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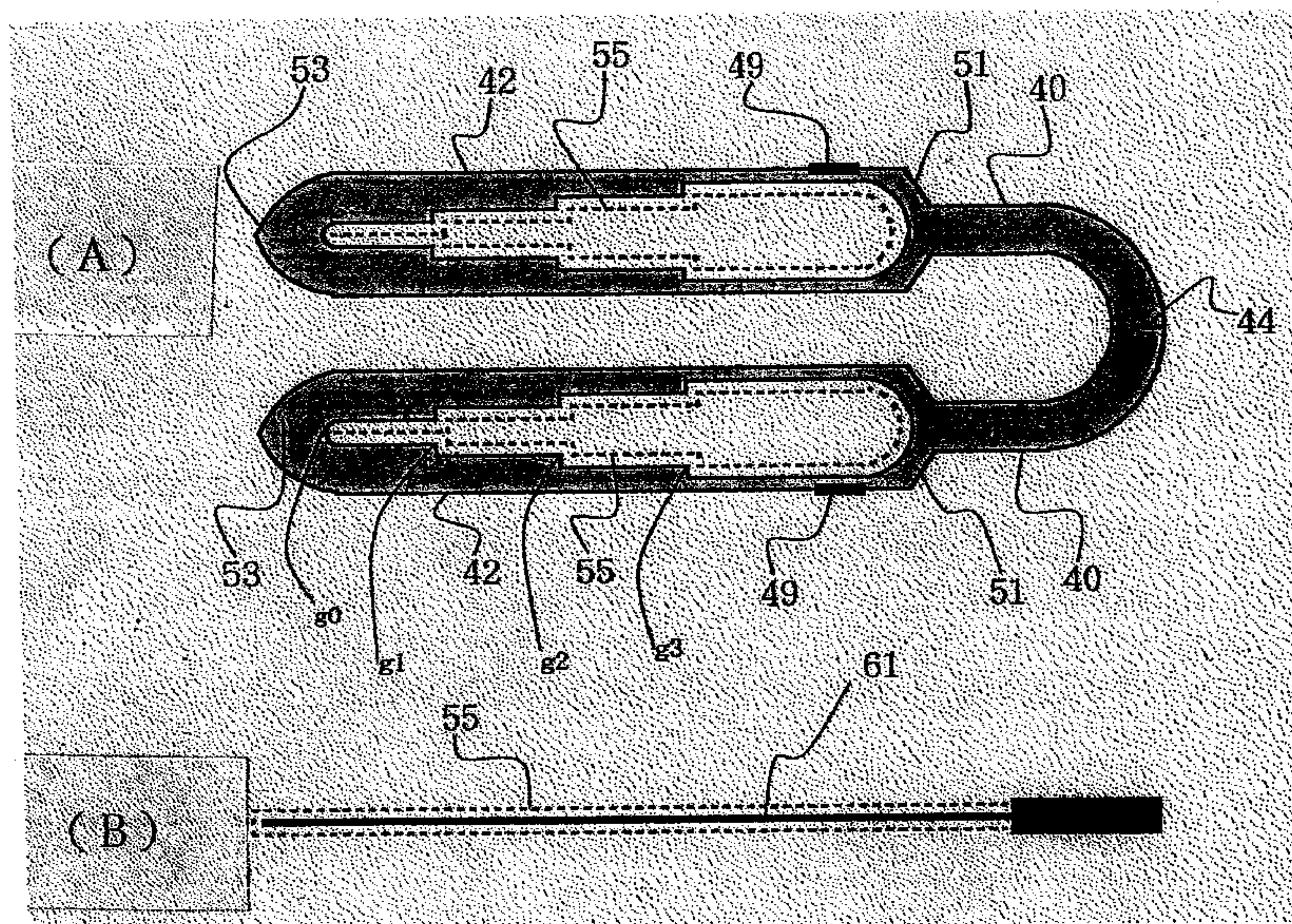
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(30) 1999/06/17 (11-170456) JP

(30) 1999/08/26 (11-239706) JP

(54) **APPAREIL POUR L'INTUBATION DU CONDUIT LACRYMAL**

(54) **APPARATUS FOR INTUBATION OF LACRIMAL DUCT**



(57) An apparatus for intubation of the lacrimal duct comprising a thinner tube (or rod), a thicker tube(s) extending from one end or both ends of a thinner tube (or rod) and a probe which is inserted through a small cut applied to the thicker tube(s) wherein for the tube to be pushed into the lacrimal duct using a probe, the inner surface of the thicker tube(s) has a step(s), protuberance(s), groove(s) and septum (septa), and the shape of the inner space of the thicker tube is the frustum of a circular cone, and for the probe to be removed easily, lubricants such as olive oil, lipiodol ultrafluid, ointment and so on are applied to the surface of the probe and/or inner part of the thicker tube, and also the thinner tube (or rod) is longer than the canalicular length for the boundary portion(s) between the thinner tube (or rod) and thicker tube(s) to be positioned in the lacrimal sac - nasolacrimal duct to get better stability in the lacrimal duct.

ABSTRACT

An apparatus for intubation of the lacrimal duct comprising a thinner tube (or rod), a thicker tube(s) extending from one end or both ends of a thinner tube (or rod) and a probe which is inserted through a small cut applied to the thicker tube(s) wherein for the tube to be pushed into the lacrimal duct using a probe, the inner surface of the thicker tube(s) has a step(s), protuberance(s), groove(s) and septum (septa), and the shape of the inner space of the thicker tube is the frustum of a circular cone, and for the probe to be removed easily, lubricants such as olive oil, lipiodol ultrafluid, ointment and so on are applied to the surface of the probe and/or inner part of the thicker tube, and also the thinner tube (or rod) is longer than the canalicular length for the boundary portion(s) between the thinner tube (or rod) and thicker tube(s) to be positioned in the lacrimal sac - nasolacrimal duct to get better stability in the lacrimal duct.

APPARATUS FOR INTUBATION OF LACRIMAL DUCT

TECHNICAL BACKGROUND

This invention relates to an apparatus for intubation of lacrimal duct (lacrimal drainage pathway) for treatment of lacrimal duct obstruction and so on.

PRIOR ART

A typical prior method of silicone intubation is shown in Japanese Patent Publication No. 56-50579.

In the prior method, the silicone tube is drawn into the lacrimal duct by a probe which is pulled out from the inferior nasal meatus.

Therefore, in the previous methods, a probe as a guide must be pulled out from the nostril. This maneuver is difficult. It is not rare that it takes a lot of time to retrieve the probes from the nostril or the retrieval is impossible.

For many years the present inventor has studied keenly for the treatment of lacrimal duct obstruction and dry eye, apparatus for intubation of the lacrimal duct which can be used easily with decreased pain to patients, can be quickly and correctly inserted into the lacrimal duct, is not easily dislocated during the intubation period, and can be easily removed after accomplishment of treatment.

As a result, various kinds of apparatus for intubation have been invented, for example, as shown in Japanese Patent Publication No.2811283,

Japanese Patent Publication No. 2572340, Japanese Patent Publication No. 2539325, Japanese Patent Publication No. 8-19271, Japanese Patent Publication No. 8-30104, Japanese Patent Publication No. 9-276318, Japanese Patent Publication No. 2572352, Japanese Patent Publication No. 10-256109.

Above all, the apparatus shown in Japanese Patent Publication No. 2539325 is a typical invention made by the present inventor.

As shown in Figs. 1~3, in the typical prior art apparatus, the central part 20~40 mm of the tube 50~120 mm in length is thinner and softer, and the bilateral parts of the tube are thicker, and both ends are sharp pointed and closed. Thus, the apparatus for intubation of the lacrimal duct resembling a "nunchaku" type device which is used by Chinese martial art practitioners, has been developed.

Fig. 3 (A) shows a cross sectional view showing a conventional nunchaku-style tubing.

As shown in Fig. 3, the thicker tube **42** is pushed into the lacrimal duct with the probe **61** which is inserted into the thicker tube. At the time, if there is too much lubricity between the probe **61** and the thicker tube **42**, the tube sometimes cannot be inserted into the lacrimal duct because the tip of the probe **61** slips on the inner surface **X** of the thicker tube, whereas, if the lubricity between the probe **61** and the thicker tube **42** is poor, the thicker tube sometimes turns back in the lacrimal duct together with the probe **61** when the probe **61** is removed from the thicker tube **42** (see for example, Kurihashi K: Dacryology, Medical A01 Shuppan, Inc, 1998, p.171).

SUMMARY OF THE INVENTION

One object of the present invention is to provide an apparatus which can be easily pushed into the lacrimal duct with the tip of a probe by making the inner surface of the thicker tube uneven.

Another object of the present invention is to provide an apparatus in which the probe can be easily removed from the thicker tube by making better lubricity between the probe and the thicker tube.

According to one mode of the invention, a step(s), protuberance(s), groove(s), other irregular surface and/or septum (septa) is applied to the inner surface of the thicker tube to make the inner surface uneven, and a septum (septa) is also applied.

By doing so, the thicker tube can be easily pushed into the lacrimal duct because the tip of the probe touches the step(s), protuberance(s), groove(s), other irregular surface or septum (septa). Furthermore lubricants such as olive oil, lipiodol ultrafluid and/or ointment are applied to the inner part of the thicker tube and/or probe. By doing so, better lubricity is provided between the thicker tube and the surface of the probe.

Although the columnar shape is good for the shape of the inner surface of the thicker tube, the frustum of the circular cone is better for the shape of the inner surface to operate the apparatus for intubation of the lacrimal duct. The shape of the frustum of the circular cone makes the thicker tube able to be pushed more effectively into the lacrimal duct.

The materials and shapes for the thicker tube and probe described in Japanese Patent Publication No. 2811283, Japanese Patent Publication No.

2572340, Japanese Patent Publication No.2539325, Japanese Patent Publication No. 2572352, Japanese Patent Publication No. 8-19271, Japanese Patent Publication No. 8-30104, Japanese Patent Publication No. 9-276318, Japanese Patent Publication No. 10-256109 can be used for the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view showing a conventional nunchaku-style tube.

Fig. 2 is a perspective view showing a conventional nunchaku-style tube.

Fig. 3A is a sectional view showing a conventional nunchaku-style tube shown in Fig. 2.

Fig. 3B is an end elevational view showing one end of a conventional nunchaku-style tube shown in Fig. 2.

Fig. 4A is a sectional view showing lubricant(s) applied to an apparatus according to the present invention.

Fig. 4B is an explanatory diagram showing lubricant(s) applied to a probe according to the present invention.

Fig. 5 is a sectional view showing an apparatus for intubation according to the present invention.

Fig. 6 is a sectional view showing an apparatus for intubation according

to the present invention.

Fig. 7 is a sectional view showing an apparatus for intubation according to the present invention.

Fig. 8 is a sectional view showing an apparatus for intubation according to the present invention.

Fig. 9A is a sectional view showing an apparatus for intubation according to the present invention.

Fig. 9B is an end elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 10A is a sectional view showing an apparatus for intubation according to the present invention.

Fig. 10B is an end elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 11A is a sectional view showing an apparatus for intubation according to the present invention.

Fig. 11B is an end elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 12A is a sectional view showing an apparatus for intubation according to the present invention.

Fig. 12B is an end elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 13A is a sectional view showing an apparatus for intubation

according to the present invention.

Fig. 13B is an end elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 14A is a sectional view showing other apparatus for intubation according to the present invention.

Fig. 14B is an end elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 15A is a sectional view showing other apparatus for intubation according to the present invention.

Fig. 15B is an end elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 16 is a sectional view showing other apparatus for intubation according to the present invention.

Fig. 17A is a sectional view showing other apparatus for intubation according to the present invention.

Fig. 17B is an end elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 18 is a sectional view showing other apparatus for intubation according to the present invention.

Fig. 19 is a sectional view showing other apparatus for intubation according to the present invention.

Fig. 20 is an explanatory diagram showing bicanalicular intubation

according to the present invention.

Fig. 21 is a perspective view showing an apparatus for monocanalicular intubation shown in Japanese Patent Publication No.10-256109.

Fig. 22 is an explanatory diagram showing monocanalicular intubation shown in Japanese Patent Publication No.10-256109.

Fig. 23A is a perspective view showing an apparatus for intubation according to the present invention.

Fig. 23B is an end elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 23C is an end elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 24A is a perspective view showing an apparatus for intubation according to the present invention.

Fig. 24B is an end elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 24C is an end elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 25 is a perspective view showing an apparatus for intubation according to the present invention.

Fig. 26A is a sectional view showing an apparatus for intubation according to the present invention.

Fig. 26B is an end elevational view showing one end of an apparatus for

intubation according to the present invention.

Fig. 26C is an and elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 27A is a sectional view showing an apparatus for intubation according to the present invention.

Fig.27B is an end elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 27C is an end elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 28A is a sectional view showing an apparatus for intubation according to a present invention.

Fig. 28B is an end elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 28C is an end elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 29A is a sectional view showing an apparatus for intubation according to the present invention.

Fig. 29B is an end elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 29C is an end elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 30A is a sectional view showing an apparatus for intubation

according to the present invention.

Fig. 30B is an and elevational view showing one end of an apparatus for intubation according to the present invention.

Fig. 31 is an explanatory diagram showing a previous apparatus for intubation.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Embodiment shown in Figs. 4~20

As shown in Fig. 4(A), thicker tubes are connected with both ends of the thinner tube (or rod), while the inner surface of the thicker tube has steps **g1**, **g2**, **g3** and the tip of the thicker tube **42** is sharp pointed, conical in shape and closed.

As shown in Fig. 4(A) (B), lubricant **55** such as olive oil, lipiodol ultrafluid, and/or ointment is applied to the inner part of the thicker tube and/or probe in advance.

Small cuts (1.5~1.0mm in length) **49** for the probe (0.25~0.4mm in diameter) **61** to insert, are made. The small cuts **49** are applied to the thicker tubes parallel to the axis of the tube **42**. The positions of the small cuts **49** are near the other end of the thicker tube **42**. Markings corresponding to the positions of the small cuts make it easier to discover the small cuts.

The length and thickness of the tube depend on the length of the lacrimal duct and size of the inner space of the individual lacrimal ducts. The

present invention (85~105mm in total length) which consists of the central thinner tube (or rod) **40** (0.5mm in thickness and 25mm in length), and bilateral thicker tube **42**, (1mm in outer diameter, 0.5mm in inner diameter and 30~40mm in length) is most frequently used.

Although in order for the tube to be stable in the lacrimal duct, it is important that the central segment of the tube is thinner and softer, other optional shapes of it are also useful.

The middle point **44** of the central thinner segment is marked.

The thicker tubes **42** are connected with both ends of the thinner tube (or rod) with silicone adhesive.

As shown in Fig. 4, it is better to make a slope at the junction **51** between the thicker tube **42** and the thinner tube (a rod) **40**.

As shown in Fig. 4, if the tip **53** of the thicker tube **42** is sharp pointed and in conical shapes, it is more easily inserted from the lacrimal puncta.

As shown in Fig. 5, the thicker tubes **42** equipped with probes **61** in advance are more convenient.

As shown in Figs. 6, 7 and 8, the thicker tubes **42** can be pushed into the lacrimal duct by pushing the steps **g1**, **g2** and **g3** on the inner surface of the thicker tubes **42** with the tip of the probe **61**.

