JS 44 (Rev. 3/99)

CIVIL COVER SHEET

APPENDIX H

The JS-44 civil cover sheet and the information contained herein neither replace nor supplement the filing and service of pleadings or other papers as required by law, except as provided by local rules of court. This form, approved by the Judicial Conference of the United States in September 1974, is required for the use of the Clerk of Court for the purpose of initiating the civil docket sheet. (SEE INSTRUCTIONS ON THE REVERSE OF THE FORM.)

I. (a) PLAINTIFF

GRACO CHILDREN'S PRODUCTS, INC.
150 Oaklands Boulevard
Exton, PA 19341

(b) County of Resident of First Listed Plaintiff _____
(EXCEPT IN U.S. PLAINTIFF CASES)

(c) Attorney's (Firm Name, Address, and Telephone Number)
Lynn E. Rzonca, Esquire 215-864-8109
Ballard Spahr Andrews & Ingersoll, LLP
1735 Market St., 51st Fl., Phila., PA 19103

DEFENDANTS

FISHER-PRICE, INC.
636 Girard Avenue
East Aurora, NY 14052

County of Residence of First Listed Defendant _____
(IN U.S. PLAINTIFF CASES ONLY)

NOTE: IN LAND CONDEMNATION CASES, USE THE LOCATION OF THE LAND INVOLVED.

Attorneys (If Known)

II. BASIS OF JURISDICTION (Place an "X" in One Box Only)

- ☐ 1 U.S. Government Plaintiff
- ☒ 3 Federal Question (U.S. Government Not a Party)
- ☐ 2 U.S. Government Defendant
- ☐ 4 Diversity (Indicate Citizenship of Parties in Item III)

III. CITIZENSHIP OF PRINCIPAL PARTIES (Place an "X" in One Box for Plaintiff and One Box for Defendant)
(For Diversity Cases Only)

	PTF	DEF		PTF	DEF
Citizen of This State	☐ 1	☐ 1	Incorporated *or* Principal Place of Business In This State	☐ 4	☐ 4
Citizen of Another State	☐ 2	☐ 2	Incorporated *and* Principal Place Of Business in Another State	☐ 5	☐ 5
Citizen or Subject of a Foreign Country	☐ 3	☐ 3	Foreign Nation	☐ 6	☐ 6

IV. NATURE OF SUIT (Place an "X" in One Box Only)

CONTRACT
- ☐ 110 Insurance
- ☐ 120 Marine
- ☐ 130 Miller Act
- ☐ 140 Negotiable Instrument
- ☐ 150 Recovery of Overpayment &Enforcement of Judgment
- ☐ 151 Medicare Act
- ☐ 152 Recovery of Defaulted Student Loans (Excl. Veterans)
- ☐ 153 Recovery of Overpayment of Veteran's Benefits
- ☐ 160 Stockholders' Suits
- ☐ 190 Other Contract
- ☐ 195 Contract Product Liability

REAL PROPERTY
- ☐ 210 Land Condemnation
- ☐ 220 Foreclosure
- ☐ 230 Rent Lease & Ejectment
- ☐ 245 Tort Product Liability
- ☐ 290 All Other Real Property

TORTS

PERSONAL INJURY
- ☐ 310 Airplane
- ☐ 315 Airplane Product Liability
- ☐ 320 Assault, Libel & Slander
- ☐ 330 Federal Employers' Liability
- ☐ 340 Marine
- ☐ 345 Marine Product Liability
- ☐ 350 Motor Vehicle
- ☐ 355 Motor Vehicle Product Liability
- ☐ 360 Other Personal Injury

CIVIL RIGHTS
- ☐ 441 Voting
- ☐ 442 Employment
- ☐ 443 Housing/ Accommodations
- ☐ 444 Welfare
- ☐ 440 Other Civil Rights

PERSONAL INJURY
- ☐ 362 Personal Injury-Med. Malpractice
- ☐ 365 Personal Injury-Product Liability
- ☐ 368 Asbestos Personal Injury Product Liability

PERSONAL PROPERTY
- ☐ 370 Other Fraud
- ☐ 371 Truth in Lending
- ☐ 380 Other Personal Property Damage
- ☐ 385 Property Damage Product Liability

PRISONER PETITIONS
- ☐ 510 Motions to Vacate Sentence
- Habeas Corpus:
- ☐ 530 General
- ☐ 535 Death Penalty
- ☐ 540 Mandamus &Other
- ☐ 550 Civil Rights
- ☐ 555 Prison Condition

FORFEITURE/PENALTY
- ☐ 610 Agriculture
- ☐ 620 Other Food & Drug
- ☐ 625 Drug Related Seizure of Property 21 USC
- ☐ 630 Liquor Laws
- ☐ 640 R.R. & Truck
- ☐ 650 Airline Regs.
- ☐ 660 Occupational Safety/Health
- ☐ 690 Other

LABOR
- ☐ 710 Fair Labor Standards Act
- ☐ 720 Labor/Mgmt. Relations
- ☐ 730 Labor/Mgmt Reporting & Disclosure Act
- ☐ 740 Railway Labor Act
- ☐ 790 Other Labor Litigation
- ☐ 791 Empl. Ret. Inc. Security Act

BANKRUPTCY
- ☐ 422 Appeal
- ☐ 423 Individual 28 USC 157

PROPERTY RIGHTS
- ☐ 820 Copyrights
- ☒ 830 Patent
- ☐ 840 Trademark

SOCIAL SECURITY
- ☐ 861 HIA (1395ff)
- ☐ 862 Black Lung (923)
- ☐ 863 DIWC/DIWW (405(G))
- ☐ 864 SSID Title XVI
- ☐ 765 RSI (405(g))

FEDERAL TAX SUITS
- ☐ 870 Taxes (U.S. Plaintiff or Defendant)
- ☐ 871 IRS--Third Party 26 USC 7609

OTHER STATUTES
- ☐ 400 State Reapportionment
- ☐ 410 Antitrust
- ☐ 430 Banks and Banking
- ☐ 450 Commerce/ICC Rates/etc.
- ☐ 460 Deportation
- ☐ 470 Racketeer Influenced and Corrupt Organizations
- ☐ 810 Selective Service
- ☐ 850 Securities/Commodities/ Exchange
- ☐ 875 Customer Challenge 12 USC 3410
- ☐ 890 Other Statutory Actions
- ☐ 891 Agricultural Acts
- ☐ 892 Economic Stabilization Act
- ☐ 893 Environmental Matters
- ☐ 894 Energy Allocation Act
- ☐ 895 Freedom of Information Act
- ☐ 900 Appeal of Fee Determination Under Equal Access to Justice
- ☐ 950 Constitutionality of State Statutes

V. ORIGIN (Place an "X" in One Box Only)

☒ 1 Original Proceeding ☐ 2 Removed from State Court ☐ 3 Remanded from Appellate Court ☐ 4 Reinstated or Reopened ☐ 5 Transferred from another district (specify) ☐ 6 Multidistrict Litigation ☐ 7 Appeal to District Judge from Magistrate Judgment

VI. CAUSE OF ACTION (Cite the U.S. Civil Statute under which you are filing and writ brief statement of cause.**(Do not cite jurisdictional statutes unless diversity.)**

35 U.S.C. § 101

Brief description of cause:
Patent Infringement

VII. REQUESTED IN COMPLAINT

☐ CHECK IF THIS IS A CLASS ACTION UNDER F.R.C.P. 23 declaratory and injunctive relief

DEMAND $

CHECK YES only if demanded in complaint:
JURY DEMAND: ☒ Yes ☐ No

VIII. RELATED CASE(S) IF ANY (See instructions): JUDGE _____ DOCKET NUMBER _____

DATE
October 27, 2005

SIGNATURE OF ATTORNEY OF RECORD
Lynn E. Rzonca

FOR OFFICE USE ONLY

RECEIPT # _____ AMOUNT _____ APPLYING IFP _____ JUDGE _____ MAG. JUDGE _____

INSTRUCTIONS FOR ATTORNEYS COMPLETING CIVIL COVER SHEET FORM JS-44

Authority For Civil Cover Sheet

The JS-44 civil cover sheet and the information contained herein neither replaces nor supplements the filings and service of pleading or other papers as required by law, except as provided by local rules of court. This form, approved by the Judicial Conference of the United States in September 1974, is required for the use of the Clerk ofCourt for the purpose of initiating the civil docket sheet. Consequently, a civil cover sheet is submitted to the Clerk of Court for each civil complaint filed. The attorney filing a case should complete the form as follows:

I. (a) **Plaintiffs-Defendants.** Enter names (last, middle initial) of plaintiff and defendant. If the plaintiff or defendant is a government agency, use only the full name or standard abbreviations. If the plaintiff or defendant is an official within a government agency, identify first the agency and then the official, giving both name and title.

(b) County of Residence. For each civil case filed, except U.S. plaintiff cases, enter the name of the county where the first listed plaintiff resides at the time of filing. In U.S. plaintiff cases, enter the name of the county in which the first listed defendant resides at the time of filing. (NOTE: In land condemnation cases, the county of residence of the "defendant" is the location of the tract of land involved.)

(c) Attorneys. Enter the firm name, address, telephone number, and attorney of record. If there are several attorneys, list them on an attachment, noting in this section "(see attachment)".

II. **Jurisdiction.** The basis of jurisdiction is set forth under Rule 8(a), F.R.C.P., which requires that jurisdictions be shown in pleadings. Place an "X" in one of the boxes. If there is more than one basis of jurisdiction, precedence is given in the order shown below.

United States plaintiff. (1) Jurisdiction based on 28 U.S.C. 1345 and 1348. Suits by agencies and officers of the United States, are included here.

United States defendant. (2) When the plaintiff is suing the United States, its officers or agencies, place an "X" in this box.

Federal question. (3) This refers to suits under 28 U.S.C. 1331, where jurisdiction arises under the Constitution of the United States, an amendment to the Constitution, an act of Congress or a treaty of the United States. In cases where the U.S. is a party, the U.S. plaintiff or defendant code takes precedence, and box 1 or 2 should be marked.

Diversity of citizenship. (4) This refers to suits under 28 U.S.C. 1332, where parties are citizens of different states. When Box 4 is checked, the citizenship of the different parties must be checked. (See Section III below; federal question actions take precedence over diversity cases.)

III. **Residence (citizenship) of Principal Parties.** This section of the JS-44 is to be completed if diversity of citizenship was indicated above. Mark this section for each principal party.

IV. **Nature of Suit.** Place an "X" in the appropriate box. If the nature of suit cannot be determined, be sure the cause of action, in Section IV below, is sufficient to enable to deputy clerk or the statistical clerks in the Administrative Office to determine the nature of suit. If the cause fits more than one nature of suit, select the most definitive.

V. **Origin.** Place an "X" in one of the seven boxes.

Original Proceedings. (1) Cases which originate in the United States district courts.

Remove from State Court. (2) Proceedings initiated in state courts may be removed to the district courts under Title 28 U.S.C., Section 1441. When the petition for removal is granted, check this box.

Remanded from Appellate Court. (3) Check this box for cases remanded to the district court for further action. Use the date of remand as the filing date.

Reinstated or Reopened. (4) Check this box for cases reinstated or reopened in the district court. Use the reopening date as the filing date.

Transferred from Another District. (5) For cases transferred under Title 28 U.S.C. Section 1404(a) Do not use this for within district transfers or multidistrict litigation transfers.

Multidistrict Litigation. (6) Check this box when a multidistrict case is transferred into the district under authority of Title 28 U.S.C. Section 1407. When this box is checked, do not check (5) above.

Appeal to District Judge from Magistrate Judgment. (7) Check this box for an appeal from a magistrate judge's decision.

VI. **Cause of Action.** Report the civil statute directly related to the cause of action and give a brief description of the cause.

VII. **Requested in Complaint.** Class Action. Place an "X" in this box if you are filing a class action under Rule 23, F.R.Cv.P.

Demand. In this space enter the dollar amount (in thousands of dollars) being demanded or indicate other demand such as a preliminary injunction.

Jury Demand. Check the appropriate box to indicate whether or not a jury is being demanded.

VIII. **Related Cases.** This section of the JS-44 is used to reference related pending cases if any. If there are related pending cases, insert the docket numbers and the corresponding judge names for such cases.

Date and Attorney Signature. Date and sign the civil cover sheet.

APPENDIX I

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF PENNSYLVANIA

CASE MANAGEMENT TRACK DESIGNATION FORM

GRACO CHILDREN'S PRODUCTS, INC.	:	CIVIL ACTION
	:	
v.	:	
	:	
FISHER-PRICE, INC.	:	
	:	NO.

In accordance with the Civil Justice Expense and Delay Reduction Plan of this court, counsel for plaintiff shall complete a case Management Track Designation Form in all civil cases at the time of filing the complaint and serve a copy on all defendants. (See § 1:03 of the plan set forth on the reverse side of this form.) In the event that a defendant does not agree with the plaintiff regarding said designation, that defendant shall, with its first appearance, submit to the clerk of court and serve on the plaintiff and all other parties, a case management track designation form specifying the track to which that defendant believes the case should be assigned.

SELECT ONE OF THE FOLLOWING CASE MANAGEMENT TRACKS:

(a)	Habeas Corpus – Cases brought under 28 U.S.C. §2241 through §2255.	☐
(b)	Social Security – Cases requesting review of a decision of the Secretary of Health and Human Services denying plaintiff Social Security Benefits.	☐
(c)	Arbitration – Cases required to be designated for arbitration under Local Civil Rule 53.2.	☐
(d)	Asbestos – Cases involving claims for personal injury or property damage from exposure to asbestos.	☐
(e)	Special Management – Cases that do not fall into tracks (a) through (d) that are commonly referred to as complex and that need special or intense management by the court. (See reverse side of this form for a detailed explanation of special management cases.)	☐
(f)	Standard Management - Cases that do not fall into any one of the other tracks	☒

10/27/2005	Lynn E. Rzonca	Graco Children's Products, Inc.
Date	**Attorney-at-law**	**Attorney for**
215-864-8109	215-864-9278	rzoncal@ballardspahr.com
Telephone	**FAX Number**	**E-Mail Address**

APPENDIX F

UNITED STATES DISTRICT COURT

FOR THE EASTERN DISTRICT OF PENNSYLVANIA - DESIGNATION FORM to be used by counsel to indicate the category of the case for the purpose of assignment to appropriate calendar.

Address of Plaintiff: 150 Oaklands Boulevard, Exton, PA 19341

Address of Defendant: 636 Girard Avenue, East Aurora, NY 14052

Place of Accident, incident or Transaction: _____
(Use Reverse Side For Additional Space)

Does this civil action involve a nongovernmental corporate party with any parent corporation and any publicly held corporation owning 10% or more of its stock?

(Attach two copies of the Disclosure Statement Form in accordance with Fed.R.Civ.P. 7.1(a)) Yes ☒ No ☐

Does this case involve multidistrict litigation possibilities? Yes ☐ No ☒

RELATED CASE IF ANY

Case Number: _____ Judge _____ Date Terminated: _____

Civil cases are deemed related when yes is answered to any of the following questions:

1. Is this case related to property included in an earlier numbered suit pending or within one year previously terminated action in this court? Yes ☐ No ☒
2. Does this case involve the same issue of fact or grow out of the same transaction as a prior suit pending or within one year previously terminated action in this court? Yes ☐ No ☒
3. Does this case involve the validity or infringement of a patent already in suit or any earlier numbered case pending or within one year previously terminated action in this court? Yes ☐ No ☒

CIVIL: (Place ☒ in *ONE CATEGORY ONLY*)

A. *Federal Questions Cases:*
1. ☐ Indemnity Contract, Marine Contract, and All Other Contracts
2. ☐ FELA
3. ☐ Jones Act - Personal Injury
4. ☐ Antitrust
5. ☐ Patent
6. ☐ Labor-Management Relations
7. ☐ Civil Rights
8. ☐ Habeas Corpus
9. ☐ Securities Act(s) Cases
10. ☐ Social Security Review Cases
11. ☒ All other Federal Question Cases
(please specify) Telecommunications Act of 1996

B. *Diversity Jurisdiction Cases:*
1. ☐ Insurance Contract and Other Contracts
2. ☐ Airplane Personal Injury
3. ☐ Assault, Defamation
4. ☐ Marine Personal Injury
5. ☐ Motor Vehicle Personal Injury
6. ☐ Other Personal Injury (Please specify)
7. ☐ Products Liability
8. ☐ Products Liability - Asbestos
9. ☐ All other Diversity Cases (Please specify)

ARBITRATION CERTIFICATION
(Check appropriate category)

I, Lynn E. Rzonca, counsel of record do hereby certify:

☐ Pursuant to Local Civil Rule 53.2, Section 3(c)(2), that, to the best of my knowledge and belief, the damages recoverable in this civil action case exceed the sum of $150,000.00 exclusive of interest and costs;

☒ Relief other than monetary damages is sought.

DATE: October 27, 2005 _____ Attorney-at-Law

86747 Attorney I.D. #

NOTE: A trial de novo will be a trial by jury only if there has been compliance with F.R.C.P. 38.

I certify that, to my knowledge, the within case is not related to any case now pending or within one year previously termination action in this court except as noted above.

DATE: October 27, 2005 _____

86747

IN THE UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF PENNSYLVANIA

GRACO CHILDREN'S PRODUCTS, INC.,	)	
	)	
Plaintiff,	)	**Civil Action No. _____**
	)	
v.	)	**Jury Trial Demanded**
	)	
FISHER-PRICE, INC.,	)	
	)	
Defendant.	)	

COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff Graco Children's Products, Inc. ("Graco") complains of defendant Fisher-Price, Inc. ("Fisher-Price") as follows:

Nature of the Action

1. This is an action for injunctive relief and damages arising out of defendant Fisher-Price's infringement of two United States patents owned by Graco.

Jurisdiction and Venue

2. This action arises under the patent laws of the United States, 35 U.S.C. § 101 *et seq.* This Court has subject matter jurisdiction pursuant to 28 U.S.C. §§ 1331 (federal question jurisdiction) and 1338(a) (original jurisdiction under patent laws). Venue lies in the Eastern District of Pennsylvania under 28 U.S.C. §§ 1391 and 1400.

The Parties

3. Graco is a Delaware corporation with a place of business in Exton, Pennsylvania. Graco is a leading manufacturer of juvenile products, including children's swings, strollers, infant car seats and carriers, high chairs, mobiles, playards, and cribs.

4. On information and belief, Fisher-Price is a Delaware corporation with its principal place of business in East Aurora, New York. Fisher-Price sells children's products, including children's swings, to retailers throughout the United States, including to retailers and consumers in this District.

Fisher-Price's Acts of Infringement

5. On June 11, 1996, the United States Patent and Trademark Office issued United States Patent No. 5,525,113 entitled "Open Top Swing & Control" ("the '113 Patent"). A copy of the '113 Patent is attached hereto as Exhibit A.

6. At all relevant times, Graco has owned all right, title, and interest in the '113 Patent.

7. Fisher-Price was or is making, using, selling, or offering for sale children's swings that infringe one or more claims of the '113 Patent, including: the Deluxe Flutterbye Dreams Swing; the Flutterbye Dreams Swing; the Smart Stages 3 in 1 Rocker Swing; the Magical Mobile Swing; the Deluxe Quick Response Swing; the Deluxe Smart Response Swing; and the Peaceful Time Open Top Swing.

8. On information and belief, Fisher-Price was or is selling or offering for sale in this District children's swings, including: the Deluxe Flutterbye Dreams Swing; the Flutterbye Dreams Swing; the Smart Stages 3 in 1 Rocker Swing; the Magical Mobile Swing; the Deluxe Quick Response Swing; the Deluxe Smart Response Swing; and the Peaceful Time Open Top Swing

9. On May 24, 2005, the United States Patent and Trademark Office issued United States Patent No. 6,896,624 entitled "Foldable Swing Having Rotatable Handle" (the '624 Patent"). A copy of the '624 Patent is attached as Exhibit B.

10. At all relevant times Graco has owned all right, title, and interest in and to the '624 Patent.

11. Fisher-Price was or is making, using, selling, or offering for sale a children's swing called the "Fisher-Price Aquarium Take-Along Swing" that infringes one or more claims of the '624 Patent.

12. On information and belief, Fisher-Price was or is selling or offering for sale its Fisher-Price Aquarium Take-Along Swing in this District.

COUNT I—PATENT INFRINGEMENT
The '113 Patent

13. Graco incorporates by reference each of the allegations of the foregoing paragraphs as if fully stated herein.

14. Fisher-Price has infringed one or more claims of the '113 Patent by making, using, selling, offering for sale, and/or importing into the United States children's swings, including: the Deluxe Flutterbye Dreams Swing; the Flutterbye Dreams Swing; the Smart Stages 3 in 1 Rocker Swing; the Magical Mobile Swing; the Deluxe Quick Response Swing; the Deluxe Smart Response Swing; and the Peaceful Time Open Top Swing.

15. Graco has been injured by Fisher-Price's infringement of the '113 Patent.

16. Graco will continue to be injured by Fisher-Price's infringement of the '113 Patent unless the Court enjoins Fisher-Price from further infringement.

17. Fisher-Price's infringement has caused and will continue to cause Graco irreparable harm for which there is no adequate remedy at law.

18. Fisher-Price's infringement has been with full knowledge of the '113 Patent.

COUNT II – PATENT INFRINGEMENT
The '624 Patent

19. Graco incorporates by reference each of the allegations of the foregoing paragraphs as if fully stated herein.

20. Fisher-Price has infringed one or more claims of the '624 Patent by making, using, selling, offering for sale, and/or importing into the United States children's swings, including the Fisher-Price Aquarium Take-Along Swing.

21. Graco has been injured by Fisher-Price's infringement of the '624 Patent.

22. Graco will continue to be injured by Fisher-Price's infringement of the '624 Patent unless the Court enjoins Fisher-Price from further infringement.

23. Fisher-Price's infringement has caused and will continue to cause Graco irreparable harm for which there is no adequate remedy at law.

24. Fisher-Price's infringement has been with full knowledge of the '624 Patent.

PRAYER FOR RELIEF

WHEREFORE, Graco prays that this honorable Court:

A. Enter judgment against Fisher-Price for infringement of the '113 and '624 Patents;

B. Issue an Order permanently enjoining Fisher-Price, its officers, directors, agents, servants, employees, attorneys, subsidiaries, affiliates, and all those persons in active concert or participation therewith, from making, selling, offering for sale, using, and/or importing juvenile products, including the Deluxe Flutterbye Dreams Swing; the Flutterbye Dreams Swing; the Smart Stages 3 in 1 Rocker Swing; the Magical Mobile Swing; the Deluxe Quick Response Swing; the Deluxe Smart Response Swing; the Peaceful Time Open Top Swing; and the Fisher-Price Aquarium Take-Along Swing, or

otherwise directly or indirectly infringing the '113 and '624 Patents;

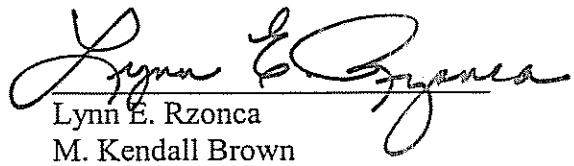
C. Award Graco damages adequate to compensate Graco for Fisher-Price's infringement, trebled pursuant to 35 U.S.C. § 284, together with interest and costs as fixed by the Court;

D. Enter an Order declaring this an exceptional case pursuant to 35 U.S.C. § 285 and award Graco its attorney fees; and

E. Grant Graco such further relief as this Court deems just under the circumstances.

DEMAND FOR JURY TRIAL

Graco demands trial by jury of all issues properly so triable under applicable law.



Lynn E. Rzonca
M. Kendall Brown
BALLARD SPAHR, ANDREWS & INGERSOLL, LLP
1735 Market Street, 51st Floor
Philadelphia, PA 19103-7599
(215) 864-8109 (Telephone)
(215) 864-9278 (Telecopier)

Counsel for Plaintiff
GRACO CHILDREN'S PRODUCTS, INC.

Dated: October 27, 2005

EXHIBIT "A"

US005525113A

United States Patent [19]

Mitchell et al.

[11] **Patent Number: 5,525,113**

[45] **Date of Patent: Jun. 11, 1996**

[54] **OPEN TOP SWING & CONTROL**

[75] Inventors: **Daniel R. Mitchell**, Morgantown; **Scott B. Caley**, Elverson; **Truman Allison**, York, all of Pa.

[73] Assignee: **Graco Childrens Products Inc.**, Elverson, Pa.

[21] Appl. No.: **322,125**

[22] Filed: **Oct. 13, 1994**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 13,747, Oct. 1, 1993.

[51] **Int. Cl.**[6] **A63G 9/16**

[52] **U.S. Cl.** **472/119**; 472/118; 74/48

[58] **Field of Search** ..... 472/118, 119; D6/347, 333, 344; 74/48; 185/40 C

[56] **References Cited**

U.S. PATENT DOCUMENTS

D. 250,861	1/1979	Boudreau et al. .
D. 293,046	12/1987	Richm .
D. 348,157	6/1994	Amburgey et al. .
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1,505,117	8/1924	Withun .
1,906,768	5/1933	Romine .
2,024,855	12/1935	Goetter .
2,076,675	4/1937	Sharp .
2,564,547	8/1951	Schrougham .
2,609,031	9/1952	Puscas .
2,807,309	9/1957	Saint et al. .
2,908,917	10/1959	Pinson .
2,972,152	2/1961	Vincent .
2,979,734	4/1961	Saint et al. .
3,071,339	1/1963	Saint .
3,128,076	4/1964	DiPasqua .
3,146,985	9/1964	Grudoski .
3,166,287	1/1965	DiPasqua .
3,459,423	8/1969	Meade .
3,526,400	9/1970	Carpenter et al. .
3,692,305	9/1972	Allen .
3,818,517	6/1974	Casella .
3,842,450	10/1974	Pad .
4,150,820	4/1979	Bochmann .
4,452,446	6/1984	Saint .

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

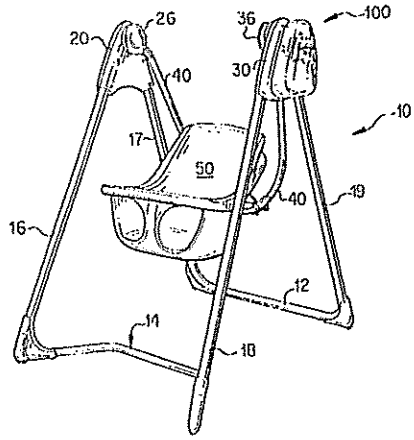
450755	8/1949	Italy .
497871	9/1954	Italy .
1070921	7/1967	United Kingdom .

Primary Examiner—Kien T. Nguyen
Attorney, Agent, or Firm—Pennie & Edmonds

[57] **ABSTRACT**

An open top swing assembly uses a unique swing drive mechanism and a control to provide three selective swing height settings. The assembly has a frame which provides an open top structure for ease of access and a trapezoidal shaped front base to provide foot clearance. The swing drive mechanism includes a drive sleeve rotatably mounted to an axle that operatively supports the hanger. A drive flange is mounted on the axle, with a drive flange coupling device positioned between the sleeve and the drive flange to provide a limited lost motion connection. The coupling device includes a hub member coaxially and rotatably mounted on the axle and at least one torsional spring mounted coaxially on the hub member. The hub member includes abutments for engaging with the drive flange, whereby torque applied to the sleeve is transferred to the axle. A crank driven by a motor is linked to the sleeve to oscillate the sleeve. The swing height control device can have a sensor for detecting the swing height or amplitude. Preferably, three swing height settings are provided. The control device selectively outputs either no voltage, first, second or third predetermined voltages to selectively control the voltage input to the motor based on the selection of the swing height setting and/or the sensed swing height to achieve the selected swing height.

44 Claims, 13 Drawing Sheets



U.S. PATENT DOCUMENTS

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4,722,521	2/1988	Hyde et al. .	
4,785,678	11/1988	McGugan et al. .	
4,805,902	2/1989	Casagrande .	
4,807,872	2/1989	Spilman et al. .	
4,822,033	4/1989	Kohus et al.	472/119
4,911,429	5/1990	Ogbu .	
5,326,326	7/1994	Cunard et al. .	
5,326,327	7/1994	Stephens et al. .	

