PATENTS

DESIGNED BY ROB ROY | 2006

Since founding Switch in 2000, Rob Roy has transformed the way data center ecosystems are engineered and utilized.

As CEO, founder, chief inventor and designer of Switch data centers, he has been continually innovating and improving technologies to build smarter, stronger, faster, safer and more efficient data center elements.

With more than 950+ issued and pending patent claims for mission critical facility systems, designs and related industry technologies, Rob Roy's inventions and thought leadership have changed the industry landscape and created a new standard of excellence for technology solutions ecosystems.

Switch's patented technology makes possible the world's only Tier 5® Platinum data centers.

US008523643B1

(12) **United States Patent**
Roy/Rob

(10) **Patent No.: US 8,523,643 B1**
(45) **Date of Patent: Sep. 3, 2013**

(54) **ELECTRONIC EQUIPMENT DATA CENTER OR CO-LOCATION FACILITY DESIGNS AND METHODS OF MAKING AND USING THE SAME**

(75) Inventor: **Rob Roy,** Las Vegas, NV (US)

(73) Assignee: **Switch Communications Group LLC,** Las Vegas, NV (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1098 days.

(21) Appl. No.: **12/384,109**

(22) Filed: **Mar. 30, 2009**

Related U.S. Application Data

(63) Continuation-in-part of application No. 12/138,771, filed on Jun. 13, 2008.

(60) Provisional application No. 60/944,082, filed on Jun. 14, 2007, provisional application No. 61/040,636,

Initial Filing June 14, 2007

(51) **Int. Cl.**
G06F 1/16 (2006.01)

(52) **U.S. Cl.**
USPC **454/184**

(58) **Field of Classification Search**
USPC 454/184
See application file for complete search history.

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2005/0225936	A1	10/2005	Day	
2005/0278070	A1	12/2005	Bash et al.	
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2007/0064389	A1 *	3/2007	Lewis et al.	361/690
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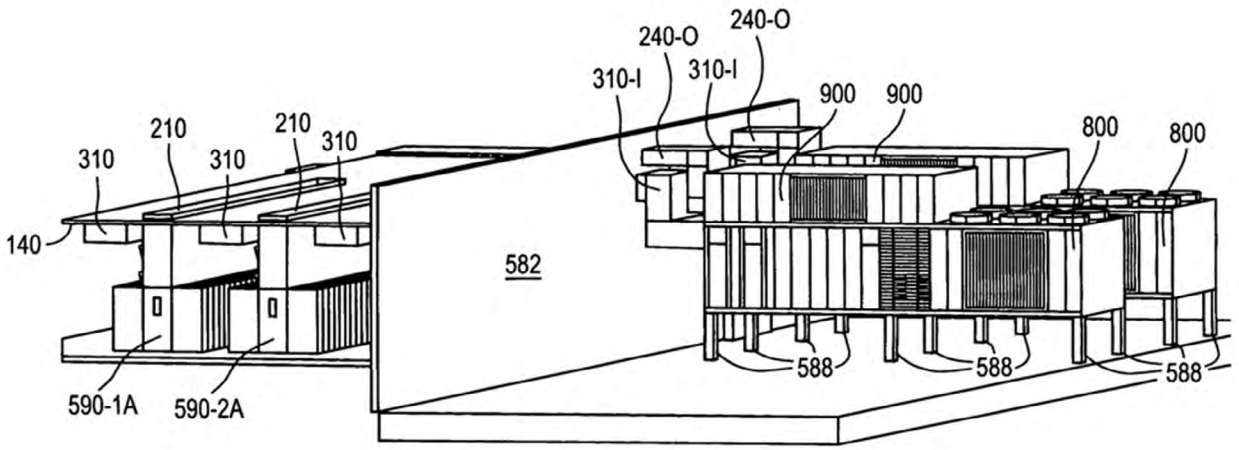
(Continued)

Primary Examiner — Steven B McAllister
Assistant Examiner — Samantha Miller
(74) *Attorney, Agent, or Firm* — Pillsbury Winthrop Shaw Pittman LLP

(57) **ABSTRACT**

Described herein is an integrated data center that provides for efficient cooling, as well as efficient wire routing.

12 Claims, 19 Drawing Sheets



US008072780B1

(12) **United States Patent**
Roy/Rob

(10) **Patent No.: US 8,072,780 B1**
(45) **Date of Patent: Dec. 6, 2011**

(54) **INTEGRATED WIRING SYSTEM AND THERMAL SHIELD SUPPORT APPARATUS FOR A DATA CENTER**

(75) Inventor: **Rob Roy,** Las Vegas, NV (US)

(73) Assignee: **Switch Communications Group LLC,** Las Vegas, NV (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 181 days.

(21) Appl. No.: **12/384,105**

(22) Filed: **Mar. 30, 2009**

Related U.S. Application Data

(63) Continuation-in-part of application No. 12/138,771, filed on Jun. 13, 2008.

(60) Provisional application No. 61/040,636, filed on Mar. 28, 2008, provisional application No. 60/944,082,

Initial Filing June 14, 2007

(51) **Int. Cl.**
H02B 1/01 (2006.01)

(52) **U.S. Cl.** **361/825**

(58) **Field of Classification Search** 361/825
See application file for complete search history.

(56) **References Cited**

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6,862,179	B2	3/2005	Beitelmal et al.	
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2005/0225936	A1	10/2005	Day	
2005/0278070	A1	12/2005	Bash et al.	
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2006/0187636	A1 *	8/2006	Fink et al.	361/695
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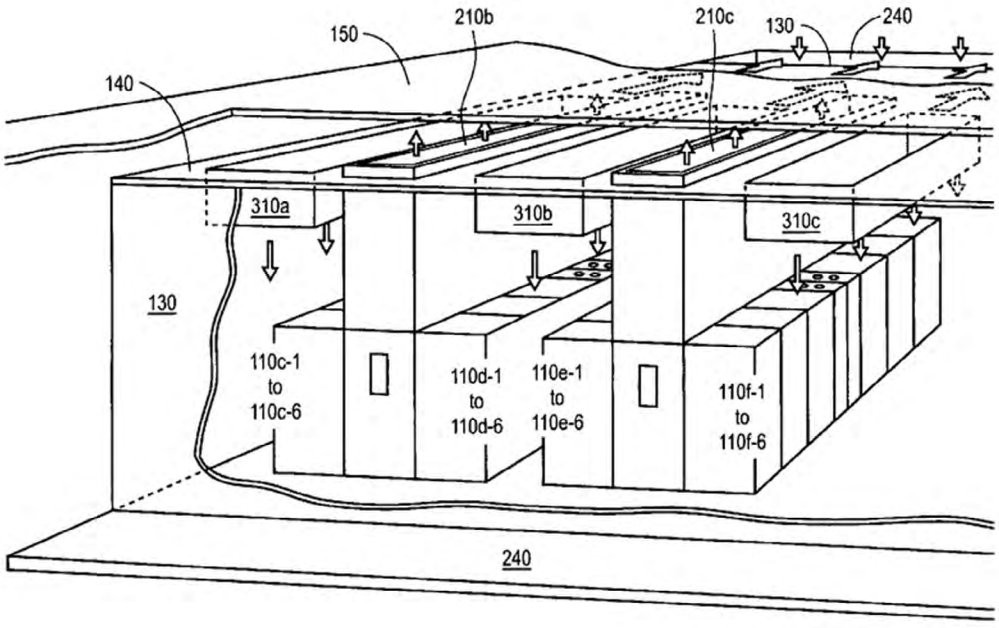
Primary Examiner — Jeremy Norris
Assistant Examiner — Tremesha S Willis
(74) *Attorney, Agent, or Firm* — Pillsbury Winthrop Shaw Pittman LLP

(57) **ABSTRACT**

Described herein is an integrated data center that provides for efficient cooling, as well as efficient wire routing, and in particular a support for a thermal shield, distribution wiring, as well as cabinet cluster wiring.

8 Claims, 19 Drawing Sheets



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US008469782B1

(12) **United States Patent**
Roy/Rob

(10) **Patent No.: US 8,469,782 B1**
(45) **Date of Patent: Jun. 25, 2013**

(54) **DATA CENTER AIR HANDLING UNIT**

(75) Inventor: **Rob Roy,** Las Vegas, NV (US)

(73) Assignee: **Switch Communications Group, LLC,** Las Vegas, NV (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 998 days.

(21) Appl. No.: **12/384,102**

(22) Filed: **Mar. 30, 2009**

Related U.S. Application Data

(63) Continuation-in-part of application No. 12/138,771, filed on Jun. 13, 2008.

(60) Provisional application No. 60/944,082, filed on Jun. 14, 2007, provisional application No. 61/040,636,

Initial Filing June 14, 2007

(51) **Int. Cl.**
F25B 23/00 (2006.01)

(52) **U.S. Cl.**
USPC **454/187**; 454/184; 62/119

(58) **Field of Classification Search**
USPC 454/184, 237, 238, 248; 62/119, 62/310, 314
See application file for complete search history.

(56) **References Cited**

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6,862,179	B2	3/2005	Beitelmal et al.	
7,542,287	B2	6/2009	Lewis et al.	
7,787,260	B2	8/2010	Hruby et al.	
7,804,685	B2	9/2010	Krietzman	
8,037,644	B2	10/2011	Hall	
8,040,673	B2	10/2011	Krietzman	
8,113,010	B2	2/2012	Carlson	
8,144,467	B2	3/2012	Campbell et al.	
8,209,993	B2	7/2012	Carlson et al.	
8,223,495	B1	7/2012	Carlson et al.	
8,257,155	B2	9/2012	Lewis	
8,282,451	B2	10/2012	Taylor	
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2005/0170770	A1	8/2005	Johnson et al.	
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2006/0146520	A1	7/2006	Vitense et al.	
2006/0187636	A1	8/2006	Fink et al.	
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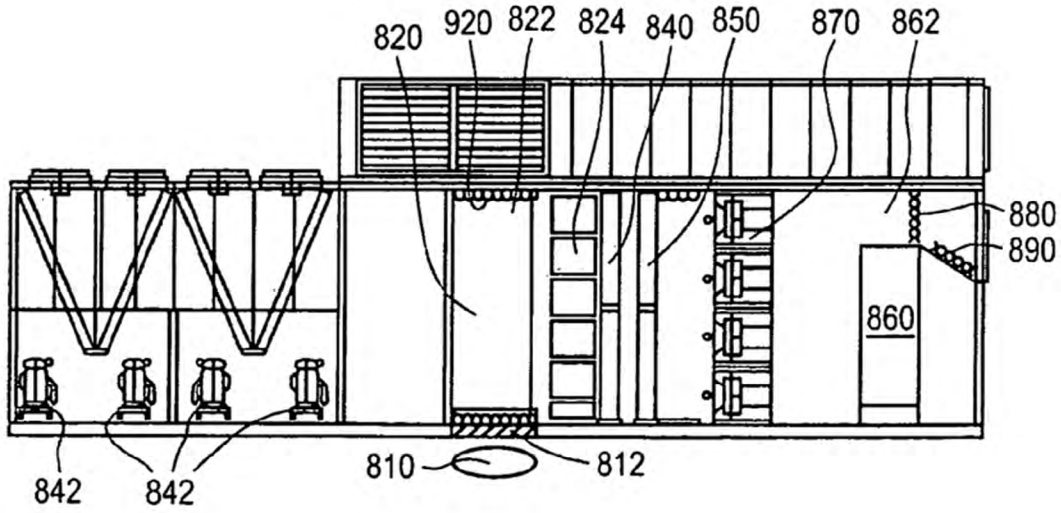
Primary Examiner — Steven B McAllister
Assistant Examiner — Samantha Miller
(74) *Attorney, Agent, or Firm* — Pillsbury Winthrop Shaw Pittman LLP

(57) **ABSTRACT**

Described herein is an air handling unit for use in an integrated data center that provides for efficient cooling.

13 Claims, 19 Drawing Sheets



[Click here (http://goo.gl/bbkCzE) for text/images via the USPTO]

US008180495B1

(12) **United States Patent**
Roy/Rob

(10) **Patent No.: US 8,180,495 B1**
(45) **Date of Patent: May 15, 2012**

(54) **AIR HANDLING CONTROL SYSTEM FOR A DATA CENTER**

(75) Inventor: **Rob Roy,** Las Vegas, NV (US)

(73) Assignee: **Switch Communications Group LLC,** Las Vegas, NV (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 149 days.

(21) Appl. No.: **12/384,111**

(22) Filed: **Mar. 30, 2009**

Related U.S. Application Data

(63) Continuation-in-part of application No. 12/138,771, filed on Jun. 13, 2008.

(60) Provisional application No. 60/944,082, filed on Jun. 14, 2007, provisional application No. 61/040,636,

Initial Filing June 14, 2007

(51) **Int. Cl.**
G05D 23/19 (2006.01)

(52) **U.S. Cl.** **700/278**; 361/679.47; 361/691; 454/184; 165/67

(58) **Field of Classification Search** 700/278; 361/679.47, 691; 454/184; 165/67
See application file for complete search history.

(56) **References Cited**

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6,034,873	A	3/2000	Stahl et al.	
6,822,859	B2	11/2004	Coglitore et al.	
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2006/0187636	A1	8/2006	Fink et al.	
2006/0260338	A1	11/2006	VanGilder et al.	
2007/0040263	A1	2/2007	Towada	
2007/0064389	A1	3/2007	Lewis, II et al.	
2007/0078635	A1	4/2007	Rasmussen et al.	
2008/0305733	A1	12/2008	Noteboom et al.	
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2010/0061059	A1	3/2010	Krietzman et al.	
2011/0143644	A1	6/2011	McMahan et al.	

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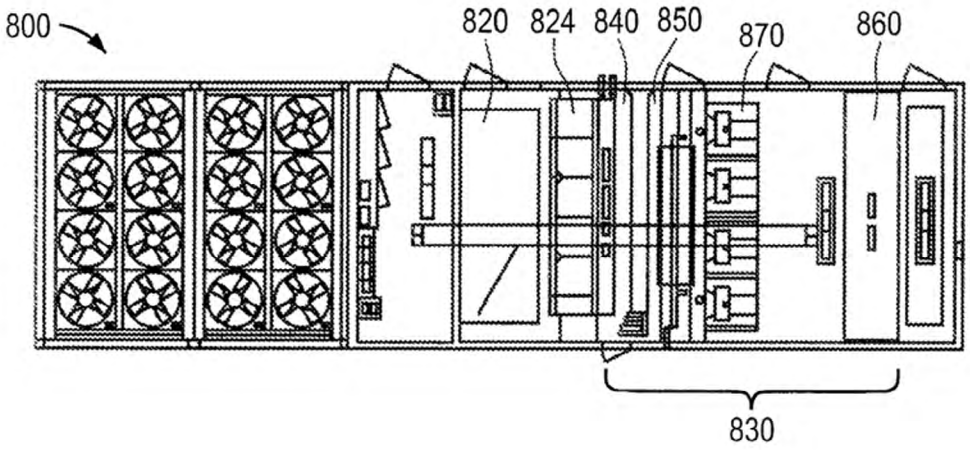
Primary Examiner — Kakali Chaki
Assistant Examiner — Tejal Gami
(74) *Attorney, Agent, or Firm* — Pillsbury Winthrop Shaw Pittman LLP

(57) **ABSTRACT**

Described herein is an integrated data center that provides for efficient cooling, as well as efficient wire routing, and in particular a control system for controlling the temperature and pressure within the data center.

34 Claims, 19 Drawing Sheets



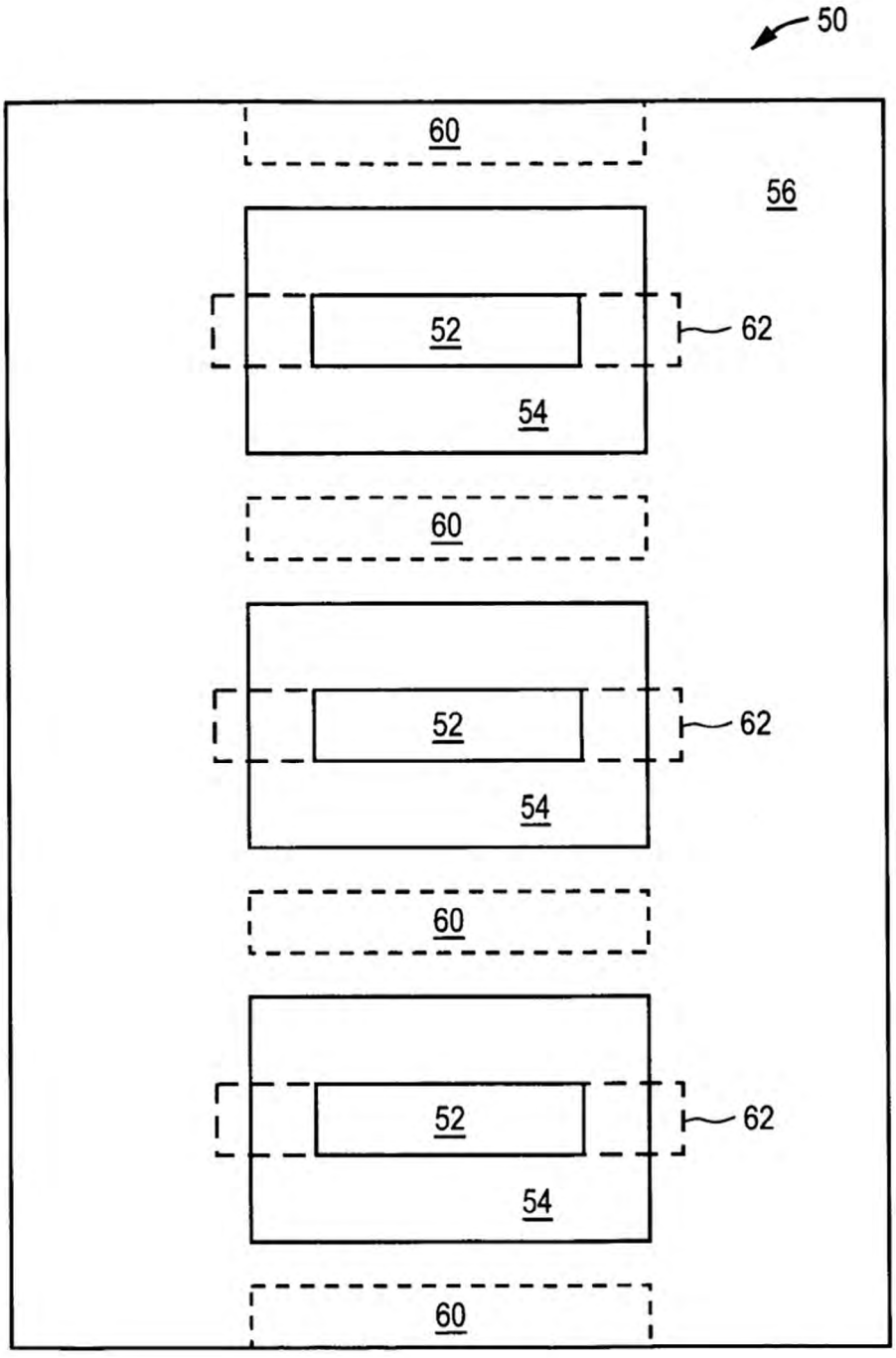


FIG. 1A

T-SCIF (Multi-Cabinet Heat Containment Rows)
Floor Layout and Segregation Designs

