through and be disposed.
(28) In accordance with this embodiment, the blade **1210** further comprises a cover **1250**. The cover **1250** is typically provided on the external surface of the blade and covers the opening **1240**. As shown in FIG. **2**B, during a normal use of the apparatus **1200**, the opening **1240** is sealed by the

cover **1250**. The cover **1250** in this state may be referred to herein as the "closed" position.
(29) In one version, the cover **1250** is provided via an adhesive that allows the cover **1250** to be peeled off when disposal of the batteries is desired. For example, the cover **1250** is a sticker that is placed over the opening **1240** to secure the batteries **1230** against its surface. The sticker may be coated so that the batteries **1230** do not stick thereto but the sticker can be adhesively secured to the blade **1210**. In another version, the cover **1250** is made of plastic material (e.g., same or similar substance as the blade). The plastic cover may be attached to the blade **1210** via adhesives, hinges, latches, clips, rails, screws, snaps or using other suitable techniques. The plastic cover may be articulated from the closed position to an "open" position by, for example, pressing onto the plastic cover, sliding the plastic cover, peeling the plastic cover, turning or rotating the plastic cover, etc. In some versions, a button may be used for releasing the cover when pressed. In a further version, the cover **1250** is formed as part of the blade **1210** itself. For example, the cover **1250** is a hinged door that opens/closes the opening **1240** or a slide door that exposes the opening **1240** for battery disposal. FIG. **2**C shows an example of the cover **1250** in its "open" position.
(30) As variations to one or more of the versions of this embodiment, the illumination assembly **1220**, the opening **1240** and the cover **1250** may be positioned at the distal (front) end of the blade **1210**, the center of the blade **1210**, the proximal (rear) end of the blade **1210**, or within the handle, or extends along two or more of these portions of the blade. Regardless of position, the operation of the illumination assembly with respect to the opening and the cover remains the same or substantially similar.
(31) In accordance with this embodiment of the present invention, once the cover **1250** is either removed, peeled, or otherwise in the open position, the user can apply a force, such as shaking, pressing or bumping the apparatus, to "pop" the batteries **1230** out from their retained position. Upon such force, the batteries **1230** and/or the illumination assembly **1220** can be detached from the blade **1210** or the handle and can be disposed separately and safely from the rest of the apparatus **1200**. In certain versions, no force is necessary to remove the battery(ies) and, in such versions, the batteries fall out when the cover **1250** is removed, peeled or otherwise in the open position. In yet other versions, a ribbon or the like may be passed behind the batteries and when the cover is removed, the ribbon can be pulled to dislodge and release the batteries.
(32) Another embodiment of the present invention is provided with reference to FIGS. **3**A-**3**D. In this embodiment, a speculum apparatus **1300** includes a blade **1310**, an illumination assembly **1320** with one or more batteries **1330**, an opening **1340** and a battery compartment **1350** for holding the one or more batteries. Again, only the lower member of the speculum is shown for ease of understanding. The structure and operation of the apparatus and the illumination assembly are the same as those described in reference to FIG. **2**A, and thus, further description thereof will be omitted. It is understood that although FIGS. **3**A-**3**D show the illumination assembly **1320** being disposed in the proximal end of the blade or in the area that joins the blade to the handle, in other embodiments, the illumination assembly may be provided in other areas of the blade, e.g., closer to the distal end, or in the handle portion of the apparatus in combination with a light guide or a similar device.
(33) In accordance with this embodiment, the battery compartment **1350** houses the one or more batteries used in the illumination assembly and is inserted into the opening **1340** in the apparatus **1300**. The battery compartment **1350** includes an opening **1350***a* at one end which allows the batteries **1330** to be electrically coupled with a light source of the illumination assembly when the battery compartment **1350** is in a closed state, and allows for removal of the batteries when the battery compartment **1350** is in an open state. In the closed state, the battery compartment **1350** acts as a cover for the opening wherein the outer wall of the battery compartment **1350** is coextensive with the walls of the blade and/or handle.
(34) As shown in FIGS. **3**A-**3**C, the battery compartment **1350** is articulated by operating a release mechanism that includes a release tab **1360** that can be moved from a first position in which the

release tab **1360** holds the battery compartment **1350** in the closed state and a second position in which the release tab **1360** allows the battery compartment **1350** to drop down into an open state. In this illustrative embodiment, the release tab **1360** is engaged with the battery compartment **1350** at point **1370**, but in other embodiments, the release tab **1360** may be engaged with the battery compartment **1350** at other points or other types of release mechanisms to move the battery compartment from the first position to the second position may be used.

(35) As shown in FIGS. **3**B and **3**C, the release tab **1360** is coupled to a pull-down member **1380** via a connection line **1360***a*, which extends down through the handle portion of the apparatus. The pull-down member **1380** may be inserted into or engaged with the distal end of the handle so as to form a cap or the like which can be easily removed from the handle by the user and pulled down so as to move the release tab **1360** into the open state.

(36) In operation, the user pulls on the pull-down member **1380** in the direction indicated by the arrow A**1**, causing the release tab **1360** to move from the first position to the second position so as to cause the battery compartment **1350** to articulate from its closed position to its open position and to cause the batteries **1330** to be disposed in the direction indicated by the arrow A**2** through the opening **1350***a* in the battery compartment. In one version, the release tab **1360** opens a cover **1350** on the blade and only the batteries are disposed through the opening **1350***a* in the battery compartment. In another variation, the battery compartment may be replaced with an illumination assembly compartment holding the entire illumination assembly so that the entire illumination assembly can be disposed via the opening **1340** when the illumination assembly compartment is in the open state. In another variation, the pull-down member **1380** is connected directly to the battery compartment **1350** or the illumination assembly compartment, and when the pull-down member **1380** is pulled, the battery compartment or the illumination assembly compartment is disengaged from the closed state and the batteries or the whole illumination assembly is disposed.

