

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
17 July 2008 (17.07.2008)

PCT

(10) International Publication Number
WO 2008/084384 A2

(51) International Patent Classification:
F25B 43/00 (2006.01)

Paolo [IT/IT]; Via Bologna 8, I-20010 Cornaredo (Milan) (IT).

(21) International Application Number:
PCT/IB2008/000049

(74) Agents: **DE GREGORI, Antonella** et al.; Barzano' & Zarnardo Milano S.p.A., Via Borgonuovo, 10Milano S.p.A., I-20121 Milan (IT).

(22) International Filing Date: 7 January 2008 (07.01.2008)

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

(25) Filing Language: Italian

(26) Publication Language: English

(30) Priority Data:
MI2007A 000018 8 January 2007 (08.01.2007) IT

(71) Applicant (for all designated States except US): **TI AUTOMOTIVE CISLIANO S.R.L.** [IT/IT]; Via Abbiategrasso, I-20080 Cislano (Milan) (IT).

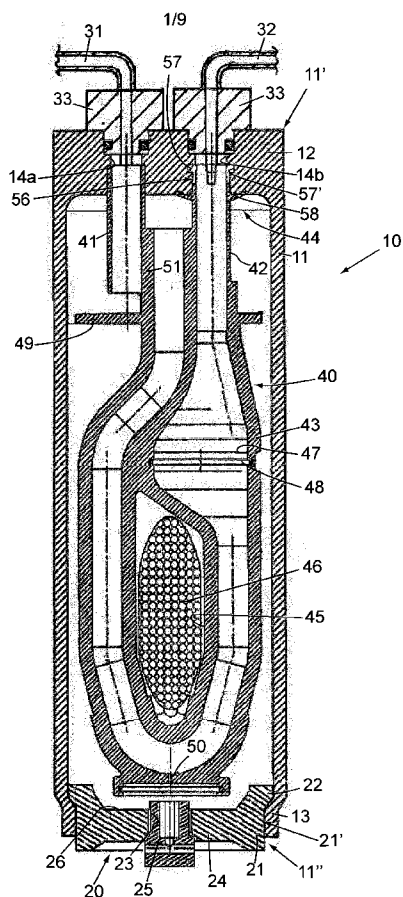
(72) Inventors; and

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,

(75) Inventors/Applicants (for US only): **TOSSI, Carlo** [IT/IT]; Via A. Stradella, 8, I-20129 Milano (IT). **MUSSI,**

[Continued on next page]

(54) Title: ACCUMULATOR FOR AUTOMOTIVE REFRIGERATION SYSTEM



(57) Abstract: An accumulator (10) for an automotive refrigeration system comprises a tubular casing element (11) adapted to accommodate a pipes assembly (40,60) within which the refrigerant flows, the accumulator being provided with a bottom (12) which closes a first end (11') thereof, and in which a pair of connections (14a, 14b) is provided respectively for refrigerant inlet (31) and outlet (32) pipes and closable in a sealed manner at a second end (11''), opposite to the first, by means of a cap (20).

WO 2008/084384 A2



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, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL,
NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG,
CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished
upon receipt of that report*

-1-

ACCUMULATOR FOR AUTOMOTIVE REFRIGERATION SYSTEM

The present invention regards an accumulator for automotive refrigeration system.

According to the known art, accumulators for refrigeration systems in the automobile industry, are assembled by welding the cap onto the tubular body after having inserted the pipes for the circulation of the refrigerant or by pinning the tubular body after having inserted the pipes for the circulation of the refrigerant.

Two examples of such systems are provided for in US patent US5191775 and by the European patent application EP1319909A2.

When manufacturing elements in large numbers, the cost effectiveness of the operations is a key factor in order to ensure the commercial success of the product.

Furthermore, taking into account the intended use of the accumulator, lightness is one of the key requirements.

Thus, currently there is the need to manufacture an accumulator for an automotive refrigeration system capable of allowing use of light material such as metallic alloys and thin plastics and capable of ensuring sufficient sealing through a low cost assembling operation.

