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An agency of Industry Canada

CA 2417954 C 2009/11/10

(11)(21) 2 417 954

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2001/08/03
(87) Date publication PCT/PCT Publication Date: 2002/02/14
(45) Date de délivrance/Issue Date: 2009/11/10
(85) Entrée phase nationale/National Entry: 2003/02/04
(86) N° demande PCT/PCT Application No.: EP 2001/009052
(87) N° publication PCT/PCT Publication No.: 2002/011973
(30) Priorité/Priority: 2000/08/04 (DE200 13 596.1)

(51) Cl.Int./Int.Cl. *B29C 65/34* (2006.01),
*B29C 65/36* (2006.01)

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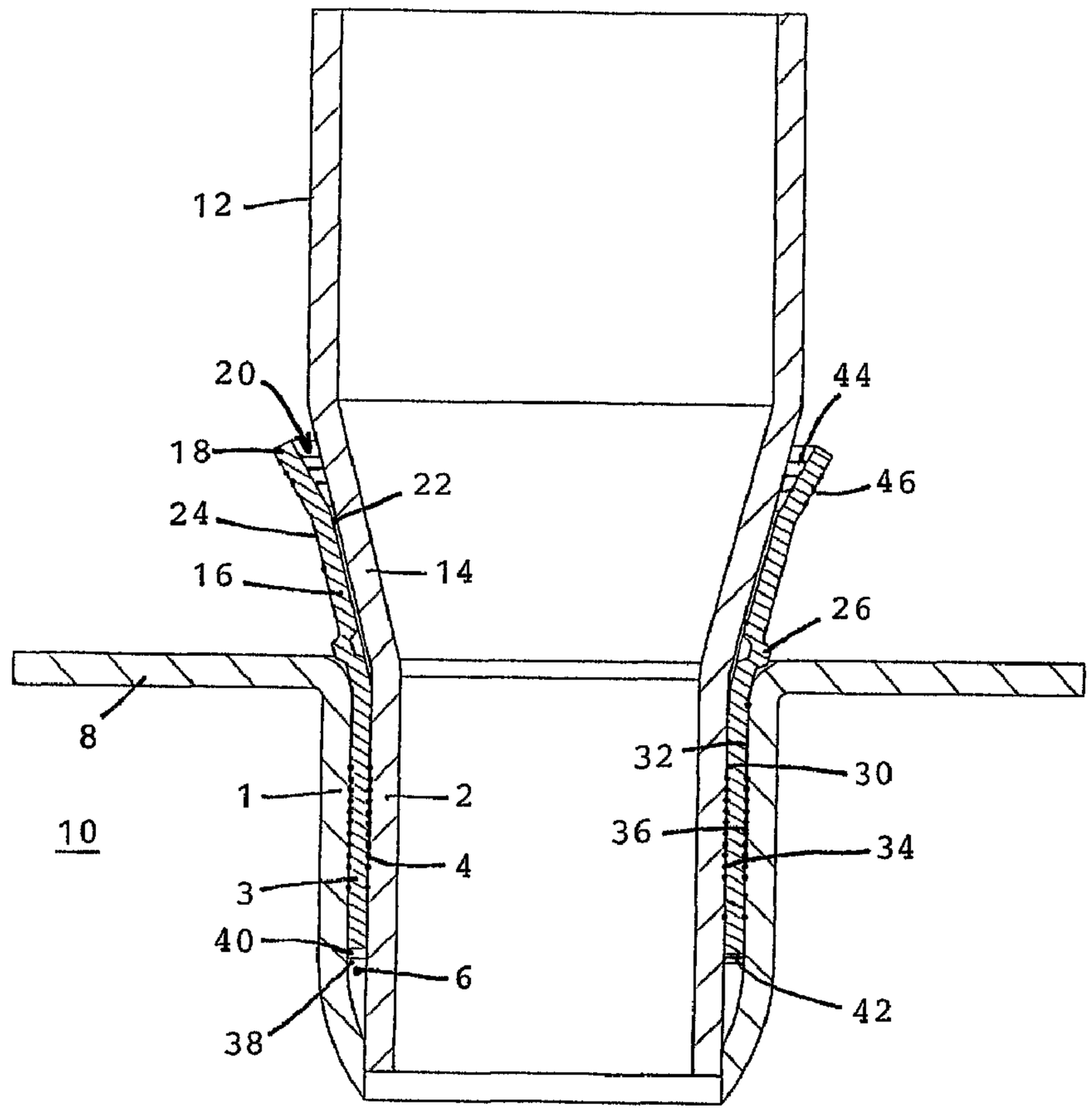
(54) Titre : DISPOSITIF DE RACCORDEMENT D'ELEMENTS PLASTIQUES FUSIBLES
(54) Title: DEVICE FOR CONNECTING COMPONENTS MADE OF FUSIBLE PLASTIC




(57) Abrégé/Abstract:
The invention relates to a device for connecting components (1, 2, 3), which consist of fusible plastic, in particular the pipes (12, 60) of a fuel supply conduit or similar to a fuel tank (8) of a vehicle. Said device contains a heating element (4), whose ends (44, 46)

CA 2417954 C 2009/11/10

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are used to supply electric energy. The aim of the invention is to improve said device to such an extent that it is easy to use, simple to mount and that the welded joint of the components (1, 2, 3) is functionally reliable. To achieve this, one component (3) has a retaining body (16) for a retaining tool (50) and both ends (44, 46) of the heating element (4) lead onto the retaining body (16) where they can be brought into contact with contact elements (56, 57) of the retaining tool (50).

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

(19) Weltorganisation für geistiges Eigentum
Internationales Büro

(43) Internationales Veröffentlichungsdatum
14. Februar 2002 (14.02.2002)

PCT

(10) Internationale Veröffentlichungsnummer
WO 02/11973 A1

(51) Internationale Patentklassifikation[7]: B29C 65/34 // B29K 23:00

(21) Internationales Aktenzeichen: PCT/EP01/09052

(22) Internationales Anmeldedatum:
3. August 2001 (03.08.2001)

(25) Einreichungssprache: Deutsch

(26) Veröffentlichungssprache: Deutsch

(30) Angaben zur Priorität:
200 13 596.1 4. August 2000 (04.08.2000) DE

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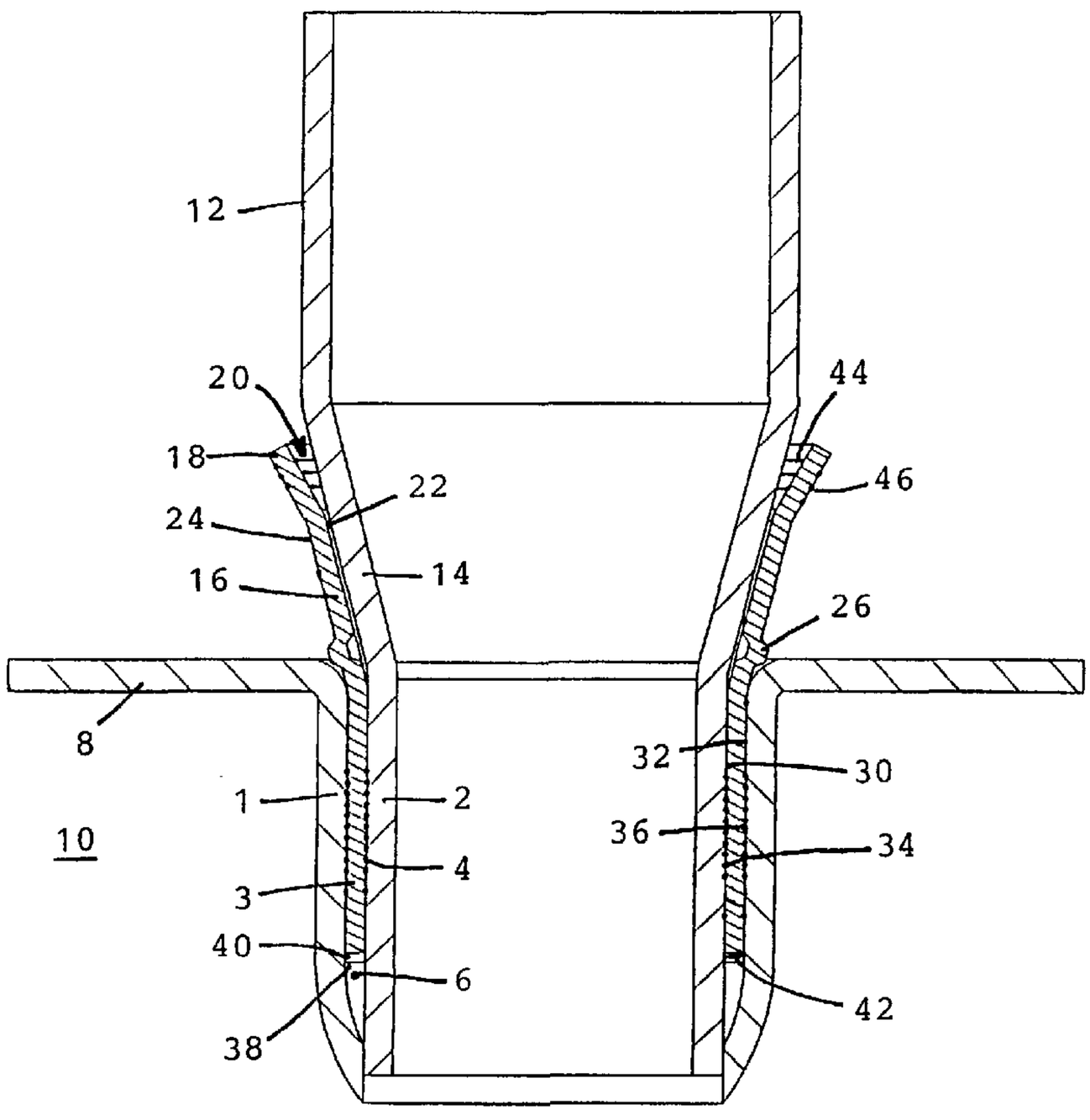
(81) Bestimmungsstaaten *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU,

*[Fortsetzung auf der nächsten Seite]*

(54) **Title:** DEVICE FOR CONNECTING COMPONENTS, WHICH CONSIST OF FUSIBLE PLASTIC

(54) **Bezeichnung:** VORRICHTUNG ZUM VERBINDEN VON BAUTEILEN AUS SCHMELZBAREM KUNSTSTOFF




**(57) Abstract:** The invention relates to a device for connecting components (1, 2, 3), which consist of fusible plastic, in particular the pipes (12, 60) of a fuel supply conduit or similar to a fuel tank (8) of a vehicle. Said device contains a heating element (4), whose ends (44, 46) are used to supply electric energy. The aim of the invention is to improve said device to such an extent that it is easy to use, simple to mount and that the welded joint of the components (1, 2, 3) is functionally reliable. To achieve this, one component (3) has a retaining body (16) for a retaining tool (50) and both ends (44, 46) of the heating element (4) lead onto the retaining body (16) where they can be brought into contact with contact elements (56, 57) of the retaining tool (50).

**(57) Zusammenfassung:** Eine Vorrichtung zum Verbinden von Bauteilen (1, 2, 3) aus schmelzbarem Kunststoff, insbesondere von Rohren (12, 60) einer Kraftstoffleitung oder einer solchen mit einem Kraftstofftank (8) eines Fahrzeuges, enthält ein Heizelement (4), über dessen Enden (44, 46) elektrische Energie zuführbar

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CZ, DE, DK, DM, DZ, EE, 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, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

**(84) Bestimmungsstaaten** *(regional)*: europäisches Patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR).

**Veröffentlicht:**

— *mit internationalem Recherchenbericht*

— *vor Ablauf der für Änderungen der Ansprüche geltenden Frist; Veröffentlichung wird wiederholt, falls Änderungen eintreffen*

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ist. Die Vorrichtung soll dahingehend weitergebildet werden, daß bei einfacher Handhabung und mit geringem Montageaufwand eine funktionssichere Schweißverbindung der Bauteile (1, 2, 3) erreicht wird. Hierzu wird vorgeschlagen, daß das eine Bauteil (3) einen Haltekörper (16) für ein Haltewerkzeug (50) aufweist und daß die beiden Enden (44, 46) des Heizelements (4) auf den Haltekörper (16) geführt sind und mit Kontaktelementen (56, 57) des Haltewerkzeugs (50) in Eingriff bringbar sind.

# Device for Connecting Components Made of Fusible Plastic

The invention relates to a device for connecting components made of fusible plastic, particularly pipes of a fuel line, or for connecting a fuel line with a fuel tank of a vehicle.

European application EP-A-0 919 761 discloses such a device, which comprises a sleeve body for connecting two pipe ends. In the inside surface of the substantially hollow cylindrical sleeve body a heating element is arranged, which is configured as a heating coil made of resistance wire and to which a current or electric energy can be applied. The wire ends of the heating element configured as a heating coil are guided to the exterior into sockets. With corresponding contacts of connecting lines, the electrical connection with a welding device can be established to supply the heating element with current and thereby to heat the plastic so that an electric weld is produced. Such electric welding sleeves have been used very successfully to connect pipes in supply networks, e.g., water pipes or gas pipes. However, the personnel must be experienced in handling the welding device and producing the electric weld, and the welding operation has to be carefully prepared and executed. Also, the production of such welding

sleeves, particularly with respect to the contacting of the wire ends in said sockets is quite complex. To prepare and execute the electric welding operation, various actions must be performed manually, which involves a considerable amount of time and assembly.