As shown in Figs. 9 and 10, the length **a** of the thicker tube is 15~40mm, the length **bb** of the thinner tube (or rod) is 15~30mm, and the length **q** of the boundary portion **51** between the thicker tube **42** and the thinner tube (or rod) is 1~3mm.

As shown in Figs. 9 and 10, the outer diameter **c** of the thicker tube is 0.7~1.2mm, the inner diameter **I** is 0.25~0.35mm, the inner diameter **II** is 0.35~0.4mm, the inner diameter **III** is 0.4~0.5mm, and the inner diameter **d** is 0.5~0.9mm. The outer diameter **f** of the thinner tube (or rod) is 0.3~0.6mm.

As shown in Figs. 9 and 10, the length **A** from the tip to closed end **g0** is 1~2mm, the length **B** from the closed end **g0** to step **g1** is 5~14mm, and the length **m1** from the tip to step **g1** is 6~16mm, the length **m2** from the step **g1** to step **g2** is 3~10mm, the length **m3** from the step **g2** to step **g3** is 3~10mm, the length **n1** from the step **g3** to small cut **49** is 3~10mm, the length **n2** of the small cut is 0.5~1mm, and the length **n3** from the small cut to other end of the thicker tube is 1~3mm.

As shown in Figs. 9 and 10, the wall thickness **e** of the thicker tube **42** is 0.15~0.3mm, and the height of the step is 0.03~0.3mm in any of the steps **S1**, **S2** and **S3**.

Fig. 11 shows a typical embodiment among many with step(s) shown in Figs. 9 and 10. Although in Figs. 9, 10 and 11, the number of steps in the thicker tube **42** is three: **g1**, **g2** and **g3**, more or less than three is also useful.

As shown in Fig. 12, if the shape of the inner space of the thicker tube is the frustum of the circular cone, a probe **61** can be pushed into the lacrimal duct easier. The reason for this is that because the angle **73** formed by the inner surface of the tube and the probe shown in Fig. 12 is greater than the angle **77** shown in Fig. 13, the tip of the probe can press the inner surface more effectively.

As shown in Fig. 14, if the protuberances **Y** and grooves **U** are applied to

the inner surface **72** with the shape of the frustum of the circular cone of the thicker tube, the thicker tube **42** can be pushed into the lacrimal duct by the probe **61** more easily than the apparatus for intubation shown in Figs. 12. Other irregular inner surface (not illustrated) is also useful for the thicker tube **42**.

As shown in Fig. 15, by setting the septa **W1**, **W2** and **W3** in the thicker tubes like knot(s) of bamboo, the thicker tubes can be inserted into the lacrimal duct securely and easily by using a probe **61**.

In the embodiment of Fig. 16 with a typical size, the thicker tube **42** consists of the anterior portion **42A** and posterior portion **42B**. The outer diameter of the anterior portion **42A** is 0.1~0.3 mm smaller than that of the posterior portion **42B**. There is a slope **52** and step **g1** between the two different sized tubes **42A** and **42B**.

In the embodiment shown in Fig. 17 with a typical size, the carrot thicker tubes **42C** are in the shape of a carrot and have the steps **g1**, **g2**. The different sized tubes **42A**, **42B** in Fig. 16 and the carrot thicker tubes **42C** in Fig. 17 can be more easily inserted into the lacrimal duct than the thicker tube **42** in Figs. 1~15.

In the embodiment shown in Fig. 18, the thicker rods **42R** are connected with a thinner rod **40**. The thicker rods **42R** have a hole **Z** for a probe **61** to be inserted. The thicker rods **42R** have the same size and shape as the thicker tube in Figs. 1~15.

The different sized thicker rods which have the same size and shape as the different sized thicker tubes **42A**, **42B** are also useful (not illustrated).

In the embodiment shown in Fig. 19, the carrot thicker rods **42CR** are connected with the thinner rod **40**. The carrot thicker rods **42CR** are in the shape of a carrot and have a hole **Z** for a probe to be inserted.

Fig. 20 shows an instance of the state of the present invention which is inserted into the lacrimal duct.

The thicker tubes (or rods) **42**, **42C**, **42A**, **B**, **42R**, **42CR** in Figs. 4~19 can be used as the thicker tube **42** for monocanalicular intubation, for example, in Figs. 21 and 22 as shown in Japanese Patent Publication No.10-256109 and Figs. 23 and 24 with typical size and shape which are other apparatus for monocanalicular intubation according to the present invention.

As shown in Fig. 25, the apparatus in Figs. 21~24 are designed based on the nunchaku style tubing in Fig. 2 and consists of a half part of the nunchaku style tubing and a brim **23** which is glued with the end of the thinner tube (or rod) **40**.

And Figs. 26~30 with typical size and shape show an apparatus for monocanalicular intubation according to the present invention. In the embodiments shown in Figs. 23, 26 and 27, the thinner rod **40** 16mm in length consists of the horizontal segment **hr** 11.6mm in length, curved segment **an** 3.2mm in length and vertical segment **vt** 1.2mm in length and the end of the latter is glued with the brim **23**.

In Figs. 24 and 28~30 with typical size, the thinner rod **40** 15mm in length consists of the horizontal segment **hr** 10.4mm in length, slope **sl** 1.2mm in length, narrow segment **nr** 2mm in length and short segment **sh** 1.2mm in length.

Fig. 22 shows an instance of the state of the present invention in Figs. 23~30 which is inserted into the lacrimal duct from the upper punctum.

As shown in Figs. 20 and 22, the boundary portion **51** must be positioned in the lacrimal sac - nasolacrimal duct for the stability of the apparatus in the lacrimal duct.

The canalicular length of an adult is 10~15mm with an average of 11mm (for example see Kurihashi K:Dacryology, Medical A01 shuppan Inc., Tokyo, 1998),. Therefore, the thinner tube (or rod) **40** in Fig. 20 must be 20~30 mm or more in length for adults, and the thinner tube (or rod) **40** in Fig. 22 must be 10~15mm or more for adults. If the boundary portion **51** is positioned in the canaliculus as shown in Fig. 31, the apparatus are not stable in the lacrimal duct and easily dislocate.

The length of the thinner tube (or rod) in Fig. 22 is more than the canalicular length to get better stability in the lacrimal duct. By doing so, the boundary portion **51** between the thinner tube (or rod) **40** and thicker tube (or rod) **42** positioned in the lacrimal sac - nasolacrimal duct **11, 12** which runs perpendicularly and slight posteriorly and thinner tube (or rod) **40** in the horizontal part of the canaliculus **7,8** which runs horizontally and is pulled by the thicker tube (or rod) with the help of gravity, results in good stability in the lacrimal duct without fixation like the nunchaku style tube shown in Fig.20.

The thicker tube (or rod) **42** is heavier than the thinner tube (or rod) **40**. With the pulling effect of the thicker tube (or rod) **42**, the brim **23** in Figs. 21~30 presses the punctum and prevents tear fluid from entering the punctum (the opening of the canaliculus).

The apparatus in Figs. 4~30 can be used as a drug delivery system or in conjunction with a drug delivery system as in the conventional nunchaku-style tube in Figs. 1~3, and the brim **23** in Figs. 23~30 can be used as the ocusert which is a drug delivery system for glaucoma, or other drug delivery system (For example see Kurihashi K: Japanese Patent Publication No.9-276318).

Apparatus for intubation of the lacrimal duct can be easily inserted into the lacrimal duct, resulting in a short operating time and small burden on patients.

WHAT IS CLAIMED IS:

1. An apparatus for intubation of the lacrimal duct comprising first and second thicker tubes extending from both ends of a thinner tube (or rod), the thicker tubes having a small cut, and a probe which is inserted through the small cut of the thicker tubes to enable the insertion of the thicker tubes and thinner tube (or rod) into the lacrimal duct, wherein the thicker tubes have inner surfaces which are convex and/or concave in shape.
2. An apparatus for intubation of the lacrimal duct as defined in claim 1, wherein the shape of the inner surface of the thicker tubes is the frustum of a circular cone.
3. An apparatus for intubation of the lacrimal duct as defined in claim 1 or 2, wherein the inner surface of the thicker tubes have a step, and the longer the distance from the tip, the larger the inner space of the thicker tubes becomes.
4. An apparatus for intubation of the lacrimal duct as defined in claim 1, 2 or 3, wherein the inner surface of the thicker tubes has a soft and elastic protuberance(s), groove(s), other irregular surface and/or septum (septa).
5. An apparatus for intubation of the lacrimal duct as defined in any of claims 1~4, wherein the thicker tubes consist of two different sized tubes in outer diameter.
6. An apparatus for intubation of the lacrimal duct as defined in any of claims 1~4, wherein the thicker tubes are in the shape of carrot.
7. An apparatus for intubation of the lacrimal duct as defined in any of claims 1~6, wherein the thicker rod without inner space having a hole is used

instead of the thicker tube.

8. An apparatus for intubation of the lacrimal duct as defined in any of claims 1~7, wherein lubricant such as olive oil, lipiodol ultrafluid and/or ointment is applied to the inner part of the thicker tube and/or probe.

9. An apparatus for intubation of the lacrimal duct as defined in any of claims 1~8, wherein the boundary portions (51) between the thinner tube (or rod) and thicker tubes (or rods) are positioned in the lacrimal sac - nasolacrimal duct.

10. An apparatus for intubation of the lacrimal duct comprising: the half part of an apparatus defined in any of claims 1~9, and a brim wherein the brim is glued with the end of the thinner tube (or rod) and the thinner tube (or rod) is longer than the canalicular length for the boundary portion (51) to be positioned in the lacrimal sac - nasolacrimal duct.

11. An apparatus for intubation of the lacrimal duct defined in claim 10, wherein the thinner tube (or rod) consists of the horizontal, curved and vertical segments.

12. An apparatus for intubation of the lacrimal duct defined in claim 10, wherein the thinner tube (or rod) consists of the horizontal segment, slope, narrow segment and short segment.

13. An apparatus for intubation of the lacrimal duct defined in any of claims 10~12, wherein the brim is in charge of a drug delivery system.