The general objective of the present invention is

-2-

that of manufacturing an accumulator for an automotive refrigeration system made through assembly of components made of various materials without risks of damaging the components and capable of obtaining the sealing and lightness qualities required for the particular intended use.

This and other objectives according to the present invention are attained by the accumulator according to the description provided for by the independent claims 1 and 28.

Further characteristics according to the invention are the subject of the dependent claims.

The accumulator according to the present invention is intended for a refrigeration device in the automobile industry and comprises a tubular casing adapted to accommodate an assembly of pipes within which the refrigerant flows, the accumulator being provided with a bottom which closes a first end thereof and in which a pair of connections is provided respectively for refrigerant inlet and outlet pipes and closable in a sealed manner against at second end, located opposite to the first, by means of a cap.

Characteristics and advantages of the accumulator according to the present invention shall be clearer from the following exemplifying and non-limiting

-3-

description with reference to the schematic drawings attached wherein:

Figures 1a-1f show a cross-sectional schematic view of an equivalent number of embodiments of the accumulator according to the present invention;

Figure 2 is a cross-sectional schematic view of a detail of an accumulator according to the invention;

Figure 3 is a perspective view of an accumulator according to the invention;

Figure 4 is a perspective view of a detail of the accumulator according to a different embodiment of the invention.

With reference to the figures, an accumulator intended for an automotive refrigeration device, comprises a substantially cylindrical tubular casing element 11, adapted to accommodate an assembly of pipes 40 within which the refrigerant is flowed.

The accumulator 10 is provided with a bottom which closes a first end 11' of the tubular element 11 and in which a pair of connections 14a, 14b is provided respectively for an inlet pipe 31 coming from an evaporator and an outlet pipe 32 of the refrigerant flowing towards the exchanger and/or compressor.

The tubular element 11 is closable in a sealed manner at a second end 11'' located opposite to the first, through a cap 20.

-4-

Depending on the requirements, the cap 20 can be made in a substantially flat shape (figures 1a,1c,1d,1e) or alternatively be dome-shaped (figure 1b).

5 The tubular element 11 and the cap are made of metal, preferably aluminium. The sealing is performed by magnetic impulse explosive welding. In particular, depending on the preferred embodiment of the invention, the cap 20 is intended to be at least partially
10 inserted into the tubular element 11, by means of an insertion portion 21 of smaller diameter with respect to the internal diameter of the tubular element 11 and ending with a circumferential abutment 22 on which, through magnetic impulse explosive welding, an end
15 portion 13 of the end 11'' of the tubular element 11 is deformed and shaped until the crystalline planes of the surfaces in contact of the two, penetrate into each other substantially forming a single body and thus attaining the sealing.

20 With reference in particular also to figures 1a-1e it can be observed that in the dome-shaped embodiment (figure 1b) of cap 20 the thickness of the insertion portion 21 is greater than the corresponding thickness of the end portion 13 of the end 11'' of the tubular
25 element 11 or alternatively, in case of a substantially flat cap 20, such end portion 13 is intended to come

-5-

into contact with the circumferential edge 21' of the insertion portion 21 and thus consequently the circumferential abutment 22 can also be provided with a smaller thickness with respect to the corresponding end portion 13 of the tubular element 11, given that the deformation of the latter is directly countered by the circumferential edge 21'.

Obviously it is possible that the cap be intended to be fitted externally with respect to the tubular element and be deformed on the same by means of magnetic impulse explosive welding. In such a case, the cap is made thinner than the tubular element 11.

In any case, such welding systems protect the bottom 12 of the tubular element and the connections fixed in it against any kind of damage. In addition, given the extremely limited and restricted variation of temperature, it is possible to insert the plastic pipes assembly in advance without risks of damaging them.

According to an embodiment illustrated in figure 1c, the accumulator is provided with a side inlet and thus the inflow connection 14a and the relative inlet pipe 31 are provided for with a transverse insertion in the bottom 12.