Especially in automotive fuel tank systems with a plastic fuel tank and a plastic refueling pipe that is to be connected therewith, the current joining techniques consist of using hose connecting clamps or butt-welding of the connecting points with heat reflectors. The drawback is that there is no adequate diffusion barrier and complex assembly is required during production, especially since a variety of different components are required. Also, any repair or replacement of individual components requires a substantial amount of time. In addition, there is the problem of positioning add-on devices, e.g., fuel pump, hose holder, sensors, etc. in and on the tank. The currently used butt-welding process with heat reflectors is difficult, especially in the interior of the tank and/or on surfaces that are not flat. It should moreover be noted that for diffusion reasons, all additional openings on the fuel tank should be avoided, so that the positioning of additional devices in areas of the tank that are remote and/or difficult to access requires a significant amount of time and is often not possible without an auxiliary opening. When add-on devices or other parts are butt-welded with heat reflectors in the interior of the tank, a heat reflector is brought to the welding position through the existing tank opening, i.e., the opening for the tank fitting, by means of a complex telescope mechanism in order to melt the tank wall at that point. Since the additional device cannot be carried along directly for lack of space, the heat reflector must first be withdrawn and the additional device must then be brought to the desired position. Since a properly welded joint requires a predefined welding temperature and contact pressure, process control is very difficult and costly.

Based thereon, the object of the invention is to provide a device that ensures a functionally reliable welded connection of the components by simple means and at low cost. The preparation and production of the connection should require little fabrication and assembly time and/or the production of the connection should be automatable to a large extent and/or producible in an automated production plant.

According to one aspect of the invention, there is provided a device for connecting components made of fusible plastic, comprising: a heating element having ends through which electrical energy can be supplied; and a holding element for engaging a holding tool, wherein the ends of the heating element extend to the holding element and engage contacts on the holding tool when the holding tool is applied to the holding element, the heating element and the holding element are part of a welding sleeve having the heating element arranged on inner and outer surfaces thereof, the holding element is formed as at least a portion of an annular flange surface of the welding sleeve, and the welding sleeve includes an insertion depth limit stop on the outer surface of the welding sleeve, wherein said insertion depth limit stop is a radially-outward projecting ridge formed over at least two portions of a circumference of the welding sleeve.

The proposed device is distinguished by its simple construction and makes it possible to produce the welded joint at low cost. The component containing the heating element is provided with a holding element which carries the particularly planiform heating-element ends serving for electrical connection and which is configured for the component to be held by means of a holding tool. Sockets or the like to produce the connection with a welding device are not required, since contact is established via the holding element and the holding tool. The holding tool is especially made clamp-like to receive said components in preparation of the welding procedure, and during welding ensures the electric connection with the heating element through suitable contacts. The component is preferably sleeve-like and on an outer surface as well as on an inner surface contains the heating element or parts thereof. It is placed into an annular gap between the components to be joined, one of which is configured as a sleeve and the other as a pipe end. Within the scope of the invention, the sleeve can be part of a tank or a pipe for putting fuel into a motor vehicle. This sleeve is configured as an annular section which is pulled inwardly in the area of the tank opening and which is preferably an integral part of the tank. This has the significant advantage that the

connection satisfies all the requirements and specifications associated with automotive technology, particularly fuel permeability relative to the environment. An improved diffusion seal and a longitudinal interference fit between the refuelling pipe and the fuel tank are ensured with a high degree of functional reliability.

In an alternative embodiment, the component provided with the heating element can be configured to receive and position add-on devices, e.g., a fuel pump, hose holders, sensors, etc., on the fuel tank. In automotive technology, the proposed device provides the substantial advantage that the device and/or connection satisfy all the requirements and specifications and, in particular, reduce fuel permeability relative to the environment. In the embodiment with a fuel tank, the tank comprises the sleeve-like component in the area of the tank opening for the fitting. This sleeve-like component is configured as an annular section or sleeve that is pulled into the interior of the tank, into which the plastic refuelling pipe is inserted while forming a

circumferential annular gap. The component configured as the welding sleeve and containing the heating element is inserted into this annular gap. In the embodiment for connecting two pipes, particularly of an automotive fuel line, the one pipe end is configured as a sleeve into which the pipe to be connected can be inserted while forming an annular gap. The component configured as the welding sleeve and provided with the heating element is again inserted into this gap. Furthermore, the component provided with the heating element can comprise this heating element in the area of an end surface or an annular surface. The surface contour can be flat, concave, convex, etc. to correspond with the surface contour of the other component. Additional pressure means are used to generate and/or maintain the required contact pressure during the welding operation, particularly between the latter component and the other component, especially the wall of a fuel tank.

The holding element of the component that contains the heating element is advantageously configured as a segment or flange such that the aforementioned holding tool can engage therewith and establish the electrical contact or the electrical connection with the heating element. The contacts of the heating element are preferably arranged opposite one another so that the electrical connection with the heating element is established when the holding tool engages and/or presses against and/or holds said component. The heating element advantageously consists of a wire and/or is configured as a winding. Furthermore, the heating element or the electrical conductor or conductors can be applied to the welding surface of said component and, in particular, can be an electrically conductive vapor-deposited material, or a metal grid, or electrically conductive carbon fibers, or electrically conductive plastic or polymers. The welding energy is supplied through the heating element using electric resistance heating or induction or microwave technology. Irrespective of the corresponding configuration and the concrete embodiment of the heating element, it is decisive within the scope of the invention that the electrical connections and/or the wire ends or the like are guided to the holding element such that the electrical connection to a welding device, which provides the voltage and/or the current required for the welding operation, is established by means of the holding tool, particularly by means of the contacts arranged in the holding tool.

Special embodiments and further developments of the invention are set forth in the following description.

The invention will now be described in greater detail, by way of example, with reference to the special embodiments depicted in the drawings, without however limiting the scope of the invention. The following show:

FIG 1 a partial longitudinal section through a fuel tank and the refueling pipe connected therewith by means of a welding sleeve,

FIG 2-4 a schematic representation illustrating the production of the welded joint,

FIG 5-8 representations of a further embodiment according to FIG 4 during different process steps for producing the connection with a clamp-like holding tool,

FIG 9 a further embodiment for connecting two pipes, particularly of a fuel line,

FIG 10 a perspective view of the component provided with the heating element according to FIG 9,

FIG 11 a further embodiment of a component which comprises the heating element in the area of an end face and which is used to position additional devices,

FIG 12 a side view of the component according to FIG 11,

FIG 13-16 schematic representations for positioning the component according to FIG 11 in the interior of the tank,

FIG 17 a further embodiment of the component with a heating element arranged on an annular surface, and

FIG 18 a schematic representation of the component according to FIG 17 inside a fuel tank.

FIG 1 is a longitudinal section through a first component 1, a second component 2 and an additional component 3 that comprises a heating element 4 for connecting the first and second components 1, 2. The first component 1 is configured as a sleeve that surrounds the second component while forming an annular gap 6 that receives the additional component 3. The first component 1 forms part of a tank 8, which is only partially indicated here. It extends into the interior 10 of the tank and is configured as an annular section that is pulled inwardly in the area of the tank opening. The second component 2 is part of a pipe 12, which is also only partially indicated here and is used to fill the tank 8 with fuel. These components 1, 2 and 3 are made of a fusible and/or thermoplastic material, particularly polyethylene (PE). The second component 2 or pipe 12 comprises a conical section 14 that is located outside the tank 8 and forms a taper of pipe 12 toward the interior 10. The additional component 3 comprises a collar or flange 16, also located outside the tank, in such a way that at least in the area of its free end 18 a clearance 20 is formed. Flange 16 and/or its free end 18 is configured as a holding element for a holding tool (not depicted), which can engage on the one hand with the inner surface 22 of clearance 20 and on the other hand with the outer surface 24 of holding element 16 to grasp and hold the latter. The holding element 16 as depicted is advantageously closed along its circumference. Within the scope of the invention, however, at least its free end 18 can also be configured as a segment that extends over only a portion of the circumference. The additional component 3, hereinafter also referred to as a welding sleeve, further comprises a limit stop 26, which ensures a defined insertion depth in the first sleeve-like component 1. The conical or tapered configuration of section 14, where the cone angle advantageously corresponds to that of the flange of holding element 16, determines a defined insertion depth in tank 8 for pipe 12. The limit stop 26 may be annularly closed along the circumference or may consist of a plurality of radially outwardly facing projections.

The additional component or welding sleeve 3, in the area of annular gap 6, is provided with a heating element 4, which is disposed on both the inner surface 30 and the outer surface 32 of the welding sleeve 3. The heating element 4 on the inner surface 30 has an inner heating spiral 34 and on the outer surface 32 an outer heating spiral 36

made of an electrically conductive wire and/or resistance wire. The heating spirals 34, 36 are interconnected at the end face 38 of the welding sleeve 3 by means of a wire part 40. This wire part 40 is advantageously disposed in a recess 42 of end face 38 and is thus protected against external influences. Advantageously, the end face 38 comprises a plurality of such radially extending recesses 42, so that during manufacture of heating element 4, which consists of a single continuous heating wire, wire part 40 can easily be inserted into one of these recesses 42.

According to the invention, the ends of heating element 4 or the free wire ends 44, 46 of the two heating spirals 34 and 36 are guided to the holding element 16 and/or its free end 18, i.e., along the inner surface and along the outer surface thereof. It is particularly important that the wire ends and/or contacts 44, 46 of the heating element 4 are opposite one another. Preferably, the contacts are arranged and/or configured to be planiform. The ends 44, 46 thus form a first and a second planiform contact of heating element 4. The ends 44, 46 advantageously extend over the entire circumferential area of holding element 16 or, if the holding element is configured in segments, over a predefined circumferential angle. Thus, the aforementioned holding tool can engage with the holding element 16 over a predefined circumferential angle, advantageously over the full circumferential angle of 360°, to establish the electrical connection with heating element 4. The holding tool has additional contacts that correspond with the ends or contacts 44, 46 of heating element 4 to ensure the electrical connection and contacting of heating element 4 when the holding element 16 is grasped.

In preparation of producing the welded joint, the additional component 3 is inserted into the first sleeve-like component 1, with limit stop 26 defining the insertion depth. Thereafter, the second component 2 is inserted into the additional component 3, with the conical section 14 on the correspondingly conical flange or holding element 16 likewise defining the insertion depth. Alternatively, the additional component 3 can first be pushed onto the second component 2, and the second component 2 and the additional component 3 can then be inserted into the first sleeve-like component 1. It should be noted here that the inside and outside diameters of the adjacent surfaces of these

components are adjusted in such a way as to ensure direct contact to a large extent between the associated component surfaces, so that the necessary contact pressure can be produced during the welding operation to ensure a complete and tight electric weld without gaps over the circumference and in axial direction.

As will be explained below, the holding tool, in a special embodiment of the invention, can be initially used to grasp the additional component or welding sleeve 3 by the flange 16 and/or its free ends 18, e.g., to take it out of a supply box. By means of the holding tool the additional component 3 is then inserted into the first component 1 or the tank opening configured according to the invention. Thereafter, pipe 12 with the second component 2 is inserted into the interior of the additional component 3, while the holding tool remains engaged with the holding element 16. The welding device, which is electrically connected with the holding tool, is preferably furthermore configured in such a way that proper contact and/or the required configuration of heating element 4 can be verified, so that incorrect contact and/or faulty additional components 3 can be detected and can advantageously be exchanged prior to the welding operation so that faulty joints are reliably avoided.

The procedure for producing the electric weld will now be explained in greater detail with reference to FIG 2 to 4. According to FIG 2, the three components 1, 2 and 3 are inserted into one another in the manner described above. The welding sleeve 3 is provided with holding element 16, which in this case is segmented. Holding tool 50 comprises two clamp-like jaws 52, 53, between which the holding element 16 can be positioned in the holding tool 50 while components 1, 2, 3 are inserted, as shown in FIG 3. The holding tool 50 has at least one additional jaw 54, 55, which is/are spaced at predefined distance(s) from the two aforementioned jaws 52, 53. These distances substantially correspond to the associated outside diameters of components 1, 2, 3 to ensure a defined orientation relative to the holding tool 50. According to FIG 4, the two upper jaws 53, 55 are moved downward in such a way that the holding element 16 is clamped between the two jaws 52, 53 with a defined pressure so as to ensure proper contact with the two contact elements of welding sleeve 3. As may be seen from FIG 2, the lower jaw

52 of the holding tool 50 has an additional contact 56 and, correspondingly, the upper jaw 53 has an additional contact 57. These contacts 56, 57 are connected with the welding device via electric lines (not depicted). Alternatively, one of the jaws 54, 55 (depicted on the rear side in the drawing) can be provided with a corresponding contact to establish the electrical connection with an end or a contact of the heating element on an additional holding element that is provided there.