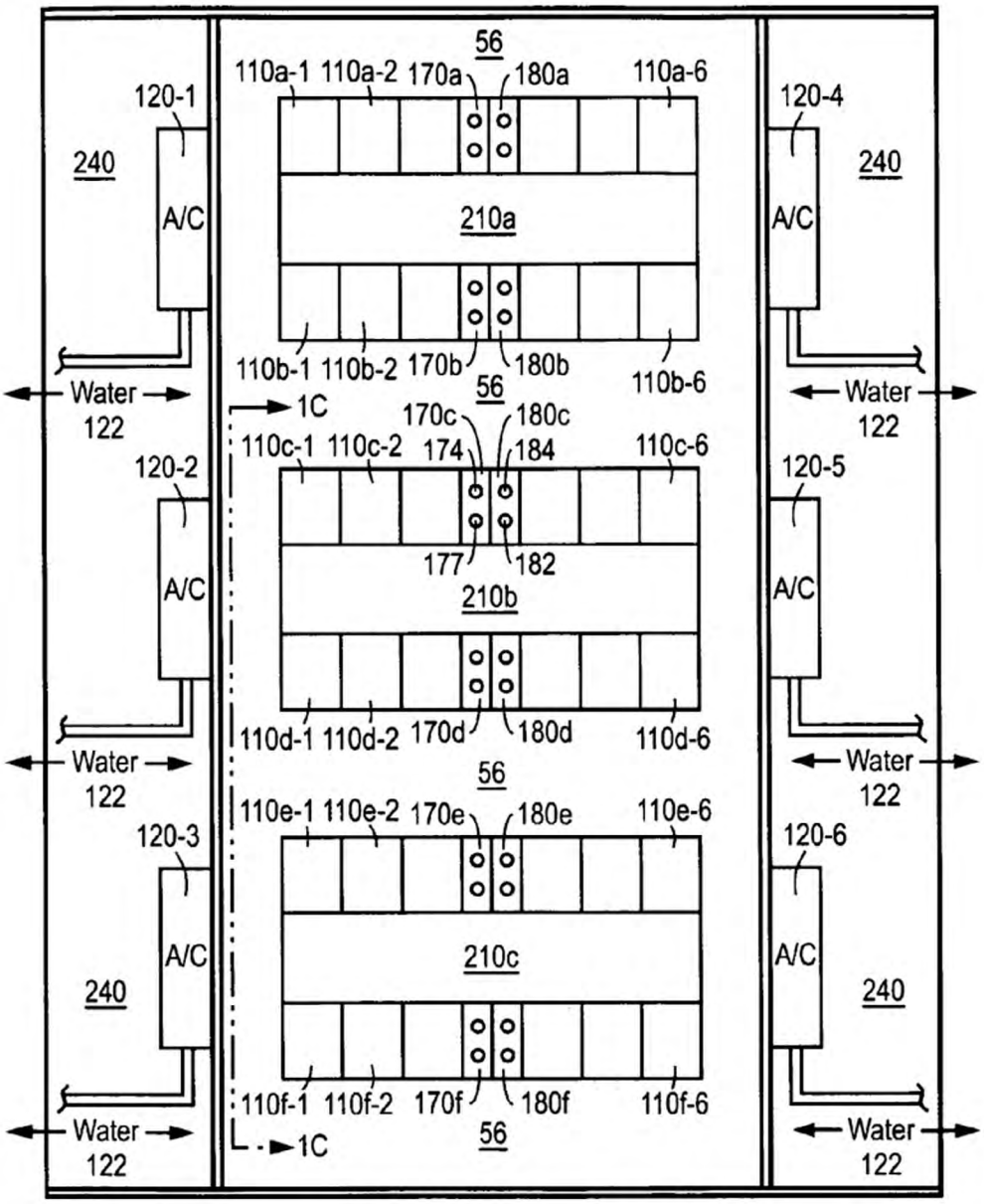


FIG. 1B

T-SCIF (Multi-Cabinet Heat Containment Rows)
Floor Layout and Segregation Designs Combined with Hot Aisles and Separated C.R.A.C. Unit Locations

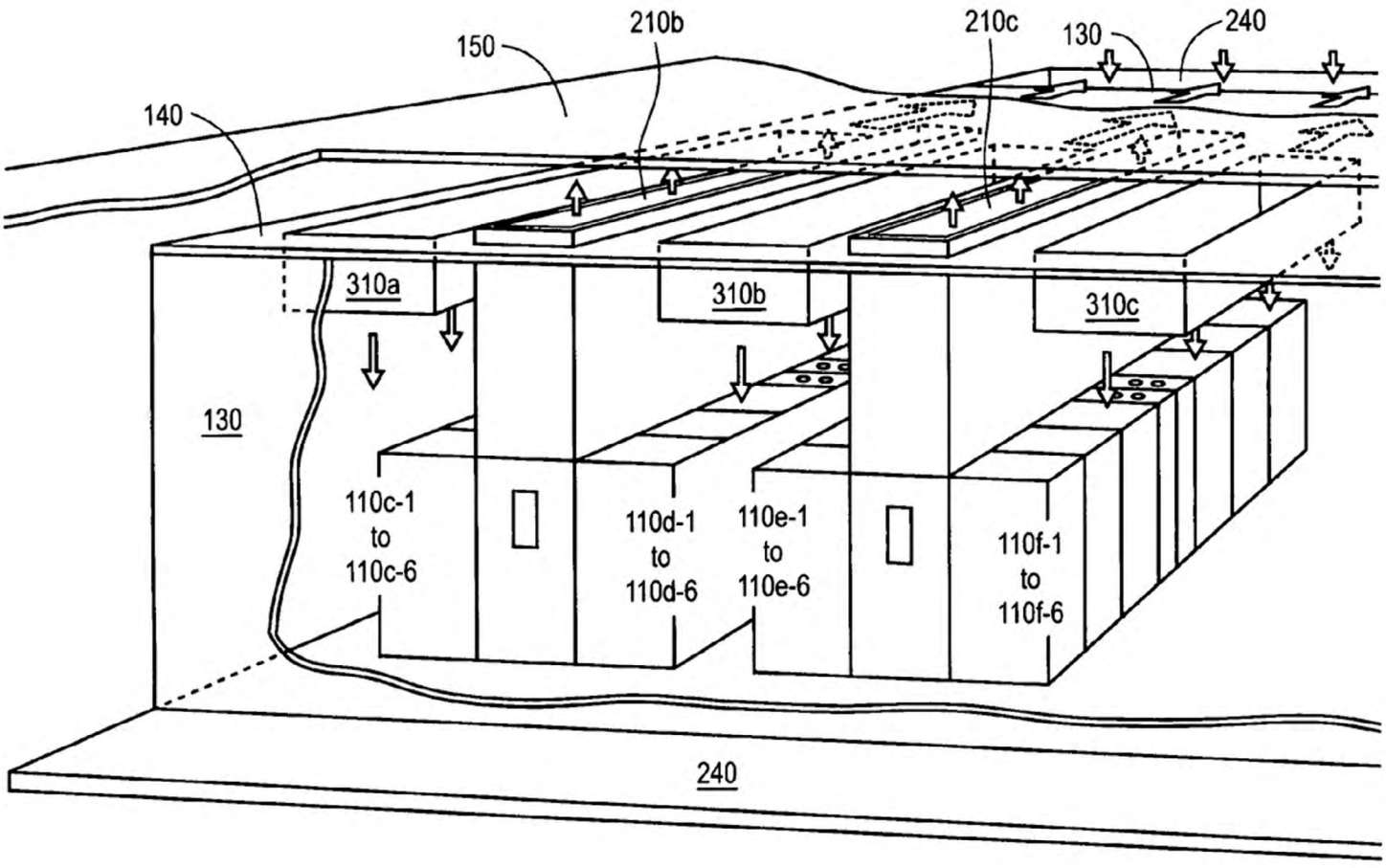


FIG. 1C

T-SCIF (Multi-Cabinet Heat Containment Rows) Heat Containment Pods
100% Heat and Cooling Separation Chambers (2006)