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FIG. 1

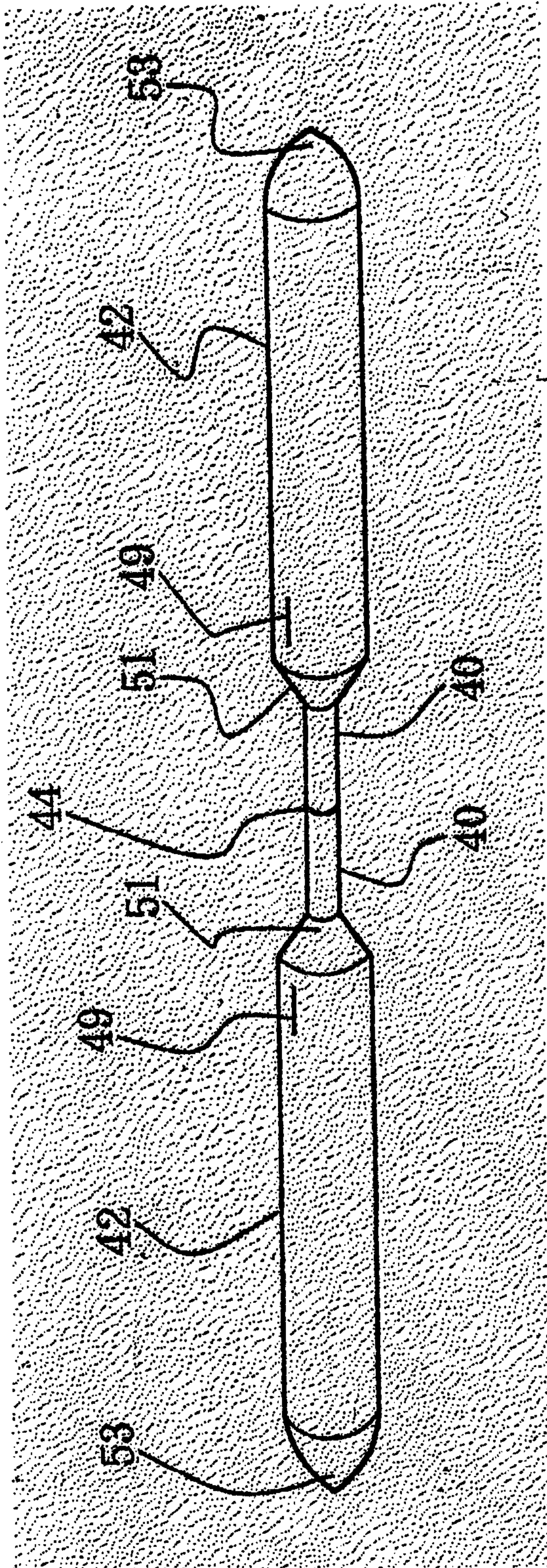


FIG. 2

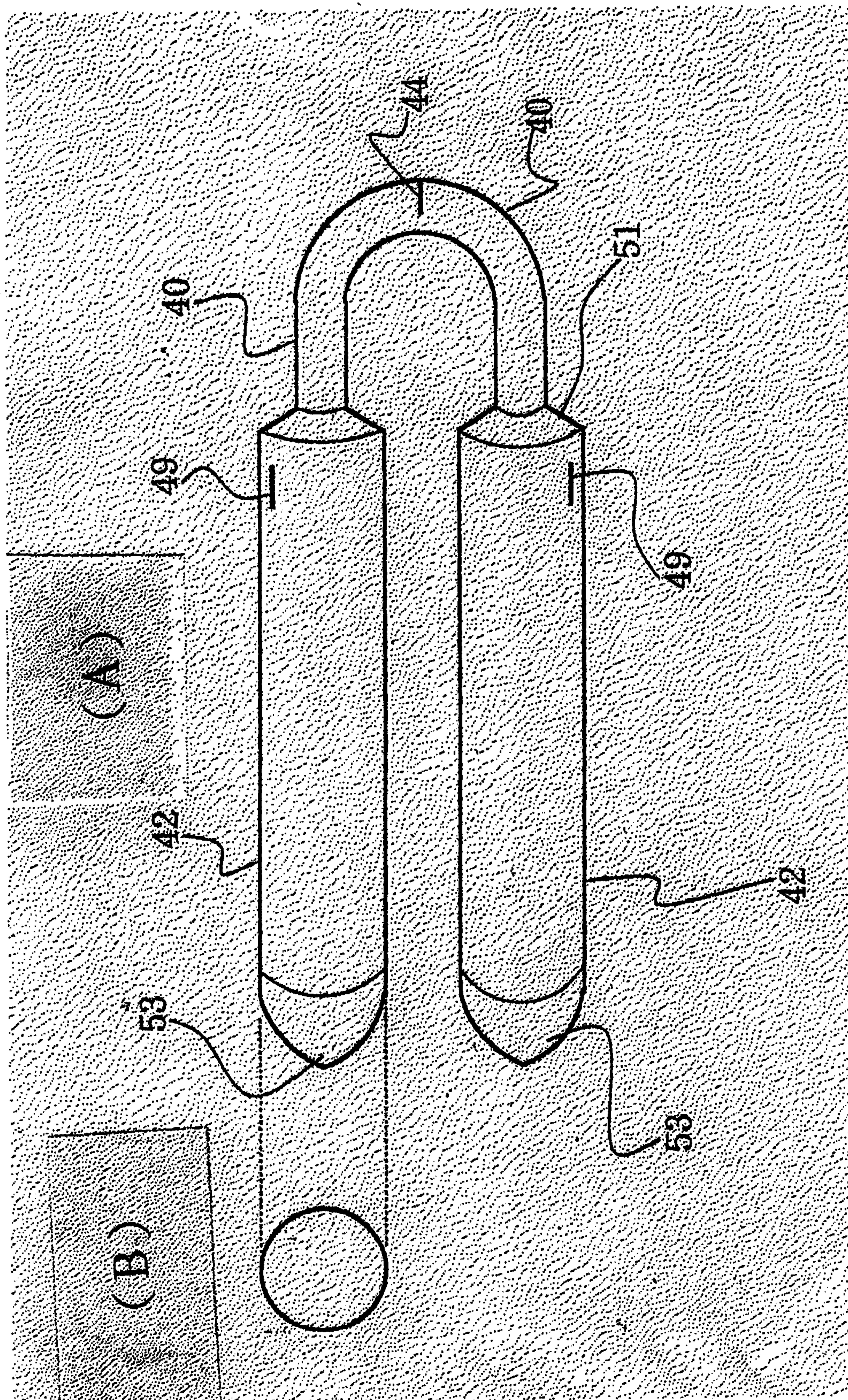


FIG. 3

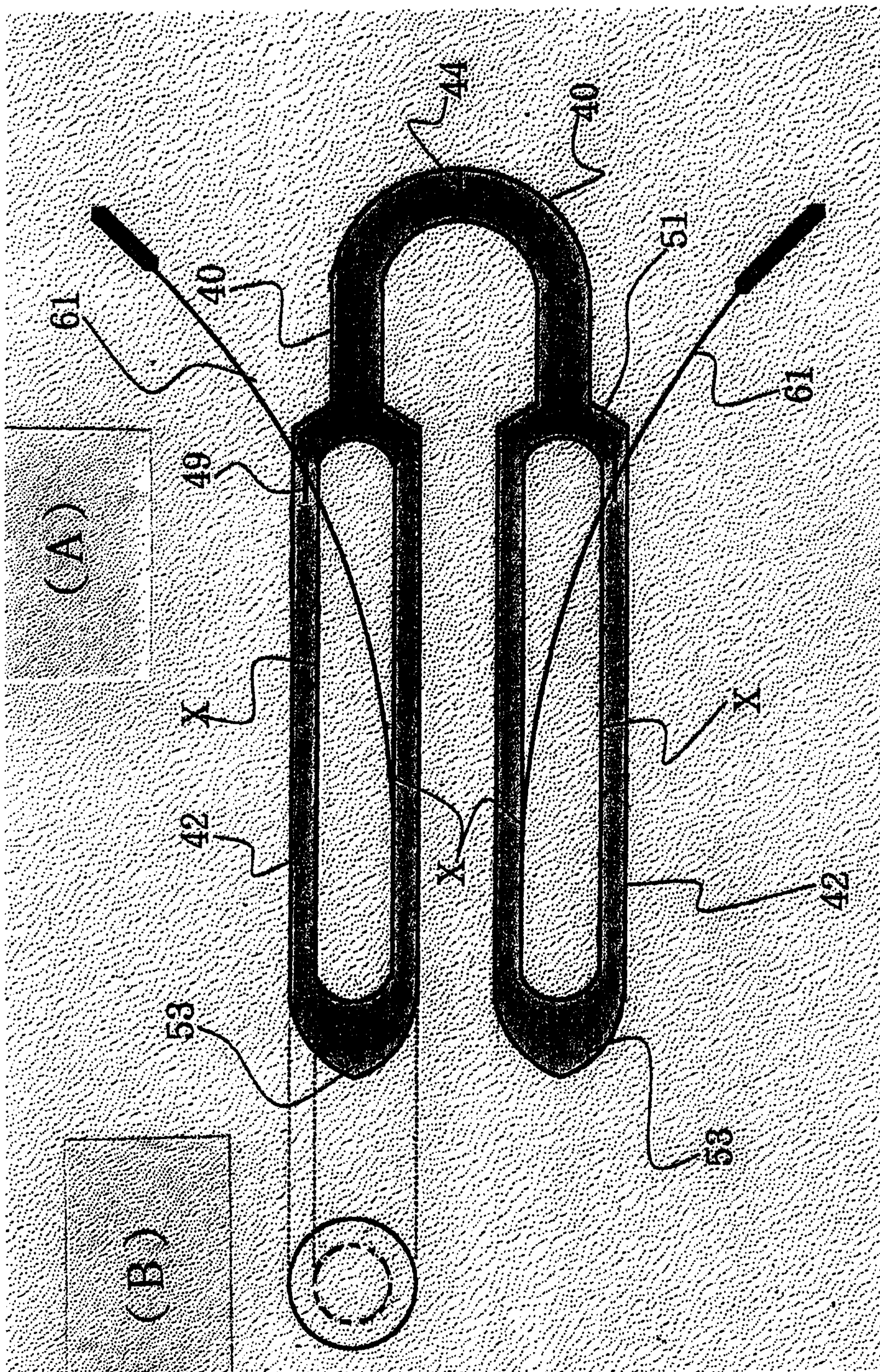


FIG. 4