(37) FIG. **3**B shows an example of a pull-down member prior to activation and FIG. **3**C shows an example of the pull-down member after activation in which the battery compartment is pushed through the opening of the blade. As shown, the pull-down member may be freely hanging from the handle in some embodiments, while in other embodiments, the pull-down member may be engaged with the distal end of the cap to form an end cap or the like that is removable from the handle. In yet other embodiments, the pull-down member may be replaced by another activation mechanism, such as a switch or a pull-tab provided on the handle of the apparatus. In yet further embodiments, the activation mechanism may be disposed within the interior of the handle and is engaged or otherwise activated by placing a tool or a finger inside the handle from its open end. For example, a switch, a button, a pull-tab, a pull-down member or any other suitable mechanism may be provided on the interior of the handle or on the interior wall of the handle. In such embodiments, the activation mechanism cannot be accidentally triggered.

(38) In the embodiment described above with respect to FIGS. **2**A-**2**C, the battery removal mechanism uses a battery compartment or an illumination assembly compartment which is articulated between the closed position and the open position so as to release the batteries and/or the illumination assembly from the apparatus for disposal. In other embodiments, the battery removal mechanism may use a cover for covering the opening **1340** and for articulating between the first position in which the cover is closed and the batteries and/or illumination assembly are retained in the apparatus and the second position in which the cover is open and the batteries and/or illumination assembly can be removed from the apparatus through the opening **1340** and disposed. The same or substantially similar release mechanism is used for causing the cover to articulate between the first and second positions. In these embodiments, the batteries may be housed within a separately formed battery compartment so that when the cover is opened, the entire battery compartment with the batteries is removed. In other variations, the whole illumination assembly is housed within an illumination assembly compartment so that when the cover is opened, the illumination assembly compartment is removed, thus disposing of the entire illumination assembly.

In yet other variations, the batteries are held in a partially open battery or illumination assembly compartment or case, which has an opening coextensive with the cover, so that when the cover is opened, the batteries drop down from the partially open compartment and can be disposed.

(39) A further variation of this embodiment is shown in FIG. **3**D. In this version, the battery compartment **1350** includes one or more batteries **1330** and an opening **1350***b* that opens into the handle portion of the apparatus. Specifically, in this version, the battery compartment **1350** is further configured with a closing tab (or a "door") **1390** that holds the batteries **1330** within the battery compartment **1350**, when the closing tab **1390** is in a closed state. As shown in FIG. **3**D, the batteries **1330** rest on the closing tab **1390** in the closed state. In the illustrated example of FIG. **3**D, the batteries are disposed in the area that connects the blade to the handle portion on an angle relative to the blade and to the handle portion. However, in other variations, the batteries may be disposed in other areas of the apparatus, such as within the handle or in the blade area and the orientation of the batteries may be varied depending on the construction of the illumination assembly. For example, the battery compartment may be provided in the handle portion in a substantially vertical orientation so that the batteries are supported by the closing tab **390** in the closed state.

(40) In FIG. **3**D, for disposal of the batteries, the closing tab **1390** is actuated from its closed state to an open state by pulling on the release tab **1360**. For example, the user can pull on the release tab **1360** that hangs loose through the handle portion causing the closing tab **1390** to detach from the battery compartment **1350**, allowing the batteries **1330** to drop down through the handle portion of the speculum. In one version, the entire closing tab **1390** is detached. In this version, the closing tab, once detached, is also dropped through the handle portion. In another version, the detachment of the closing tab **1390** is only partial. In this version, pulling of the release tab **1360** partially breaks the attachment of the closing tab **1390** to the battery compartment **1350** and allows the closing tab **1390** to remain partially attached to the battery compartment **1350** (e.g., swinging via a hinge) to release the batteries via the handle portion. In yet other versions, the closing tab may be hingedly, rotatably or slidably connected to the battery compartment **1350** or to the handle portion and may be held in the closed state until the release tab **1360** is pulled. In certain variations, a spring member may force the closing tab **1390** into the closed state, while in other variations, the closing tab **1390** may be mechanically coupled with the battery compartment **1350**. Pulling of the release tab **1360** in these versions would cause the closing tab **1390** to rotate or to slide relative to the opening in the battery compartment into the open state so that the batteries can be dropped into and through the handle portion.

(41) A further embodiment of the present invention is shown in FIG. **4**. In this embodiment, a speculum apparatus **1400**, similar to those described in reference to FIG. **2**A, includes similar components such as the blade, the illumination assembly with one or more batteries, an opening formed in the blade or handle, and a cover for the opening. In this embodiment, the illumination assembly **1420** may include a bottomless battery compartment with an opening that corresponds to the opening in the blade or handle. Alternatively, the illumination assembly **1420** may be a self-contained illumination assembly with a housing that partially houses the illumination assembly and in which the one or more batteries are at least loosely retained by the housing by a small force. In such variation, an opening in the housing for the illumination assembly corresponds at least in part with the opening in the blade or handle.

(42) As shown in FIG. **4**, the opening in the blade or handle is covered by the cover **1450** which may be formed from a plastic, polymer or rubber material. The cover **1450** is releasably attachable to the handle or blade or the apparatus. Any suitable fastening or attachment mechanism may be used for releasably attaching the cover to the handle or blade of the apparatus, including but not limited to providing protrusions and corresponding recesses or slots on the cover and handle or blade, using an adhesive to attach the cover to the handle or blade, or any suitable fastener. The cover **1450** may be completely removable from the handle or blade of the apparatus or in certain

embodiments, the cover **1450** may be hingedly connected to the handle or blade so as to open and close relative to the blade or handle. In yet other embodiments, the cover **1450** may be elastic and squeezable, so that the cover is fitted into the opening in the handle or blade of the apparatus and can be removed by squeezing the cover on the sides to detach it from the opening.

(43) During operation of the apparatus, the cover **1450** covers at least the one or more batteries and retains them in the illumination assembly **1420**. After the operation is completed and before disposing the apparatus, the cover **1450** is removed to expose the batteries, and the batteries can then be removed by a small outside force such as a shake, or a jerk, applied to the apparatus. In certain embodiments, the cover **1450** forms an elastic and squeezable layer around a portion of the batteries so that the cover **1450** is depressible or squeezable by the user for releasing the contained batteries. Specifically, pressing on the sides of the squeezable cover **1450** forces the batteries to be released through the opening **1440** and to be removed simultaneously with the cover **1450**. The user can then dispose the batteries while holding the cover over the recycling container for the batteries. In another variation, the cover has to be articulated by sliding, rotating or the like so as to cause the batteries to be released and removed together with the cover.