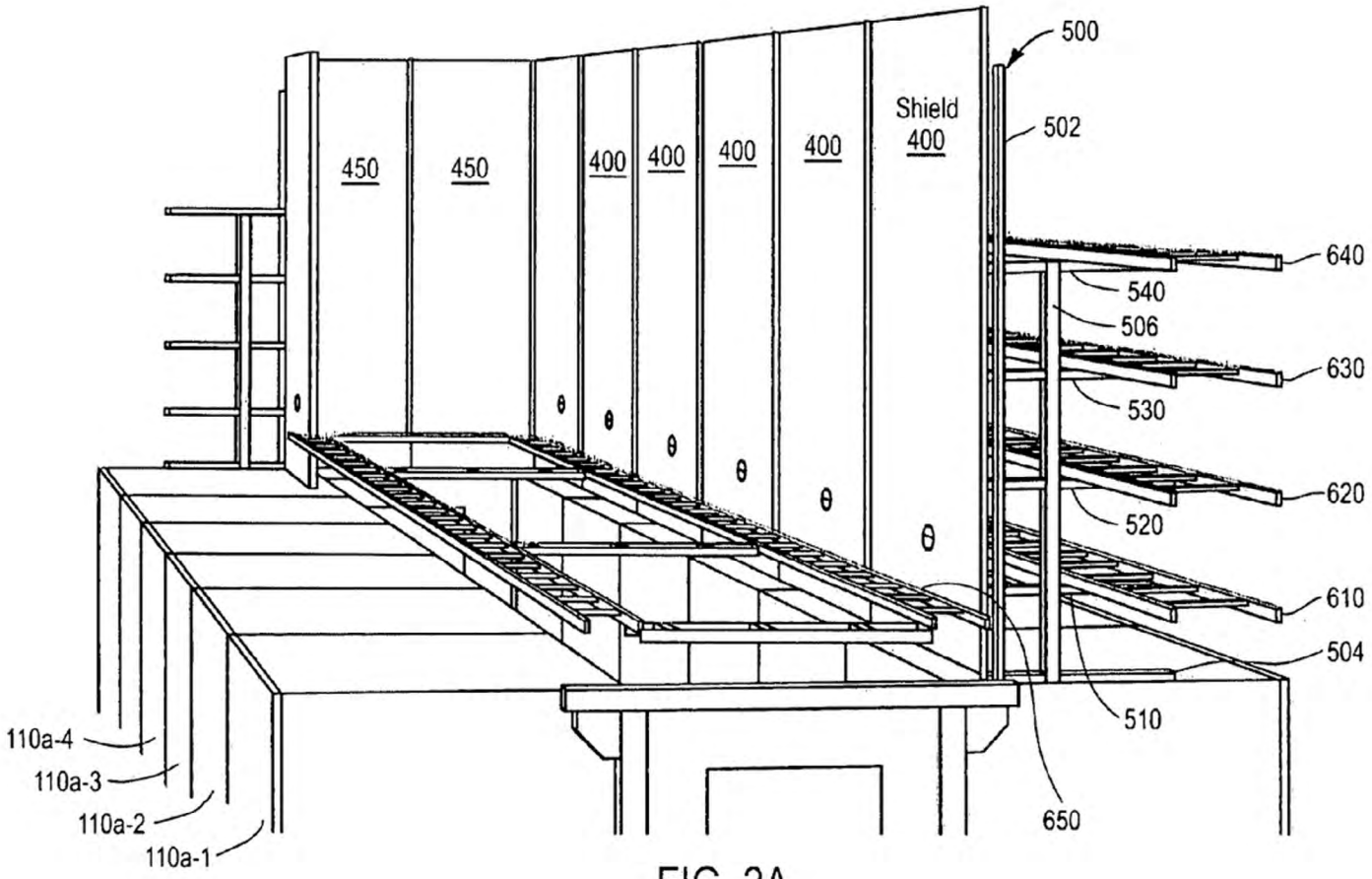


FIG. 2A

T-SCIF (Multi-Cabinet Heat Containment Rows) Heat Shield Designs

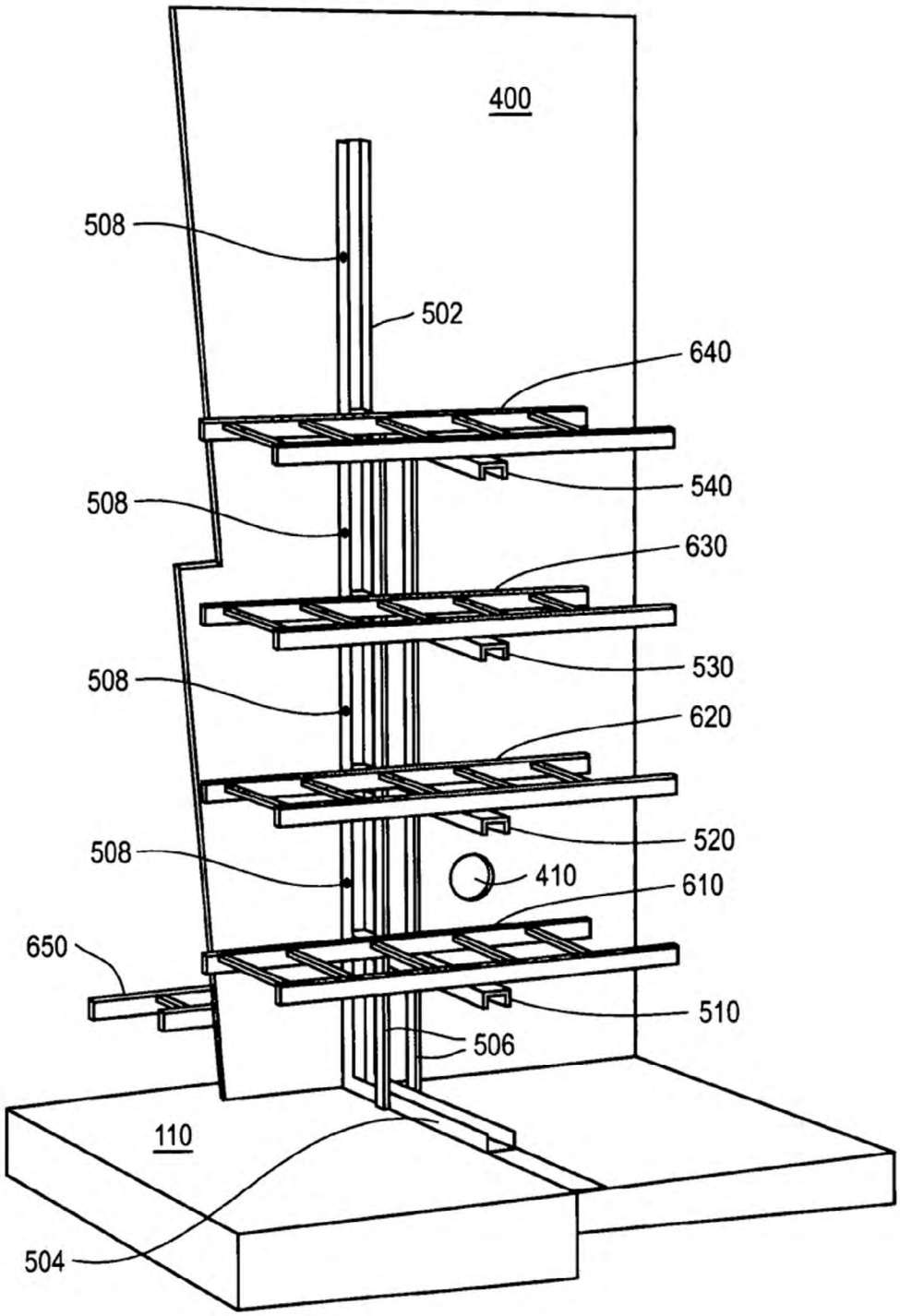


FIG. 2B

T-SCIF (Multi-Cabinet Heat Containment Rows) Heat Shield Designss

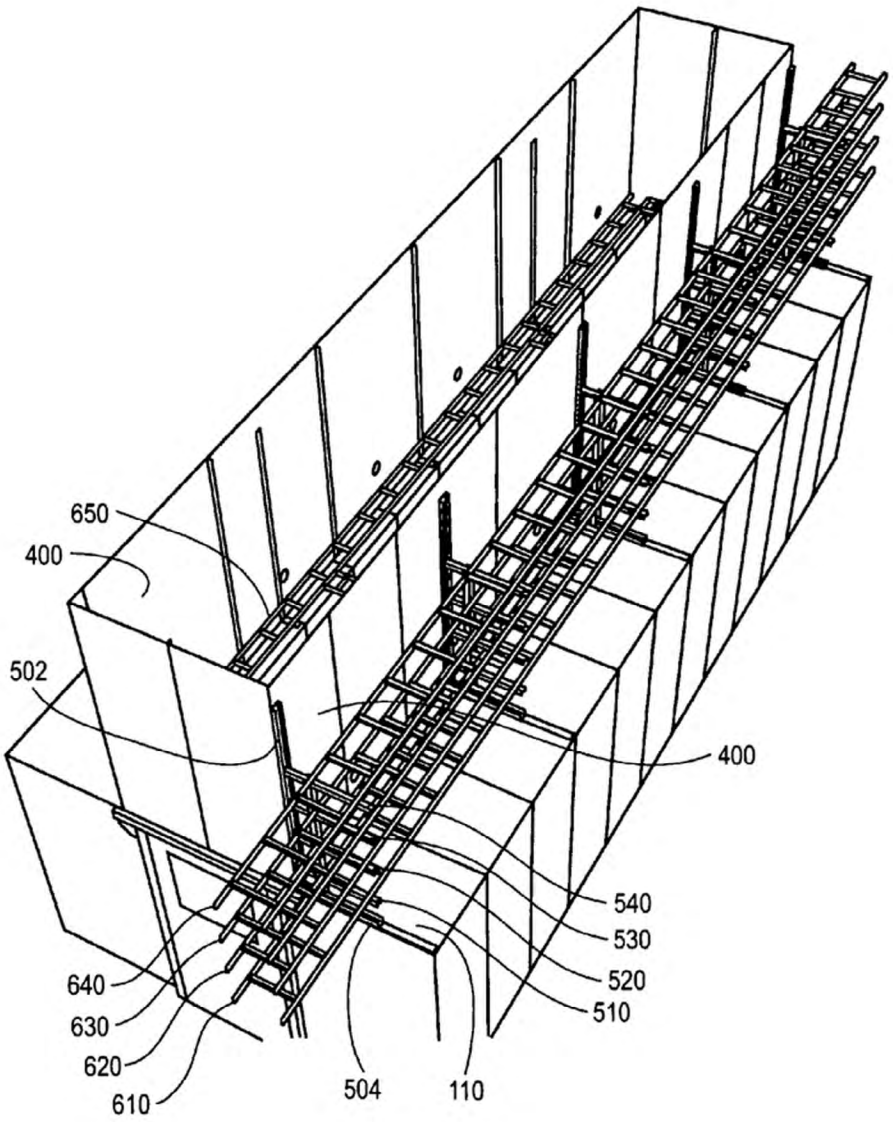


FIG. 2C

T-SCIF (Multi-Cabinet Heat Containment Rows) Heat Shield Designs

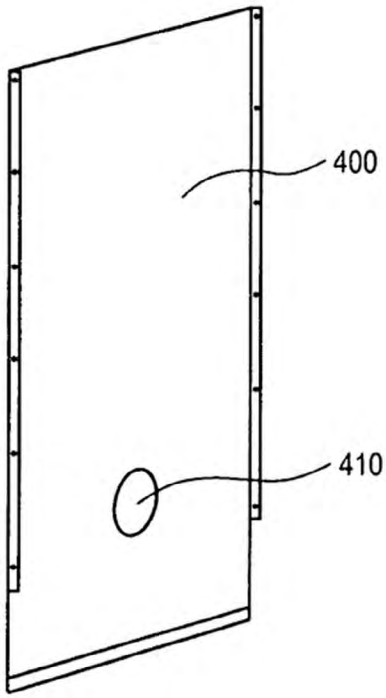


FIG. 3A

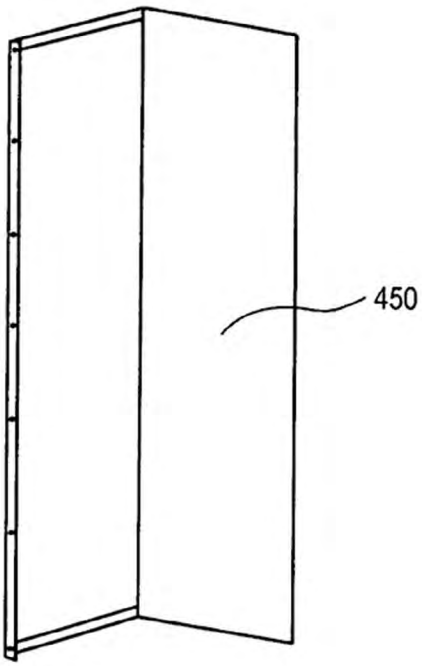


FIG. 3B

T-SCIF (Multi-Cabinet Heat Containment Rows) Heat Shield Designs

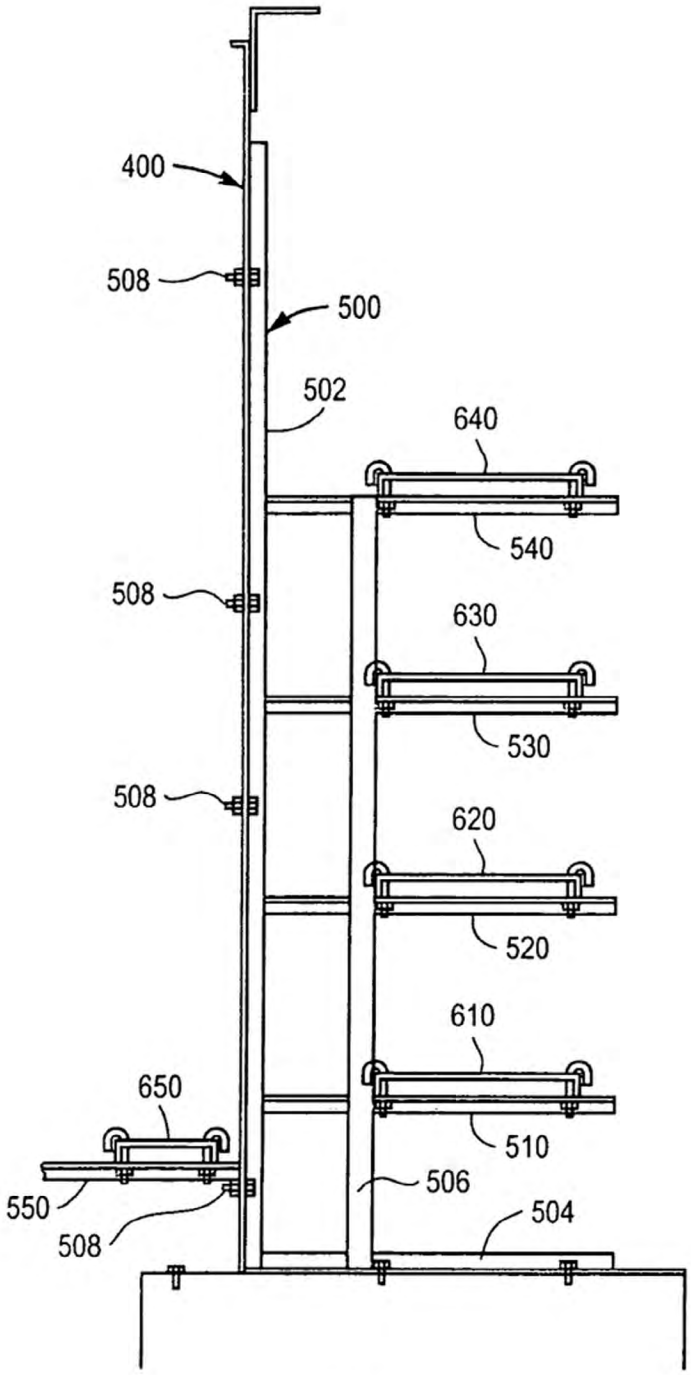


FIG. 4

Switch Stantion Support Design

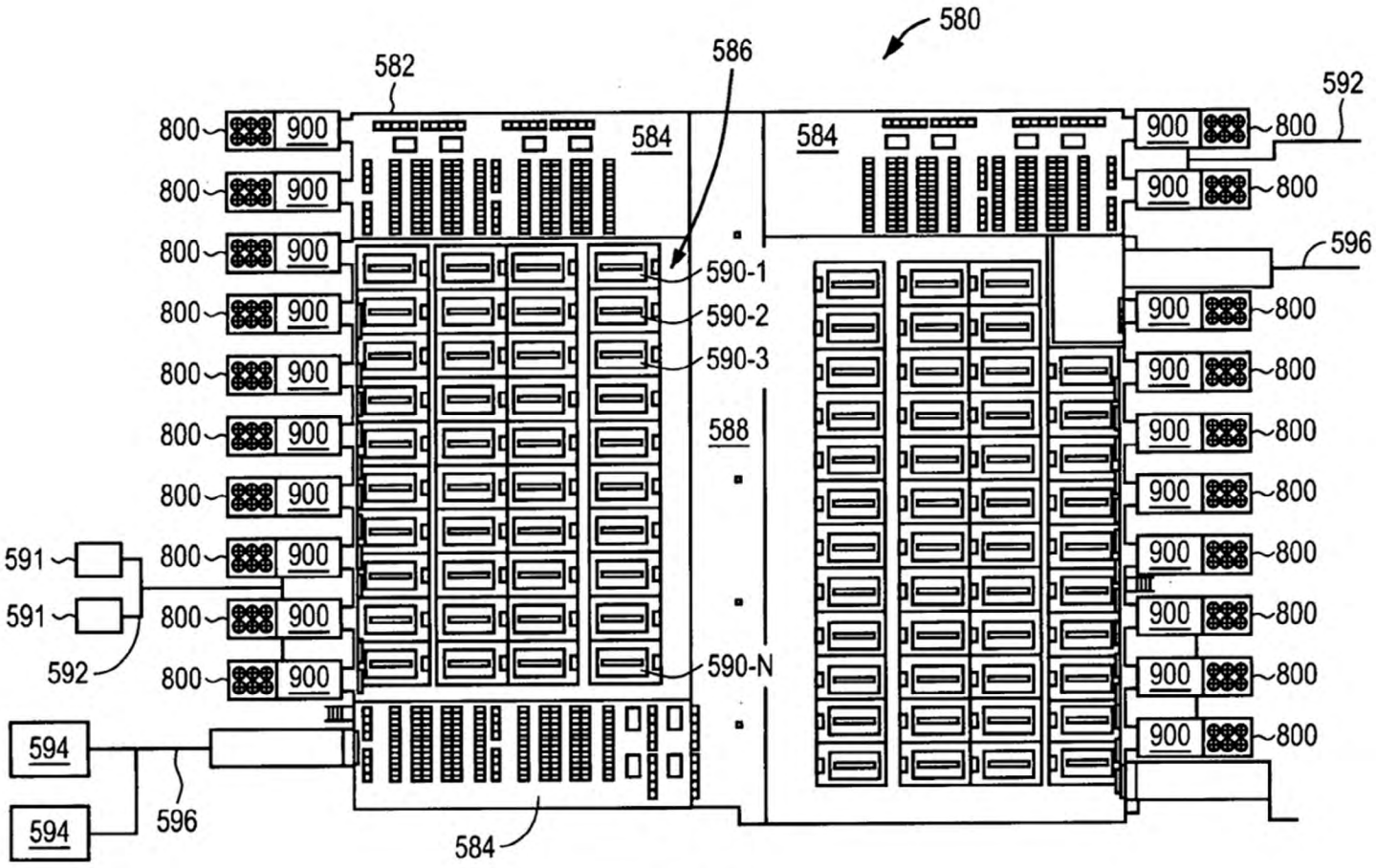


FIG. 5A

Switch MOD - W.D.M.D. (Wattage Density Modular Design)

Switch's Highly Efficient 100% Heat Segregated Data Center Ecosystem

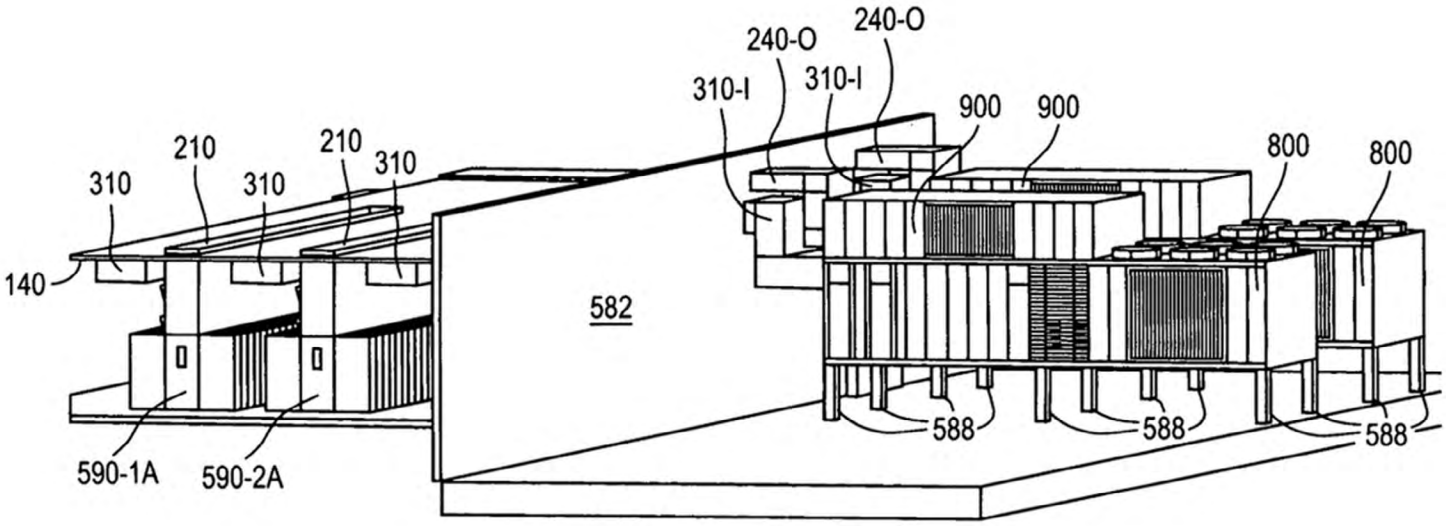


FIG. 5B1

TSC (Multi-System Exterior Wall Penetrating HVAC Units)
Shown Connected to the T-SCIF (Multi-Cabinet Heat Containment Rows)
Data Center Environment

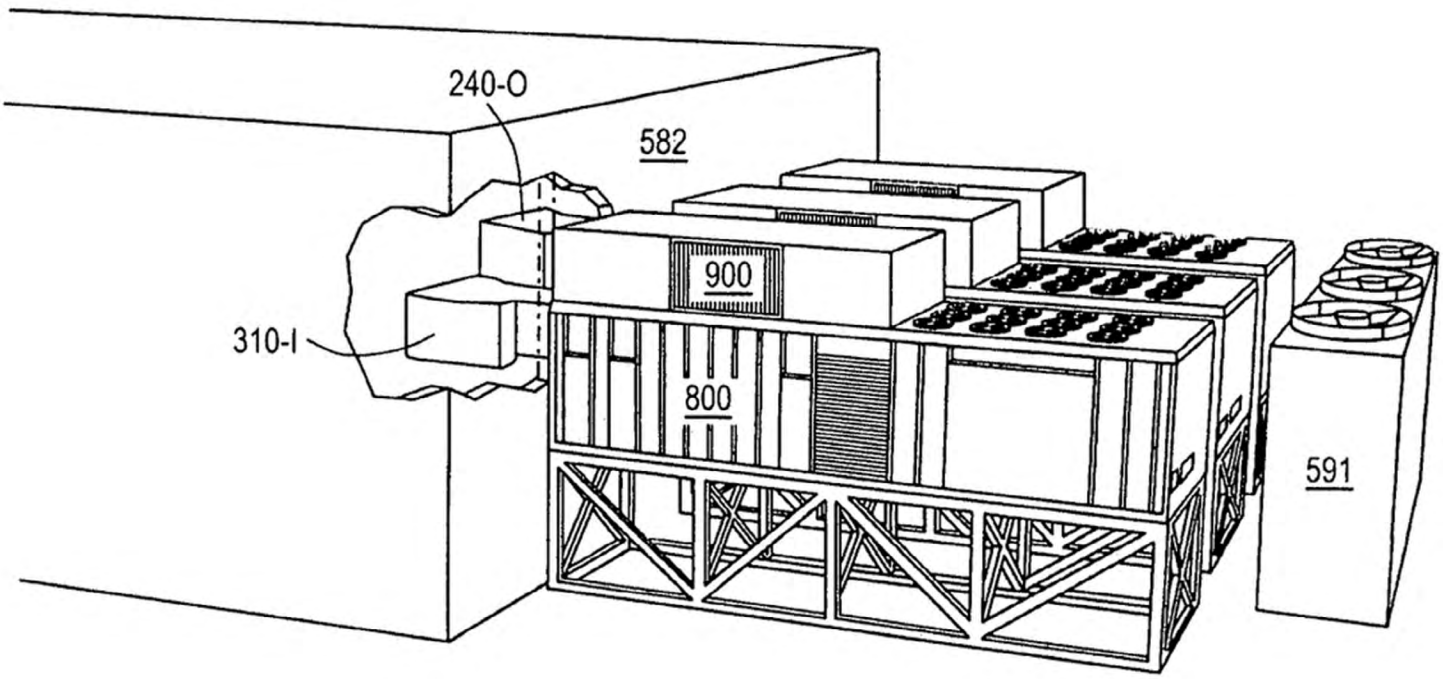


FIG. 5B2

TSC (Multi-System Exterior Wall Penetrating HVAC Units)
Switch's "Connect and Cool" Modular HVAC Designs

