Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2513941 A1 2004/08/19

(21) 2 513 941

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(86) Date de dépôt PCT/PCT Filing Date: 2004/01/06
(87) Date publication PCT/PCT Publication Date: 2004/08/19
(85) Entrée phase nationale/National Entry: 2005/07/21
(86) N° demande PCT/PCT Application No.: US 2004/000078
(87) N° publication PCT/PCT Publication No.: 2004/069597
(30) Priorité/Priority: 2003/01/31 (10/355,417) US

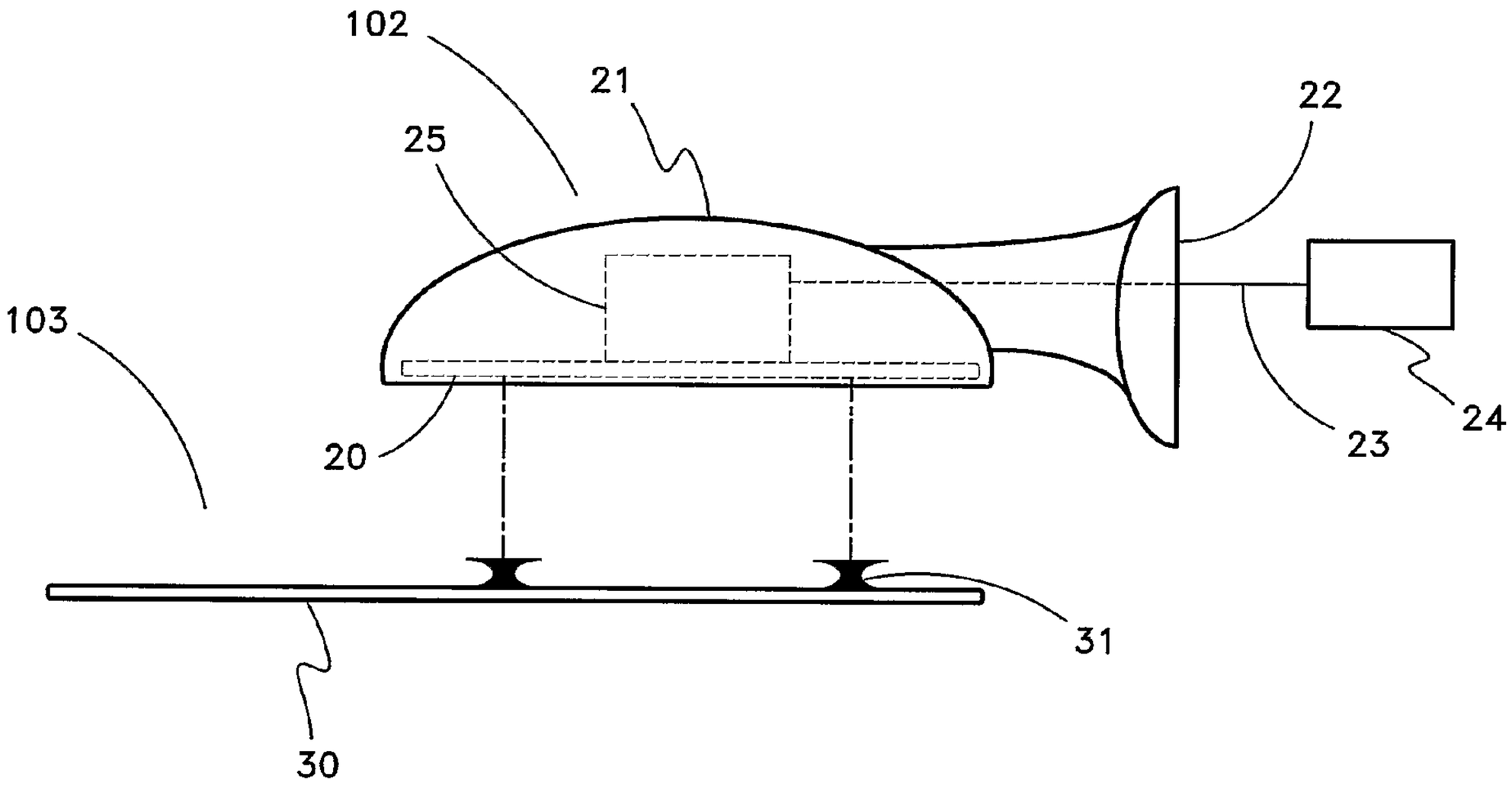
(51) Cl.Int.^{7}/Int.Cl.^{7} G02B 5/08, B60R 1/06, G02B 7/182

(71) Demandeur/Applicant:
VANDERHORST, JOHN, US

(72) Inventeur/Inventor:
VANDERHORST, JOHN, US

(74) Agent: RIDOUT & MAYBEE LLP

(54) Titre : SYSTEME DE RETROVISEUR REGLABLE A DISTANCE ET DETACHABLE
(54) Title: DETACHABLE REMOTELY-ADJUSTABLE EXTENSION MIRROR SYSTEM



(57) Abrégé/Abstract:
Motion from a first reflective surface (20) of a remotely-adjustable original-equipment side view mirror unit (102) is coupled to a detachable extension mirror unit (103) to provide a motor vehicle driver a remotely-adjustable extended rearward view around a wide trailer or similar object blocking the original inboard rearward view from the remotely-adjustable original equipment side view mirror unit (102).

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
19 August 2004 (19.08.2004)

PCT

(10) International Publication Number
WO 2004/069597 A3

(51) International Patent Classification[7]: G02B 5/08, 7/182, B60R 1/06

(21) International Application Number: PCT/US2004/000078

(22) International Filing Date: 6 January 2004 (06.01.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10/355,417 31 January 2003 (31.01.2003) US

(71) Applicant and
(72) Inventor: **VANDERHORST, John** [US/US]; 10872 Mill Hollow Road, Littleton, CO 80127 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

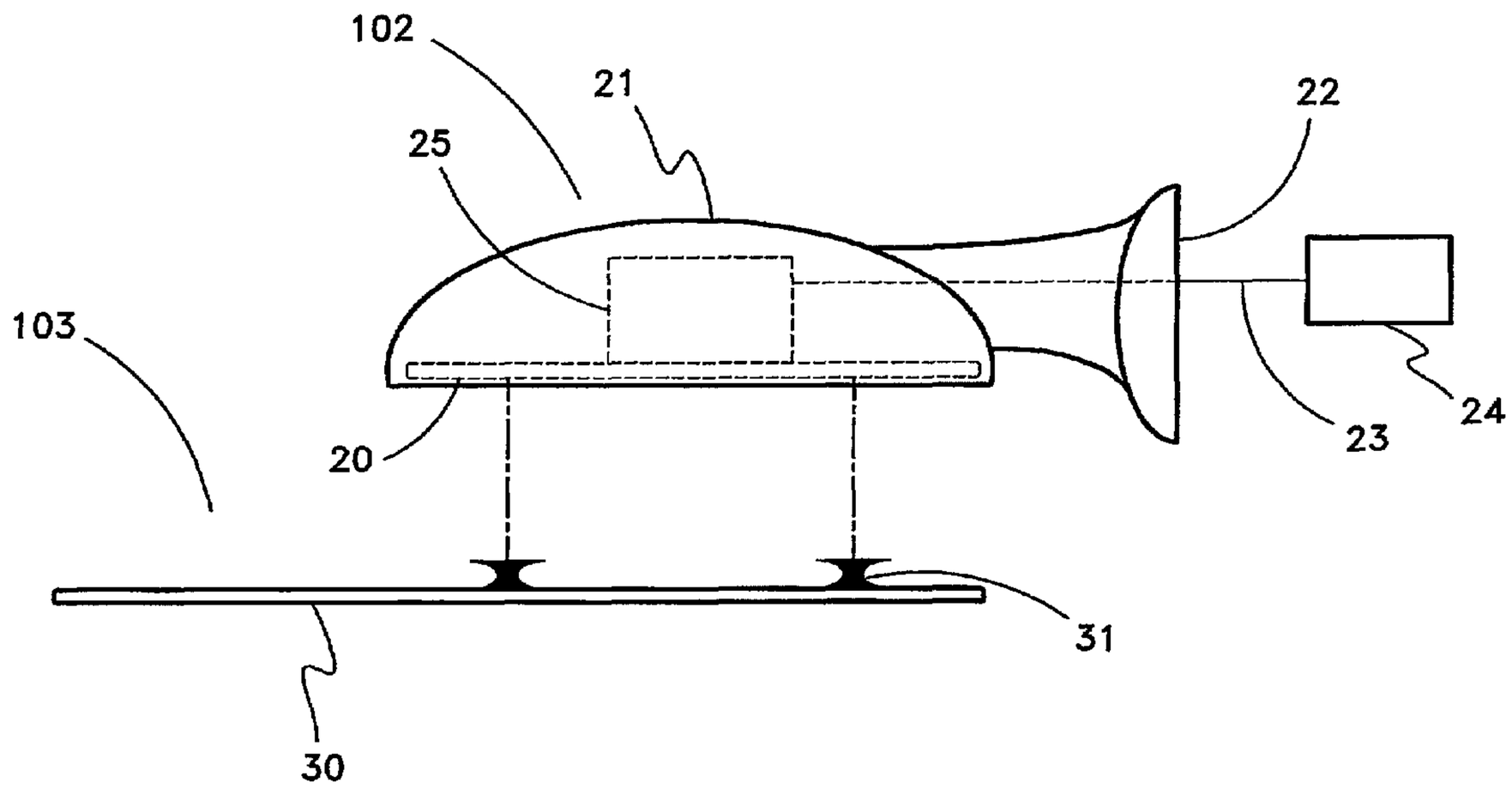
Declaration under Rule 4.17:
— *of inventorship (Rule 4.17(iv)) for US only*

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report:
29 December 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: DETACHABLE REMOTELY-ADJUSTABLE EXTENSION MIRROR SYSTEM



(57) Abstract: Motion from a first reflective surface (20) of a remotely-adjustable original-equipment side view mirror unit (102) is coupled to a detachable extension mirror unit (103) to provide a motor vehicle driver a remotely-adjustable extended rearward view around a wide trailer or similar object blocking the original inboard rearward view from the remotely-adjustable original equipment side view mirror unit (102).

WO 2004/069597 A3

Title: DETACHABLE REMOTELY-ADJUSTABLE EXTENSION MIRROR SYSTEM

BACKGROUND OF THE INVENTION:

1. Field of Invention

This invention relates to exterior rearview mirror assemblies located on the side of a vehicle, particularly to the addition of a detachable extension mirror unit to extend rearward vision around wide objects blocking the driver's original rearward view. Wide objects blocking the driver's original rearward view could be campers or other wide loads mounted on a vehicle, trailers attached to the rear of the vehicle, or similar items that obstruct a driver's rearward view.

2. Description of the Problem and Prior Art

Motor vehicles typically come equipped with mirror units secured to the driver's side and the passenger's side for viewing to the side and rear of the vehicle. These side-view mirror units protrude from the side of the vehicle and generally determine the overall width of the vehicle. The side-view mirror units permanently mounted on a vehicle are designed not to protrude too far because it would be easier to hit something with the mirror unit while driving. Many of these side-view mirror units now include a housing around a remotely-adjustable reflective surface mounted on the exterior of the vehicle and a remote control input device mounted

inside the vehicle. Having such a remote control system allows the driver to adjust both the driver's side and the passenger's side rearward views to accommodate different driver heights and driving positions without needing to reach out of the vehicle, leave his driving position, or use an assistant to adjust the mirrors. This remote adjustability is now common and popular.

People can use their vehicles to tow trailers or fifth wheelers that are wider than their vehicle. With pickup trucks one can also install a camper or carry a load that is wider than the truck body. When using a trailer, fifth wheeler, camper or similar object with this additional width, the normal exterior mirrors often become useless because the primary exterior rearward view is blocked by the trailer or similar wide object. In addition, the view through the interior rearview mirror is usually also blocked by the camper, fifth wheeler, trailer, or similar wide object leaving the driver with no rearward view at all. It is both dangerous and illegal in most places to drive without having a rearward view.

It is known to provide a separate extension mirror unit that attaches to a vehicle and extends further laterally from the vehicle than the original mirror unit so the driver of a vehicle can see rearwards around a wide object attached to the vehicle behind him, such as a truck camper or a trailer. For example, US Pat. No. 4,105,296 to Tomlin discloses a extension mirror unit that provides an extended rearward view to solve the wide trailer problem. The extension mirror unit disclosed by Tomlin can be detached when not needed to return the overall width of the vehicle back to its original width. However, mirror units of this type do not provide remote adjustability. It would be complex and costly to add remote adjustability to this type of extension mirror unit.

It is known to provide temporary extension mirror units that: attach to permanently-installed side-view mirror units; extend the lateral viewing angle from the vehicle; and detach to return the vehicle to its original width when the extended view is not needed. US Pat. No. 4,111,532 to Budish discloses a mirror unit that mounts over an existing exterior mirror unit to give an extended rearward view around wide objects. The extension mirror mounting configuration disclosed by Budish cannot provide remote adjustability because it is based on attachment elements that will not fit in the narrow gap between the remotely-adjustable

reflective surface in the existing mirror and the stationary housing around this reflective surface in typical remotely-adjustable mirror units..

Similarly, US Pat. No. 4,892,400 to Brookes, et al, US Pat. No. 4,892,401 to Kittridge, et al, US Pat. No 4,921,340 to Dyer, US Pat. No. 5,096,283 to Croteau, US Pat. No. 5,870,236 to Barksdale disclose different types of temporary mirror units that attach to existing mirror units to provide an extended rearward view. However, when used with remotely-adjustable existing mirror units, these detachable extension mirror units are fixed to the stationary housing, not to the remotely-adjustable reflective surface and therefore do not provide remote adjustability of the extension reflective surface.

It is known to permanently attach a replacement reflective surface to an original reflective surface to repair the original reflective surface. In this case, if the original reflective surface was remotely adjustable, the replacement reflective surface will also become remotely-adjustable. However, this configuration does not extend rearward vision around wide objects. This idea can not be used to create an adjustable extension mirror because most modern side view mirror units have adjustable reflective surfaces located inside a stationary housing and separated from this housing by a narrow gap. Also, the repair of one reflective surface by another is designed to be permanent. Therefore, the attachment method used is permanent.

It is known to have a compound mirror assembly comprising multiple mirrors surfaces that move together. U.S. Pat. No 4,907,871 to Hou discloses an exterior rearview mirror assembly containing three mirror elements that adjust together. US Pat. No. 6,024,459 to Lewis, US Pat. No. 6,116,743 to Hoek and US Patent Application Publication No. 2002/0072026 to Lynam et al disclose exterior rearview mirror assemblies containing two elements that adjust together. These compound mirror assemblies allow more than one mirror to be adjusted at once. Some of these configurations are also remotely adjustable.

It is known to have remotely-adjustable side view mirror units that can move laterally from a position close to the vehicle to a position further out from the vehicle when an extended rearward image is needed. In some cases, such remotely-adjustable extension mirror systems even have remote control movement of the reflective surface from the inboard (non-towing)

to an outboard (towing) position. For example, US Pat. No. 4558,930 to Deedreek discloses such an extension mirror system.

However, U.S. Pat. No. 4,907,871, U. S. Pat No. 6,024,459, US Pat. No. 6,116,743, US Pat. No. 4558,930, and US Patent Application Publication No. 2002/0072026 all disclose mirror units that are used as or substitute for original equipment mirror assemblies and are subsequently permanently attached. In the automotive aftermarket, replacing an original equipment mirror assembly is quite difficult and typically involves taking off the interior door panel. If the extension mirror unit is to be remotely-controlled, a new remote control input device compatible with the rest of the extension mirror unit must typically also be installed in the vehicle. Consequently, people who did not buy specialized "towing mirrors" when they purchased their vehicle prefer add-on mirrors that can be attached in a simple way to their existing side view mirrors. Many motor vehicle buyers who anticipate that they may need extension mirrors still prefer to use detachable extension mirrors because these are generally significantly less expensive than the incremental cost of buying an original equipment or dealer-installed "towing mirror" that can be manually or automatically moved from an inboard to an extended position.

To summarize, it is not known to have a system:

(a) with a mirror unit that provides an extended rearward view to see around a wide trailer or similar object;

(b) that is easily attached and detached when not needed to reduce the overall width of the vehicle; and

(c) that uses the remote adjustability elements of an existing remotely-adjustable exterior rearview mirror unit permanently attached to a motor vehicle;

(d) to adjust the extension mirror unit;

thereby providing a low cost, remotely-adjustable, end-user installable solution to the "towing mirror" problem.

In addition, add-on extension mirrors can fall off and get lost or damaged during operation as a result of high wind loads or poor installation. It is not known to have a secondary attachment system as a backup, such as a safety cord, in case the primary extension mirror unit mounting fails.

SUMMARY OF THE INVENTION

This invention provides exterior rearview mirrors that give better visibility and more convenient adjustability (and therefore better safety) to drivers of automotive vehicles that are towing a trailer (fifth wheeler, boat, etc) or are carrying wide loads (as for truck campers, etc) by:

(a) Protruding further from the side of the vehicle than the original mirror units to see around obstacles,
(b) Using the remote adjustability controls of the original mirror unit,
(c) Being removable to allow the use of the original mirror unit when an extended image is not needed,
(d) Being quickly installable and removable with minimal or no tools,
(e) Offering the option of giving the driver a single large perfectly-adjusted mirror instead of several mirrors,
(f) Providing extra security for the auxilary mirror by also attaching the vehicle or existing mirror housing with a safety cord, and
(g) Being manufacturable for a fraction of the cost of other products that provide remote adjustability. These other products must replace some or all of the current remote controls and actuators.