Advantageously, the pipes assembly 40 is made of two plastic shells welded by means of known systems for example through vibrations as indicated in the European

-6-

patent application EP1319909A2.

The cap 20 can be made in the form of a "blind" cover otherwise it can comprise, as in the present embodiment, an outlet hole 23 provided at its base 24 and shaped in such a manner to be able to accommodate a vent valve 25 preferably a shut-off valve.

Regarding this, the liquids collecting in the lower zone 26 of the cap are filtered through a net or filter 27 provided at the base of the pipes assembly, before being suctioned and reintroduced into the circulation.

The accumulator according to the present invention is particularly but not exclusively adapted for systems provided with Carbon Dioxide (CO₂) as a refrigerant.

Thus, the pipes assembly has an inflow fitting 41 and an outflow fitting 42 adapted to be inserted into the inner portion of the connections 14a and 14b respectively and at least one of which is adapted to be inserted through a quick connector 44.

The quick connector 44 can be conveniently provided at the end of the inflow fitting 41 or outflow fitting 42 or both.

In any case, the quick connector 44 is in the form of a tubular element provided with grooves 59 which divide the walls of the element into a plurality of indents 56 ending in abutments 57 adapted to snap-engage into seats 57' correspondingly made in the

-7-

bottom 12. To complete the quick connector 44, there are at least two flaps 58 made close to the end portion of the inflow fitting (or the outflow pipe) and meant to hold the connector 12 engaged against the bottom 5 through deformation.

The inflow fitting 41 can be made in a substantially cylindrical shape to be fitted into the inflow connection 14a or else as in figure 1d it can be provided with a conical portion 41' arranged facing the 10 inflow connection 14a, to optimise fluid inflow.

According to a different embodiment illustrated in figure 1e, the inflow fitting 41 is provided with a quick connector 44.

The liquid/gas separation of the refrigerant flow, 15 preferably CO₂, is provided for at the entrance of the accumulator, due to a round diffuser diaphragm 49 which forces the fluid to deviate and allows it to flow down along the sides of the tubular element, the liquid thus settles at the bottom of the same while the gas is 20 suctioned by the central pipe 43, follows the loop path and is conveyed to the outflow pipe.

The central pipe 43 has a substantially U-shaped path provided with loops and a loop close to the base of the accumulator provides for a housing 45 for a 25 dehydrating agent container 46.

Joined to the inflow fitting 41, a suction pipe 51

-8-

is made at the entrance of the central pipe 43 through which the refrigerant in gaseous phase after the first separation from the liquid phase is suctioned.

As a matter of fact, at the entrance of the accumulator there is a gas/liquid separation due to the
5 diffuser diaphragm 49 joined to the pipes assembly and having a diameter slightly smaller than the internal diameter of the tubular element 11 in such a manner to leave a free section for the passage of the liquid.

10 Such diffuser diaphragm forces the liquid to deviate and allows it to flow down along the sides, thus the liquid settles at the bottom 26 of the accumulator while the gas is suctioned by the suction pipe 51 at the entrance of the central pipe 43 and
15 follows the loop path to be then conveyed to the inflow fitting 42 which provides the end section of the central body.

The difference of level provided between the inflow fitting 41 and the suction pipe 51 of the pipes
20 assembly 40 allows to prevent flooding of the inflowing refrigerant and thus allows direct suction of the refrigerant in gaseous phase into the pipes assembly 40.

On the bottom of the pipes assembly 40 there is a
25 hole 50 which allows suction of the oil present in the refrigerant flow and which was separated from the gas

-9-

alongside the liquid CO₂.

Before being discharged from the outflow pipe 42 the refrigerant is passed through a screen filter 48 provided fixed in an expansion vessel 47 arranged along
5 the central pipe 43 in such a manner that the fluid expands tending to evaporate as much as possible and releases any impurities drawn along.