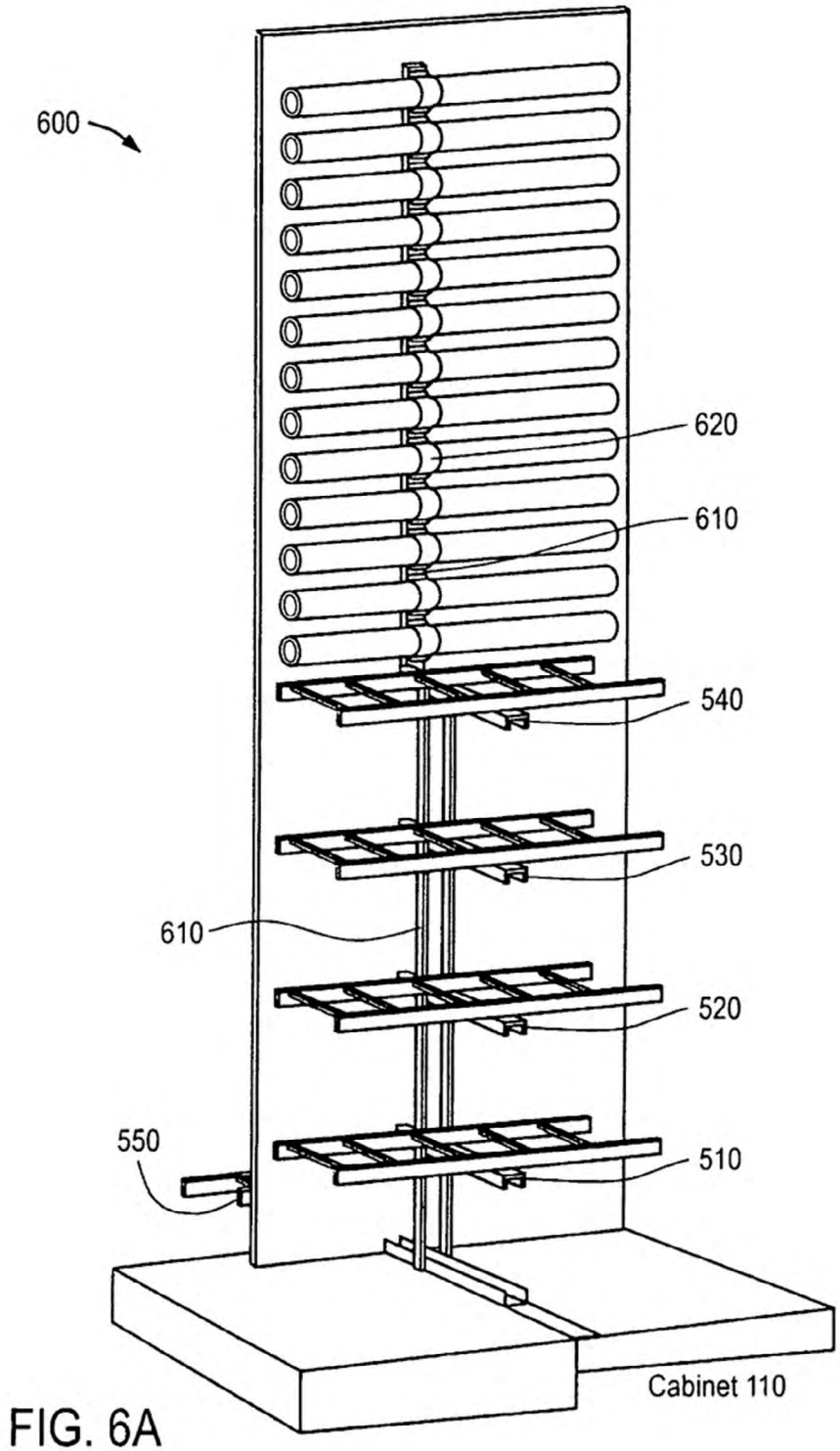


FIG. 6A

Switch Stantion Support Design Version 1

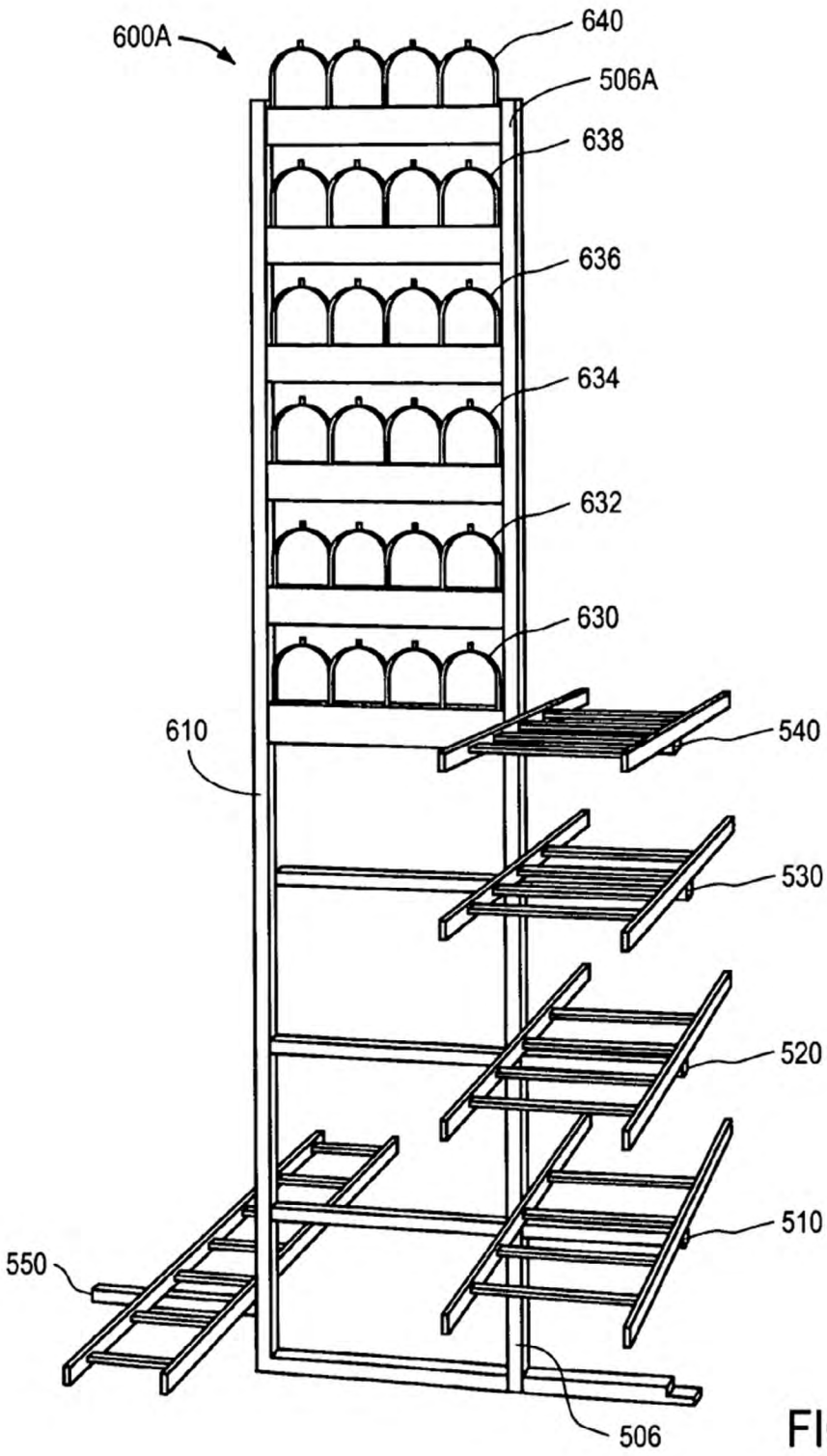


FIG. 6B

Switch Stantion Support Design Version 2

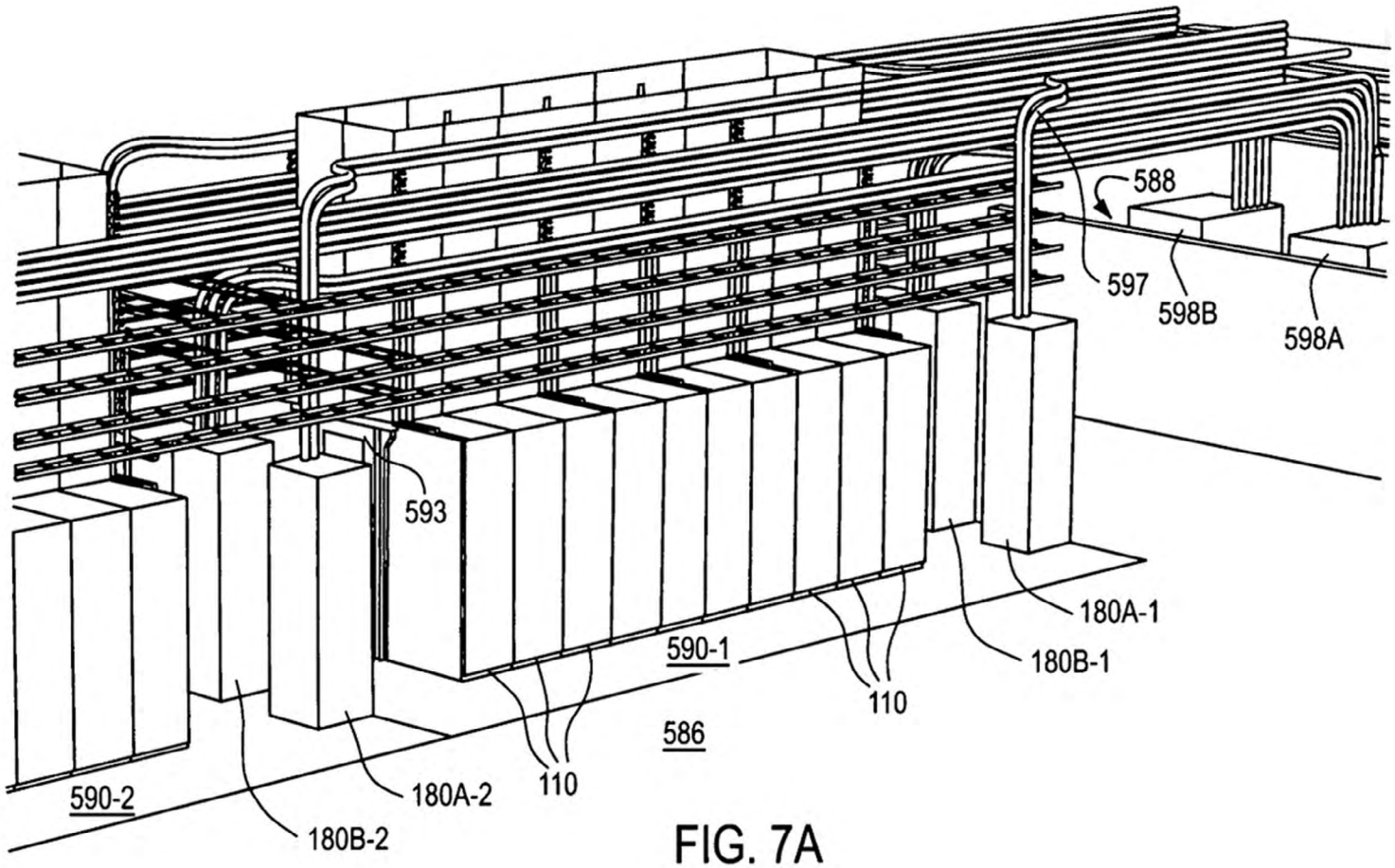


FIG. 7A

T-SCIF (Multi-Cabinet Heat Containment Rows) Heat Containment Pods
Power and Cabling Pathway Designs

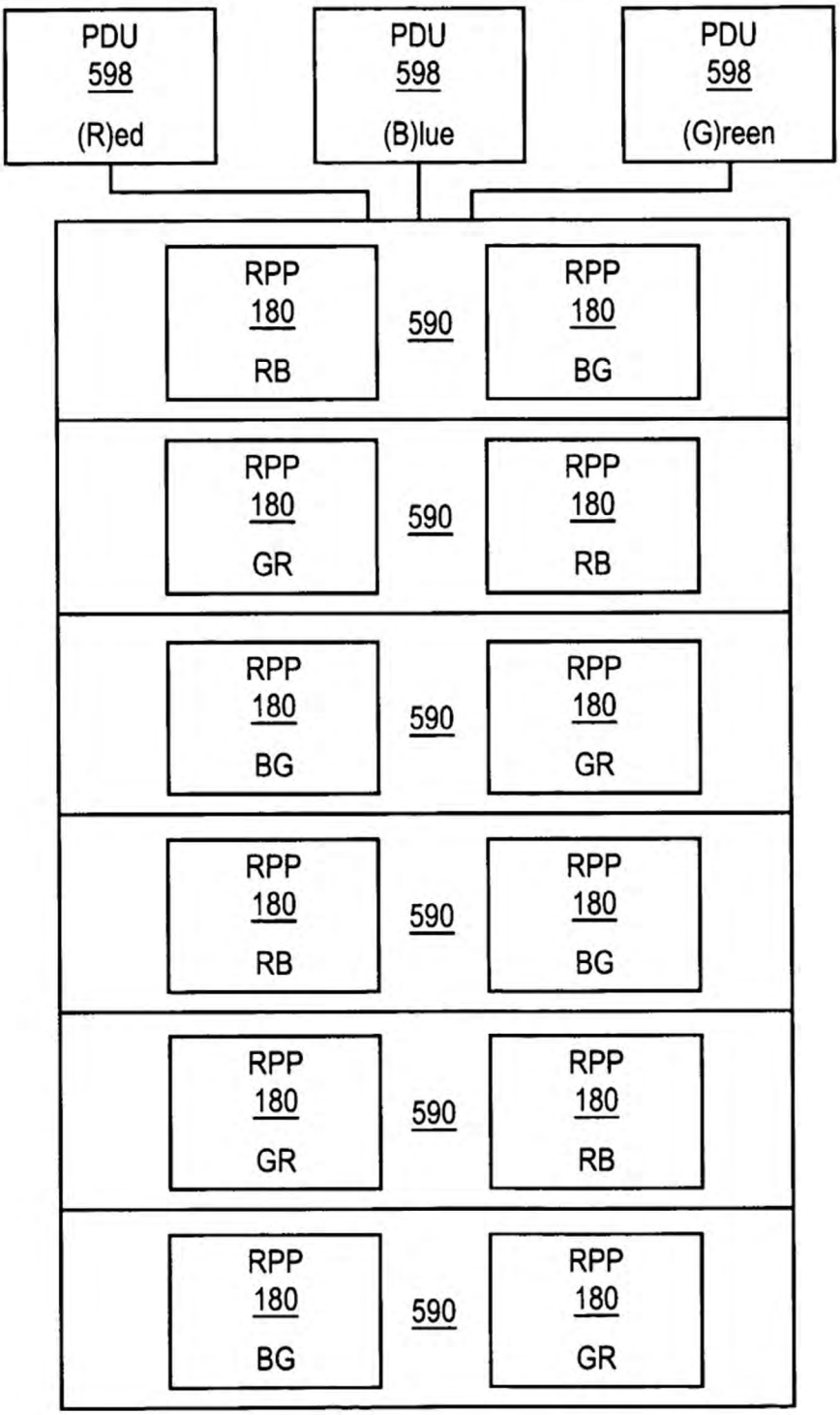


FIG. 7B

Tri-Redundant Power Layout and Color Segregation Designs and Concepts

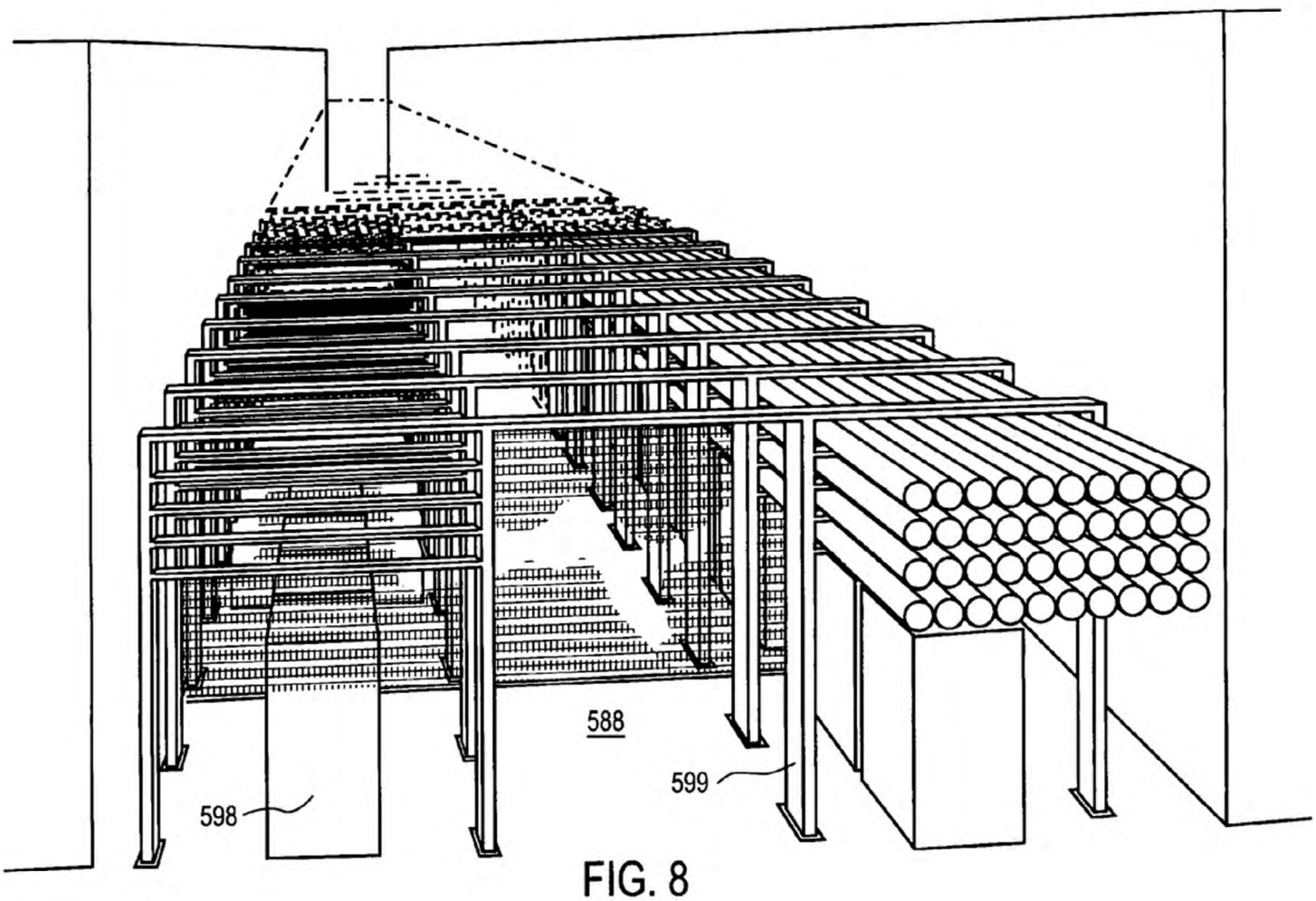


FIG. 8

The Switch Power Spine Design

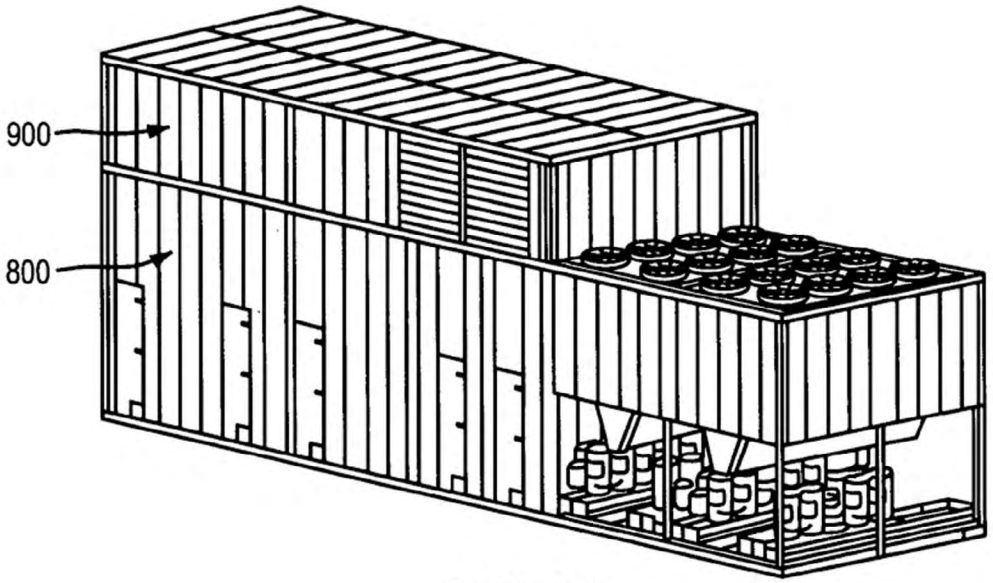


FIG. 9A

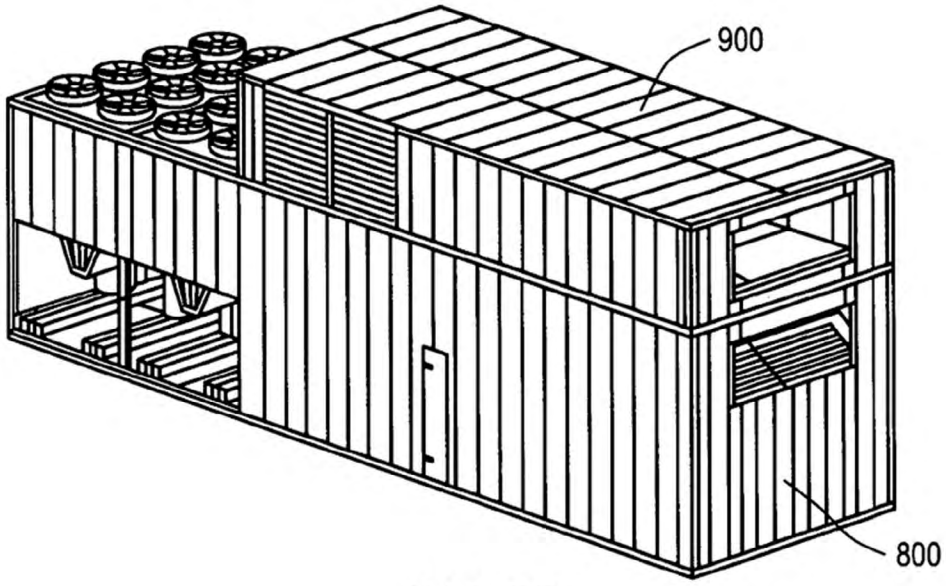


FIG. 9B

TSC (Multi-System Exterior Wall Penetrating HVAC Units)
Modular Design Specifications

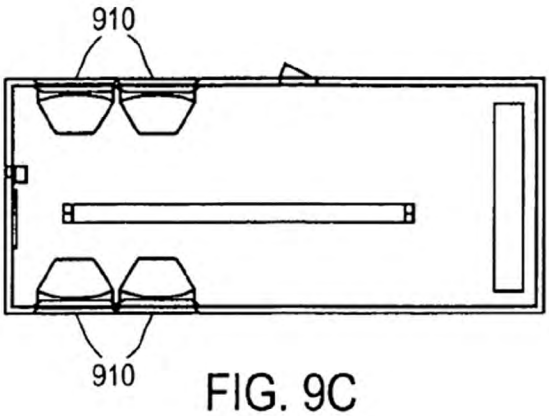


FIG. 9C

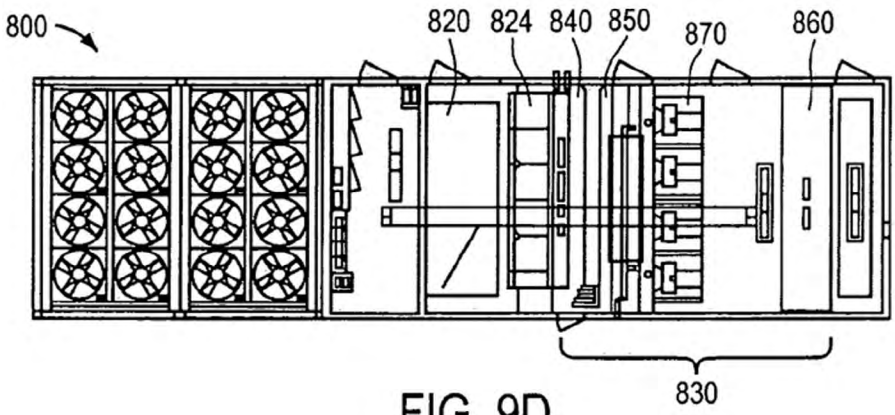


FIG. 9D

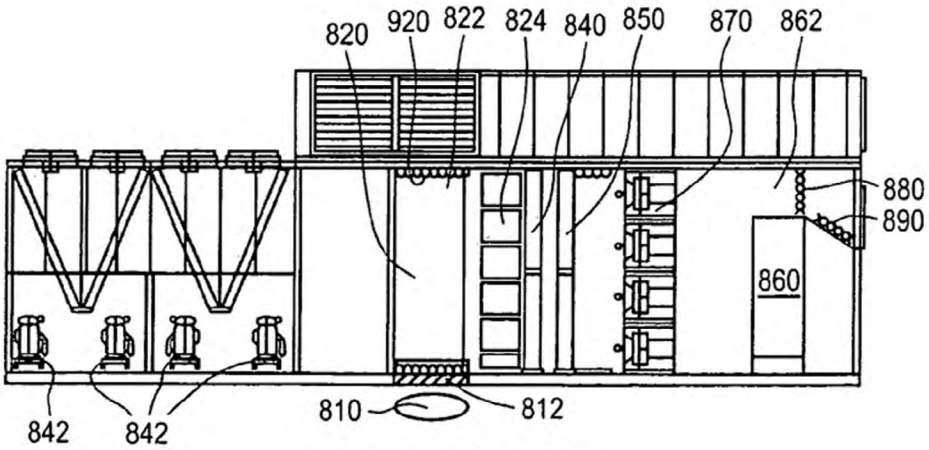


FIG. 9E

TSC (Multi-System Exterior Wall Penetrating HVAC Units)
Designs Showing Switch's Pioneering Multi-System HVAC Chambers

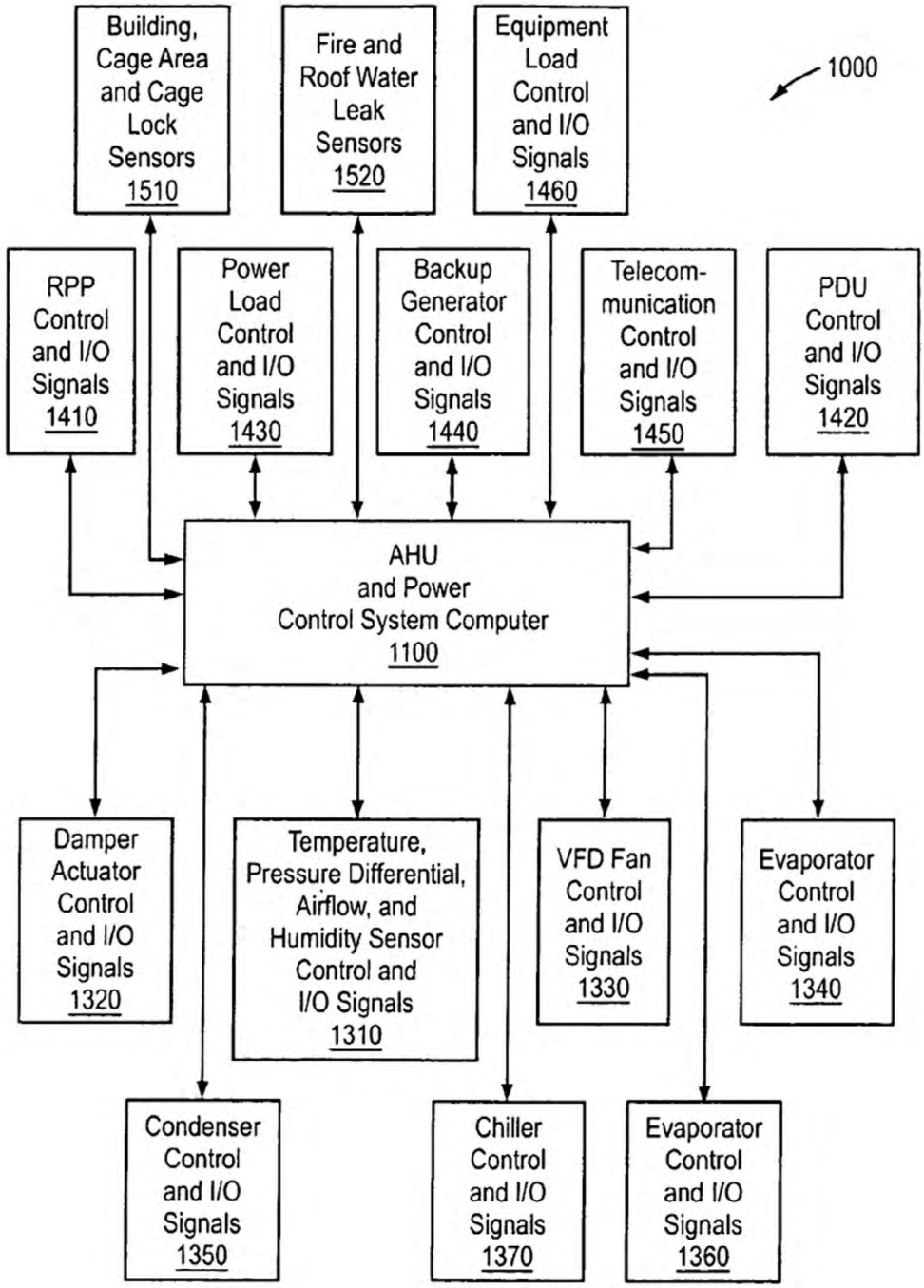


FIG. 10

Designs for Switch's "Living Data Center"