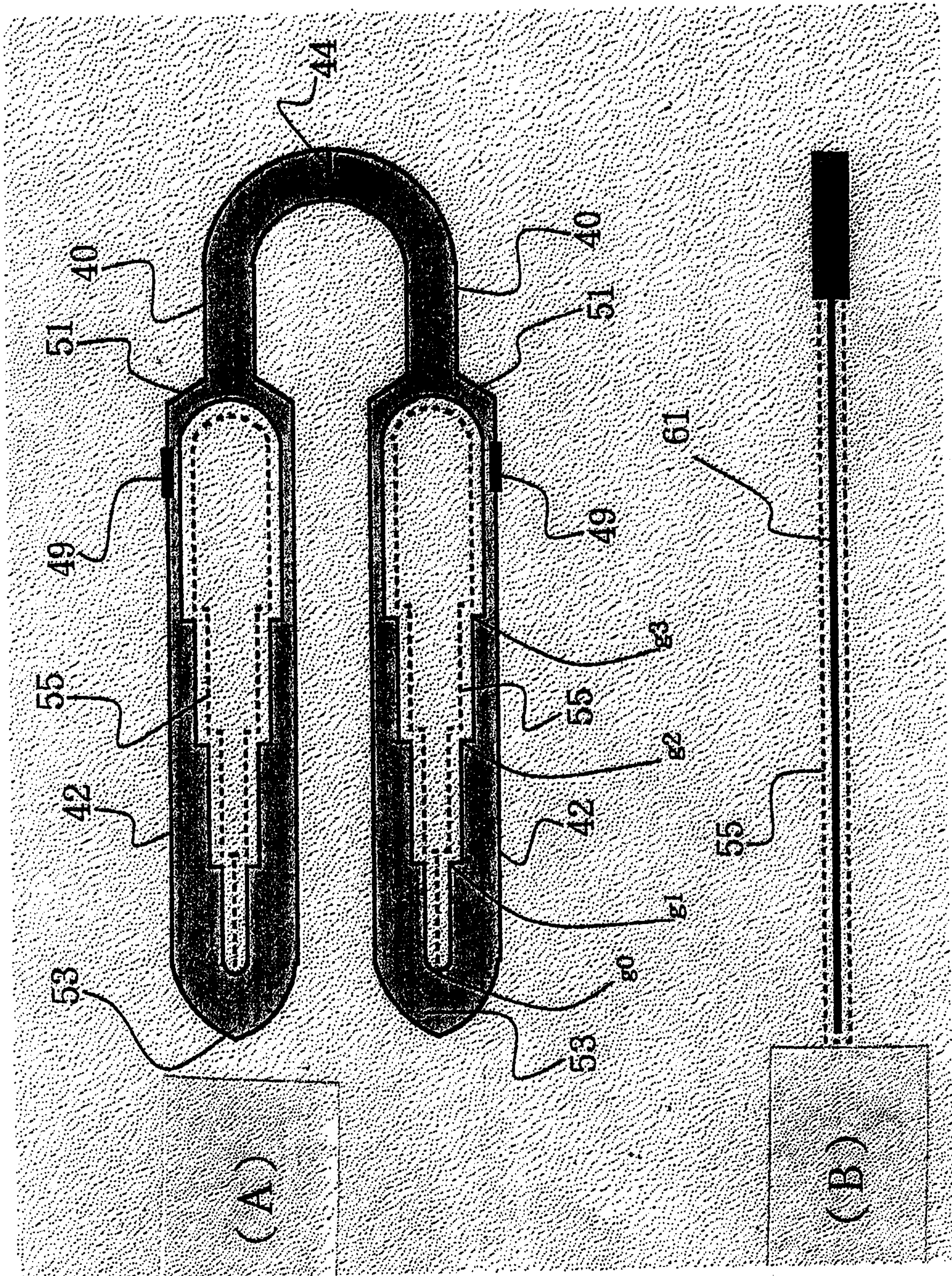


FIG. 5

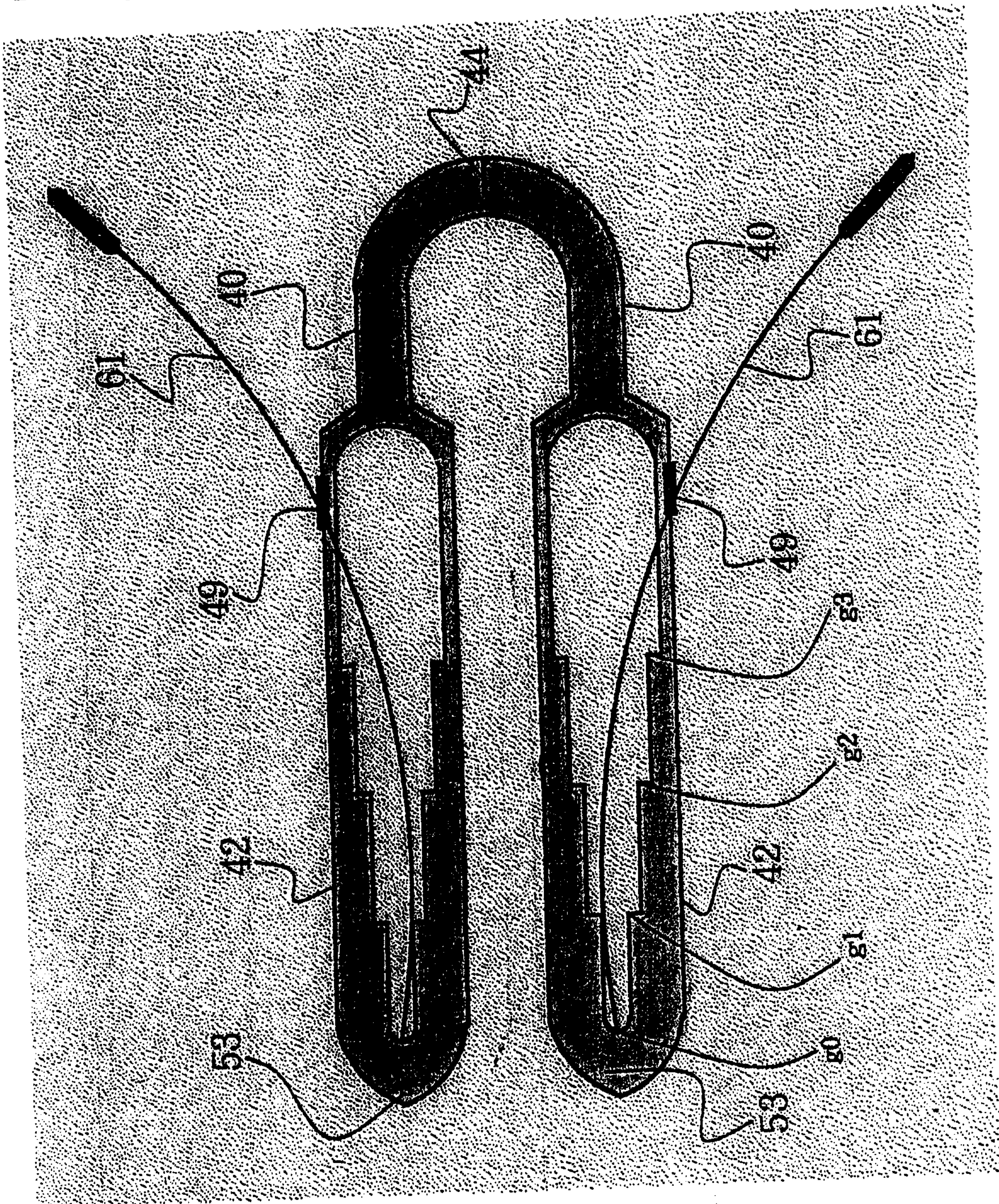


FIG. 6

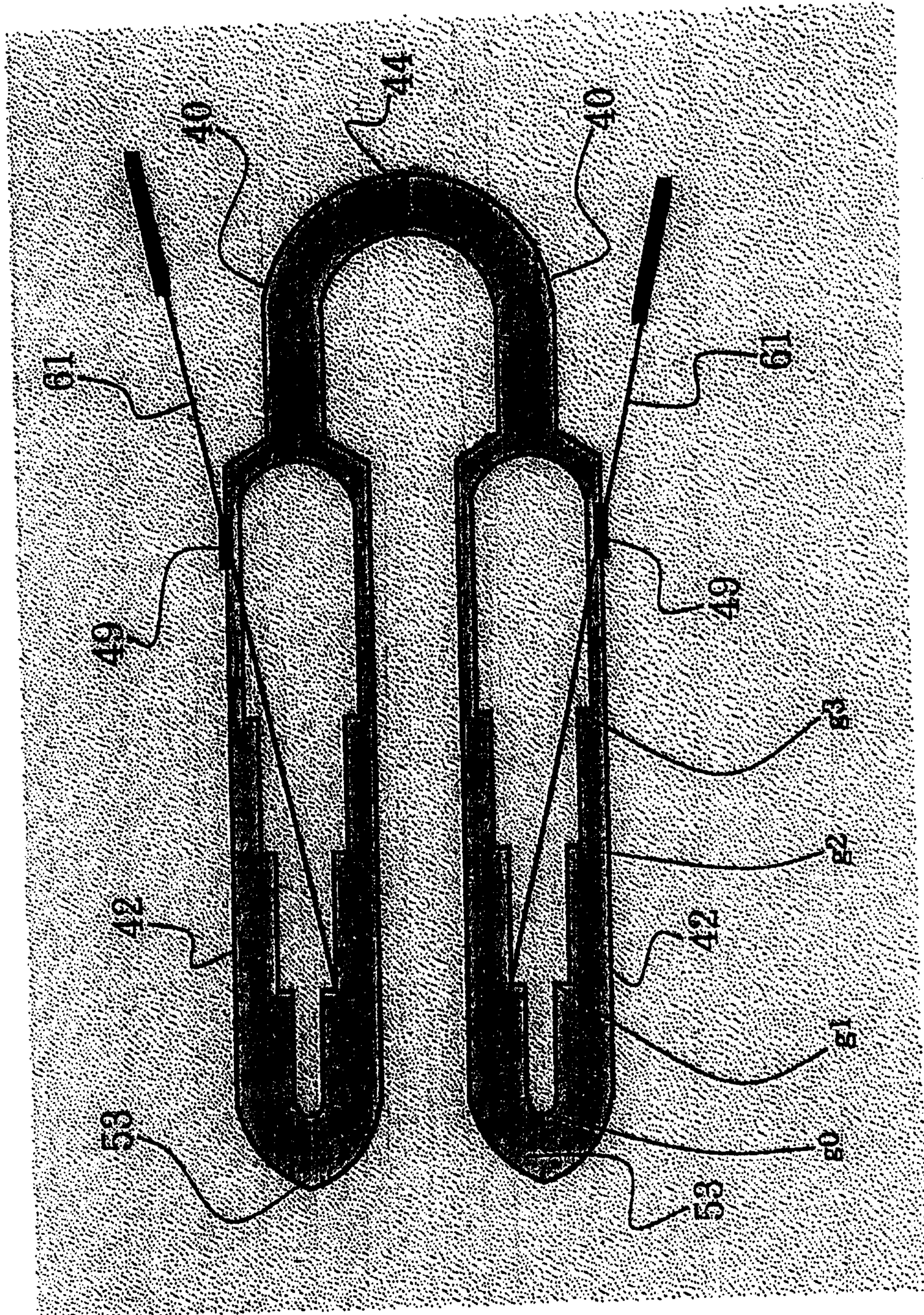


FIG. 7

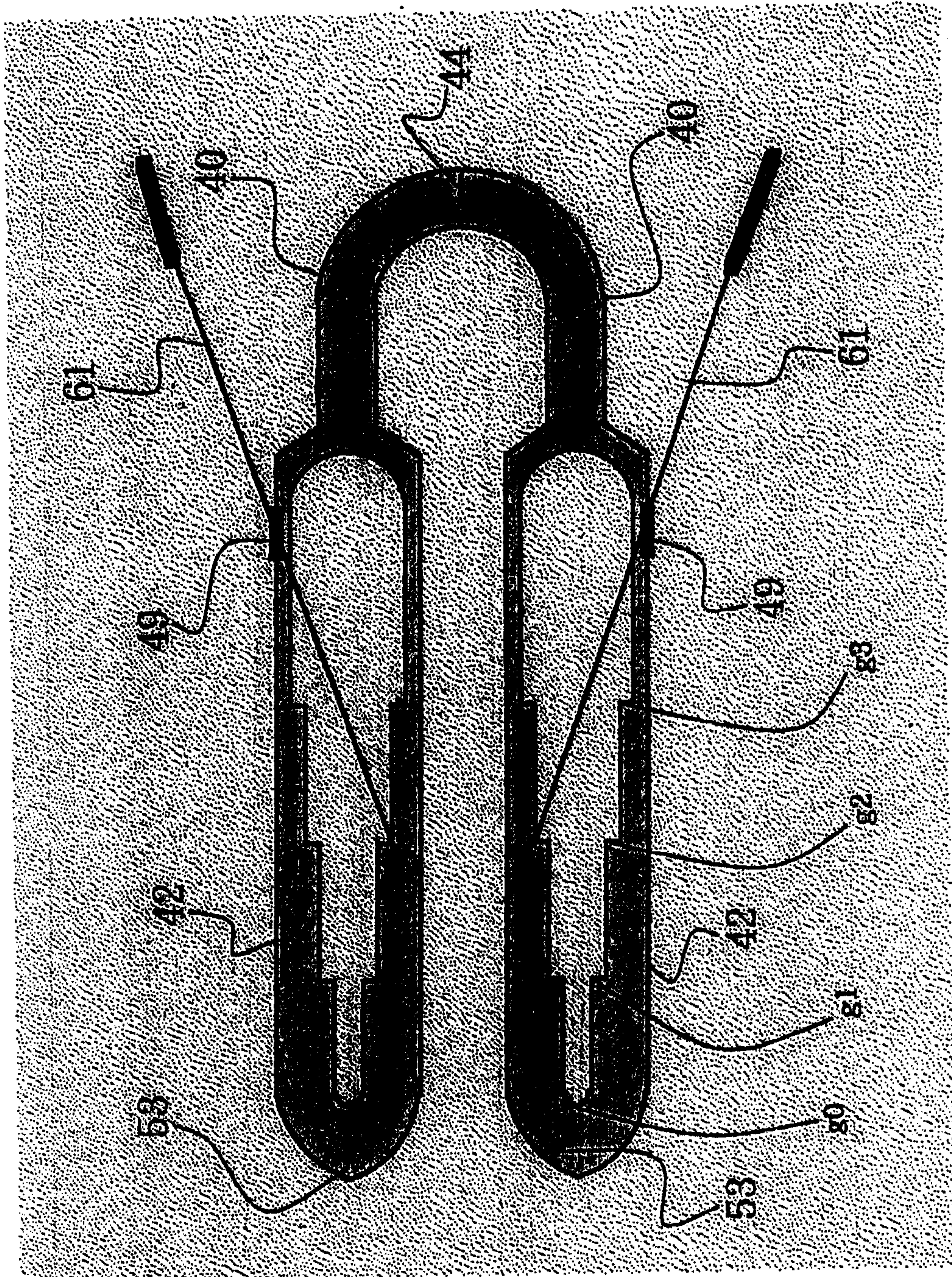


FIG. 8