The invention consists of an extension mirror unit for an existing remotely-adjustable side view mirror unit. The invention uses the remote control input device and the mirror actuator of the existing mirror unit to provide a remotely-adjusted extended rearward view. The extension mirror unit can be installed by a novice with no tools and detached by a novice using rudimentary tools such as a knife blade. The invention can be in various forms including versions in which there wind shields or multiple pivots to reduce or completely eliminate the forces of the wind on the extension mirror while still providing remote adjustability using the remote control input device and the mirror actuator of the existing mirror unit.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. 1 is a top view of a vehicle and a wide trailer;

FIG. 2 is an exploded top view of a suction-cup remotely-adjustable extension mirror system comprising a remotely-adjustable original-equipment side-view mirror unit (remotely-adjustable side-view mirror unit) and a suction-cup detachable obscuring extension mirror unit;

FIG. 3 is a top view of a detachable extension mirror system comprising an original-equipment side-view mirror unit (side-view mirror unit) and the suction-cup detachable obscuring extension mirror unit;

FIG. 4 is an exploded rear view, taken from the side of a motor vehicle looking forwards, of the suction-cup remotely-adjustable extension mirror system;

FIG. 5 is a rear view of the suction-cup remotely-adjustable extension mirror system;

FIG. 6 is a top view of the suction-cup remotely-adjustable extension mirror system showing the suction-cup detachable obscuring extension mirror unit pivoted about the vertical axis through movement of the original reflective surface;

FIG. 7 is a top view of an enhanced extension mirror system comprising the remotely-adjustable side-view mirror unit, the suction-cup detachable obscuring extension mirror unit, an add-on wind deflector, and a safety attachment element;

FIG. 8 is a rear view of the enhanced extension mirror system;

FIG. 9 is an exploded rear view of a mirror-gap-element remotely-adjustable extension mirror system comprising the remotely-adjustable side-view mirror unit and a mirror-gap-element detachable obscuring extension mirror unit that uses an alternate movement offset element and a mirror-gap attachment element;

FIG. 10 is a rear view of the mirror-gap-element remotely-adjustable extension mirror system;

FIG. 11 is a sectional view of the mirror-gap-element remotely-adjustable extension mirror system taken at section A-A from **FIG. 10**;

FIG. 12 is a top view of the mirror-gap-element remotely-adjustable extension mirror system showing the mirror-gap-element detachable obscuring extension mirror unit pivoted about the vertical axis through movement of the original reflective surface;

FIG. 13 is a top view of an side-view mirror unit showing more detail of the actuator;

FIG. 14 is an exploded rear view, taken from the side of a motor vehicle looking forwards, of a multiple-pivot remotely-adjustable extension mirror system;

FIG. 15 is an exploded top view of the multiple-pivot remotely-adjustable extension mirror system;

FIG. 16 is a top view of the multiple-pivot remotely-adjustable extension mirror system showing movement of a multiple-pivot detachable extension mirror unit in response to rotation about the vertical axis of the original reflective surface and showing the impact of wind-induced forces;

FIG. 17 is a top view of a single-pivot remotely-adjustable extension mirror system showing movement of a single-pivot detachable extension mirror unit in response to rotation about the vertical axis of the original reflective surface and showing the impact of wind-induced forces;

FIG. 18 is a top view of a zero mirror wind load remotely-adjustable extension mirror system;

FIG. 19 is a section view of the mirror attachment unit through section B-B in **FIG. 14** showing a vacuum diaphragm in an attached state;

FIG. 20 is a section view of the mirror attachment unit through section B-B in **FIG. 14** showing the vacuum diaphragm in a loose state;

FIG. 21 is a perspective view of an second-pivot detachable attachment unit;

FIG. 22 is a horizontal view of section C-C in **FIG. 16** showing details of how the flexible spacing element functions; and

FIG. 23 is a top view of section D-D in **FIG. 20** showing details of the flexible spacing element and extension reflective surface pivot attachment unit.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS:

Referring to **FIG. 1**, a vehicle is shown at **100.** A wide trailer, shown at **101**, is attached to the rear of the vehicle **100**. Original equipment side-view mirror units (side-view mirror units) are shown at **108**. The side-view mirror units **108** include reflective surfaces that provide primary exterior rearward views, shown at **98,** to a motor vehicle driver, shown at **97**. The primary exterior rearward views **98** are acceptable when the vehicle **100** is not pulling a trailer **101** wider than the vehicle **100** because they allow the motor vehicle driver **97** to see behind the side of the vehicle **100** and because the right and left primary exterior rearward views **98** can converge at some point behind the vehicle **100**.

Also referring to **FIG. 1**, the primary exterior rearward views **98** cannot show the sides of the wide trailer **101** or anything directly behind the wide trailer **101** to the motor vehicle driver **97** because the wide trailer **101** is wider than the distance between the outermost portion of the reflective surfaces of the side-view mirror units **108.**

Also referring to **FIG. 1**, non-obscuring extension reflective surfaces, shown at **40,** have been located further from the side of the vehicle **100** than the outermost portion of the reflective surfaces of the side-view mirror units **108**. The non-obscuring extension reflective surfaces **40** provide extended rearwards views, shown at **99,** that include views of the sides of the wide trailer **101.** Although there is still a blind spot directly behind the wide trailer **101**, the size of this blind spot decreases the further one is behind the wide trailer **101**. By locating the non-obscuring reflective surfaces **40** further from the side of the vehicle, the size of the blind spot decreases, but the distance between the non-obscuring reflective surfaces **40,** and therefore the effective width of the vehicle **100,** increases.

Also referring to **FIG. 1,** the non-obscuring extension reflective surfaces **40,** are called "non-obscuring" because the extension surfaces do not block the motor vehicle driver **97** from seeing the primary exterior rearward views **98.** Extended rearward views **99** can be provided by:

fully-obscuring extension reflective surfaces, that block all the primary exterior rearwards view **98**;

partially-obscuring extension reflective surfaces, that block some of the primary exterior rearwards view **98**; or

non-obscuring extension reflective surfaces, block none of the primary exterior rearwards view **98.**

The invention described here can have non-obscuring extension reflective surfaces **40,** partially-obscuring extension reflective surfaces, or fully-obscuring extension reflective surfaces shown at **30** in **FIG. 5**. Although a partially-obscuring reflective surface is not illustrated, the concept and implementation can be understood by anyone skilled in the art.

By the term surface, it should be understood that the surface need not be flat. The term is intended in a broader context and also encompasses convex, concave, curved, angular and compound shapes. By the term reflective, it should be understood that this includes partially-reflective or tinted objects that do not return the full intensity of the image or the full color spectrum of the image that bounces off of them.

Referring to **FIG 1**, **FIG. 2** and **FIG. 3**, a remotely-adjustable original equipment side-view mirror unit (remotely-adjustable side-view mirror unit) is shown at **102** in **FIG. 2**. The remotely-adjustable side-view mirror unit **102** is a subtype of the side-view mirror unit shown at **108** in **FIG. 1** and **FIG. 3**. Both the remotely-adjustable side-view mirror unit **102** and the side-view mirror unit **108** include a side-view mirror housing shown at **21** and a first reflective surface, shown at **20**. The side-view mirror housing **21** includes a base member shown at **22** for securing the side-view mirror unit **108** or the remotely-adjustable mirror unit **102** to the vehicle, shown at **100** in **FIG. 1**. The remotely-adjustable mirror unit **102** also includes a remote input device, shown at **24,** and an actuator, shown at **25**. The remote input device **24** is external to the side-view mirror housing **21** and is typically mounted inside the motor vehicle within reach of the motor vehicle driver, shown at **97** in **FIG. 1**. The actuator **25,** is typically mounted inside the side-view mirror housing **21**. The actuator **25,** typically imparts a pivoting motion to the first reflective surface **20.** This pivoting motion adjusts the primary exterior rearward view shown as **98** in **FIG. 1**.

Referring to **FIG. 1** and **FIG. 2** the motor vehicle driver **97** adjusts the original rearward view **98** by interacting with the remote input device **24,** which transmits force, power, or signals via a transmission element, shown at **23** in **FIG. 2,** to the actuator **25** which moves the first reflective surface **20.**

Referring to **FIG. 3** a suction-cup detachable obscuring extension mirror unit, shown at **103,** has been attached to the side-view mirror unit **108,** making a detachable extension mirror system, shown at **109**.

Referring to **FIG. 2** and **FIG. 4** the suction-cup detachable obscuring extension mirror unit is shown at **103**. The suction-cup detachable obscuring detachable extension mirror unit **103** includes an obscuring extension reflective surface, shown at **30,** made of a clear material including, but not limited to glass, polycarbonate, and acrylic, with a reflective coating on the side opposite the visible side of the obscuring extension reflective surface **30.** The suction-cup detachable obscuring extension mirror unit **103** also includes vacuum suction cups, shown at **31** that are attached to the non-visible side of the obscuring extension reflective surface **30** by means of adhesives, hook and loop fasteners (Velcro™ made by Velcro Industries) or some equivalent. Although the detail for attaching the vacuum suction cups **31** to the obscuring reflective surface **30** is not illustrated, it is capable of being understood by anyone skilled in the art. The connection between the vacuum suction cups **31** and the obscuring reflective surface **30** can be permanent or detachable, direct or indirect. The attachment can be made using a variety of different materials including, but not limited to, adhesives, fasteners, and various other mechanical elements or adapters between the vacuum suction cups **31** and the non-visible side of the obscuring reflective surface **30**.

FIG. 6 shows typical motion of the first reflective surface **20** and how this is coupled to the obscuring extension reflective surface **30** in a suction-cup remotely-adjustable extension mirror system, shown at **110**. In the suction-cup remotely-adjustable extension mirror system **110**, the vacuum suction cups **31** serve two functions:

the vacuum suction cups **31** are detachable first attachment elements, providing a first method by which the obscuring extension reflective surface **30** is attached to the first reflective surface **20;** and

the vacuum suction cups **31** are movement offset elements that allow the first reflective surface **20** to go through its full range of motions and all potential positions without creating interference between the obscuring extension reflective surface **30** and any element of the remotely-adjustable side-view mirror unit (shown as **102** in **FIG. 2**), especially the side-view mirror housing **21.** It is important that any movement offset elements create enough spacing between the first reflective surface **20** and the other

elements of the suction-cup remotely-adjustable extension mirror system **110** to provide a full range of motion of the suction-cup remotely-adjustable extension mirror system **110** in response to movement of the first reflective surface **20.**

Referring to **FIG. 2** and **FIG. 4**, the first reflective surface **20** sits inside the space enclosed by the side-view mirror housing **21** for at least some possible positions in most remotely-adjustable side-view mirror units, **102**. The first reflective surface **20** is typically separated from the side-view mirror housing **21** by a narrow gap, called a mirror gap. By geometry, any extension reflective surface--whether it is obscuring, non-obscuring or partially obscuring--can only provide an extended image, **99** in **FIG. 1,** if is has part of its reflective surface located farther outboard of the motor vehicle than the envelope created by the potential positions of the first reflective surface **20.** It is also important that the first reflective surface **20** and any extension reflective surface are connected in a way that does not create interference with the side-view mirror housing **21** for all ranges of motion of an extension mirror system.

Further referring to **FIG. 4**, vacuum suction cups **31** must adhere to the first reflective surface **20** with a force great enough to support the suction-cup detachable obscuring extension mirror unit **103**. The suction-cup detachable obscuring extension mirror unit **103** shown in **FIG. 4** uses four vacuum suction cups **31** made of polyvinyl chloride (PVC). It is possible to use a different number of vacuum suction cups **31** to give the coupling required. It is possible to use vacuum suction cups **31** made of other materials. It is also possible to make a more complex attachment system for attaching an extension mirror unit to an side-view mirror unit, **108** in **FIG. 3**, or to the vehicle, **100** in **FIG. 1**, in a way that reduces the forces placed onto the first reflective surface **20** by the extension mirror unit while still allowing the motion of the first reflective surface **20** to couple to and adjust the obscuring extension reflective surface **30** or a non-obscuring extension reflective surface **40** in **FIG. 1.**

Referring also to **FIG. 4**, installation of the suction-cup detachable obscuring extension mirror unit **103** to the remotely-adjustable side-view mirror unit **102**, is best accomplished by first cleaning the first reflective surface **20** with a mirror cleaner to ensure long-term adhesion of the vacuum suction cups **31.** Installation needs to be performed accurately enough to give a good appearance and not to create interference with any part of the remotely-adjustable

side-view mirror unit **102**, or the vehicle, **100** in **FIG. 1**. No tools or specialized expertise are required to install the suction-cup detachable obscuring extension mirror unit **103** to the remotely-adjustable side-view mirror unit, **102.**

Referring to **FIG. 4** and **FIG. 6**, detachment of the suction-cup detachable obscuring extension mirror unit **103** from the remotely-adjustable side-view mirror unit **102** is accomplished by pivoting the first reflective surface **20** successively to positions where each vacuum suction cup **31** is accessible and then slipping a knife blade between the first reflective surface **20** and the lip of each vacuum suction cup **31**.

Referring to **FIG. 7** and **FIG. 8**, a wind-shielded safety-corded remotely-adjustable extension mirror system (enhanced extension mirror system) is shown at **120**. This enhanced extension mirror system **120** includes all of the elements of the suction-cup remotely-adjustable extension mirror system **110** described previously and also includes an add-on wind deflector, shown at **42,** and a safety attachment element, shown at **43.** The enhanced extension mirror system uses the safety attachment element **43** to connect the suction-cup detachable obscuring extension mirror unit, shown at **103** to the remotely-adjustable side-view mirror unit, shown at **102**. The add-on wind deflector **42:**

reduces the wind forces on the suction-cup detachable obscuring extension mirror unit **103**;

reduces the possibility that the suction-cup detachable obscuring extension mirror unit **103** is accidentally bumped; and

improves the appearance of the enhanced extension mirror system **120**.

The safety attachment element **43** can be used as a backup in case attachment of the primary attachment element or elements, (e.g. vacuum suction cups **31** in **FIG. 6**) fails. Although the safety attachment element **43** is shown as connecting the suction-cup detachable obscuring extension mirror unit **103** to the remotely-adjustable side-view mirror unit **102**, the safety attachment **43** can also be used to connect any embodiment of an extension mirror unit to some other part of the vehicle, shown as **100**, in **FIG. 1**. The alternative materials and mountings of this safety attachment element **43** are not critical and can be understood and implemented by anyone skilled in the art.

Referring to **FIG. 9, FIG. 10, FIG. 11**, and **FIG. 12** a mirror-gap-element remotely-adjustable extension mirror system is shown at **130**. The difference between the mirror-gap-element remotely-adjustable extension mirror system **130** and the suction-cup remotely-adjustable extension mirror system, **110** in **FIG. 5** and **FIG. 6**, is that the vacuum suction cups **31** in **FIG. 5** and **FIG. 6** have been replaced by mirror-gap attachment elements, shown at **52,** and alternate movement offset elements, shown at **53.** Instead of using one type of element (vacuum suction cups **31**) for both the attachment and the offset function, as was the case in the suction-cup-based extension mirror systems shown in **FIG. 1, FIG. 2, FIG. 3,** and **FIG. 4**, the mirror-gap-element remotely-adjustable extension mirror system **130** separates these functions into two types of elements, mirror-gap attachment elements **52** and alternate movement offset elements **53**.

Referring to **FIG. 9**, **FIG. 11**, and **FIG. 12** the mirror gap attachment element is shown at **52**. In this embodiment, the mirror-gap attachment elements **52** are made of a spring steel that has been formed into a "U-shape". Because:

the gap between the first reflective surface **20** and the side-view mirror housing **21** is minimal in most side-view mirror units;

the first reflective surface **20** moves relative to the side-view mirror housing **21** in remotely-adjustable side-view mirror units; and

a detachable system like the present invention should be designed to be usable with a variety of shapes and sizes of side-view mirror units,

the mirror gap attachment element **52** has been designed to be of the thinnest possible commercially-feasible material that gives a good clamping force on the edges of the first reflective surface **20** with minimal requirement for any retention on the side opposite the viewing side of the first reflective surface **20**.

Also referring to **FIG. 9**, **FIG. 11** and **FIG. 12**, the alternate movement offset element **53** establishes the necessary distance between the first reflective surface **20** and the obscuring extension reflective surface **30**. Although the alternate movement offset elements **53** shown in this figure are rectangular cross- section beams, these alternate movement offset elements **53** can be made in any of a variety of geometries out of any of a variety of materials using any of a variety of direct or indirect attachment methods to the obscuring reflective surface **30** so long as the alternate movement offset elements **53** accomplish the objective of resting

on the first reflective surface **20** and provide sufficient spacing between the obscuring reflective surface **30** and the first reflective surface **20** so that there is no interference between the obscuring reflective surface **30** and the side-view mirror housing **21** for all potential positions of the first reflective surface **20** relative to the side-view mirror housing **21**. It is possible to make a single element that combines the functions of the alternate spacing element **53** and the mirror gap attachment element **52**.

Referring to **FIG. 9, FIG. 10, FIG. 11** and **FIG. 12**, installation of the mirror-gap-element detachable obscuring extension mirror unit **104** to the remotely-adjustable side-view mirror unit **102** can be accomplished by pressing the alternate extension mirror unit over the first reflective surface **20**. If there is any difficulty getting any of the legs of the mirror gap attachment elements **52** to seat properly, it is possible to move the first reflective surface **20** to a position where one can access the legs of the mirror gap attachment elements **52** to help seat them. Detachment of the mirror-gap-element detachable obscuring extension mirror unit **104** is accomplished by moving the first reflective surface **20** successively to positions where the each leg of each mirror gap attachment element **52** is accessible and then slipping a thin knife blade between the leg of the mirror gap attachment element **52** and the edge of the first reflective surface **20** while pulling the mirror-gap-element detachable obscuring extension mirror unit **104** away from the first reflective surface **20**.

Referring to **FIG. 13**, the remotely-adjustable side view mirror unit is shown at **102**. The remotely-adjustable side-view mirror unit **102** is the same as previously described except that the actuator shown at **25** has now been separated into three subcomponents: an actuator housing shown at **26**; an actuator pivot shown at **82**; and an actuator attachment element shown at **27**. The actuator housing **26** is fixedly attached to the side-view mirror housing **21**. The first reflective surface **20** is fixedly attached to the actuator attachment element **27**. By the term pivot it should be understood that the element, action or point in space need not occur at an end. The term is intended in a broader context and also encompasses a location, surface, or element about which any type of rotational movement occurs. The first reflective surface **20** moves about the actuator pivot **82** when a motor vehicle driver, **97** in **FIG. 1**, adjusts the original rearward view, **98** in **FIG. 1**, by interacting with a remote input device, shown at **24**, which transmits force, power, or signals via a transmission element, shown at **23**, to the actuator **25** which causes the actuator attachment element **27** and the first reflective

surface **20** to move relative to the actuator housing **26** and the side-view mirror housing **21**. The pivoting motion that occurs about the actuator pivot **82** can be separated into motion about perpendicular axes that intersect at the actuator pivot **82**. For purpose of explaining the present invention, rotation of the first reflective surface **20** about the vertical axis and a rotation of the first reflective surface about a horizontal axis perpendicular to the vertical axis and parallel to the plane of the first reflective surface **20** are of greatest interest and are referred to in this document as vertical rotation of the first reflective surface and horizontal rotation of the first reflective surface **20**.

Referring to **FIG. 14**, a exploded rear view, taken from the side of the motor vehicle looking forwards, of a multiple-pivot remotely-adjustable extension mirror system is shown at **150**. The multiple-pivot remotely-adjustable extension mirror system **150** includes the remotely-adjustable side-view mirror unit **102** and a multiple-pivot detachable extension mirror unit shown at **106**. The remotely-adjustable side-view mirror unit **102** includes the actuator housing **26**, the actuator attachment element **27,** and an actuator pivot **82**. The multiple-pivot detachable extension mirror unit **106** includes a non-obscuring extension reflective surface shown at **40** which is attached to an extension mirror housing shown at **33**. The extension mirror housing **33** is attached to an extension mirror link element shown at **32.** The extension mirror link element **32** is attached to a detachable vacuum attachment unit shown at **60**. The detachable vacuum attachment unit **60** attaches to the first reflective surface **20**.