(44) In another exemplary embodiment of the present invention, a speculum apparatus, is provided in which one or more batteries for powering a light source are provided within the handle portion thereof. It is understood that this embodiment may also be applied to another medical device apparatus, such as a retractor, laryngoscope, anoscope, suction device, or the like. In accordance with this embodiment, the illumination assembly is structured such that the batteries for powering the light source are retained in the handle portion and the light source is positioned along the blade or some other component of the apparatus where illumination is needed. The batteries are connected to the light source using wires. In some versions, the illumination assembly is structured such that the batteries and the light source are both retained in the handle portion and the light is directed to the area where illumination is needed, e.g., the distal end of the blade, using a light directing means (e.g., a light pipe, prism, mirrors, etc.).

(45) Referring now to the battery removal aspect, the apparatus as shown in FIG. **5** includes a handle portion **1500** having an open-bottom receiving end **1510** for receiving and retaining one or more batteries **1520**. In accordance with this embodiment, the open-bottom receiving end **1510** of the handle portion **1500** is covered by a platform **1530** that forms an end cap or end wall of the handle portion. The platform **1530** is hingedly (or rotatably) attached to the handle portion **1500** via a hinge **1540**, and is locked in place by a tab **1545** and a release switch **1550**. When the release switch **1550** is actuated in the direction indicated by the arrow C, the tab **1545** is moved away from a closed position and the platform **1530** drops down and rotates via the hinge **1540**, which causes the batteries **1520** retained in the handle portion to be disposed in the direction indicated by arrow D. Although this illustrative embodiment uses a tab **1545** to hold the platform **1530** in a closed position and to release the platform **1530** into the open position, it is contemplated that other mechanisms may be used for retaining the platform **1530** in the closed state and for releasing the platform to allow it to drop down.

(46) In this embodiment, it should be noted that the batteries **1520** are merely resting upon the platform **1530** when the platform is in its “closed” position and a biasing member, such as a spring, may be used to bias the batteries **1520** in a direction of the platform **1530**. As shown in FIG. **5**, the spring **1535** is provided above the batteries and pushes the batteries toward the platform **1530**. As a result, when the release switch **1550** is actuated to open the platform **1530**, the batteries are pushed out of the handle by the force of the spring **1535**.

(47) In one version, when the entire illumination assembly is positioned within the handle portion of the apparatus, all or a portion of the illumination assembly may be adhesively or mechanically attached to the handle portion. However, the batteries may be held by a bottomless battery compartment with an opening at the bottom covered by the platform **1530**, or as shown in FIG. **5**, the handle portion may form the bottomless battery compartment that houses the batteries. In either

case, when the platform **1530** is opened, the batteries can drop down through the open-bottom receiving end **1510** of the handle portion.

(48) In another version, the light source of the illumination assembly is attached to the blade portion or some other portion of the apparatus where illumination is needed, and the batteries are retained in the handle portion of the apparatus, either in a separate bottomless compartment or in the handle portion itself forming the bottomless battery compartment that houses the batteries. In this version, the batteries may be held in place within the handle portion or within the separate bottomless compartment using a biasing member, an adhesive or some other retention force, but application of an external force to the apparatus causes the batteries to drop out when the platform **1530** is opened. As a variation to this version, the apparatus may further comprise one or more buttons or a separate switch that causes the batteries to drop loose.

(49) As a variation to this embodiment, the apparatus shown in FIG. **6**A comprises similar components as the apparatus shown in FIG. **5**, but further comprises a pull switch **1650** in place of the tab **1545** and the release switch **1550** as described with reference to FIG. **5**. In one version, the handle portion **1600** includes one or more slots or holes near its open-bottom receiving end **1610** through which the pull switch **1650** passes. The pull switch **1650**, in its "closed" (or inserted) position, attaches to or otherwise secures to the platform **1630**. Although FIG. **6**A shows the pull switch **1650** holding the platform **1630** at the top and bottom, in other variations, the pull switch **1650** may hold only the bottom of the platform **1630**. In yet other variations, the pull switch **1650** may be inserted into a corresponding opening in the platform **1630** side edge so as to hold it in the closed position, as shown in FIG. **6**C. Any other type of engagement between the pull switch **1650** and the platform **1630** may be used to releasably engage the pull switch **1650** with the platform **1630** in the closed state. Moreover, a biasing member, such as a spring member, may be used with the pull switch **1650** to bias the pull switch **1650** in the direction of the closed position. In this way, a predetermined pulling force on the pull switch **1650** would be needed in order to disengage the pull switch **1650** from the platform **1630** so as to prevent accidental opening of the platform **1630**.

(50) When the pull switch **1650** is articulated (in direction indicated by arrow E) to its "open" (or pulled) position, the pull switch **1650** separates from the platform **1630** and the platform **1630** drops down and rotates via the hinge **1640**. The batteries are disposed in the handle portion in the same manner as discussed herein in reference to FIG. **5** above, and thus, separate discussion thereof is omitted. FIGS. **6**B-**6**C show different perspective views of the apparatus as shown and described in FIG. **6**A.

(51) As a further variation of this embodiment, the entire platform **1630** may pass through slots formed in opposing walls of the handle portion. As shown in FIG. **6**D, the platform **1630**, having a length that traverses the entire width of the handle portion and provides a resting surface for the batteries, is provided in place of the platform-and-the-pull-switch combination shown in FIG. **6**A. In this version, corresponding slots are provided in opposing walls of the lower end of the handle portion allowing the platform to be pulled in either direction. In an alternative configuration, the platform may be pulled only in one direction and may be prevented from being pulled in the other direction, e.g., by a flange or the like. Similar to the foregoing versions, once the platform **1630** is removed, the batteries drop through the open end of the handle portion.

(52) As further variations to embodiments as described in reference to FIGS. **5** and **20**, the platform may be articulated from its closed position to open position via different methods. For example, the release switch may be an external push button that releases the platform. For instance, a variation that includes a battery holding compartment with a pivotable platform is shown in FIGS. **7**A-**7**G. As shown in FIGS. **7**A-**7**C, a battery holding compartment **1740** is used for housing the batteries therein and for coupling the batteries, e.g., using wires, to the light source or to any other component of the apparatus that requires power supply. As shown in FIG. **7**D, the battery compartment **1740** is inserted into an open end at the bottom of the handle portion of the apparatus. Although FIGS. **7**A-**7**C show a separate battery holding compartment **1740** for housing the

batteries and for releasing the batteries from the apparatus, in other embodiments, the handle portion may be configured to house the batteries directly therein and a similar pivotable platform mechanism may be used at the bottom of the handle portion as the one shown in FIGS. **7**A-**7**C.