According to a different embodiment illustrated in 1f, the diffuser diaphragm 49 is provided with a
10 support of a layer of absorbing material 53, such as a felt or other similar material, and, if required, it is provided with holes 52 through which the liquid phase flows. Such layer facilitates the gas/liquid separation.

15 Such support can be provided only on one portion of the annular diffuser diaphragm 49, for example a section 54 directly facing the inflow fitting 41.

For the assembly of the pipes for the inflow 31 and outflow 32 of the refrigerant on the accumulator,
20 blocks 33 on which the abovementioned pipes 31, 32 are brazed, are used.

Alternatively, the refrigerant inlet 31 and outlet 32 pipes can be joined to the corresponding blocks through the insertion of the pipe into the
25 corresponding block and subsequent mechanical deformation of the pipe to adhere it against the

-10-

internal walls of the block thus providing the required seal.

Each block 33 is provided with a projecting portion 34 adapted to be inserted into the corresponding connection 14a or 14b and provided with a sealing system.

The block is fixed by means of screws 35 to be screwed into threaded holes 15 made on the bottom 12.

Connections 14a and 14b are made respectively coaxial to the inflow 41 and outflow 42 fittings in such a manner to prevent interference with refrigerant flowing into and out of the accumulator.

According to a different embodiment of the invention, illustrated in figures 3 and 4, the accumulator 10 for an automotive refrigeration system comprises a pipes assembly 60 which in turn comprises the diffuser diaphragm 49' joined to the pipes assembly and having an internal diameter slightly smaller than the internal diameter of the tubular element 11.

Along the circumferential edge, the diffuser diaphragm 49' is provided with spacers 66 adapted to keep the diffuser diaphragm 49' centred and spaced from the walls of the tubular element 11.

A section 65 of the diffuser diaphragm 49' is made similar to a seat 67 to accommodate an absorbing element 64 provided with a framework 69 adapted to be

-11-

arranged and engaged below abutments 70 provided along the sides of the seat 67.

The base of the seat 67 is provided with holes 68 for the passage of the fluid.

5 Directly above the section 65 an inflow fitting 41 is mounted provided with a conical portion 41' to be arranged facing the connection at the inflow connection 14a, to optimise fluid inflow.

10 Raised along the internal profile of the section 65 is a separation element 63 onto which the inflow fitting 41 might be fixed and which is intended for withholding the fluid flowing into the accumulator while this passes through the absorbing element 64, in such a manner to prevent the fluid from flooding over
15 the entire diffuser diaphragm 49'.

In order to improve the separation between the liquid and gas phases constituting the fluid flowing into the accumulator, a suction pipe 51 connected from the opposite side of the diffuser diaphragm 49' to the
20 entrance of the central pipe is elevated from the diffuser diaphragm 49', thus performing the suction of the fluid made up of 95% or more of gas, avoiding suction of liquid phases.

The suction pipe 51 is made in the form of a
25 cylindrical capsule 61 provided with walls made of a net or a filtering element 62.

-12-

The central pipe 43 according to the present embodiment, does not require an expansion vessel and screen filter in that filtration is performed in advance outside the central pipe 43 through the
5 filtering element 62.

In the loop formed by the central pipe a vat 64 for accommodating the drying agent sachet is provided outside the central pipe.

Furthermore, provided is a method for the
10 implementation of an accumulator 10 for an automotive refrigeration system, the accumulator comprising a tubular casing element 11 adapted to accommodate a pipes assembly 40, 60 within which the refrigerant flows, and being provided with a bottom 12 adapted to
15 close a first end 11' of the tubular element 11 and provided with a pair of connections 14a, 14b respectively for the refrigerant inlet 31 and outlet 32 pipes, and closable in a sealed manner at a second end 11'' of the tubular element 11 opposite to the first,
20 by means of a cap 20.

The method according to the invention comprises the steps of:

- Preparing the tubular element 11;
- Inserting and fitting the pipes assembly 40, 60
25 into the tubular element 11;
- Assembling the cap 20 to the tubular element 11

-13-

arranging an insertion portion 21 of the cap 20 ending with a circumferential abutment 22 in contact with an end portion 13 of the end 11'' of the tubular element 11;

- 5 - Subjecting said portions 21 and 13 to a magnetic impulse explosive welding.