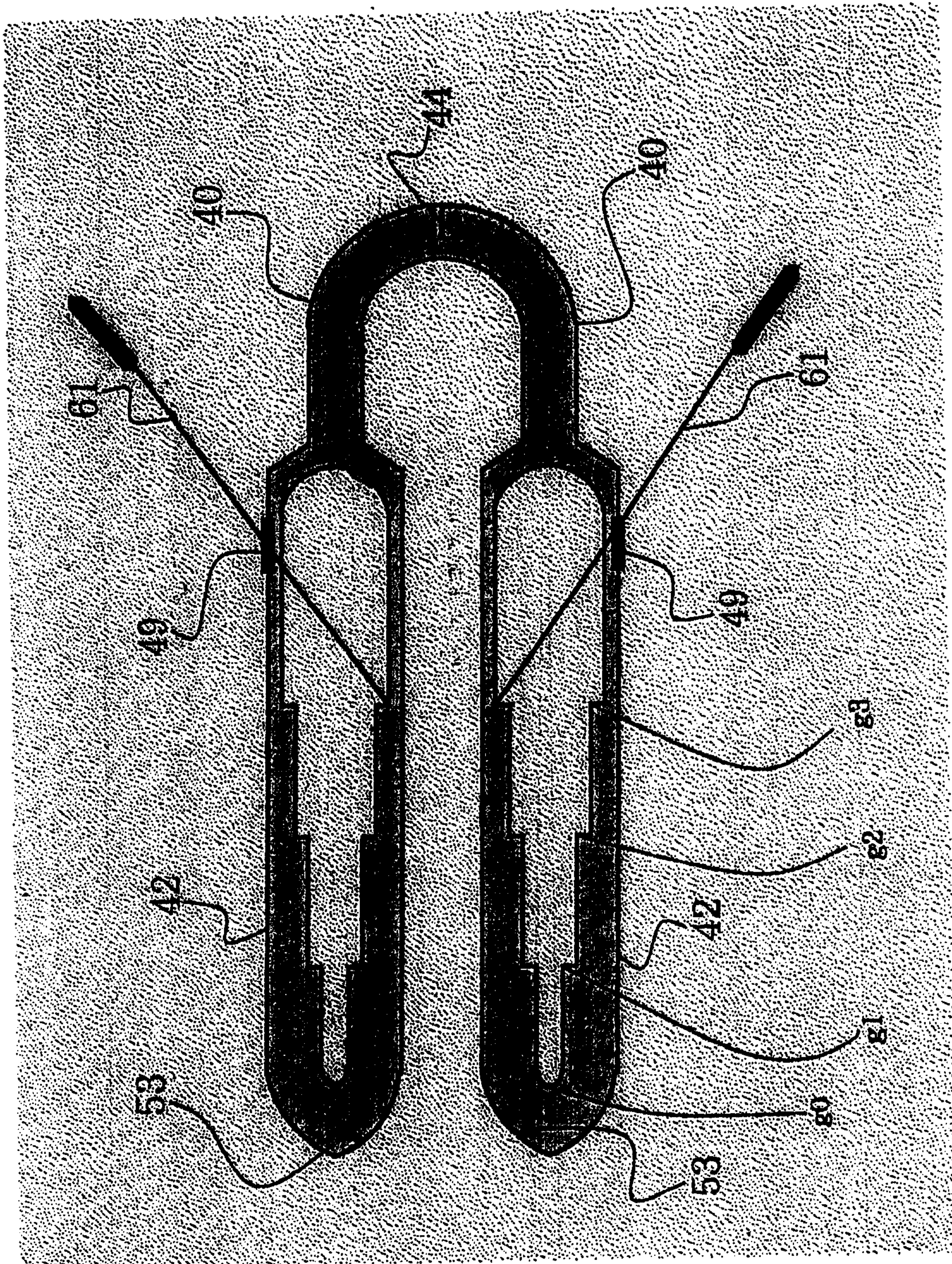


FIG. 10

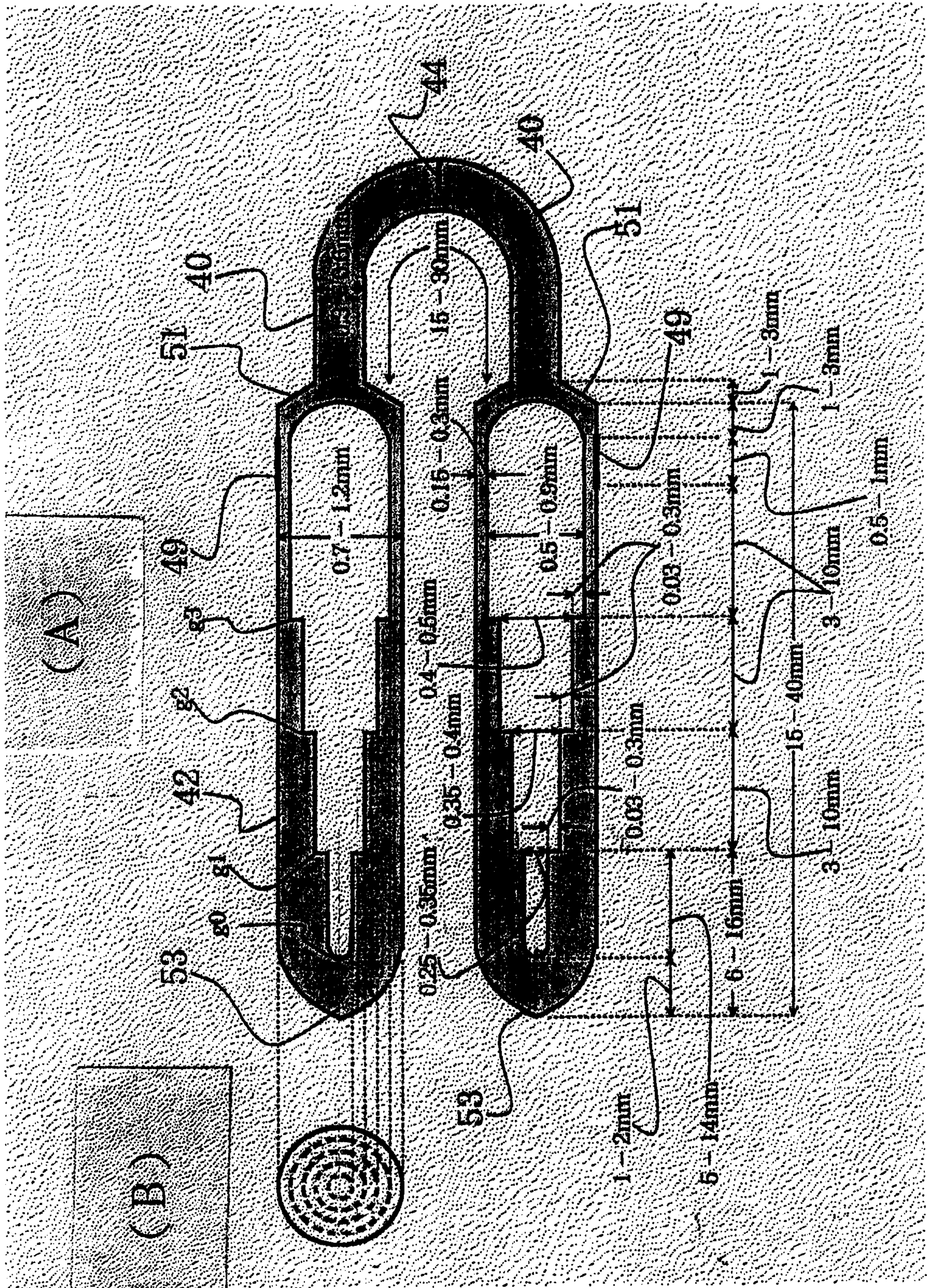


FIG. 12

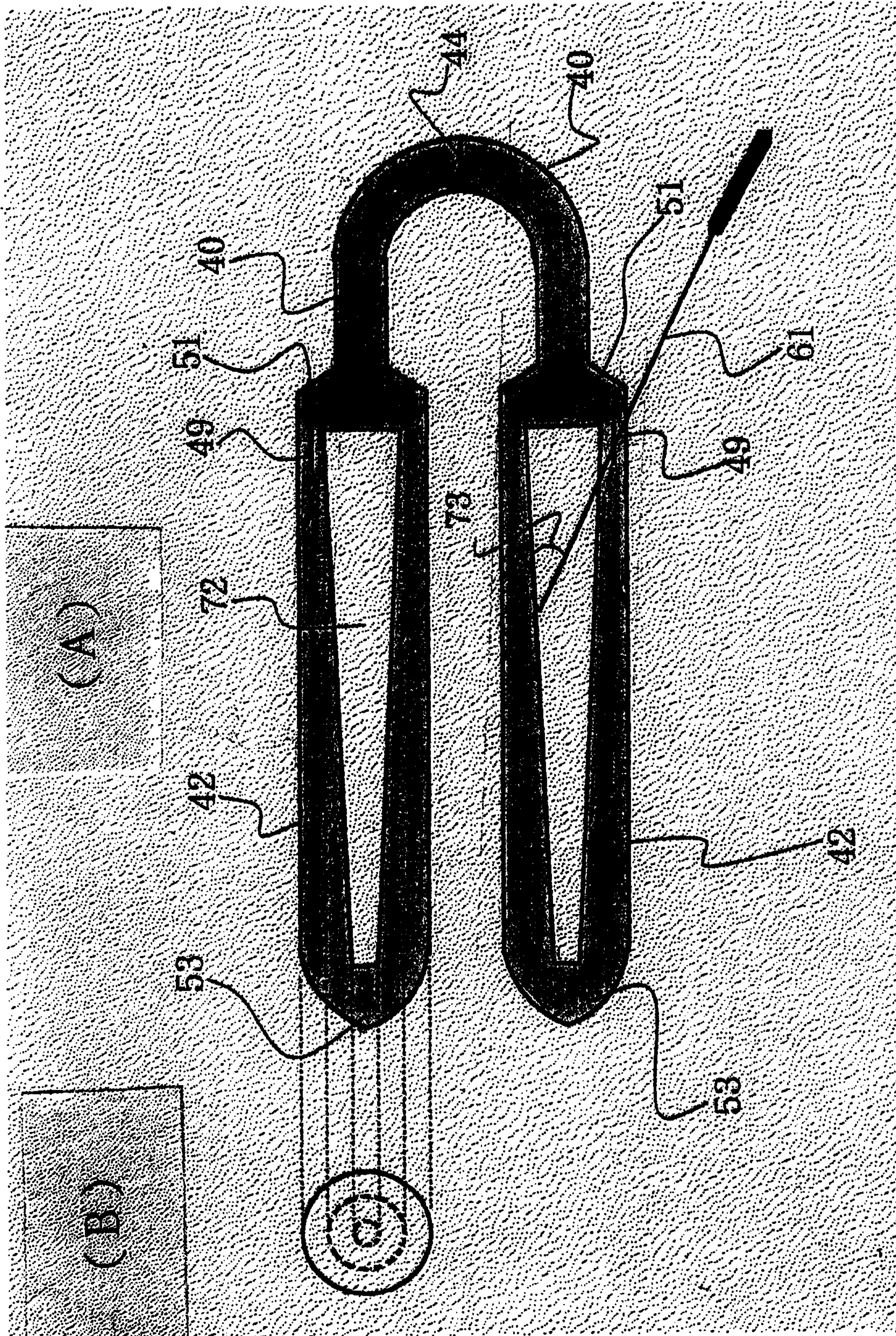


FIG. 13

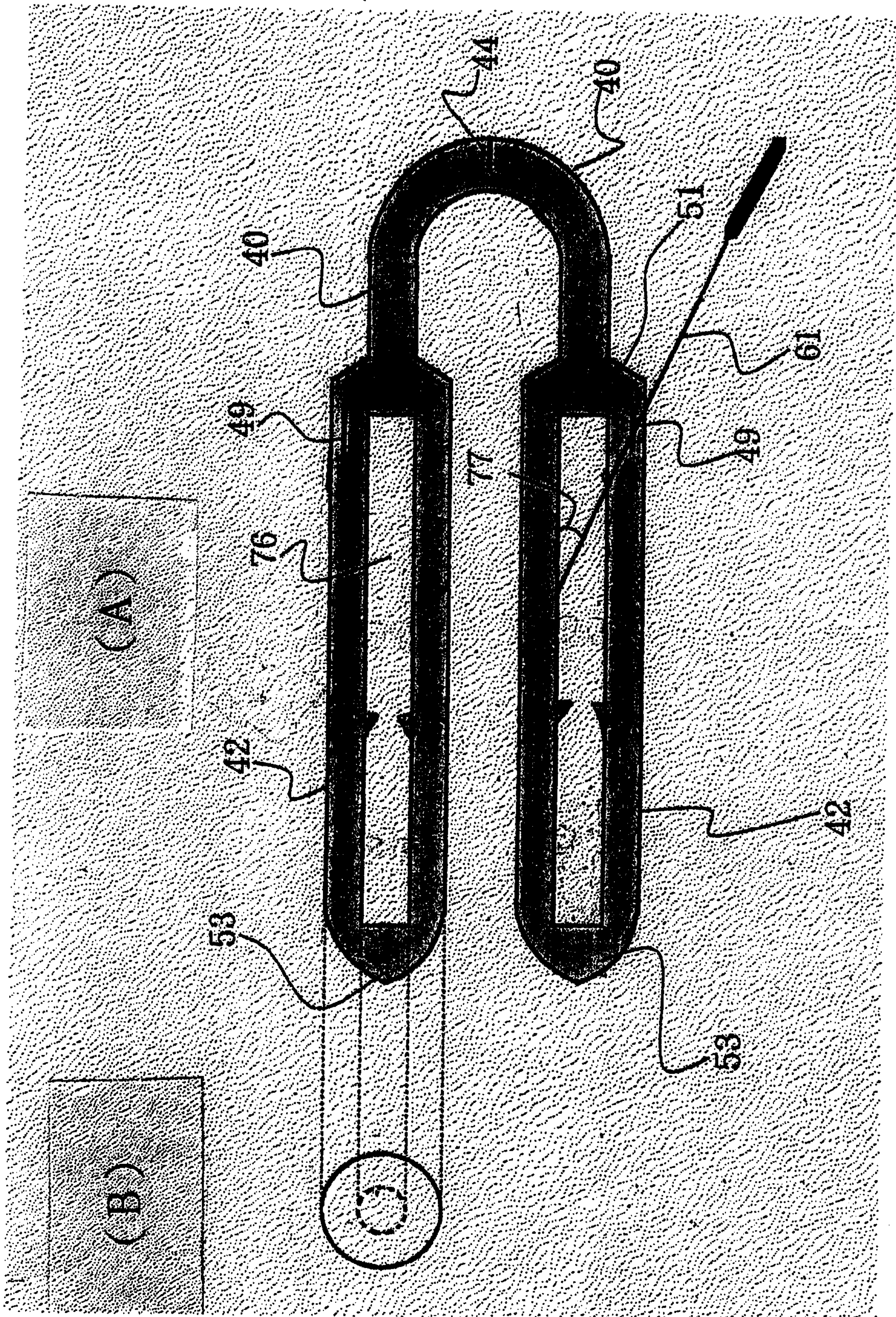


FIG. 14