(53) As shown in FIGS. **7**A-**7**C, a bottom end of the battery holding compartment **1740** is provided with an opening **1710**, which may be circular in cross section or any other suitable shape, and a mating portion **1720**, which in this illustrative example is shown as a protrusion. As more clearly shown in FIG. **7**B, a pivotable platform **1730** is provided, with the pivotable platform **1730** having a pivoting end **1730***a* and a mating end **1730***b*. The pivoting end **1730***a* pivotably engages with the opening **1710** formed on the bottom end of the battery holding compartment **1740**. The mating end **1730***b* engages with the mating portion **1720** in a closed state so as to lock the pivotable platform **1730** relative to the battery holding compartment **1740**. In the illustrative embodiments shown in FIGS. **7**B-**7**D, the mating portion **1720** of the battery holding compartment **1740** is formed as a protrusion extending outwardly from a sidewall of the battery holding compartment **1740**. In such embodiments, the mating end **1730***b* of the pivotable platform **1730** includes a locking tooth **1732** that mates with the mating portion **1720** so as to lock the pivotable portion **1730** in the closed state, and further includes an operating tab **1734** which can be operated by a user to release the mating between the locking tooth **1732** and the mating portion **1720**. When the operating tab **1734** is actuated by a user (e.g., by pressing), the lock between the locking tooth **1732** of the pivotable platform **1730** and the mating portion **1720** is released and the pivotable platform **1730** may be pivoted into the open state relative to a pivot point at the pivot end **1730***a*. In other illustrative embodiments, the mating portion **1720** may be formed as a recess so that the locking tooth **1732** of the mating end **1730***b* is inserted into the mating portion **1720** recess in the closed state. Other configurations of the mating portion **1720** and the mating end **1730***b* may be used for providing a locking mechanism for locking the pivotable platform **1730** to the battery holding compartment **1740**.

(54) As further shown in FIG. **7**C, the pivotable platform **1730** in its “closed” position provides a surface on which one or more batteries rest within the battery holding compartment **1740**. The batteries are electrically connected to a distantly positioned light source via electrical wires extending through the handle portion. For disposal of the speculum and/or the batteries, the pivotable platform **1730** is released from engagement with the mating portion **1720** via an external force applied to the operating tab **1734** at the mating end **1730***b*. The pivotable platform **1730** then pivots via the pivoting end **1730***a* and permits the batteries to drop through the open bottom of the speculum handle portion. As shown in FIGS. **7**C-**7**D, a spring or another type of biasing member may be provided at the top of the batteries so as to bias the batteries in the direction of the opening in the battery holding compartment, i.e., in the direction of the pivotable platform **1730**.

(55) In the embodiment described above and shown in FIGS. **7**B-**7**D, the pivotable platform **1730** is configured together with a battery holding compartment **1740** as a standalone structure. In such version, as shown in FIG. **7**D, the battery holding compartment is sized and/or shaped such that it is insertable (or fittable) into the hollow end of the handle portion. In this version, the mating portion is included on the battery compartment **1740**. When the standalone structure is received a certain length within the hollow end of the handle portion, the user can actuate, by operating the operating tab **1734**, the mating end **1730***b* of the pivotable platform **1730** to pivot the platform to its open position.

(56) FIGS. **7**E-**7**G show respective bottom views of the foregoing examples of FIGS. **7**B-**7**D. As shown in FIGS. **7**E and **7**G, the battery holding compartment **1740** includes openings or recesses **1710** in opposing walls thereof at the lower end. In FIG. **7**E, the pivotable platform **1730** includes a pair of legs or shafts **1736** projecting from the sides of the platform at or near the pivoting end **1730***a*. The legs **1736** are inserted into the corresponding openings or recesses **1710** in the walls of the battery holding compartment **1740**. In the illustrative example shown, the openings or recesses **1710** have a smaller cross-section than the thickness of the legs **1736** at an initial point of insertion,

with the cross-section increasing to accommodate the thickness of the legs. In this configuration, the legs **1736** of the platform **1730** snap into the openings or recesses **1710**, and can be prevented from disengaging from the openings or recesses **1710**. As shown in FIG. **7**E, the body of the platform may be narrower than the opening in the battery holding compartment **1740** as long as the platform **1730** can retain the batteries within the battery holding compartment **1740**. In other variations, the body of the platform **1730** is the same width or wider than the opening in the battery holding compartment **1740**.

(57) Another embodiment of a battery removal mechanism for removing and disposing batteries from a speculum or retractor apparatus is shown in FIGS. **8**A-**8**B. FIGS. **8**A-**8**B show a cross-sectional view looking axially down a handle portion having a battery ejection mechanism for removing batteries disposed within the handle portion through an opening **1850** formed in a sidewall of the handle portion. The ejection mechanism includes a door **1830** that covers the opening **1850** in the handle portion and includes with an ejection lever **1835** extending partially around the batteries housed within the handle portion. The door **1830** is pivotable around a pivot point P between a closed state, shown in FIG. **8**A, and an open state shown in FIG. **8**B. The door **1830** also includes an operation tab **1830***a* which can be operated (e.g., by pressing) by a user to open the door **1830** so as to move it from the closed state to the open state. When the door **1830** is opened, the ejection lever **1835**, which moves together with the door **1830**, pushes the batteries through the opening **1850** in the handle, thereby ejecting the batteries from the apparatus.

(58) More specifically, as shown in FIG. **8**A, the door **1830** is in its closed state. The door **1830** and the ejection lever **1835** are structured and/or shaped in a manner such that the one or more batteries can be released (or pulled) through an side opening **1840** formed between the door **1830** and the ejection lever **1835** using a small force or without using any force. In one version, the door **1830** and the ejection lever **1835** may be made of elastic material and the size of the side opening **1840** is smaller than the diameter of the retained batteries. In this version, a small force, such as a tap on the handle or a shake, would be required to release the batteries when the door **1830** is in the open state. In another version, the door **1830** and the ejection lever **1835** are made from plastic or polymer materials and the size of the side opening **1840** is the same or larger than the diameter of the batteries. In this version, no force is needed to release the batteries when the door is in the open state.