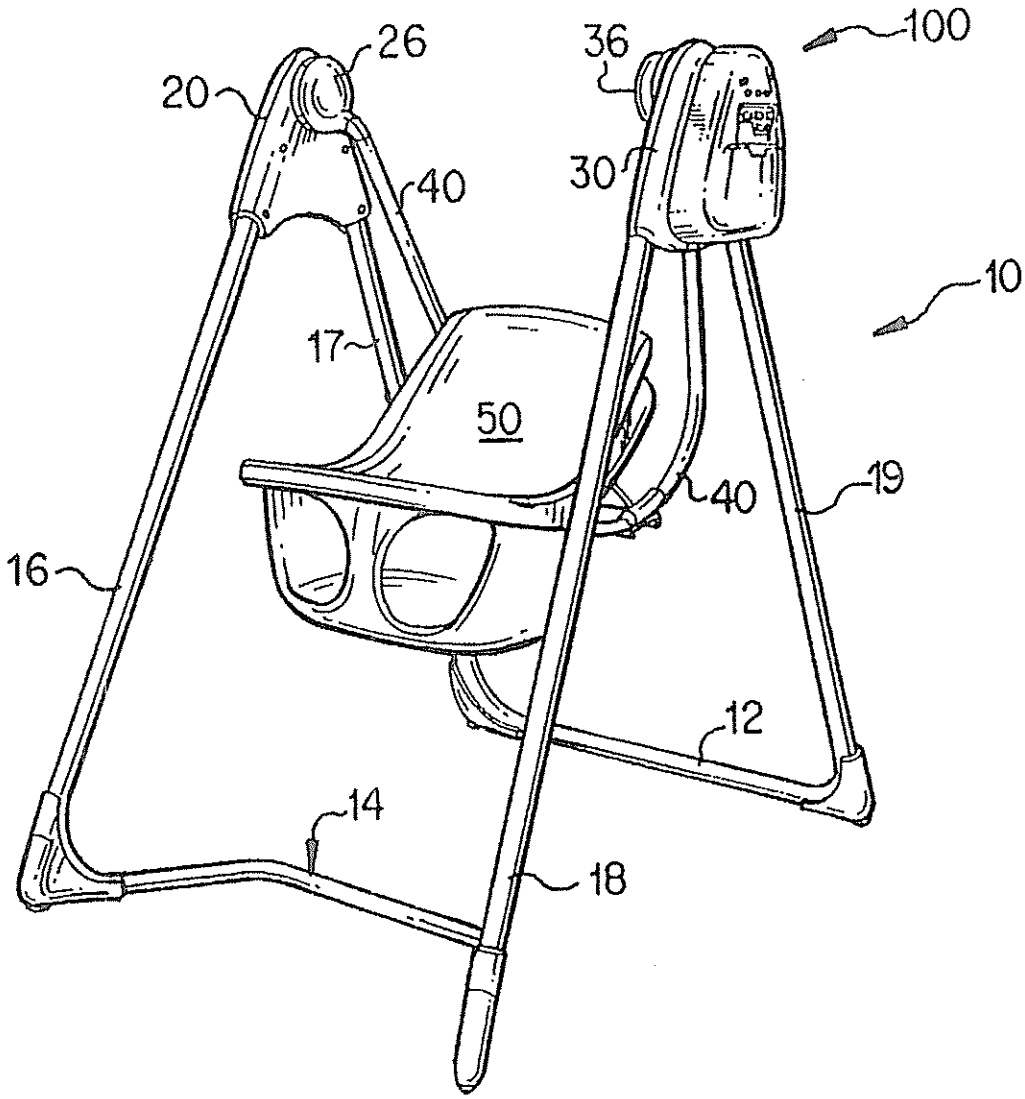


FIG. 1

OPEN TOP SWING & CONTROL

This is a continuation-in-part of design application Ser. No. 29/013,747 filed on Oct. 1, 1993.

BACKGROUND

Different types ok swings for an infant or child have been contemplated in the past. A swing typically comprises a support frame, a seat and at least one hanger attached to the seat, the seat and the hanger defining a swing carriage, and a swing drive mechanism operatively connected to the hanger for maintaining the pendular movement of the swing carriage. If the swing carriage swings with no mechanical friction and no wind resistance, only a single push would be needed to maintain the swing in a perpetual pendulum motion. In such a case, the swing will maintain its amplitude indefinitely and a swing drive mechanism would not be necessary. However, such is not the case in reality, as wind resistance and bearing friction are always present. The mechanical or bearing friction can be reduced such that it becomes negligible. However, the wind resistance cannot be eliminated. The bigger the child, the more wind resistance will there be. It is the wind resistance that mainly dampens the swing amplitude, requiring use of a swing drive mechanism to supply energy lost and maintain its pendular movement.

Typically, the swing drive mechanism is either electrically powered or manually powered. The electrically powered drive mechanism generally uses a DC or AC motor or solenoid, as described for instance in U.S. Pat. No. 4,452,446 issued to Saint; U.S. Pat. No. 4,491,317 issued to Bansal; U.S. Pat. No. 4,722,521 to Hyde et al. The manually powered drive mechanism typically uses a spring wind-up mechanism which can be manually rotated using a crank to store energy within the spring, as described for instance in U.S. Pat. Nos. 3,128,076 and 3,166,287 issued to Pasqua; and U.S. Pat. No. 3,459,423 issued to Meade.

SUMMARY

The present invention relates to an open top swing frame, an electrically powered swing drive mechanism, a swing height or amplitude control for providing selectable swing amplitudes, and an open top swing assembly using the same. The open top support frame according to the present invention has a rear horizontal base, a substantially trapezoidal shaped front base, first, second, third and fourth legs, and first and second connectors. Specifically, the first and second legs extend upwardly, substantially parallel to one another, at an incline from the ends of the rear base. Similarly, the third and fourth legs extend upwardly, substantially parallel to one another, at an incline from the ends of the front base. The first and third legs converge toward each other, as well as the second and fourth legs in a similar fashion. The first and third leg pair and the second and fourth leg pair can be made substantially parallel and symmetrical to each other. A first connector is attached to the first and third leg pair to maintain them at a fixed position relative to each other and to the first connector. Similarly, the second connector is attached to the second and fourth leg pair to maintain them at a fixed position relative to each other and to the second connector.

The rear and front bases are substantially on the same plane, namely on the floor to support the entire frame thereon. The trapezoidal shaped front base has its median arm joined by a pair of laterally and forwardly extending arms so that the opening thereof faces away from the rear base, or rather faces toward the front. The median arm is substantially parallel to and closer to the rear base. The opening created by the trapezoidal shaped front base provides an obstruction free foot clearance for the person seating or removing an infant or child from the swing.

A first pivot or pendulum axle is rotatably journaled to the first connector and a second pivot or pendulum axle is rotatably journaled to the second connector. A pair of hangers extending laterally from the seat can be connected to the first and second pendulum axles such that the seat can oscillate thereabout. Preferably, the first and second axles are aligned so that their axes are collinear about a same horizontal axis.

While it is not necessary, a hub can be use to connect the axles to the hangers, with one of the hangers mounted to one of the hubs and the other of the hangers mounted to the other of the hubs. Each of the hubs can have an overrotation stop which cooperates with a cooperating overrotation stop mounted on each of the first and second connectors adjacent to each of the hubs to prevent overrotation of the hubs relative to the first and second connectors and thus prevent overrotation of the swing carriage.

Another feature of the present invention is a swing drive mechanism. Although it is preferable to use an open top swing frame described above with the drive mechanism according to the present invention, the present drive mechanism can be used with any conventional swing. The drive mechanism comprises a drive sleeve mounted coaxially and rotatably about an axle so that it can substantially freely rotate thereabout. A drive flange is mounted on the axle with no relative rotational movement therebetween. A drive flange coupling device is positioned between the drive sleeve and the drive flange to cause the axle to oscillate with the sleeve in the same direction. A crank driven by a motor via a gear reduction train is linked to the sleeve to oscillate the sleeve and thus the axle via the coupling device and the drive flange.

The sleeve includes a channel radially spaced from the axle and extends parallel with the axle. The crank basically rotates about an axis that is perpendicular to the axle. The crank has a driven portion that is offset from the axis of rotation of the crank. Accordingly, rotation of the crank causes its offset driven portion to follow a circular orbit path whose radius is the distance of the offset. The offset driven portion preferably has a ball that is rotatably mounted thereabout. The ball is slideably mounted in the channel such that rotation of the crank enables the sleeve to oscillate about the axis of the axle while the ball slideably oscillates back and forth within the channel. Means other than the ball, such as a cylinder or universal pivot, can be attached to the driven portion to carry out the same function.

The coupling device comprises a hub member coaxially and rotatably mounted on the axle and at least one torsional spring mounted coaxially on the hub member. The hub member includes abutments for engaging with the drive flange, whereby torque applied to the sleeve is transferred to the spring which can cause the hub member to rotate relative to the axle which in turn can cause the abutments to engage the drive flange and transfer torque to the axle. Preferably, the spring is provided with a limited free play and sufficient travel before it engages with the sleeve and to allow the swing carriage to swing when the motor is stopped, or to allow the motor to rotate when the swing carriage is stopped, without causing damage to the swing drive mechanism. During the interim when the free play (lost motion) is

operational, the sleeve is decoupled from the axle and thus from the swing carriage.

The motor has its output shaft mounted substantially perpendicularly to the axle with the crank rotating about an axis perpendicular to both the output shaft and the axle. Preferably, a flywheel is attached to the motor.

Another aspect of the present invention is a swing height or amplitude control which can be used with the swing drive mechanism according to the present invention. The swing height control according to the present invention, however, can be used to control any conventional swing having a motor operated swing drive mechanism. The control can provide at least two swing height settings (first and second), where the first setting is smaller than the second setting, where it simply outputs either a first or second predetermined voltage to the motor based on the selection of the swing height setting, where the first voltage is lower than the second voltage.

The control can also include a sensor for continuously detecting the swing height or amplitude. Where the control provides at least first and second swing height settings, the control can output either no voltage, a first predetermined voltage or a second predetermined voltage to selectively control the voltage input to the motor based on the selection of the swing height setting and the sensed swing height to achieve the desired swing height. The control can also provide three or more swing height settings (first, second, and third), with the third setting being the largest. In this regard, the control selectively outputs either no voltage, the first predetermined voltage, the second predetermined voltage or a third predetermined voltage, with the third being the greatest. The control can be made to output as many (or more) different voltage outputs as there are different swing amplitude settings.

In operation, using the sensor with the three height setting, upon selection of the first swing height setting, the first voltage is continuously applied to the motor regardless of the swing height detected. Preferably, when and if the detected swing height exceeds the selected swing height setting, the voltage can be cut-off to the motor for the duration of the portion of the swing cycle that exceeds the selected first height setting to provide a more accurate swing height setting.

If the second swing height setting is selected, again the first voltage is initially input to the motor until the detected swing height exceeds the first swing height setting. Upon the swing height exceeding the first swing height setting, the second voltage is applied to the motor only for the duration of the portion of the swing cycle that exceeds the first swing height setting.

If the third swing height setting is selected, again the first voltage is initially applied to the motor until the detected swing height exceeds the first swing height setting. Upon the swing height exceeding the first swing height setting, the third voltage is applied to the motor for the duration of the portion of the swing cycle that exceeds the first swing height setting.

Preferably, when and if the swing height is greater than the third swing height setting, to prevent excessively high swing height, the first voltage is applied to the motor for the duration of the portion of the swing cycle that exceeds the third swing height setting.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features, aspects, and advantages of the present invention will become much more apparent from the following description, appended claims, and accompanying drawings where:

FIG. **1** is a perspective view of an open top swing according to the present invention.

FIG. **1A** is a top elevational view of a portion of FIG. **1**, showing the front base of the open top swing frame according to the present invention.

FIG. **2** is an enlarged side view of the right leg connector which houses the swing drive mechanism and associated control.

FIG. **3** is a perspective view of FIG. **2**, with its cover removed, showing the swing drive mechanism.

FIG. **4** is a sectional view taken along line **4**—**4** of FIG. **3**, showing the details of the swing drive mechanism.

FIG. **5** shows the details of the motor and the crank.

FIG. **6** is a sectional view of the right connector with the hub, showing the overrotation stops formed on the connector and the corresponding overrotation stop formed on the hub for limiting the swing amplitude of the swing carriage.

FIG. **6A** is a perspective view of the left leg connector with its hub removed therefrom to show its pendulum axle and its overrotation stops for limiting the swing amplitude of the swing carriage.

FIGS. **7A**,**7B**, **8A**,**8B**, **9A**,**9B** and **10A**,**10B** show the operation of the swing drive mechanism and the relative position of the crank relative to the sleeve member.

FIG. **11** is an exploded view of the drive mechanism arrangement, including the sleeve, the flange drive coupling device, the drive flange and the axle.

FIG. **12** is an exploded view of the drive flange and the drive coupling device arrangement, taken along line **12**—**12** of FIG. **11**.

FIG. **13** is sectional view taken along line **13**—**13** of FIG. **4**, showing the drive flange and a swing position detector.

FIG. **14** is a schematic elevational bottom view of the prongs taken along line **14**—**14** of FIG. **11**.

FIG. **15** is a schematic representative of a pendulum.

FIG. **16** shows one embodiment of the controls for the swing drive mechanism.

FIG. **17** shows another embodiment of the controls for the swing drive mechanism.

DESCRIPTION OF THE DRAWINGS

FIG. **1** shows an embodiment of a swing according to the present invention, which has a support frame **10** which holds a swing drive mechanism **100**, a pair of hangers **40**, and a seat **50**. The support frame **10** according to the present invention has an open top design. It has no overhang support member to make removal and seating of an infant to and from the swing seat convenient. The open top frame **10** has a rear horizontal base **12**, a substantially trapezoidal shaped front base **14**, a front left leg **16**, a rear left leg **17**, a front right leg **18** and a rear right leg **19** in a splayed position as shown in FIG. **1**, a left leg connector **20** and a right leg connector **30**. The rear left and right legs **17**,**19** extend upwardly, substantially parallel to one another, at an incline or angle from the ends of the rear base **12**. Similarly, the front left and right legs **16** and **18** extend upwardly, substantially parallel to one another, at an incline from the ends of the front base **14**. The front and rear left legs **16**,**17** incline in the opposite directions such that they converge toward each other as shown in FIG. **1**. Similarly, the front and rear right legs **18**,**19** incline in the opposite directions such that

they too converge toward each other. The front and rear left leg pair **16,17** can be substantially parallel and symmetrical to the front and rear right leg pair **18,19** if desired.

The left leg connector **20** connects the front and rear left legs **16** and **17** to maintain them at a fixed position relative to each other. Similarly, the right leg connector **30** connects the front and rear right legs **18,19** to maintain them at a fixed position relative to each other.

The rear and front bases are substantially on the same plane, namely on the floor to support the entire frame thereon. The front base is substantially trapezoidal shaped. Specifically, as shown in FIG. **1**A, the front base is formed by a horizontal median arm **14***a* joined by a pair of oppositely extending arms **14***b*,**14***c*. The arms **14***b*,**14***c* are angled greater than 90° with respect to the median arm **14***a* such that they form a trapezoidal shape. The front base extends inwardly toward the rear base with the median arm **14***a* preferably parallel to the rear base. Due to this feature, the front base provides an opening or clearance space which enables one to move close to the seat during seating or removal of an infant or child from the swing, i.e., foot clearance.

As shown in FIGS. **3**, **4**, **6**, and **11**, a right pendulum axle **32** is rotatably journaled via axially spaced apart bearings **34** or the like on the right leg connector which houses the swing drive mechanism **100**. A left pendulum axle **22** can be rotatably journaled via axially spaced apart bearings **24** or the like on the left leg connector in the similar fashion. The ends of the left and right hangers **40** which extend laterally from the seat **50** can be operatively connected to the left and right pendulum axles, respectively, to enable the seat to swing or oscillate about the axles. The left and right pendulum axles can be aligned so that their axes are collinear about a same horizontal axis to maintain an equal pendulum left and right hanger length.

According to the present invention, left and right hubs **26,36** are preferably connected to the left and right pendulum axles, respectively, with no relative rotational movement between the hubs and their axles. The left hanger is mounted to the left hub **26** and the right hanger to the right hub **36**. As shown in FIGS. **4**, **6** and **6**A, each of the hubs preferably has means cooperating with their respective left and right leg connectors **20,30** for limiting the degree of rotation. Specifically, the limiting means comprises at least one overrotation stop **60**, a pair of stops being preferable as shown in FIGS. **6** and **6**A, extending laterally from each leg connector **20,30**. The stops **60** cooperate with cooperating overrotation abutments or stops **62** formed on each of the hub **26,36** to prevent overrotation of the hubs relative to the connectors and thus the swing carriage. The maximum degree of rotation Θ_{MAX} between the abutments is about 70° or the swing amplitude of about 35° as schematically shown in FIG. **6**.

A swing can generally be considered to behave as a simple pendulum when the amplitude is relatively small, where the period of oscillation is also generally unaffected by the mass of the pendulum. The swing amplitude is preferably between about 0° to 22° as presently contemplated by an embodiment of the present invention, which means that the period of oscillation for the swing is more or less can be considered to be substantially constant between these amplitudes. The velocity of the pendulum is greatest at its neutral position, i.e., swing amplitude of 0° and smallest at its peak amplitude (zero velocity) where it changes its direction. When the period is constant, a pendulum swinging at a bigger amplitude will have to travel at a greater velocity than the same swinging at a smaller amplitude. That is, a pendulum swinging at a bigger amplitude has to travel further during the same period and thus has to travel faster. In this regard, the drive mechanism needs to accommodate not only for variations of speed of the swing carriage, it must be synchronized with the swing cycle in order to achieve a natural swing motion.

The present invention contemplates a novel swing drive mechanism which operates in synchronism with the swing cycle regardless of the swing amplitude. Preferably, the present swing drive mechanism can selectively maintain two or more different levels of swing amplitude or swing speed, i.e., low, medium and high, for example. The swing drive mechanism **100** according to the present invention is shown in FIGS. **3** -**5** and **7**–**12**. Although it is preferable to use an open top swing frame described above with the swing drive mechanism according to the present invention, any conventional swing frame can be used. The swing drive mechanism **100** comprises a drive sleeve **110** mounted coaxially and freely rotatably about the axle **32**, a drive flange **120** is mounted substantially collinearly adjacent the drive sleeve on the axle with no relative rotational movement between the axle and the drive flange. A drive flange coupling device **130** is positioned between the drive sleeve and the drive flange, and a crank **150** driven by a motor **160** via a gear reduction train **155,156** is linked to the sleeve to oscillate the sleeve and thus the axle **32** via the coupling device and the drive flange.

As better shown in FIGS. **11** and **12**, the drive flange **120** comprises a disc member **121** with a central circular flange **122** extending collinearly therewith from the inner side or face **123** thereof. A central hole **124** extends through the flange and the disc member, which is provided with conventional means for limiting the rotational movement of the disc member relative to the axle, such as a non-circular hole, i.e., a square-shaped, D-shaped, V-shaped or crescent-shaped openings, etc., as shown in FIG. **11**, which cooperates with a complementary shaped axle. The inner side **123** of the disc member is provided with a recess **125** having five symmetrical divisions, substantially akin to a propeller or five-leafed clover. Each of the five divisions has opposed abutment side walls **125***a*,**125***b*.

The disc member **121** also has a radial extension **126** extending radially therefrom. An abutment **128** extends substantially perpendicularly from the free end of the extension **126**. The abutment **128** also extends coaxially and circumferentially about the axle **32**, parallel with the axle, and has two opposed abutment edges **128***a*,**128***b* formed by the parallel edges thereof.

The coupling device **130** comprises a hub member **140** coaxially and rotatably mounted on the axle and at least one torsional spring **133,134** mounted coaxially on the hub member. Although the drawings show two discrete springs, a single continuous torsional spring attached to the hub member can also be used. The hub member has a central throughhole **141** slightly larger than the outer diameter of the flange **122** so that it coaxially engages thereover and freely rotates thereabout. The hub member preferably has a pentagonal central flange **142** collinearly arranged about a star-shaped disc **143** which has five symmetrical radial extensions **143***a*. Any non circular central flange can be used so long as it does not permit the spring to rotate thereabout. Each of the extensions **143***a* is substantially narrower than the distance between the abutment walls **125***a*,**12***b* formed on each of the five divisions of the recess to enable the hub member to freely rotate relative to the drive flange **120**, for example, of about 20°.

As shown in FIG. **11**, two discrete torsional springs **133,134** of substantially equal spring constant are preferably positioned between the sleeve and the hub member and coaxially wrapped around the hub member in the opposite directions with no relative rotational movement between the hub member and the springs. Each of the springs has a substantially pentagonal central opening which corresponds to the pentagonal flange **142** of the hub member to enable the springs to be mounted coaxially thereon with no relative rotational movement. Each of the spring has a hook **135,136** facing toward each other for engaging with the sleeve. As previously indicated, a single spring attached to the hub member, for instance by way of a slot, with their ends capable of engaging the sleeve can also be used rather than two springs if desired.

The sleeve **110** comprises a substantially cylindrically shaped body **111** collinearly formed with a tear drop shaped plate member **116** having a planar outer face **116***a*, with a central throughhole **112** extending through the cylindrical body and the plate member. The throughhole **112** is dimensioned to enable the sleeve to freely rotate about the axle **32**. The body **111** is preferably provided with a plurality of radially extending reinforcement ribs **113** and a channel **114** radially spaced from the axle and extending parallel with the cylindrical body.

The drive sleeve engages the springs via a spring engaging element **115** extending axially from the apex of the tear drop shaped plate member. The engaging element is axially and angularly aligned with the channel. The spring engaging element is also formed radially further away from the throughhole than the channel and can be aligned with the abutment **128**. Two opposed abutment edges **115***a* and **115***b* are formed by the lateral edges of the spring engaging element **115**. The distance between the abutment edges **115***a*,**115***b* is preferably about same as that between the abutment edges **128***a*,**128***b*, but smaller than the distance between the two hooks **135,136** such that the sleeve can freely move relative to the springs for a limited degree (providing a free play or lost motion relationship), which in turn translates to lost motion or free play relative to the axle **32**. Specifically, unless the spring is already adjacent to one of the abutment portions **115***a*,**115***b*, the sleeve has to rotate relative to the spring before it engages one of the springs and cause the hub member **140** to rotate and abut the drive flange **120**.

The springs are arranged such that they engage opposed abutment edges of the abutments **115,128** and tend to cause the springs to coil tighter around the pentagonal central flange **142**. Specifically, the two springs are coiled in the opposite directions such that rotation of the sleeve **110** in the clockwise direction (CW) causes the abutting edge **115***a* thereof to engage the hook **135** while causing the abutting edge **128***b* to engage the hook **136**. Rotation of the sleeve in the counterclockwise direction (CCW) causes the abutting edge **115***b* thereof to engage the hook **136** while causing the abutting edge **128***a* to engage the hook **135**.

The load required to oscillate the swing carriage at a relatively low amplitude, for instance of 10°, is generally relatively small. However, the energy required to oscillate increases by the square as the amplitude increases. In order to accommodate for varying loads, the present invention contemplates use of a spring or springs, in conjunction with the free play arrangement, to provide a plurality of spring gradients, three to be specific, to accommodate different swing heights. Specifically, the free play arrangement (where the relative differences between the width of the abutment **128** and the distance between the hooks **135,136**)

enables the sleeve to rotate freely relative to the spring. The free play provides the first gradient of zero load for a first predetermined angle of rotation. When the sleeve is rotated relative to the axle beyond the first predetermined angle of rotation in the same direction, one of the abutment edges **128***a*,**128***b* is engaged with one of the hooks **135,136** and the other of the hooks **135,136** is engaged with one of the abutment edges **115***a*,**115***b*, both springs being engaged such that they both become active. When the two springs are active, they provide a second gradient of load for a second predetermined angle of rotation. The second predetermined angle of rotation is preferably small relative to the first angle of rotation, which can begin when the load necessary to increase the swing amplitude increases relatively sharply to preferably parallel the load requirement for the corresponding swing amplitude. When the sleeve is rotated beyond the second predetermined angle of rotation in the same direction, the radial extensions **143***a* abut against one side of the side walls **125***a*,**125***b*, preventing the hub member from rotating relative to the drive flange. When this happens, only one of the springs, the spring engaging the sleeve, becomes functional, which provides the third spring gradient which is substantially greater than the second spring gradient again to parallel the load requirement for a greater swing amplitude. In essence, if the spring constant between the two springs is equal, the third spring gradient would increase about two folds since only one of the two opposingly acting springs becomes active. These three spring gradients can provide the necessary load constants to operate a swing having variable swing amplitudes.

Referring to FIG. **4**, the swing drive mechanism is housed in the right leg connector **30**, but can just as easily be housed in the left leg connector **20**. The axle **32** is rotatably journaled to the connector **30** to enable the axle to pivot or oscillate to cause the hub **36** to rotate along with the axle to thereby oscillate the hanger connected thereto. According to the present invention, the sleeve is caused to oscillate using a crank **150** which is driven preferably by a DC motor **160**. As previously indicated, it is desirable to prevent the motor from straining or seizing when the seat is stopped from swinging, intentionally or otherwise while the motor is running. The torsional springs **133,134** in conjunction with lost motion arrangement (of the sleeve relative to the axle) can absorb the energy input by the motor in the event the swing carriage is stopped while the motor is running or in the event the motor is stopped while the swing carriage is in motion. During the interim when the lost motion is operational, the sleeve is basically decoupled from the axle and thus from the swing carriage. In this regard, the free play or the lost motion arrangement can enable the axle to oscillate less than the amplitude driven by the crank, as will be explained from below.

The crank **150** basically rotates about an axis **151** that is perpendicular to the axle. The crank has a driven portion **152** that is offset from and parallel to the axis **151** of rotation of the crank. Rotation of the crank thus causes its offset driven portion to follow a circular orbit whose radius R is the distance of the offset. In this regard, the radius of the offset should be such that the orbiting crank oscillates the sleeve at a greater amplitude than the greatest desired oscillation (third amplitude).

The offset drive portion **152** preferably has a ball **153** that is rotatable about the driven portion, the ball being slideably mounted in the channel such that rotation of the crank enables the sleeve to oscillate about the axle while the ball slideably oscillates back and forth within the channel. To properly track the ball within the channel, the length of the

channel should be same or longer than the diameter of the orbiting ball. Means other than the ball, such as a cylinder, universal pivot or flexible link can be attached to the driven portion to enable transfer of orbiting motion to oscillatory motion.

As shown in FIG. 5, the crank is fixedly connected to a drive train which includes a driving gear **155** engaged to a worm shaft **156** which is connected to an output shaft **162** of the motor **160**. The output shaft **162** is mounted substantially perpendicular to the axle, and the crank rotates about the axis **151** that is perpendicular to the output shaft **162** and the axle **32**. Preferably, the motor has a flywheel **164** connected to the output shaft **162** to even the varying load (encountered during the swing cycle) applied to the motor. The motor and the crank are preferably housed in a motor housing **170** which is non-displaceably connected to the connector **30**. The crank and the motor rotate about their axes of rotation which does not change relative to each other, to the axle **32** or to the connector **30**.

FIGS. **7–10** show the schematic position of the crank in relationship to the sleeve. FIGS. **7A**, **8A**, **9A** and **10A** are views taken along the line A—A of FIG. **3**, with the drive flange **120**, the hub member **140** and the springs **133,134** omitted for convenience of illustration. FIGS. **7B**, **8B**, **9B** and **10B** are views similar to FIG. **4**, but showing only the motor housing **170**, including the motor **160** and the crank **150**, and a section of the channel **114** formed on the sleeve **110**. As seen from arrows W, the crank rotates in one direction.

FIGS. **7A** and **7B** show the instance where the sleeve has rotated counter-clockwise (CCW) and reached its maximum amplitude Θ_1, Θ_2, or Θ_3 as shown in FIG. **15**. At this instance, the force vector V output by the crank is substantially parallel to the axis of rotation of the sleeve, thus imparting no oscillatory motion. The sleeve is moving at zero velocity and changing its direction of rotation. As seen from FIG. **7B**, the offset driven portion **152** is positioned about the midpoint of the channel, with the ball **153** slid up relative thereto as shown by the arrow U.

FIGS. **8A** and **8B** show the instance where the crank has rotated 90° relative to the crank positioned in FIGS. **7A** and **7B**, respectively, causing the sleeve to rotate in the opposite direction. At this instance, the sleeve is rotating in the clockwise (CW) direction at its maximum velocity, with the ball slid down as shown by arrow D to its lowest point relative to the offset driven portion. At this instance, the force vector V output by the crank is perpendicular to the axis of rotation of the sleeve, where the velocity of the rotating sleeve is substantially equal to the orbiting velocity of the crank. As shown in FIG. **8B**, the offset driven portion is at its rightmost point on the channel.

FIGS. **9A** and **9B** show the instance where the crank has rotated about 90° relative to the crank positioned in FIGS. **8A** and **8B**, respectively. In this instance, the sleeve has rotated clockwise (CW) and reached its maximum amplitude Θ_1, Θ_2, or Θ_3. Again, the force vector V output by the crank is parallel to the axis of rotation of the sleeve at this point. Thus, the sleeve is moving at zero velocity and changing its direction of rotation. As seen from FIG. **9B**, the offset driven portion is positioned about the midpoint of the channel, with the ball slid up relative thereto as shown by the arrow U.

FIGS. **10A** and **10B** show the instance where the crank has rotated about 90° relative to the crank positioned in FIGS. **9A** and **9B**, respectively, causing the sleeve to rotate in the opposite direction. At this instance, the sleeve is rotating in the clockwise (CCW) direction at its maximum velocity, with the ball moved down as shown by the arrow D to its lowest point relative to the offset driven portion. Again, the force vector V output by the crank is perpendicular to the axis of rotation of the sleeve, where the velocity of the rotating sleeve is substantially equal to the orbiting velocity of the crank. As shown in FIG. **10B**, the offset driven portion is at its leftmost point on the channel.