Data Center Building Management System

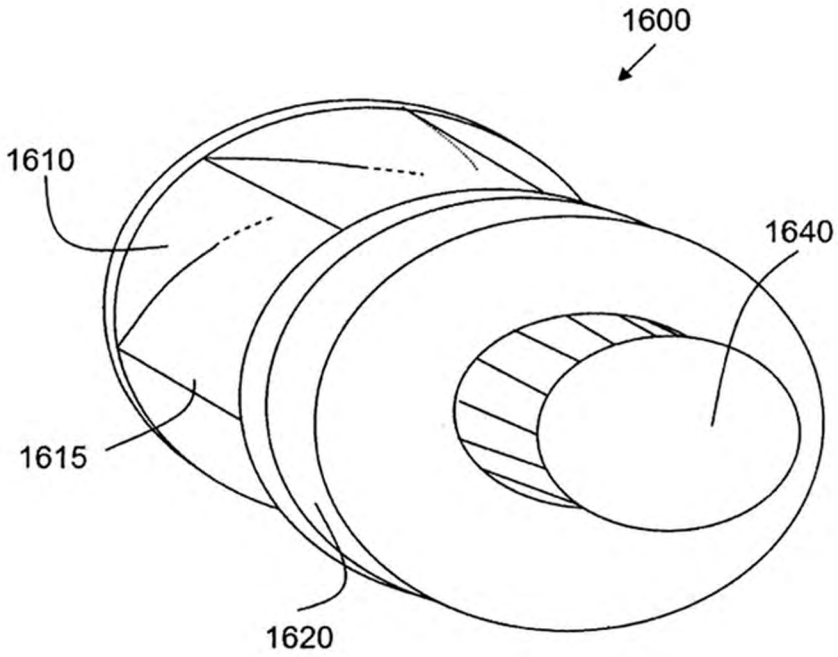


FIG. 11A

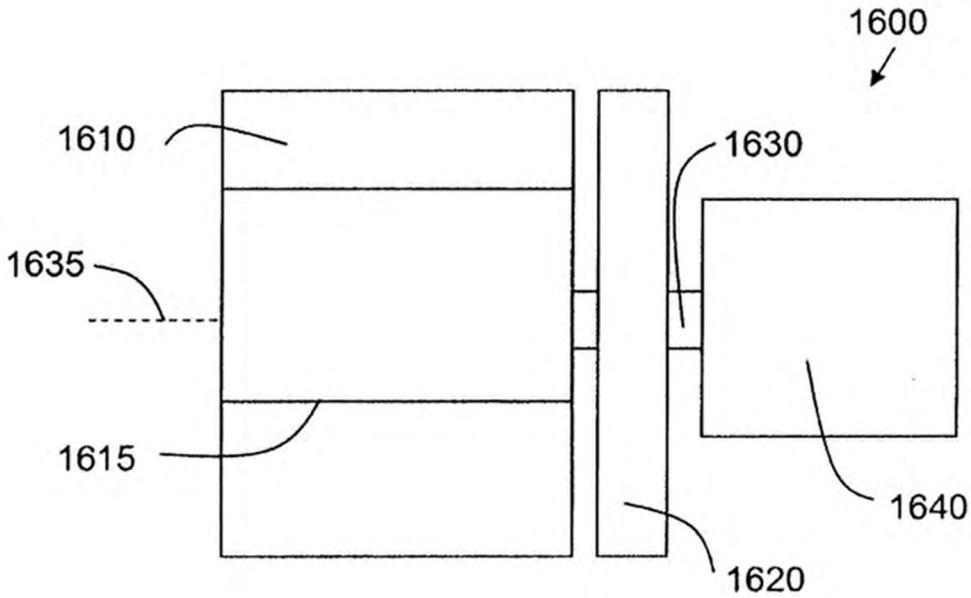


FIG. 11B

Centri - Fan ROTOFLY System

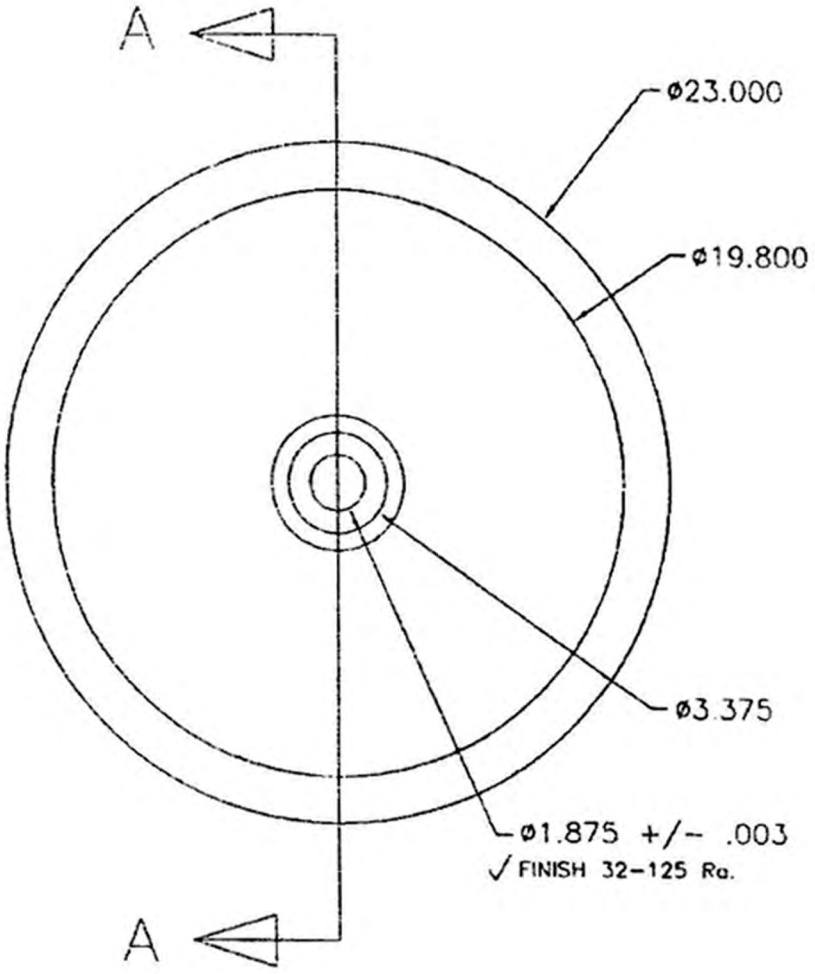


FIG. 12A

ROTOFLY Weight

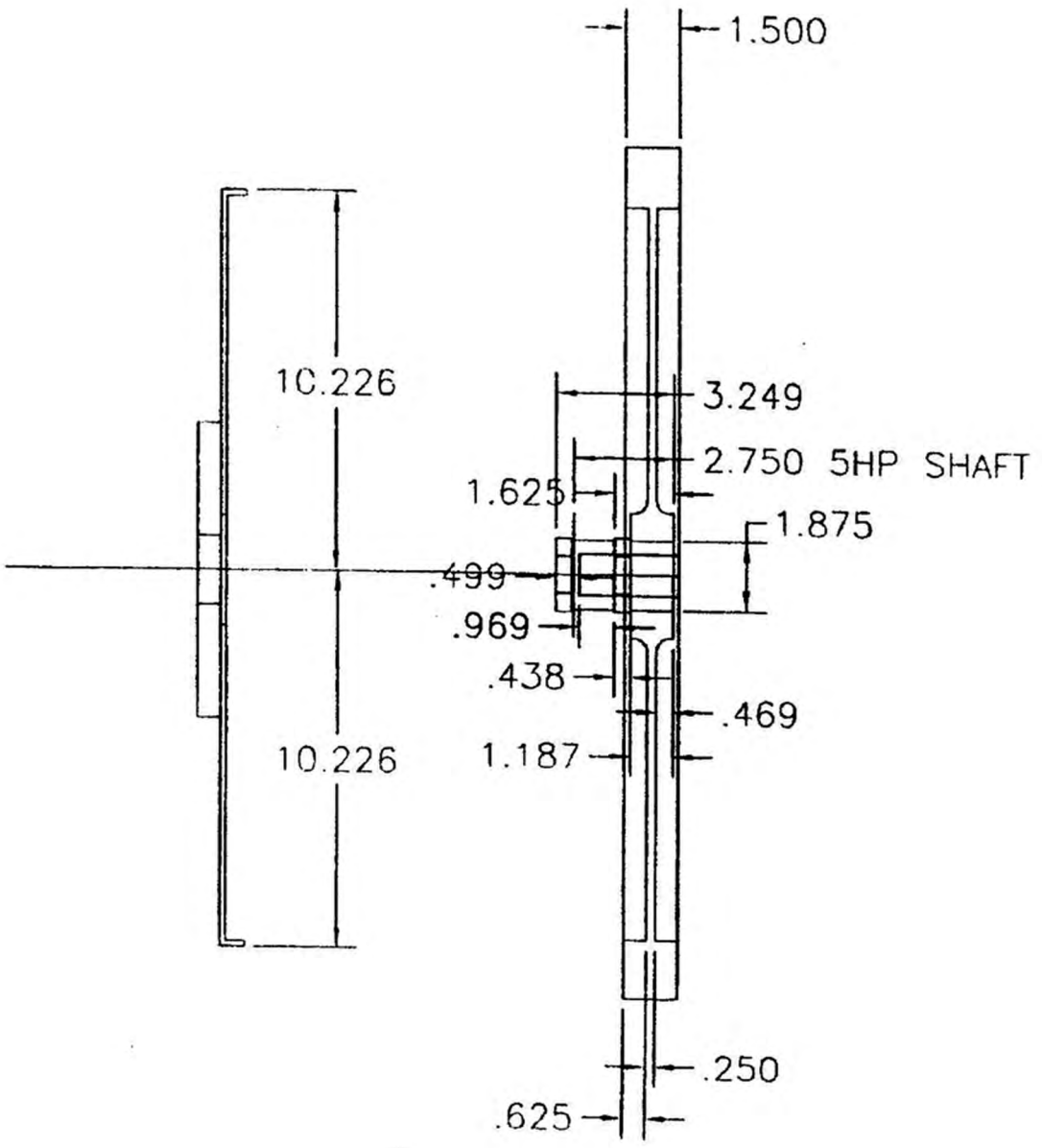


FIG. 12B

ROTOFLY Weight

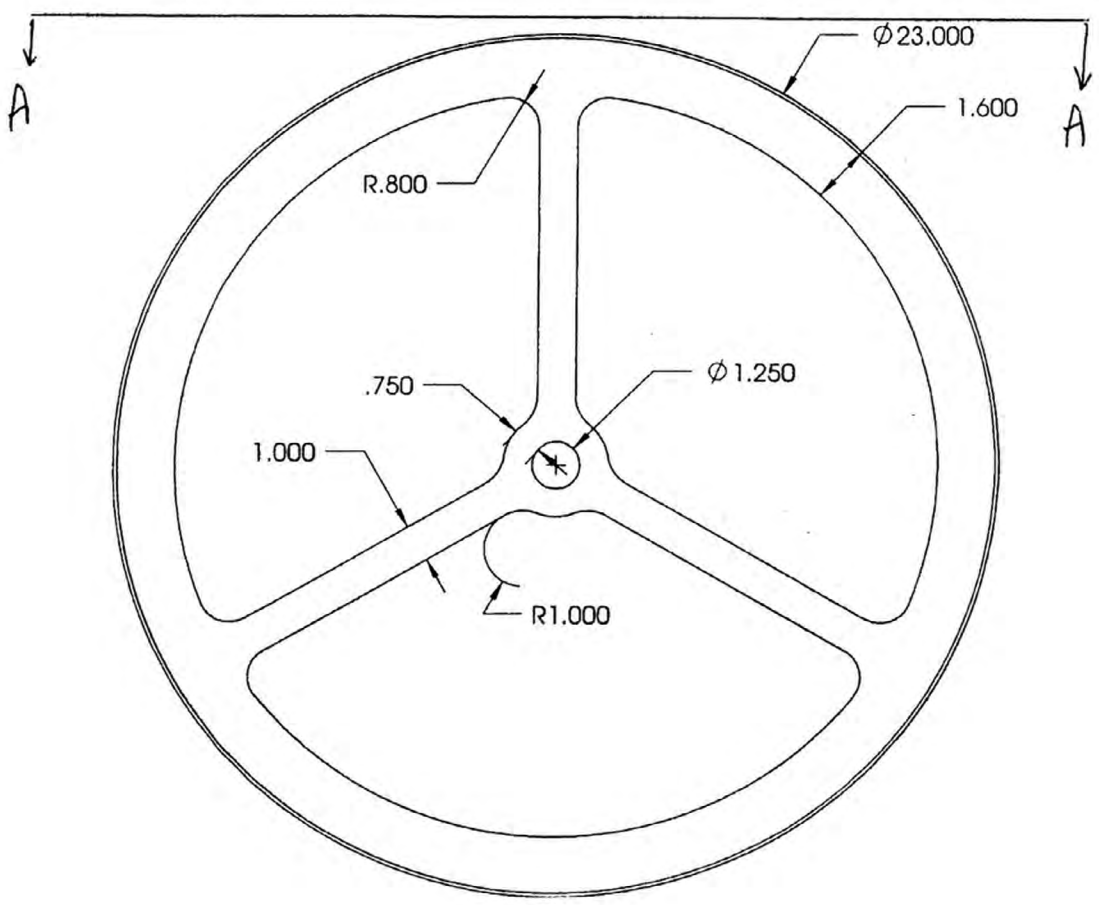


FIG. 13A

ROTOFLY Weight

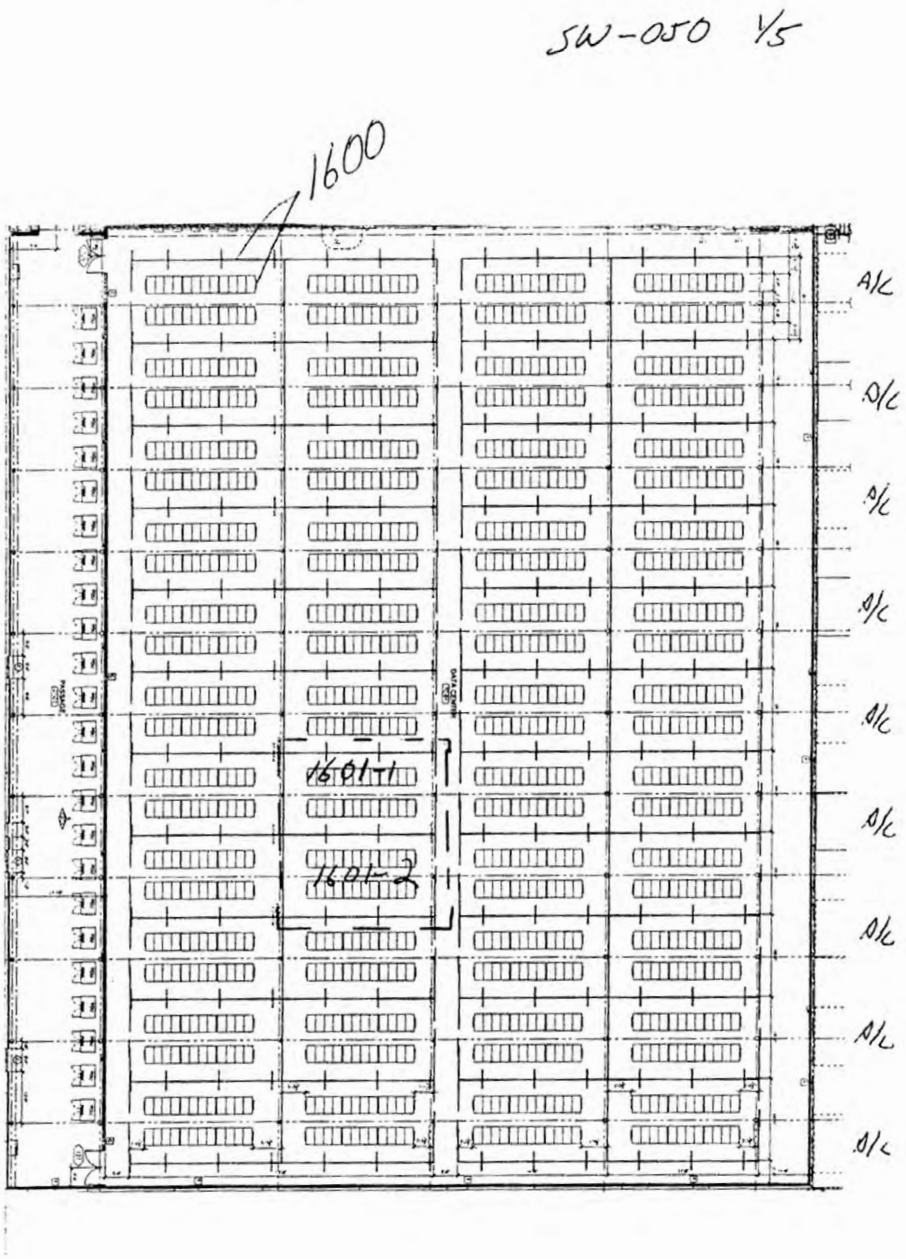


FIG. 14A1

Floating T-SCIF Layout