(59) When the operation tab **1830***b* on the door is operated by a user, the door **1830** and the ejection lever **1835** rotate around the pivot point P, and as they rotate, the side opening **1840** formed between the door and the ejection lever is exposed through the side opening **1850** in the handle portion, and the batteries are pulled/pushed forward and out the opening **1850** in the handle portion. As discussed above, the batteries may be released through the side opening **1840** with no or little force. FIG. **8**B illustrates the batteries being released in the direction indicated by arrow “F.” As a variation to the embodiment shown in FIGS. **8**A and **8**B, a column-shaped structure (hereinafter “structure”) with a hollow center and sidewalls for retaining and partially enclosing one or more batteries may be provided in the handle portion. The structure may have a platform for supporting the one or more batteries thereon, with the platform being connected to the sidewalls so as to be movable together with the rest of the structure. The structure is sized to be insertable and pivotable through the opening **1850** in the handle portion of the apparatus relative to the pivot point P. The cross-section of the sidewalls of the structure is substantially the same or similar to that of the door and ejection lever shown in FIG. **8**A. Similar to the door and the ejection lever shown in FIG. **8**A, the structure includes a circumferential sidewall that covers the opening **1850** in the handle portion of the apparatus and extends around the one or more batteries but does not completely encircle the batteries. For example, the circumferential sidewall includes an opening that allows the retained batteries to be released therethrough when the structure is rotated from the closed state to the open state. The rotation of the structure about the pivot point and the release mechanism for the batteries in the structure are similar to those described with respect to FIGS. **8**A and **8**B.

(60) Further variations to the embodiments described in reference to FIGS. **5**-**8** are also contemplated. For example, the release switch shown in FIG. **6**A may be an external push button that releases the platform. As another example, the platform shown in FIG. **6**D may include further components that can be pushed or pulled to assist in articulation of the platform to its open position.

(61) In yet another embodiment of the present invention, the handle portion of the apparatus is configured such that at least a portion thereof is breakable or detachable from the rest of the handle portion. As shown in FIG. **9**A, the apparatus **1900** includes a handle portion **1910** in which a lower end portion **1920** is breakable or detachable from the remaining portion of the handle portion **1910**. In accordance with this embodiment of the present invention, one or more batteries are retained within the lower end portion **1920** that is breakable or detachable from the rest of the handle portion **1910**. In one embodiment, the breakable lower end portion **1920** completely detaches from the rest of the handle portion **1910**. In another version, a hinge **1930** is provided between the breakable lower end portion **1920** and the rest of the handle portion **1910** such that when the breakable lower end portion **1920** is articulated to be "broken off" or detached from the handle portion **1910**, the breakable lower end portion **1920** hinges via the hinge **1930** and the one or more batteries retained therein are released and can be disposed. FIG. **9**B illustrates disposal of the batteries when the breakable lower end portion **1920** is separated from the rest of the handle portion of the apparatus and hinges via the hinge **1930**. Actuation of the breakable lower end portion **1920** as described herein may be enabled using a variety of different methods such as manual force (pressing, twisting, pulling, etc.), a pull switch, a push button, or other similar techniques. The embodiments as described herein are intended to present a concept of separate disposal for batteries used in a medical device. In certain embodiments, a platform placed at the bottom end of the handle portion of the speculum apparatus or another medical device is opened in one of many different ways to allow the batteries to be disposed separately and quickly. In certain other embodiments, the blade or handle of the speculum or another apparatus includes an opening through which the batteries held in a bottomless battery compartment of an illumination assembly are disposed separately and quickly. In certain other embodiments, portions of the medical device that retains the batteries are detached completely or partially from the medical device itself. Separate disposal of batteries solves the problems of hazardous contamination and/or pollution of the environment. Furthermore, since the batteries are removed from the speculum at the time of disposal, users need not worry about throwing out lit up speculums in the trash.

(62) FIGS. **10**A-**14**G show another embodiment of a speculum **2000** which includes a battery removal mechanism which uses a battery compartment **2060** (also referred to as a "battery sled") provided in a handle **2034** of the speculum **2000**. The battery compartment **2060** holds batteries **2074** within the handle **2034** in a retained state, which is the operating state of the speculum, and allowing the batteries **2074** to be released and disposed through an opening in a bottom of the handle in an ejected state.

(63) FIGS. **10**A-**10**B show a general assembled configuration of the speculum **2000** of this embodiment. The speculum **2000** includes an upper member **2020** comprising an upper blade **2022** and an operating mechanism **2027**, a lower member **2030** comprising a lower blade **2032**, a handle **2034** and a rear faceplate assembly **2036** that engages with the handle **2034**, and a linear support member **2050** which hingedly engages with the upper member **2020** for angular adjustment between the upper and lower blades, and slidably engages with the rear faceplate assembly **2036** for vertical adjustment between the upper and lower blades. The speculum **2000** includes an illumination assembly **2070** comprising at least one light source **2072**, such as an LED or similar light emitting device, one or more batteries **2074** and wires (not shown) electrically connecting the light source **2072** with the one or more batteries. The illumination assembly may also include an activation device (not shown), which can be in a form of a pull tab, a button, a switch, a motion detector or the like, for activating the light source **2072** from on OFF state to an ON state and vice