Also referring to **FIG. 14**, a flexible spacing element is shown at **41**. The flexible spacing element **41** is located between the extension mirror link element **32** and the side-view mirror housing, shown at **21,** when the multiple-pivot detachable extension mirror unit **203** is mounted on the remotely-adjustable side-view mirror unit **102**. The flexible spacing element **41** and side-view mirror housing **21** are shaped in such a way as to creates an second pivot shown at **83**, around which the non-obscuring extension reflective surface **40** will rotate when the multiple-pivot detachable extension mirror unit **106** is mounted on the remotely-adjustable side-view mirror unit **102**. A second-pivot detachable attachment unit is shown at **34**. In the embodiment shown here, the second-pivot detachable attachment unit **34** includes an attachment ring shown at **36** that attaches to the extension mirror link element **31** in close proximity to the flexible spacing element, a hook shown at **38** that attaches to the side-view mirror housing **21**, and a belt shown at **37** that connects the attachment ring **36** to the hook

38. Although only one configuration for the second-pivot detachable attachment unit **34** is illustrated here, it is possible to make other types of attachment units using other elements and to have this attach at different locations to the ones shown here.

Referring to **FIG. 14**, **FIG. 15**, and **FIG. 16** a safety attachment element is shown at **43**. In the configuration shown here, the safety attachment element is a cord that connects the multiple-pivot detachable extension mirror unit **106** to the side-view mirror unit, **102**.

Referring to **FIG. 15**, a exploded top view of the multiple-pivot remotely-adjustable extension mirror system is shown at **150**. The multiple-pivot remotely-adjustable extension mirror system **150** includes the remotely-adjustable side-view mirror unit **102** and the multiple-pivot detachable extension mirror unit **106**. The multiple-pivot detachable extension mirror unit **106** includes the non-obscuring extension reflective surface **40** which is attached to the extension mirror housing **33**. The extension mirror housing **33** is attached to the extension mirror link element **32** which is attached to the detachable vacuum attachment unit **60** which attaches to the first reflective surface **20**.

Also referring to **FIG. 15**, the flexible spacing element **41** is located between the extension mirror link element **32** and the side-view mirror housing **21,** when the multiple-pivot detachable extension mirror unit **106** is mounted on the remotely-adjustable side-view mirror unit **102**. The flexible spacing element **41** and side-view mirror housing **21** are shaped in such a way as to creates a second pivot shown at **83**, around which the non-obscuring extension reflective surface **40** will rotate when the multiple-pivot detachable extension mirror unit **106** is mounted on the remotely-adjustable side-view mirror unit **102**. The second-pivot detachable attachment unit is shown at **34**. In the embodiment shown here, the second-pivot detachable attachment unit **34** includes the attachment ring **36** that attaches to the extension mirror link element **31** in close proximity to the flexible spacing element **41**, the hook **38** that attaches to the stationary housing **21**, and the belt **37** that connects the attachment ring **36** to the hook **38**. Although only one configuration for the second-pivot detachable attachment unit **34** is illustrated here, it is possible to make other types of attachment units using other elements and to have these attachment units attach at different locations than configuration shown here.

Referring to **FIG. 16**, a top view the multiple-pivot remotely-adjustable extension mirror system is shown at **150**. The multiple-pivot remotely-adjustable extension mirror system **150** includes the multiple-pivot detachable extension mirror unit shown at **106**. The multiple-pivot detachable extension mirror unit **106** includes the non-obscuring extension reflective surface **40**, the extension mirror housing **33**, the extension mirror link element **32**, and the flexible spacing element **41**. The non-obscuring extension reflective surface **40** is attached to the extension mirror housing **33**, which is attached to the extension mirror link element **32.** The flexible spacing element **41** is located between the extension mirror link element **32** and the stationary housing, **21.** The flexible spacing element **41** and stationary housing **21** create a second pivot shown at **83**, around which the non-obscuring extension reflective surface **40** will move when the first reflective surface **20** rotates horizontally or vertically about the actuator pivot **82**. The second-pivot detachable attachment unit is shown at **34** connects the extension mirror link element **31** to the side-view mirror housing **21**. In the embodiment shown here, the safety attachment element **43** is a cord that connects the multiple-pivot detachable extension mirror unit **106** to the remotely-adjustable side-view mirror unit, **102.**

Also referring to **FIG. 16**, the first reflective surface **20** is rotated vertically in the clockwise direction about the actuator pivot **82** to an alternate position shown at **20'**. The clockwise pivoting motion **20'** of the first reflective surface **20** causes an attachment unit pivot, shown at **84**, to rotate clockwise about the vertical axis around the actuator pivot **82** to a new position, shown as **84'**. The movement of the attachment unit pivot **84** to a new position **84'** causes the extension mirror link element **32** and the flexible spacing element **41**, to rotate about the second pivot **83**. The movement of the attachment unit pivot **84** to a new position **84'** also causes the extension mirror link element **32** to move a small distance in the axial direction. Because the angles of motion are small the flexible spacing element **41** can absorb these small axial movements, creating a four-bar linkage that is understood by anyone skilled in the art, wherein:

there is one link bar between the actuator pivot **82** and the attachment unit pivot **84**;

there is one link bar between the attachment unit pivot **84** and the flexible spacing element **41**;

there is one link bar between the flexible spacing element **41** and the second pivot **83**; and

there is one link bar between the second pivot **83** and the actuator pivot **82**.

Further referring to **FIG. 16**, vertical rotation of the extension mirror link element **32** about the second pivot **83** results in rotation of the extension mirror housing **33** and the non-obscuring extension reflective surface **40** about the second pivot **83** as illustrated by the displacement of the extension mirror housing center point, shown at **81** to a rotated position shown at **81'**. Thus, the non-obscuring extension reflective surface **40** can be adjusted by movement of the first reflective surface **20** providing remote adjustability to the multiple-pivot extension mirror system **150**.

Referring to **FIG. 17** a top view of a single-pivot remotely-adjustable extension mirror system is shown at **140**. The single-pivot remotely-adjustable extension mirror system **140** includes the remotely-adjustable side-view mirror unit **102** and a single-pivot suction-cup detachable extension mirror unit shown at **105**. The single-pivot suction-cup detachable mirror unit **105** uses vacuum suction cups shown at **31** to mount to the first reflective surface shown at **20** in the same way as the suction-cup detachable obscuring extension mirror unit, shown at **103** in **FIG. 2** , is mounted. The single-pivot suction-cup detachable mirror unit **140** also includes the extension mirror link element **32**, the extension mirror housing **33**, and the non-obscuring extension reflective surface **40**, which are part of the multiple pivot detachable extension mirror unit shown at **106** in **FIG. 14**, **FIG. 15** and **FIG. 16**. Thus, the single-pivot remotely-adjustable extension mirror system **140** is a hybrid of the suction-cup remotely-adjustable extension mirror system shown at **110** in **FIG. 2** and the multiple-pivot remotely-adjustable extension mirror system **150** shown in **FIG. 14**, **FIG. 15** and **FIG. 16**. In the suction-cup remotely-adjustable extension mirror system, **110** in **FIG. 2**, and the single-pivot remotely-adjustable extension mirror system **140**, the extension reflective surface, shown as **30** in **FIG. 6** and as **40** in **FIG. 17** rotates about the actuator pivot, shown as **82** in **FIG. 17**. Movement of the first reflective surface **20** translates to movement of the extension mirror housing center point shown as **81** to a rotated position shown at **81'**. Thus, the non-obscuring extension reflective surface **40** can be adjusted by movement of the first reflective surface **20** providing remote adjustability to the single-pivot remotely-adjustable extension mirror system **140** shown here.

Referring to **FIG. 16** and **FIG. 17**, an extension wind load is shown at **71**. The extension wind load **71** is caused by air flow as the car moves in the forward direction. Although the extension wind load **71** is distributed over the entire surface of the extension mirror unit, it

can be approximated as a single force vector at about the middle of the extension mirror housing **33**.

Referring to **FIG. 17**, a single-pivot wind-induced actuator force **75** at the actuator pivot **82**, can be calculated to be equal in magnitude and opposite in direction to the extension wind load **71** (i.e. $F_{75} = -F_{71}$). The single-pivot wind-induced actuator torque **79** can be calculated as $M_{79} = X_1 F_{71}$ where X_1 is the perpendicular distance between **81** and **82**.

Referring to **FIG. 16**, the multiple-pivot wind-induced actuator force **72** and multiple-pivot wind-induced actuator torque **78** can be calculated using the following formulas:

$$F_{72} = F_{71} (X_1-X_2)/(X_2+X_3)$$

$$M_{78} = -F_{71}X_3(X_1-X_2)/(X_2+X_3)$$

The reduction in force and torque by converting from the single-pivot remotely-adjustable extension mirror system **140** to the equivalently-sized multiple-pivot remotely-adjustable extension mirror system **150** can be calculated as:

$$F_{72}/F_{75} = - (X_1-X_2)/(X_2+X_3)$$

$$M_{78}/M_{79} = - (X_3/X_1) (X_1-X_2)/(X_2+X_3)$$

For a typical situation in which X_1 is 200 mm, X_2 is 100 mm and X_3 is 50 mm this results in the following:

$$F_{72}/F_{75} = -2/3$$

$$M_{78}/M_{79} = -1/6$$

This means that, by converting from the single-pivot remotely-adjustable extension mirror system **140** to the equivalently-sized multiple-pivot remotely-adjustable extension mirror system **150** we have changed a tensile force on the first reflective surface to a compressive force, which is much easier to provide and reduce the magnitude of this force to 2/3 of its original value and we have reduce the magnitude of the torque at the actuator pivot **82** by a factor of **6**. This is especially a benefit in situations where the actuator **25** in **FIG. 2**, **FIG. 4**, and **FIG. 5** is weak and the needed extension distance X_1 is large, which most commonly occurs when small cars pull large trailers.

Referring to **FIG. 18** a zero-mirror-wind-load remotely-adjustable extension mirror system is shown at **160**. This zero-mirror-wind load remotely-adjustable extension mirror system includes the remotely-adjustable side-view mirror unit **102** and a zero-mirror-wind-load multiple-pivot detachable extension mirror unit. The extension wind load **71** does not create any force on the first reflective surface **20** because the non-obscuring extension reflective surface **40** is shielded from the extension wind load **71** by the extension mirror housing **33** that is fixedly attached to the side-view mirror housing **21** using an extension wind load transfer element, shown at **39**. In the system shown here, the first reflective surface **20** pivots about the actuator pivot **82** and the non-obscuring extension reflective surface **40** pivots about the second pivot **83**. A third pivot, shown at **85**, fourth pivot, shown at **86**, fifth pivot, shown at **87**, sixth pivot, shown at **88**, and seventh pivot, shown at **89** are used to transfer movement of the first reflective surface 20 to the non-obscuring extension reflective surface **40** as one example of the zero-mirror-wind-load remotely-adjustable extension mirror system **160** can be implemented. It can also be implemented using other methods of mechanically, electrically, hydraulically, or pneumatically transferring motion of the first reflective surface **20** to the non-obscuring extension mirror surface **40**. It can also be implemented using a fully-obscuring extension reflective surface, **30** in **FIG. 2**, or a partially-obscuring extension reflective surface.

Referring to **FIG. 19** and **FIG. 20** a detachable vacuum attachment unit is shown at **60**. In **FIG. 19**, the detachable vacuum attachment unit **60** is shown attached to the first reflective surface **20**. In **FIG. 20**, the detachable vacuum attachment unit **60** is shown loose from the first reflective surface **20**. The detachable vacuum attachment unit **60** is designed to provide a secure method of attachment to the first reflective surface **20**. The detachable vacuum attachment unit **60** includes:

an attachment unit housing, shown at **61**;

a vacuum diaphragm, shown at **62**;

a diaphragm tensioning element, shown at **63**;

a tensioning nut, shown at **64**;

a connecting yoke, shown at **65**; and

a connecting pin, shown at **66**.

In the embodiment shown here, the vacuum diaphragm **62** is made of poly-vinyl-chloride (PVC) and is in the form of a disk. The side of the vacuum diaphragm **62** facing the first

reflective surface **20** is called the attachment surface. The central area of the attachment surface of the vacuum diaphragm **62** protrudes further than the circumferential area of the attachment surface when the vacuum diaphragm **62** is in its relaxed state. The vacuum diaphragm **62** does not have the same shape or operating characteristics as the vacuum suction cups, shown as **31** in **FIG. 2**, **FIG. 4**, **FIG. 5**, **FIG. 6**, and **FIG. 7**. The vacuum suction cups **31** have a central area of the attachment surface that is recessed from the edges of the attachment surface relative to the circumferential area of the attachment surface when the suction cups **31** are in their relaxed state. Thus, the suction cups **31** can be made to adhere to the first reflective surface **20** by pressing them against the first reflective surface **20** and will continue to adhere to the first reflective surface until the vacuum is broken by prying the edges of the suction cups **31** off of the first reflective surface **20**. In comparison, the vacuum diaphragm **62** can only be made to adhere to the first reflective surface **20** if the circumferential area of the vacuum diaphragm **62** is pressed against the first reflective surface **20** and the central area of the attachment surface of the vacuum diaphragm **62** is pulled away from the first reflective surface **20** creating a vacuum or localized low pressure area. The benefit of the vacuum diaphragm **62** and the configuration shown in **FIG. 18** and **FIG. 19** is that when the vacuum diaphragm **62** is brought back to its relaxed state as shown in **FIG. 19**, the vacuum diaphragm **62** will release from the first reflective surface **20** without needing to be pried off. By the term vacuum, that is used to describe the behavior of either of the vacuum suction cups **31** or the detachable vacuum attachment unit **60**, it should be understood that vacuum means a localized area of low pressure that creates an attachment force between the first reflective surface and either the vacuum suction cups **31** or the detachable vacuum attachment unit **60**.

FIG. 19 and **FIG. 20** further illustrate how the vacuum diaphragm **62** functions as part of the detachable vacuum attachment unit **60**. A diaphragm tensioning element **63** is attached to the vacuum diaphragm **62** to pull the central area of the vacuum diaphragm **62** away from the first reflective surface **20**. In the configuration shown here, the tensioning element **63** is made of molded polypropylene and is insert molded into the vacuum diaphragm **62**. In the configuration shown here, the tensioning element **63** has threads molded into the end opposite the vacuum diaphragm **62** and these threads can engage with the threads in the tensioning nut **64**. The attachment unit housing **61** has a circular lip that presses against the circumference of the vacuum diaphragm **62** when the attachment unit housing **61** is pressed against the first

reflective surface **20**. The attachment unit housing **61** also provides a surface for the tensioning nut **64** to rest against when the tensioning nut **64** has been tightened as shown in **FIG. 19**.

FIG. 19 and **FIG. 20** also illustrate how the detachable vacuum attachment unit **60** provides an attachment unit pivot, shown at **84.** When the original reflective surface **20** rotates about the vertical axis, the attachment unit will translate and rotate about the centerline of the connecting pin **66** that is mounted in the attachment unit housing **62**. The connecting pin **66** also goes through the yoke **65** allowing the yoke **65** to rotate about the vertical axis around the attachment unit pivot **84**. In the preferred embodiment, the yoke **65** attaches to the extension mirror link element shown as **32** in **FIG. 14**, **FIG. 15**, **FIG. 16**, **FIG. 17**, and **FIG. 18**. Other views of the yoke **65** are shown in **FIG. 14** and **FIG. 15**.

Referring to **FIG. 21** the second-pivot detachable attachment unit **34** includes the attachment ring **36**, the belt **37**, and the hook **38**. The attachment ring **36** can be made of metal that has been bent in a D-shape. The attachment ring **36** can also be made of other materials and in other configurations. The attachment ring **36** is placed over the extension mirror link element, shown as **32** in **FIG. 14**, **FIG. 15**, **FIG. 16**, **FIG. 17**, and **FIG. 18**. In the embodiment shown here, the hook **38** is made of metal that has been bent to be able to clip onto the side-view mirror housing shown as **21** in **FIG. 2**, **FIG. 4**, **FIG. 5**, **FIG. 6**, **FIG. 11**, **FIG. 13**, **FIG. 14**, and **FIG. 18**. The hook **38** can also be made of other materials and in other configurations. In the embodiment shown here, the belt **37** is an elastic band made of a rubber compound with low sensitivity to ultraviolet light. Although a specific configuration of a specific set of elements is illustrated here, the second-pivot detachable attachment unit **34** can be of any combination of elements as long as they provide an attachment between a multiple pivot detachable extension mirror unit shown as **106** in **FIG. 14** and **FIG. 15** and an side-view mirror unit shown as **102** in **FIG. 1**, **FIG. 2**, **FIG. 3**, **FIG. 4**, **FIG. 7**, **FIG. 8**, **FIG. 9**, **FIG. 10**, **FIG. 12**, **FIG. 13**, **FIG. 14**, and **FIG. 15**.

The view shown in **FIG. 22** was created by taking section C-C from **FIG. 16**. Referring to **FIG. 22** an end view of the flexible spacing element is shown at **41**. In the embodiment shown here, the flexible spacing element **41** is a hollow poly-vinyl-chloride (PVC) cylinder that can be pressed onto the extension mirror link element **32**. In the embodiment shown

here, the extension mirror link element **32** is a hollow cylindrical aluminum tube. The flexible spacing element **41** rests against the side-view mirror housing **21**. **FIG. 22** also shows a section view of the first reflective surface at **20**. When the first reflective surface **20** is pivoted counterclockwise in the horizontal axis about the actuator pivot, shown as **82** in **FIG. 13**, to an alternate position shown as **20''**, this results in a counterclockwise rotation of the mirror link element **32** and the flexible spacing element **41** causing the flexible spacing element **41** to roll a small vertical distance along the edge of the side-view mirror housing **21** to a new position shown as **41''**. Thus, the flexible spacing element **41** can continue to be connected to the edge of the side-view mirror housing **21** when a rotation of the first reflective surface **20** is translated to horizontal rotation of the extension mirror link element **32** and ultimately to horizontal rotation of the non-obscuring extension reflective surface shown as **40** in **FIG. 14**, **FIG. 15**, and **FIG. 16**.

The view shown in **FIG. 23** was created by taking section D-D from **FIG. 22**. Referring to **FIG. 23** a section view of the flexible spacing element is shown at **41**. In the embodiment shown here, the flexible spacing element **41** is a hollow poly-vinyl-chloride (PVC) cylinder that can be pressed onto the extension mirror link element, shown in section view at **32**. In the preferred embodiment, the extension mirror link element **32** is a hollow cylindrical aluminum tube. The flexible spacing element **41** rests against the side-view mirror housing **21**. When the first reflective surface, shown in section view as **20,** is pivoted clockwise in the vertical axis about the actuator pivot, shown at **82** in **FIG. 16**, to an alternate position shown at **20'**, this results in a displacement of the attachment unit pivot, shown at **84** in **FIG. 16**, to a new position, shown at **84'** in **FIG. 16**. The movement of the attachment unit pivot **84** to position **84'** causes the extension mirror link element **32** and the flexible spacing element **41** to rotate in the vertical axis about the second pivot **83**. The movement of the actuator pivot point **84** to a new position **84'** also causes the extension mirror link element **32** to move a small distance in the axial direction. Because the angles of motion are small the flexible spacing element **41** can absorb these small axial movements as shown by the new position **41'** of the flexible spacing element **41**.