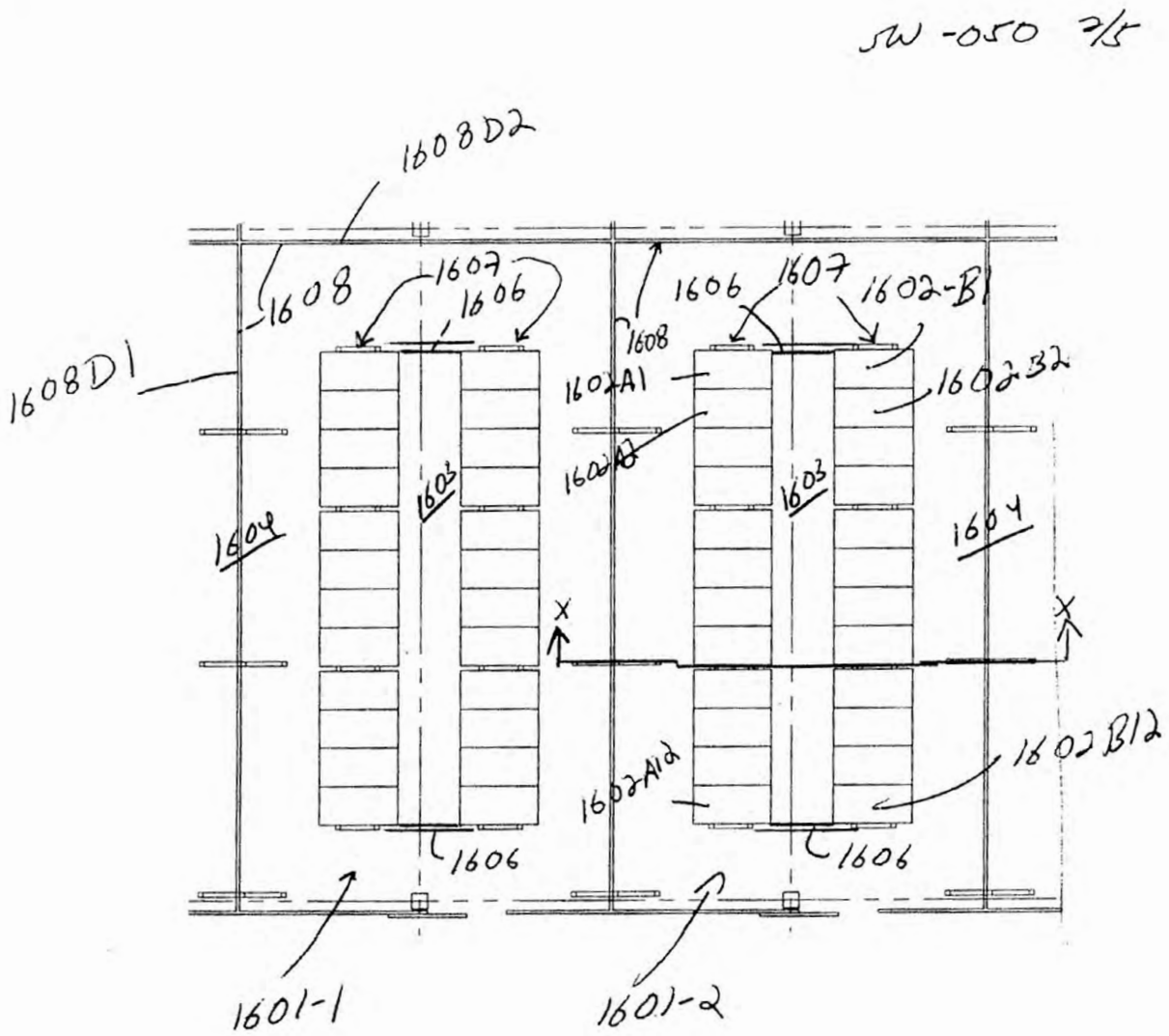


FIG. 14A2

Floating T-SCIF

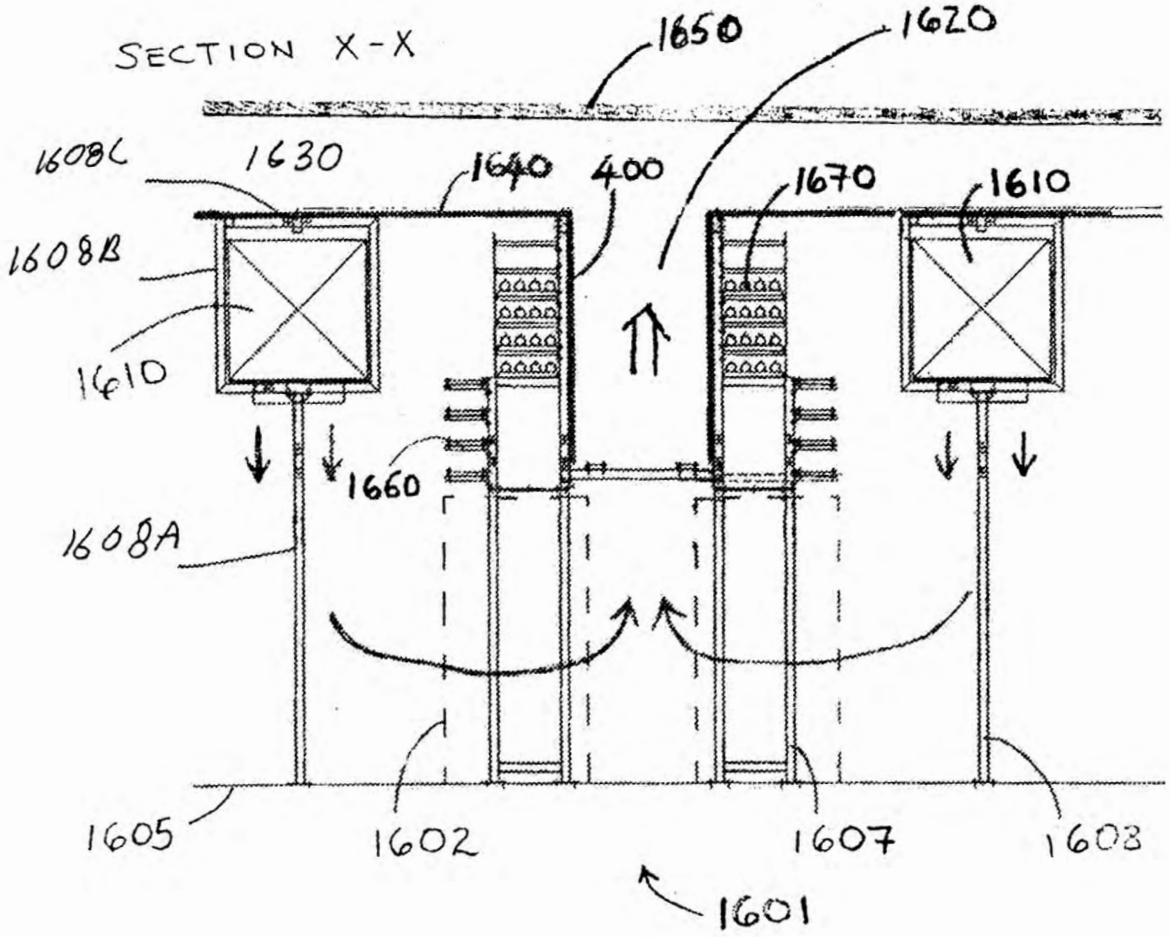


FIG. 14B

T-SCIF Heat Containment Side View

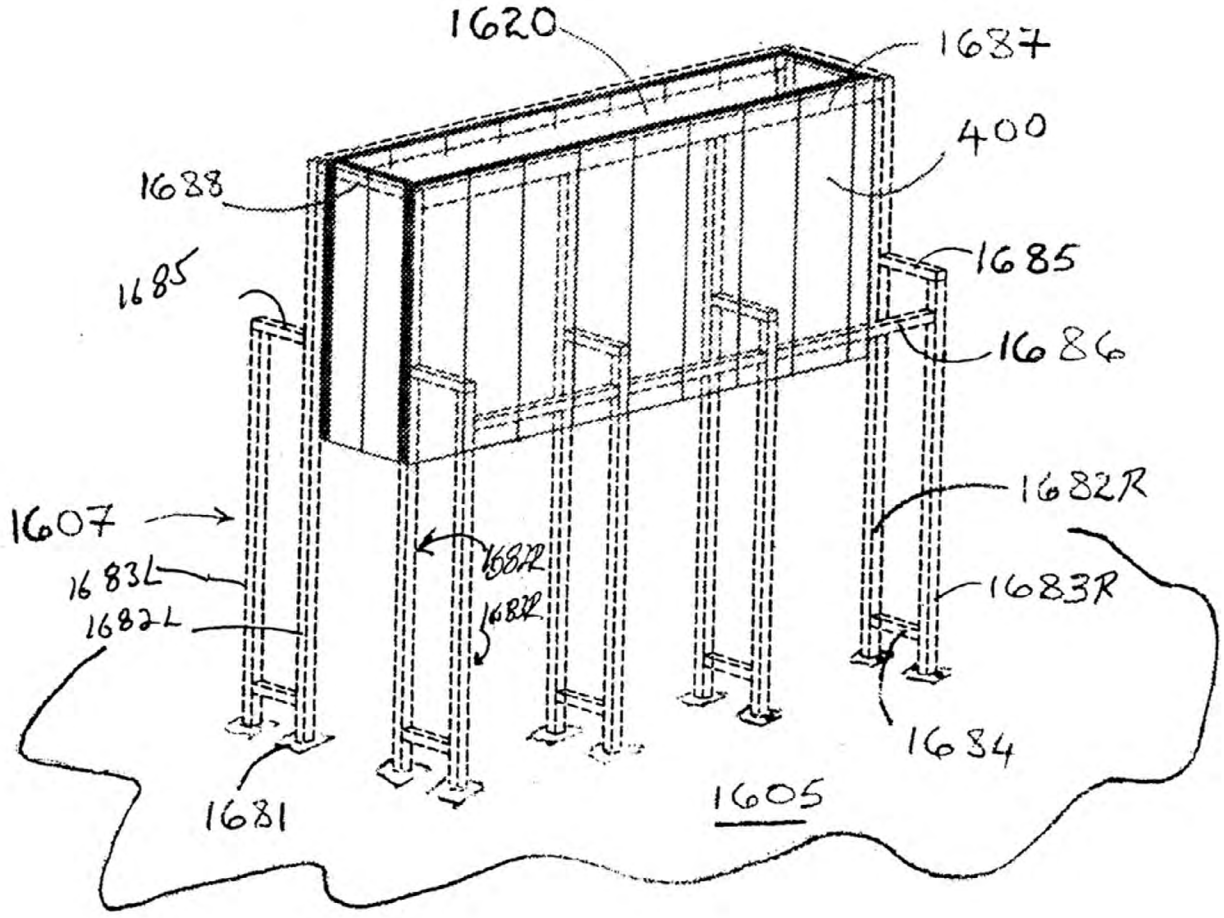


FIG. 15

Floating T-SCIF Version 1

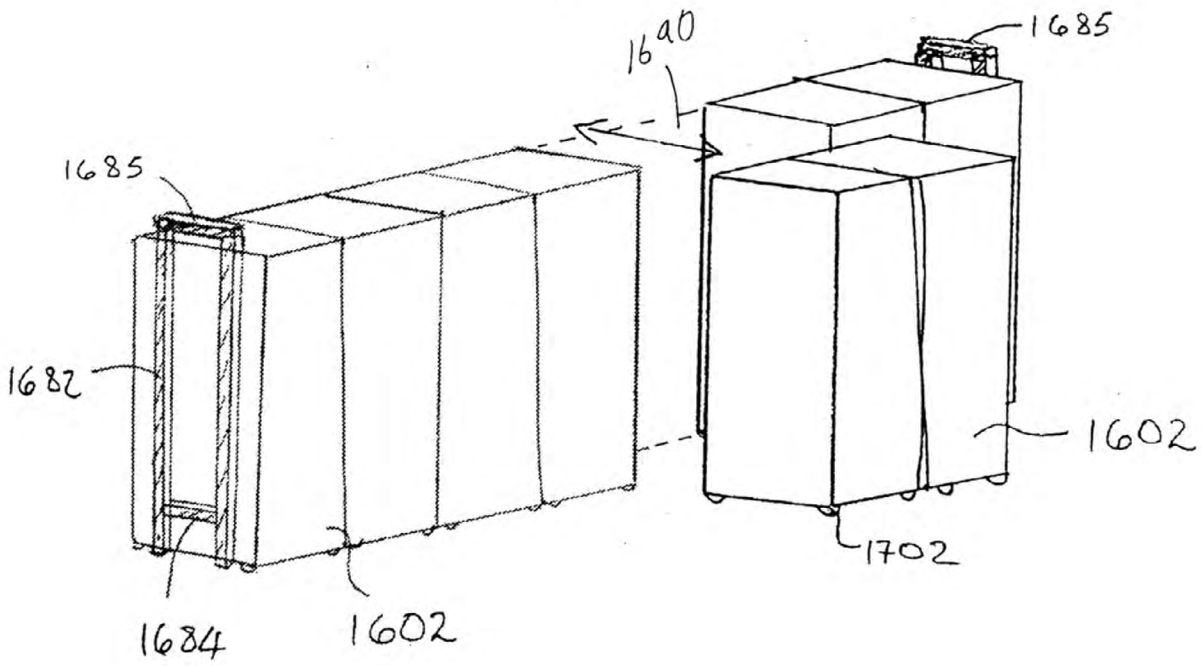


FIG. 16

Plug & Play Full Cabinet Refresh Layout

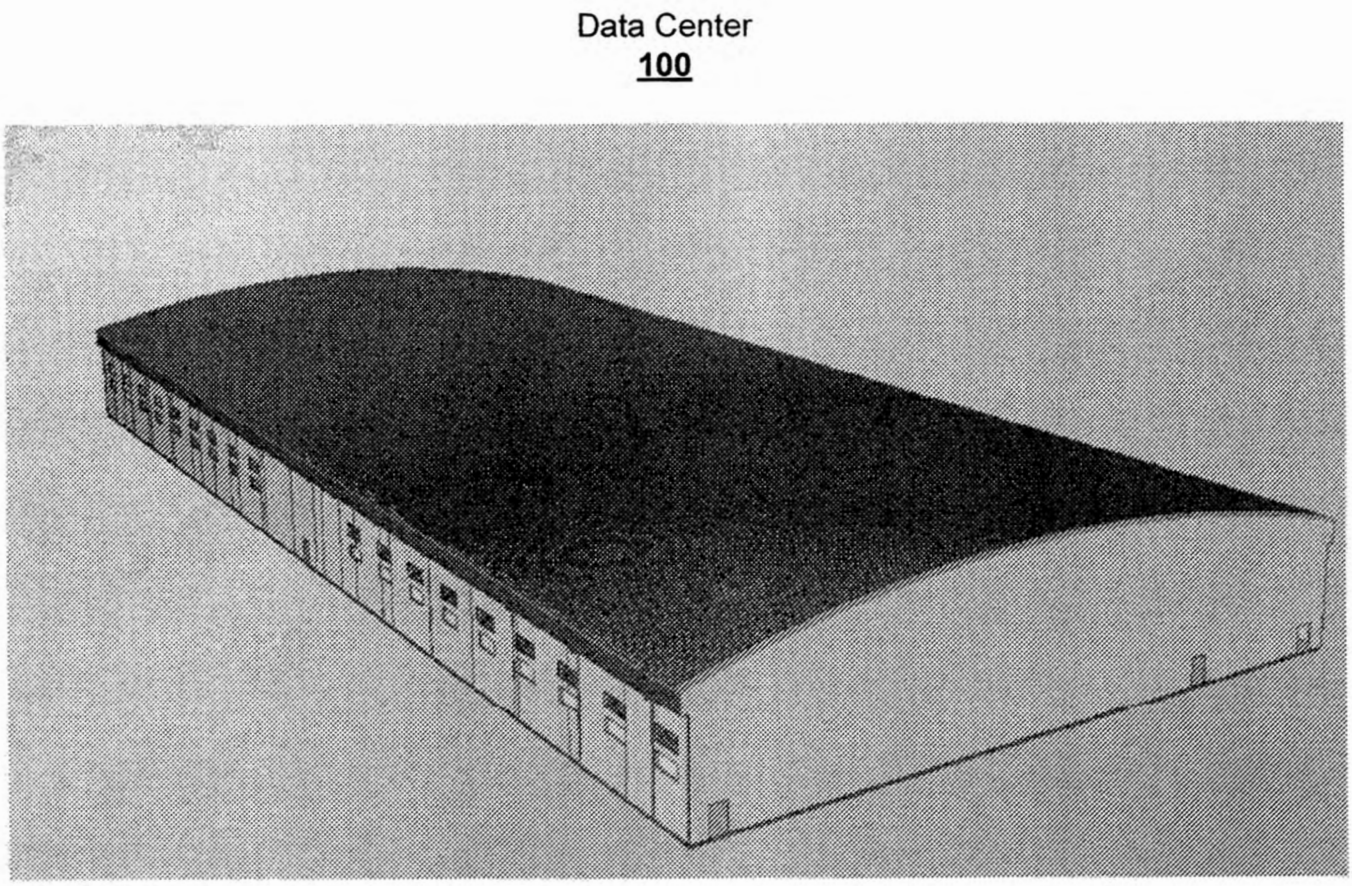


FIG. 17

SwitchMOD Shell – Dual Roofs - Zero Roof Penetrations