versa.
(64) As shown in FIG. **10**B and shown in more detail in FIGS. **11**A and **11**B, the rear face plate assembly **2036** includes a rear faceplate **2037** that engages with sidewalls of the handle **2034** and forms a rear wall of the handle **2034**. The rear faceplate assembly **2036** also includes a shelf portion **2038** which extends from an upper end of the rear faceplate **2037** and an illumination assembly cover **2039** which extends from the shelf portion **2038**. The illumination assembly cover **2039** extends along an inner surface of a front wall of the handle **2034** and along a curved portion **2033** that connects the handle and the lower blade **2032**. The illumination assembly cover **2039** is open on the side that abuts the inner surface of the handle **2034** and the curved portion **2033**, and encloses the wires connecting the batteries **2074** and the light source **2072**. In this illustrative embodiment, the illumination assembly cover **2039** also partially encloses the light source **2072**, which protrudes from an end of the illumination assembly cover **2039**. In the present illustrative embodiment, the illumination assembly cover **2039** is engaged with the curved portion **2033** using tabs formed on the illumination assembly cover that engage with corresponding slots formed in the curved portion **2033**. However, in other embodiments, the illumination assembly cover **2039** may engage with the handle **2034** and/or with the lower blade **2032**.
(65) In the embodiment shown in FIGS. **10**A-**10**B, the illumination assembly **2070** is configured so that the light source **2072** is positioned adjacent the curved portion **2033** of the lower member. However, in other embodiments, the light source **2072** may be positioned closer to the lower blade **2032** or adjacent the lower blade **2032**, at any location along the length of the lower blade **2032**. In some embodiments, the illumination assembly cover **2039** may extend further than in the embodiments shown in FIGS. **10**A-**10**B. For example, the illumination assembly cover **2039** may extend along a portion of the lower blade **2032**. In some embodiments, the illumination assembly cover **2039** may also function as a smoke evacuation channel and may extend along the lower blade **2032** toward the distal end of the blade **2032**.
(66) FIGS. **11**A-**11**D and **12**A-**12**C show the rear faceplate assembly **2036** together with the battery compartment **2060** and the illumination assembly **2070**. In FIGS. **11**A-**11**D, the battery compartment **2060** is in the retained or operating state, while in FIGS. **12**A-**12**C, the battery compartment is in the ejected state. In addition, FIG. **13** shows the rear face plate assembly **2036** without the battery compartment.
(67) As shown in FIGS. **11**A-**11**B, **12**A and **13**, the rear faceplate **2037** includes a plurality of engagement portions **2037***a* protruding from an inner surface thereof and configured to engage with corresponding protrusions formed on the inner side of the handle sidewalls. In certain embodiments, the protruding engagement portions **2037***a* may engage with a channel or one or more recesses formed in each of the handle sidewalls. In the illustrative embodiment of FIGS. **10**-**14**, the inner surface of the rear faceplate **2037** includes a plurality of stop tabs **2037***b* for engagement with a lock tooth of the linear support member. In other embodiments, however, the rear faceplate **2037** may include a plurality of stop tabs on an opposing, outer surface thereof. As also shown in FIGS. **11**A-**11**B, the rear faceplate **2037** includes a through recess **2037***c* extending along its length which is used for sliding the linear adjustment member therein so as to provide for vertical adjustment In the embodiments of FIGS. **10**-**14**, the rear faceplate also includes rail portions **2037***e* protruding from the inner surface thereof and extending on each side of the through opening. The rail portions **2037***e* guide the linear support member **2050** when it is inserted into the through recess **2037***c*.
(68) The battery compartment **2060** comprises a housing **2062** for holding the batteries **2074** in the retained state, and an operating member **2064**, which can be operated by a user to cause the housing **2062** to move from the retained state to the ejected state. In the present illustrative embodiment, the operating member **2064** is a button protruding from the top surface of the housing. When the battery compartment **2060** is assembled with the rear faceplate assembly **2036**, the operating member **2064** passes through an opening formed in the shelf **2038** of the rear

faceplate assembly **2036**. The shelf has a pair of sidewalls **2040** extending from a lower surface of the shelf and surrounding the batteries **2074** held by the battery compartment **2060** in the retained state. The sidewalls **2040**, together with the housing **2062** of the battery compartment **2060** hold the batteries **2074** in place and prevent dislodgement of the batteries. One or both of the sidewalls **2040** may include coupling elements attached thereto for electrically coupling the batteries **2074** to the wires. In addition, one or more biasing members, e.g., a spring, may be used to hold the batteries **2074** in place between the sidewalls **2040**.

(69) FIGS. **11**C-**11**D show a cross-section of the speculum in which battery compartment **2060** is engaged with the rear face plate assembly **2036** in the retained state. As shown in the close-up view of FIG. **11**C, the housing **2062** is a C-shaped housing which has an open side and holds the batteries **2074** against a projection **2035** formed on an inner front surface of the handle. Thus, in the retained state, the batteries **2074** are held in the C-shaped housing **2062** and are supported from the opposite side by the projection **2035** formed on the inner surface of the handle. Moreover, as described above, the batteries **2074** are also retained in their position by the sidewalls **2040** shown in FIGS. **11**A-**11**B. The projection **2035** may be shaped as a beam with a plurality of ribs traversing the beam, as shown in FIGS. **11**C and **12**B. However, the shape of the projection **2035** may vary depending on the type of batteries used and the arrangement of the batteries in the housing **2062**.

(70) As shown in FIG. **11**D, in the retained state, the battery compartment **2060** is locked in place relative to the rear face plate **2037** by a locking mechanism. In the illustrative embodiment shown in FIG. **11**D, the locking mechanism is a snap arm **2037***d* formed at a top portion of the rear faceplate **2037** which includes an arm having some flexibility/elasticity and a lock tooth which engages with the bottom surface of the battery compartment **2060**. In this way, the top surface of the housing **2062** of the battery compartment prevents the battery compartment from moving in an upward direction relative to the rear faceplate **2037** and the snap arm **2037***d* prevent the battery compartment **2060** from moving in a downward direction relative to the rear faceplate **2037**. Alternatively, a notch may be provided in the bottom portion of the battery compartment **2060** for engagement with the snap arm **2037***d* so as to prevent movement of the battery compartment. FIG. **13** shows a more detailed view of the snap arm **2037***d*, which is formed in the rear faceplate **2037** and extends into the through recess **2037***c* in the rear faceplate **2037**. In some embodiments, instead of the snap arm or in addition to the snap arm, other mechanical engagements may be used to retain the battery compartment in the retained state and in the ejected state. For example, the button **2064** may include a lip formed at or near its top surface, with the periphery of the lip being greater than the opening in the shelf **2038**. The lip would prevent the button **2064** from being pushed through the opening in the shelf **2038** past the lip and from falling out together with the batteries. Other types of retaining means may be used for preventing the battery compartment from falling out when the button is moved to the ejected state.