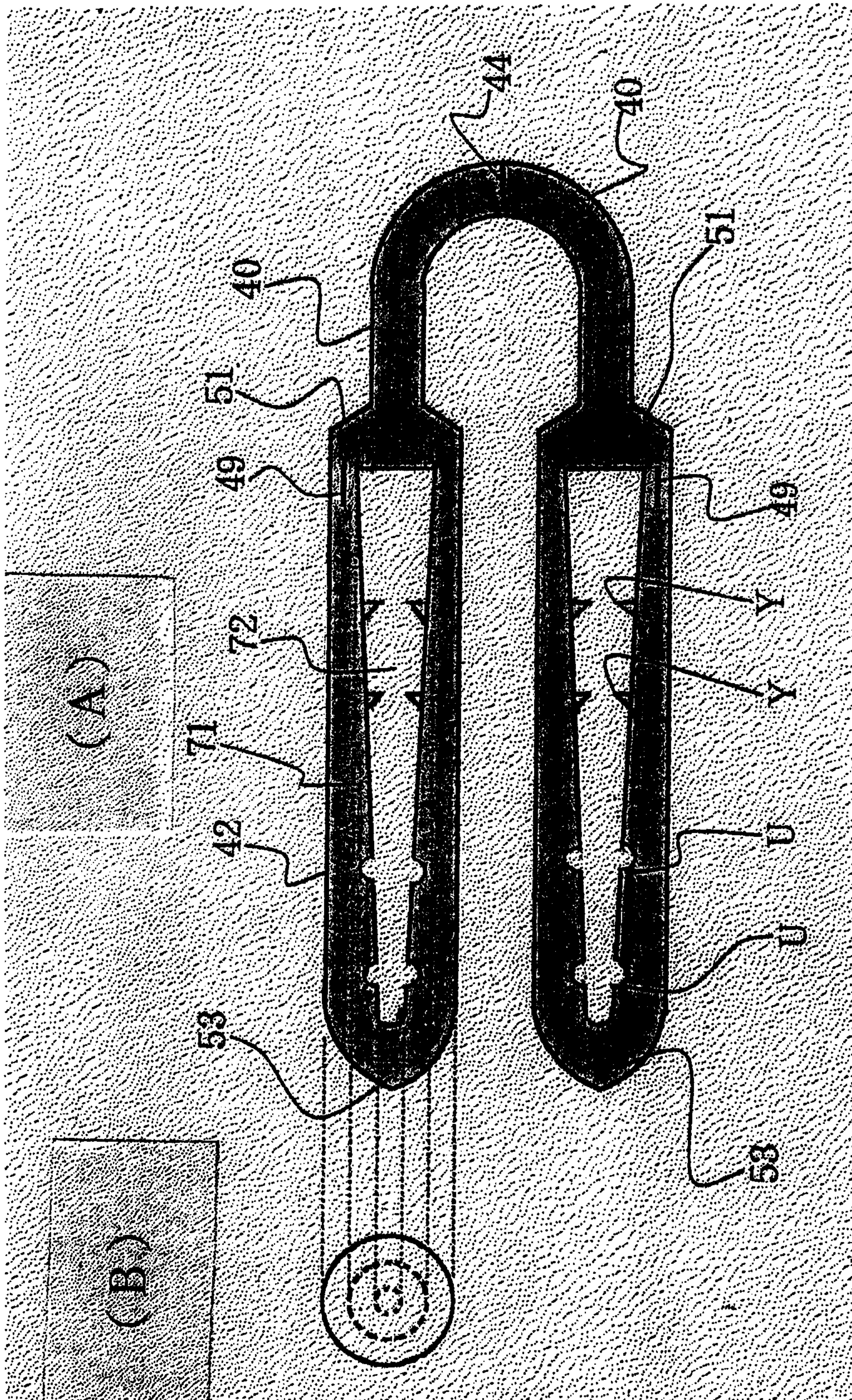


FIG. 16

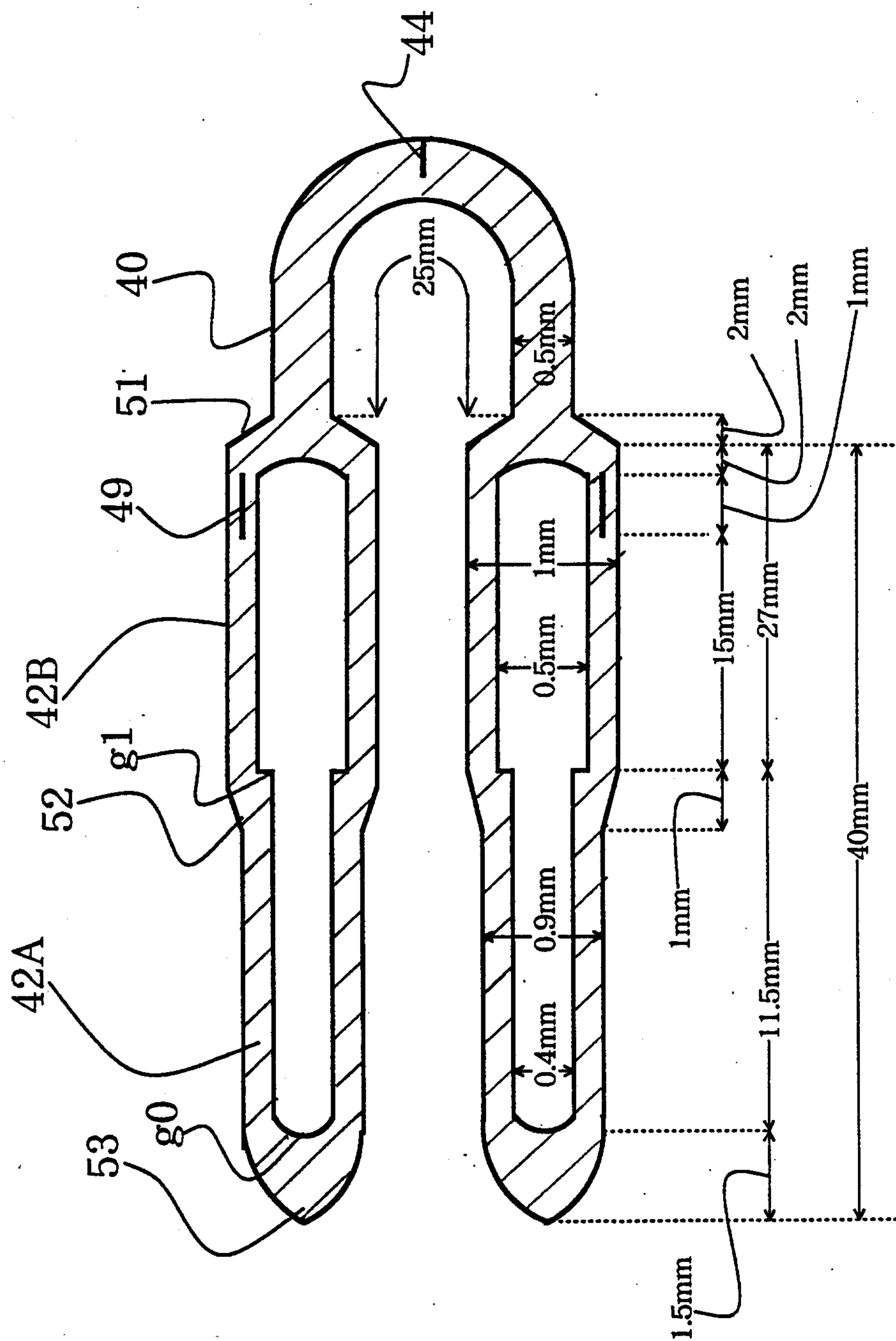


FIG. 17

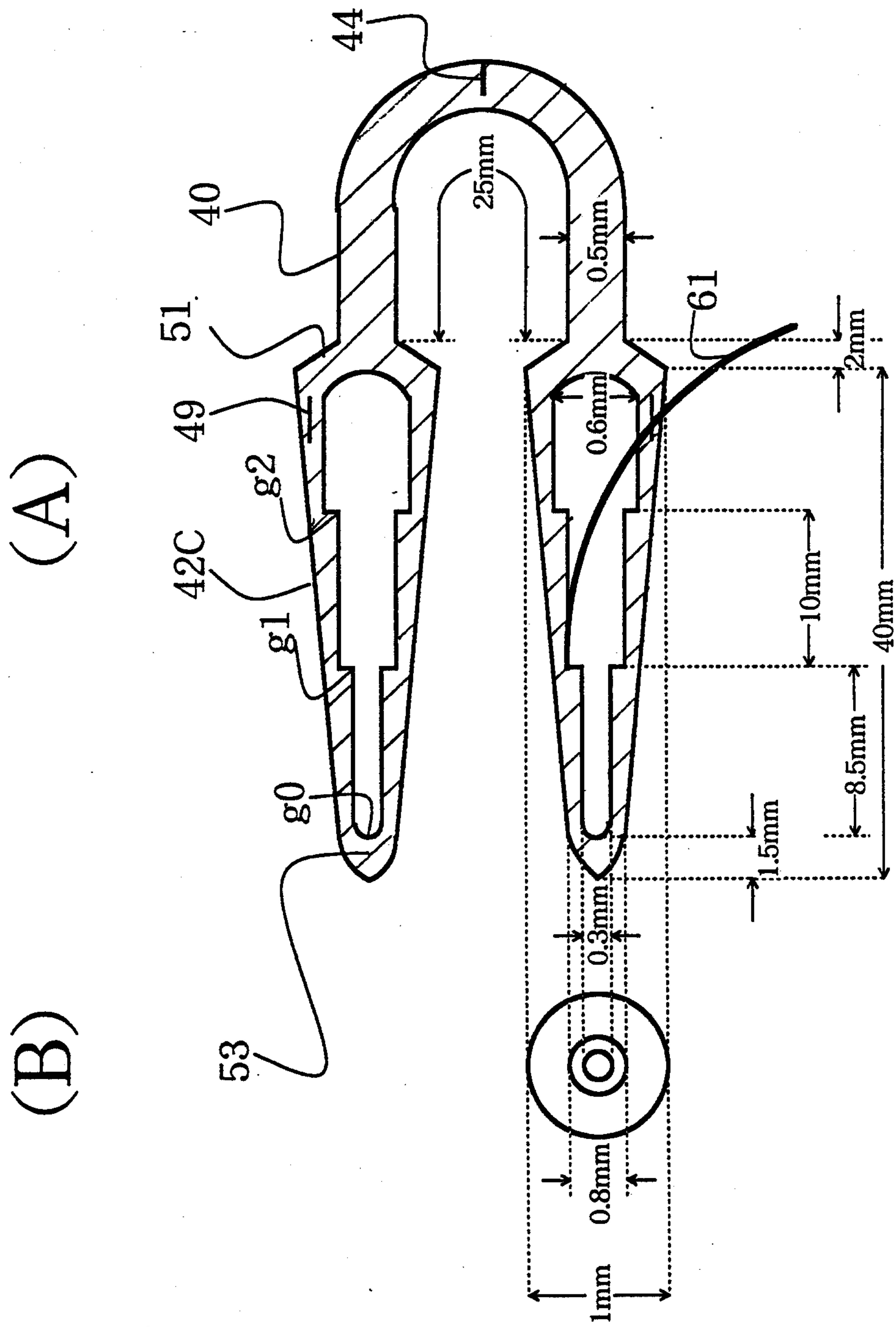


FIG. 18

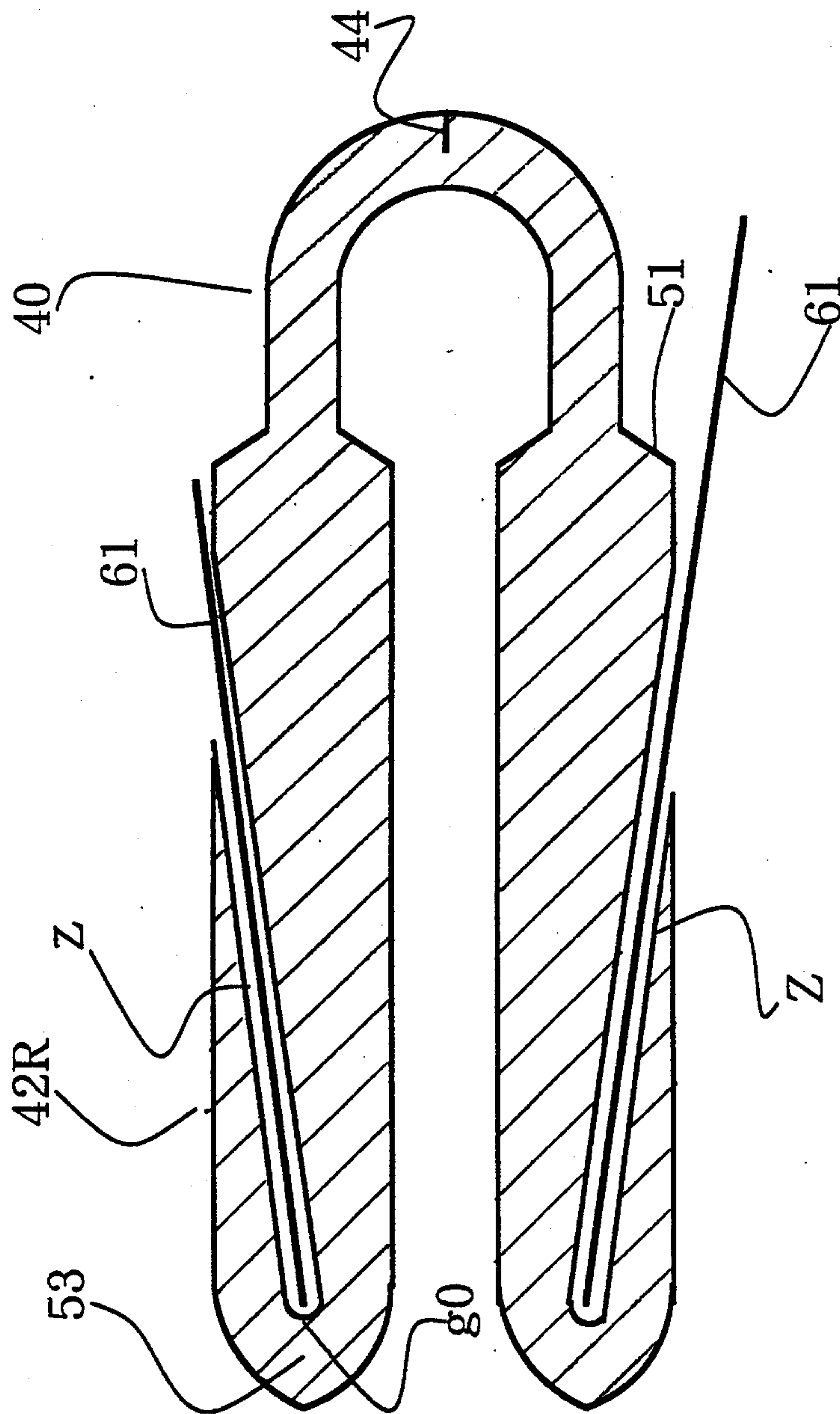


FIG. 19