Further referring to **FIG. 23** a ring shown at **36** pulls the extension mirror link element **36** towards the side-view mirror housing **21** to ensure that the flexible spacing element **41** is always resting against the side-view mirror housing **21**. The ring **36** is held taught by the belt

37. In the embodiment disclosed here, the belt **37** is made of elastic material, which helps keep the flexible spacing element **41** pressed against the side-view mirror housing **21** even when the flexible spacing element **41** rotates about the horizontal axis and therefore rolls along the edge of the side-view mirror housing **21**. More details of the configuration of the ring **36** and belt **37** are provided by **FIG. 14**, **FIG. 15** and **FIG. 21**. It should be noted that the ring **36** does not connect the multiple-pivot detachable extension mirror unit **106** in **FIG. 14** and **FIG. 15** to the remotely-adjustable side-view mirror unit **102** in **FIG. 14** and **FIG. 15** at exactly at the second pivot **83.** However the attachment is sufficiently close that the second-pivot detachable attachment unit **34** can be considered to operate at the second pivot for purposes of calculating the force equations that were described in reference to **FIG. 16**.

The invention has been described in an illustrative manner, and it is to be understood that the terminology, which has been used, is intended to be in the nature of words of description rather than of limitation. Many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore to be understood that within the scope of the appended claims, the invention may be practiced other than as specifically described.

I claim:

1. A detachable remotely-adjustable extension mirror system for a motor vehicle comprising:

a remotely-adjustable side-view mirror unit comprising

a remote input device,

a transmission element,

an actuator,

a first reflective surface, and

a side-view mirror housing,

wherein said transmission element is between said remote input device and said first reflective surface

and wherein said actuator comprises an actuator housing, an actuator attachment element and a pivot; and

a detachable extension mirror unit comprising

a movement offset element and

an extension reflective surface,

wherein said movement offset element is between said first reflective surface and said extension reflective surface.

2. A system according to claim 1 wherein said movement offset element comprises a vacuum suction cup.

3. A system according to claim 1 further comprising a safety attachment element whereby said safety attachment element prevents said detachable extension mirror unit from detaching from said motor vehicle if said detachable vacuum suction cup first attachment element fails.

4. A system according to claim 3 wherein said safety attachment element comprises a cord between said detachable extension mirror unit and said remotely-adjustable side-view mirror unit.

5. A system according to claim 1 further comprising a second pivot.

6. A system according to claim 5 further comprising second-pivot detachable attachment unit.

7. A system according to claim 5 further comprising an extension wind load transfer element.

8. A system according to claim 1 wherein said movement offset element comprises a detachable vacuum attachment unit.

9. A detachable remotely-adjustable extension mirror system for a motor vehicle comprising:

a remotely-adjustable side-view mirror unit comprising
a remote input device,
a transmission element,
an actuator,
a first reflective surface, and
a side-view mirror housing,
wherein said transmission element is between said remote input device and said first reflective surface
and wherein said actuator comprises an actuator housing, an actuator attachment element and a pivot; and
a detachable extension mirror unit comprising
an extension reflective surface and
a detachable vacuum suction cup first attachment element;
wherein said detachable vacuum suction cup first attachment element is between said first reflective surface and said extension reflective surface.

10. A system according to claim 9 wherein said detachable vacuum suction cup first attachment element comprises a movement offset element.

11. A system according to claim 9 further comprising a safety attachment element whereby said safety attachment element prevents said detachable extension mirror unit from detaching from said motor vehicle if said detachable vacuum suction cup first attachment element fails.

12. A system according to claim 11 wherein said safety attachment element comprises a cord between said detachable extension mirror unit and said remotely-adjustable side-view mirror unit.

13. A system according to claim 9 further comprising a second pivot.

14. A system according to claim 13 further comprising a second-pivot detachable attachment unit.

15. A system according to claim 13 further comprising an extension wind load transfer element.

16. A detachable extension mirror system for a motor vehicle comprising:

a side-view mirror unit comprising a first reflective surface and a side-view mirror housing;

a detachable extension mirror unit comprising an extension reflective surface; and

a detachable first attachment element between said side-view mirror unit and said detachable extension mirror unit wherein said detachable first attachment element further comprises a movement offset element.

17. A system according to claim 16 wherein said detachable first attachment element comprises a vacuum suction cup.

18. A system according to claim 16 further comprising a safety attachment element whereby said safety attachment element prevents said detachable extension mirror unit from detaching from said motor vehicle if said detachable vacuum suction cup first attachment element fails.

19. A system according to claim 18 wherein said safety attachment element comprises a cord between said detachable extension mirror unit and said side-view mirror unit.

20. A system according to claim 16 wherein said side-view mirror unit is remotely-adjustable.

21. A system according to claim 16 further comprising at least two pivots.

22. A system according to claim 21 further comprising a second-pivot detachable attachment unit.

23. A system according to claim 21 further comprising an extension wind load transfer element.

24. A system according to claim 16 wherein said detachable first attachment element comprises a detachable vacuum attachment unit.

25. A detachable extension mirror system for a motor vehicle comprising:

a side-view mirror unit comprising a first reflective surface and a side-view mirror housing;

a detachable extension mirror unit comprising an extension reflective surface;

a pivot around which said first reflective surface rotates; and

a second pivot around which said second reflective surface rotates.

26. A system according to claim 25 wherein said detachable extension mirror unit further comprises a movement offset element.

27. A system according to claim 26 wherein said movement offset element comprises a vacuum suction cup.

28. A system according to claim 26 further comprising a safety attachment element whereby said safety attachment element prevents said detachable extension mirror unit from detaching from said motor vehicle if said detachable vacuum suction cup first attachment element fails.

29. A system according to claim 28 wherein said safety attachment element comprises a cord between said detachable extension mirror unit and said remotely-adjustable side-view mirror unit.

30. A system according to claim 25 wherein said side-view mirror unit is remotely-adjustable.

31. A system according to claim 25 further comprising a second-pivot detachable attachment unit.

32. A system according to claim 25 further comprising a extension wind load transfer element.

33. A system according to claim 26 wherein said movement offset element comprises a detachable vacuum attachment unit

34. A detachable system for a motor vehicle comprising:

a side-view mirror unit comprising a first reflective surface and a side-view mirror housing; and

a detachable vacuum attachment unit;

wherein said detachable vacuum attachment unit is connected to said first reflective surface.

35. A system according to claim 34 further comprising a safety attachment element whereby said safety attachment element prevents said detachable vacuum attachment unit from detaching from said motor vehicle if said detachable vacuum attachment unit fails.

36. A system according to claim 35 wherein said safety attachment element comprises a cord between said detachable vacuum attachment unit and said side-view mirror unit.

37. A system according to claim 35 wherein said side-view mirror unit is remotely-adjustable.

38. A system according to claim 34 further comprising an extension reflective surface attached to said detachable vacuum attachment unit.

39. A system according to claim 34 further comprising at least two pivots.

40. A system according to claim 39 further comprising a second-pivot detachable attachment unit.

41. A system according to claim 39 further comprising an extension wind load transfer element.

42. A method of providing the driver of a motor vehicle with a remotely-adjustable extended rearward view comprising:

interacting with a remote input device located inside the vehicle to create an input;

transmitting said input to a mirror actuator;

converting said input at said mirror actuator to a pivoting motion of a first reflective surface;

establishing an offset extension reflective surface; and

moving said offset reflective surface in response to said pivoting motion of said first reflective surface.

43. The method of claim 42 where establishing comprises using vacuum.

44. The method of claim 43 further comprising the step of mechanically attaching said offset extension reflective surface to said motor vehicle in case said vacuum fails.

45. The method of claim 44 where mechanically attaching uses a safety cord.

46. The method of claim 42 where moving occurs about a second pivot.

47. The method of claim 46 further comprising the step of transferring an extension wind load using a second-pivot detachable attachment unit.

48. The method of claim 46 further comprising the step of transferring an extension wind load to a side-view mirror housing attached to said motor vehicle.

49. A method of providing the driver of a motor vehicle with a remotely-adjustable extended rearward view comprising:

interacting with a remote input device located inside the vehicle to create an input;

transmitting said input to a mirror actuator;

converting said input at said mirror actuator to a pivoting motion of a first reflective surface; and

using vacuum to couple said pivoting motion to an extension reflective surface.

50. The method of claim 49 further comprising the step of offsetting said first reflective surface from said extension reflective surface.

51. The method of claim 49 further comprising the step of mechanically attaching said offset extension reflective surface to said motor vehicle in case said vacuum fails.

52. The method of claim 51 where mechanically attaching uses a safety cord.

53. The method of claim 49 where coupling comprises using a second pivot.

54. The method of claim 53 further comprising the step of transferring an extension wind load using a second-pivot detachable attachment unit.

55. The method of claim 53 further comprising the step of transferring an extension wind load to a side-view mirror housing attached to said motor vehicle.

56. A method of providing the driver of a motor vehicle with an extended rearward view comprising:

attaching a detachable extension mirror unit having an extension reflective surface to a side-view mirror unit having a first reflective surface; and

offsetting said first reflective surface and said extension reflective surface.

57. The method of claim 56 where offsetting comprises using vacuum.

58. The method of claim 57 further comprising the step of mechanically attaching said offset extension reflective surface to said motor vehicle in case said vacuum fails.

59. The method of claim 58 where mechanically attaching uses a safety cord.

60. The method of claim 56 further comprising the step of remotely adjusting said secondary reflective surface by interacting with a remote input device located inside the vehicle to create an input.

61. The method of claim 56 further comprising moving said first reflective surface about a first pivot and moving said extension reflective surface about a second pivot.

62. The method of claim 61 further comprising the step of transferring an extension wind load using a second-pivot detachable attachment unit.

63. The method of claim 61 further comprising the step of transferring an extension wind load to a side-view mirror housing attached to said motor vehicle.

64. A method of providing the driver of a motor vehicle with an extended rearward view comprising:

attaching a detachable extension mirror unit having an extension reflective surface to a side-view mirror unit having a first reflective surface

where said first reflective surface moves about a first pivot and said extension reflective surface moves about a second pivot.

65. The method of claim 64 further comprising the step of offsetting said first reflective surface from said extension reflective surface.

66. The method of claim 65 where offsetting comprises using vacuum.

67. The method of claim 66 further comprising the step of mechanically attaching said offset extension reflective surface to said motor vehicle in case said vacuum fails.

68. The method of claim 67 where mechanically attaching uses a safety cord.

69. The method of claim 64 further comprising the step of remotely adjusting said secondary reflective surface by interacting with a remote input device located inside the vehicle to create an input.

70. The method of claim 64 further comprising the step of transferring an extension wind load using a second-pivot detachable attachment unit.

71. The method of claim 64 further comprising the step of transferring an extension wind load to a side-view mirror housing attached to said motor vehicle.

72. A method of detachably attaching a unit to a side view mirror unit having a first reflective surface comprising:

placing a diaphragm against said first reflective surface,

placing a housing over said diaphragm,

pressing said housing and said diaphragm against said first reflective surface to create a seal around the periphery of said diaphragm,

pulling the center of said diaphragm away from said first reflective surface to create a vacuum,

clamping said center of said diaphragm in place to prevent losing said vacuum, and

attaching said object to said housing.

73. The method of claim 72 further comprising the step of mechanically attaching said object to said motor vehicle in case said vacuum fails.

74. The method of claim 73 where mechanically attaching uses a safety cord.

75. The method of claim 72 further comprising the step of remotely adjusting said unit by interacting with a remote input device located inside the vehicle to create an input.

76. The method of claim 75 further comprising the step of providing an extended rearward view using said unit.

77. The method of claim 72 further comprising moving said first reflective surface about a first pivot and moving said unit about a second pivot.

78. The method of claim 77 further comprising the step of transferring an extension wind load using a second attachment unit.

79. The method of claim 77 further comprising the step of transferring an extension wind load using a second-pivot detachable attachment unit.