It was already described that the velocity of the pendulum is greatest at its neutral position, i.e., swing amplitude of 0° and zero at its peak amplitude where it changes its direction. The sleeve/crank arrangement according to the present invention substantially mimics the pendulum motion, where the velocity of the oscillating sleeve is greatest where its amplitude is at 0° and zero at its maximum amplitude where the direction of rotation changes.

The drive mechanism according to the present invention accommodates not only for variations of speed of the swing carriage to achieve a natural swing motion. This is achieved by using the above described crank/sleeve arrangement in conjunction with the above described drive flange coupling device **130** which has three different spring gradients or constants. Specifically, the oscillation amplitude of the sleeve will remain substantially constant at Θ_S as schematically represented in FIG. **15**, generally limited by the orbit diameter of the driven portion. However, due to the lost motion or free play arrangement described above in conjunction with the springs, the axle does not need to oscillate the same amount. Depending on the amount of torque output by the motor, the axle can always be controllably driven less than the oscillation amplitude of the sleeve.

Specifically, the crank can be tuned to oscillate the sleeve at a period substantially equal to the natural oscillation period of the swing carriage to synchronize the sleeve with the oscillation of the swing carriage. With reference to FIG. **15**, if the torque applied to the motor is such that the swing carriage can only oscillate a fraction of the oscillation amplitude, at Θ_1 for instance, the lost motion arrangement can enable the sleeve to oscillate to Θ_S. Since the period of oscillation is the same for the sleeve and the swing carriage, the sleeve will remain synchronized with the swing carriage. Any small synchronizing discrepancy occurring between the sleeve and the swing carriage due to mechanical aberration can be absorbed by the loss motion arrangement and the springs to maintain proper synchronization.

The swing mechanism described above can be used with any conventional swing control. For instance, to provide two different amplitudes, low and high, one can provide a control that outputs two different voltages depending on the swing height selected. Upon selection of the low amplitude setting, a low voltage can be input to the motor. Upon selection of the high amplitude setting, a relatively higher voltage can be input to the motor. Preferably, the motor operates substantially at a constant speed regardless of the voltage input to the motor. By inputting higher voltage, the motor will impart a greater torque to cause the axle to oscillate at a relatively greater amplitude.

Another aspect according to the present invention is a unique swing height or amplitude control **200** which can be used with the swing drive mechanism described above or with any conventional swing. According to the present invention, the swing control incorporates means for detecting the swing height or amplitude, which can be any conventional switches which can be triggered by any element that oscillates with the seat such as the hanger or the pendulum axle.

The swing control **200** according to the present invention, can provide three swing height or speed settings (first,

second, and third), where the first setting is smallest, the third setting the largest and the second setting falling between the first and second settings. The swing control can selectively output either zero voltage, a first predetermined voltage, a second predetermined voltage or a third predetermined voltage to selectively control the voltage input to the motor based on the swing height or speed selected and the sensed swing height to achieve the desired swing height. The first, second and third voltages are greater than zero, with the first voltage being the smallest and the third being the greatest, with the intermediary second voltage falling between first and second voltages.

According to the present invention, the swing height detection means shown in the preferred embodiment comprises a swing angle indicator formed on the drive flange **120** and a light interrupt detector **210**. As shown in FIGS. **11** and **14**, the angle indicator comprises a pair of spaced apart prongs **127** extending substantially perpendicularly from the free end of the extension **126**. The prongs **127** extend coaxially and circumferentially about the axle **32**, parallel with the axle, in the direction opposite the abutment **128**. The dimensions of the two prongs are substantially the same, with the spacing between the prongs being about the width of one of the prongs. The prongs operate in conjunction with a light interrupt indicator **210** to determine the angle of rotation of the axle relative to the connector.

The light interrupt detector **210** comprises a photodetector or phototransistor **212** aligned with and spaced apart from an infrared light emitting diode (IRLED) **214**. Since the drive flange is non-rotatably connected to the axle, the prongs rotate along with the axle **32**. As shown in FIGS. **4** and **13**, the light interrupt detector is positioned so that the prongs can oscillate between the photodetector and the IRLED. As the prongs oscillate, they can interrupt or block light emitting from the IRLED to the photodetector, representative of the swing amplitude exceeding a predetermined setting. The prongs and spacing therebetween are dimensioned such that they can indicate at least three different patterns of light interruption to detect the swing amplitude. Specifically, when the oscillation occurs between the prongs (within the spacing between the prongs), light emitting from the IRLED is not interrupted. In this mode, the swing height is within the first swing height setting. When the oscillation is greater such that the prongs do interrupt light emitting from the IRLED, the swing is oscillating within the second or third swing height setting. When the oscillation occurs even at a greater angle, the prongs interrupt light emitting from the IRLED as in the second swing height setting, but the prongs can swing past its extreme outer edges **127***a*,**127***b*, which at that point ends the light interruption (within the same period). In this mode, the swing oscillates past the third swing height setting.

Depending on the amplitude of the swing, the prongs either interrupt or do not interrupt light emitted by the IRLED. When the swing is centered (at its neutral position), the amplitude Θ is at 0° as shown by schematic representations in FIGS. **14** and **15**. The prongs can be dimensioned, for instance, so that the amplitude at Θ_1 is about 9° and at Θ_3 is about 22°. The prongs do not interrupt light emitted by the IRLED until the prongs rotate either direction from the center by an amplitude of about 9°. From the amplitude of about 9° to the amplitude of about 22°, the prongs interrupt light emitting from the IRLED. When the prongs rotate beyond about 22° amplitude, the light becomes uninterrupted.

FIGS. **16** and **17** show schematic representative block diagrams of different embodiments of the control according to the present invention which can selectively produce a plurality of different voltages which can be applied to the motor in order to produce three different swing amplitudes. For convenience, the same or equivalent elements have been identified with the same reference numerals. The amplitudes are referred to as low (first), medium (second) and high (third), which are actuated by switches, preferably pushbuttons **301**, **302**, and **303**, respectively. A stop switch, preferably pushbutton **304** is provided for turning off the control.

According to the preferred embodiment, a switch interface **300** is provided between the switches LOW **301**, MED **302**, HIGH **303** and STOP **304** and their respective LOW LED **305**, MED LED **306** and HIGH LED **307**. The interface can include a conventional circuitry which remembers the last switch depressed, such as a non-clocked flip-flop(s). The control can include a power on switch. However, since such an interface typically uses an insignificant amount of power, it can remained powered to eliminate the need for a separate power on switch. When any one of the switches **301**, **302** and **302** is turned on, a digital RUN output signal **309** and the corresponding "L", "M", or "H" digital signal become high. These digital signals then control other control elements. Specifically, the run output enables power to be supplied to the control elements or circuitry **320**, **330**, **330'**, **360** (**360'**) and **380**, **380'**. When the STOP switch is pushed, the RUN output becomes disabled or turned low to shut off the control. Any switch can be activated at any time regardless of the previous selection.

The "H" and "M" outputs can be connected to two opposite outputs of a flip-flop to make them complements of each other. Accordingly, whenever "H" output from the switch interface box **300** becomes high, the "M" output will be low and vice-versa. When either the HIGH or MED switch is activated, the "L" output becomes low, for instance, by grounding the "L" output signal, to cause the LED bias current to flow through resistor RLIMIT **321** and light the HIGH or MED LED. On the other hand, whenever the LOW switch is activated, the "L" output becomes high, regardless whether the "H" or "M" output is high and the diode **308** in series with the MED or HIGH LED will cause all the biasing current to be shunted through the LOW LED **307**. The "H" or "M" output can remain high as this signal will have no effect on the voltage output when the LOW switch is turned on.

Whenever any one of the LOW, MED and HIGH switch is activated, the RUN output becomes high and a predetermined reference voltage (PRV) can be generated by the reference generator **330** and applied to the voltage regulator **380** as shown in the embodiment of FIG. **16**. Alternatively, the voltage regulator can produce its own reference voltage as shown in the embodiment of FIG. **17**. In addition, the reference generator **330** and the IRLED bias circuit **330'** produce the necessary bias voltage for the IRLED **214**.

When the RUN output is high, the pulse-width modulation (PWM) circuitry or switch **384** becomes active. A resistor divider network comprising RF **381** and RLOW **382** can provide a percentage of output voltage as a feedback value to the voltage regulator **380**. Whenever the feedback value is less than the PRV, the PWM switch **384** is closed. This causes the averaging capacitor **383** voltage to rise until the feedback voltage value becomes greater than the PRV (plus a small amount of hysteresis). At this point, the PWM switch **384** opens and the capacitor voltage decays. When the capacitor voltage decays down to the PRV (minus a small amount of hysteresis), the PWM switch **384** is closed once again, repeating the process to maintain the average value of the feedback voltage to equal the PRV. The output voltage to

the motor is controlled by resistors RLOW **382**, RMEDIUM **386**, RHIGH **387** and RF **381** since the feedback voltage represents a fixed percentage of the output.

It is important to note that because the motor acts as an inductive load, when the PWM switch is opened, current still flows into the motor. The flyback diode **385** can be used to provide a path for this current and clamp the output voltage to a diode voltage, typically 0.5 to 0.7 V below ground.

With respect to the embodiment shown in FIG. **16**, when the LOW switch **301** is activated, the "L" signal becomes high and the AND gate **362** will always output a low signal. Accordingly, the IR switch **361** will always be held open by the AND gate **362** when the LOW switch is activated, and the feedback percentage, as described above, can be defined solely by the RLOW **382** and the RF **381**. This is true for the low swing amplitude setting regardless of the position of the prong **127** or the values of the "M" or "H" signal output to the output voltage level switching circuit **360**. Alternatively, as shown in FIG. **17**, the output voltage level switching **360'** can cut-off the voltage upon the prongs **127** interrupting light emitting from the IRLED. In this embodiment, an OR gate **365** can be used to selectively provide high or low ENABLE signal to the voltage regulator **380'**. Specifically, when the "L" signal is high and the prongs do not block light emitting from the IRLED, the OR gate will always produce high ENABLE signal. However, when the prongs do block light emitting from the IRLED, the OR gate will produce a low ENABLE signal to disable the voltage regulator, providing no voltage output to the motor. The values of the RLOW and the RF thus can be selected to provide the desired low or first output voltage to the motor.

When the MEDIUM switch **302** is activated, the "M" output goes high, the "M" switch **363** is closed and the "L" input to the inverter of the AND gate **362** becomes low. The IR switch **361** is closed only when the photodetector **212** outputs high signal, i.e., interruption of light emitting from the IRLED. Accordingly, the voltage output to the motor will be controlled by the RLOW **382** and the RF **381** as in the LOW mode. Alternatively, with respect to FIG. **17**, the low "L" signal is output to the inverters of the OR gate **365** and the AND gate **366**, while either high or low signal from the photodetector **212** is input to the AND gate **366** and the inverter of the OR gate **365**. Since the "L" signal will always be low in this mode, the OR gate will always output a high ENABLE signal and always enable the voltage regulator. Again, the IR switch will close only when the photodetector outputs high signal (upon interruption of the light). When the IR switch **361** is closed, the RMEDIUM **386** is connected in parallel with the RLOW **382**, lowering the overall resistor value and thus the feedback percentage to raise the voltage output to the motor to the selected medium voltage level. The value of the RMEDIUM thus can be selected to provide the desired medium or second output voltage to the motor.

The operation of the HIGH mode is substantially similar as the MEDIUM mode. Specifically, when the HIGH switch **303** is activated, the "H" signal goes high and the "L" signal goes low. The IR switch **361** is closed only when the photodetector outputs high signal upon the prongs interrupting the light. However, when the IR switch **361** is closed, the RHIGH **387** is connected in parallel with the RLOW **382**. The value of the RHIGH can be selected to provide the desired high or third output voltage to the motor. Alternatively, the "M" switch **363** can be closed along with the "high" switch to connect the RHIGH, the RMEDIUM and the RLOW in parallel. In this regard, a higher value RHIGH can be used to provide the same high or third output voltage to the motor.

In the medium and high swing settings, whenever the IRLED light is not interrupted such that the photodetector outputs a high signal, the IR switch **361** is opened or remains opened, preventing both the RMEDIUM and the RHIGH from being connected in parallel with the RLOW. This forces the output voltage to its low value regardless of the position of the "M" switch **363** or the "H" switch **364**.

The PRV generated by the reference generator **330** can be produced for example by a semiconductor diode, which typically has a negative temperature coefficient of about −2 millivolt/°C. Thus, as the temperature increases, the reference output voltage from the semiconductor diode falls. Accordingly, when such a semiconductor diode is used, it is desirable to provide a temperature compensator **370** such as a negative coefficient thermistor connected in parallel with the RLOW **382** to compensate for the drop in reference voltage. As the temperature increases, the thermistor resistance decreases, thereby decreasing the percentage of feedback. This action increases the output voltage with increasing temperature and thus compensates for the fall of the reference voltage. Alternatively, as shown in FIG. **17**, a temperature compensator can be built into the voltage regulator **380'** which produces its own internally temperature compensated reference voltage VOLT REF.

Preferably, the battery sense and flash circuit **320** can be used to cause at least one of the indicator LEDs **305**, **306**, or **307** to flash when the battery voltage supply falls below a predetermined voltage level to provide a visual indication of when the batteries need to be replaced.

As described above, the exemplary controls shown in FIGS. **16** and **17** can be used to produce three different output voltages to the motor depending upon the swing amplitude selected by the user. However, modifications can be made to the control shown in FIGS. **16** and **17** to achieve the same functional attributes. For example, the pulse-width modulation scheme for voltage regulation may be replaced by a linear voltage regulator if desired. These changes are well within the ambit of one skilled in the art and is deemed to be within the scope of this invention.

In operation, upon selection of the first swing height or speed setting, the control outputs the first voltage to the motor regardless of the swing height detected. However, in the event that the swing height exceeds the first predetermined swing height setting of, for example, greater than 9°, it is preferable for the control to cut-off the voltage applied to the motor for the duration of the portion of the swing that exceeds the first swing height setting.

Preferably, the first voltage is sufficient to enable the swing carriage to reach about 12°, a little beyond the first swing height setting to enable the prongs to interrupt light emitting from the IRLED.

If the second swing amplitude setting is selected, again the control outputs the first voltage to the motor until the swing height exceeds the first swing height setting of about 9°. Upon the swing height exceeding the first swing height setting, the control outputs the second voltage to the motor for the duration of the portion of the swing that exceeds the first swing height setting. In the second swing amplitude setting, the control outputs the second voltage which would enable the swing carriage to reach greater than 12°, for instance.

If the third swing height setting is selected, again the control outputs the first voltage to the motor until the swing height exceeds the first swing height setting of 9°. Upon the

swing height exceeding the first swing height setting, the control outputs the third voltage to the motor for the duration of the portion of the swing that exceeds the first swing height setting. The third voltage enables the swing carriage to reach greater than the second setting, but preferably less than 22° for instance.

In the second and third swing mode, however, when and if the swing height exceeds 22°, light emitting from the IRLED is again uninterrupted, causing the control to output the first voltage to the motor for the duration of the portion of the swing height that exceeds the third swing height setting to prevent excessively high swing amplitude. It should be noted that this can apply to the first mode. However, since the voltage supplied to the motor can be cut-off when the amplitude exceeds 9°, it will generally not occur, but adds additional protection, however.

Given the disclosure of the present invention, one versed in the art would readily appreciate the fact that there can be many other embodiments and modifications that are well within the scope and spirit of the disclosure set forth herein, but not specifically depicted and described. For example, although the present invention relates to a swing construction for an infant or child, the same teaching and principle may be applied to swings that handle a lighter object such as a doll, as well as for a heavier person such as an adult. Accordingly, all expedient modifications readily attainable by one versed in the art from the disclosure set forth herein that are within the scope and spirit of the present invention are to be included as further embodiments of the present invention. Accordingly, the scope of the present invention is to be as set forth in the appended claims.

What is claimed is:

1. A swing assembly comprising:

a seat;

at least one hanger connected to said seat;

a support frame supporting said hanger; and

a swing drive mechanism mounted on said support frame for oscillating said hanger relative to said support frame, said swing drive mechanism comprising:

an axle mounted on said support frame, wherein said hanger is operatively connected to said axle;

a drive sleeve mounted coaxially and rotatably about said axle, wherein said sleeve is rotatable relative to said axle;

a drive flange mounted on said axle;

a drive flange coupling device positioned between said drive sleeve and said drive flange to cause said axle to oscillate with said drive sleeve;

a crank linked to said sleeve for oscillating said sleeve; and

a motor for rotating said crank.

2. A swing assembly according to claim 1, wherein said coupling device comprises at least one spring mounted coaxially and rotatably relative to said axle and collinearly adjacent relative to said sleeve, wherein said spring is positioned to enable engagement with said sleeve.

3. A swing assembly according to claim 2, wherein said coupling device further comprises a hub member rotatably mounted on said axle, wherein said spring is coaxially mounted to said hub member, said hub member including abutments for engaging with said drive flange, whereby torque applied to said sleeve is transferred to said spring which causes said hub member to rotate and cause said abutments to engage said drive flange and transfer to said axle.

4. A swing assembly according to claim 3, wherein said sleeve includes a channel running parallel with said axle and said crank has a ball mounted thereon, said ball being mounted in said channel and slideable and relative thereto, said ball being slideably movable and rotatable relative to said crank, whereupon rotation of said crank causes said sleeve to oscillate about said axle and along with said axle.

5. A swing assembly according to claim 4, wherein said motor has an output shaft mounted substantially perpendicular to said axle and said crank rotates about an axis that is perpendicular to said output shaft and said axle.

6. A swing assembly according to claim 1, further comprising a control for changing the swing amplitude.

7. A swing assembly according to claim 6, wherein said control has means for selectively providing at least two different predetermined swing amplitudes.

8. A swing assembly according to claim 7, wherein said control has means for selectively providing three different predetermined swing amplitudes.

9. A swing assembly according to claim 8, wherein said control has means for detecting the swing amplitude.

10. A swing assembly according to claim 9, wherein said control has means for controlling the swing amplitude based on the amplitude detected and the amplitude selected.

11. An open top swing comprising:

a seat;

a pair of hangers connected to said seat;

a free standing support frame pivotally supporting said hanger, said support frame comprising:

a rear base;

first and second opposed legs extending upwardly at an angle from ends of said rear base;

a front base;

third and fourth opposed legs extending upwardly at an angle from ends of said front base,

wherein said first and third legs converge toward each other, and said second and fourth legs converge toward each other;

a first connector attached to said first and third legs for maintaining said first and third legs at a fixed position relative to each other;

a second connector attached to said second and fourth legs for maintaining said second and fourth legs at a fixed position relative to each other;

a first axle journaled for rotation on said first connector;

a second axle journaled for rotation on said second connector;

a hub mounted to each of said first and second axles, wherein one of said hangers is mounted to one of the hubs and the other of said hangers mounted to the other of said hubs; and

a swing drive mechanism mounted on said one of said first and second connector and operatively connected to respective one of said first and second axle for oscillating said seat, wherein said swing drive mechanism has means for selectively controlling the degree of rotation of said first and second axles.

12. An open top swing according to claim 11, wherein said front base is substantially trapezoidal shaped, defined by a median arm and a pair of oppositely extending arms extending from ends of said medial arm, wherein said third and fourth legs extend from ends of said oppositely extending arms.

13. An open top swing according to claim 12, wherein said median arm is substantially parallel to said rear base and extends rearwardly toward said rear base.

14. An open top swing according to claim 11, further comprising an overrotation stop mounted to each of said hubs and a cooperating overrotation stop mounted to each of

said first and second connectors adjacent each of said hubs, wherein said stop and said cooperating stop prevent over-rotation of said hubs relative to the first and second connectors.

15. An open top swing according to claim 11, wherein said swing drive mechanism has control means for selectively providing at least two different predetermined swing amplitudes.

16. An open top swing according to claim 15, wherein said control means selectively provides three different predetermined swing amplitudes.

17. An open top swing according to claim 16, wherein said control means includes means for detecting the swing amplitude and controls the swing amplitude based on the amplitude detected and the amplitude selected.

18. An open top swing according to claim 17, wherein said swing drive mechanism comprises:

a drive sleeve mounted coaxially and rotatably about said one axle connected to said one connector mounting said swing drive mechanism, wherein said sleeve is rotatable relative to said one axle;

a drive flange mounted on said one axle to provide a limited degree of rotation of said sleeve relative to said axle;

a crank linked to said sleeve for oscillating said sleeve; and

a motor fixedly connected relative to said one connector and operatively connected to said crank for rotating said crank, wherein said sleeve converts rotary motion to oscillatory motion to thereby oscillate said one axle and thus said one hub, thereby oscillating said seat via said hangers.

19. An open top swing according to claim 18, further comprising a drive flange coupling device positioned between said drive sleeve and said drive flange to cause said axle to oscillate with said drive sleeve.

20. An open top swing according to claim 19, wherein said coupling device comprises at least one spring mounted coaxially and rotatably relative to said axle and collinearly adjacent relative to said sleeve, wherein said spring is positioned to enable engagement with said sleeve.

21. An open top swing according to claim 20, wherein said coupling device further comprises a hub member rotatably mounted on said axle, wherein said spring is coaxially mounted to said hub member, said hub member including abutments for engaging with said drive flange, whereby torque applied to said sleeve is transferred to said spring which causes said hub member to rotate and cause said abutments to engage said drive flange and transfer to said axle.

22. An open top swing according to claim 21, wherein said sleeve includes a channel running parallel with said axle and said crank has a ball mounted thereon, said ball being mounted in said channel and slideable and relative thereto, said ball being slideably movable and rotatable relative to said crank, whereupon rotation of said crank causes said sleeve to oscillate about said axle and along with said axle.

23. A swing drive mechanism adapted for a swing that includes a supporting frame and an axle operatively connected to a hanger suspending a seat comprising:

a drive sleeve adapted for mounting coaxially and rotatably about said axle, wherein said sleeve is rotatable relative to said axle;

a drive flange adapted for mounting on said axle;

a drive flange coupling device positioned between said drive sleeve and said drive flange and adapted to cause said axle to oscillate with said drive sleeve;

a crank linked to said sleeve for oscillating said sleeve; and

a motor for rotating said crank.

24. A swing drive mechanism according to claim 23, wherein said coupling device comprises at least one spring adapted for mounting coaxially and rotatably relative to said axle and collinearly adjacent relative to said sleeve, wherein said spring is positioned to enable engagement with said sleeve.

25. A swing drive mechanism according to claim 24, wherein said coupling device further comprises a hub member adapted for rotatably mounting on said axle, wherein said spring is coaxially mounted to said hub member, said hub member including abutments for engaging with said drive flange, wherein torque applied to said sleeve is transferred to said spring which causes said hub member to rotate and cause said abutments to engage said drive flange and transfer to said axle.

26. A swing drive mechanism according to claim 25, wherein said coupling device comprises two springs coaxially mounted to said hub member, wherein said springs are arranged so that said sleeve can engage one of the two springs and said drive flange can engage the other of said two springs when said sleeve is rotated in one direction, and said sleeve can engage said other spring and said drive flange can engage said one spring when said sleeve is rotated in the opposite direction.

27. A swing drive mechanism according to claim 26, wherein said springs are coiled in opposite directions such that said sleeve and drive flange tend to cause said springs to coil tighter around said hub member, wherein said springs, said hub member and said drive flange provide three spring gradients.

28. A swing drive mechanism according to claim 27, wherein said sleeve is freely rotatable relative to said springs for a limited degree, wherein the free limited degree rotation provides first of said three spring gradients, wherein said sleeve engages one of said springs and the other of said springs engages said drive flange upon rotation of said sleeve beyond said free rotation, causing said two springs to be active, providing second of said three spring gradients, wherein further rotation of said sleeve rotates said hub member along with said sleeve and causes said abutments to engage said drive flange which prevents said hub member from rotating relative to said drive flange, causing said spring engaging said drive flange to be inactive, providing the third spring gradient.

29. A swing drive mechanism according to claim 28, wherein said sleeve includes a channel adapted to run parallel with said axle and said crank has a ball mounted thereon, said ball being mounted in said channel and slideable and relative thereto, said ball being slideably movable and rotatable relative to said crank, whereupon rotation of said crank causes said sleeve to oscillate about said axle and along with said axle.

30. A swing drive mechanism according to claim 29, wherein said crank has an offset driven portion which extends a distance from its axis of rotation, wherein said ball is mounted on said offset portion and orbits about said axis of rotation.

31. A swing drive mechanism according to claim 30, wherein said motor has an output shaft mounted substantially perpendicular to said axle and said crank rotates about said axis that is perpendicular to said output shaft.

32. A swing drive mechanism according to claim 31, further comprising control means adapted for selectively controlling the degree of rotation of said axle.

33. A swing drive mechanism according to claim 32, wherein said control means has means for selectively providing three predetermined different swing amplitudes and includes means for detecting the swing amplitude, wherein said control means controls the swing amplitude based on the amplitude detected and the amplitude selected.

34. An open top support frame for a swing having a pair of hangers suspending a seat comprising:

a rear base;

first and second opposed legs extending upwardly at an angle from ends of said rear base;

a front base;

third and fourth opposed legs extending upwardly at an angle from ends of said front base, wherein said first and third legs converge toward each other, and said second and fourth legs converge toward each other;

a first connector attached to said first and third legs for maintaining said first and third legs at a fixed position relative to each other;

a second connector attached to said second and fourth legs for maintaining said second and fourth legs at a fixed position relative to each other;

a pivot operatively mounted to said first connector;

a second pivot operatively mounted to said second connector;

a hub mounted to each of said first and second pivots, wherein one of said hangers is mounted to one of the hubs and the other of said hangers mounted to the other of said hubs; and

an overrotation stop mounted to each of said hubs and a cooperating overrotation stop mounted to each of said first and second connectors adjacent each of said hubs, wherein said stop and said cooperating stop prevent overrotation of said hubs relative to the first and second connectors.

35. An open top support frame according to claim 34, wherein said front base is substantially trapezoidal shaped, defined by a median arm and a pair of oppositely extending arms extending from ends of said medial arm, wherein said third and fourth legs extend from ends of said oppositely extending arms.

36. An open top support frame according to claim 35, wherein said median arm is substantially parallel to said rear base and extends rearwardly toward said rear base.

37. A method of selectively controlling swing heights or amplitudes in a swing that has a motor operated swing drive mechanism comprising the steps of:

providing a selection of at least first and second swing height settings, wherein said first setting is smaller than said second setting;

selectively inputting at least one of no voltage, a predetermined first voltage and a predetermined second voltage to said motor based on the selection of the swing height setting to achieve the selected swing height, wherein said first and second voltages are higher than zero, and said first voltage is lower than said second voltage.

38. A method according to claim 36, wherein upon selection of said first swing height setting, applying said first voltage to said motor.

39. A method according to claim 37, further comprising the step of detecting the swing amplitude.

40. A method according to claim 39, wherein upon selection of said first swing height setting, comprising the steps of:

initially applying said first voltage to said motor;

continuously maintaining said first voltage to said motor until the swing height is greater than said selected first swing height;

applying no voltage to said motor when and if the sensed swing height exceeds said first height setting for the duration of the portion of the swing that exceeds said first swing height.

41. A method according to claim 39, wherein upon selection of said second swing height setting, comprising the steps of:

initially applying said first voltage to said motor;

continuously maintaining said first voltage to said motor until the swing height is greater than said first swing height setting;

applying said second voltage to said motor for the duration of the portion of the swing that is greater than said first swing height setting.

42. A method according to claim 39, further comprising the steps of:

further providing a third swing height setting, wherein said third setting is greater than said second setting; and

selectively inputting at least one of said no voltage, said predetermined first voltage, said predetermined second voltage and a third predetermined voltage to said motor based on the selection of the swing height setting to achieve the selected swing height, wherein said third voltage is higher than zero voltage and higher than said second voltage.

43. A method according to claim 42 further comprising the steps of, upon selection of said third swing height setting:

initially applying said first voltage to said motor;

continuously maintaining said first voltage to said motor until the swing height is greater than said first swing height setting;

applying said third voltage to said motor for the duration of the portion of the swing that is greater than said first swing height setting.

44. A method according to claim 43, further comprising the step of, when and if the swing height is greater than said selected third swing height setting, applying said first voltage to said motor for the duration of the portion of the swing that is greater than said third swing height setting.