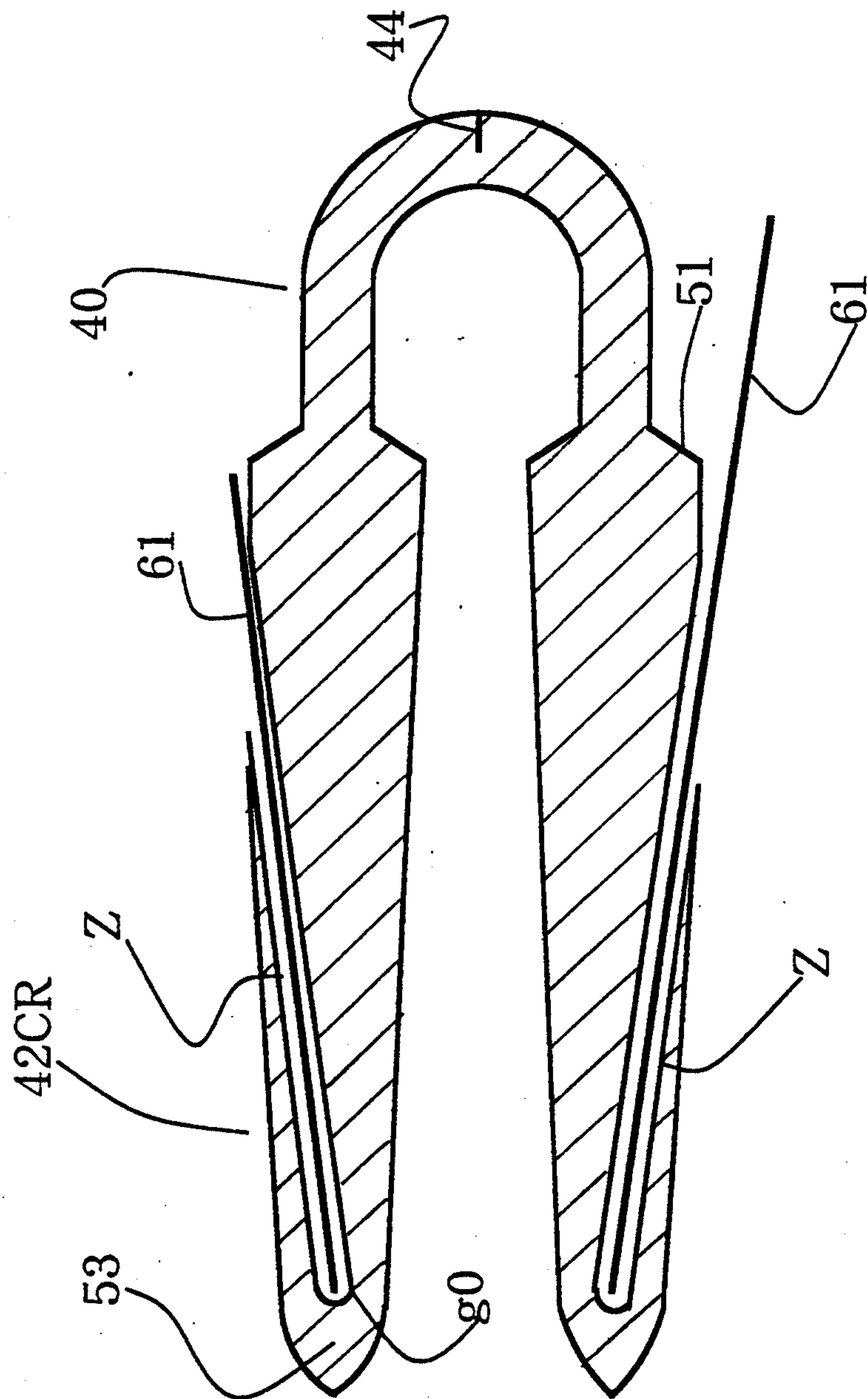


FIG. 20

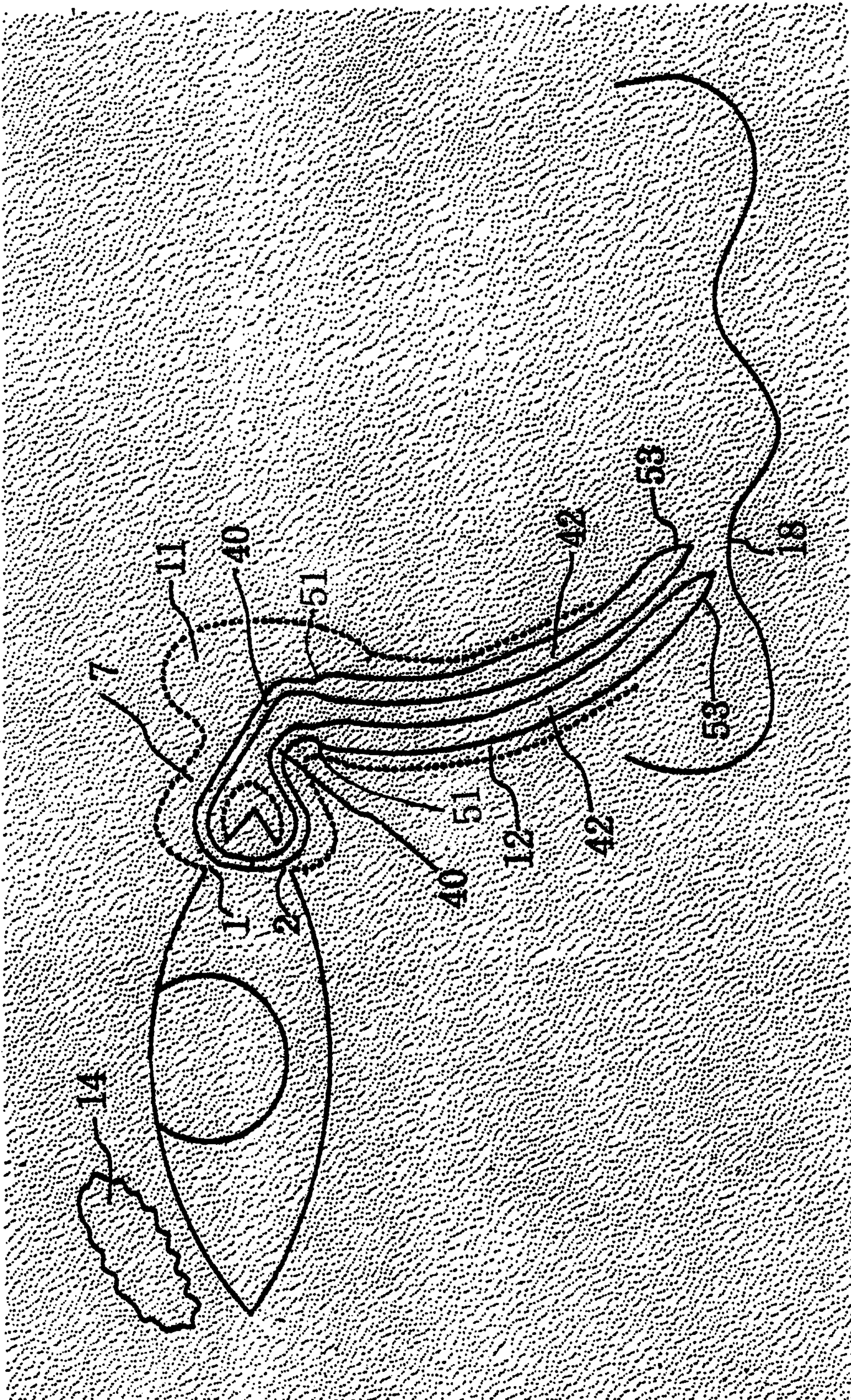


FIG. 21

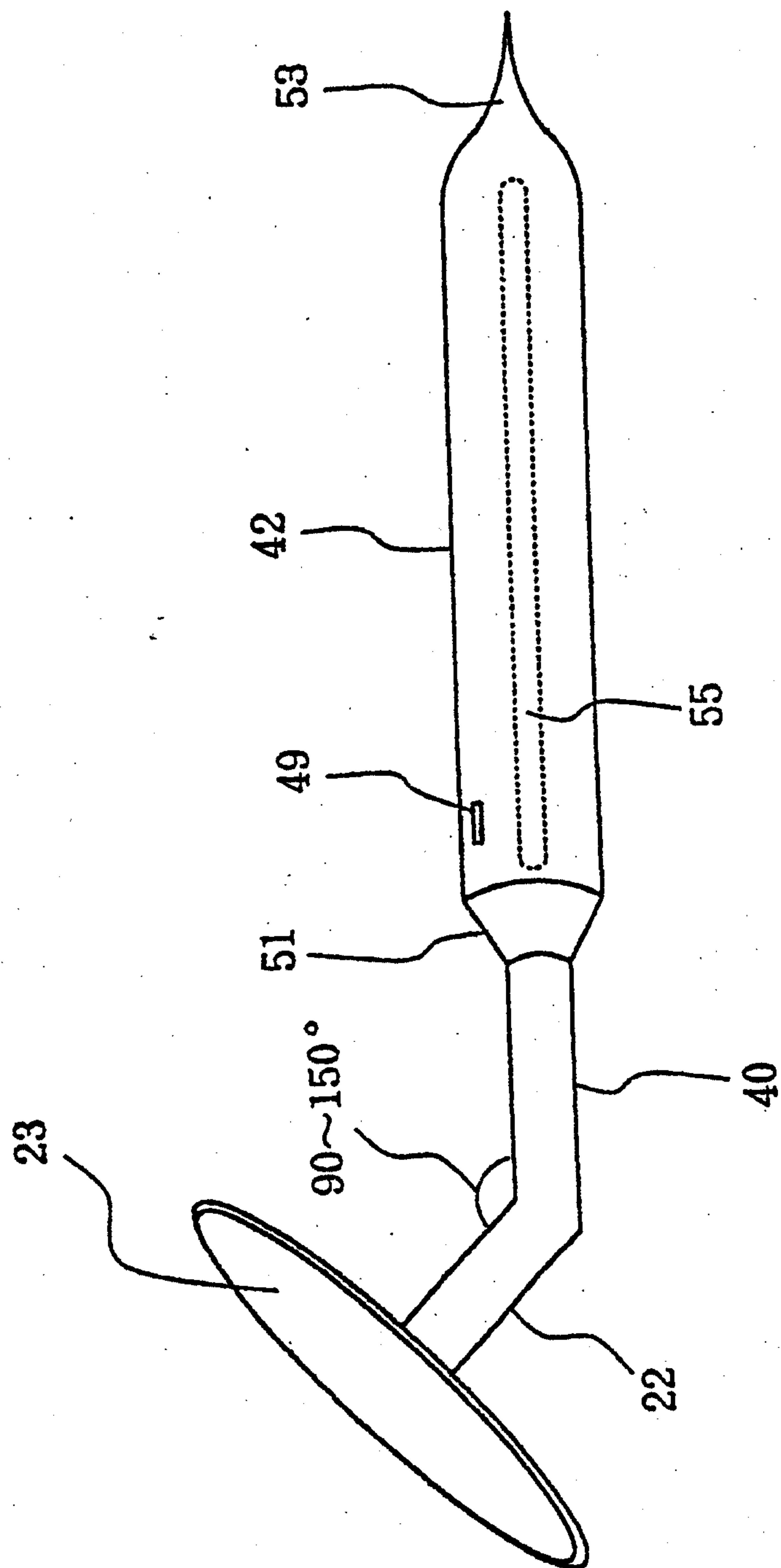


FIG. 22

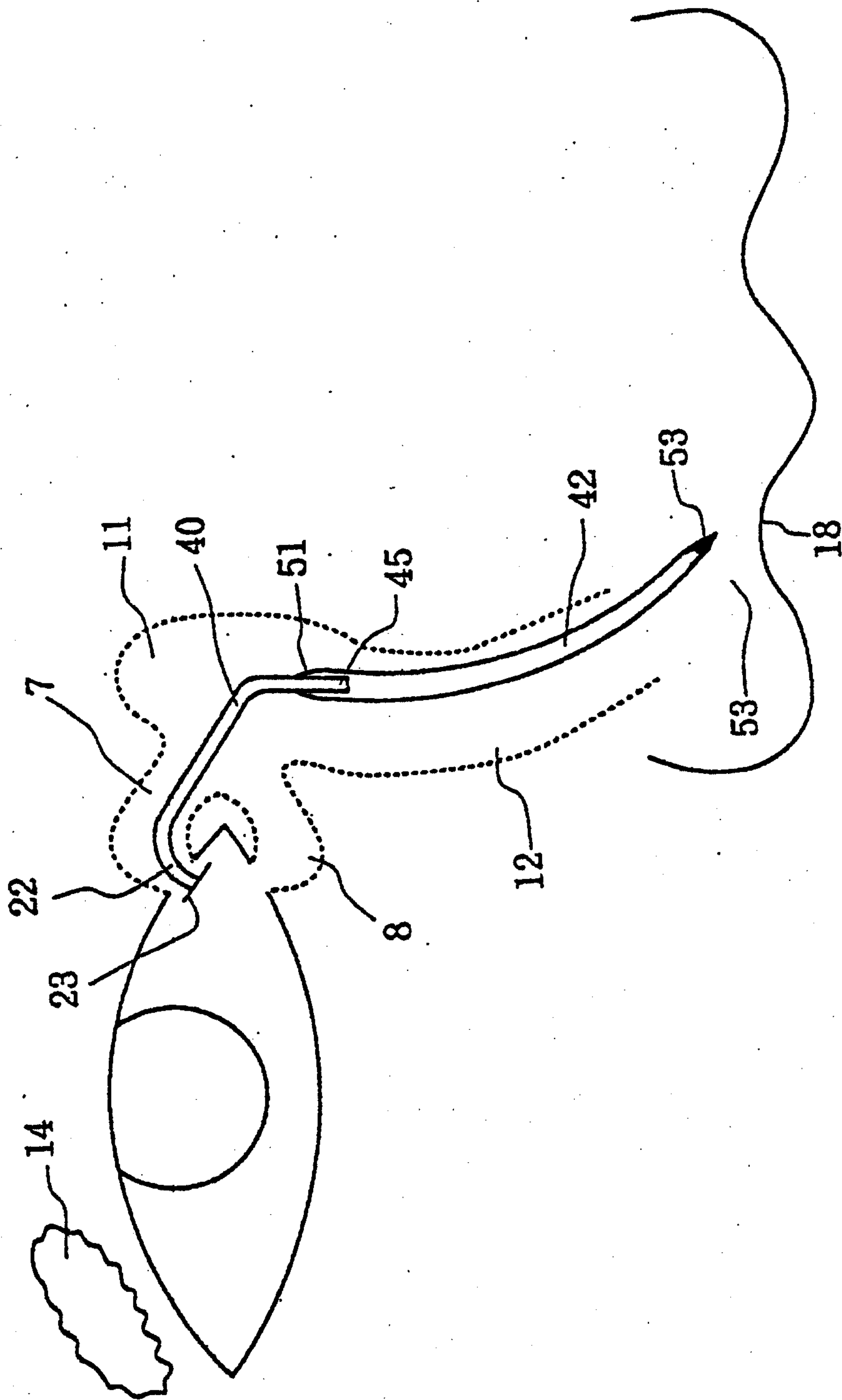


FIG. 23

(C)

(B)