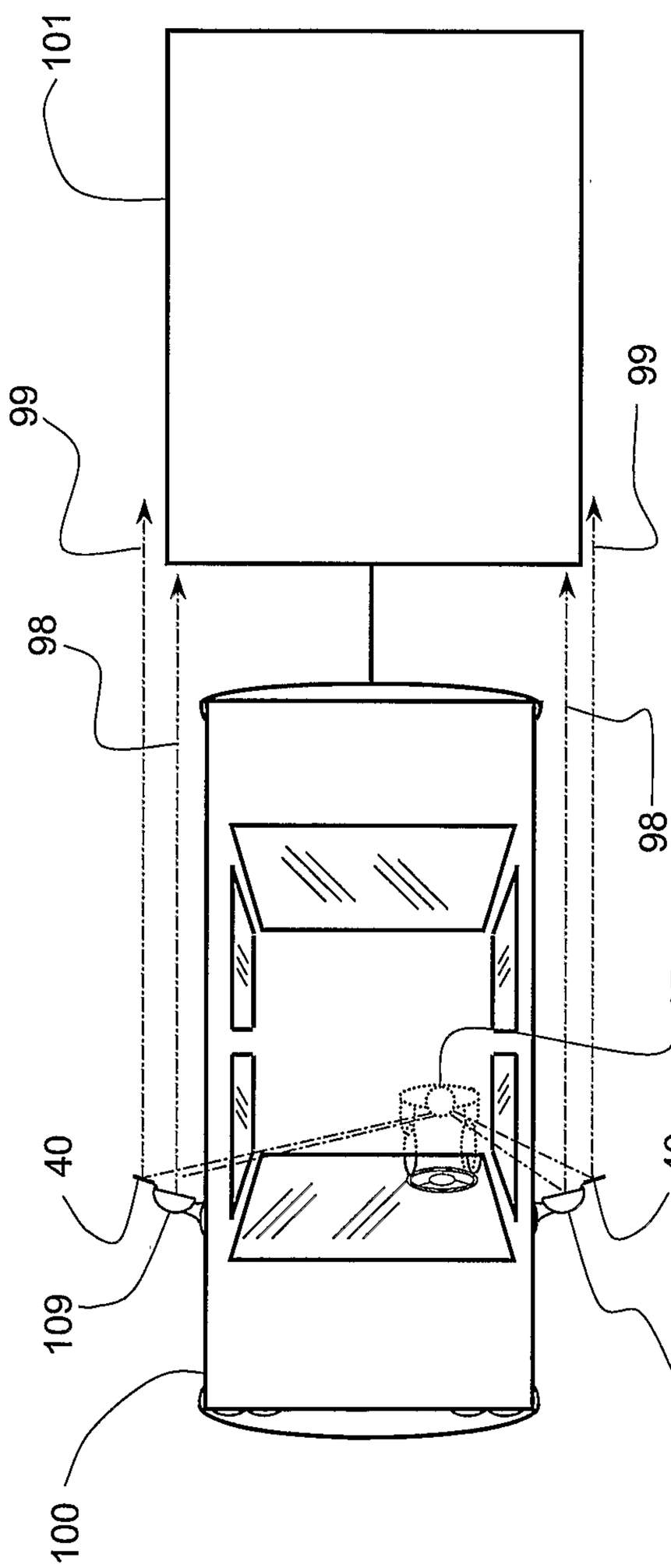


Fig. 1

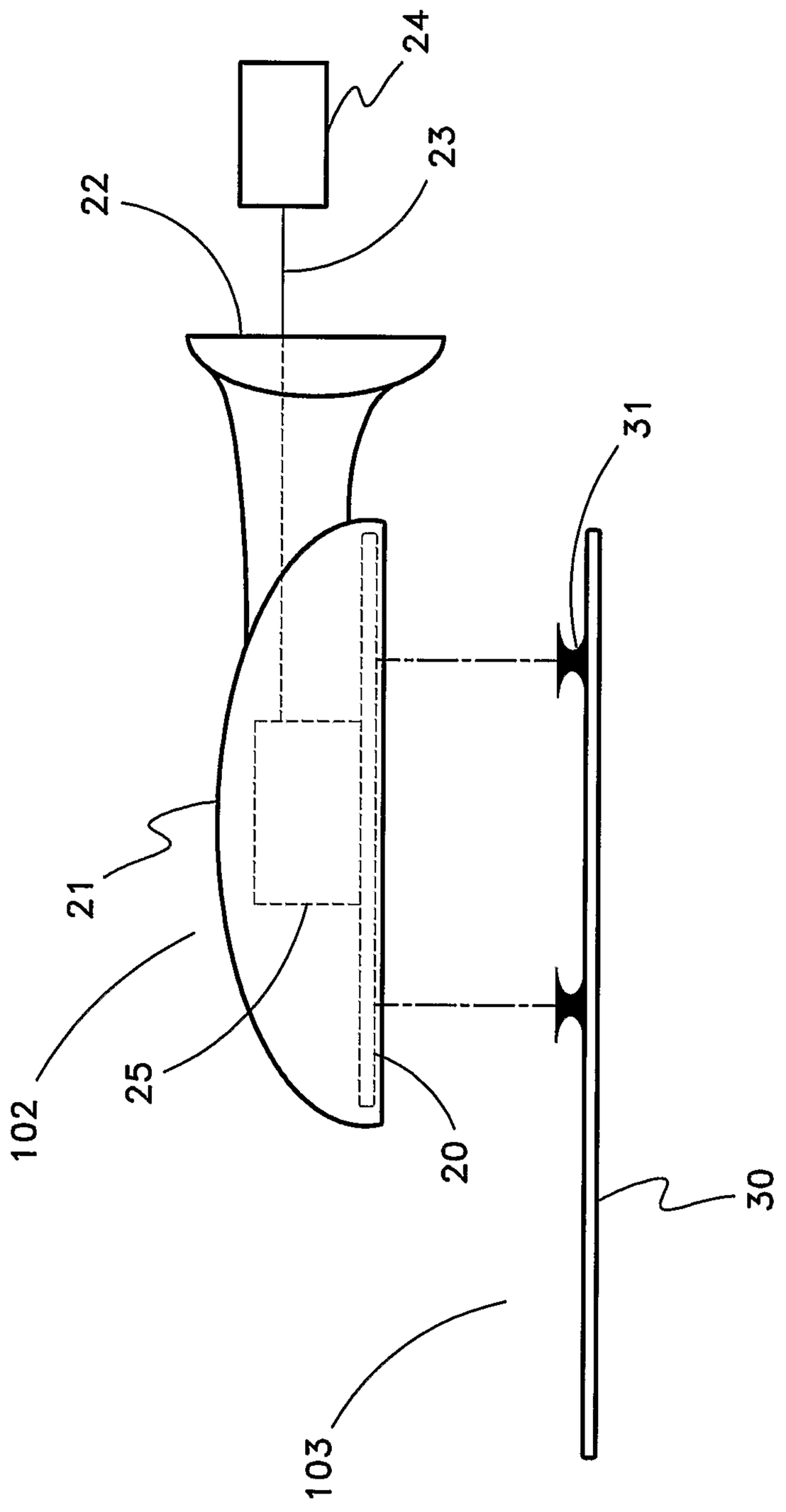


Fig. 2

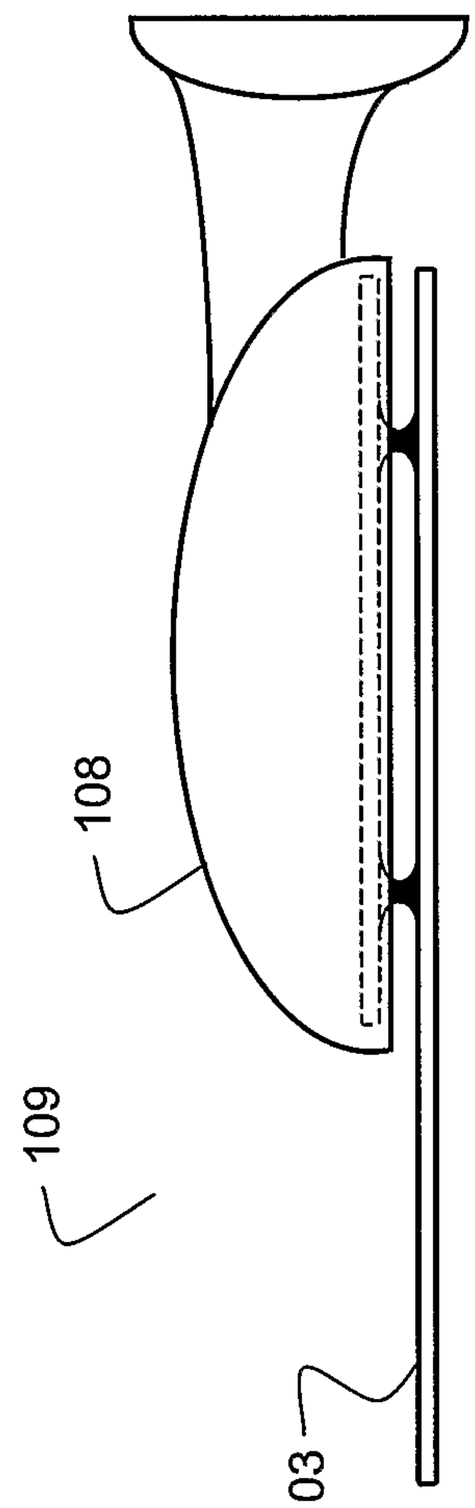


Fig. 3

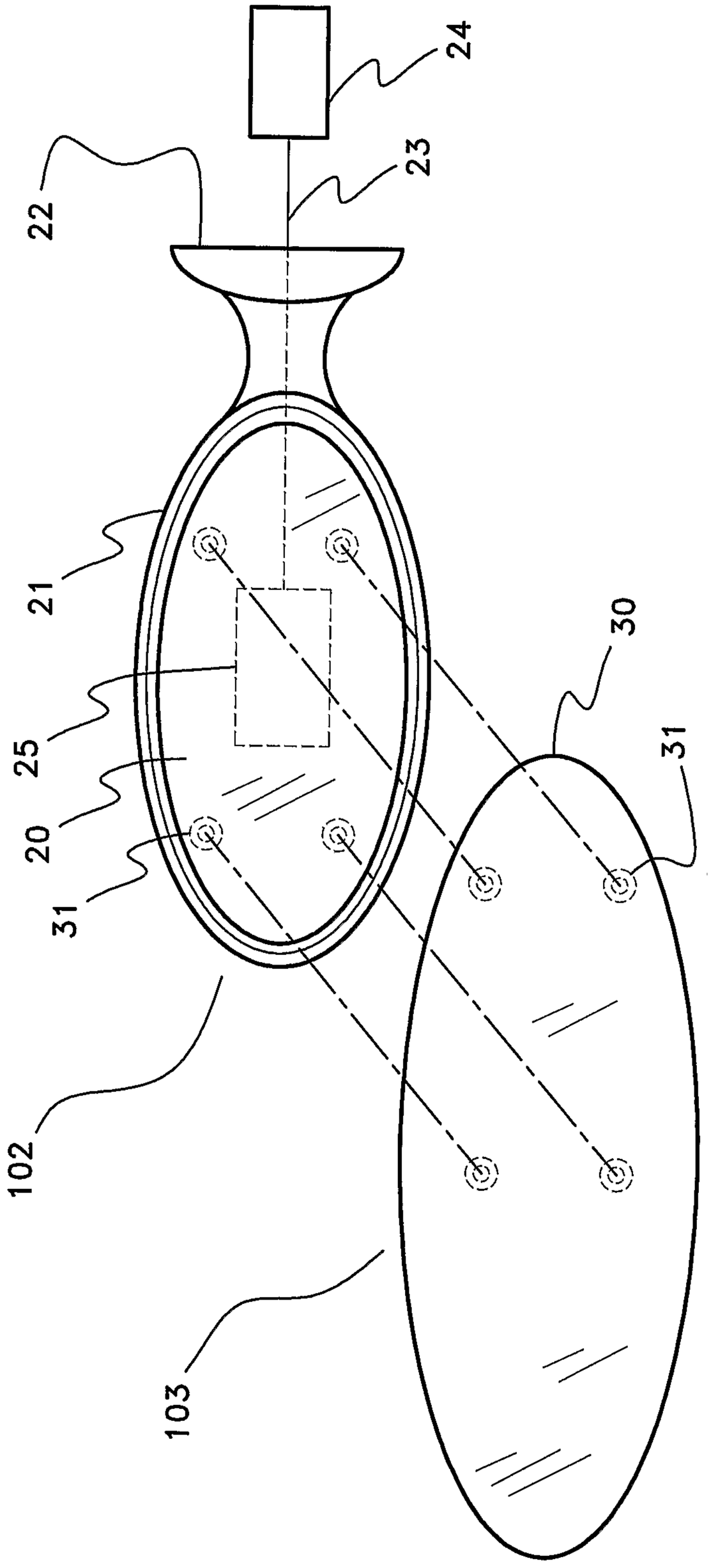


Fig. 4

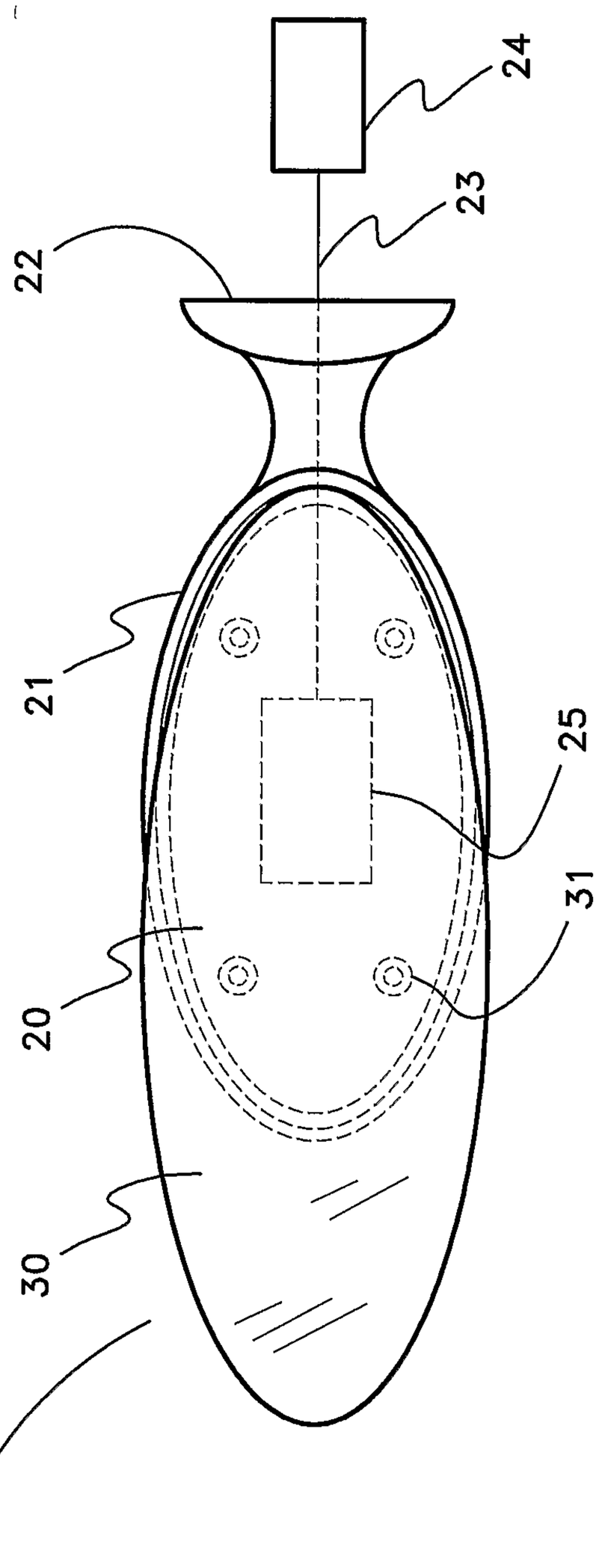


Fig. 5

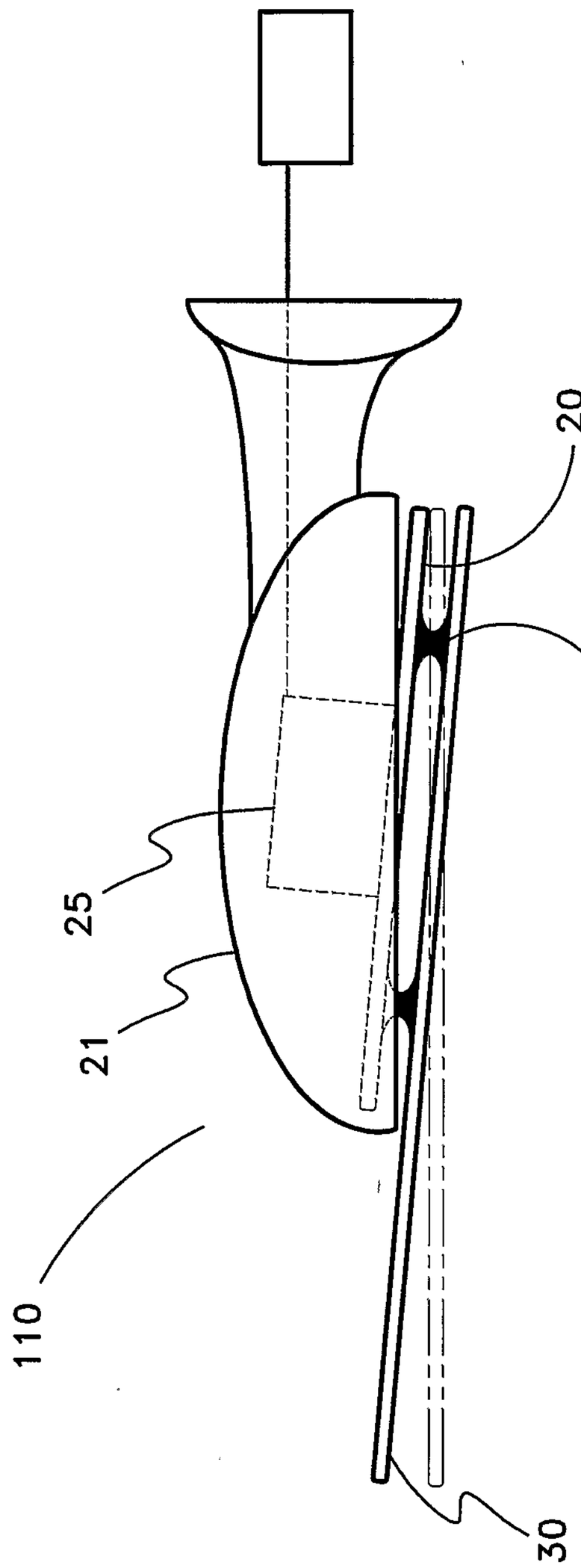


Fig. 6

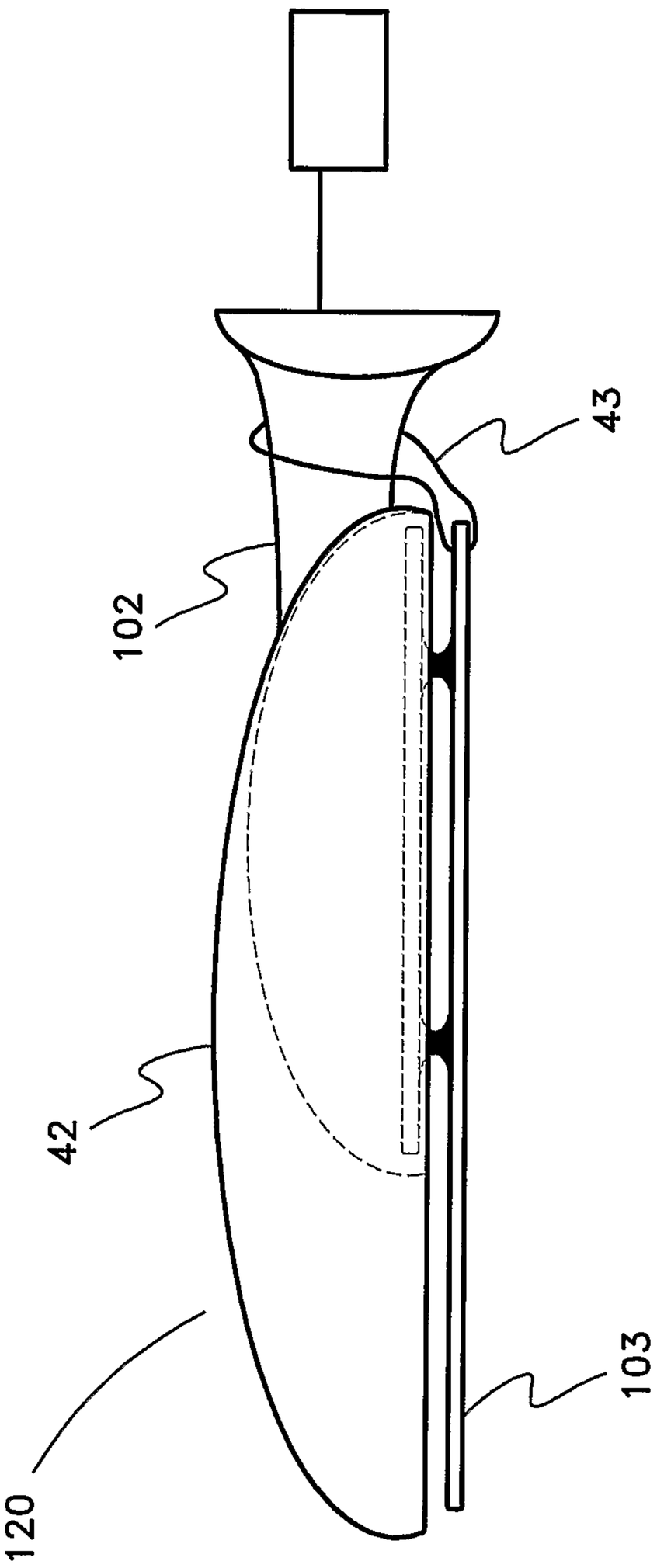