* * * * *

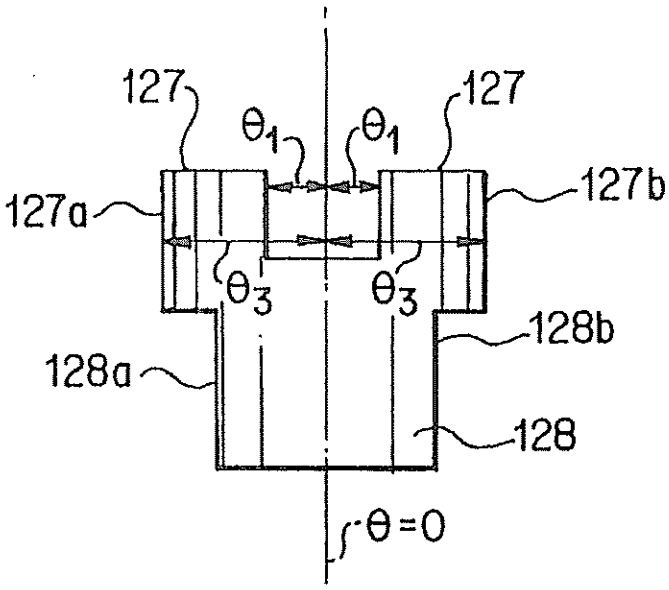


FIG. 14

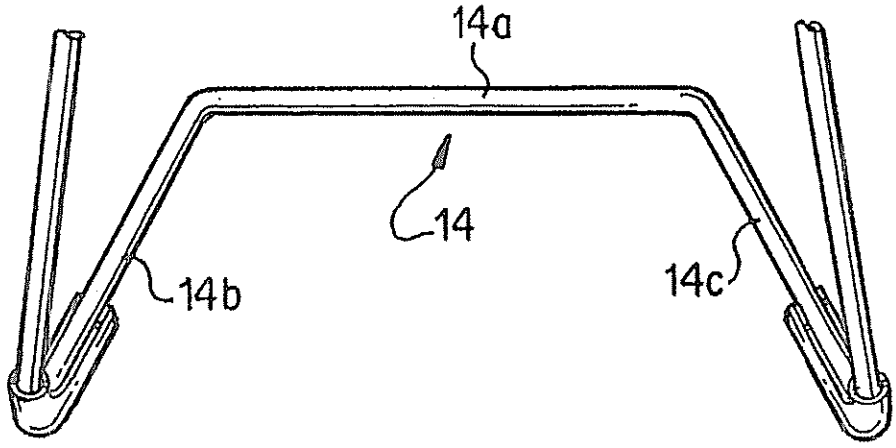


FIG. 1A

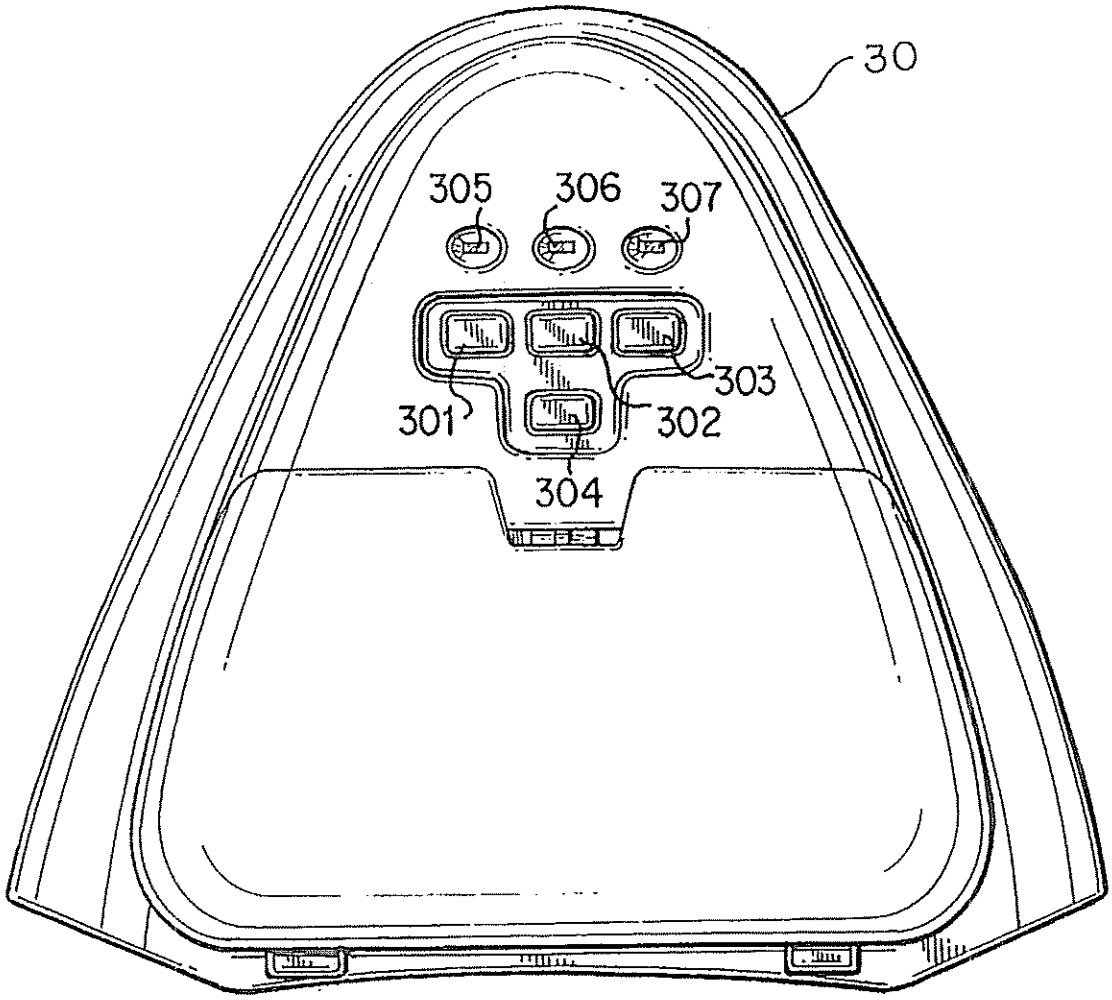


FIG. 2

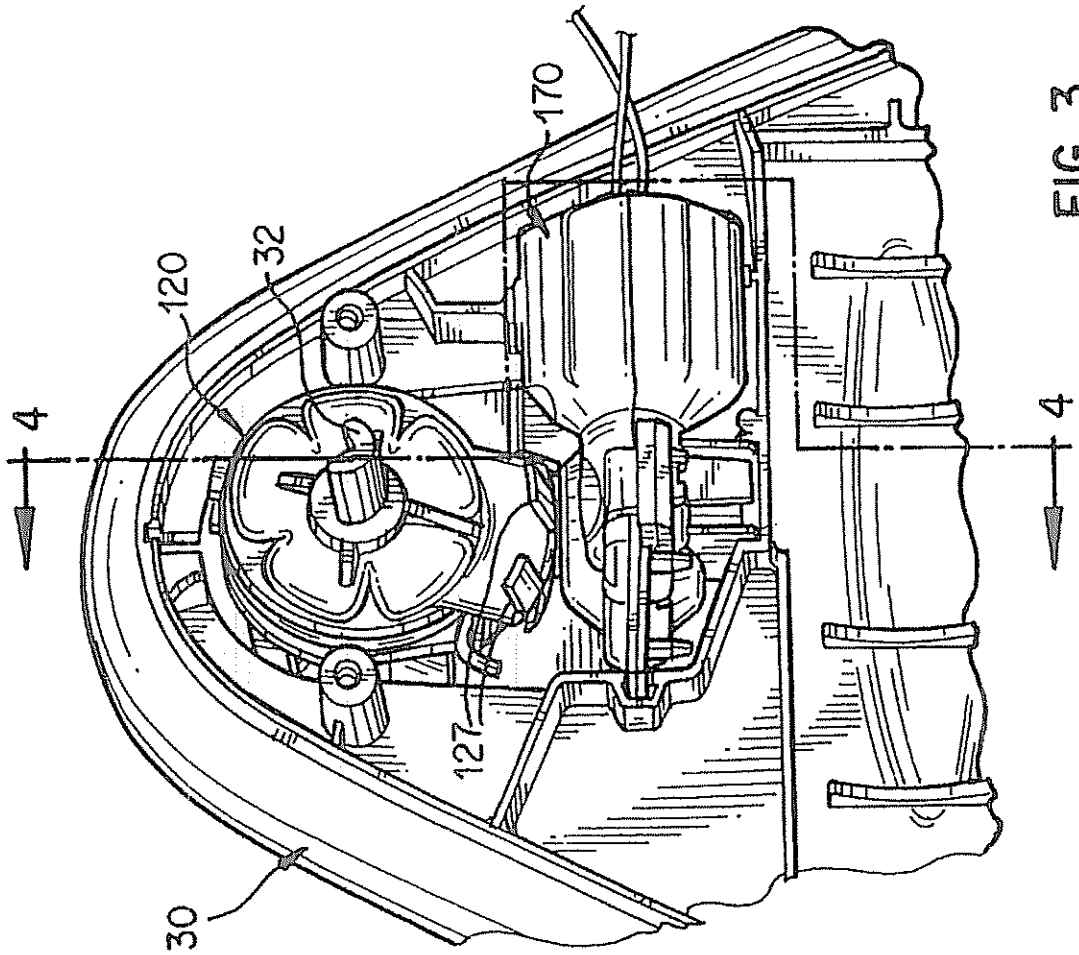
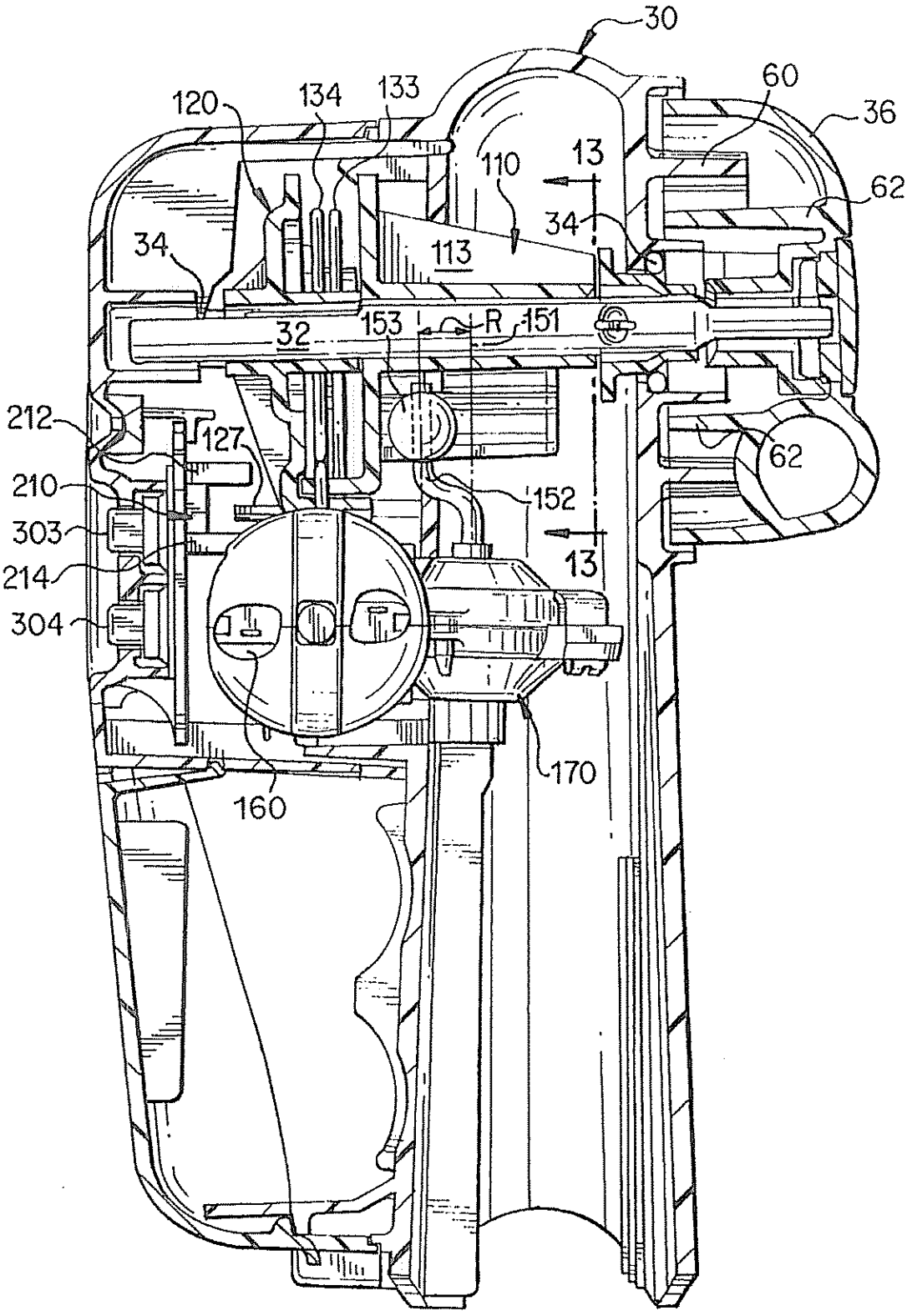


FIG. 3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120
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62
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34
113
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153
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212
127
62
210
152
303
13
214
304
170
160

FIG. 4

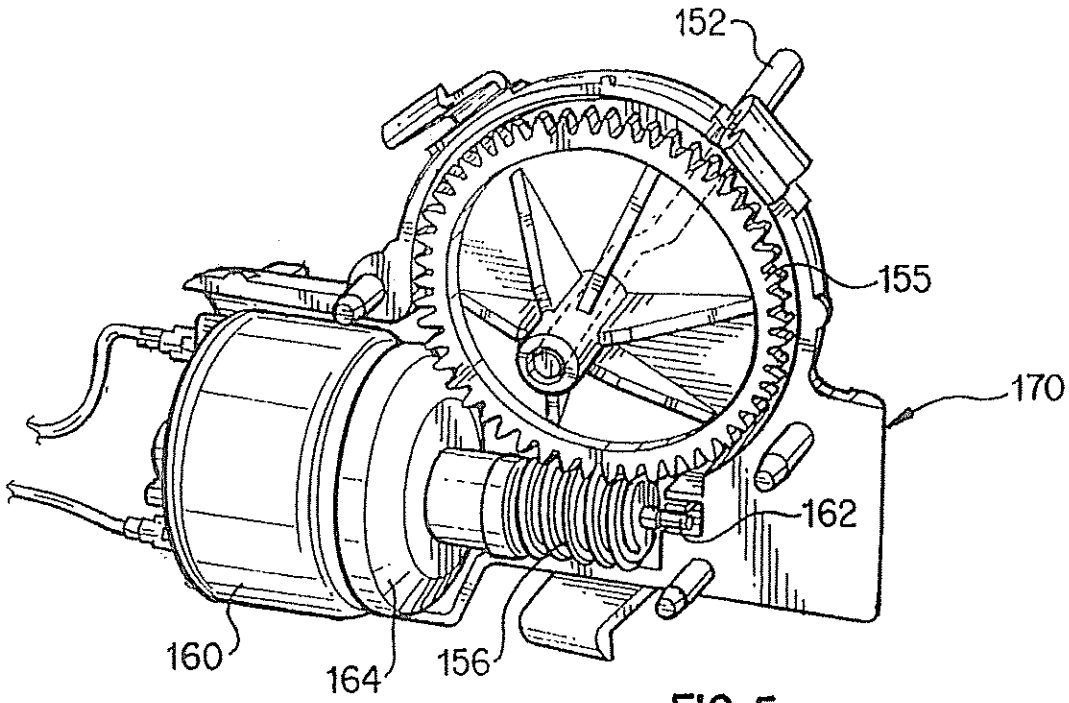


FIG. 5

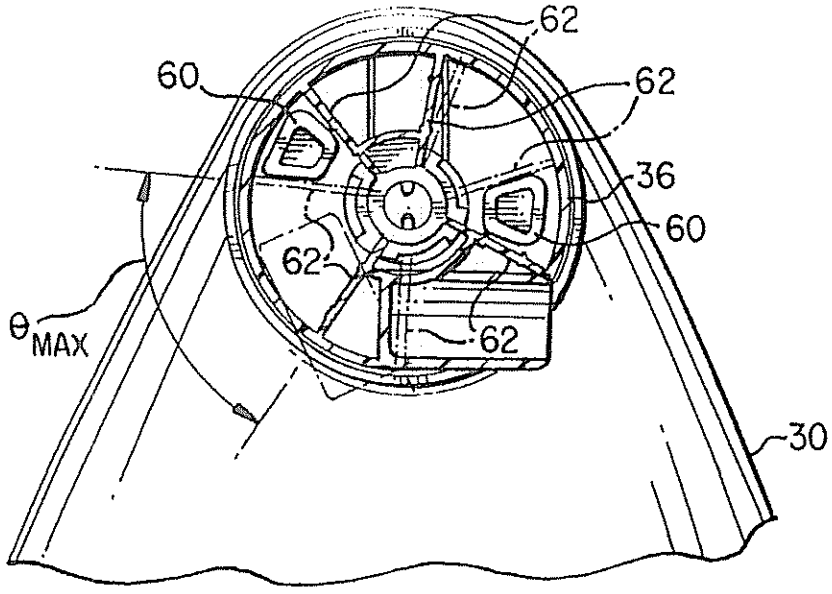


FIG. 6

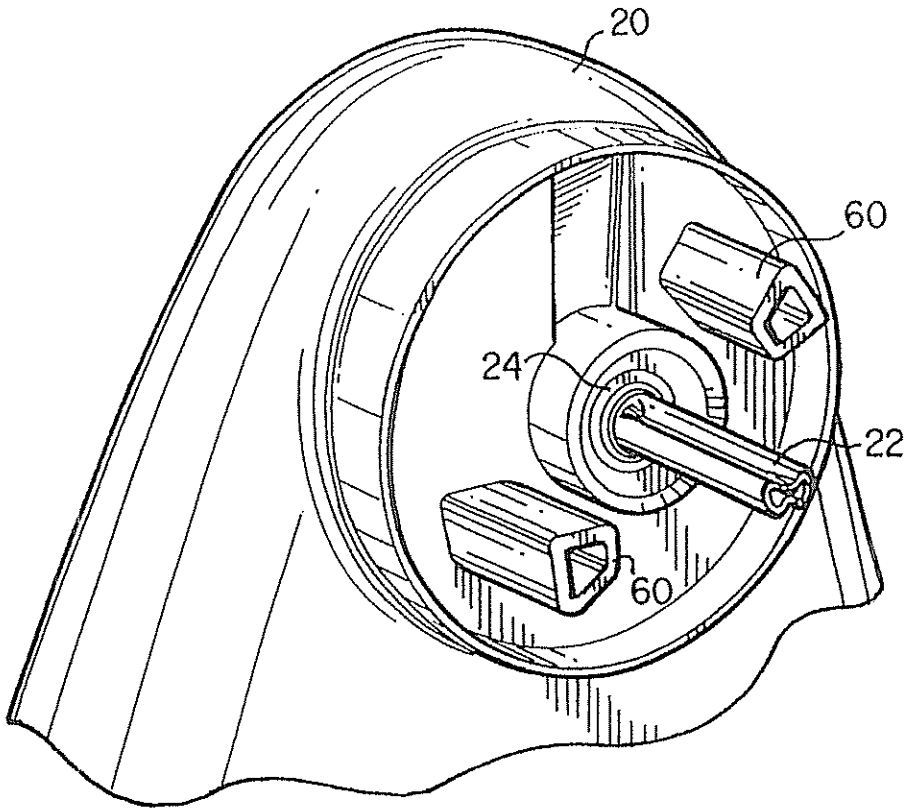


FIG. 6A

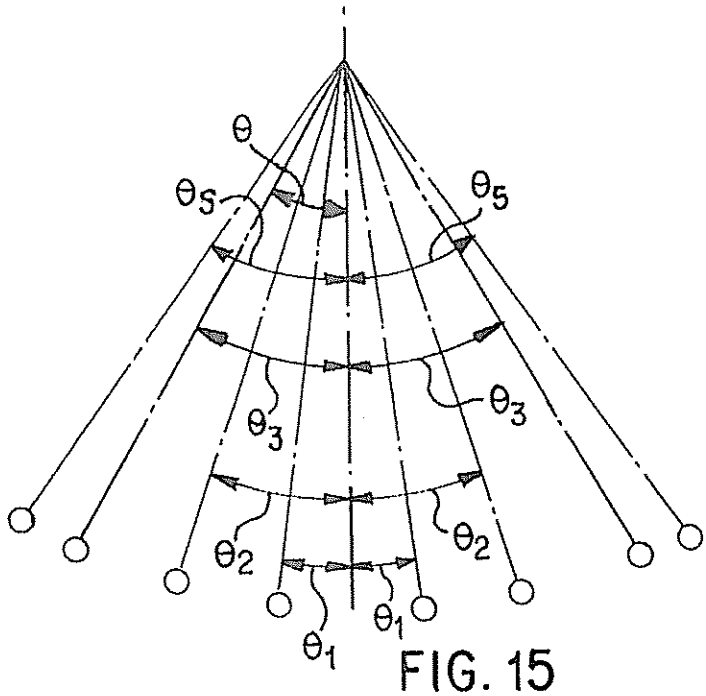


FIG. 15

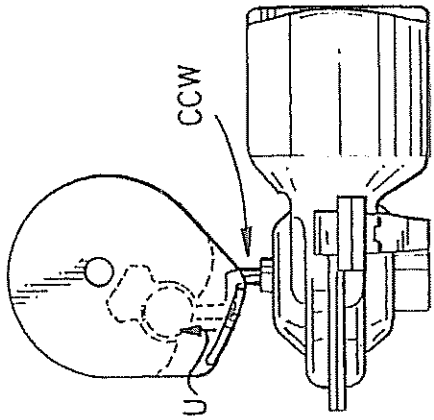


FIG. 9A

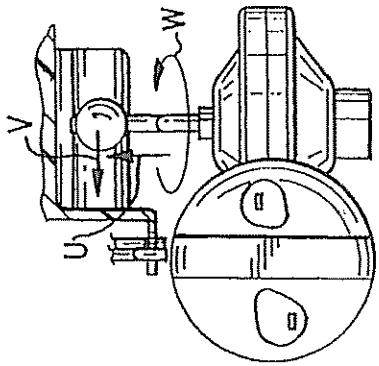


FIG. 9B

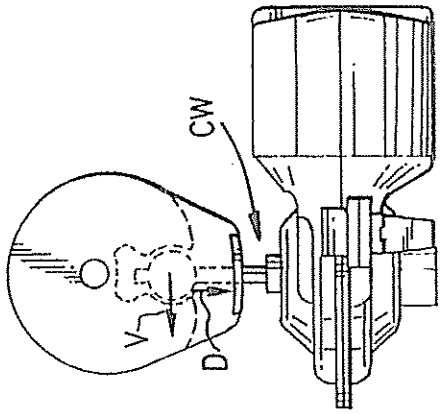


FIG. 8A

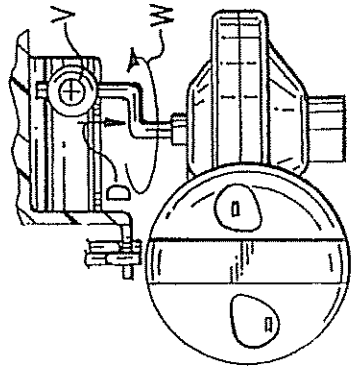


FIG. 8B

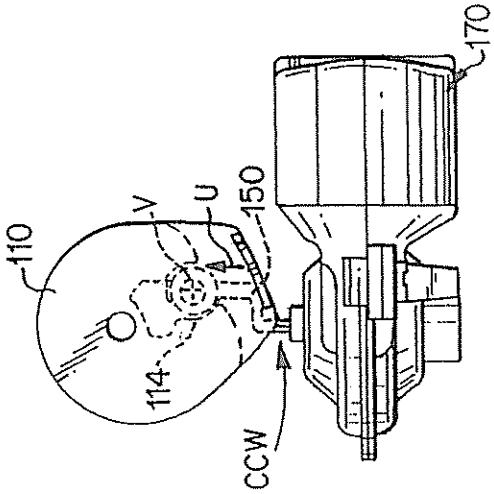


FIG. 7A

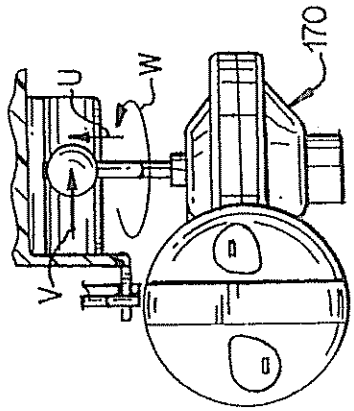


FIG. 7B

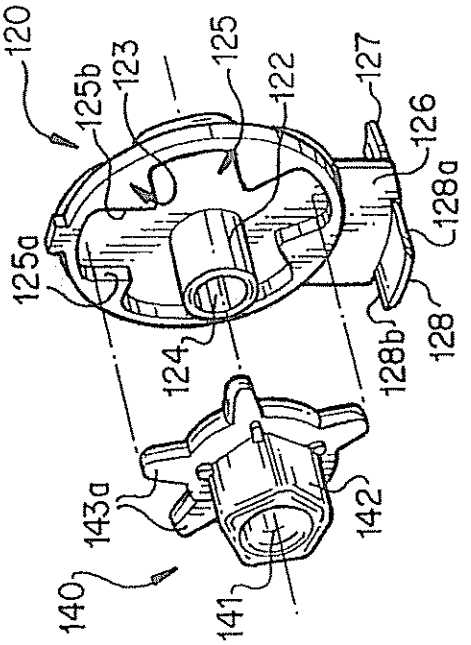


FIG. 12

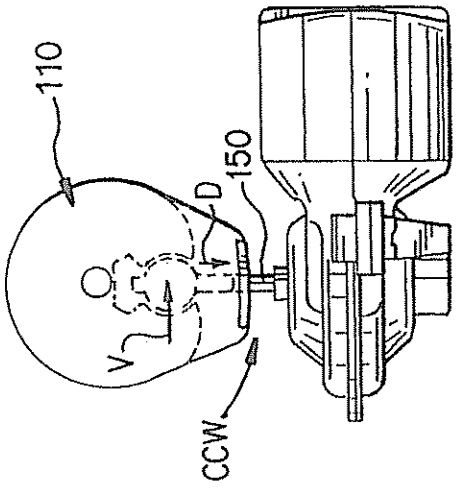


FIG. 10A

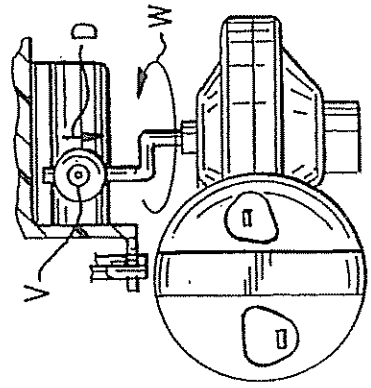
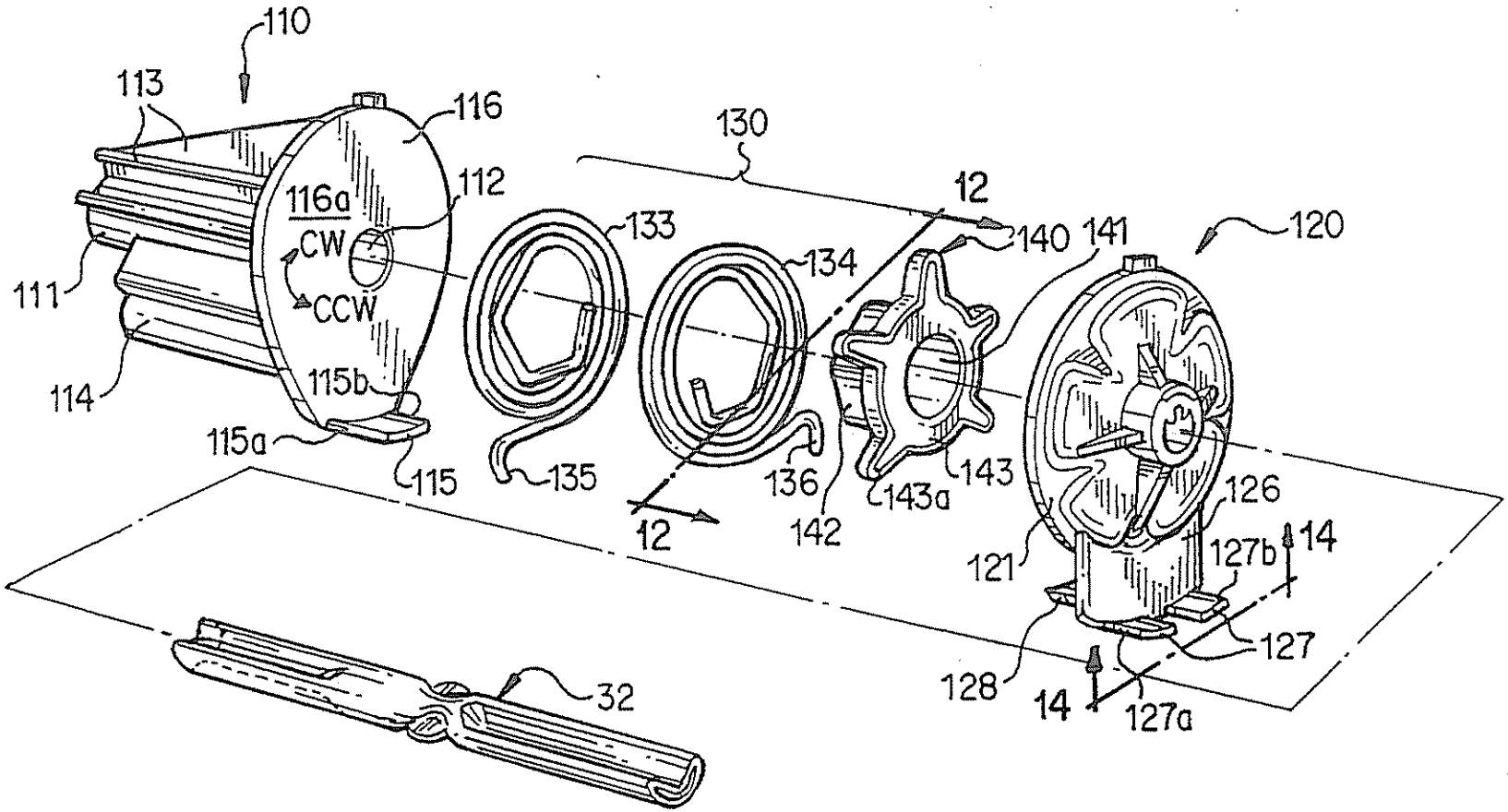