FIG 5 shows a further embodiment similar to FIG 1, but the pipe with the second component is not depicted. The welding sleeve 3 is inserted into the tank opening of tank 8 (only partially depicted) by means of the clamp-like holding tool 50. Holding tool 50 comprises the two jaws 52, 54, which can be moved relative to one another to grasp and hold the holding element 16, which is configured as an annular flange. The inner contact 44 or the inner wire end of heating element 4 can be seen on the inner surface of holding element 16. This inner contact 44 is configured as a circumferentially closed loop with which the additional contact 56 of holding tool 50 engages to establish a reliable contact. The additional contact 56 preferably fits against the inner contact 44 under a predefined tension, which is produced, in particular, by means of a spring or the like (not depicted). It should be noted that on the outer surface of the holding element 16, the wire end is arranged likewise with at least one loop extending over the entire circumference, so that an analogously arranged contact of the lower jaw 52 fits against the outer contact 46 for secure contacting. This annular or circumferentially closed configuration of the inner and the outer contact ensures reliable contacting in every circumferential position of holding tool 50 relative to the welding sleeve 3.

According to FIG 6, pipe 12 with the second component is inserted into the interior of the welding sleeve 3. It should be noted that the holding tool 50 remains engaged with the contact elements of welding sleeve 3 to maintain electrical contact. By applying the welding energy supplied by the welding device (not depicted) to the heating element via the aforementioned contacts, the electric weld of pipe 12 with tank 8 is produced through welding sleeve 3.

According to FIG 7, the holding tool 50 is then disengaged from the welding sleeve 3. For this purpose, the two jaws 52, 54 are moved away from one another so that the holding element 16 is now released and the holding tool 50 can be removed in the direction of arrow 58.

In FIG 8, the holding tool 50 is removed and pipe 12 is now tightly connected with tank 8 by means of welding sleeve 3. The aforementioned additional contact 57 of the lower jaw 52 of the clamp-like holding tool 50 is clearly visible here.

FIG 9 depicts a longitudinal section of a further embodiment, in which the first component 1 is configured as a sleeve of a second pipe 60. The first pipe 12 has a constant diameter and the bottom of sleeve 62 of the first component 1 forms a limit stop defining the insertion depth of the first pipe 12. In other respects, the description provided above applies correspondingly. The two pipes 12, 60 are preferably part of a fuel line of a motor vehicle. This fuel line is further connected with a fuel tank as described above.

FIG 10 shows the inventive welding sleeve 3 with outer heating spiral 36 and outer contact 46 of the holding element 16. The inner contact 44 is also clearly visible. Contacts 44 and 46 comprise a plurality of circumferentially closed turns to ensure functionally reliable contacting in any position of the holding tool. The configuration of limit stops 26 as radially outwardly pointing projections is also clearly visible. It should be noted that the heating element 4 configured in this manner advantageously consists of a single continuous wire, which is arranged in the manner shown and described on the inner surface and on the outer surface of the additional component 3.

FIG 11 shows a special embodiment of the additional component 3, which is used to position additional devices, e.g., fuel pump, hose holder, sensor, or similar items, in or on a first component, particularly a fuel tank. The additional component 3 is part of a positioning body 64. The flange-like holding element 16 is also provided. The additional component 3 on one end face 66 carries the heating element 4, which is configured as a bifilar winding made of an

electrically conductive heating wire or resistance wire. The end face 66 has a predefined contour that matches the associated contour of the first component or tank or the like. The surface contour of end face 66 can be flat, as depicted, or convex or concave, or configured in some other manner to correspond with the surface contour of the first component on which the positioning body 64 is to be attached and positioned. The one end of the wire is guided to the contact 44 of holding element 16.

FIG 12 is a side view of component 3 in which the other contact 46 is clearly visible in a constriction below component 3.

FIG 13 schematically shows the positioning body 64 together with a tank 8 whose outer contour is defined by the installation conditions in a motor vehicle. The tank 8 comprises a tank opening 68 through which the positioning body 64 can be inserted into the interior of the tank and placed at the desired position on the inner tank wall by means of a tool or handling device 70, which is not further described here. It should be noted that only after positioning the positioning body 64 on, and producing the welded joint with, the inner tank wall in the manner described above, the tank line or its pipe end is connected with tank 8 in the area of tank opening 68. The tool or handling device 70 comprises the clamp-like holding tool 50, which engages with flange 16 and thus securely holds the positioning body 64.

FIG 14 is an enlarged detail X according to FIG 13, in which holding tool 50 holds flange 16 between its two jaws 52, 54. The two ends 44, 46 of the heating element 4 are guided to the holding element or flange 16 where they form the contacts, or are electrically connected with the contacts provided there, particularly by spot welding.

Alternatively, the contacts or wire ends can be guided to the outer surface 72 of the positioning body 64, in which case outer surface 72 forms the holding element for the holding tool. In this type of an embodiment, the clamp-like jaws of the holding tool are rotated by 90° compared to FIG 14 and can be moved in radial direction relative to the positioning body 64 and placed radially onto the outer surface 72 and pressed onto this outer surface with a defined pressure to hold the

positioning body 64 and to ensure the required contacting pressure of the additional contact elements.

According to FIG 15, tool 70, which has several knuckle joints 74 to 76, is partially inserted into the interior of tank 8. According to FIG 16, tool 70 is inserted still further into the interior of tank 8, such that the positioning body 64 is located at the desired position in the interior of the tank. By means of tool 70, the end face of the additional component of positioning body 64 is pressed against the inner wall of the tank. It should be noted that tool 70 is provided with electric lines that ensure the electric connection between the heating element of positioning body 64 and the welding device. After applying the welding energy required to produce the weld while maintaining a predefined contact pressure by means of the tool or handling device 70, a secure connection is produced between the positioning body 64 and the inner wall of tank 18.

FIG 17 and 18 show a further embodiment in which the additional component 3 is provided with an annular heating element 4 in the form of a bifilar winding on an axial end face 66. As explained above, the contour of this end face is adapted to the surface contour of the first component to be connected, particularly the inner wall of the fuel tank. A fitting 78, which is configured as a tank outlet, e.g., for ventilating the tank, is connected with the additional component 3. The contacts and/or ends 44, 46 of heating element 4 are guided, as depicted, to the outer surface of the flange-like additional component 3. The holding tool or its clamp-like jaws are pressed against the outer surface 32 in radial direction relative to the longitudinal axis of fitting 78 to hold it and to produce the contact pressure necessary to make the welded joint. Alternatively, a flange-like holding element as described above with reference to FIG 11 may be provided below, i.e., behind the drawing plane. According to FIG 18, the tank has an opening 80 through which the aforementioned fitting 78 reaches toward the exterior once the additional component 3 has been correspondingly positioned. Prior to that, the additional component 3 was inserted through the first tank opening 68 into the interior of tank 8, as described above, by means of a tool or handling device (not depicted), was positioned underneath the second tank opening 80 and finally moved

in the direction of the inner tank wall in such a way that the fitting 78 was reaching through the second tank opening 80 toward the exterior. For the welding operation, the additional component 3 is pressed against the inner wall of tank 8 by means of the handling device so that the heating element 4 makes contact at a predefined contact pressure and upon delivery of the welding energy a tight and durable joint is produced.

## List of Reference Numerals

| | |
|---|---|
| 1 | first component / sleeve |
| 2 | second component / pipe |
| 3 | additional component / welding sleeve |
| 4 | heating element |
| 6 | annular gap |
| 8 | tank |
| 10 | interior of 8 |
| 12 | pipe |
| 14 | conical section |
| 16 | collar / flange / holding element |
| 18 | free end of 16 |
| 20 | clearance |
| 22 | inner surface of 16 |
| 24 | outer surface of 16 |
| 26 | limit stop |
| 30 | inner surface of 3 |
| 32 | outer surface of 3 |
| 34 | inner heating spiral |
| 36 | outer heating spiral |
| 38 | end face of 3 |
| 40 | wire part |
| 42 | recess in 38 |
| 44 | first contact / end of 4 |
| 46 | second contact / end of 28 |
| 50 | holding tool |
| 52 - 55 | clamp-like jaw |
| 56, 57 | additional contact of 50 |
| 58 | arrow |
| 60 | second pipe |
| 62 | bottom of sleeve |
| 64 | positioning body |
| 66 | end face |

| | |
|---|---|
| 68 | tank opening |
| 70 | tool / handling device |
| 72 | outer surface of 64 |
| 74 - 76 | knuckle joint of 70 |
| 78 | fitting |
| 80 | second opening in 8 |

**Claims:**

1. A device for connecting components made of fusible plastic, comprising:

a heating element having ends for receiving electrical energy; and

a holding element for engaging a holding tool, wherein

the ends of the heating element extend to the holding element and engage contacts on the holding tool when the holding tool is applied to the holding element,

the heating element and the holding element are part of a welding sleeve having the heating element arranged on inner and outer surfaces thereof,

the holding element is formed as at least a portion of an annular flange surface of the welding sleeve, and

the welding sleeve includes an insertion depth limit stop on the outer surface of the welding sleeve, wherein said insertion depth limit stop is a radially-outward projecting ridge formed over at least two portions of a circumference of the welding sleeve.

2. A device according to claim 1, wherein the components are pipes of a fuel supply pipeline.

3. A device according to claim 1, wherein the components are a fuel line and a fuel tank of a motor vehicle.

4. A device according to claim 1, wherein the ends of the heating element are arranged opposite one another.

5. A device according to claim 1, wherein the ends of the heating element have a planar configuration.

6. A device according to claim 1, wherein the ends of the heating element form planar electrical contacts on the holding element.

7. A device according to claim 6, wherein the holding element is flange-shaped or segmented and the contacts on the holding element are arranged on opposite surfaces thereof.

8. A device according to claim 1, wherein the holding tool comprises a clamp.

9. A device according to claim 1, wherein the holding tool has two jaws that are moveable relative to one another, between which the holding element can be clamped.

10. A device according to claim 9, wherein the jaws of the holding tool establish an electrical connection to a welding apparatus.

11. A device according to claim 1, wherein said heating element comprises at least one of a metal grid, metal threads, metal particles, metal wires, and an electrically conductive polymeric material, and wherein welding energy is applied to the heating element by at least one of an electric current flow, electrical induction, and application of microwaves.

12. A device according to claim 1, wherein the heating element comprises an electric heating coil.

13. A device according to claim 1, wherein a first component comprises a fuel tank having a tank opening configured as an inwardly directed annular sleeve protruding into the interior of the tank; a second component comprises an end of a plastic fuel line inserted into the inwardly protruding sleeve of the first component with an annular gap between the first and second components, and wherein the welding sleeve is disposed in the annular gap between the first and second components.

14. A device according to claim 1, wherein a first component comprises a pipe sleeve for receiving a pipe end; a second component comprises a pipe having an end received in said pipe sleeve with an annular gap between the received pipe end and the pipe sleeve, and wherein the welding sleeve is disposed in the annular gap between the first and second components.

15. A device according to claim 11, wherein the welding sleeve is disposed in an annular gap between a first component configured as an annular sleeve and a second component configured as a pipe end inserted in said sleeve.

16. A device according to claim 1, wherein the welding sleeve is partly received in one of the plastic components to be connected and the holding element extends out of said one component and opens out at least partially conically in a radially outward direction.

17. A device according to claim 1, wherein the heating element is arranged on an end face of at least one component which contains the heating element.

18. A device according to claim 17, wherein the at least one component which contains the heating element forms a part of a positioning body.

19. A device according to claim 17, wherein the heating element is arranged in the shape of a ring on the end face of the at least one component.

20. A device according to claim 19, wherein the heating element is arranged on the same side as a fitting that is connected with the one component.

21. An assembly of fused components made of fusible plastic, comprising a welding sleeve having a heating element arranged on inner and outer surfaces thereof and disposed between a first fusible plastic component and a second fusible plastic component, wherein the welding sleeve includes an insertion depth limit stop on an outer surface of the welding sleeve, said insertion depth limit stop is a radially-outward projecting ridge formed over at least two portions of a circumference of the welding sleeve, and wherein an inner surface of the first component is fused to the outer surface of the welding sleeve in a vicinity of an outer surface portion of the heating element, and an outer surface of the second component is fused to the inner surface of the welding sleeve in a vicinity of an inner surface portion of the heating element.