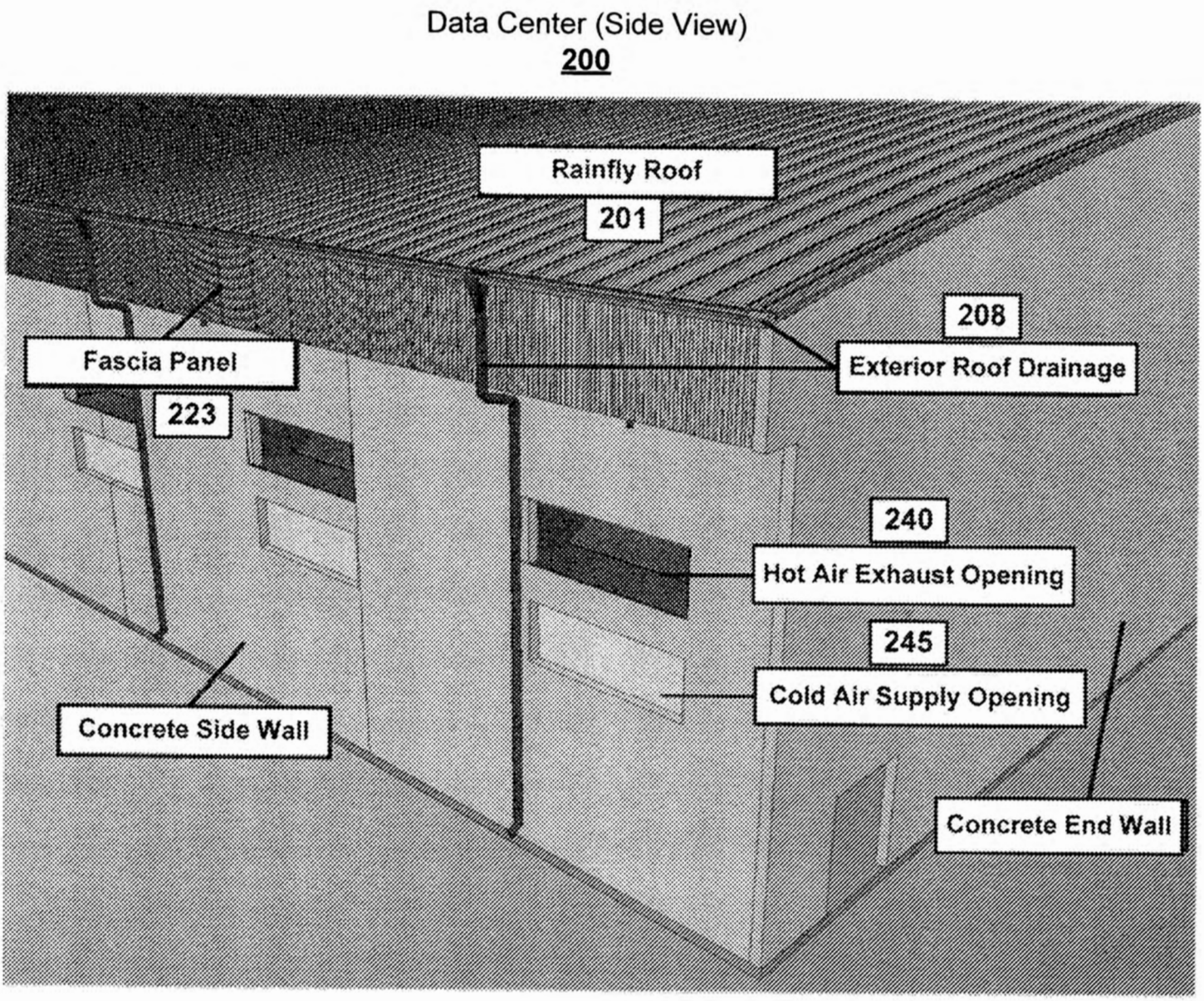


FIG. 18

SwitchMOD Shell Design

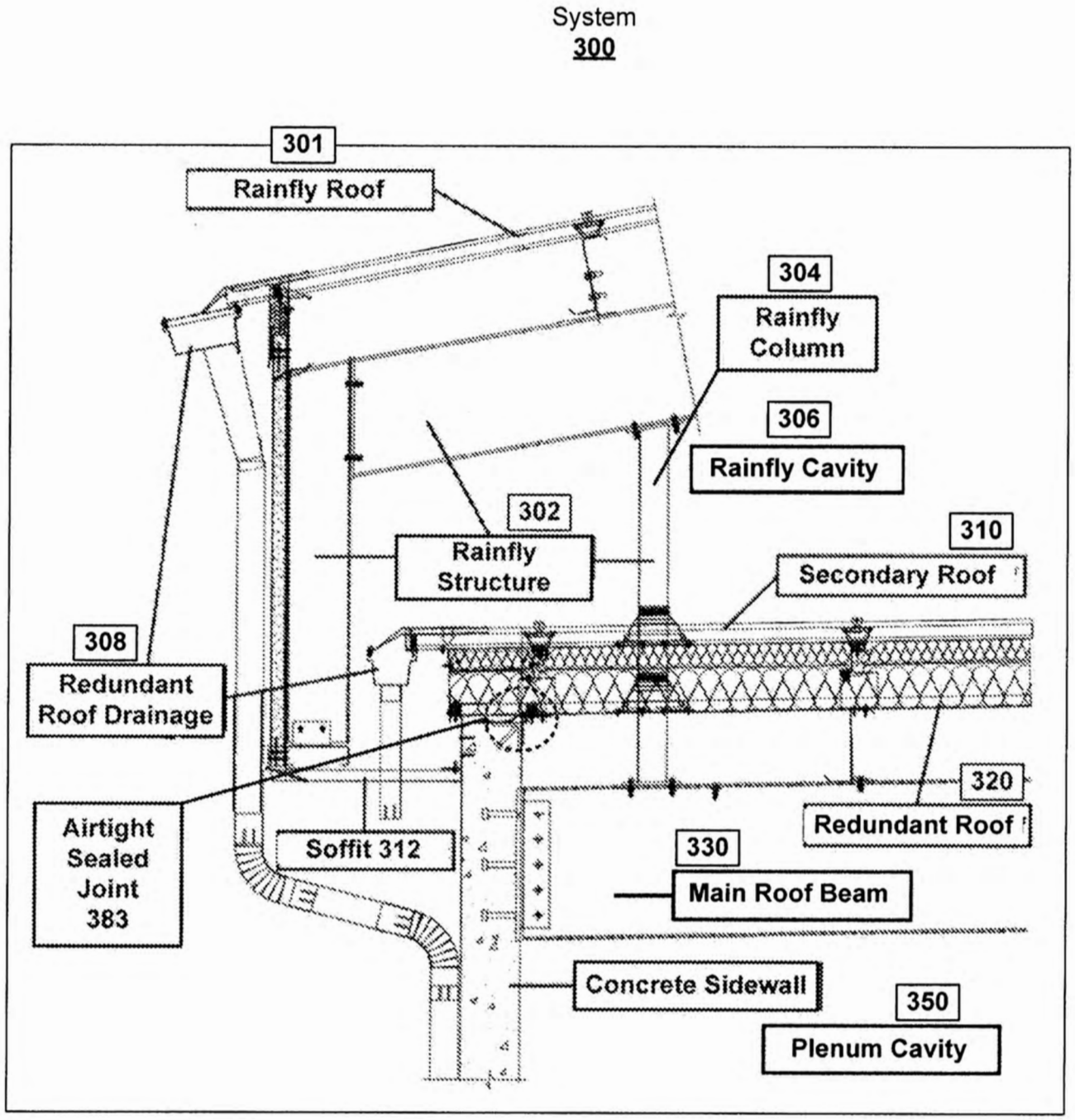


FIG. 19

Switch SHIELD Dual 200 MPH Roof System
Redundant Roof Side View

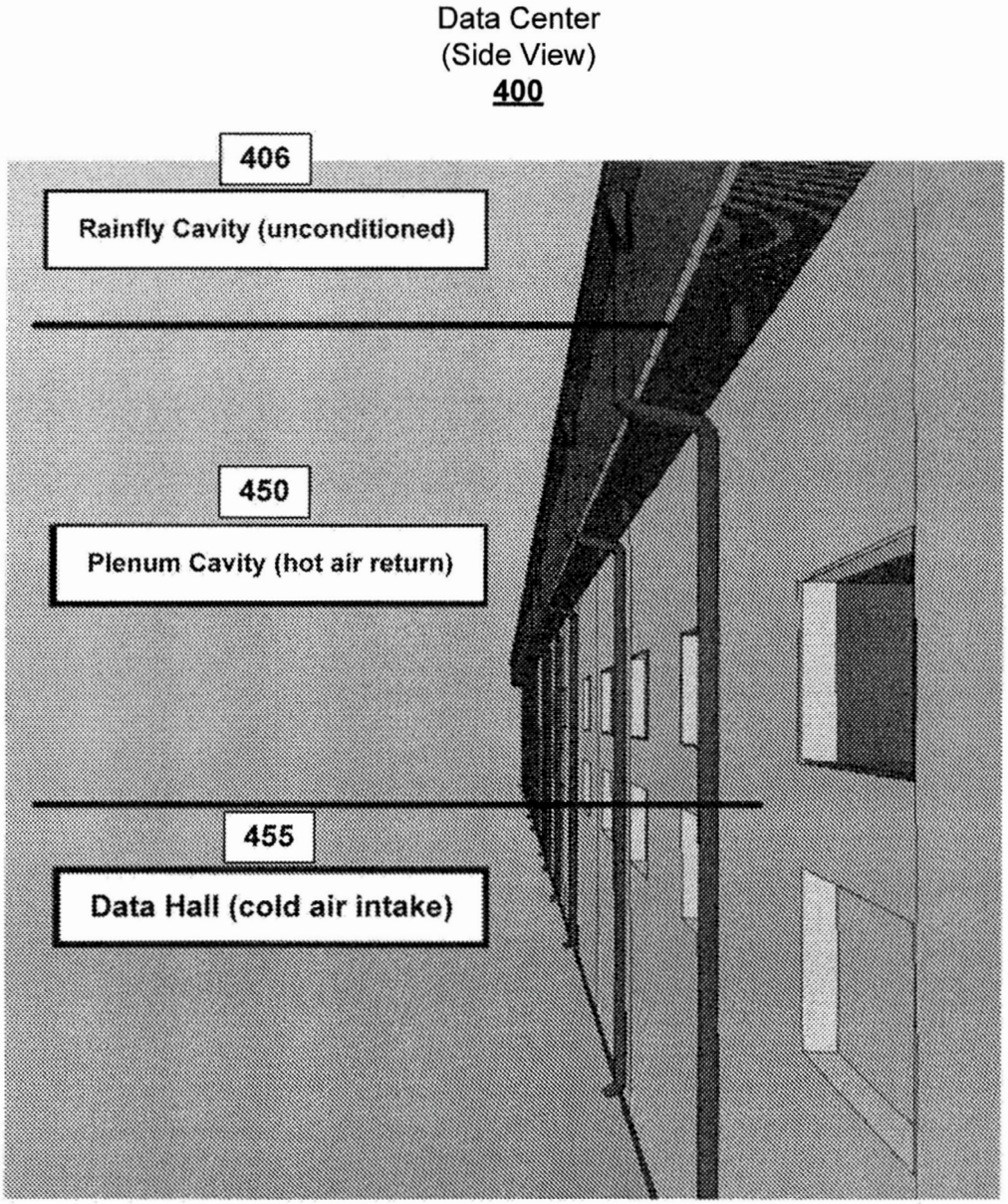


FIG. 20

SUPERNAP Shell

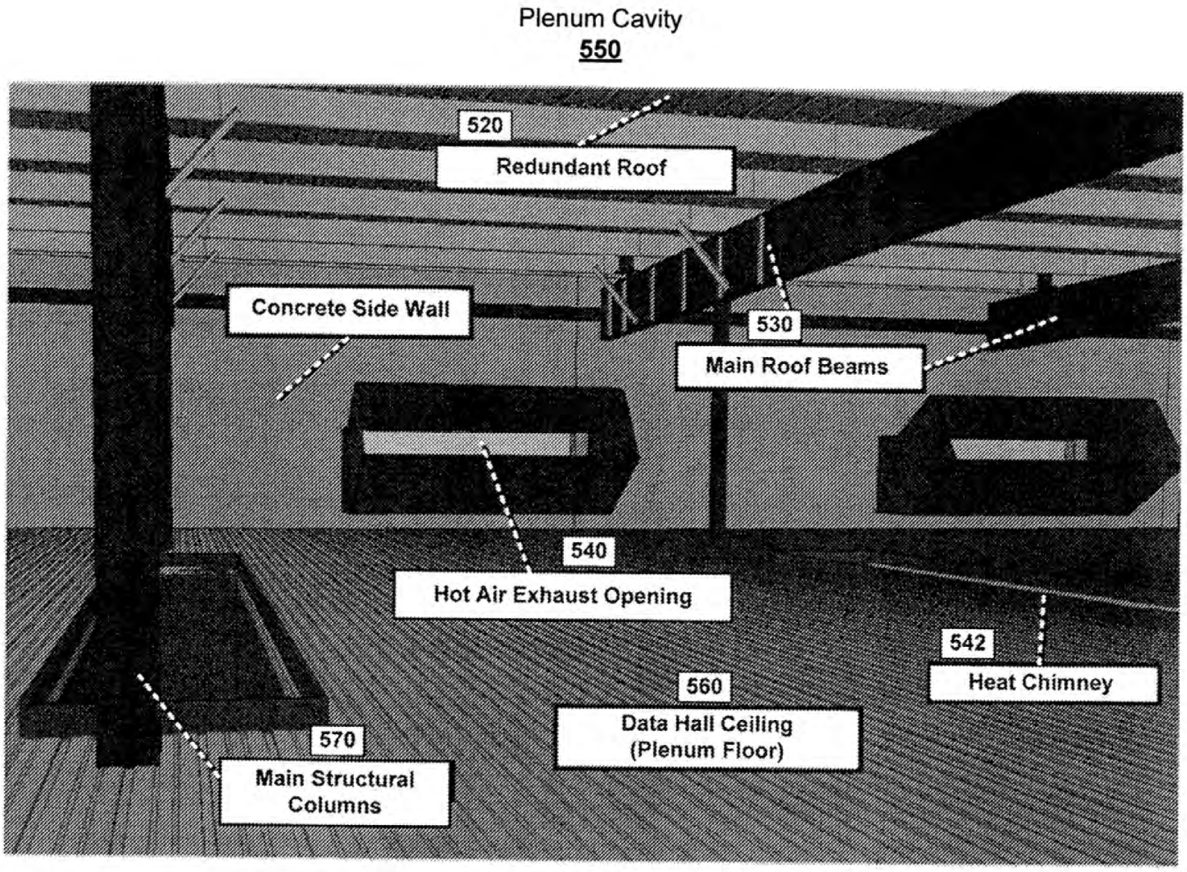


FIG. 21

SwitchMOD Heat Chamber

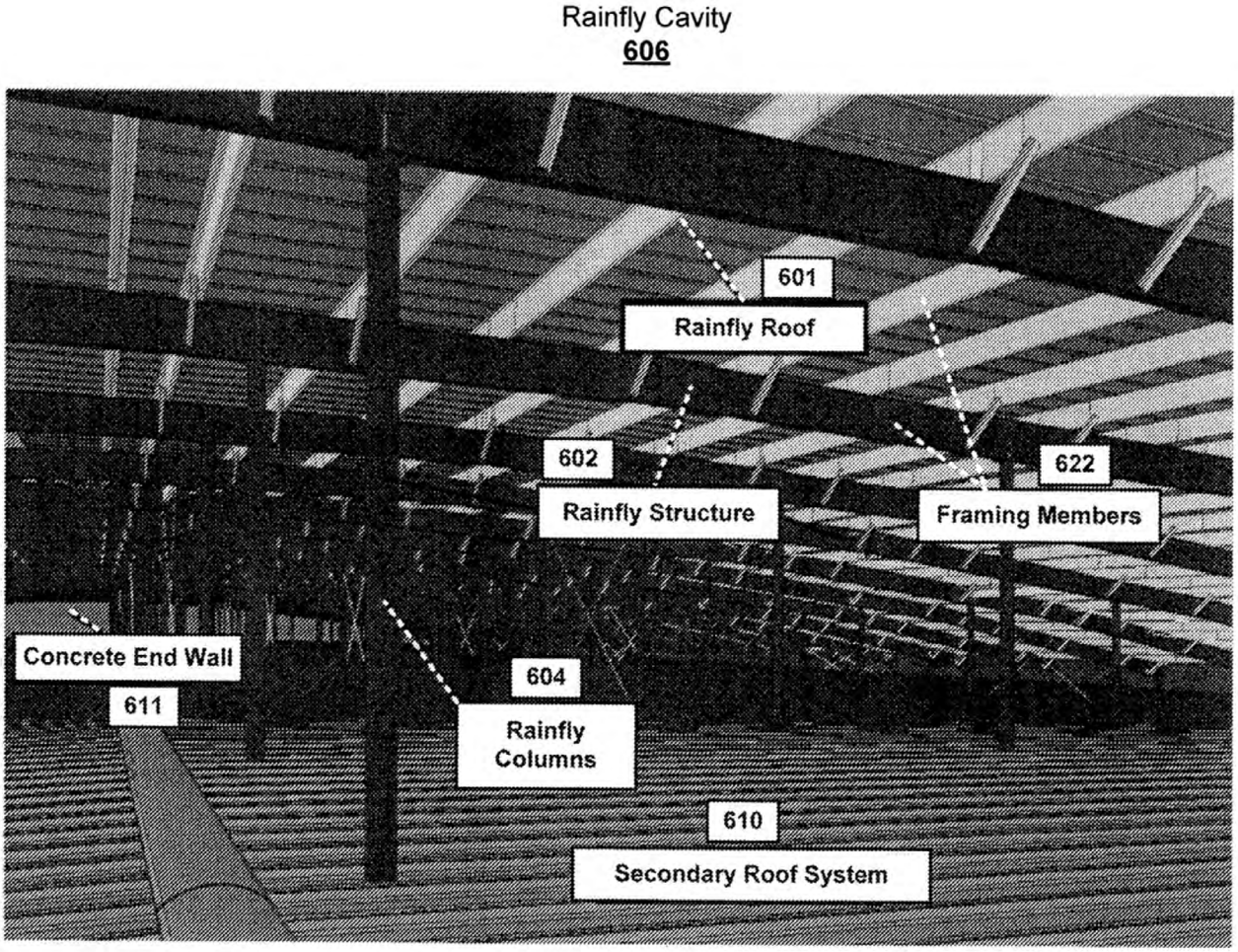


FIG. 22A

Switch SHIELD Dual 200 MPH Roof System – Zero Roof Penetrations
Redundant Roof System