(71) As also shown in FIG. **11**D, the operating member **2064** includes a notch **2064***a* or a recess in its surface that faces the rear faceplate **2037** when assembled. This notch **2064***a* engages the snap arm **2037***d* in the ejected state to prevent removal of the battery compartment **2060** from the speculum. When sufficient force is applied to the operating member **2064** in the retained state, the snap arm **2037***d* disengages from the bottom of the housing **2062** and the battery compartment **2060** is moved from the retaining state to the ejected state shown in FIGS. **12**A-**12**C.

(72) FIG. **12**A shows the rear face plate assembly **2036** together with the battery compartment **2060** in the ejected state, and FIGS. **12**B-**12**C show a cross-sectional view of the speculum **2000** with the battery compartment **2060** in the ejected state. As can be seen in FIGS. **12**A-**12**C, in the ejected state, the batteries **2074** are no longer pressed against the projection **2035** on the inner surface of the handle and are removed from the space between the sidewalls **2040** that extend from the shelf **2038**. Since the batteries are no longer retained on all sides by the housing **2062**, the sidewalls **2040** and the projection **2035**, they can be easily dislodged from the housing **2062** and removed from the open bottom end of the handle **2034**. In the present illustrative embodiment, the handle **2034** is

shaped so that the handle is smaller in circumference in the area of the projection **2035** and larger in circumference in the area below the projection **2035**. As shown in FIGS. **12**B and **12**C, the front wall of the handle protrudes outwardly below the projection **2035**. This configuration provides additional space for releasing the batteries from the housing **2062** and for allowing the batteries to easily fall through the handle to be removed from the bottom opening in the handle.

(73) Moreover, as can be seen in FIG. **12**C, the battery compartment **2060** is locked in place in the ejected state by the snap arm **2037***d*, which is engaged with the notch **2064***a* in the operating member **2064**. This prevents removal of the battery compartment **2060** together with the batteries, which could contaminate the batteries with biological materials and would require subsequent separation of the battery compartment from the batteries to be recycled.

(74) Although the batteries in the embodiment of FIGS. **10-12** are removed though the open bottom end of the handle, other variations are also contemplated. For example, the batteries may be removed from a cutout formed in one of the sidewalls of the handle **2034** or from a cutout formed in the rear faceplate **2037**. In addition, the operating member **2064** in the embodiments of FIGS. **10-12** is configured as a push-button. In other embodiments, a pulling mechanism may instead be used to pull the battery compartment **2060** downward so as to release the batteries from the battery compartment.

(75) Moreover, although FIGS. **10-12** show the battery removal mechanism being used in a speculum, it is understood that this mechanism may be adapted for use in other devices, such as retractors, laryngoscopes, anoscopes, suction devices, and other medical devices. For example, the battery removal mechanism may be adapted for use in a surgical retractor by omitting the upper member **2020** and the linear support member **2050** and using a substantially the same mechanism for battery removal in a retractor that includes a handle **2034**, a retractor blade extending at an angle with respect to the handle and the rear faceplate assembly **2036** as described above (similar to FIG. **10**B). In another example, the battery removal mechanism may be adapted for use in an anoscope by omitting the upper member **2020** and the linear support member **2050** and by modifying the shape of the lower blade.

(76) The illustrative embodiment of the speculum in FIGS. **10-13** is assembled as shown in FIGS. **14**A-**14**G. FIG. **14**A shows an exploded view of the speculum, which includes the lower member **2030** with the handle **2034** and the lower blade **2032**, the upper member **2020** with the upper blade **2022** and an operating member **2027**, the linear support member **2050**, the rear faceplate assembly **2036** together with the battery compartment **2060**, batteries **2074**, a rocker **2160** for angular adjustment, a biasing member **2164** and a pivot pin **2162** for attaching the rocker **2160**. FIGS. **14**B-**14**G show an illustrative sequence of assembling the speculum of FIGS. **10-13**.

(77) As shown in FIG. **14**B, the battery compartment **2060** is assembled with the rear faceplate assembly **2036** by inserting the button **2064** into the opening in the shelf **2038** of the rear faceplate assembly **2036**. When the button **2064** is fully inserted into the opening in the shelf **2038**, the snap arm **2037***d* engages with the bottom surface of the housing **2062**. After the battery compartment **2060** is snapped in to engage with the rear faceplate assembly **2036**, the batteries **2074** are inserted into the housing **2062**, as shown in FIG. **14**C, and are held by the housing and between the sidewalls **2040** extending from the shelf **2038**. At the time of, or prior to, positioning the batteries, battery contacts are loaded to allow for connection of the batteries to wires. In addition, as shown in FIG. **14**C, the light source **2072** is positioned to be held by the end of the illumination assembly cover **2039** and the wires are loaded to connect the light source **2072** to the battery contacts and to be enclosed by the illumination assembly cover **2039**. As shown in FIG. **14**C, the illumination assembly **2070** is assembled together with the rear faceplate assembly **2036** and the battery compartment **2060**.

(78) As shown in FIG. **14**D, the resulting assembly of FIG. **14**C is then assembled together with the lower member **2020**. In the illustrative embodiment of FIG. **14**D, the rear faceplate assembly **2036** snaps into the rear of the handle **2034** of the lower member **2020** to form the rear wall of the handle

2034. As described above, the engagement protrusions **2037***a* on the inner surface of the rear faceplate **2037** snap to engage with corresponding protrusions **2034***a* formed on the inner surface of the handle sidewalls. In other embodiments, other types of engagement may be used for assembling the rear faceplate assembly **2036** with the lower member **2020**. For example, the sidewalls of the handle may include channels formed on the inner surfaces thereof for engagement with the engagement protrusions **2037***a* on the rear faceplate **2037** by sliding the engagement protrusions **2037***a* into the channels. In other embodiments, the sidewalls of the handle may include recesses for engaging with the engagement protrusions **2037***a*. In yet other embodiments, the sidewalls of the handle may include protrusions that engage with corresponding recesses formed in the rear faceplate **2037**. Other types of engagements may be used for coupling the faceplate assembly **2036** with the lower member **2020**.

(79) As shown in FIG. **14**E, the rocker **2160**, the biasing member **2164** and the pin **2162** of the angular adjustment mechanism is assembled with the operating member **2027**.