Fig. 7

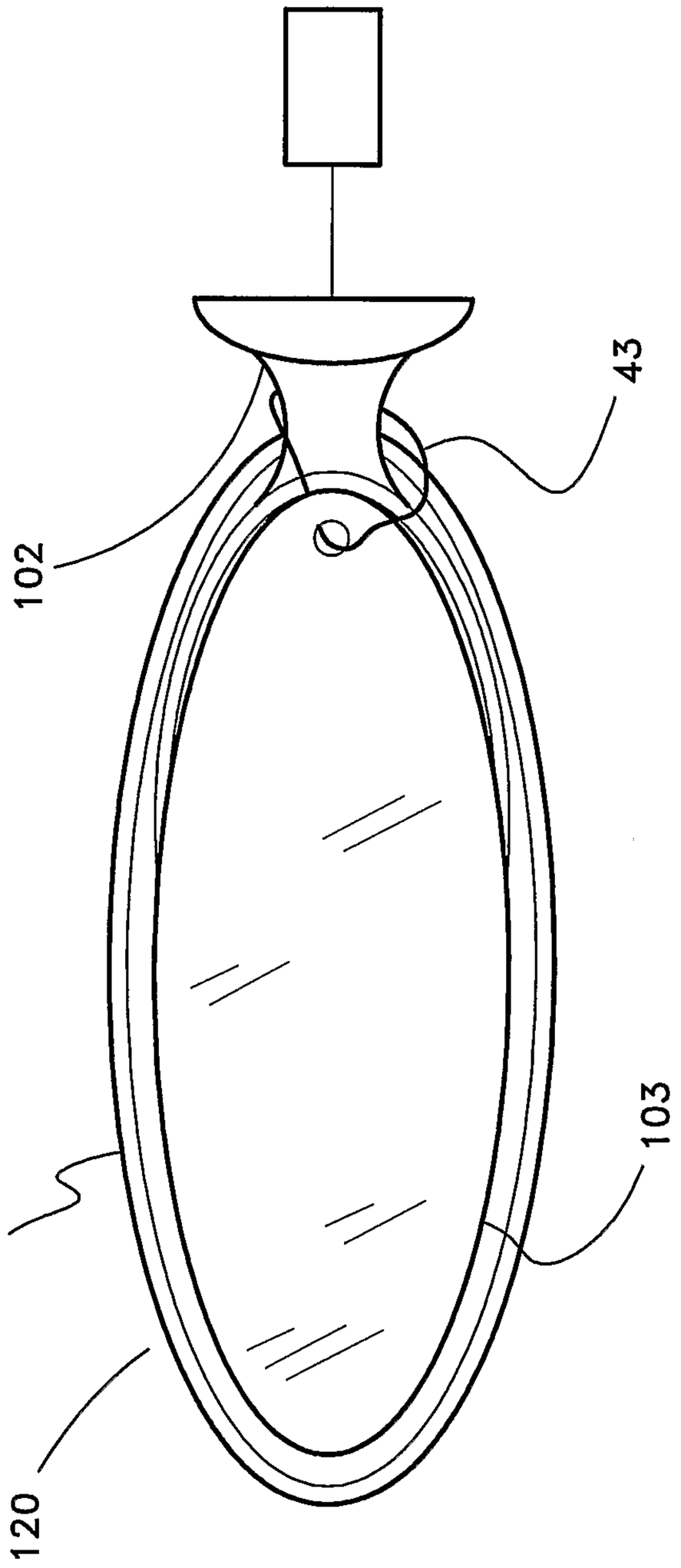


Fig. 8

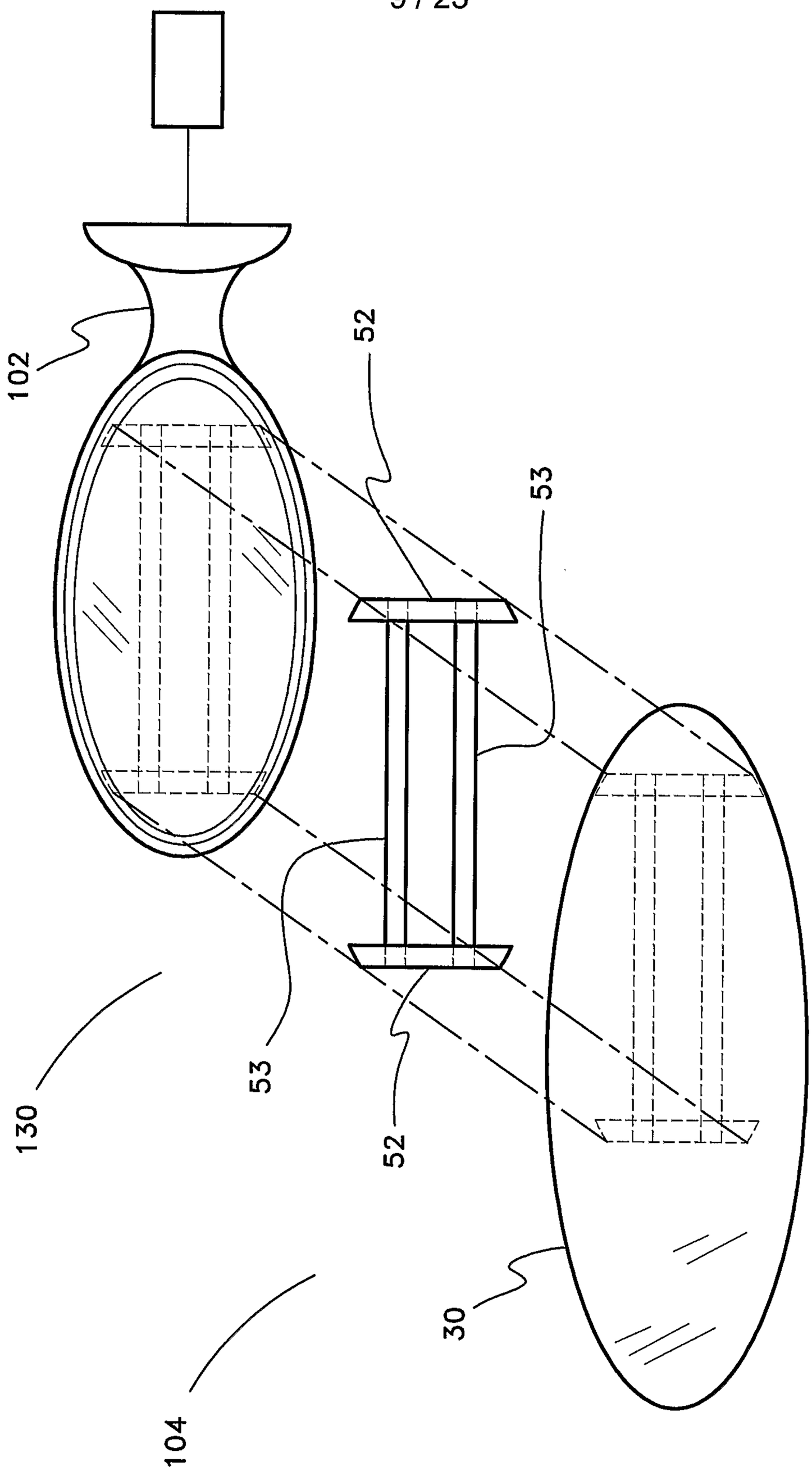


Fig. 9

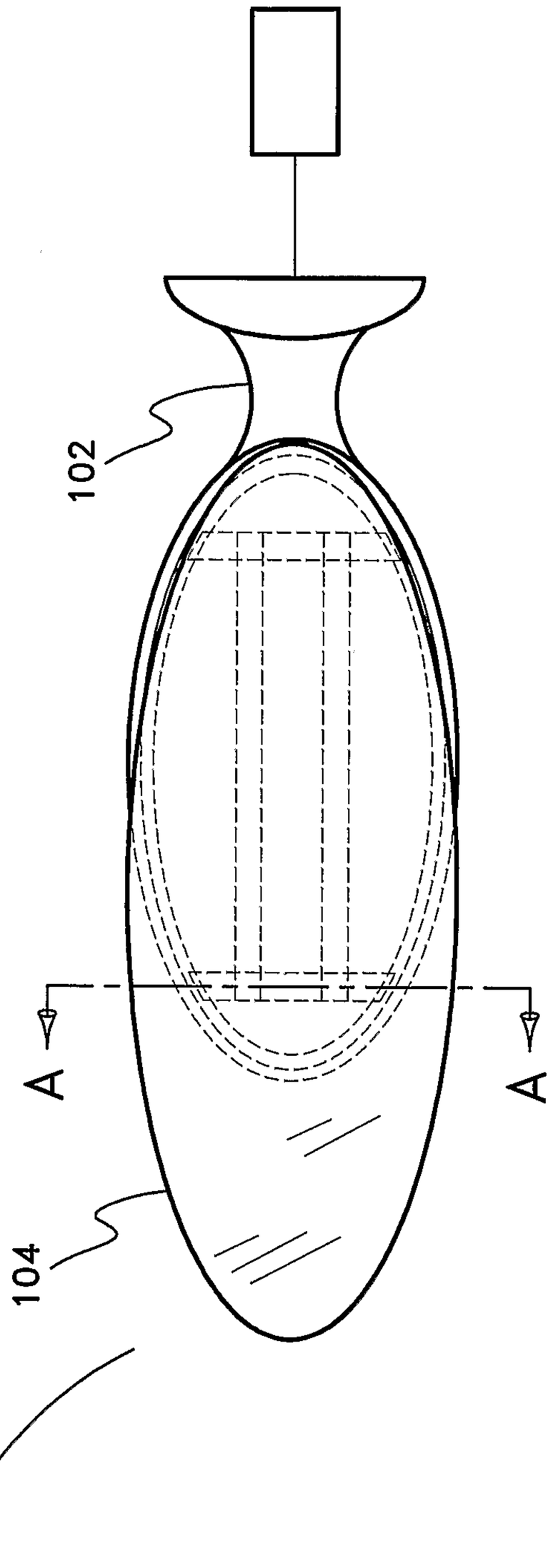


Fig. 10

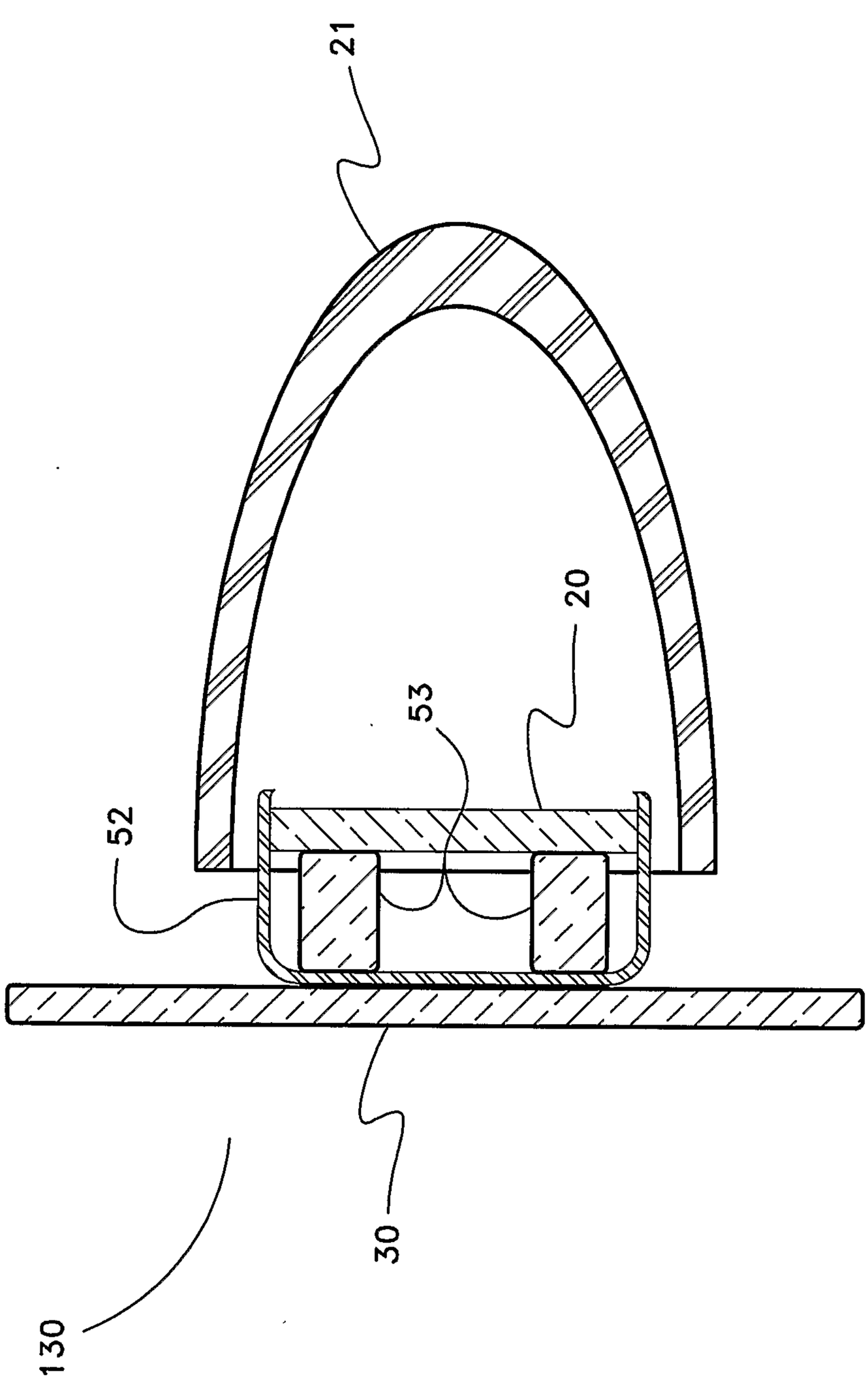


Fig. 11

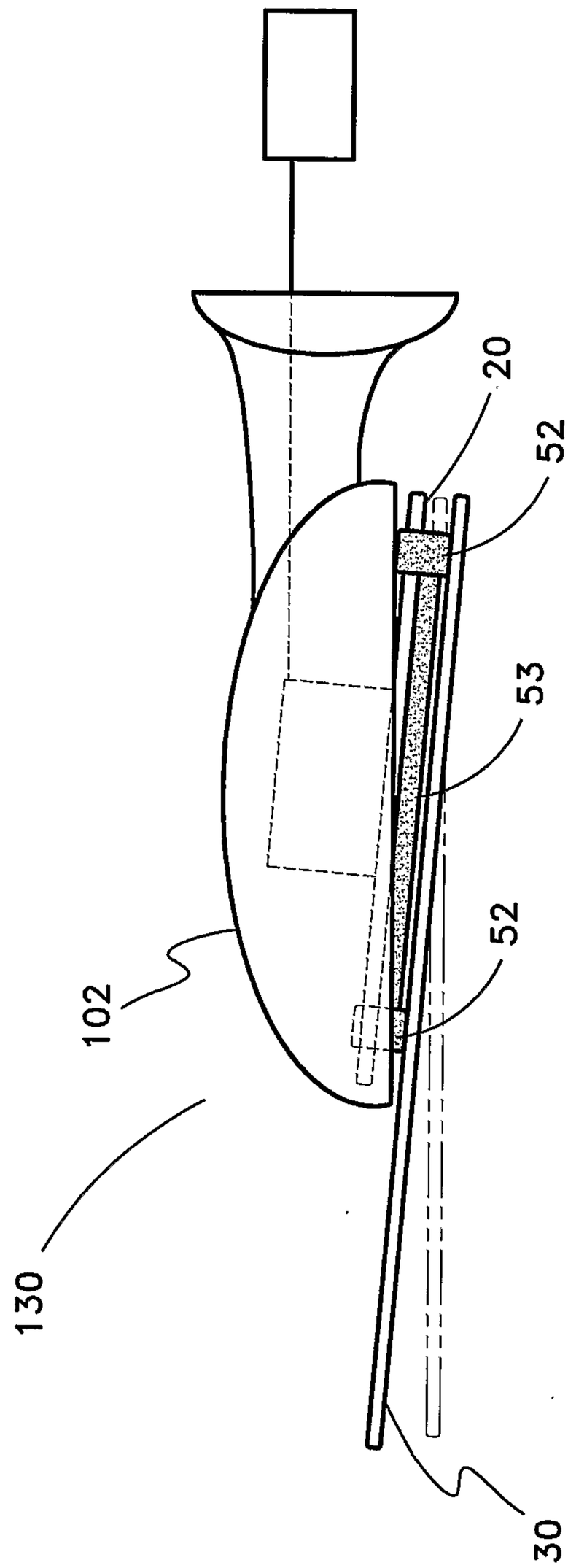


Fig. 12

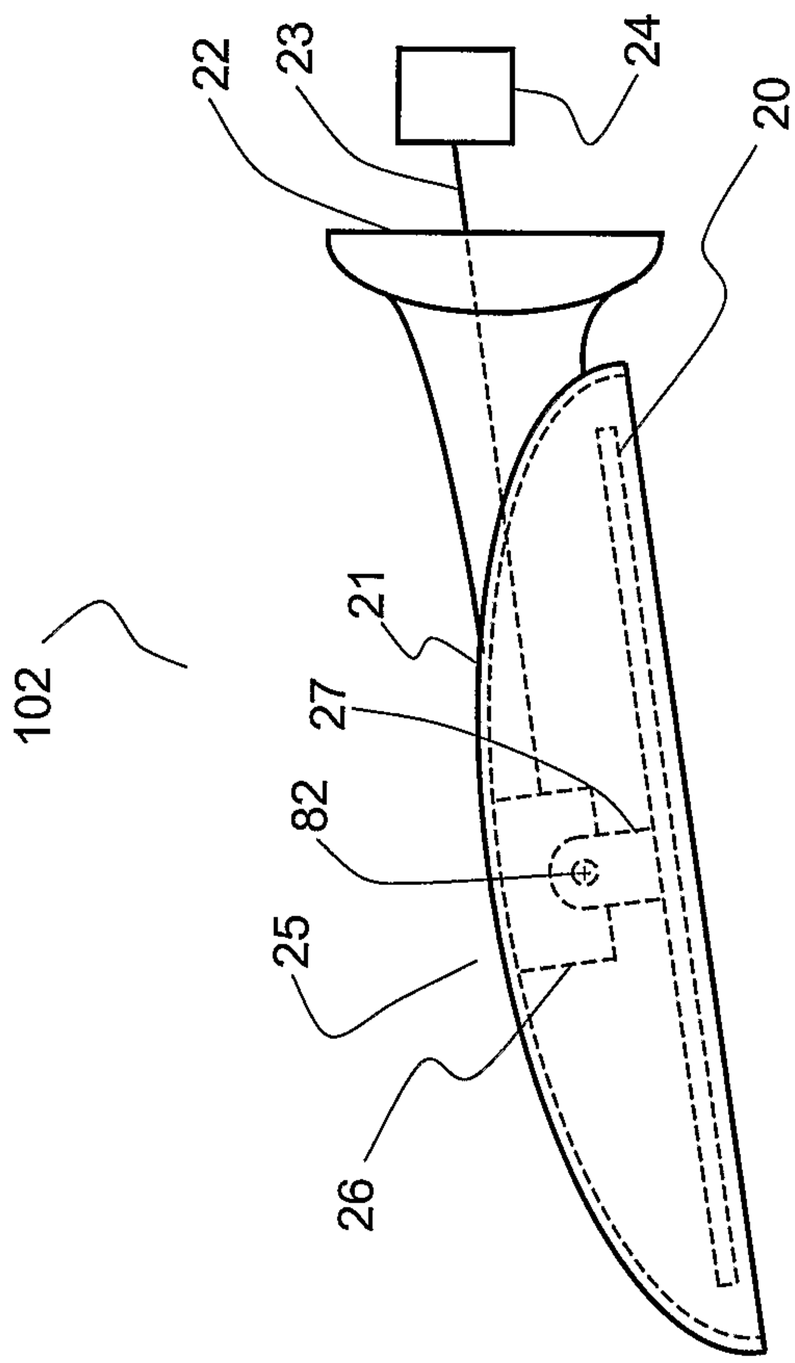


Fig. 13