FIG. 10B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CCW
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141
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111
134
114
115b
115a
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142
143a
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127b
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128
14
127a
32

FIG. 11

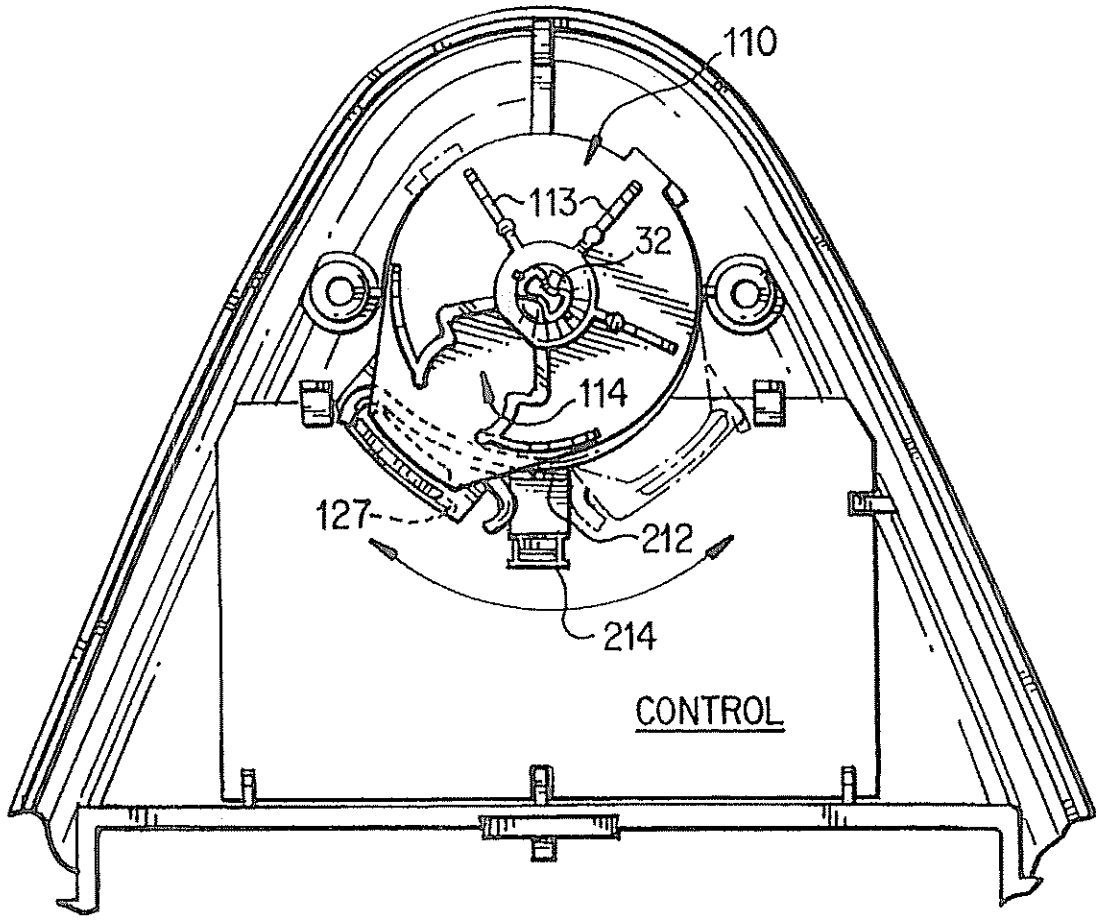

FIG. 13

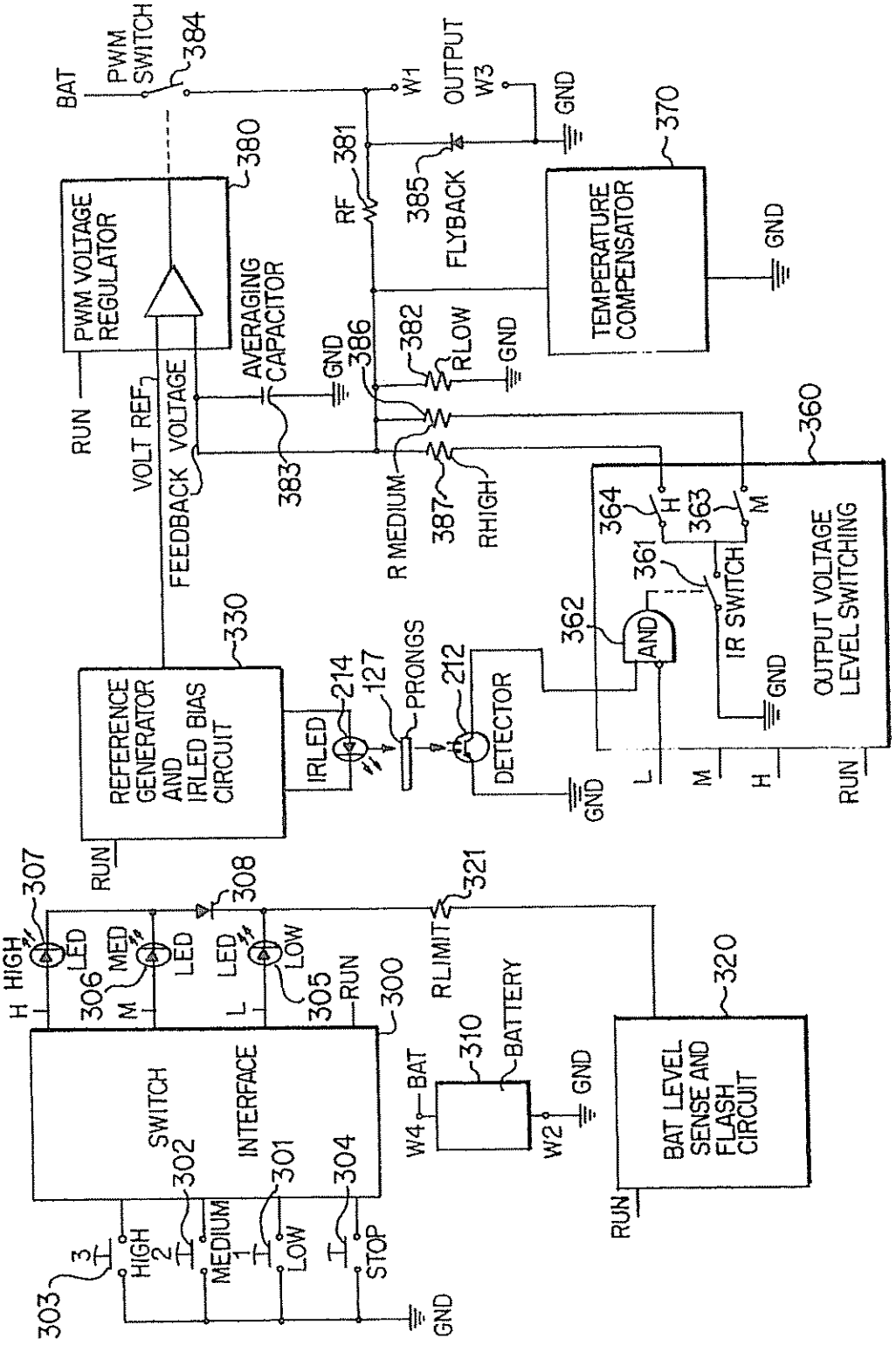
BAT
PWM SWITCH
384
W1
OUTPUT
W3
GND
380
381
370
PWM VOLTAGE REGULATOR
RF
385
FLYBACK
TEMPERATURE COMPENSATOR
AVERAGING CAPACITOR
GND
386
382
RLOW
GND
RUN
VOLT REF
FEEDBACK VOLTAGE
383
R MEDIUM
387
RHIGH
360
364
H
363
M
361
IR SWITCH
OUTPUT VOLTAGE LEVEL SWITCHING
362
AND
330
214
127
PRONGS
212
REFERENCE GENERATOR AND IRLED BIAS CIRCUIT
IRLED
DETECTOR
GND
L
M
H
RUN
RUN
307
308
321
H HIGH
LED
MED
LED
LED
LOW
306
M
L
305
RUN
300
RLIMIT
320
SWITCH INTERFACE
302
301
304
W4
BAT
310
BATTERY
GND
W2
BAT LEVEL SENSE AND FLASH CIRCUIT
RUN
303
3
HIGH
2
MEDIUM
1
LOW
STOP
GND

FIG. 16

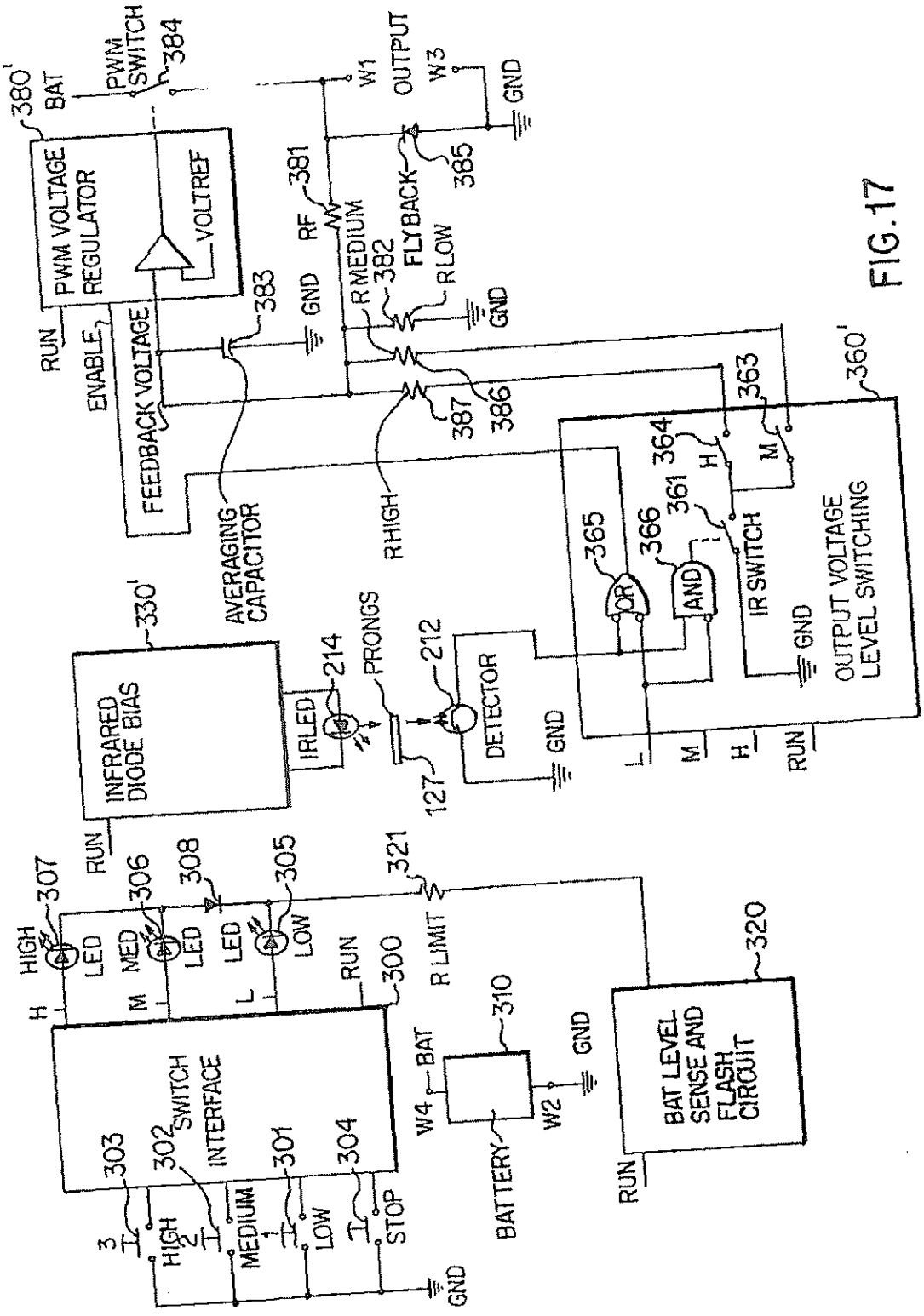
380'
BAT
PWM SWITCH
384
PWM VOLTAGE REGULATOR
VOLTREF
RUN
ENABLE
FEEDBACK VOLTAGE
383
GND
381
RF
R MEDIUM
382
R LOW
FLYBACK
385
W1
OUTPUT
W3
GND
AVERAGING CAPACITOR
RHIGH
387
386
330'
INFRARED DIODE BIAS
IRLED
214
PRONGS
212
DETECTOR
127
GND
RUN
360'
365
OR
366
AND
361
364
H
363
M
IR SWITCH
GND
OUTPUT VOLTAGE LEVEL SWITCHING
L
M
H
RUN
307
306
308
305
321
HIGH
LED
MED
LED
LED
LOW
RUN
300
R LIMIT
H
M
L
303
302
SWITCH INTERFACE
301
304
3
2
1
HIGH
MEDIUM
LOW
STOP
GND
W4
BAT
310
W2
GND
BATTERY
320
BAT LEVEL SENSE AND FLASH CIRCUIT
RUN

FIG.17

EXHIBIT "B"

US006896624B2

(12) **United States Patent**
Longenecker et al.

(10) **Patent No.: US 6,896,624 B2**
(45) **Date of Patent: May 24, 2005**

(54) **FOLDABLE SWING HAVING ROTATABLE HANDLE**

(75) Inventors: **Michael L. Longenecker**, Ephrata, PA (US); **Dennis R. Stauffer**, Birdsboro, PA (US)

(73) Assignee: **Graco Children's Products Inc.**, Exton, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/304,054**

(22) Filed: **Nov. 26, 2002**

(65) **Prior Publication Data**

US 2004/0102252 A1 May 27, 2004

(51) **Int. Cl.**[7] **A63G 9/16**
(52) **U.S. Cl.** **472/119**; 472/118; 297/273
(58) **Field of Search** 472/118–125; 297/273, 274, 281, 277, 354.12, 365, 376

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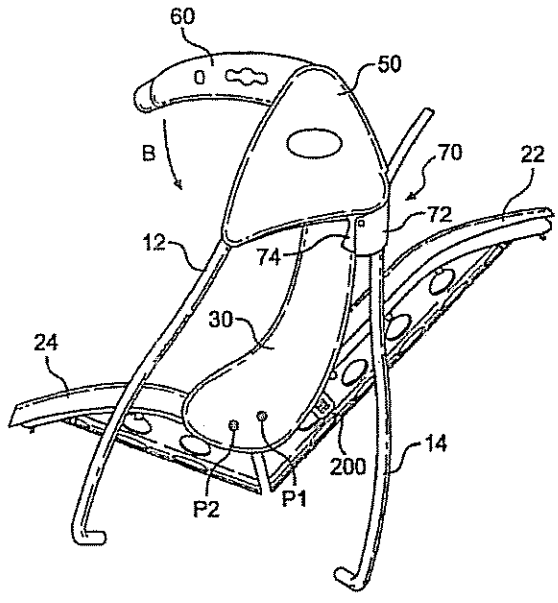
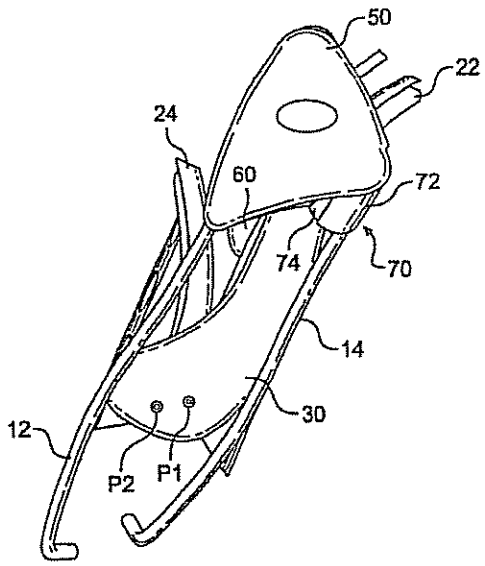
Primary Examiner—K. T. Nguyen
(74) *Attorney, Agent, or Firm*—Foley & Lardner LLP

(57) **ABSTRACT**

A child swing includes a swing frame and a swing handle rotationally coupled to the swing frame such that the swing handle may rotate about a handle rotational axis between at least two positions. The swing may further include a swing seat and at least one hanger arm rotationally coupled to the swing frame and supporting the swing seat. The at least two positions may include a lift position wherein a central portion of the swing handle is arranged above the rotational axis, an open access position wherein a central portion of the swing handle is arranged rearward of the rotational axis, an entertain position wherein a central portion of the swing handle is arranged forward of the rotational axis, and a storage position wherein a central portion of the swing handle is arranged forward and below the rotational axis.

46 Claims, 17 Drawing Sheets





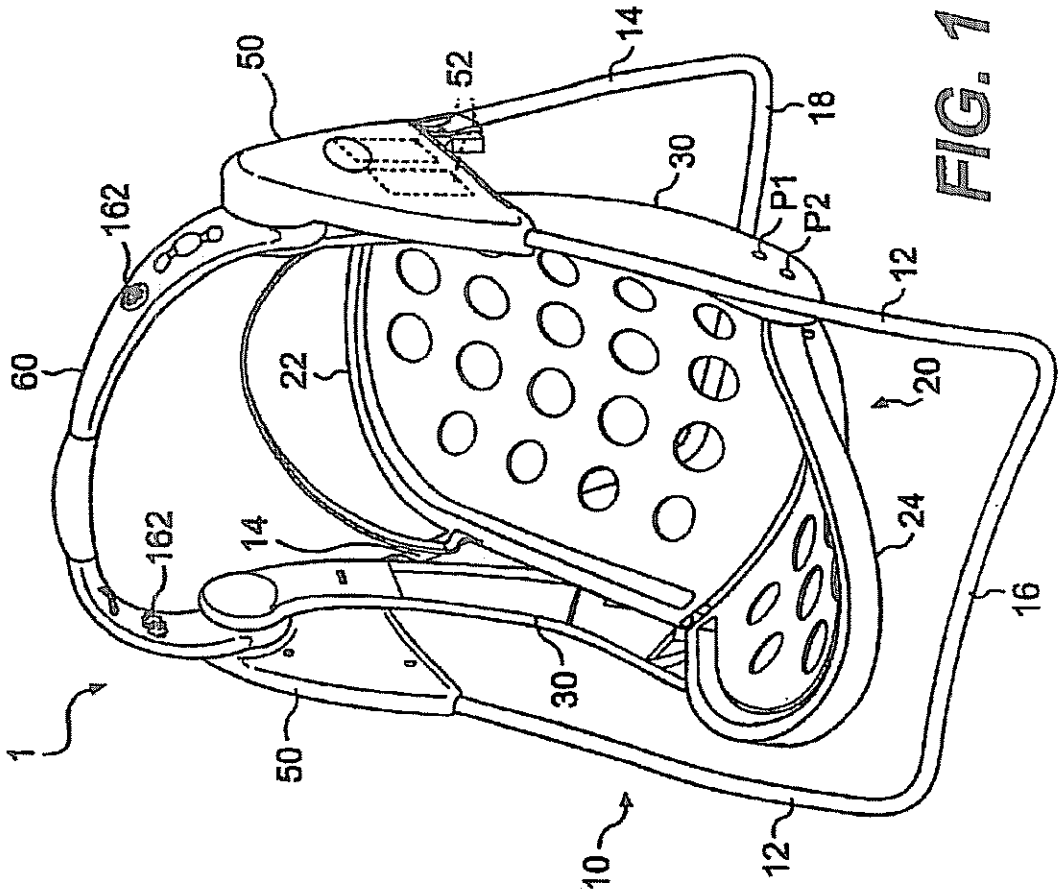
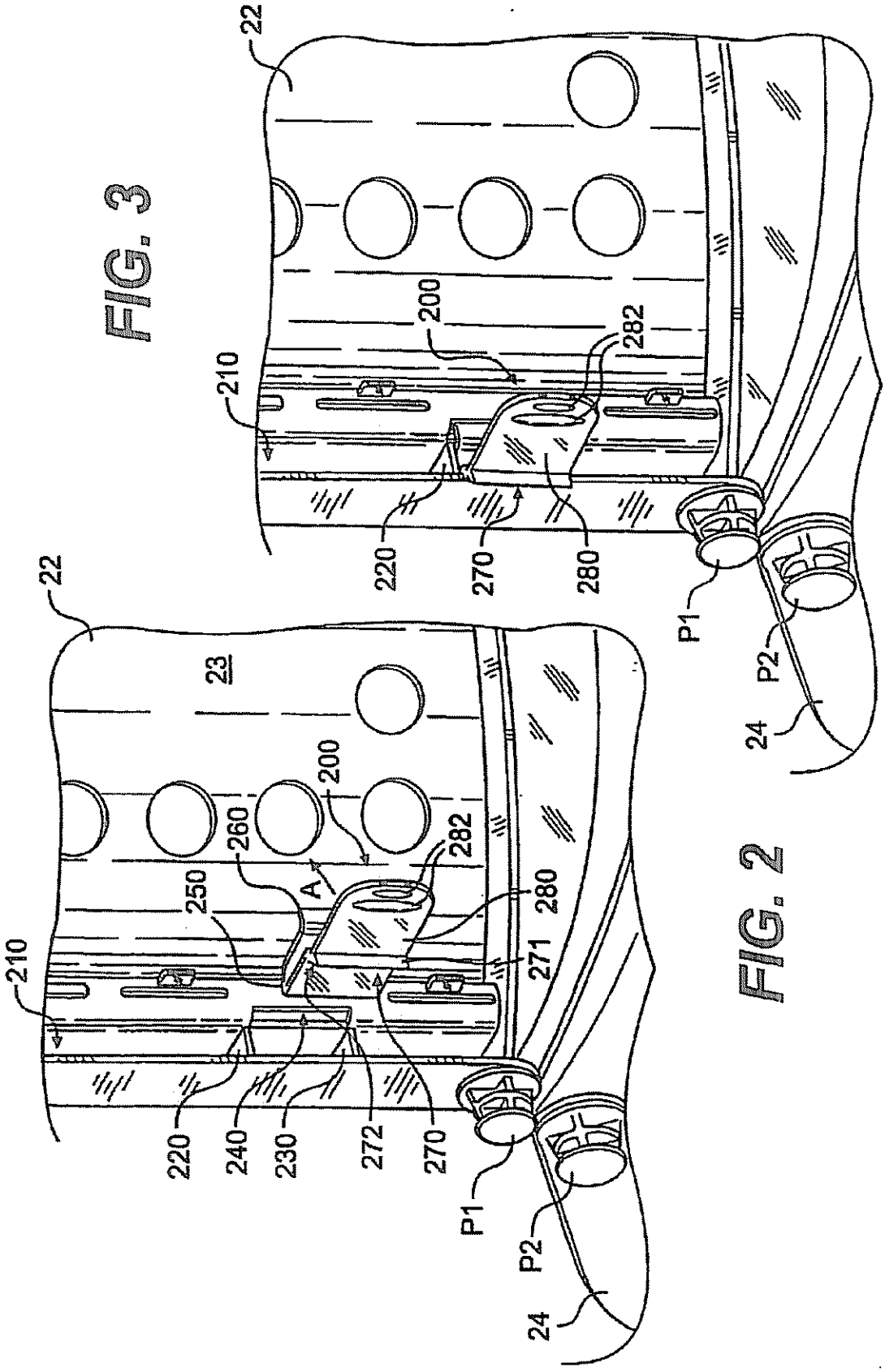


FIG. 1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220
270
280
P1
P2
24
22
23
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A
280
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271
220
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230
272
270
P1
P2
24