22. An assembly according to claim 21, wherein the components are pipes of a fuel supply pipeline.

23. An assembly according to claim 21, wherein the components are a fuel line and a fuel tank of a motor vehicle.

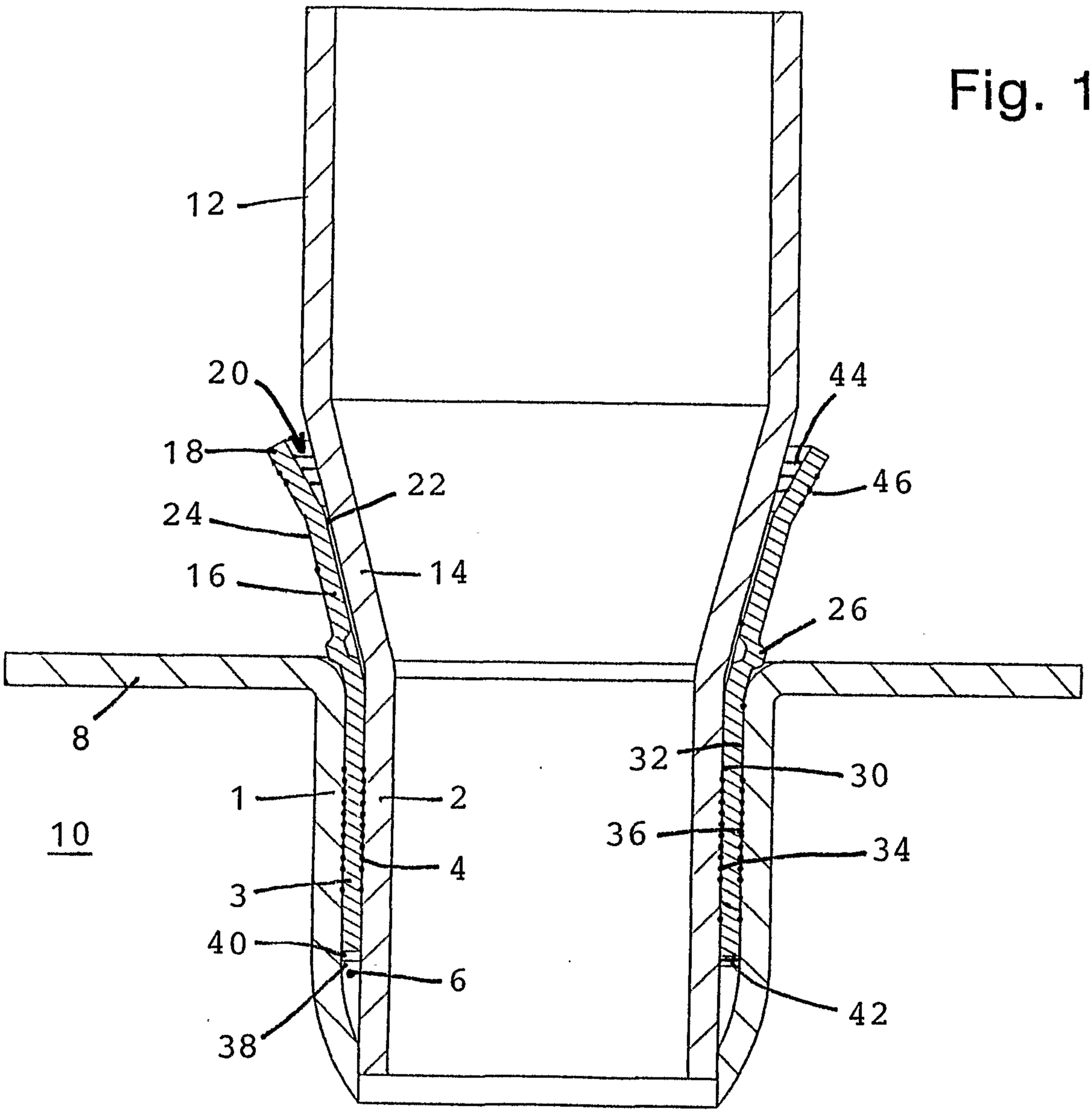