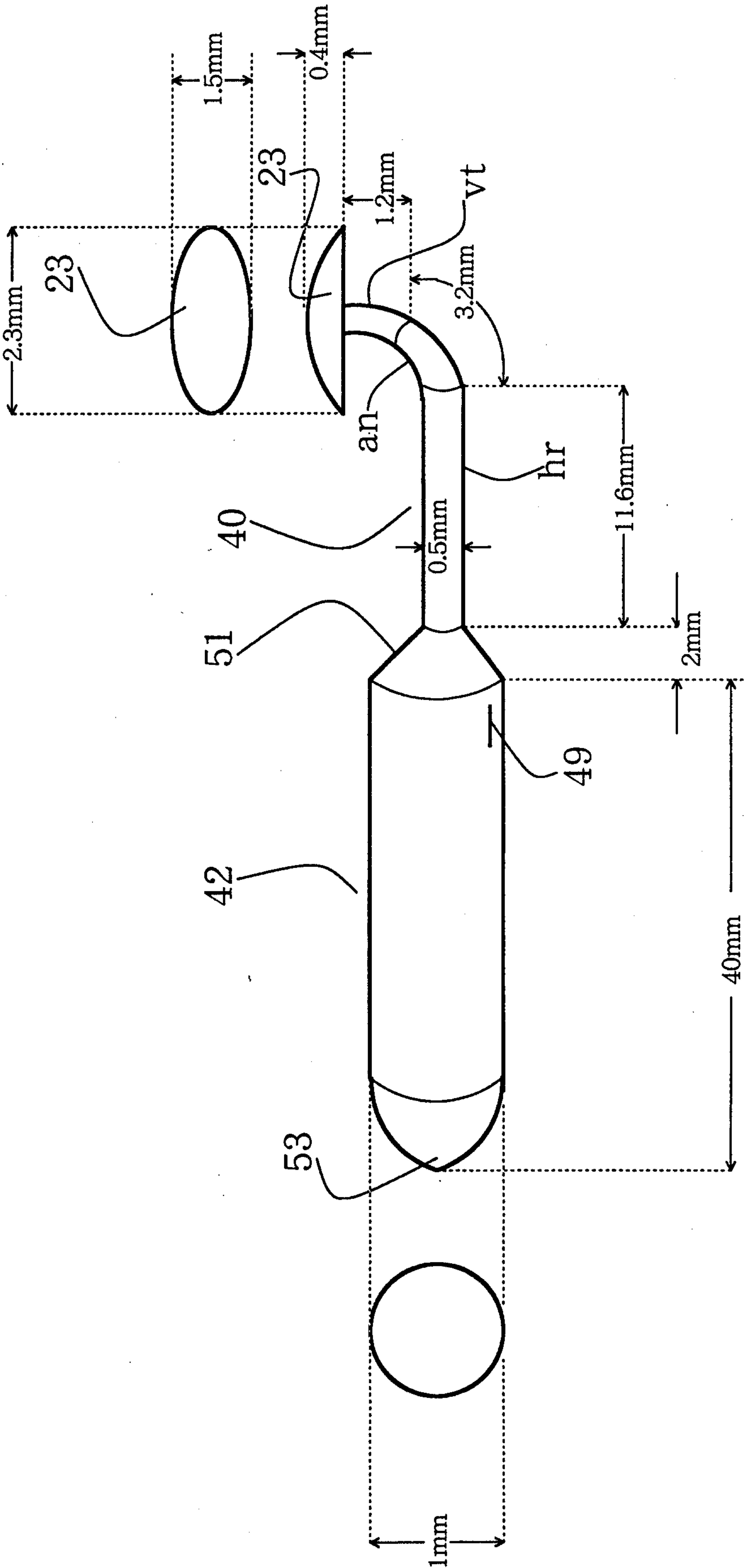


FIG. 24

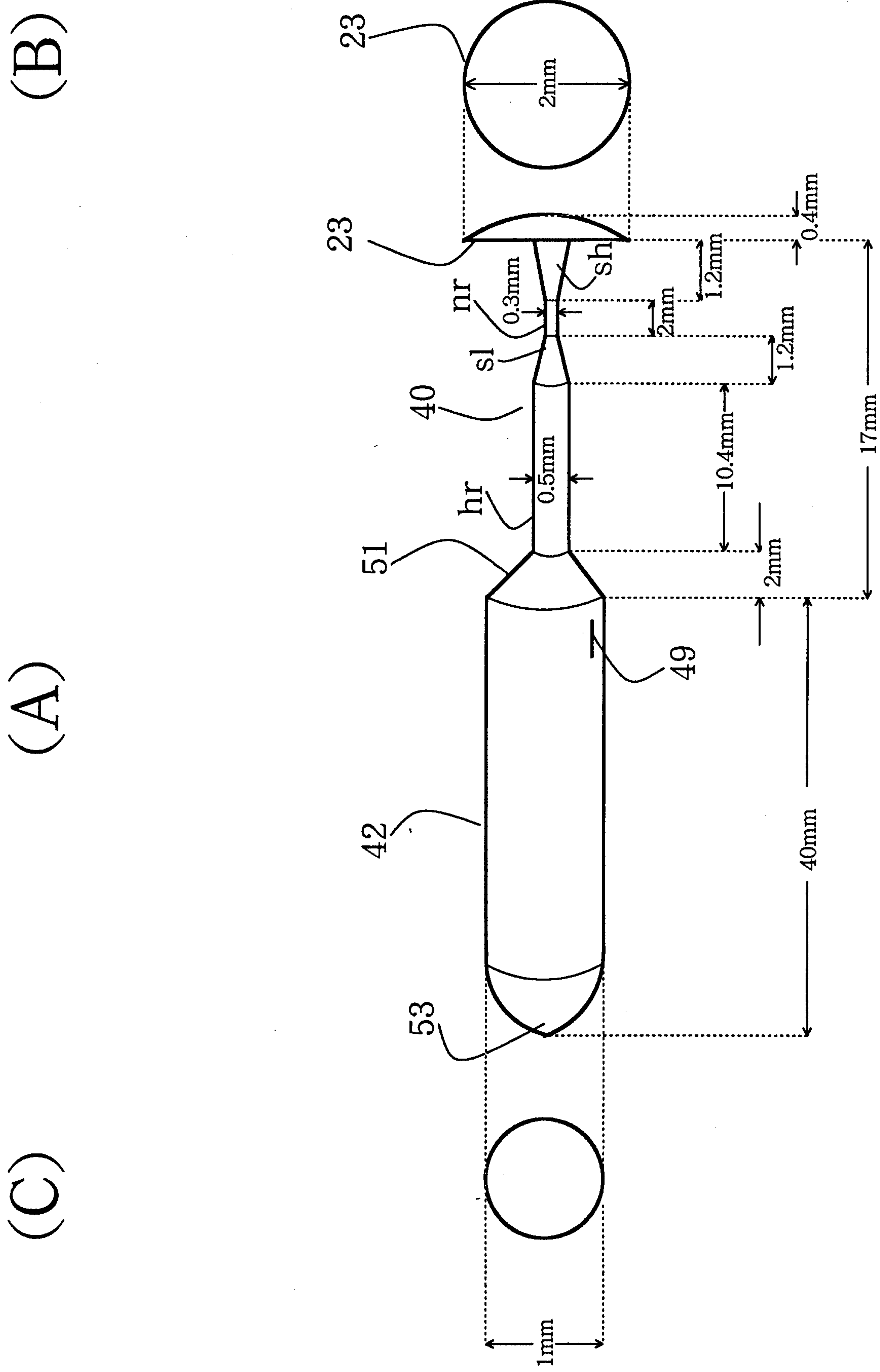


FIG. 25

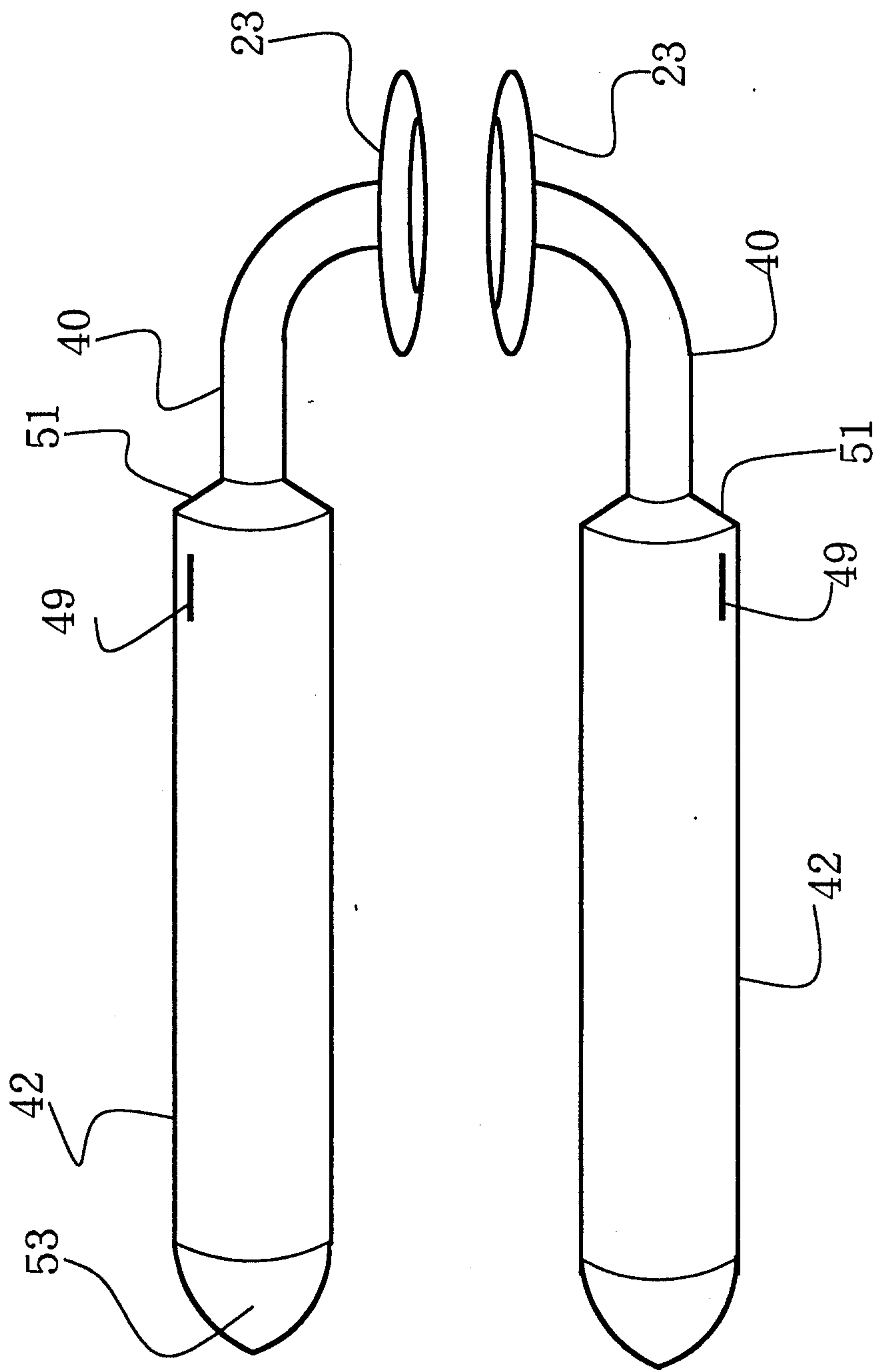


FIG. 26

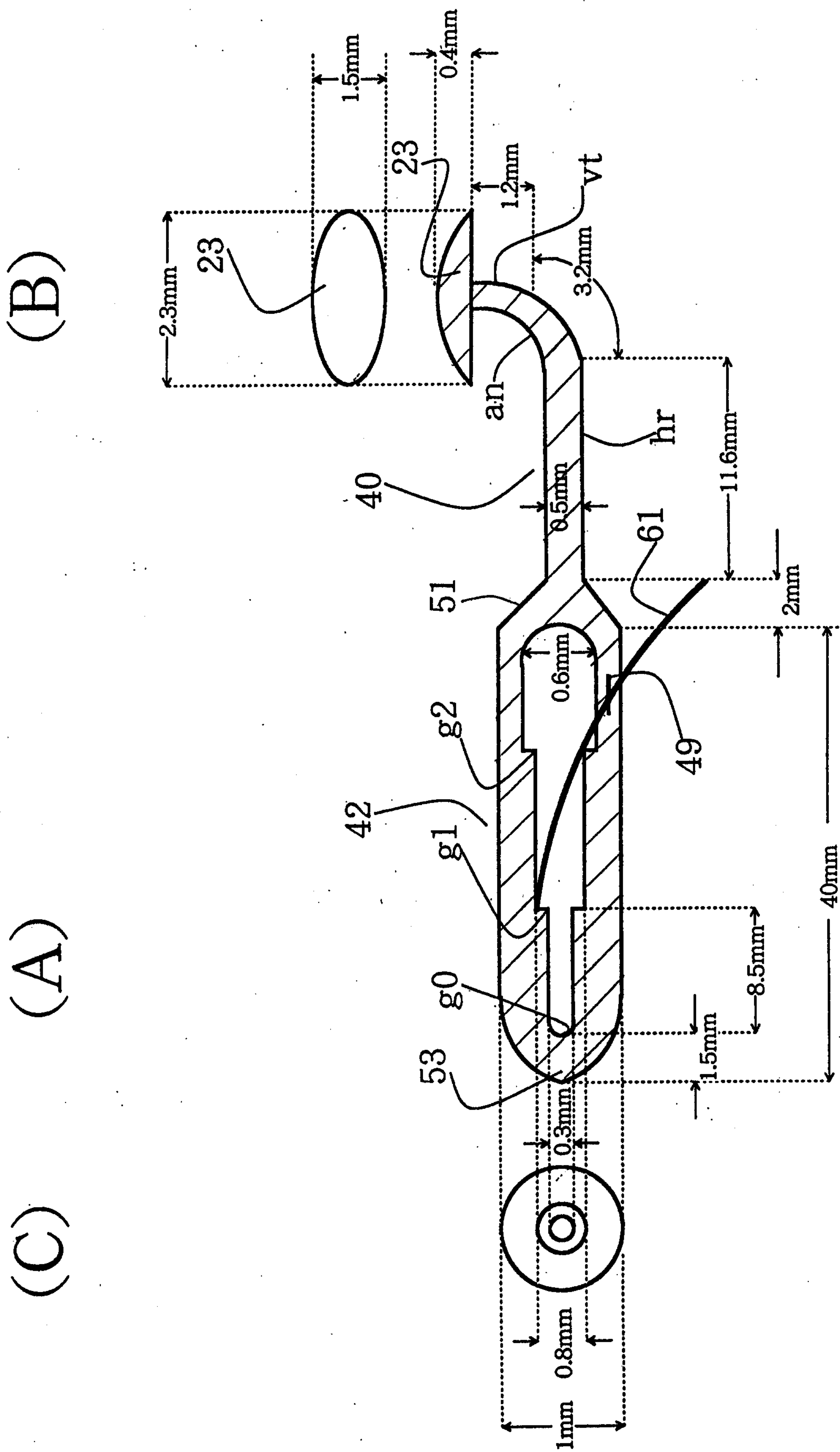


FIG. 27

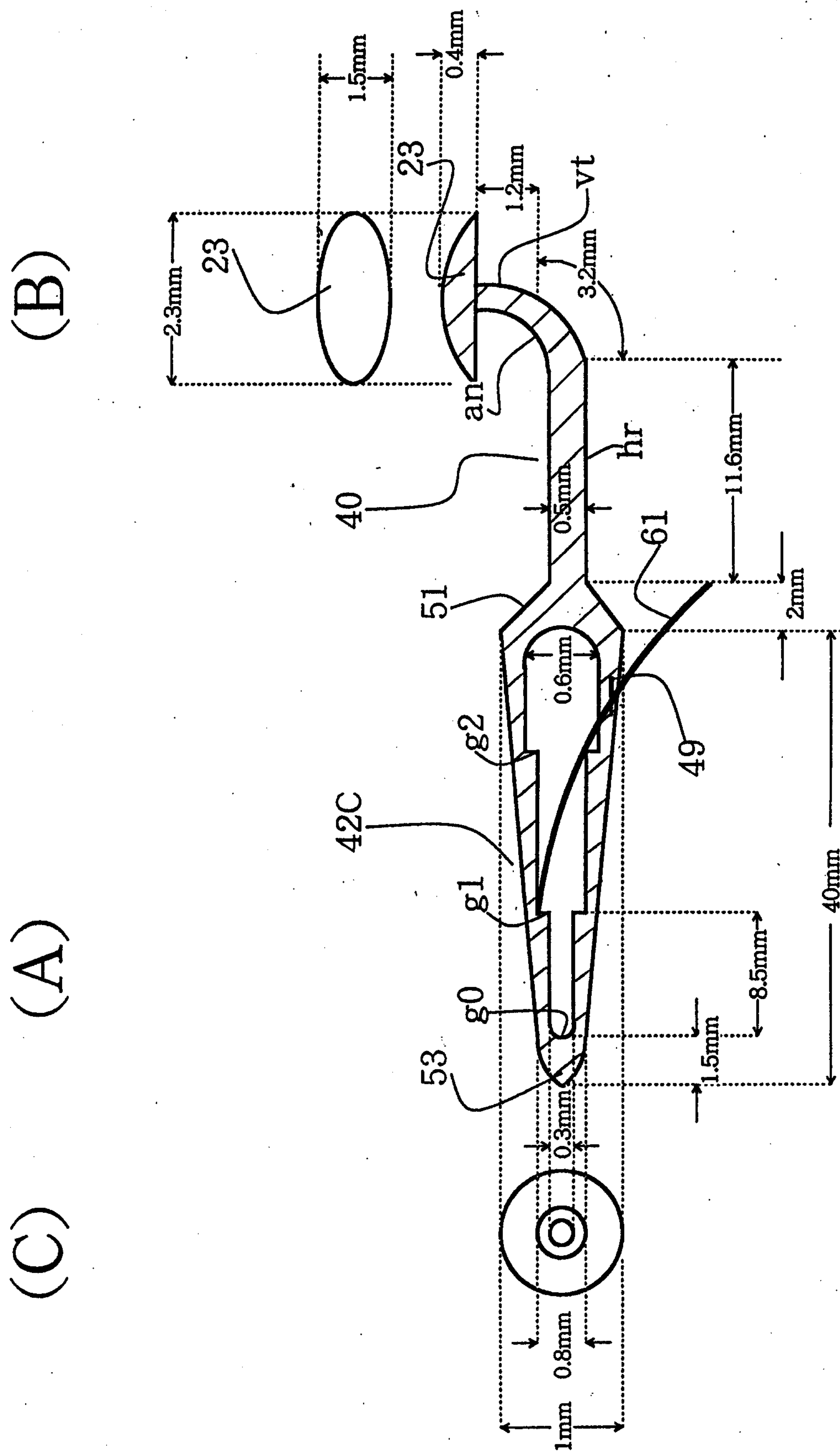


FIG. 28

(C)

(A)

(B)

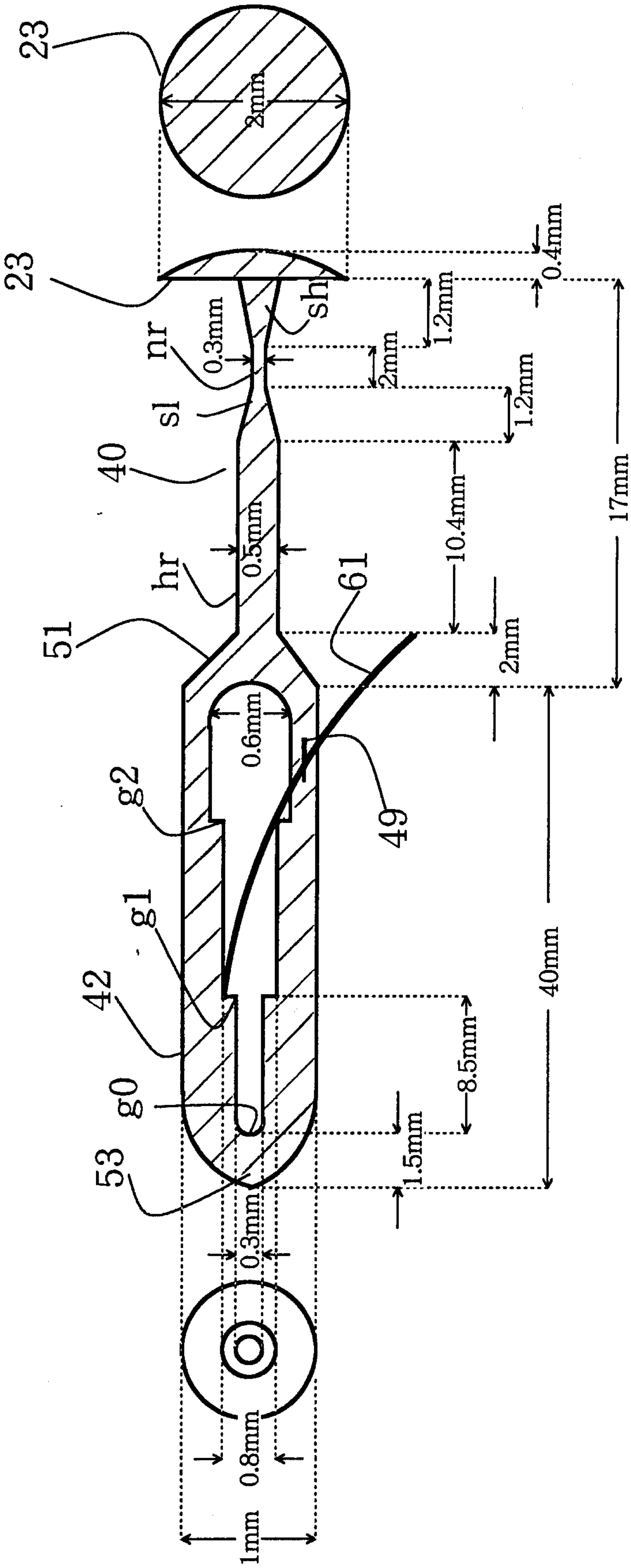


FIG. 29

(C)

(A)

(B)

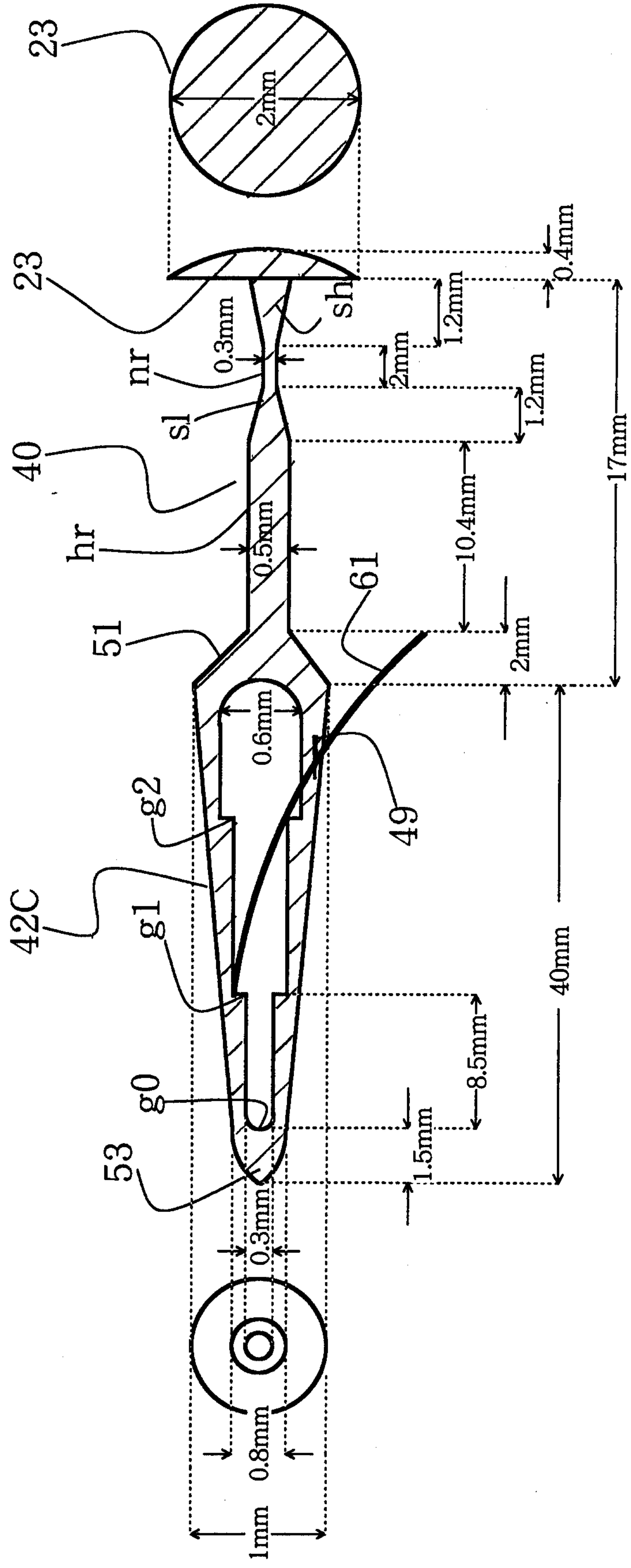


FIG. 31