FIG. 3

FIG. 2

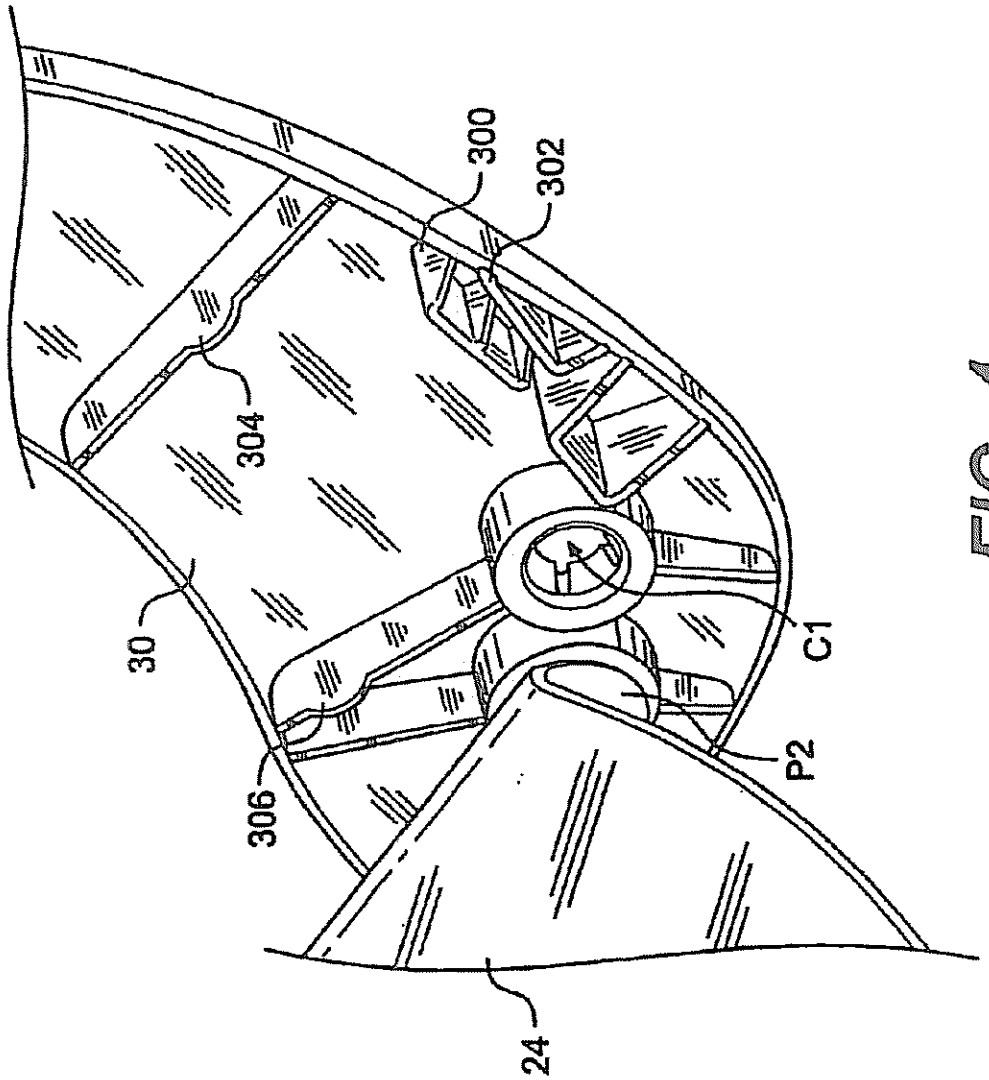


FIG. 4

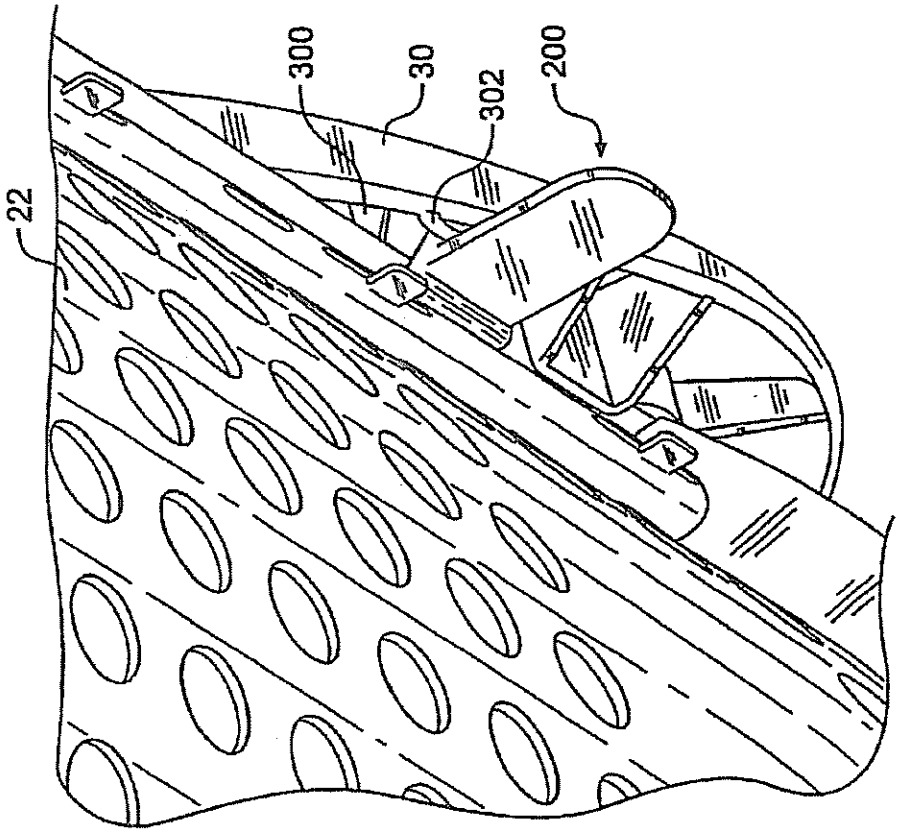


FIG. 6

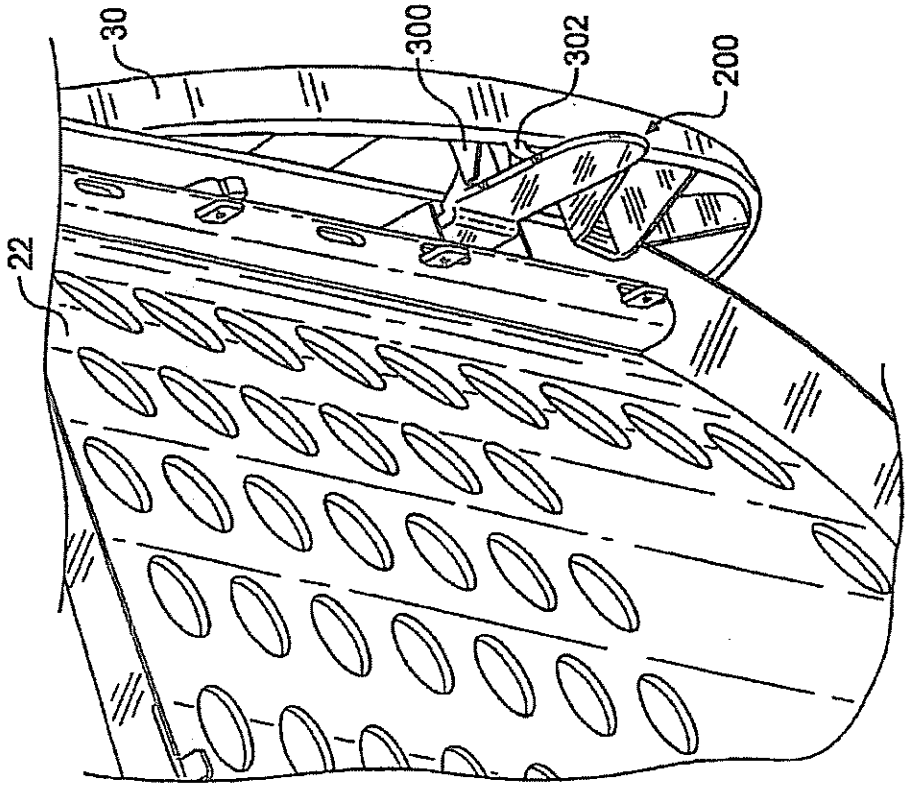


FIG. 5

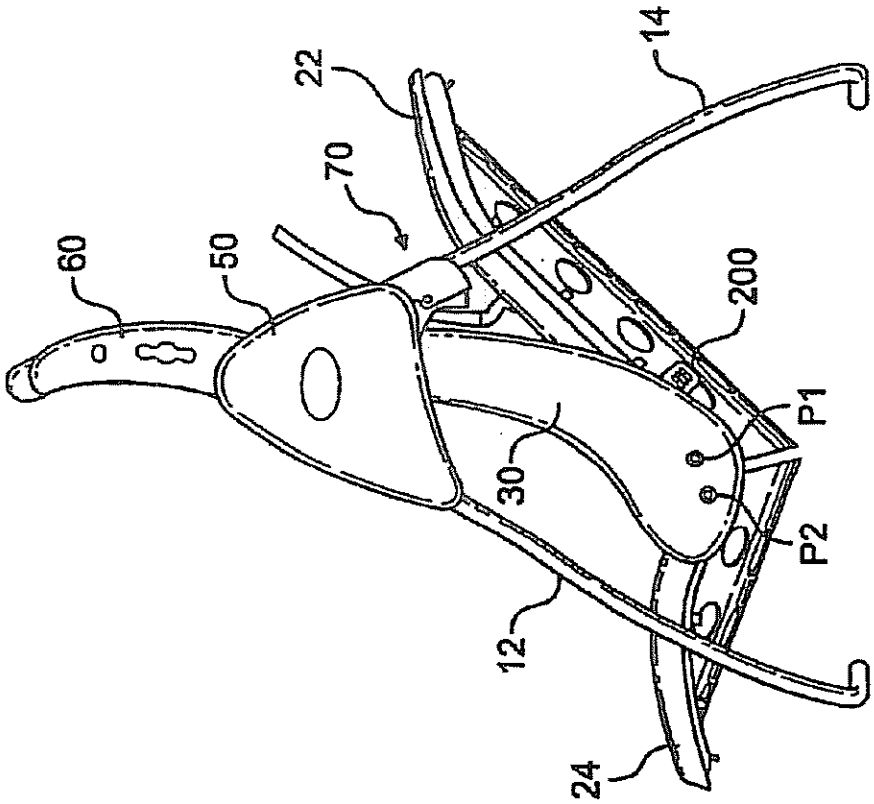
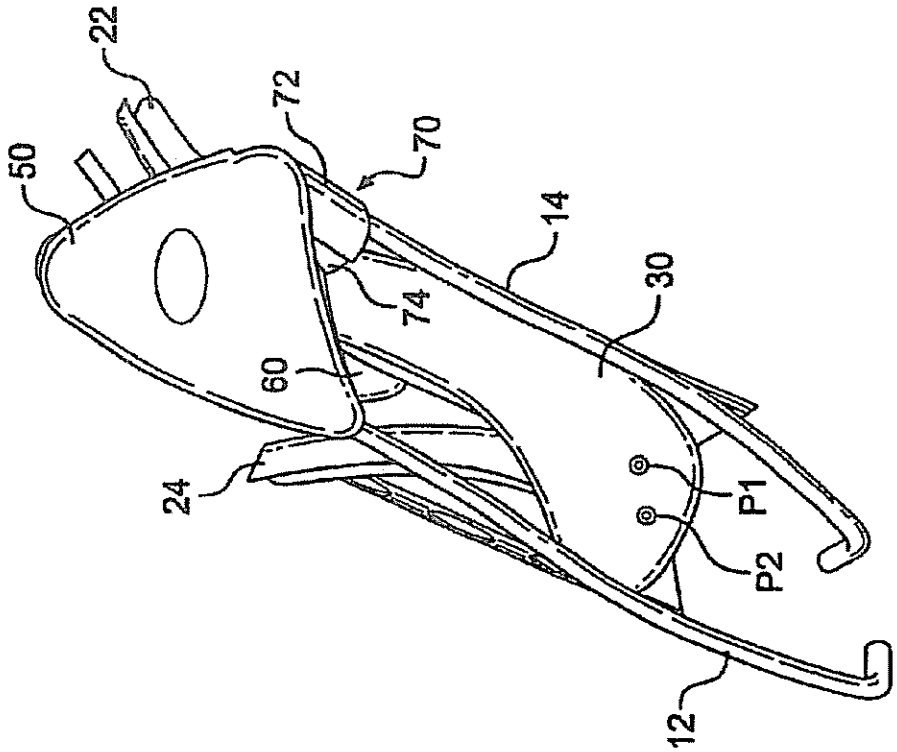


FIG. 7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P1
P2
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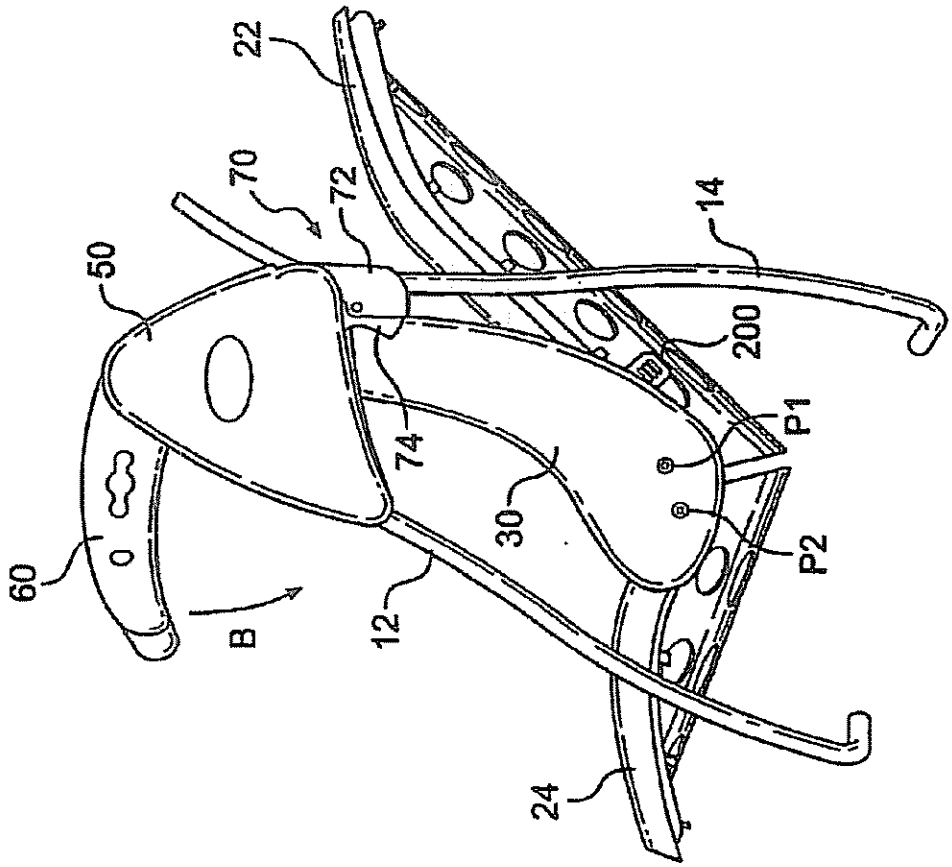
FIG. 9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74
P1
30
P2
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FIG. 8

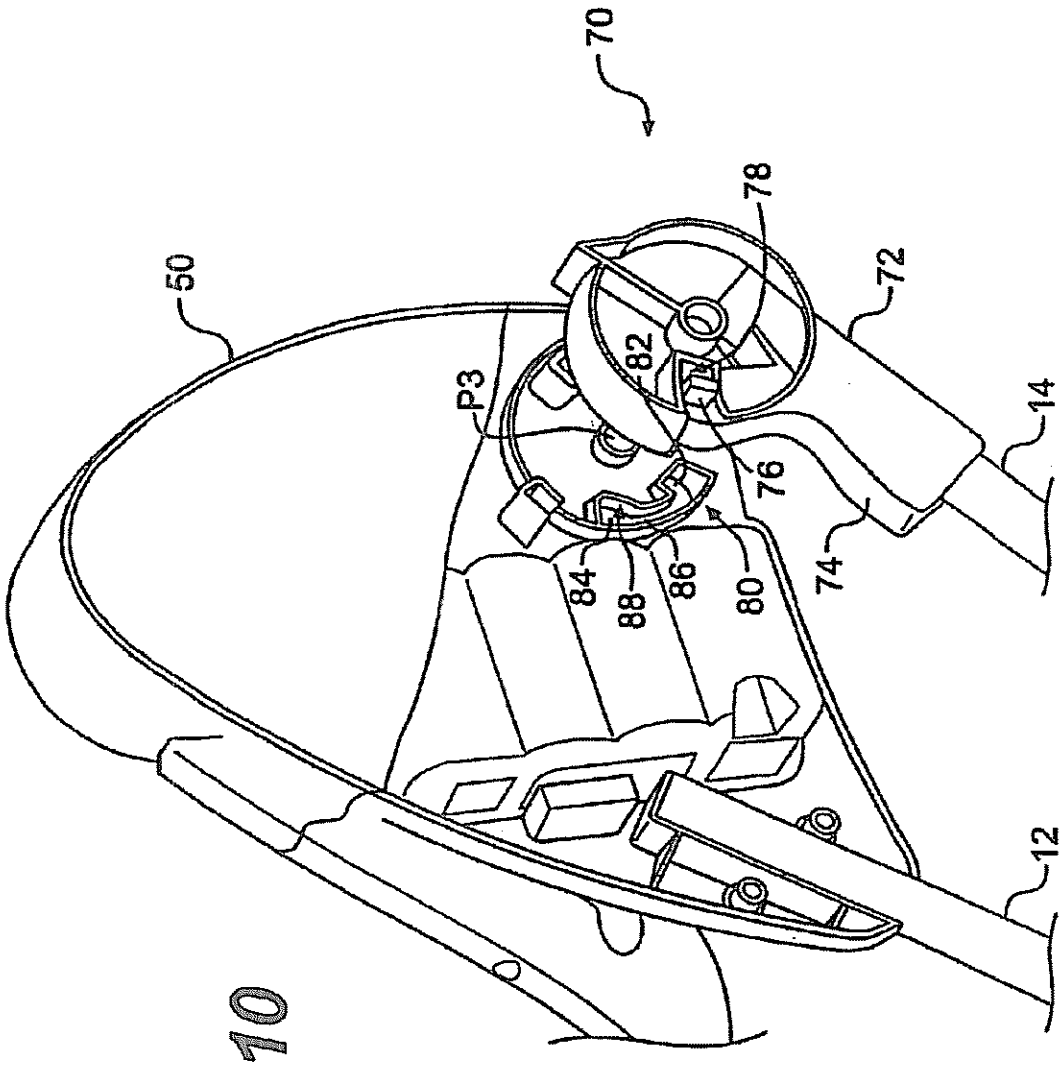

FIG. 10

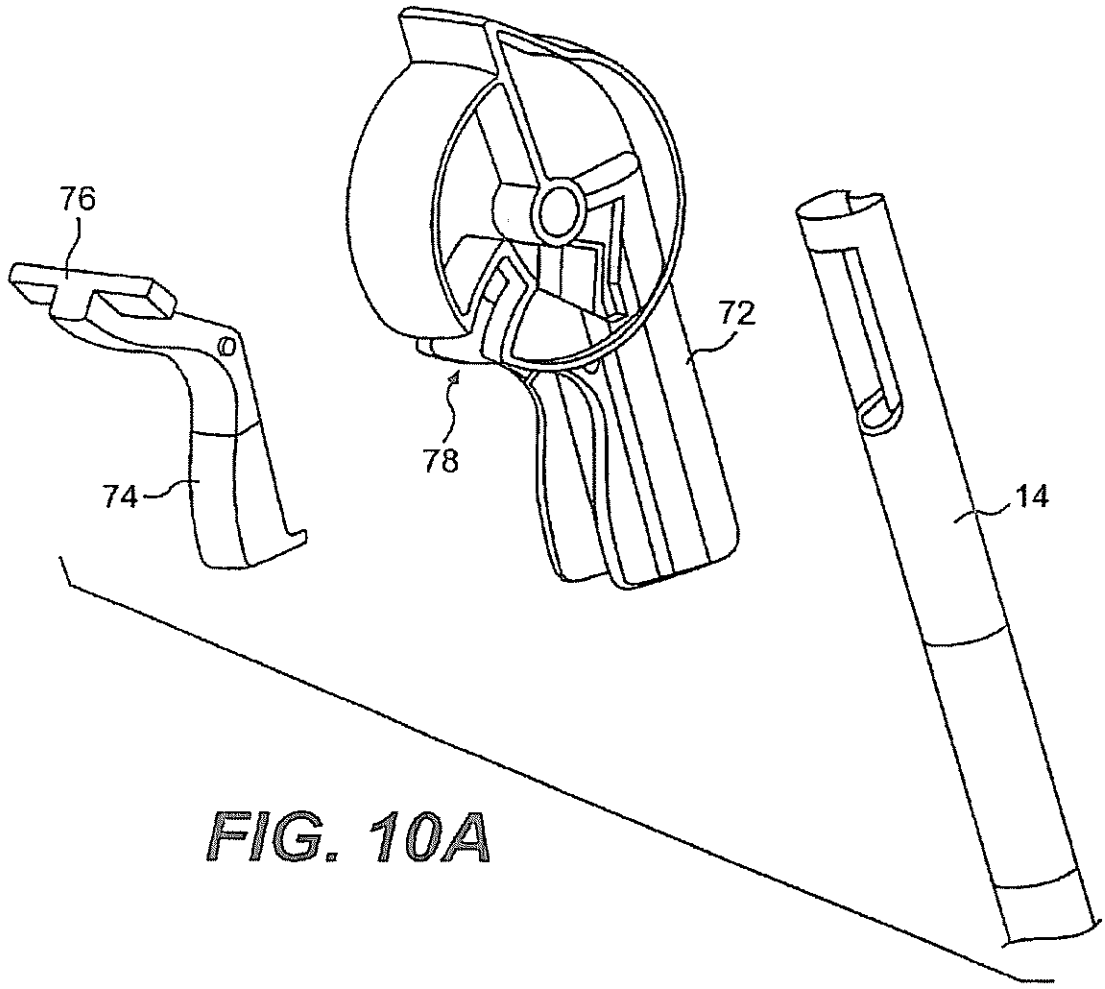

FIG. 10A

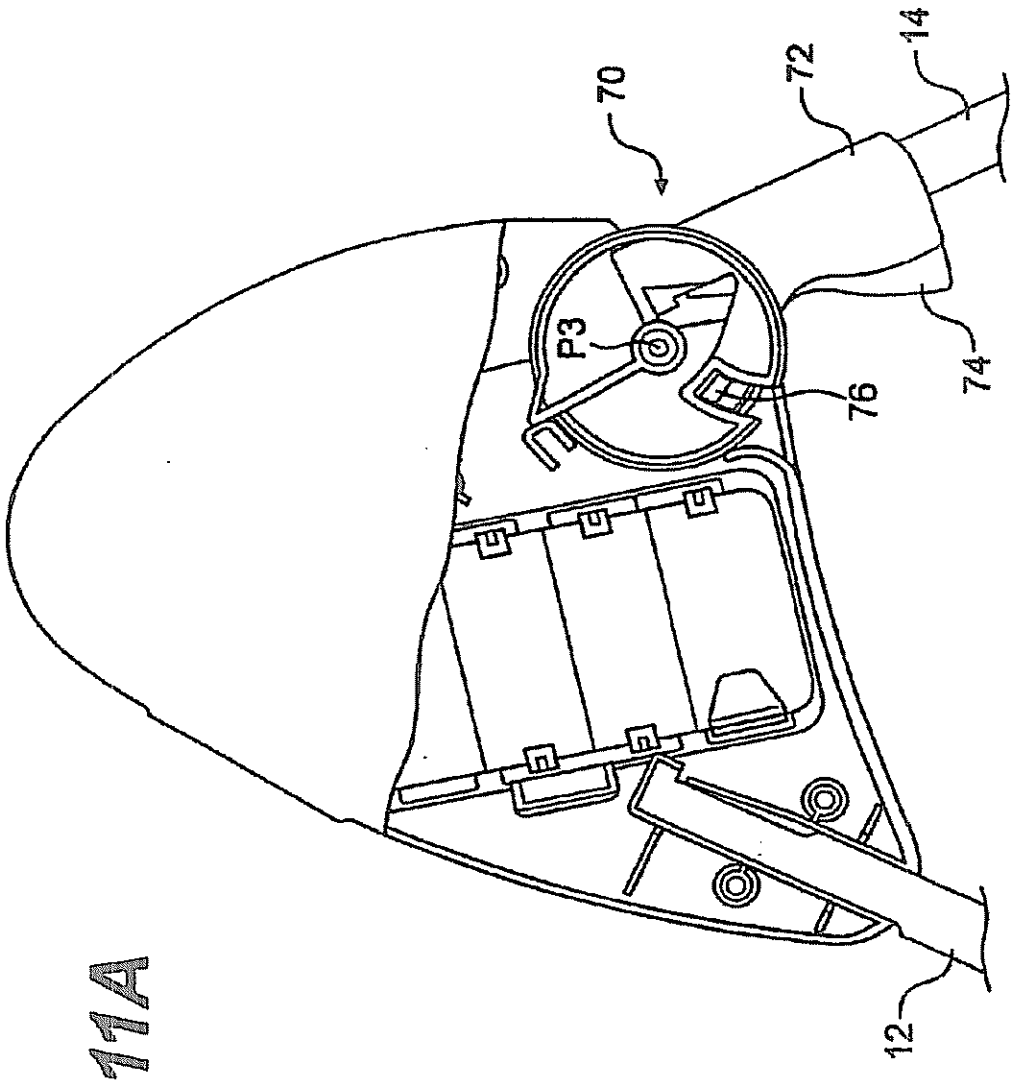

FIG. 11A

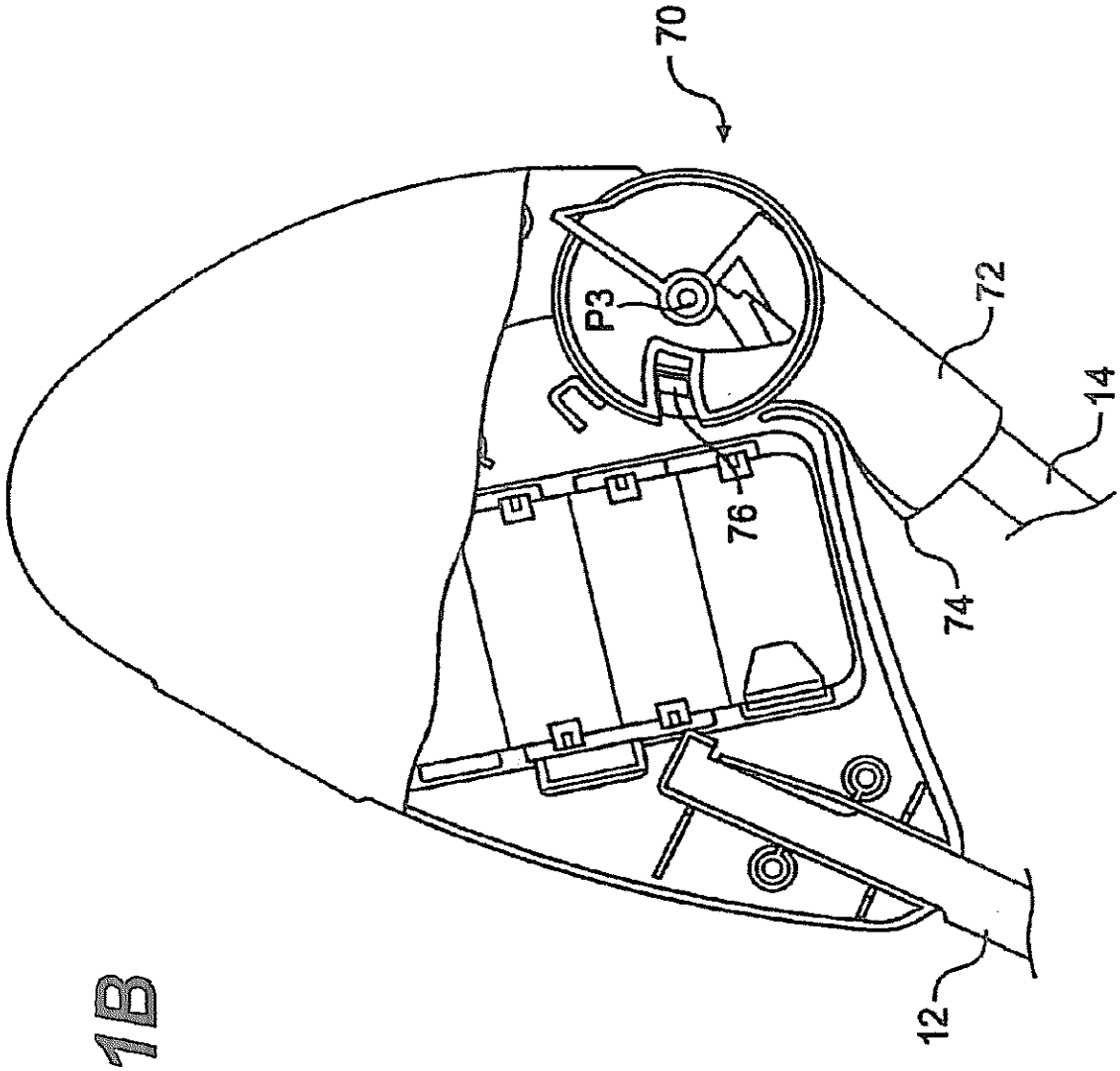

FIG. 11B

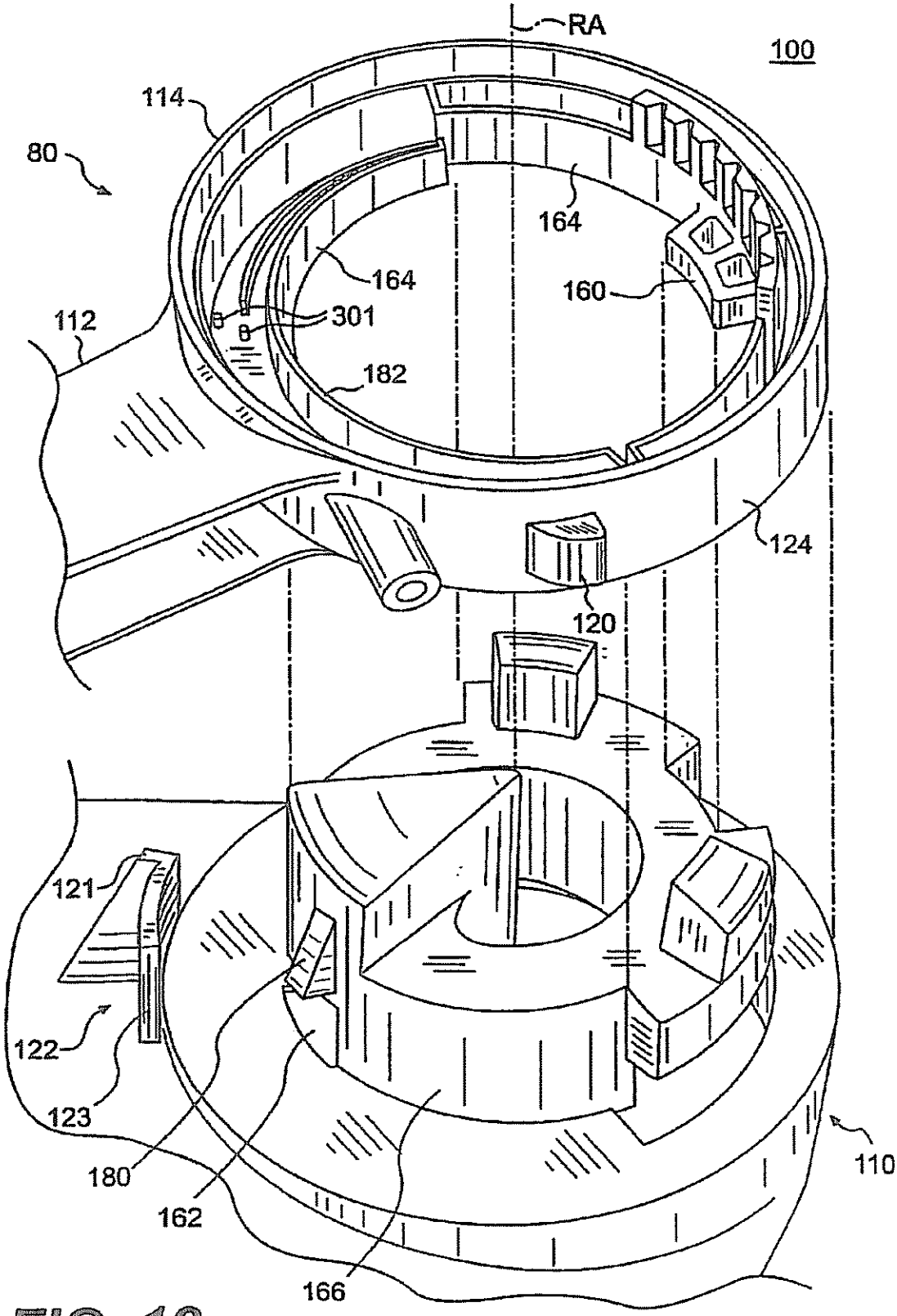
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FIG. 12