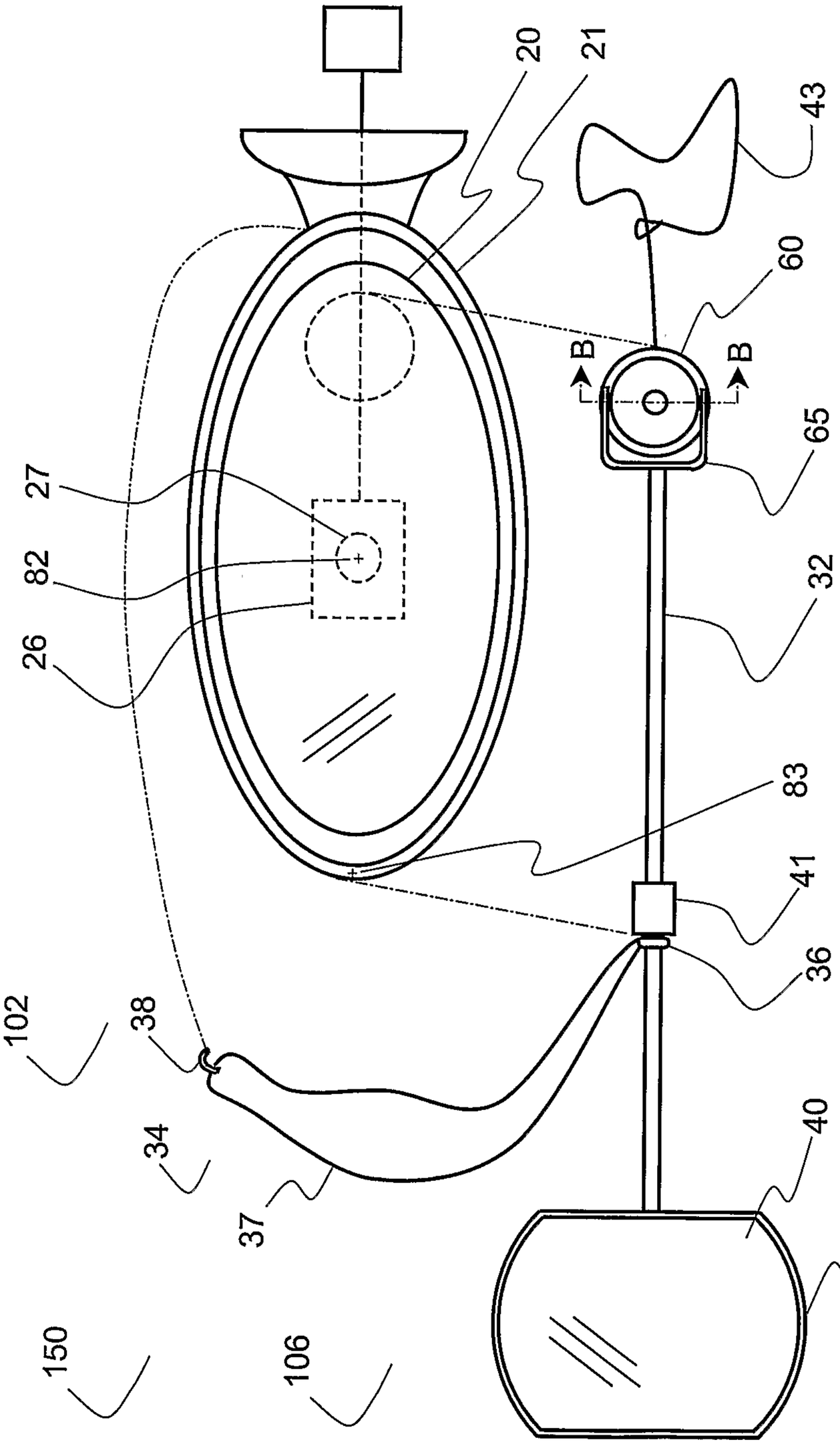


Fig. 14

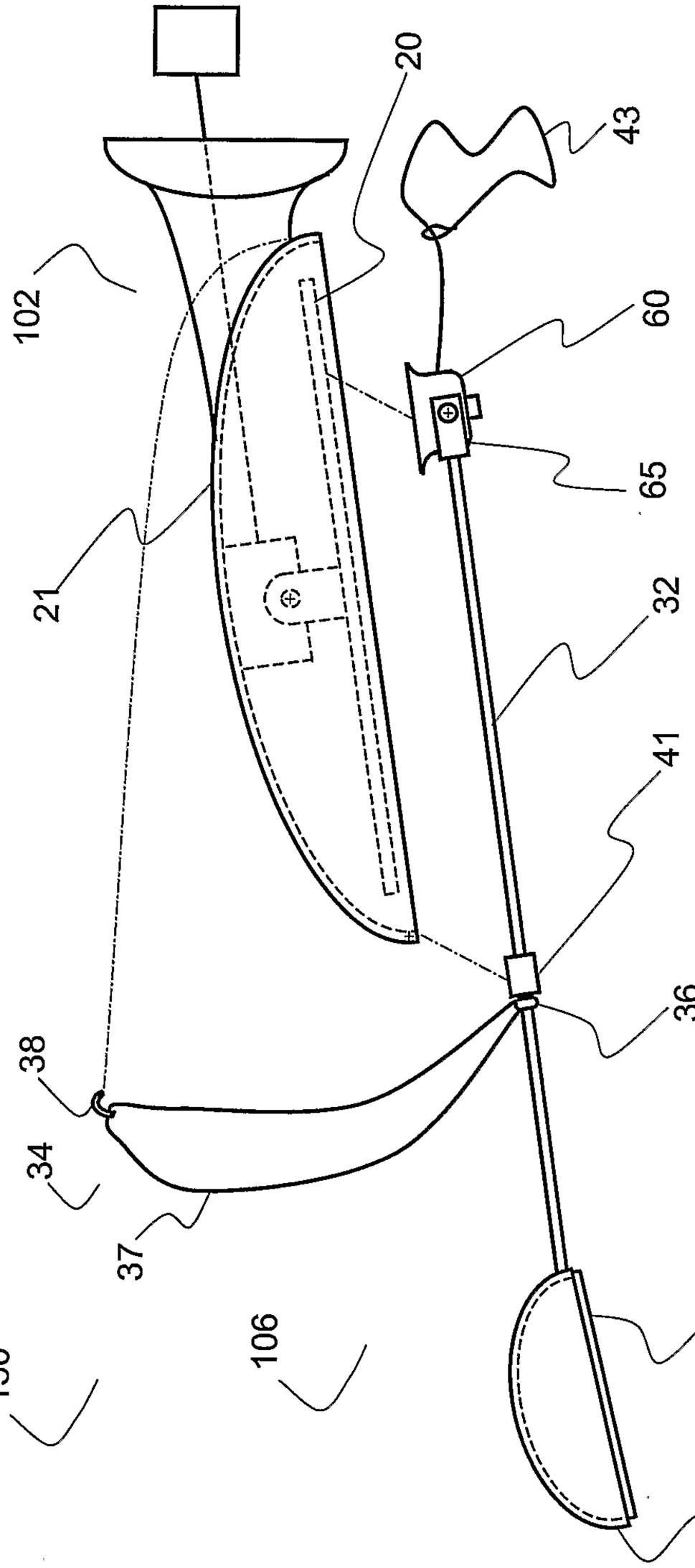


Fig. 15

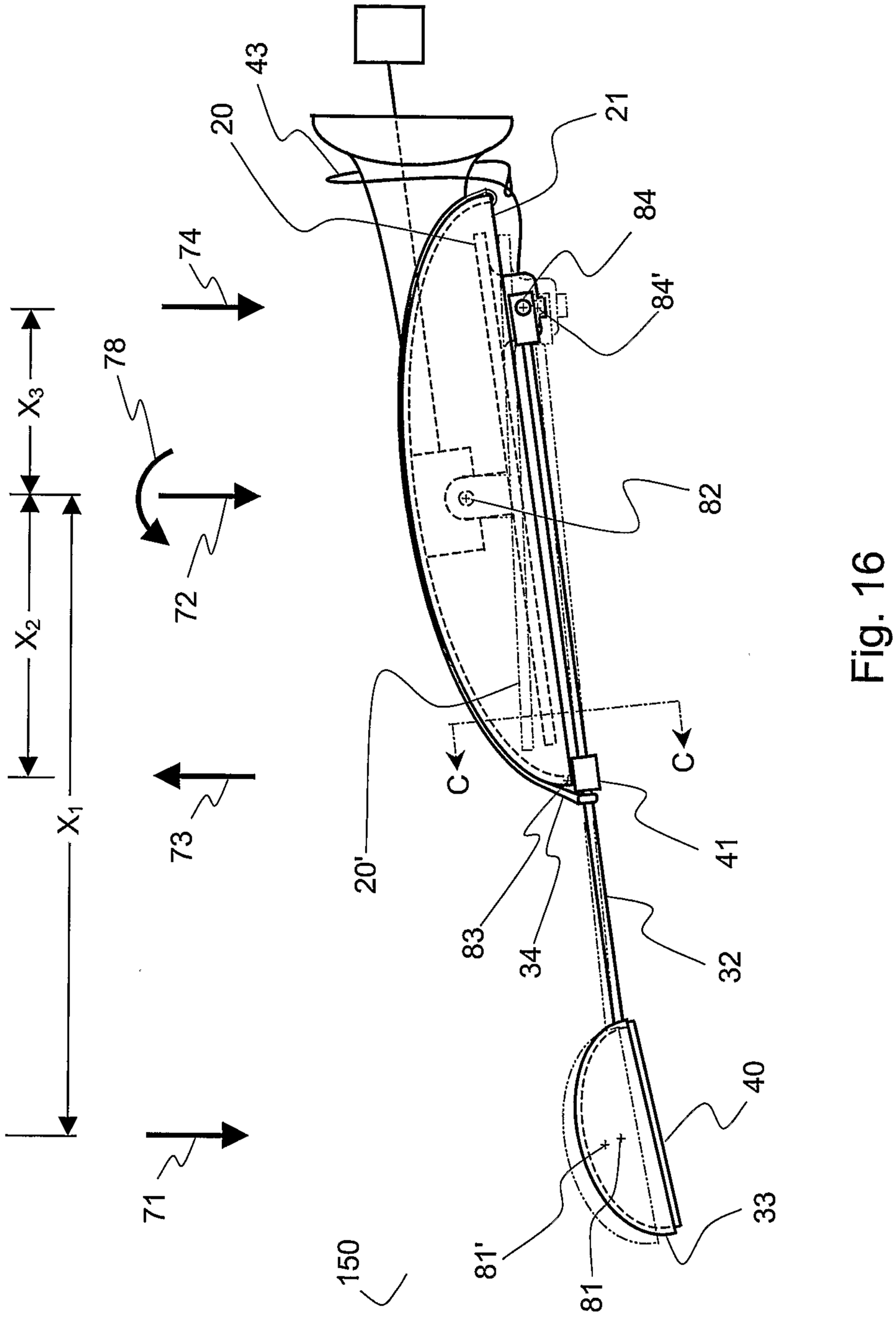

43
20
21
74
84
84'
78
82
X_3
X_2
X_1
72
73
71
C
C
20'
83
34
41
32
150
81'
81
40
33

Fig. 16

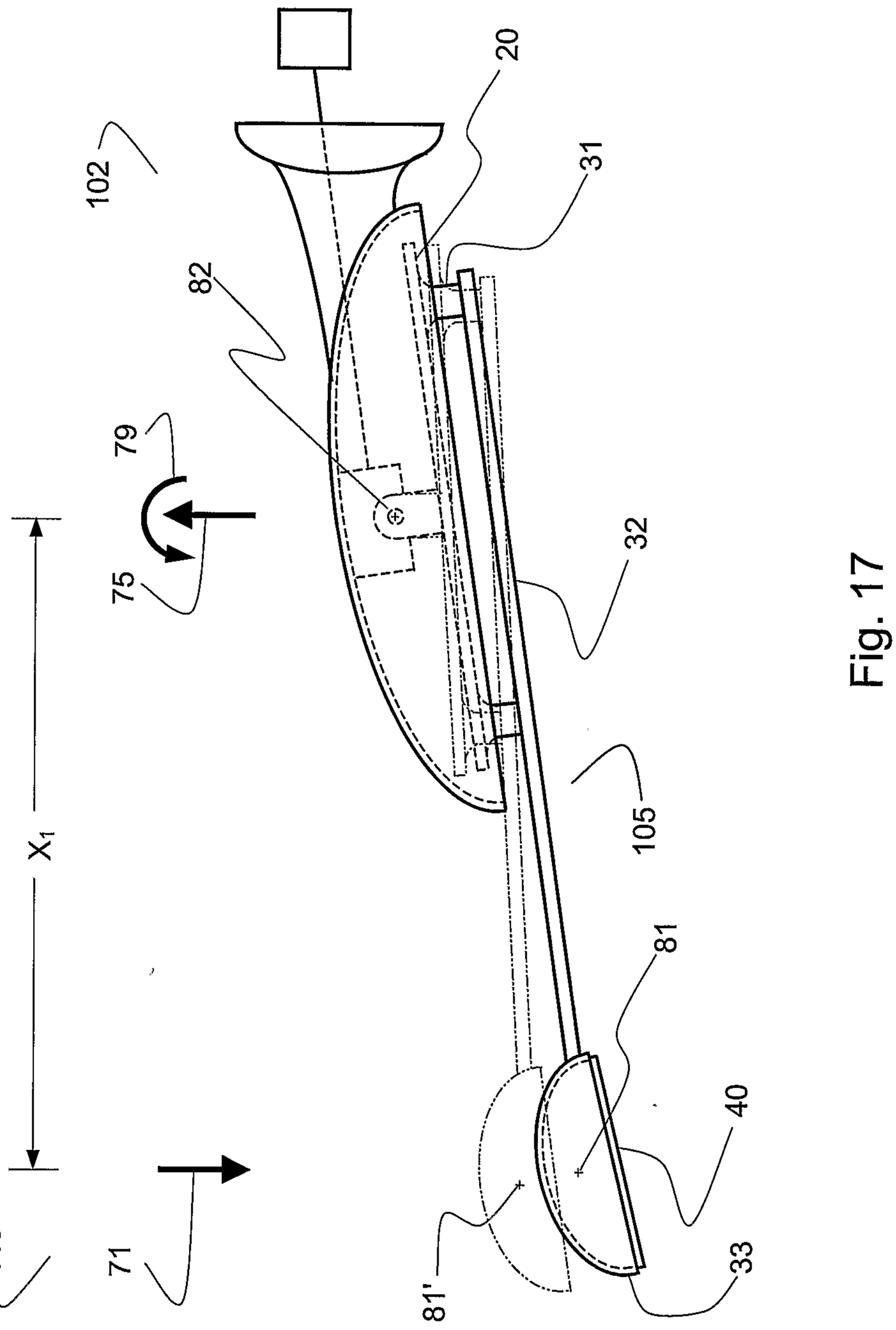


Fig. 17

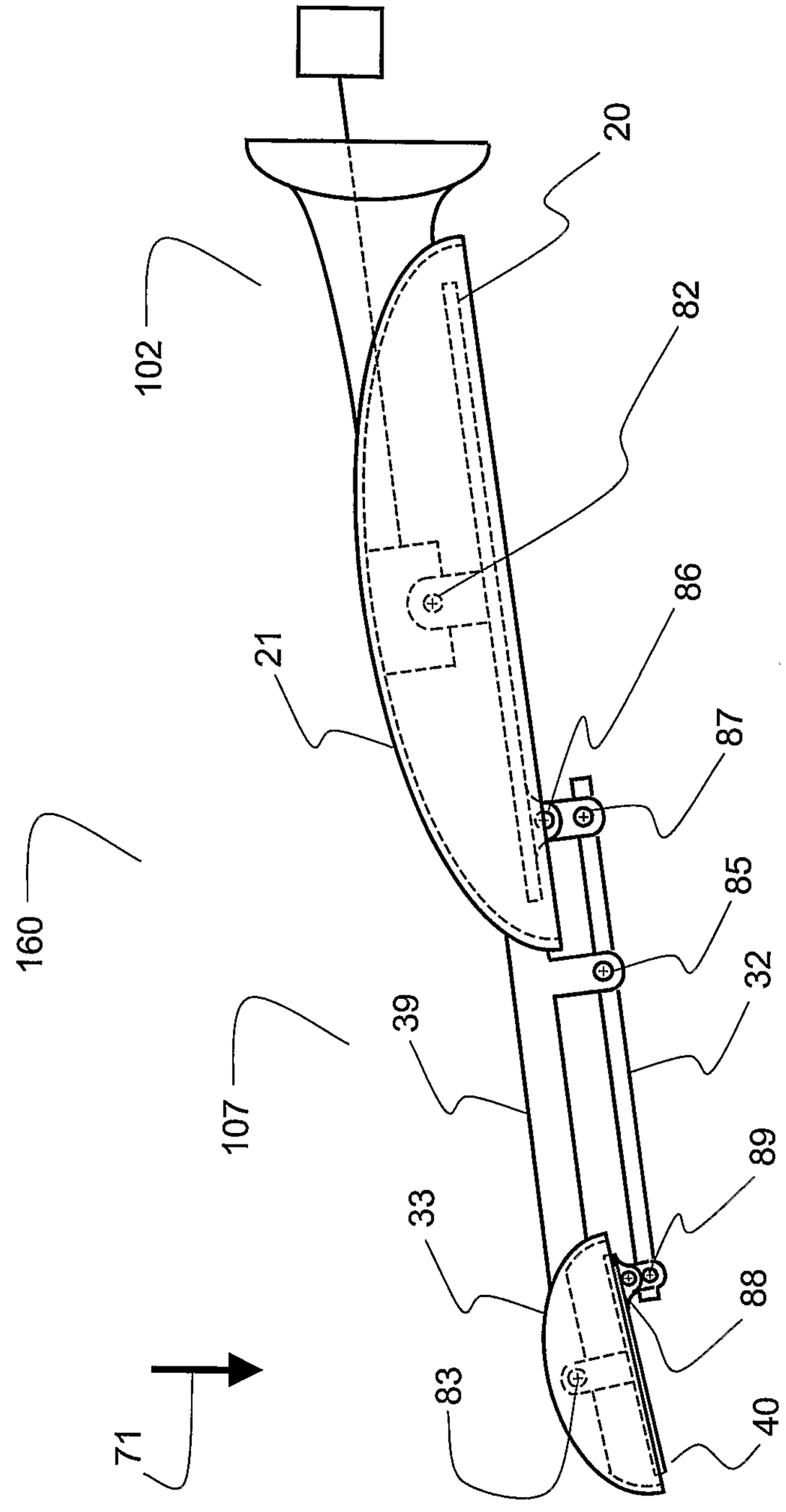


Fig. 18