Fig. 1

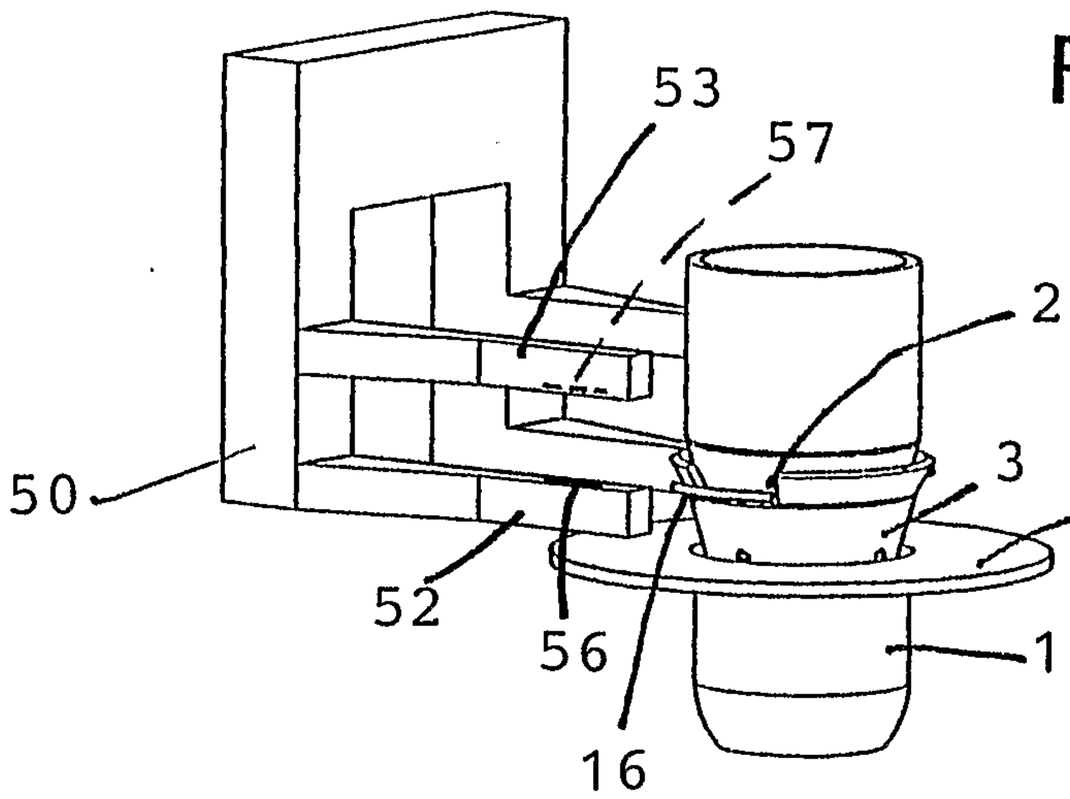



Fig. 2

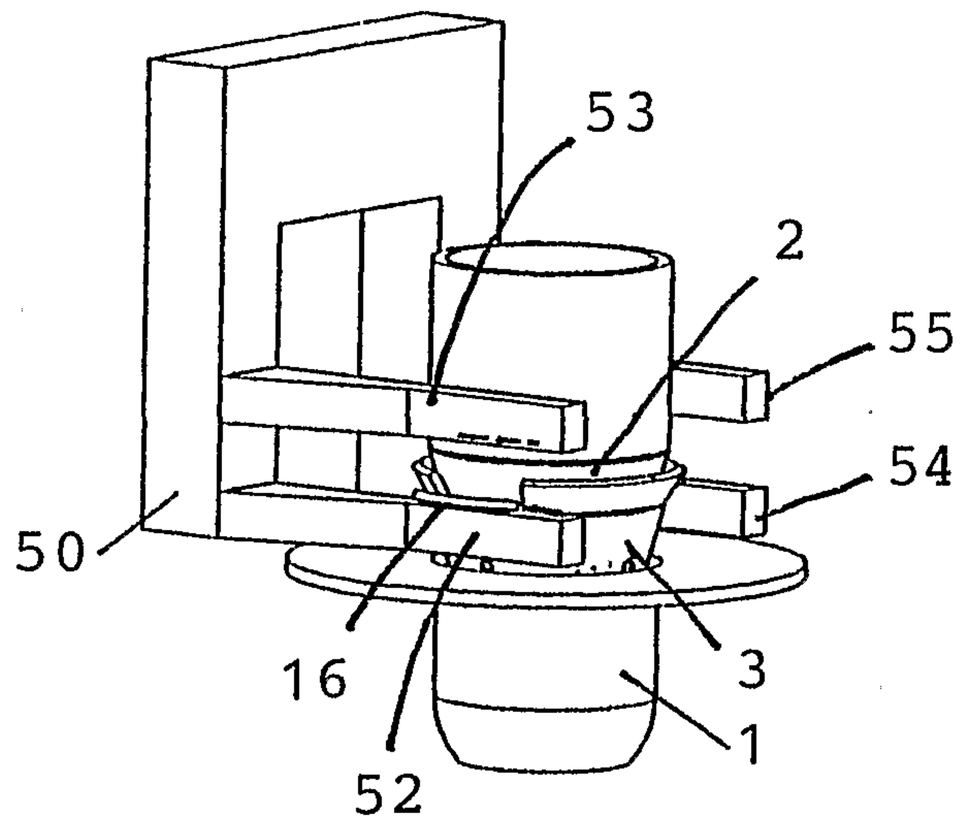



Fig. 3

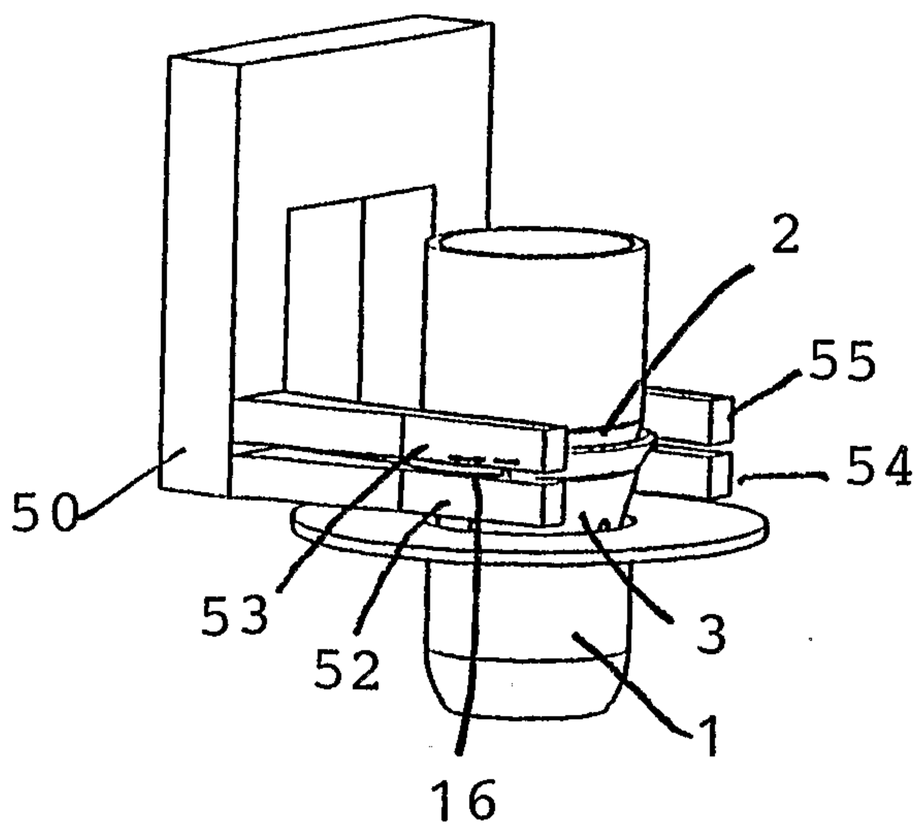



Fig. 4

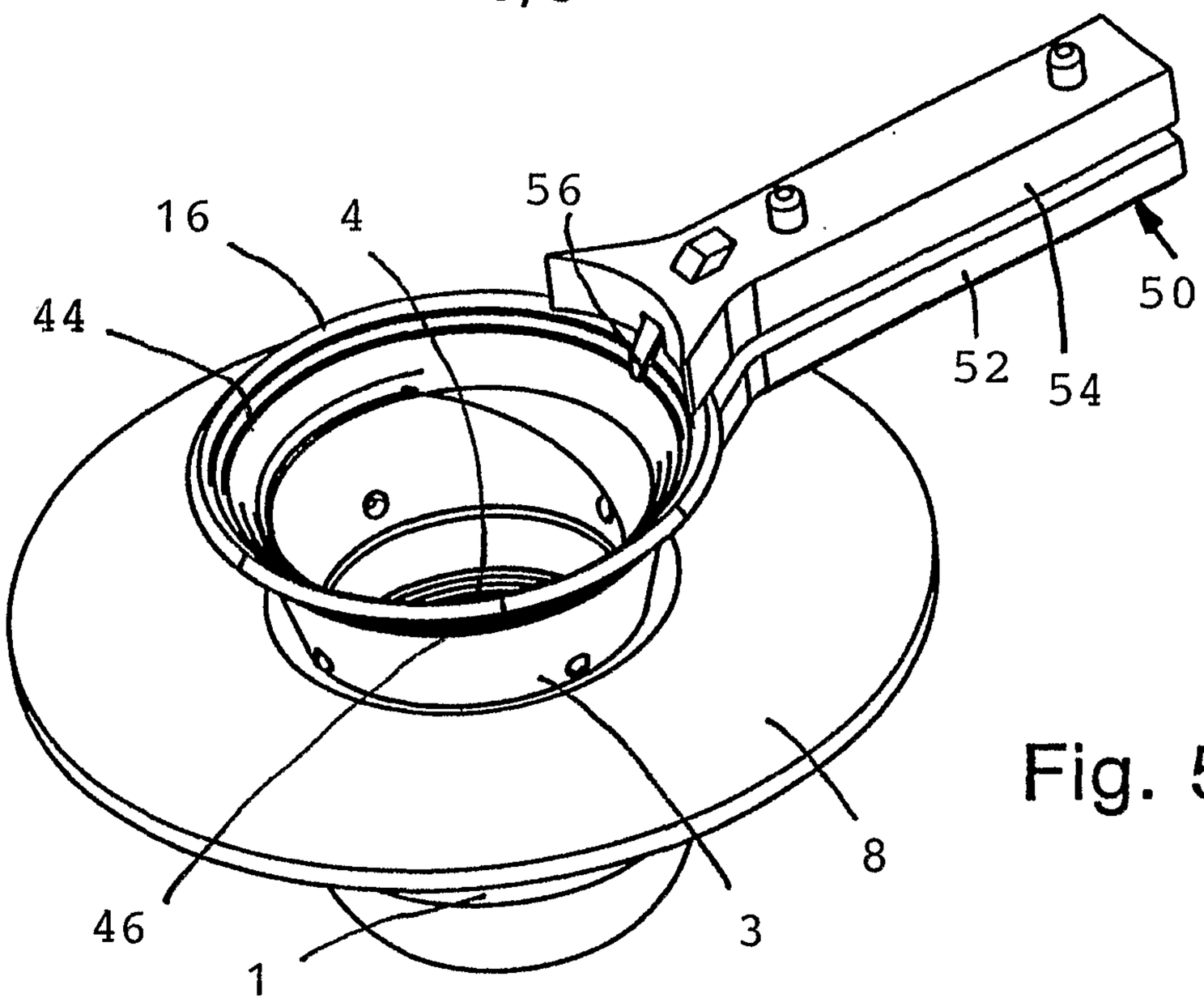



Fig. 5

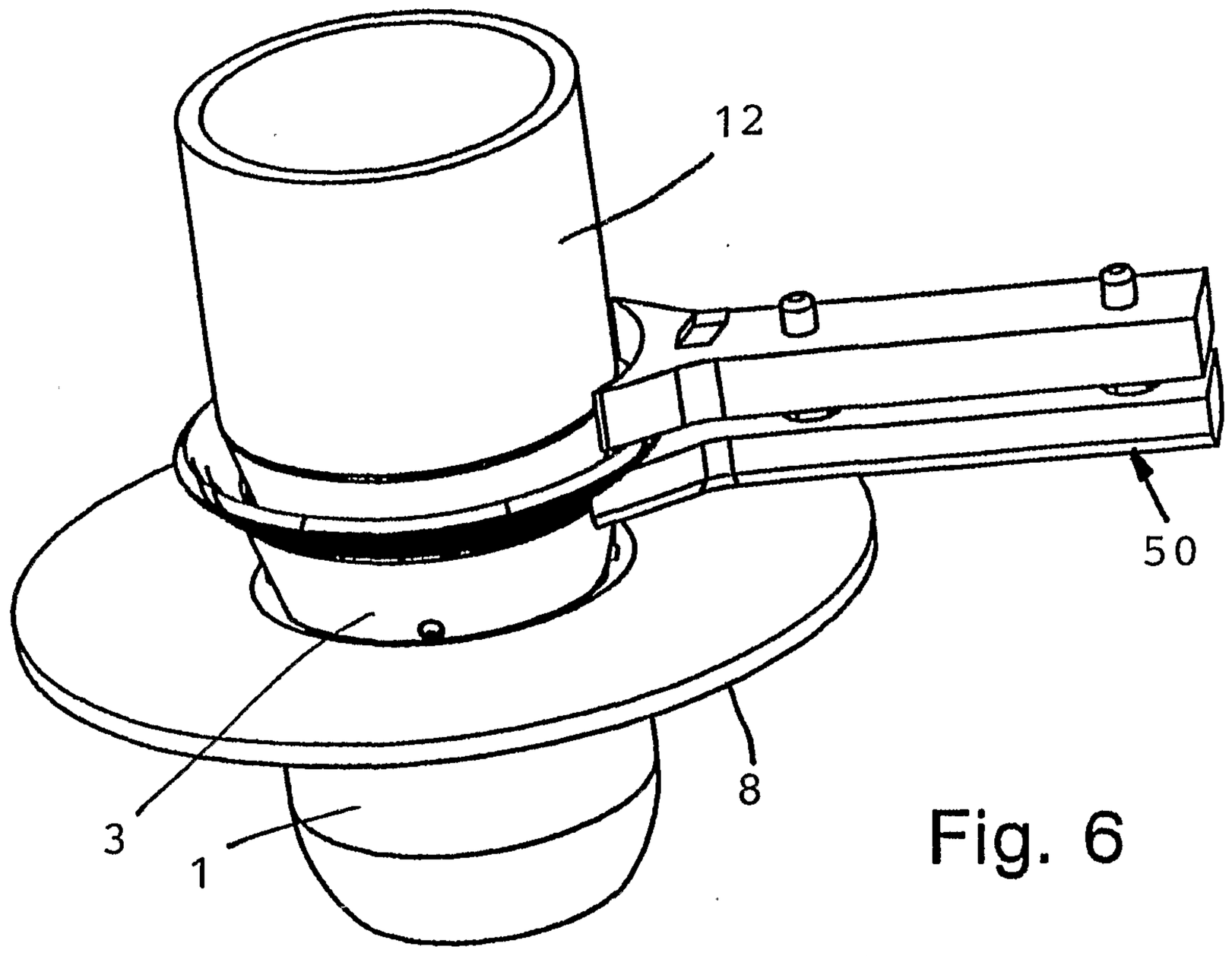