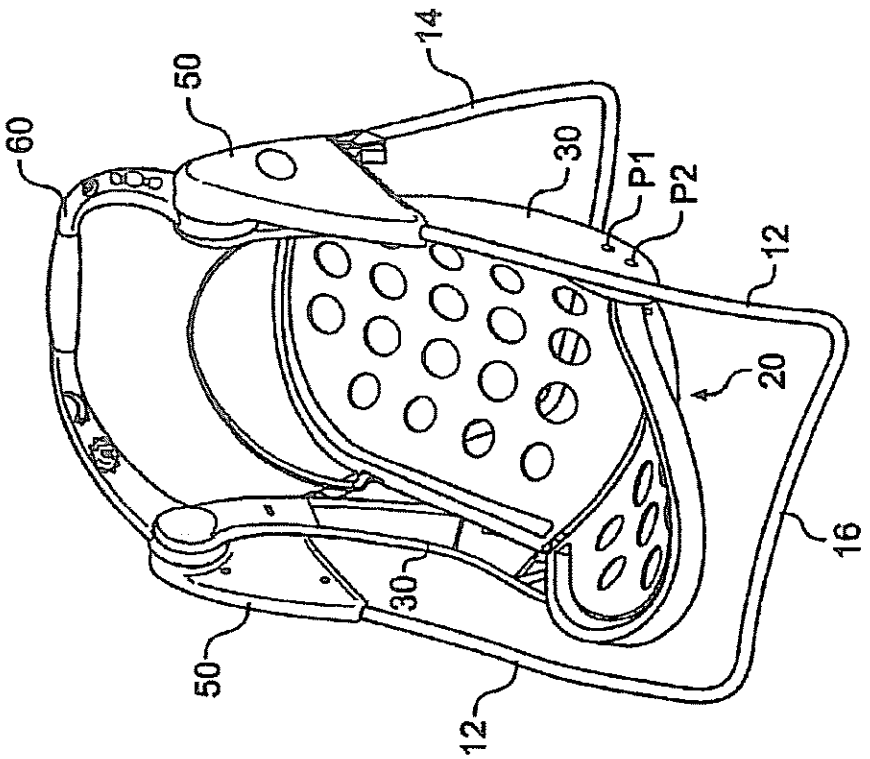
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FIG. 14

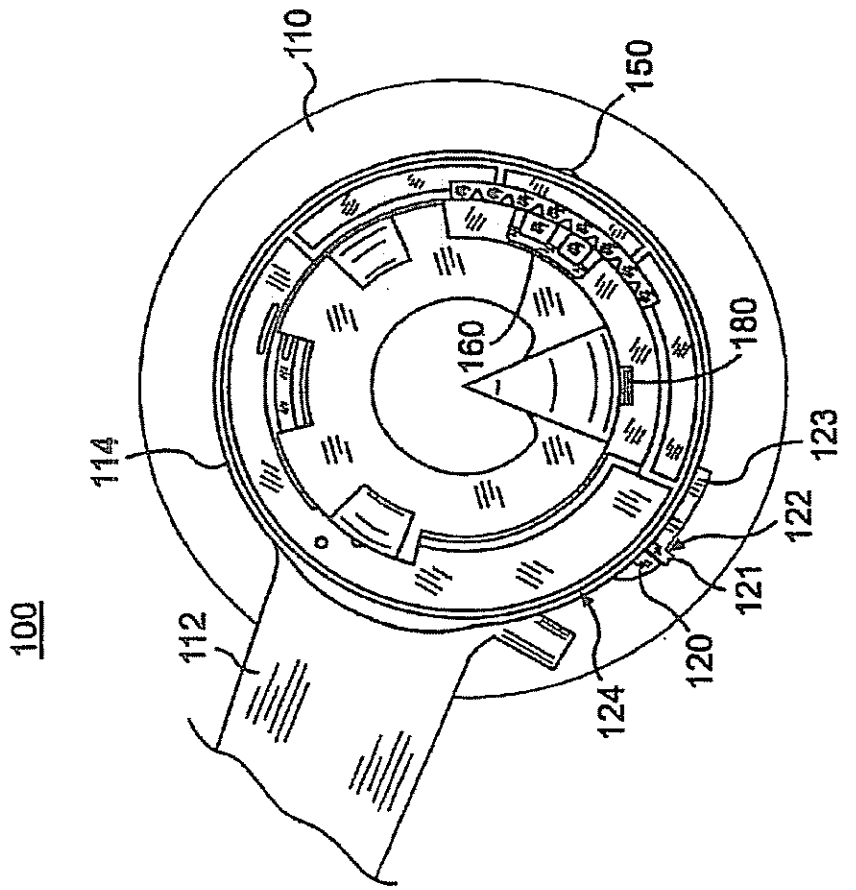
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FIG. 13

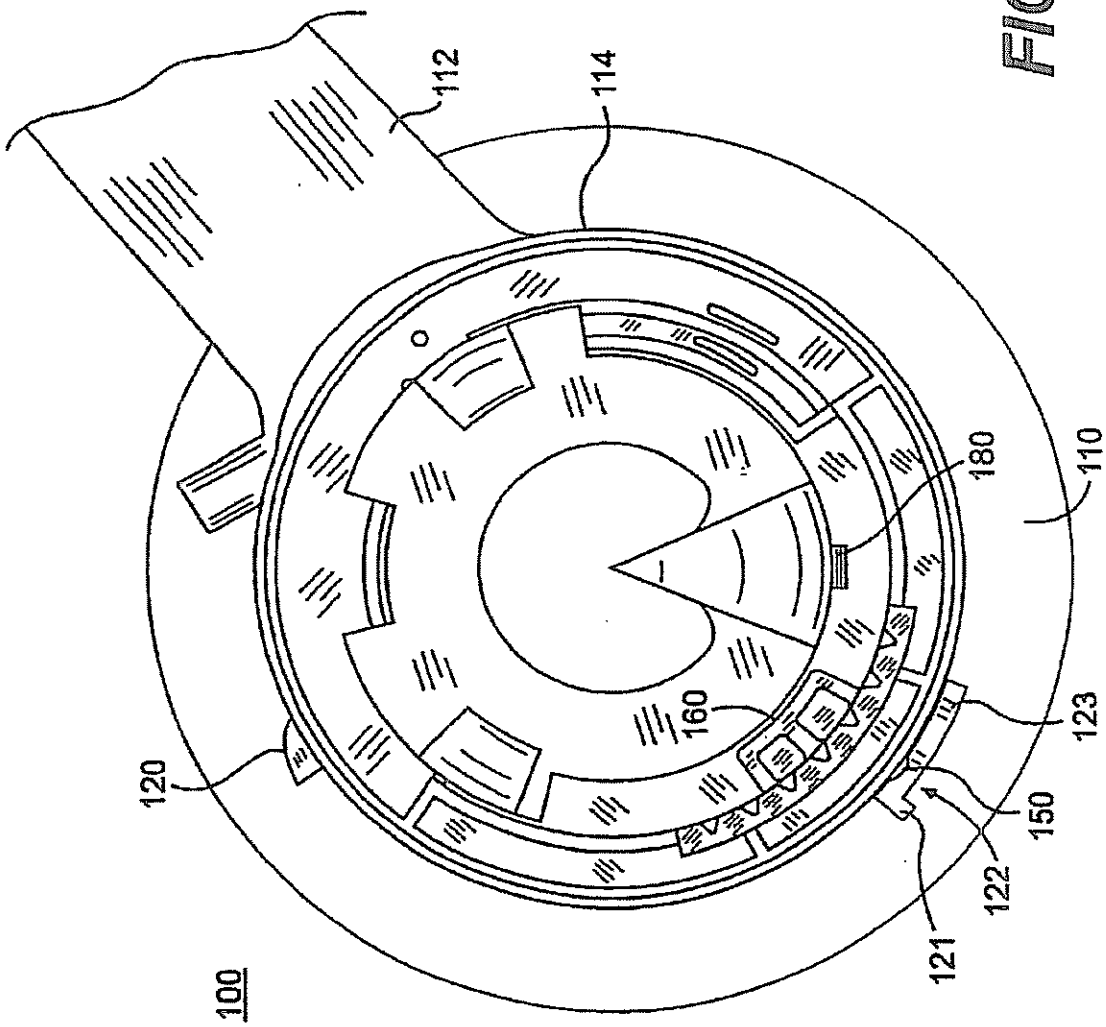

FIG. 15

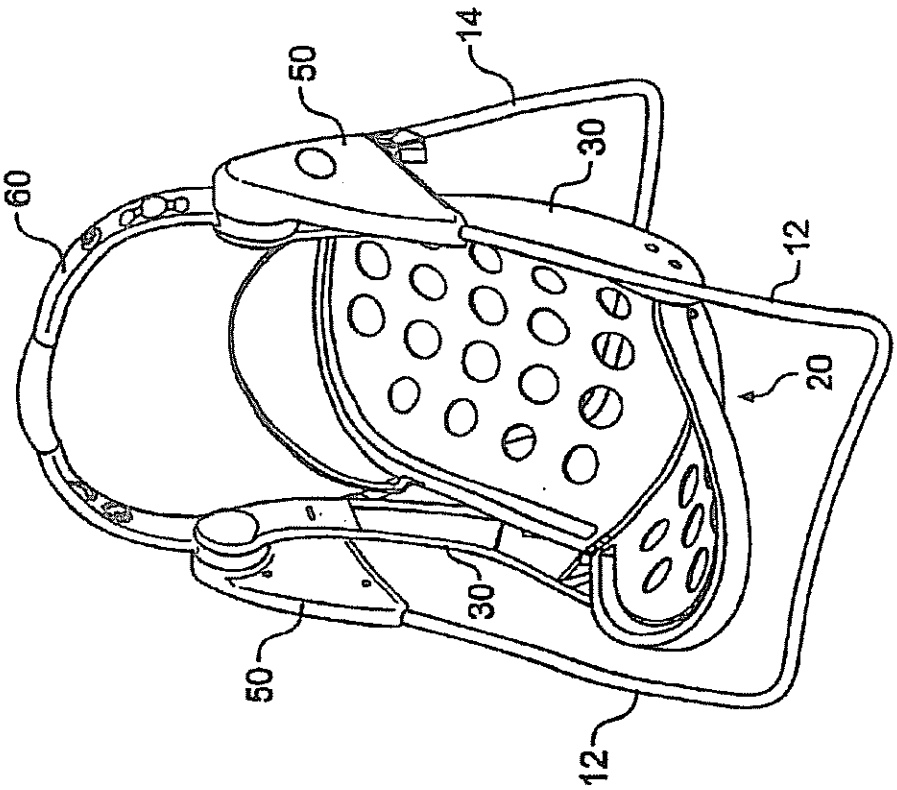
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FIG. 17

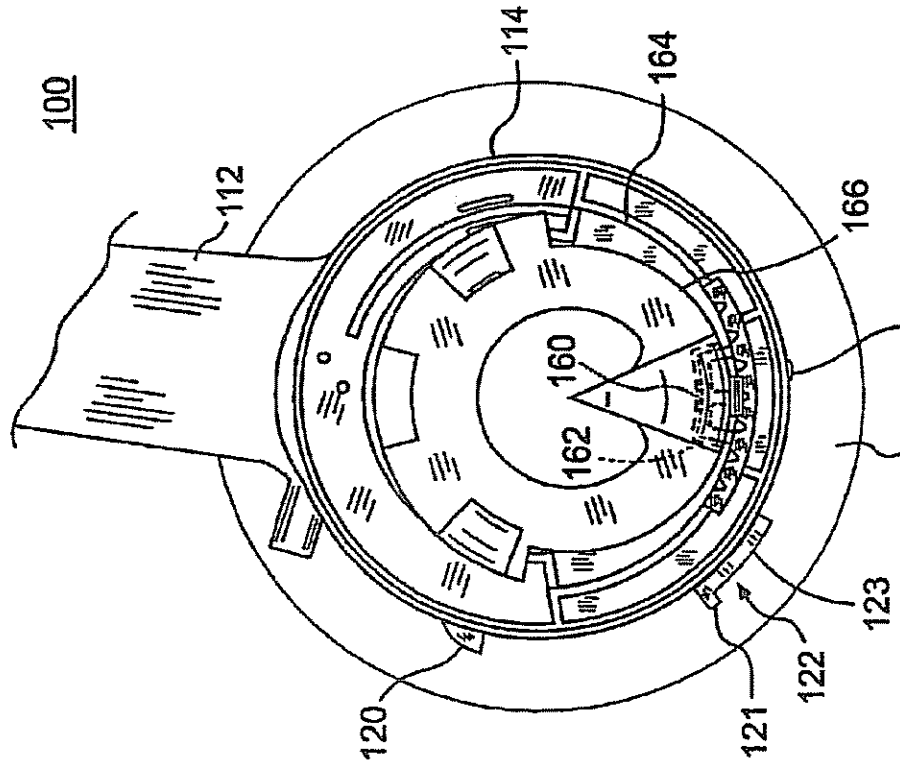
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FIG. 16

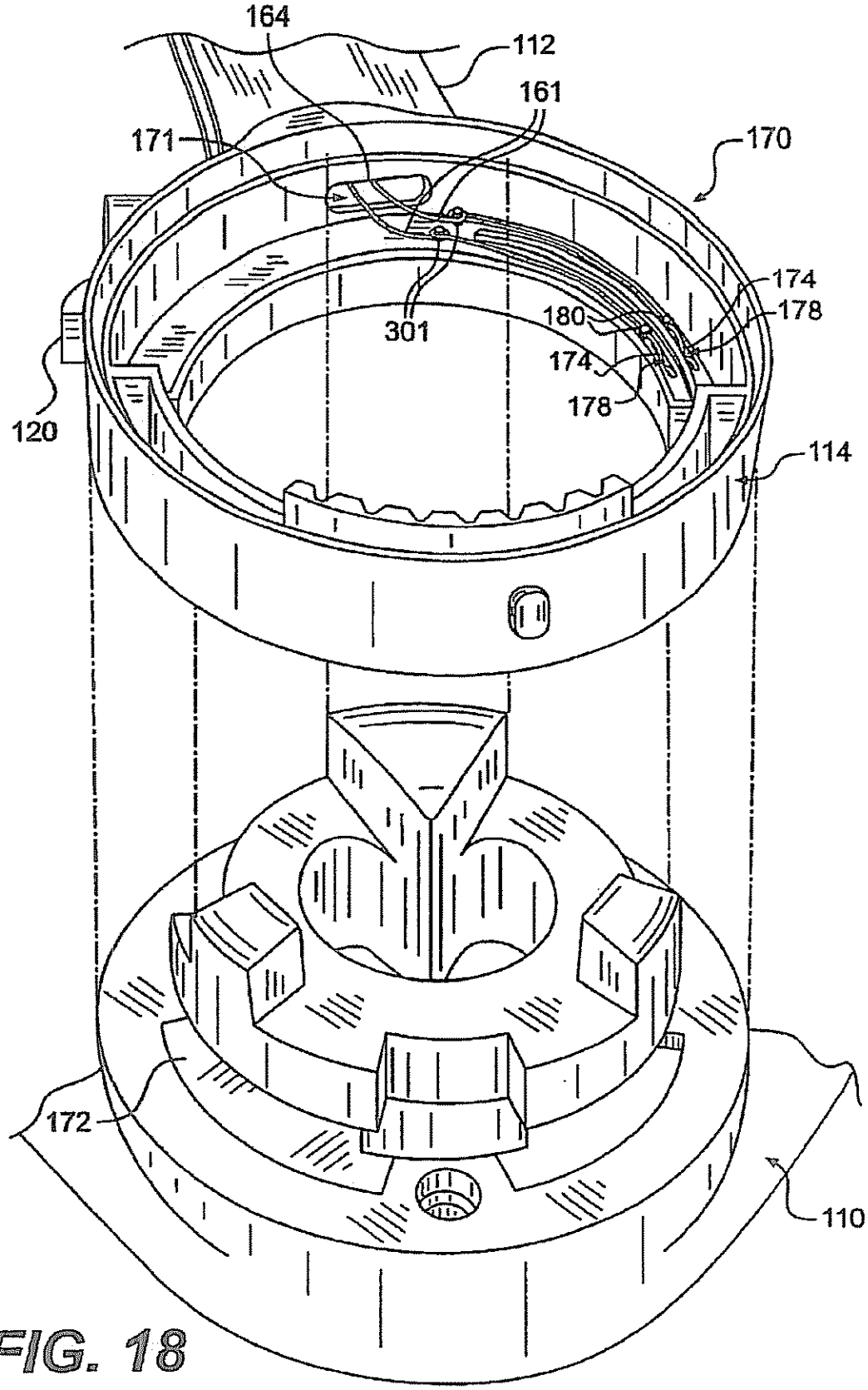

FIG. 18

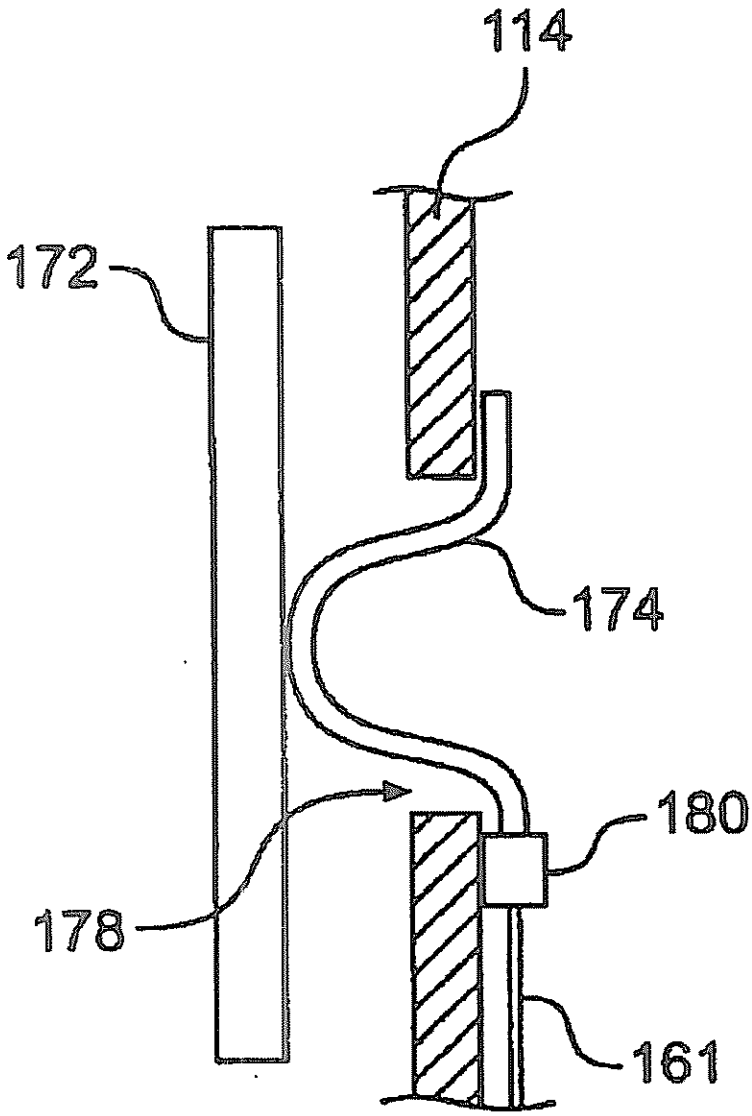

FIG. 19

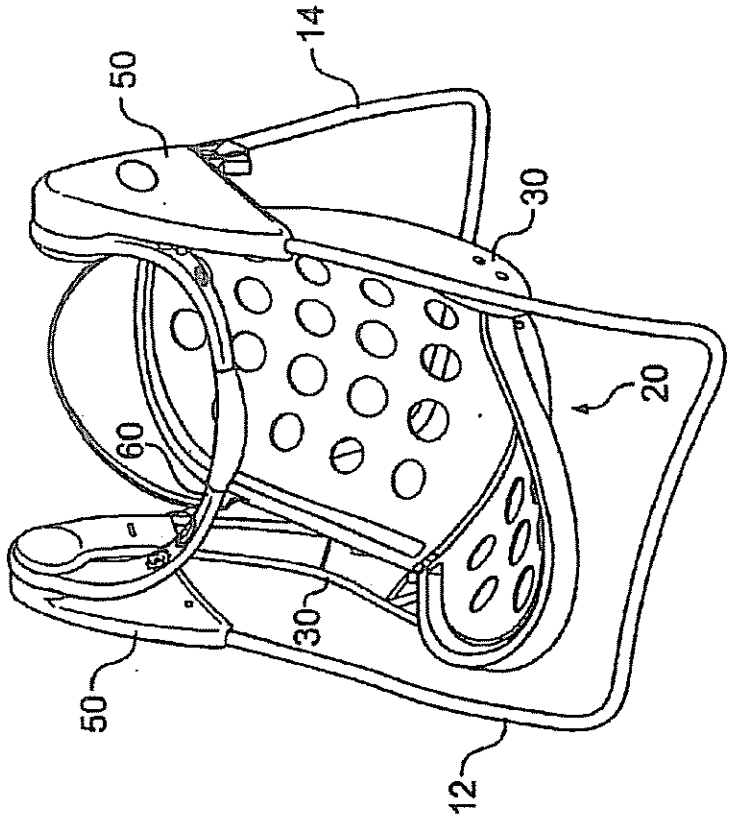

FIG. 21

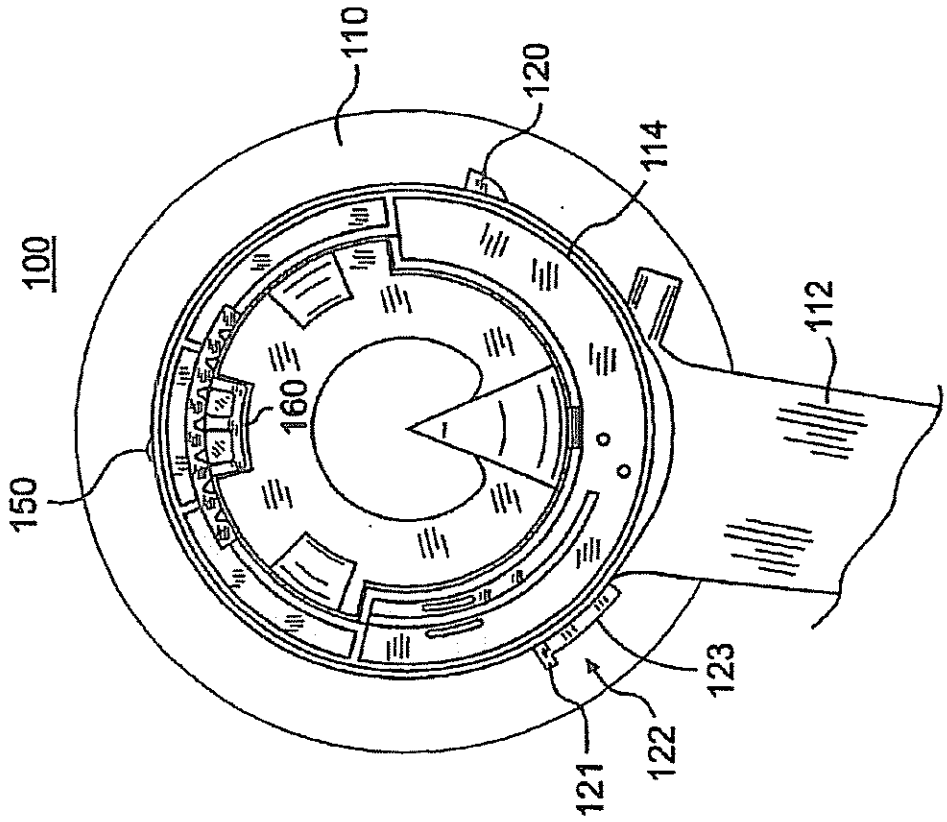

FIG. 20

FOLDABLE SWING HAVING ROTATABLE HANDLE

FIELD OF THE INVENTION

This invention relates to a rotatable handle for a swing. More specifically, this invention relates to a rotatable handle for a foldable child swing.

BACKGROUND OF THE INVENTION

Various types of child or infant swings are known in the art. Typically, such swings include a support frame, hanger arms pivotably attached to the support frame, and a seat attached to the hanger arms.

It is also known to include a handle on the swing to allow a user to carry the swing. The handle is rigidly attached to the support frame, but the swing seat can sway back-and-forth as the swing is carried, which makes the swing somewhat awkward to move.

SUMMARY OF THE INVENTION

An aspect of the present invention relates to a swing that comprises a swing frame and a swing handle rotationally coupled to the swing frame such that the swing handle may rotate about a handle rotational axis between at least two positions. The swing further may comprise a swing seat and at least one hanger arm rotationally coupled to the swing frame and supporting the swing seat. The at least two positions may include a lift position wherein a central portion of the swing handle is arranged above the rotational axis, an open access position wherein a central portion of the swing handle is arranged rearward of the rotational axis, an entertain position wherein a central portion of the swing handle is arranged forward of the rotational axis, and a storage position wherein a central portion of the swing handle is arranged forward and below the rotational axis.

According to the present invention, in the lift position, the swing handle may be locked to prevent rotation of the swing handle relative to the swing frame. In the open access position, the swing handle may be stopped from any further rearward rotation relative to the swing frame. In the entertain position, a detent mechanism may frictionally resist rotational motion by the swing handle in a forward or rearward direction relative to the swing frame. In the storage position, the swing handle may be nested between a seat back and a seat bottom of the swing when the swing is folded.

The swing also may comprise a handle support structure supported by the swing frame, and the swing handle may comprise a handle portion and a support interface portion. The support interface portion may be attached to the handle support structure. In addition, the handle portion may comprise at least one electronic device and electrical wiring extending from the at least one electronic device to the support interface portion. The electronic device may be a light producing device and/or a sound producing device. The support interface portion and the handle support structure may include at least one moving contact assembly to provide electrical contact between the handle support structure and the support interface portion, and the electrical wiring may electrically contact the at least one moving contact assembly. The moving contact assembly may be configured to maintain electrical contact over a rotational angle range as the swing handle rotates relative to the handle support structure, and this rotational angle range may correspond to the angular range about the entertain position of the swing handle.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate several embodiments of the invention and, together with the description, serve to explain the principles of the invention.

FIG. **1** is a front perspective view of a swing, where the swing handle is in an entertain position, in accordance with the invention.

FIG. **2** is a rear perspective, exploded, detail view of the seat back and latch of the swing seat.

FIG. **3** is a rear perspective, detail view of the seat back and latch of the swing seat.

FIG. **4** is a rear perspective, detail view of the inner surface of a hanger arm of the swing.

FIG. **5** is a rear perspective, detail view of a hanger arm and seat back, where the seat back is in a first in-use position.

FIG. **6** is a rear perspective, detail view of the hanger arm and seat back, where the seat back is in a second in-use position.

FIG. **7** is a side view of the swing in the first in-use position.

FIG. **8** is a side view of the swing in an intermediate fold position.

FIG. **9** is a side view of the swing in a fully folded position.

FIG. **10** is an exploded, detail view of the rear leg fold mechanism.

FIG. **10A** is an exploded, perspective view of the leg socket member and the release lever of the rear leg fold mechanism.

FIG. **11A** is a detail view of the rear leg fold mechanism in a locked, in-use position.

FIG. **11B** is a detail view of the rear leg fold mechanism in a fold position.

FIG. **12** is an exploded, detail view of a swing handle assembly in accordance with the invention.

FIG. **13** is a detail view of the right-side, swing handle assembly, where the swing handle is rotated to an open access position.

FIG. **14** is a front perspective view of the swing, where the swing handle is in the open access position.

FIG. **15** is a detail view of the right-side, swing handle assembly, where the swing handle is rotated to an entertain position.

FIG. **16** is a detail view of the right-side, swing handle assembly, where the swing handle is rotated to a lift position.

FIG. **17** is a front perspective view of the swing, where the swing handle is in the lift position.

FIG. **18** is an exploded, detail view of a swing handle assembly including a moving contact assembly in accordance with the invention.

FIG. **19** is a side view of a spring contact and an arc shaped contact according to an embodiment of the invention.

FIG. **20** is a detail view of the right-side, swing handle assembly, where the swing handle is rotated to a storage position.