(80) As shown in FIG. **14**F, the top member **2020** is assembled together with the linear support member **2050**. In the embodiment of FIG. **14**F, hinge protrusions **2022***a* are formed on the outer sides of a proximal end of the upper blade **2022**. The linear support member **2050** includes a yoke portion (U-shaped portion) extending from its elongated body with each leg of the yoke portion including an opening for engaging with the corresponding hinge protrusion **2022***a*. To assemble the upper member **2020** with the linear support member, the hinge protrusions **2022***a* are snapped into corresponding openings in the yoke portion for a hinge coupling therebetween. In other embodiments, the legs of the yoke portion may include inwardly facing protrusions and the proximal end of the blade **2022** may include corresponding openings for insertion of the protrusions on the yoke portion. Other types of couplings may be used to form a hinge coupling between the upper member **2020** and the linear support member **2050**. As shown in FIG. **14**G, the top assembly formed in FIG. **14**F is then assembled together with the bottom assembly formed in FIG. **14**D by inserting the linear support member **2050** into the through recess **2037***c* formed in the rear faceplate **2037**. When the linear support member **2050** is inserted into the through recess **2037***c*, the engagement arm **2058** of the linear support member **2050** is inserted into the through recess **2037***c* and slid below the through recess **2037***c* so that the locking tooth **2059** on the engagement arm **2058** engages with stop tabs formed on the inner surface of the rear faceplate **2037**. Also, when the linear support member **2050** is inserted into the through recess **2037***c* beyond the predetermined position, the retaining projection **2052***a* on the elongated body **2052** of the linear support member **2050** engages with the rear faceplate assembly **2036** to prevent removal and disengagement of the linear support member **2050** from the rear faceplate assembly **2036**. The resulting disposable speculum **2000** has mechanical engagements between the different elements, which makes the speculum easy to assemble and which are sufficiently strong to withstand in-use conditions. The order in which the elements of the speculum **2000** are assembled are not limited to the order shown in FIGS. **14**B-**14**G, and may be varied.

(81) The materials used for forming the speculum of FIGS. **10-14** are similar to those of other speculums shown in other figures and described above. In certain embodiments, the speculum components are formed from plastic materials. Exemplary plastic materials that may be used for constructing the speculum of the present invention include, but are not limited to, polypropylene, polystyrene, and any composite of more than one of these plastics and polymers. The upper and lower members and the rear faceplate assembly may be molded from a colorless transparent or translucent plastic material, such as acrylic plastic, polycarbonate or the like. The rocker may be made from the same or similar materials as the speculum or from metallic materials. The linear support member may be formed from a polyester or polyamide material, such as nylon, or the like. The biasing member (spring) and the pin may be formed from metallic materials or from polymers and plastics. All of these components may be formed by injection molding, extrusion, using a 3D printer or any other suitable technique. In certain embodiments, the materials for forming the

speculum, including the upper and lower members, the rear faceplate assembly, the rocker and/or the linear support member, of the present invention include glass-fiber reinforced polymers, polyacrylamide compounds, thermoplastic crystalline polymers, thermoplastic crystalline polymers of aromatic diamines and aromatic dicarboxylic anhydrides, glass-fiber reinforced polyacrylamides, and other materials having sufficient rigidity and strength. Although in the illustrative embodiments, plastic and/or polymer materials are used for the components of the speculum, in other embodiments, some or all of the components may be formed from metallic or fiberglass materials.

(82) Although the embodiments described above are shown with a speculum, it is understood that the battery removal mechanisms may be used with other medical devices that use batteries, either as part of the illumination assembly or as part of another assembly that requires batteries. In addition to the specific embodiments described above, other variations may be made for safe removal of batteries without contaminating them with biological materials, as would be appreciated to those of ordinary skill in the art. Therefore, it is to be understood that other expedients/variations may be employed but that stay within the meaning, scope and spirit of the invention.

(83) In all cases it is understood that the above-described arrangements are merely illustrative of the many possible specific embodiments which represent applications of the present invention. Numerous and varied other arrangements, including use of different materials and various configurations of components of the speculum or another medical device, can be readily devised without departing from the spirit and scope of the invention.

(84) This application claims priority to provisional patent application Nos. 62/649,190 filed on Mar. 28, 2018, 62/574,969 filed on Oct. 20, 2017 and 62/574,412 filed on Oct. 19, 2017, the disclosures of which are incorporated herein by reference.

Claims

1. A battery-powered medical device comprising: an outer housing having an opening formed therein; at least one power source housed within the outer housing, the outer housing being configured to at least partially enclose the at least one power source so as to prevent contamination of the at least one power source with biohazardous materials, and the at least one power source being removable from the outer housing via the opening; a cover configured to cover the opening in the outer housing and to retain the at least one power source within the outer housing, and an actuator provided within the outer housing that directly engages with a portion of the at least one power source when the cover covers the opening in the outer housing, wherein the cover is configured to be operated to expose the opening in the outer housing, wherein when the cover is operated to expose the opening, the actuator is configured to undergo a rotational motion with respect to the outer housing to pull the at least one power source from the outer housing and the outer housing is configured to release the at least one power source via the opening without requiring physical contact between the user and the at least one power source, wherein the outer housing comprises a handle and an operative portion coupled to the handle, and wherein the opening in the outer housing extends through at least a portion of the handle in a direction that is substantially perpendicular to a longitudinal axis of the handle.

2. The battery-powered medical device of claim 1, wherein the actuator loops around a portion of the at least one power source.

3. The battery-powered medical device of claim 1, wherein the medical device is one of a retractor and a suction device.

4. The battery-powered medical device of claim 1, wherein the at least one power source is housed in the handle.

5. The battery-powered medical device in accordance with claim 1, further comprising an illumination assembly including at least one light source, wherein the at least one power source is

configured to power the at least one light source.
6. The battery-powered medical device in accordance with claim 5, wherein the at least one light source is provided on the operative portion and the at least one power source is housed in the handle.
7. The battery-powered medical device of claim 1, wherein the outer housing has an end region and a sidewall extending from the end region, and wherein the opening is formed in the sidewall such that the at least one power source is removable from the outer housing through the opening in the sidewall along a lateral direction that is perpendicular to the longitudinal axis of the handle.
8. The battery-powered medical device in accordance with claim 1, wherein the actuator extends across the opening in the outer housing.