Fig. 6

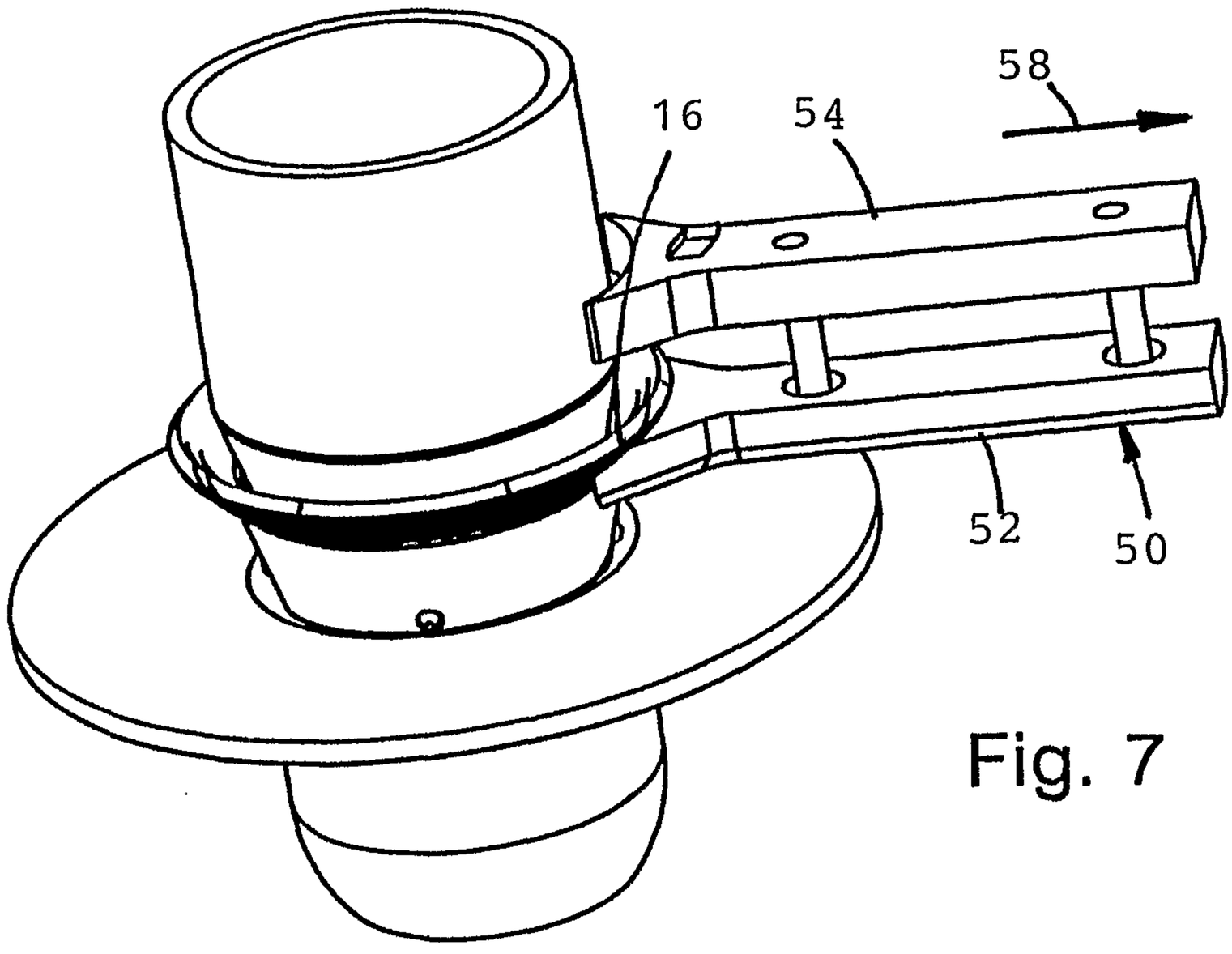



Fig. 7

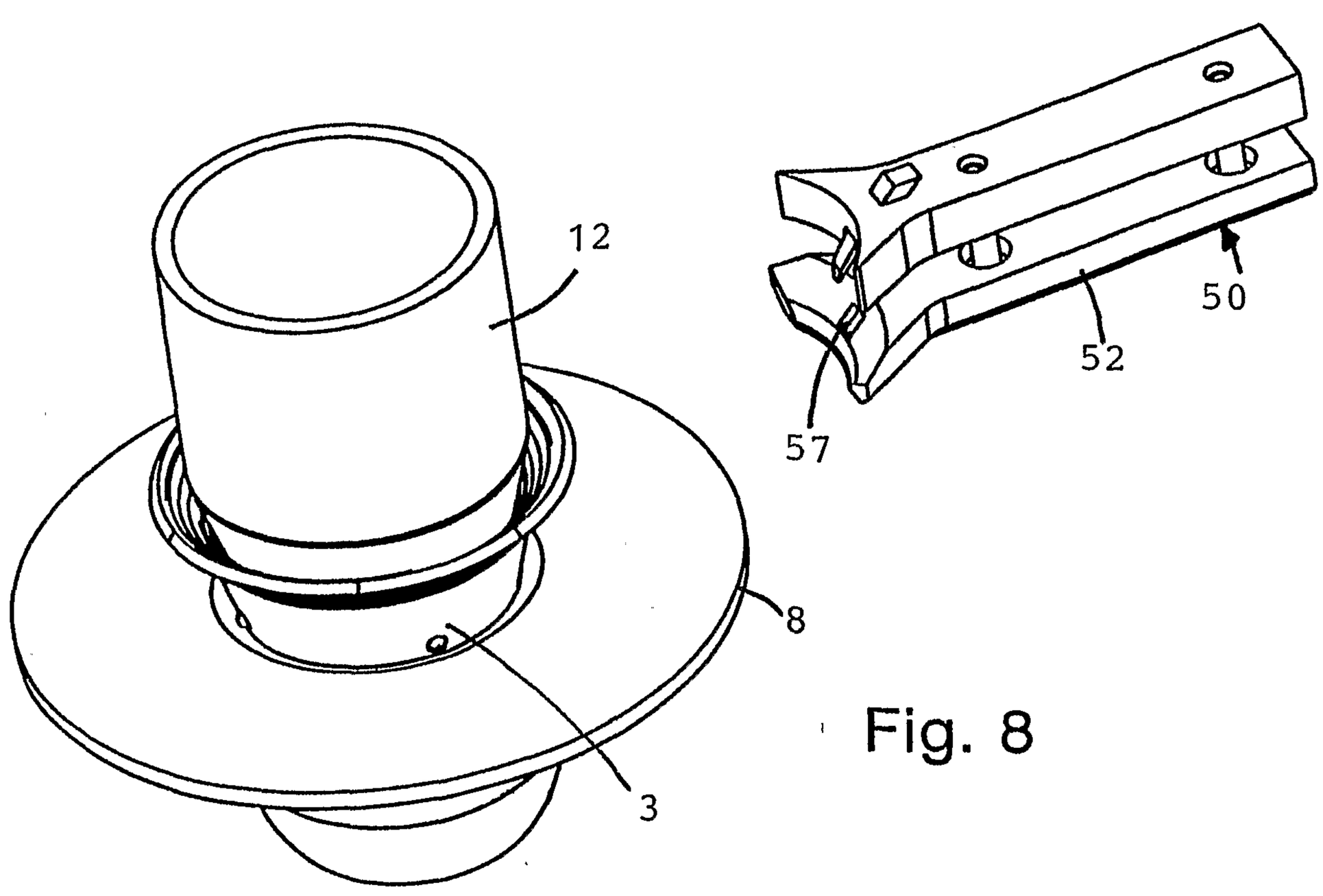



Fig. 8

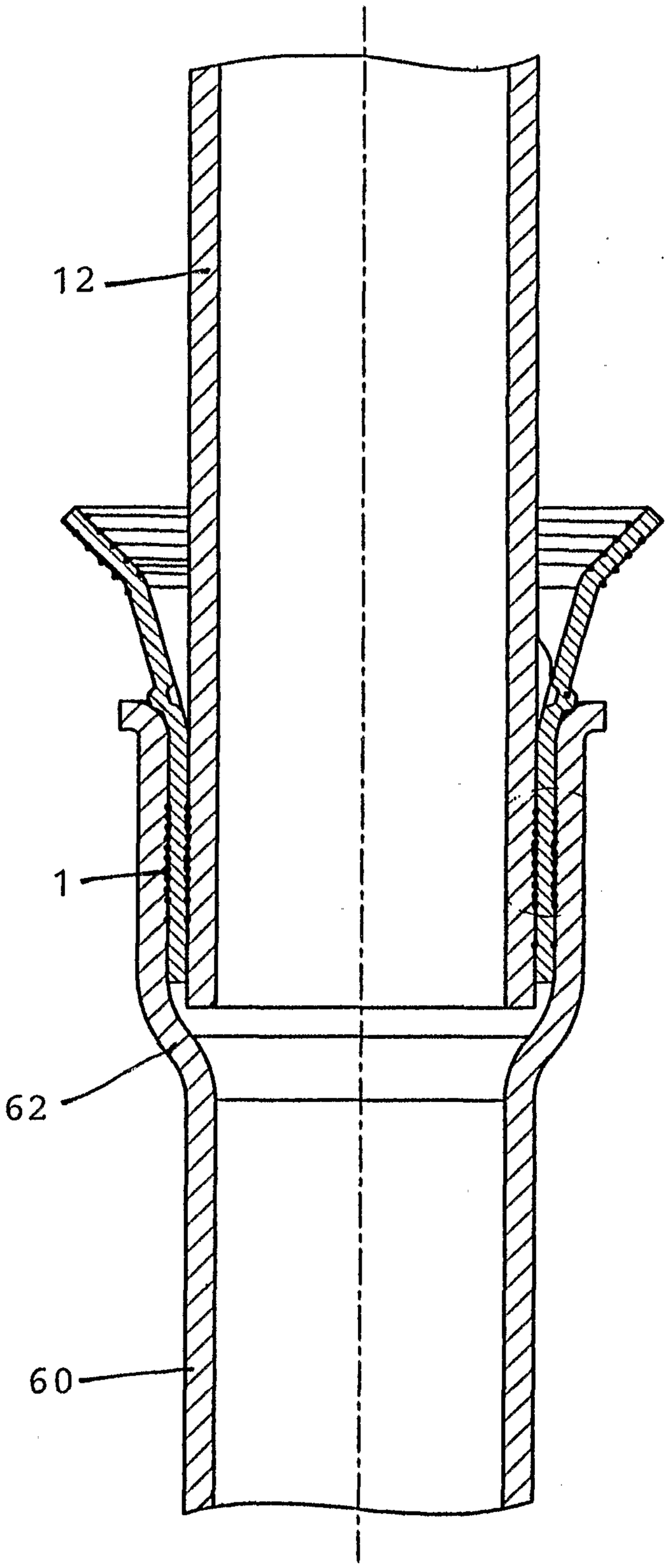



Fig. 9

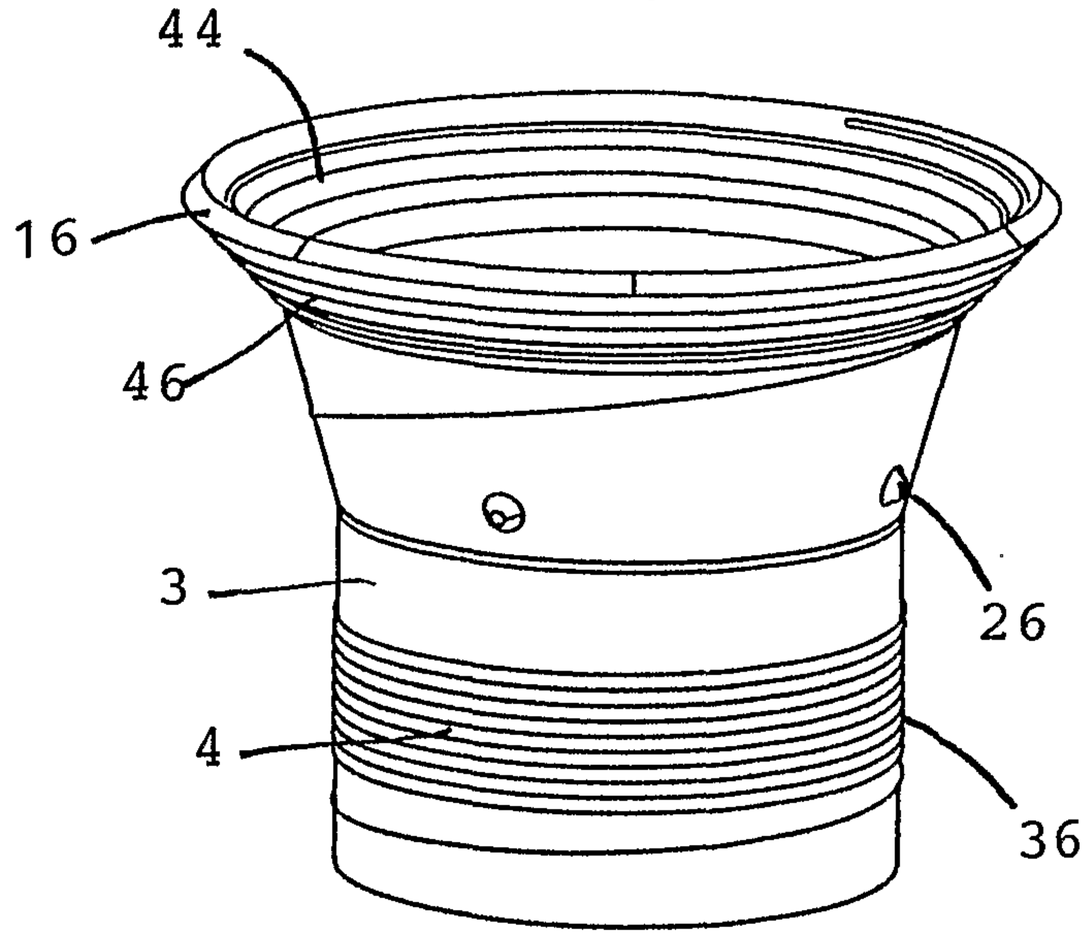



Fig. 10