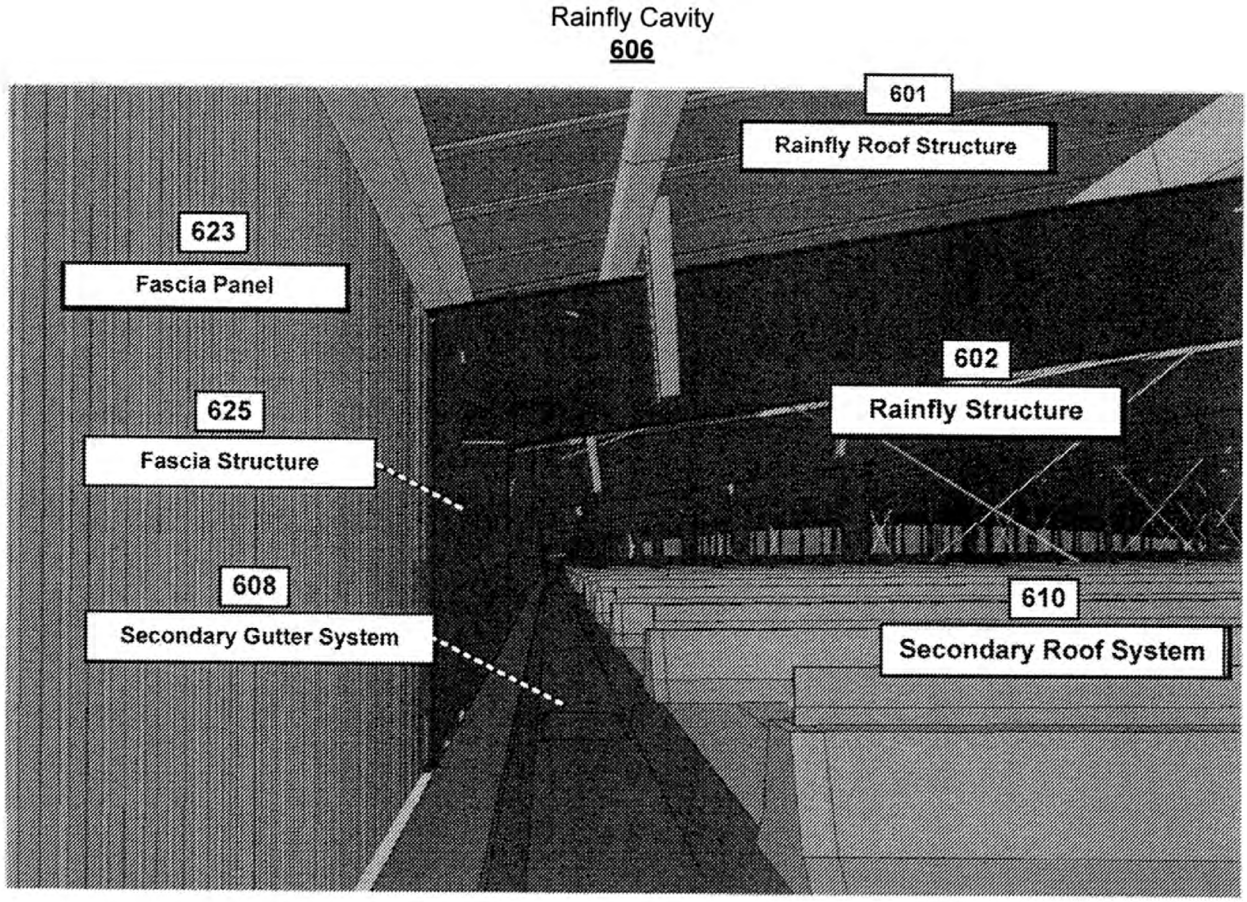


FIG. 22B

Switch SHIELD Dual Roof Chamber

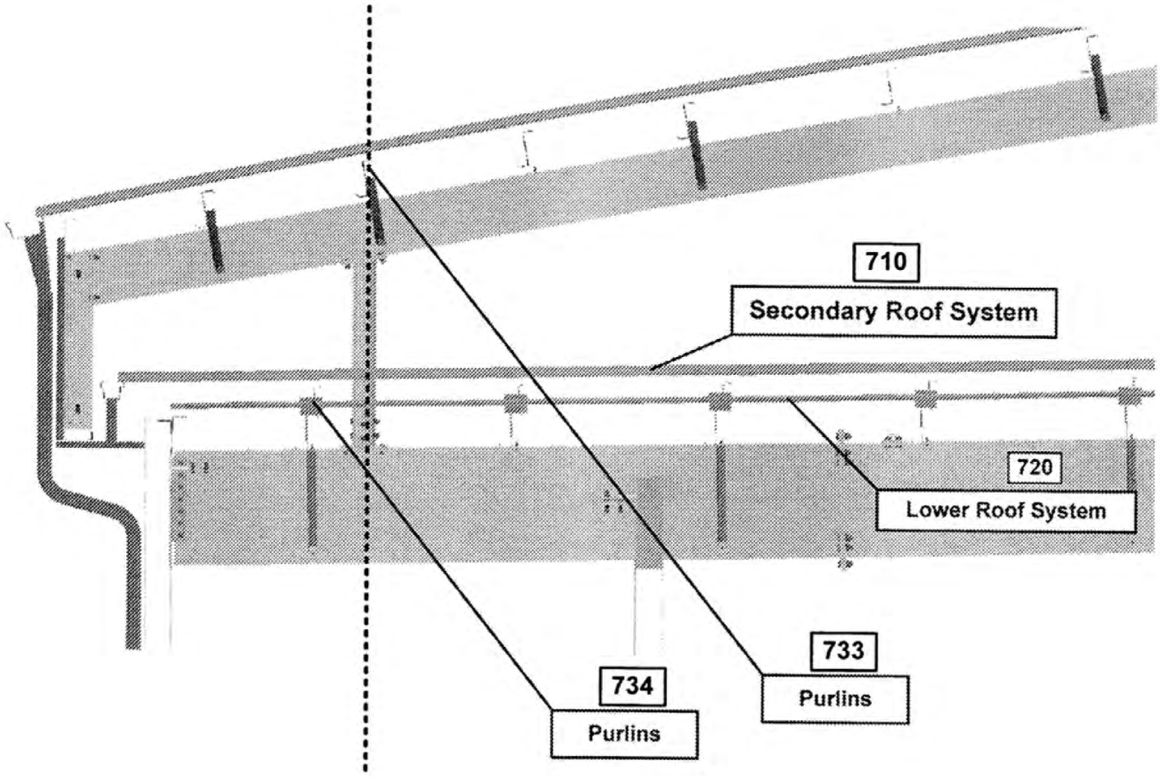


FIG. 23

Switch SHIELD Purlin Layout

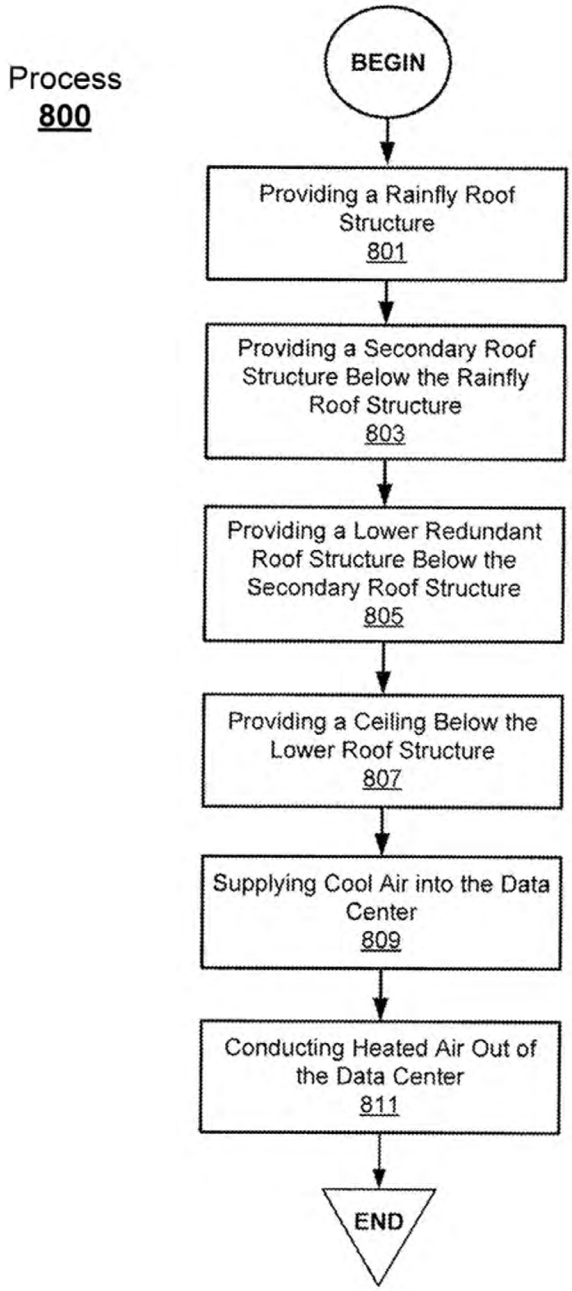


FIG. 24

SwitchMOD
Data Center Containment Process

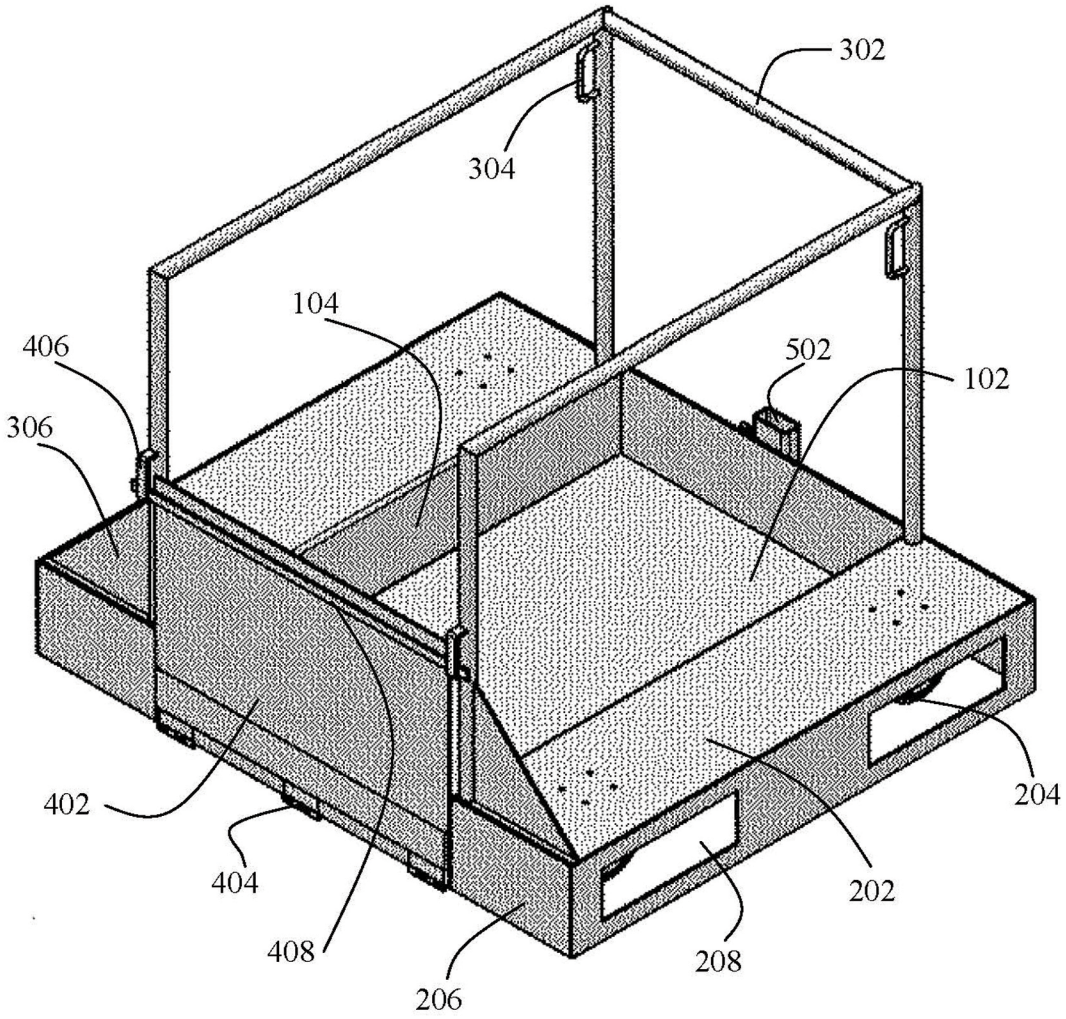


FIG. 25A

Quick Swap Heavy Cabinet Transport Cart

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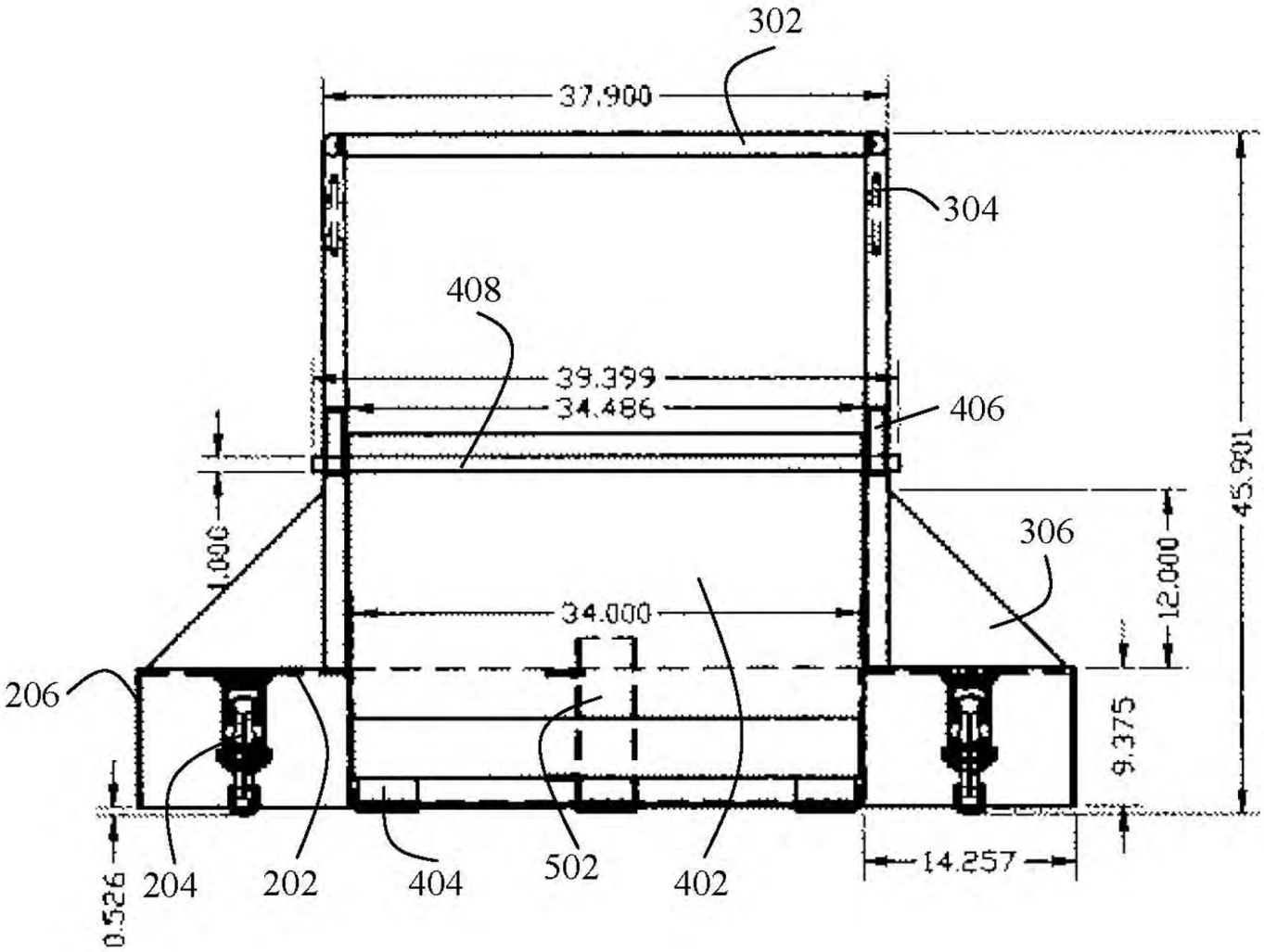

FIG. 25B

SwitchCART Design

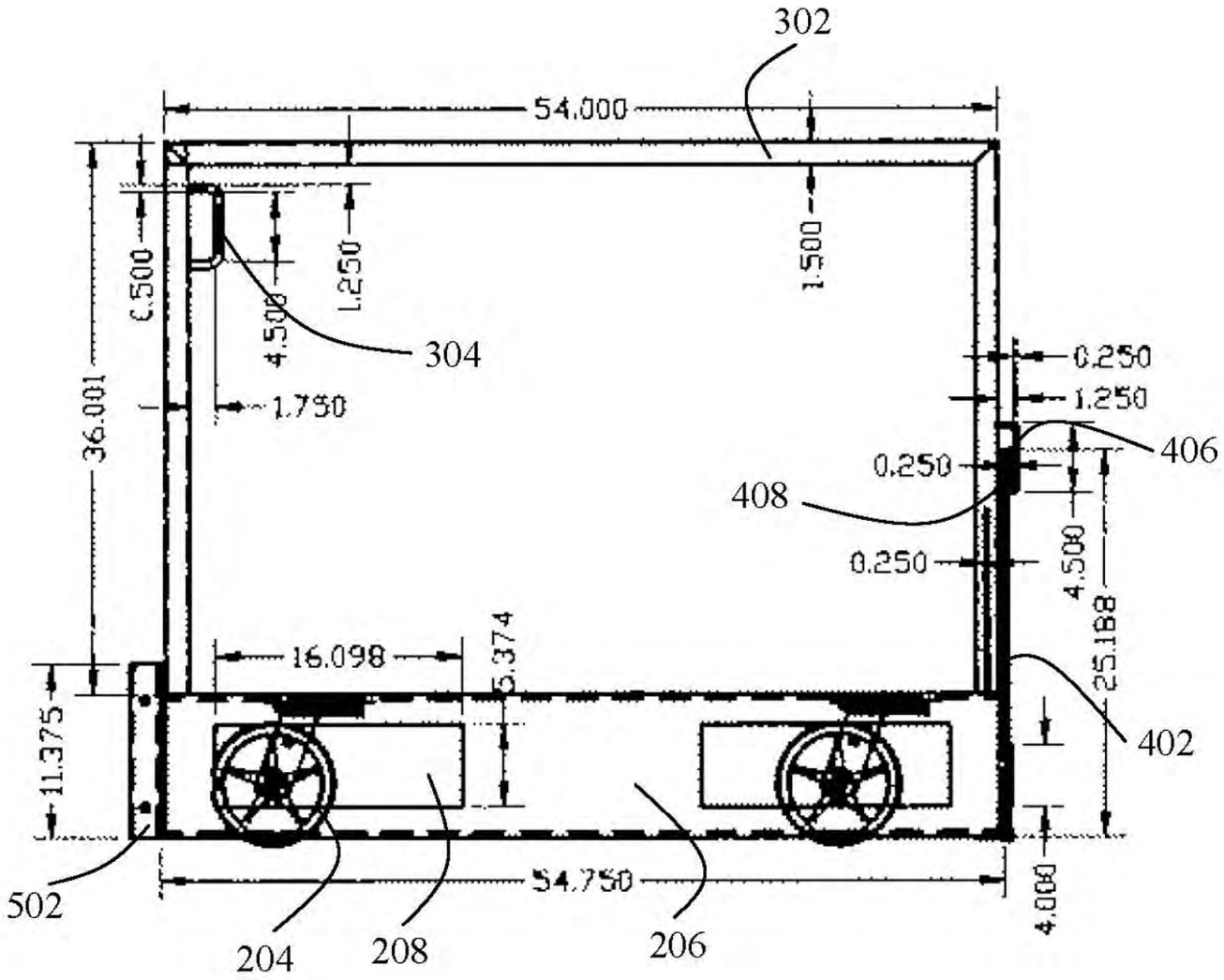

FIG. 25C

SwitchCART Design

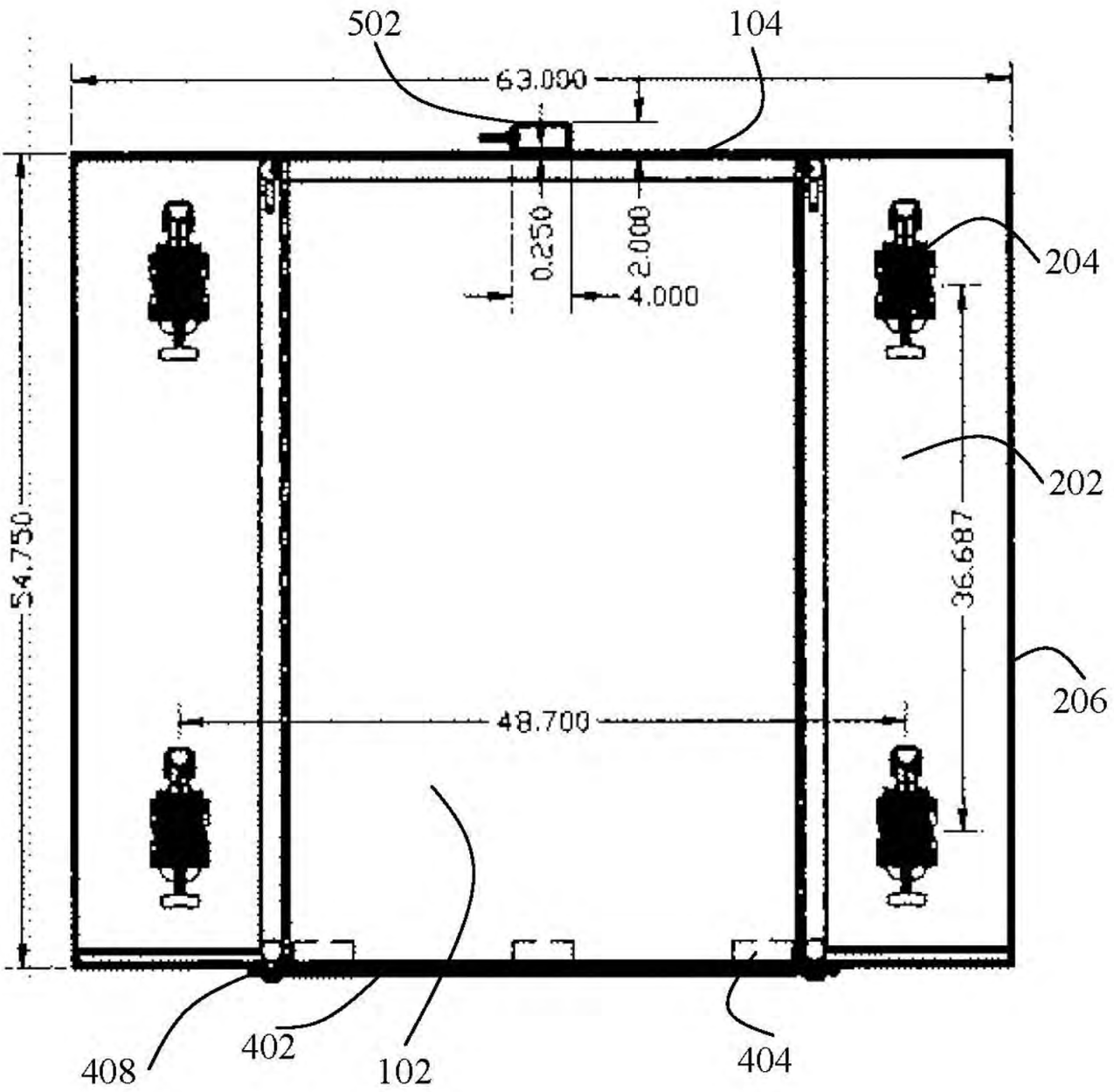

FIG. 25D

SwitchCART Design

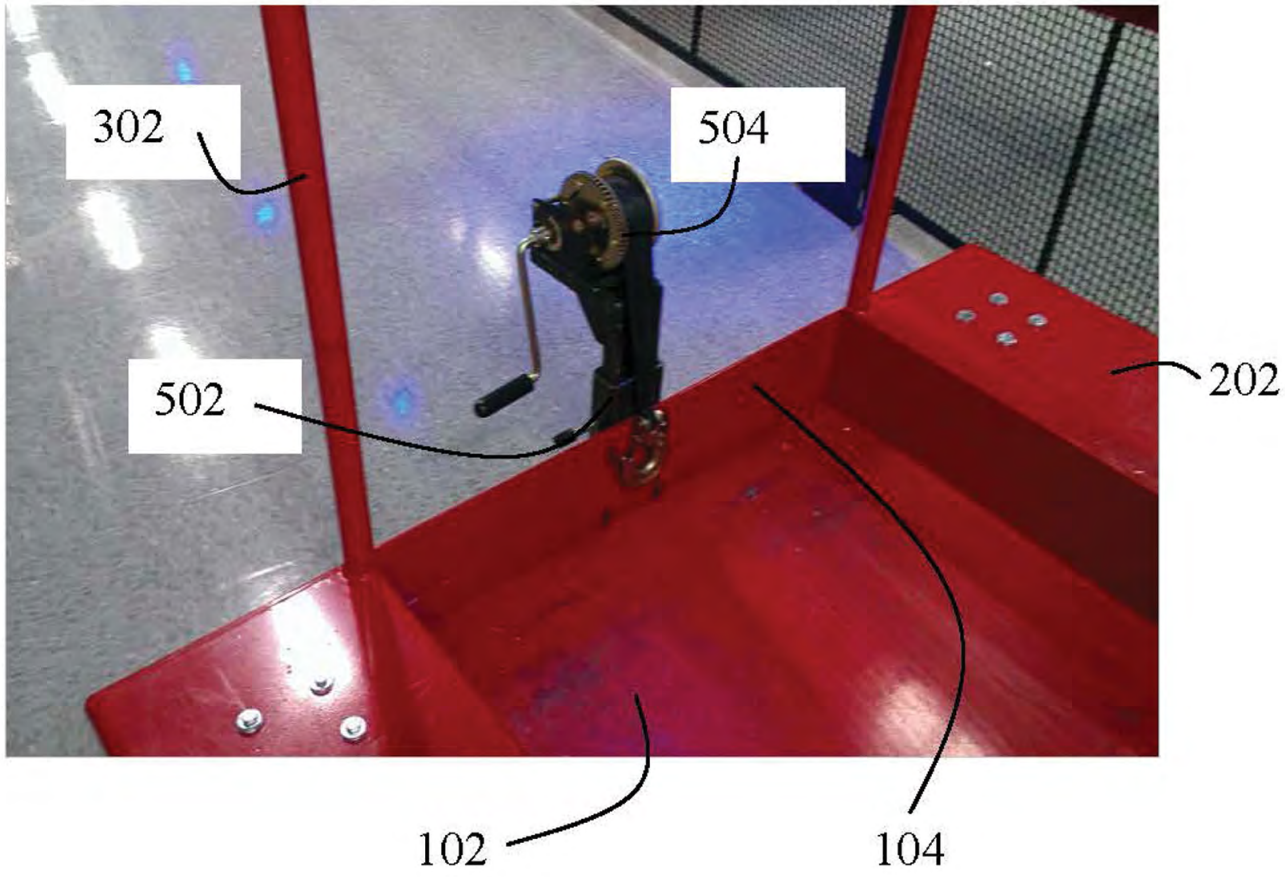

FIG. 26