FIG. **21** is a front perspective view of the swing, where the swing handle is rotated to the storage position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to presently preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. An effort has been made to use the same reference numbers throughout the drawings to refer to the same or like parts.

FIG. **1** illustrates a swing **1** according to an exemplary embodiment of the present invention. The swing **1** has a foldable frame and a reclinable swing seat **20** that can be moved between a fold position, a first, upright in-use position, and a second, reclined in-use position. The swing **1** also includes a handle **60** that can be used to carry the swing. The handle **60** can be rotated between at least two positions. For example, in one embodiment, the handle **60** can be rotated between four positions, including: an open access position during which a child can be seated in the swing, a lift and lock position during which the swing can be carried by the handle, an entertain position during which a child seated in the swing can view lights and/or other play features of the handle, and a storage position during which the handle can be compactly stored when the frame is folded. The number of positions may also be more than four.

The swing **1** generally includes a support frame **10**, a seat **20** having a seat back **22** and a seat bottom **24**, and pair of hanger arms **30** that connect the seat **20** to the support frame **10**. The seat back **22** is pivotally connected to the hanger arms **30** at pivots P1, and the seat bottom **24** is pivotally connected to the hanger arms **30** at pivots P2.

The support frame **10** generally includes front legs **12**, rear legs **14**, a front cross member **16** extending between the front legs **12**, a rear cross member **18** extending between the rear legs **14**, and first and second housings **50**. In the illustrated embodiment, the front legs **12** of the support frame **10** are fixedly connected to the respective housings **50**, and the rear legs **14** of the support frame **10** are pivotally connected to the respective housings **50** to allow the swing **1** to fold, as will be explained below. Alternatively, the front legs can be pivotally connected to the respective housings, and the rear legs can be fixedly connected to the respective housings. In a further embodiment, both the front and rear legs can be pivotally connected to the housings. The fold swing operation will be described below in connection with FIGS. **7–9**.

The support frame **10**, in addition to supporting the support hangers **30** and ultimately the seat **20**, also supports a swing handle **60**, which is part of a swing handle assembly. The swing handle **60** is rotationally connected at either end to the housings **50** and to the hanger arms **30**. The operation and structure of the swing handle assembly will be described below in connection with FIGS. **12–21**.

The swing **1** also can include a power supply **52** within one of the housings **50** for supplying power to a motor to drive the motion of the swing **1** and/or for supplying power to the swing's electronic devices. The power supply **52** may comprise, for example, a battery holder for holding batteries.

As mentioned above, the swing seat **20** can be moved between a fold position, a first, upright in-use position, and a second, reclined in-use position. More specifically, the seat back **22** of the swing seat **20** is positionable in a first, upright in-use position, in a second, reclined in-use position in which the seat back **22** is adjusted rearward relative to its first in-use position, and in a fold position in which the seat back **22** is adjusted forward relative to its first, upright in-use position. While the frame **10** of the swing **1** is in-use, that is, erect, the seat back **22** can be positioned in its first and second in-use positions, and, when the frame **10** is folded for storage, the seat back **22** can be positioned in its fold position.

The seat recline mechanism will now be described in connection with FIGS. **2–6**. The seat recline mechanism includes a latch **200** positioned on each side of the seat back **22** for engagement with the respective hanger arms **30**. FIG. **2** is a detail view of the right side of the seat back **22** and the latch **200**. Although the figures generally show the structural relationship between the seat **20** and the hanger arms **30** by reference to only one hanger arm **30**, it will be understood that, in the illustrated embodiment, the seat-hanger arm relationship on the left and right sides of the swing are mirror images.

The seat back **22** includes a channel **210** molded along at least a portion of the perimeter of the rear surface **23** of the seat back **22**. Upper and lower ribs **220**, **230** are positioned in the channel **210** for capturing the latch **200** therebetween. The seat back **22** also includes a slot **240** adjacent the ribs **220**, **230** for receipt of a portion of the latch **200**. As seen in FIG. **2**, the latch **200** is spaced from the pivot P1.

The latch **200** has a U-shaped segment **250** configured for insertion into the channel **210** between ribs **220**, **230**, a flange **260** at one end of the U-shaped segment **250**, and a locking ridge **270** at the other end of the U-shaped segment **250**. The flange **260** is configured for insertion into slot **240** in a snap fit to secure the latch to the seat back **22**. FIG. **3** illustrates the latch **200** positioned in the channel **210** of the seat back **22**, with flange **260** extending through slot **240**. The locking ridge **270** is configured to engage latch-receiving members, such as ribs, on the hanger arms **30** to secure the seat back **22** in a selected in-use position.

The latch **200** also includes a segment **280** with finger bumps **282**. A user can press on the finger bumps **282** to flex the latch **200** inwardly, about the U-shaped segment **250**, in the direction of arrow A in FIG. **2** to disengage the latch from the hanger arms **30**. This segment **280** may be visible to the user to facilitate positioning of the seat back to a desired in-use position.

FIG. **4** shows the inner surface of the left-side hanger arm **30** in accordance with the invention, the right-side hanger arm **30** being a mirror image. The hanger arm **30** includes two through holes, one of which is labeled C1, to receive the pivot P1 of the seat back **22** and the pivot P2 of the seat bottom **24**, respectively. In other embodiments, the seat back **22** and the seat bottom **24** can share a common pivot, and the hanger arm can include a single hub or single through hole to receive the pivot. The hanger arm **30** also includes first and second ribs **300**, **302** corresponding to the first, upright in-use position and the second, reclined in-use position, respectively. To position the seat back **22** in the first, upright in-use position, the locking ridge **270** of each latch **200** is positioned against the first rib **300** of the respective hanger arm **30**, as shown in FIG. **5**. To position the seat back **22** in the second, reclined in-use position, the locking ridge **270** of each latch **200** is positioned against the second rib **302** of the respective hanger arm **30**, as shown in FIG. **6**.

As can be seen from FIG. **2**, the locking ridge **270** has a flat surface **271** and an angled surface **272**. Due to the configuration of the locking ridge **270**, the user only needs to actuate the latch **200** to move the seat back **22** in a rearward direction, for example, from the upright in-use position to the reclined in-use position. The user need not actuate the latch **200** to move the seat back **22** in a forward direction, for example, from the reclined in-use position to the upright in-use position. When moving the seat back **22**

forward from the reclined in-use position toward the upright in-use position, the user can grip the seat back **22** and pivot it forward, which causes the angled surface **272** to ride over the first rib **300**. The latch **200** flexes inward until it passes the rib **300** and then restores to its at-rest configuration. At this point, the user can release the seat back **22** to allow the flat surface **271** to rest on the first rib **300**. The seat back **22** can be moved from the upright in-use position to the fold position in the same manner, that is, by simply gripping the seat back **22** and pivoting it forward.

In addition to ribs **300**, **302**, each hanger arm **30** can include a rib **304** on its inner surface, forward of rib **302**, to maintain the seat back **22** in the fold position. The rib **304** has a detent so that, when folded, the side of the seat back **22** comes into contact with the detent in a friction fit and is maintained in the fold position until the user pushes the seat back **22** rearward, away from the rib **304**. Similarly, the hanger arms **30** each can include a rib **306** with a detent for engagement with a side of the seat bottom **24** to maintain the seat bottom **24** in a fold position when pivoted upwardly and rearwardly, toward the seat back **22**.

Although only two in-use positions are shown in the figures, it will be understood that the hanger arms **30** can include additional ribs representative of additional in-use positions. Further, although the figures show the seat **20** suspended from a pair of hanger arms **30**, the present invention envisions a swing having a single hanger arm to suspend the seat.

The latches **200** can be integrally molded as a unitary body with the seat back **22**, or they can be fabricated separately from the seat back **22** and later releasably attached to the seat back **22** as shown in FIG. **2**. When fabricated separately, the latches **200** can have a different color than the seat back **22** to make them more visible to the user. In addition, the latches **200** can be fabricated from any suitable material, including plastic (such as acetal), steel, and aluminum. When the latch **200** is fabricated from a relatively rigid material, such as a metal or metal alloy, as opposed to a flexible plastic, the latching force achieved by deformation and restoration of the plastic latch material can be accomplished by a spring appropriately located relative to the metal latch **200** and the channel **210**.

The swing fold operation will now be described in connection with FIGS. **7–9**. FIG. **7** shows the swing in an in-use position, the seat back **22** in its first, reclined in-use position, and the swing handle **60** in its lift and lock position. A rear leg fold mechanism **70** is mounted to each rear leg **14** adjacent each housing **50**. To fold the swing **1**, the rear leg fold mechanisms **70** are actuated by the user so that the rear legs **14** can pivot relative to the housings **50** toward the front legs **12**.

FIGS. **10**, **10A**, **11A**, and **11B** illustrate the rear leg fold mechanism in more detail. The rear leg fold mechanism generally includes a leg socket member **72** to which the rear leg is mounted, a release lever **74**, and a locking pin **76** connected to the release lever **74**. As shown in FIG. **10A**, the locking pin **76** of the illustrated embodiment is formed as part of the release lever **74**; however, it will be understood that the locking pin **76** can be molded separately from, and then connected by a suitable fastener to, the release lever **74**. The socket member **72** is rotationally mounted to the respective housing **50** about pivot P3 and rotates with the rear leg **14** between the in-use position and the fold position. The locking pin **76** of the release lever **74** is configured to be captured in slots **78**, **80** in the socket member **72** and the housing **50**, respectively. The slot **78** in the socket member **72** has a slight arc to allow the pin **76** to move radially outward (when the lever **74** is squeezed) and radially inward (when the lever **74** is released). The slot **78** in the housing **50** is generally C-shaped to include a lock area **82**, a folded detent area **84**, and a travel area **86** between the two. When the lever **74** is released, as shown in FIG. **11A**, the pin **74** can remain located in the lower, lock area **82** and the leg **14** cannot rotate. When the lever **74** is squeezed, the pin **76** rotates into the travel area **86** in the housing slot **80**, and the pin **76** rides along this track-like area as the rear leg **14** is pivoted to the fold position. FIG. **8** shows the rear legs **14** in a partially pivoted position. In this position, the locking pin **76** is located in travel area **86**. When the rear leg **14** is completely folded, as shown in FIG. **11B**, the pin **76** is free to move to the folded detent area **84** to lock the leg **14** in place. This area **84** has a lead out angled surface **88** that creates a detent or soft lock. Because there is no positive lock in this area **84**, the legs **14** can be moved to the in-use position without squeezing the lever **74**. The degree of the angled surface **88** will determine the amount of force needed to move the legs **14** to the in-use position. Although the figures show fold mechanisms associated with the rear legs, it is envisioned that, in an alternative swing arrangement, the fold mechanisms could be associated with the front legs.

In addition to the pivoting of the rear legs **14**, the swing handle **60** is pivoted during the fold operation. The swing handle **60** is pivoted from an in-use position (one of the open access position, the lift and lock position, and the entertain position) to the storage position, in the direction of arrow B in FIG. **8**. The swing handle **60** can be moved to the storage position either before or after folding of the rear legs **14**.

Once the swing handle **60** is in the storage position, the seat back **22** and the seat bottom **24** are pivoted to their fold positions. That is, the seat back **22** and the seat bottom **24** are pivoted toward each other until the back and bottom **22**, **24** frictionally engage the detents of the respective ribs **304**, **306** on the inner surface of the hanger arms **30**. The swing handle **60** nests between the seat back **22** and bottom **24** when all three structures are folded. FIG. **9** illustrates the swing **1** in its fully folded position.

If the user wants to carry the folded swing **1**, the user can maintain the swing handle **60** in the lift and lock position shown in FIG. **7** and fold the remaining swing structures, including the rear legs **14**, the seat back **22**, and the seat bottom **24**. In this regard, the swing handle assembly operates independently of the remaining fold structures.

FIG. **12** illustrates a swing handle assembly **100** according to an exemplary embodiment of the invention. Such a swing handle assembly **100** is present at each end of the swing handle **60** to mount the swing handle **60** to the frame **10** (shown in FIG. **1**). The swing handle assembly **100** includes an end of the swing handle **60** and a handle support structure **110**. The handle support structure **110** is positioned within a respective housing **50** (shown in FIG. **1**), and it may be integrally molded with the housing **50** or may be attachable to the housing **50**. The swing handle **60** is rotationally coupled to the handle support structure **110** such that the swing handle **60** may rotate about a handle rotational axis RA between at least two positions. In addition, the swing handle **60** may include a number of electronic devices **162**, as shown in FIG. **1**.

The swing handle **60** may comprise a handle portion **112** and a support interface portion **114**. The support interface portion **114** is the portion of the swing handle **60** that is attached to the handle support structure **110**. The support interface portion **114** is positioned within the respective housing **50** (shown in FIG. **1**).

FIG. **13** illustrates the swing handle **60** rotated relative to the handle support structure **110** so that the swing handle **60** is in an open access position. In this position, a central portion of the swing handle **60**, which includes the central portion of the handle portion **112**, is arranged rearward of the rotational axis of the handle **60**. In this application forward of the rotational axis is toward a front of the swing **1** and rearward of the rotational axis is toward the rear of the swing **1**.

In this open access position, access to the seat **20** is easily facilitated because the swing handle **60** is out of the way relative to the seat **20**, as illustrated in FIG. **14**. A child may be easily placed within the seat **20** while the swing handle **60** is rotated rearward. In this open access position, the swing handle **60** is stopped from any further rearward rotation relative to the handle support structure **110** and the frame **10**. The swing handle **60** is stopped relative to the support structure **110** when a handle stop **120** on the handle **60** meets a support stop **122** on the handle support structure **110**.

Referring to FIG. **13**, the handle stop **120** is located on an outer peripheral wall **124** of the support interface portion **114**. The handle stop **120** may be shaped, for example, as a protrusion with a flat edge facing the support stop **122** when in contact with the support stop **122**. The support stop **122** may be shaped, for example, as a protrusion with a flat edge facing the handle stop **120** when in contact with the handle stop **120**. In particular, the support stop **122** may be generally L-shaped with a radial rib **121** of the L facing the handle stop **120**. The radial rib **120** extends radially from the axis of rotation. The radial rib **121** contacts the handle stop **120** when the handle stop **120** meets the support stop **122**. The support stop **122** may also include a circumferential rib **123** extending in a circumferential direction relative to the axis of rotation. In this respect, the support stop **122** has a dual function: to facilitate positioning of the swing handle **60** in the open access position, as explained above, and to facilitate positioning of the swing handle **60** in the entertain position, as will be explained below.

Rotation of the swing handle **60** relative to the handle support structure **110** to the entertain position is now described with reference to FIGS. **1**, **12**, and **15**. FIG. **15** illustrates the swing handle **60** rotated relative to the handle support structure **110** so that the swing handle **60** is in an entertain position. In this position, a central portion of the swing handle **60** is arranged forward of the rotational axis of the swing handle **60**, when the swing handle **60** is arranged as part of the swing. The swing handle **60** and handle support structure **110** are configured so that, when the swing handle **60** is in this entertain position, the central portion of the swing handle **60** is positioned above and/or in front of a child seated in the swing. Thus, the child would be able to easily view the swing handle **60** and any toys and/or electronic stimuli associated with the handle **60**. In this regard, the swing handle **60** may include features to entertain the child. As described further below, the swing handle may include electronic devices **162** (shown in FIG. **1**) to provide lights and/or sounds for entertainment.

To maintain the swing handle **60** in the entertain position, the support interface portion **114** includes a detent mechanism that frictionally resists rotational motion by the swing handle **60** in a forward or rearward direction relative to the handle support structure **110** and the swing frame **10**. The detent mechanism may comprise, for example, one or more detents on one of the support interface portion **114** of the swing handle **60** and the handle support structure **110**. The other of the support interface portion **114** and the handle support structure **110** includes a protrusion, as part of the detent mechanism, arranged such that when the swing handle **60** is rotated in a first direction relative to the handle support structure **110** and the detent and the protrusion meet, the detent frictionally resists rotational motion by the swing handle **60** in the first direction or in a direction opposite to the first direction.

FIG. **15** illustrates an example where the detent **150** is on the support interface portion **114** of the swing handle **60**. In this case, the support stop **122** may serve as the protrusion that frictionally resists the detent **150** when the detent **150** and the support stop **122** meet. Alternatively, the protrusion may be other than the support stop **122**.

The support stop **122** may be generally L-shaped, as described above with respect to FIGS. **12** and **13**. The radial rib **121** of the L extends radially from the center of rotation and acts to stop the handle stop **124**, as explained with respect to the open access position of FIG. **13**. The radial rib **121** may be angled such that its radially distance from the rotation axis increases along the rotation axis. The circumferential rib **123** of the L extends circumferentially and engages the detent **150** to provide frictional engagement between the support stop **122** and the detent **150** as the detent **150** moves along the support stop **122**. The circumferential rib **123** and the height of the detent **150** are set to provide sufficient resistance to rotation to hold the swing handle **60** in the entertain position, but not so much resistance as to make it difficult to rotate the handle out of the entertain position. FIG. **1** illustrates the swing with the handle **60** in the entertain position.

Rotation of the swing handle **60** relative to the handle support structure **110** to the lift position is now described with respect to FIGS. **12**, **16**, and **17**. FIG. **17** illustrates the swing handle **60** rotated relative to the handle support structure **110** so that the swing handle **60** is in the lift position. In this position, a central portion of the swing handle **60** is arranged generally above the rotational axis of the swing handle **60**, when the swing handle is arranged as part of the swing. In this lift position, the swing handle **60** is locked relative to the handle support structure **110** and frame **10**. The swing **1** may be lifted by grasping the swing handle **60** and lifting. Because the rotational motion of the swing handle **60** is locked relative to the swing frame **10**, the swing **1** may be more easily carried without awkwardness otherwise caused by freely swinging motion of the swing frame **10** relative to the swing handle **60**.

The swing handle may be locked relative to the swing frame **10** and handle support structure **110** by means of a protrusion and matching recess. For example, one of the support interface portion **114** of the swing handle **60** and the handle support structure **110** may include a protrusion, and the other of the support interface portion **114** and the handle support structure **110** may include a recess matched to the protrusion such that, when the protrusion is within the recess, the swing handle **60** is locked relative to the handle support structure **110**. The locking mechanism of the protrusion and recess may also incorporate a user-activated lock.

FIGS. **12** and **16** illustrate an example where the protrusion **160** is on an inner peripheral wall **164** of the support interface portion **114** of the swing handle **60**, and the recess **162** is on an outer peripheral wall **166** of the handle support structure **110**. When the swing handle **60** is rotated such that the protrusion **160** lines up with recess **162**, the handle **60** may be grasped and lifted so that the protrusion **160** enters the recess **162**, and further rotational motion of the swing

handle **60** relative to the handle support structure **110**, in either rotational direction, is prevented. The locking of the handle **60** relative to the handle support structure **110** may be released by lowering the handle **60** (such as by pushing on the handle **60**) relative to the handle support structure **110** to disengage the protrusion **160** from the recess **162**. FIG. **17** illustrates the swing with the handle **60** in the lift position.

The lift and lock mechanism described above with the matching protrusion and recess provides a number of advantages. Locking action is transparent to the user with no secondary action required. Moreover, the design uses few moving parts and is easy to assemble. Further, cost effective materials can be used to achieve the desired function.

Rotation of the swing handle **60** relative to the handle support structure **110** to the storage position is now described with respect to FIGS. **12**, **20**, and **21**. FIG. **21** illustrates the swing handle **60** rotated relative to the handle support structure **110** so that the swing handle **60** is in a storage position. In the storage position, the rotational motion of the swing handle **60** relative to the handle support structure **110** need not be stopped, locked, or frictionally resisted by structures on the swing handle **60** and/or handle support structure **110**, because the relative rotation is prevented by nesting of the swing handle **60** between the seat back **22** and the seat bottom **24** of the seat **20**. The swing handle **60** may be nested between the seat back **22** and the seat bottom **24** of the seat **20**, when the swing is in a folded position.

According to one embodiment of the invention illustrated in FIG. **12**, the handle **60** and handle support structure **110** include structure to allow the handle **60** to be snapped onto the handle support structure **110**, and thereafter the handle **60** is rotationally fixed to the handle support structure **110**. In this regard, the outer peripheral wall **166** of the handle support structure **110** includes a snap finger **180**. When the handle **60** is assembled to the handle support structure **110** such that the inner peripheral wall **164** of the support interface section **114** passes over and past the snap finger **180**, the snap finger **180** extends radially outward and beyond a lip **182** of the inner peripheral wall **164**. This extension of the snap finger **180** beyond the lip **182** prevents the handle **60** from being slid off of the handle support structure **110**.

FIGS. **18** and **19** illustrate another aspect of the invention wherein electrical wiring **161** extends from the handle portion **112** of the swing handle **60** into and through the support structure **110** so that electronic devices **162** (see FIG. **1**) on the handle portion **112** may be powered by a power supply not in the handle portion **112**, but in one of the housings **50**.

The wiring **161** extends into a cavity **164** within the handle portion **112** to the electronic devices **162** on the handle portion **112**. The electronic devices may be, for example, light producing electronic devices and/or sound producing electronic devices. For example, if the electronic devices **162** are for the entertainment of a child in the swing, one or more of the electronic devices **162** may be a colored light shaped as a pleasing design for a child, such as a star or a cat. The electronic devices **162** may also produce sounds instead of, or in addition to, light. For example, if the electronic device is a colored light shaped as a cat, the device may also produce a "meow" sound. One or more of the electronic devices **162** may also produce sounds such as music, for example.

The support interface portion **114** may include an outer peripheral wall **170** adjacent the handle portion **112**. In order to pass the wiring **161** from the cavity **164** of the handle portion **112** to the support interface portion **114** of the handle **60**, the outer peripheral wall **170** may include a slot **171**. The slot **171** allows for an electrical connection between the handle portion **112** and the interface portion **114**. An electrical connection or contact between the support interface portion **114** and the handle support structure **110** may be implemented by means of at least one moving contact assembly.

Beneficially the moving contact assembly allows electronics to be powered in a movable handle, i.e., the handle **60**, through wiring passing through a rotating joint, i.e., the joint of the support interface portion **114** and the handle support structure **110**.

The moving contact assembly may comprise a generally arc shaped contact **172** on the handle support structure **110** and at least one spring contact **174** on the support interface portion **114**. The spring contacts **174** are adapted to electrically contact the generally arc shaped contact **172** as the swing handle **60** rotates relative to the handle support structure **110**.

The generally arc shaped contact **172** may comprise a printed circuit board or conductive ink formed on a surface of the handle support structure **110**, for example. If the generally arc shaped contact **172** comprises a printed circuit board, the handle support structure **110** may comprise a board mounting slot, so that the printed circuit board may be fixedly attached to the handle support structure **110** via the board mounting slot by snapping into the slot. Alternately the printed circuit board may be fixedly attached to the handle support structure **110** by screws or glue. The wiring **160** electrically contacts the generally arc shaped contact **172** via spring contacts **174**.

The spring contacts **174** may be formed of any appropriate material, and may be, for example, formed of a sheet metal stamping, conductive plastic, or graphite, for example.

The spring contacts **174** may pass through respective slots of the at least one slot **178** on the support interface portion **114**. The wiring **161** may we attached to the support interface portion **114** by wrapping the wiring **161** around respective support posts **301**. The spring contacts **174** may be attached to the wiring **161** using a contact snap **180** attached to the support interface portion **114**. Power supply wiring (not shown) may then extend from the generally arc shaped contact **172** to the power supply **52** (shown in FIG. **1**).

The moving contact assembly comprising the generally arc shaped contact **172** and the spring contacts **174** provides an electrical contact between the generally arc shaped contact **172** and the spring contacts **174** as the swing handle **60** is rotated relative to the handle support structure **110**. The arc length of the generally arc shaped contact **172** determines the rotational range over which electrical contact is maintained between the generally arc shaped contact **172** and the spring contacts **174**, and thus the range over which power is supplied to the electronic devices **162**. Because the electrical devices **162** may need to operate only over a limited rotational range of the handle **60**, limiting the arc length of the generally arc shaped contact **172** is possible, and the limited size of the generally arc shaped contact **172** may beneficially reduce its cost. The electrical devices **162** may need to operate only over a rotational range where the swing handle **60** rotates over a certain angle forward and rearward of the entertain position, for example. In one embodiment, the position and arc length of the generally arc shaped contact **172** is configured so that the electrical devices **162** work at the lift position and at ±60 degrees from the lift position, where +60 degrees includes the entertain position.

As an alternative, the swing handle **60** itself may contain a battery support structure for containing batteries and providing power to the electronic devices **162** on the swing handle **60**. In this case, the swing handle **60** need not include wiring to the power supply **52** within the housing **50**.

The preferred embodiments have been set forth herein for the purpose of illustration. This description, however, should not be deemed to be a limitation on the scope of the invention. Various modifications, adaptations, and alternatives may occur to one skilled in the art without departing from the claimed inventive concept. The true scope and spirit of the invention are indicated by the following claims.

What is claimed is:

1. A swing comprising:

a swing frame;

a swing seat;

at least one hanger arm connecting the swing seat to the swing frame;

a motor mounted to the swing frame to drive the motion of the at least one hanger arm and the swing seat; and

a swing handle rotationally coupled to the swing frame and extending over the swing seat, wherein the swing handle may rotate about a handle rotational axis between at least two positions.

2. The swing of claim **1** wherein the at least one hanger arm is rotationally coupled to the swing frame and supports the swing seat.

3. The swing of claim **1**, wherein the at least two positions include a lift position wherein a central portion of the swing handle is arranged above the rotational axis.

4. The swing of claim **1**, wherein the at least two positions include an open access position wherein a central portion of the swing handle is arranged rearward of the rotational axis.

5. The swing of claim **1**, wherein the at least two positions include an entertain position wherein a central portion of the swing handle is arranged forward of the rotational axis.

6. The swing of claim **1**, wherein the swing frame comprises a handle support structure, and wherein the swing handle is rotationally coupled to the swing frame at the handle support structure.

7. The swing of claim **6**, wherein the handle support structure includes a snap finger and the swing handle includes a lip, such that, when the swing handle is slid onto the handle support structure, the snap finger engages the lip to prevent the swing handle from being slid off the handle support structure.

8. The swing of claim **6**, wherein one of the swing handle and the handle support structure includes a protrusion, and the other of the swing handle and the handle support structure includes a recess matched to the protrusion such that, when the protrusion is within the recess, the swing handle is locked to prevent rotation relative to the handle support structure.

9. The swing of claim **6**, wherein one of the swing handle and the handle support structure includes a detent, and the other of the swing handle and the handle support structure includes a protrusion arranged such that, when the swing handle is rotated in a first direction relative to the handle support structure and the detent and the protrusion meet, the detent frictionally resists rotational motion by the swing handle in the first direction or in a direction opposite to the first direction.

10. The swing of claim **9**, wherein the swing handle comprises a handle stop and the handle support structure comprises a support stop arranged such that, when the handle is rotated in a first direction relative to the handle support structure and the handle stop and support stop meet, further rotational motion of the swing handle relative to the handle support structure is prevented.

11. The swing of claim **10**, wherein the handle support structure includes one rib extending radially from the handle rotational axis and another rib extending circumferentially relative to the handle rotational axis, and wherein the protrusion comprises the rib extending circumferentially.

12. The swing of claim **6**, wherein the swing handle comprises a handle stop and the handle support structure comprises a support stop arranged such that, when the handle is rotated in a first direction relative to the handle support structure and the handle stop and support stop meet, further rotational motion of the swing handle relative to the handle support structure is prevented.

13. A swing comprising:

a swing frame;

a swing seat;

at least one hanger arm connecting the swing seat to the swing frame;

a motor mounted to the swing frame to drive the motion of the at least one hanger arm and the swine seat; and

a swing handle rotationally coupled to the swing frame such that the swing handle may rotate about a handle rotational axis between at least two positions

wherein the at least two positions include a lift position wherein a central portion of the swing handle is arranged above the rotational axis and wherein the swing handle is locked to prevent rotation of the swing handle relative to the swing frame.

14. A swing comprising:

a swing frame;

a swing seat;

at least one hanger arm connecting the swing seat to the swing frame;

a motor mounted to the swing frame to drive the motion of the at least one hanger arm and the swing seat; and

a swing handle rotationally coupled to the swing frame such that the swing handle may rotate about a handle rotational axis between at least two positions

wherein the at least two positions include an open access position wherein a central portion of the swing handle is arranged rearward of the rotational axis and wherein the swing handle is stopped from any further rearward rotation of the swing handle relative to the swing frame.

15. A swing comprising:

a swing frame;

a swing seat;

at least one hanger arm connecting the swing seat to the swing frame;

a motor mounted to the swing frame to drive the motion of the at least one hanger arm and the swine seat; and

a swing handle rotationally coupled to the swing frame such that the swing handle may rotate about a handle rotational axis between at least two positions

wherein the at least two positions include an entertain position wherein a central portion of the swing handle is arranged forward of the rotational axis and wherein a detent mechanism frictionally resists rotational motion by the swing handle in a forward or rearward direction relative to the swing frame.

16. A swing comprising:

a swing frame;

a swing seat; and