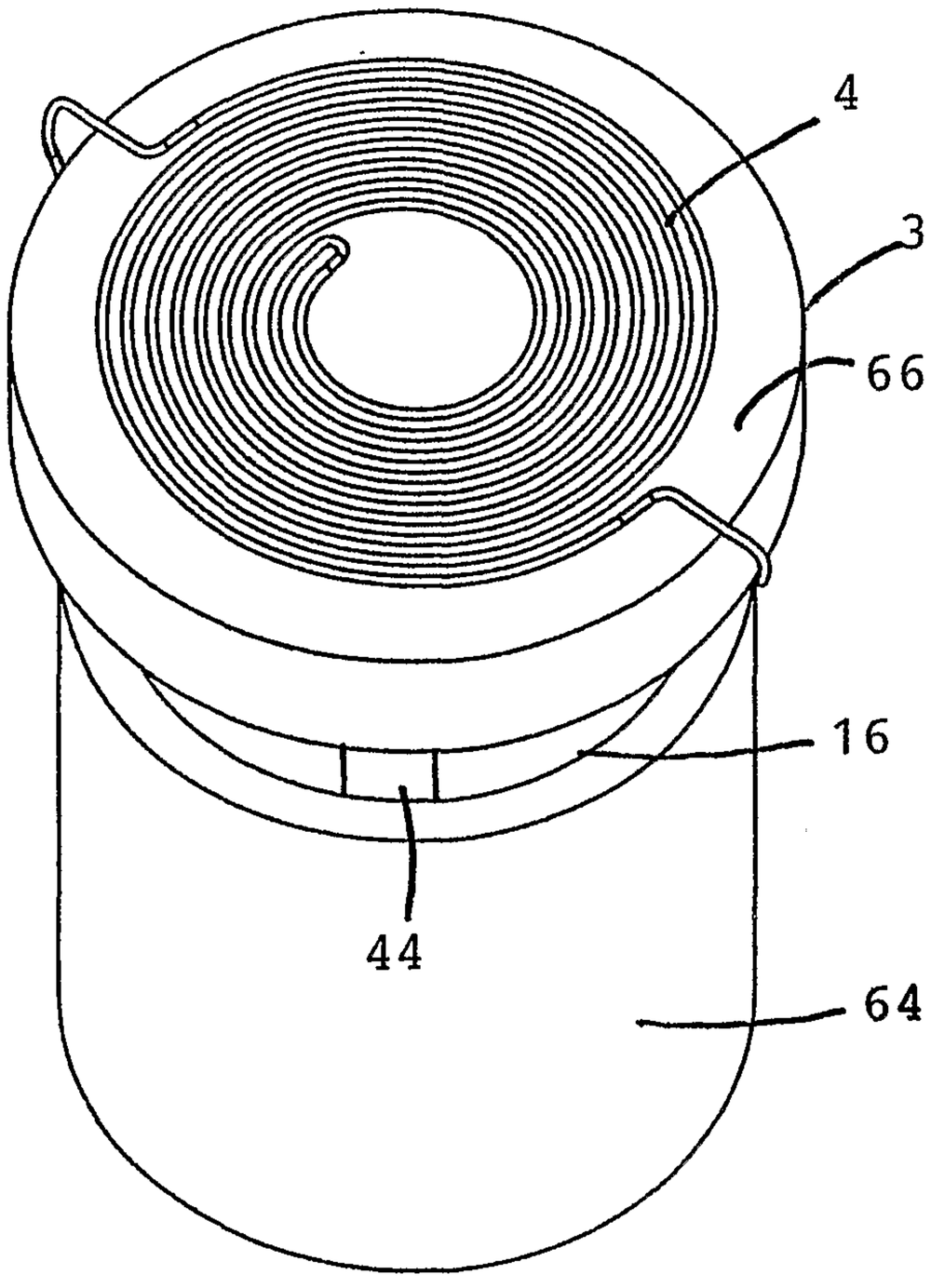



Fig. 11

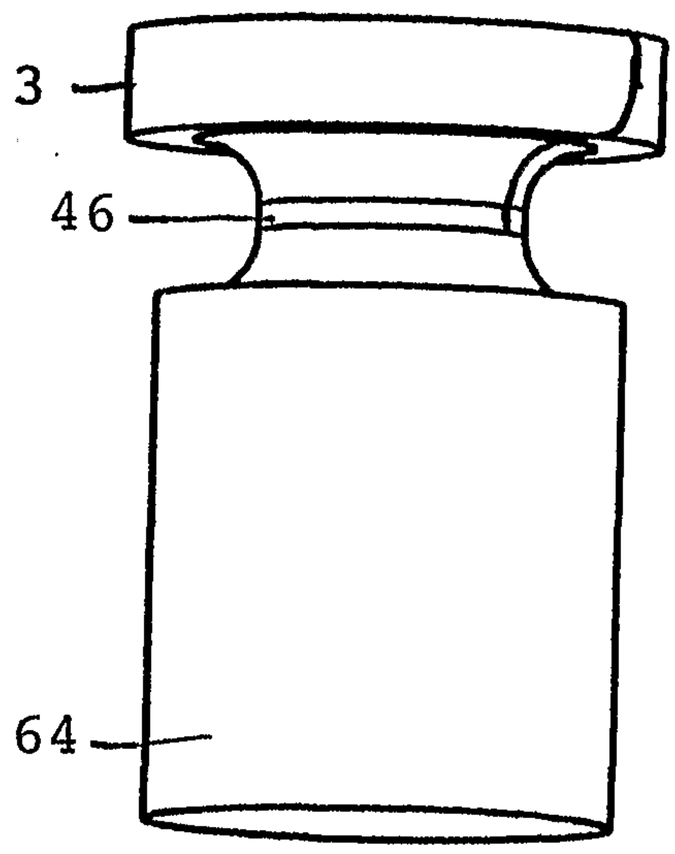



Fig. 12

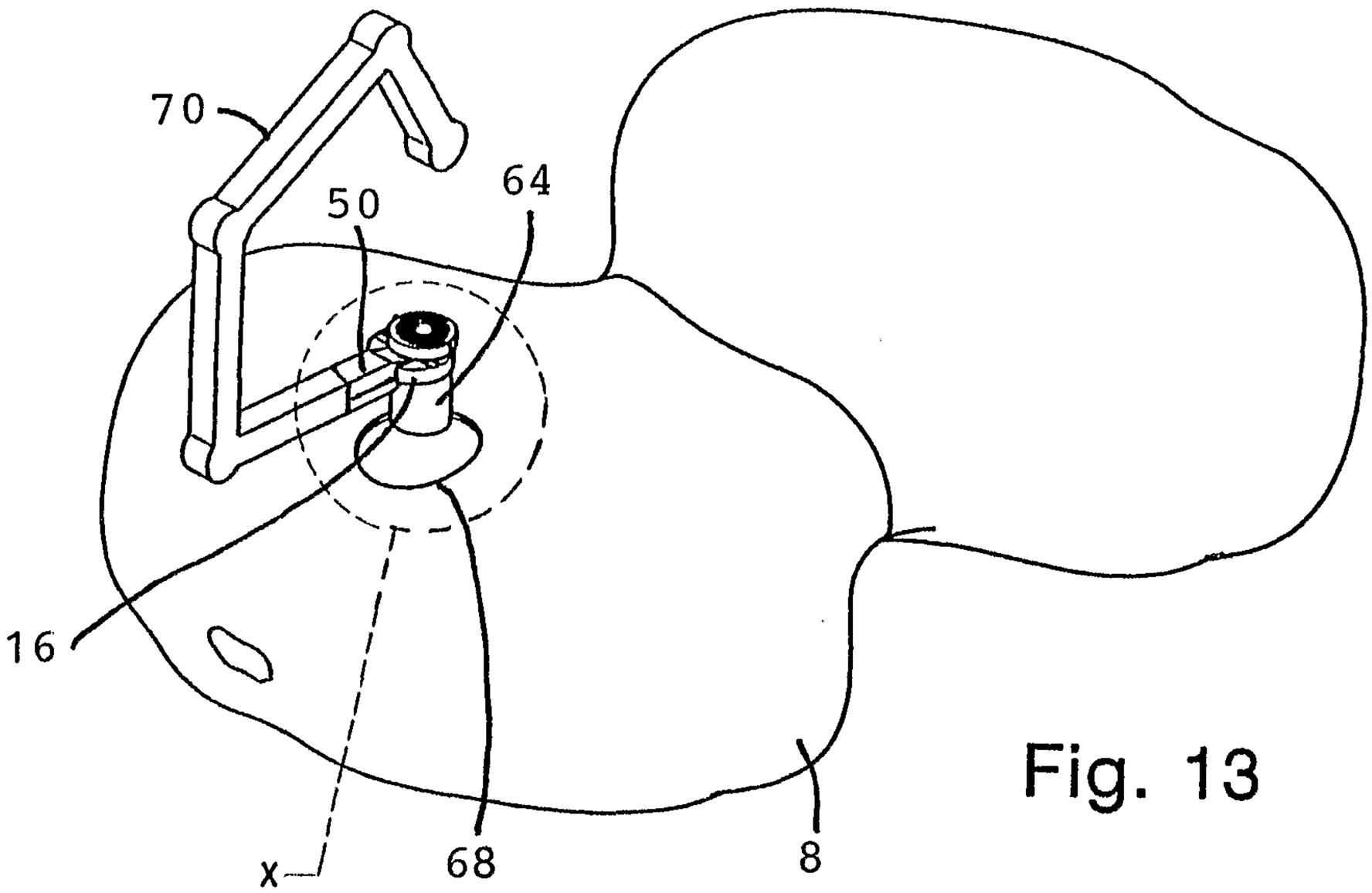



Fig. 13

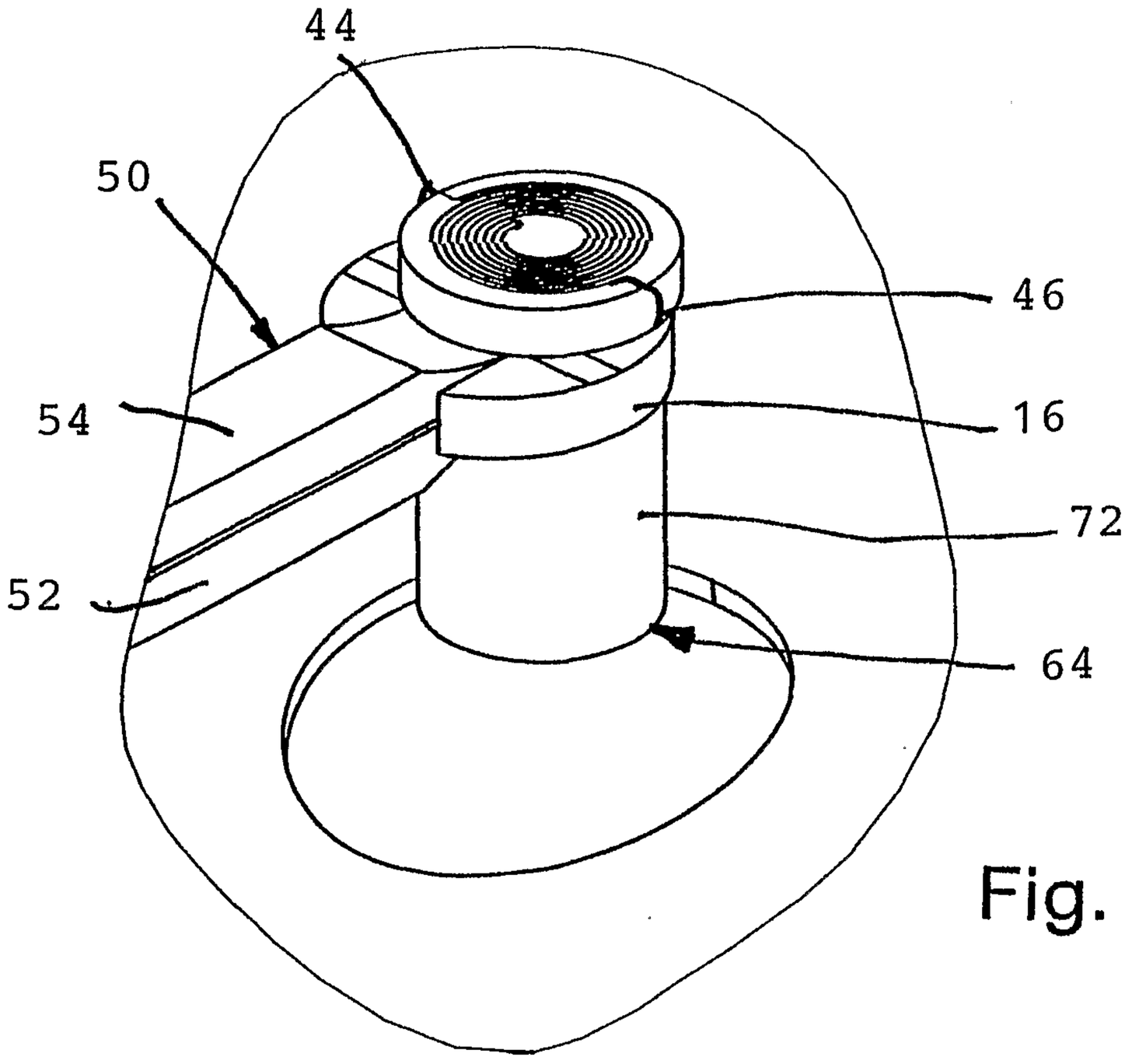



Fig. 14

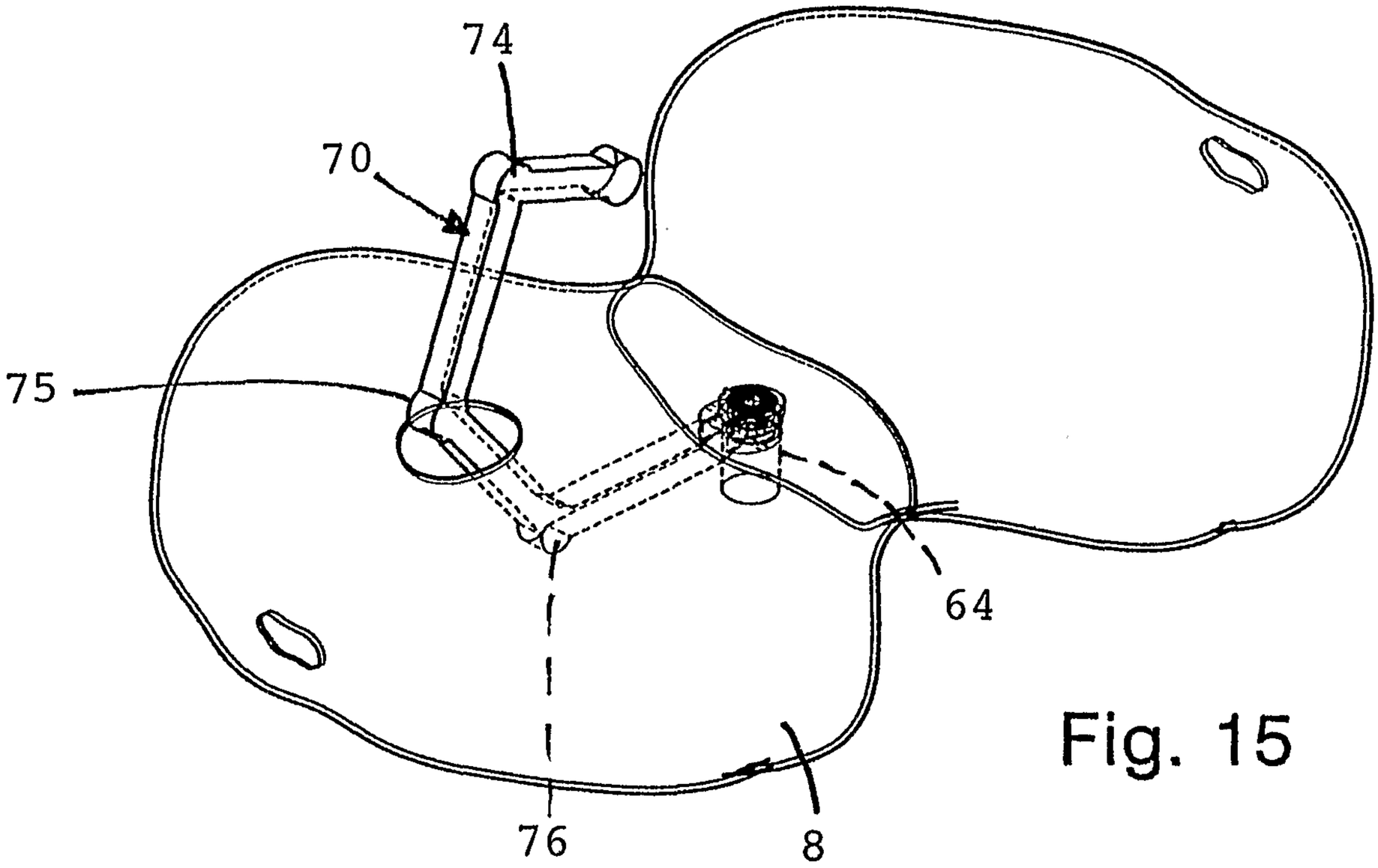



Fig. 15