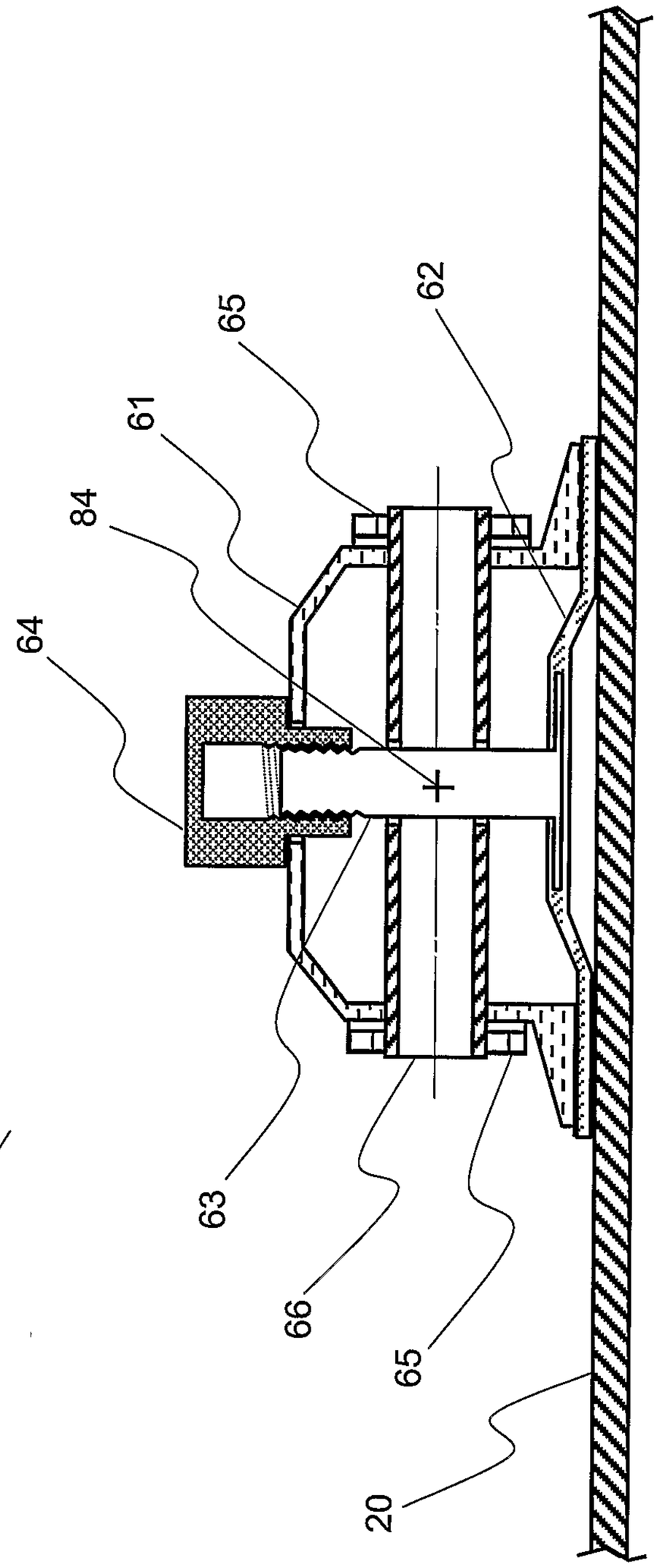


Fig. 19

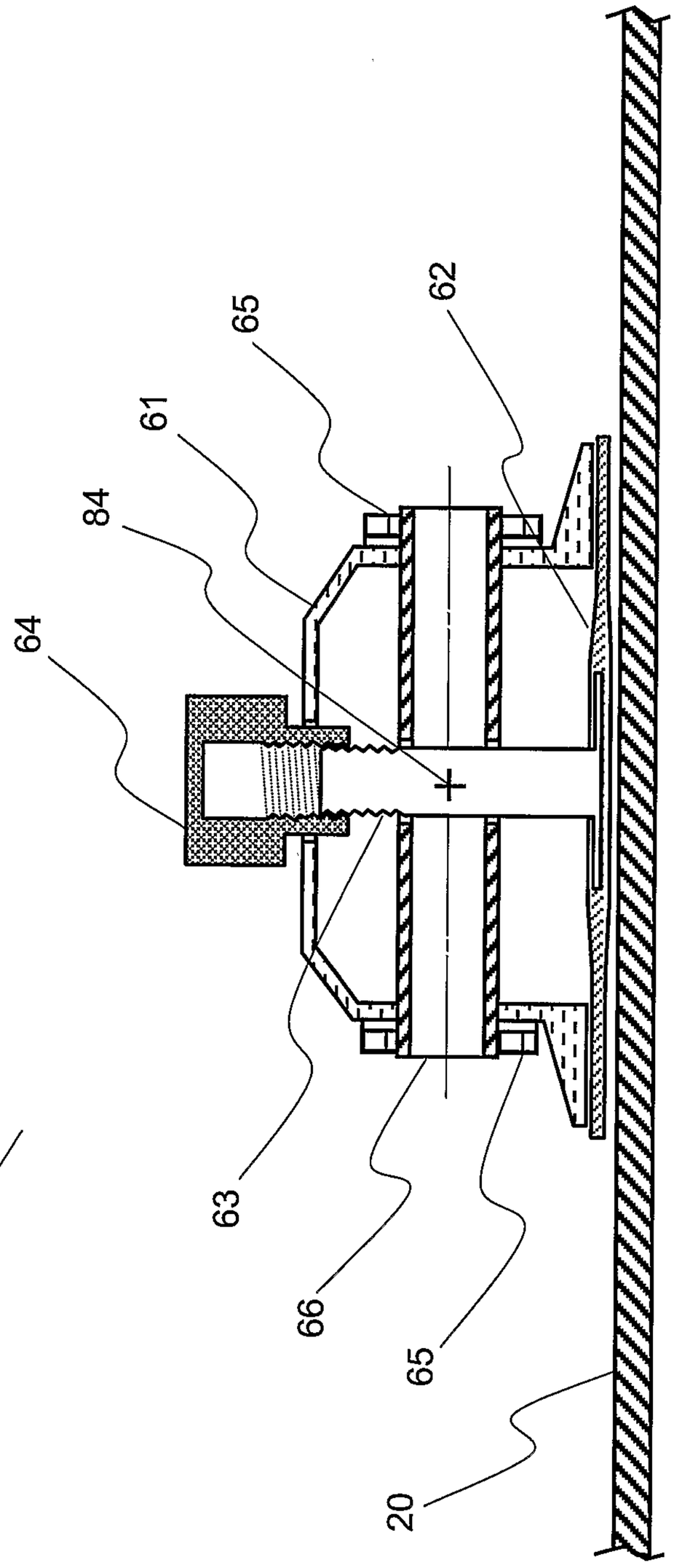


Fig. 20

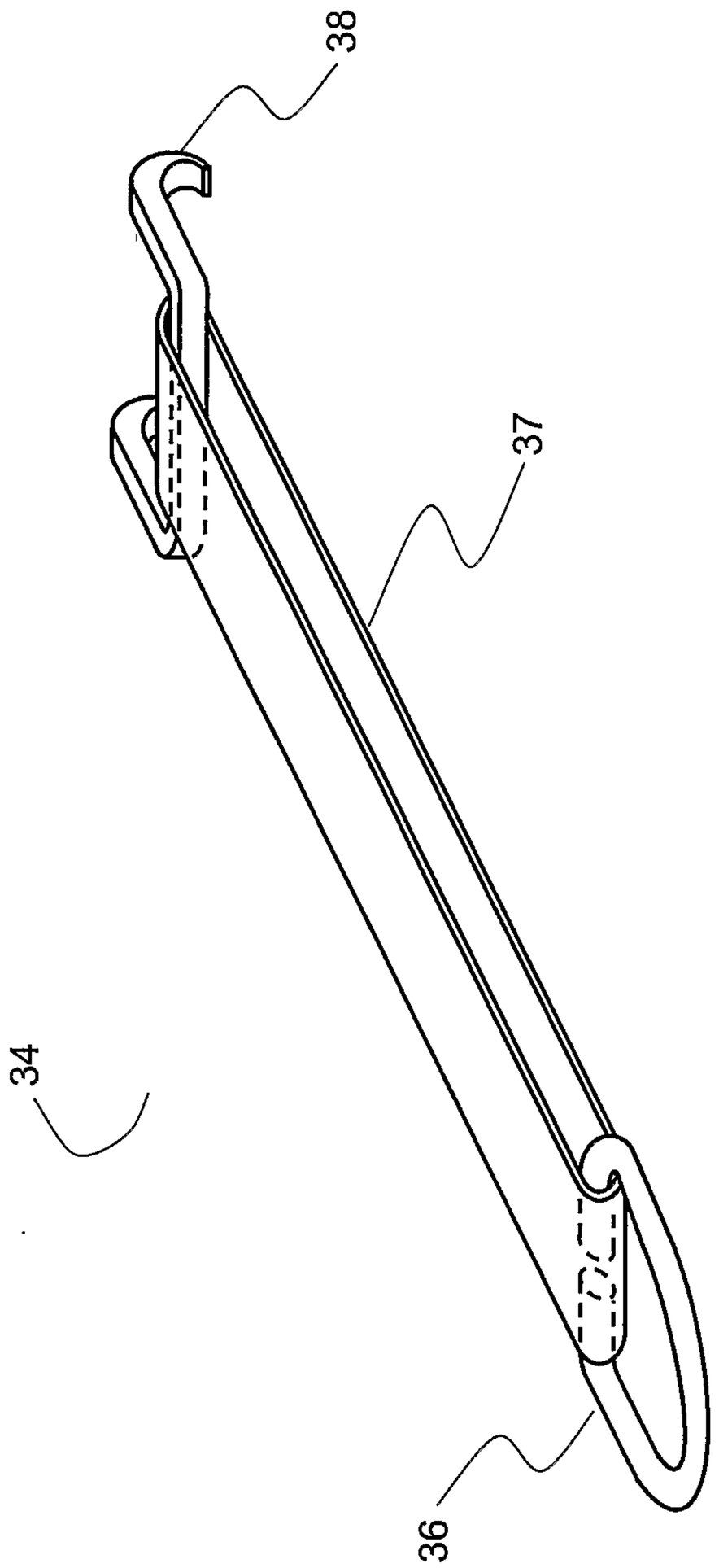


Fig. 21

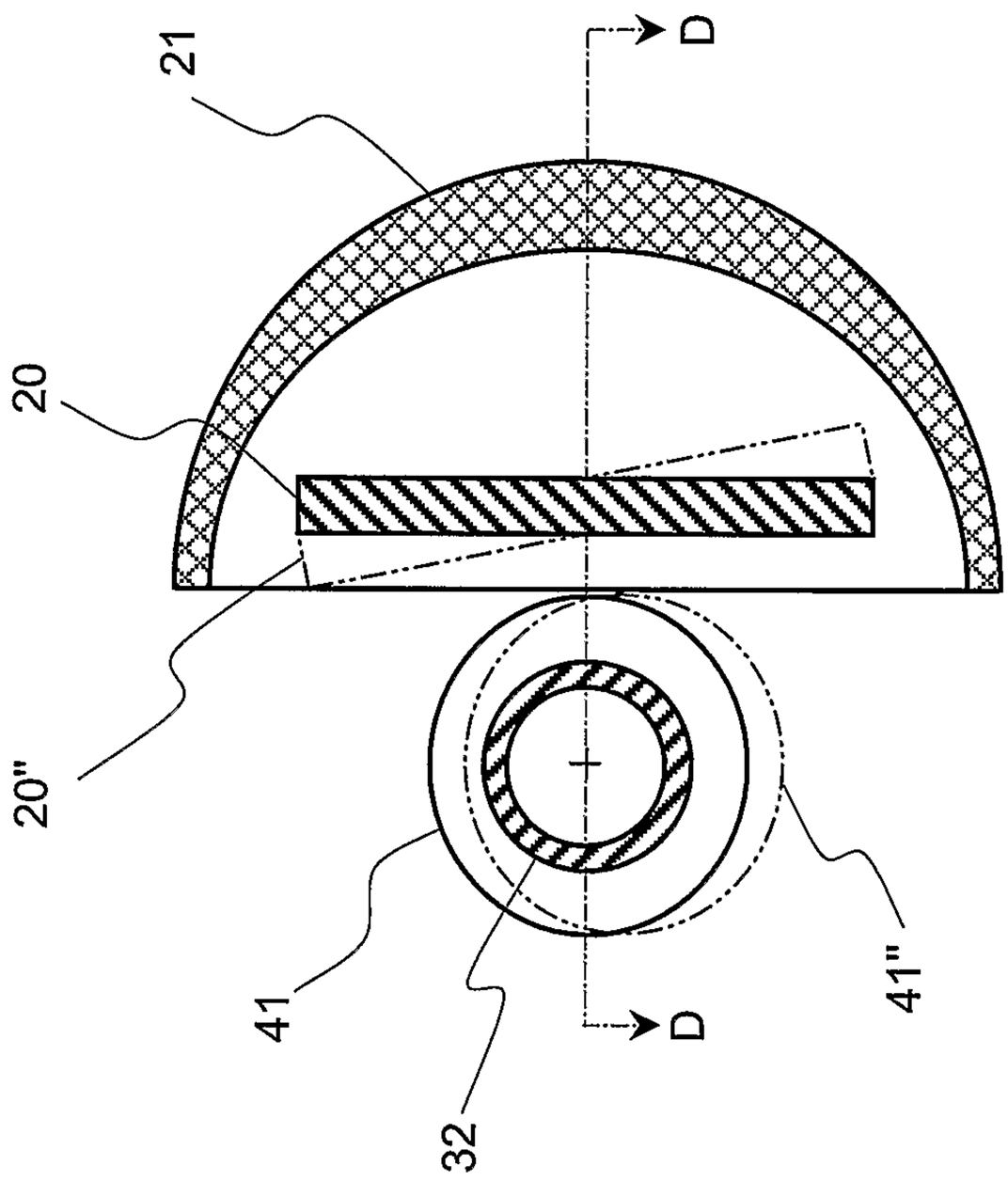


Fig. 22

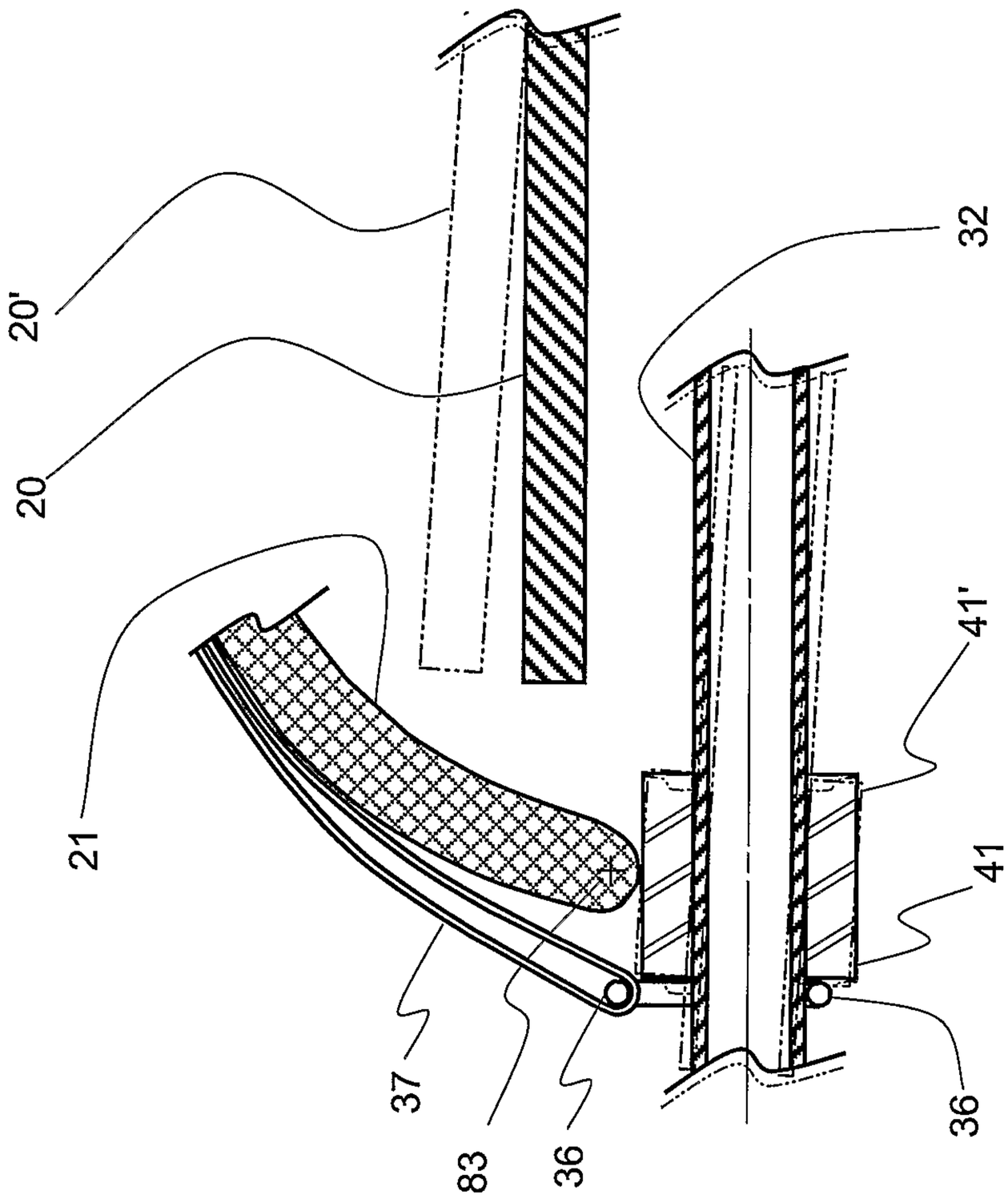
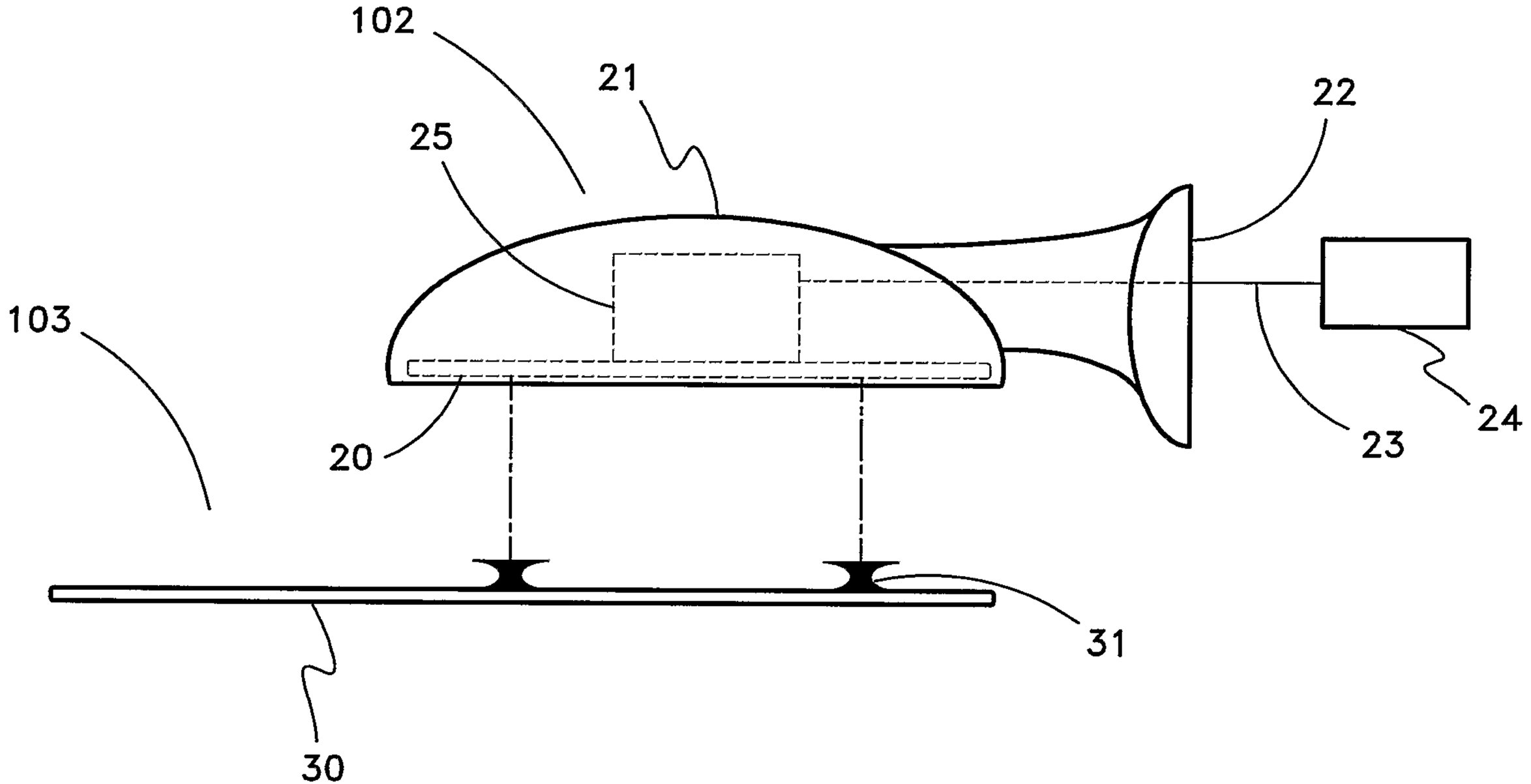


Fig. 23


102
21
25
22
103
24
23
20
31
30