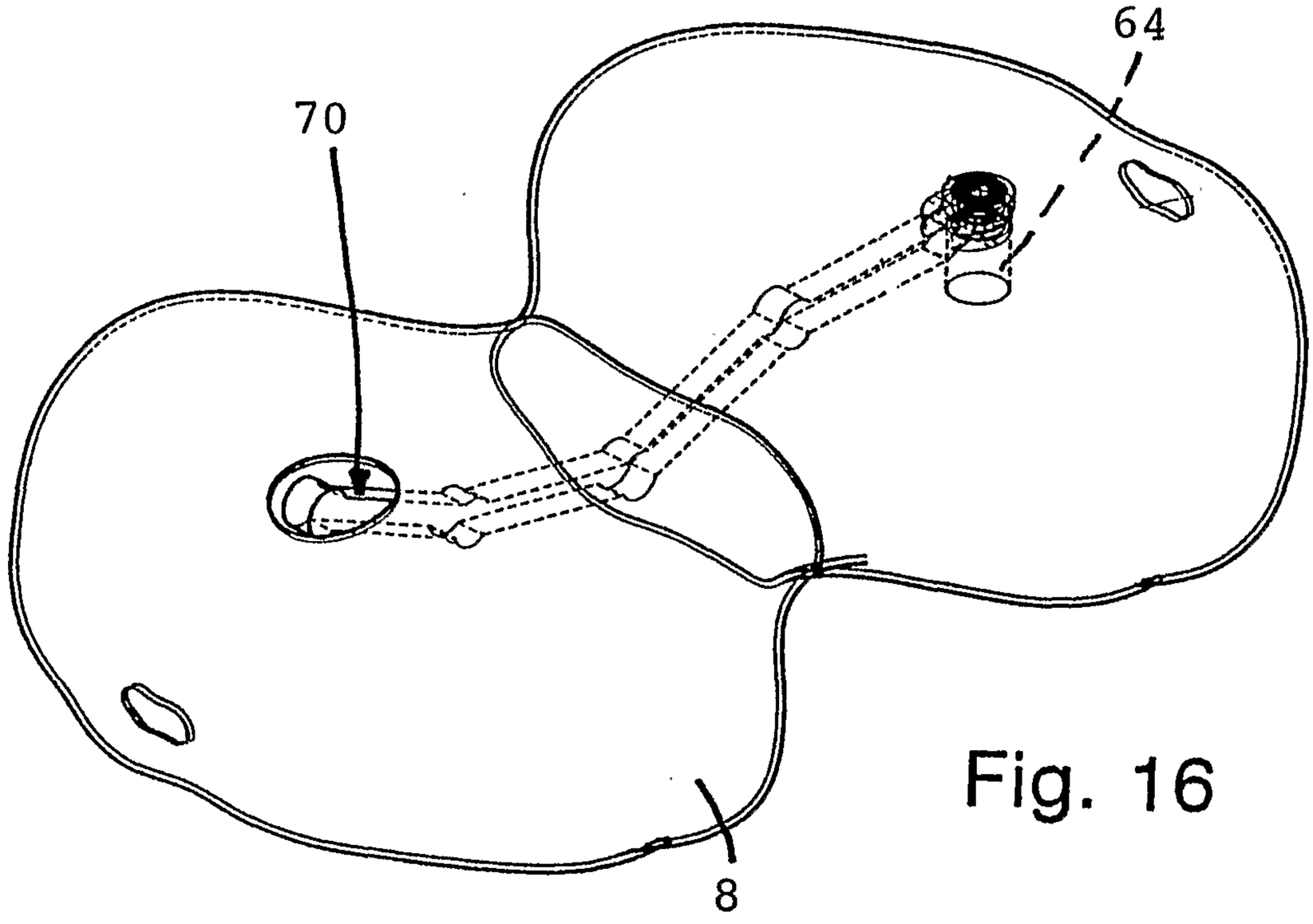



Fig. 16

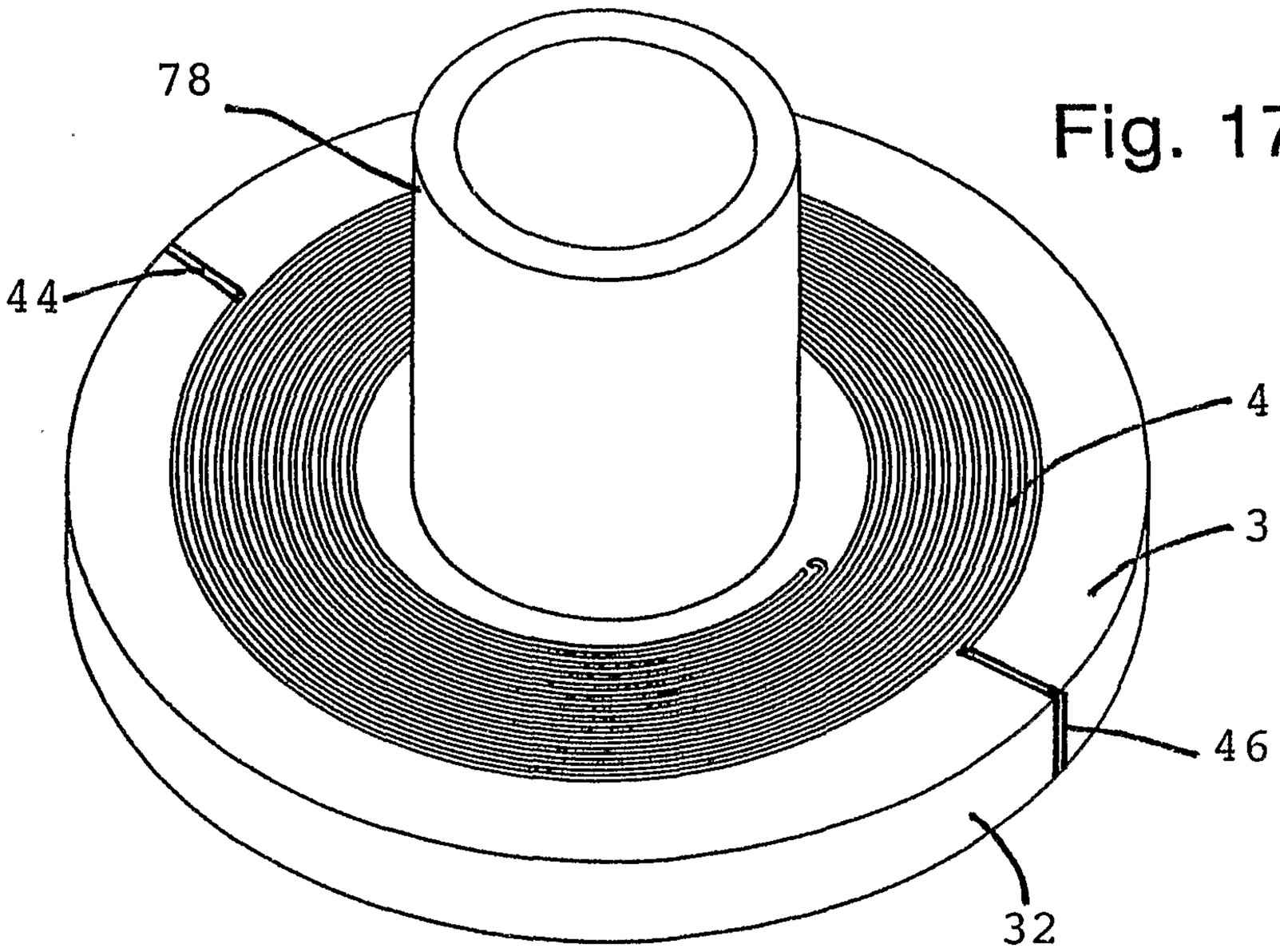



Fig. 17

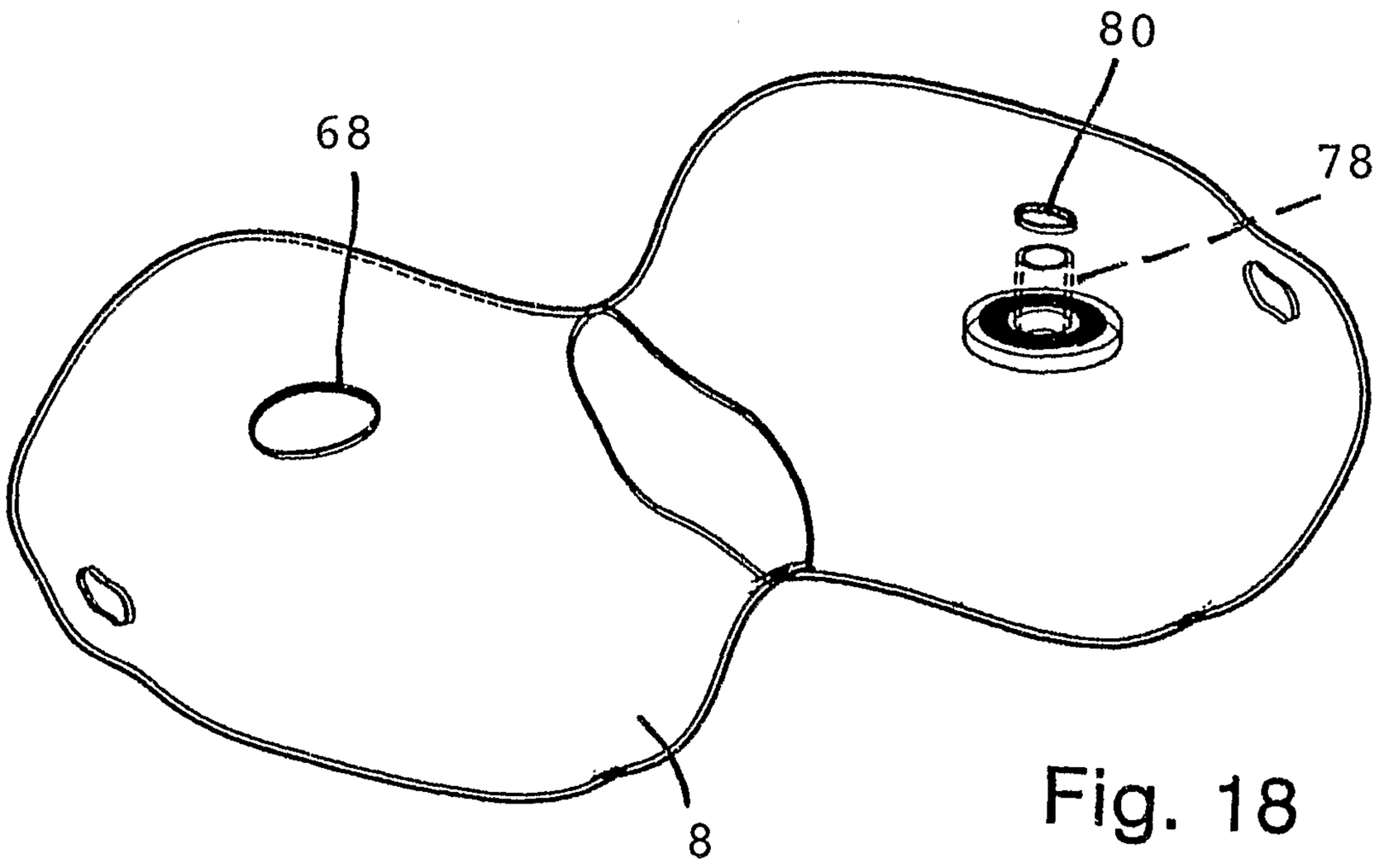
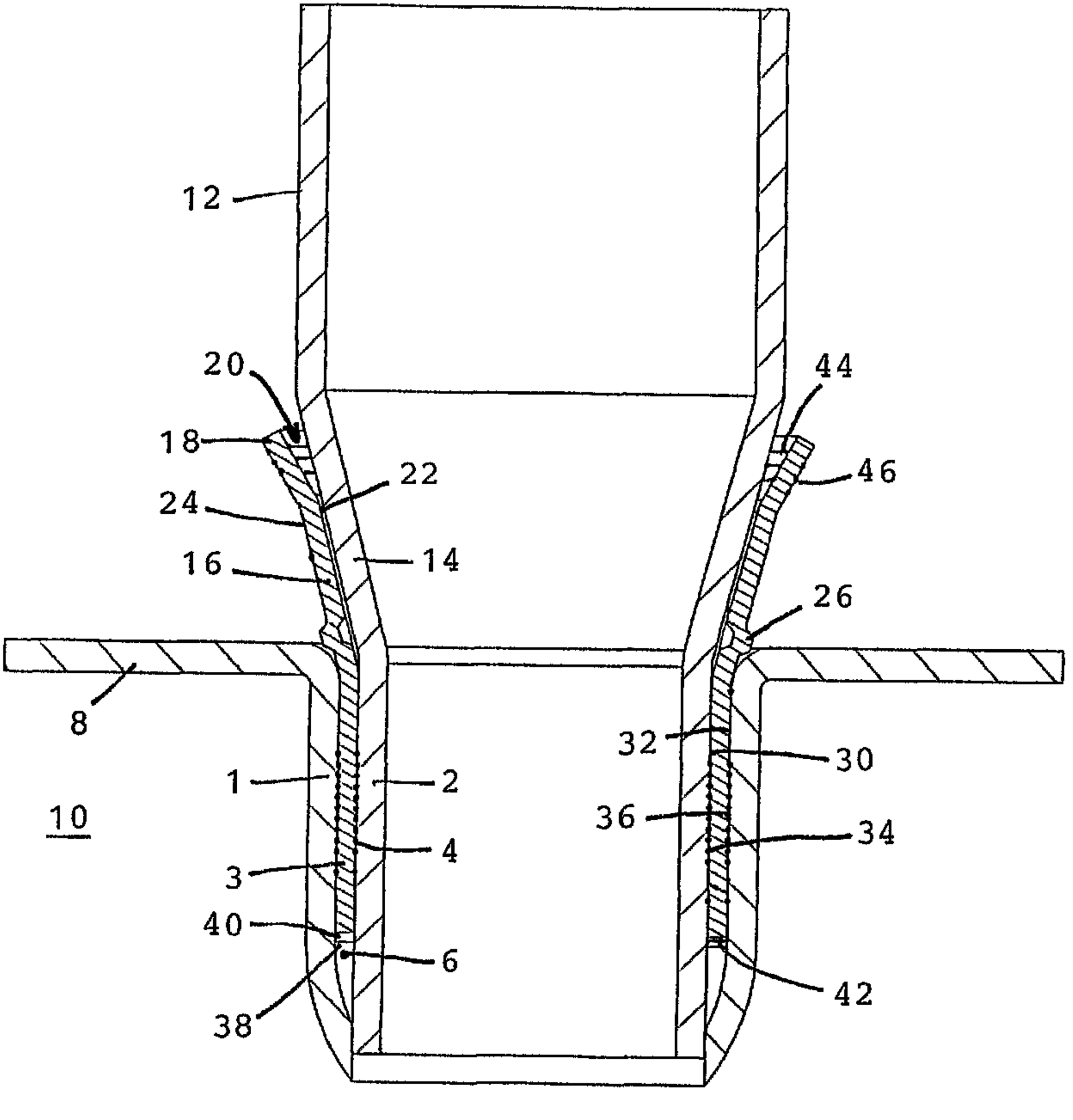



Fig. 18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