-14-

CLAIMS

1. Accumulator (10) for an automotive refrigeration system comprising a tubular casing element (11) adapted to accommodate a pipes assembly(40,60) within which
5 then refrigerant flows, characterised in that it is provided with a bottom (12) adapted to close a first end (11') of the tubular element (11) and provided with a pair of connections (14a, 14b) respectively for refrigerant inlet (31) and outlet (32) pipes, and in
10 that it is closable in a sealed manner at a second end (11'') of the tubular element (11) opposite to the first, by means of a cap (20).

2. Accumulator (10) according to claim 1, wherein said substantially cylindrical shaped accumulator is
15 provided with said tubular element (11) and said cap (20) made of metal, preferably aluminium and said pipes assembly (40) made of plastic.

3. Accumulator (10) according to claim 1, wherein the cap (20) is made dome-shaped and intended to be at
20 least partially inserted into the tubular element (11), by means of an insertion portion (21) with a smaller diameter with respect to the internal diameter of the tubular element(11) and ending with a circumferential abutment (22) on which, through magnetic impulse
25 welding, an end portion (13) of the end (11'') of the tubular element (11) is deformed and shaped.

-15-

4. Accumulator (10) according to claim 1, wherein the cap (20) is made substantially flat-shaped and it is intended to be at least partially inserted into the tubular element (11), by means of an insertion portion
5 (21) with a circumferential edge (21') having a smaller diameter with respect to the internal diameter of the tubular element (11) and ending with a circumferential abutment (22), on said circumferential edge (21') and on said circumferential abutment (22), an end portion
10 (13) of the end (11'') of the tubular element (11) being deformed and shaped by means of magnetic impulse welding.

5. Accumulator (10) according to claim 1, wherein said pipes assembly (40,60) is made in two plastic shells
15 welded to each other.

6. Accumulator (10) according to claim 1, wherein said cap (20) comprises an outflow hole (23) arranged centrally on its base (24) and shaped in such a manner to be able to accommodate a vent valve (25) preferably
20 a shut-off valve.

7. Accumulator (10) according to claim 1, wherein a net or filter (27) is provided arranged at the base of the pipes assembly for filtering the liquids which gather in the lower zone (26) of the accumulator and
25 which are suctioned into the central body through a hole (50) which allows the suction of the oil present

-16-

in the refrigerant flow and which was separated from the gas alongside the liquid CO₂.

8. Accumulator (10) according to claim 1, wherein the pipes assembly (40) comprises a central pipe (43), an inflow fitting (41) and an outflow fitting (42) adapted to be inserted into the internal portion of the connections (14a, 14b) respectively and at least one of which is adapted to be inserted by means of a quick connector (44), in form of a tubular element provided with grooves (59) which divide the walls of the element into a plurality of indents (56) ending in abutments (57) adapted to snap-engage in seats (57') correspondingly made on the bottom (12) and in which there are at least two flaps (58) provided in proximity to the end portion of the inflow fitting (or of the outflow pipe) and intended to withhold the connector engaged against the bottom (12) by means of deformation.

9. Accumulator (10) according to claim 8, wherein said pipes assembly externally includes a circular diffuser diaphragm (49) in proximity to the entrance of the accumulator having a diameter slightly smaller than the internal diameter of the tubular element (11).

10. Accumulator (10) according to claim 8, wherein said pipes assembly externally includes a circular diffuser diaphragm (49) in proximity to the entrance of the accumulator having a diameter slightly smaller than the

-17-

internal diameter of the tubular element (11), said diffuser diaphragm (49) being provided with a support of an absorbing layer (53) and, if required, having holes (52) through which the liquid phase flows.

- 5 11. Accumulator (10) according to claim 8, wherein said central pipe (43) has a substantially U-shaped loop path and in which a loop in proximity to the base of the accumulator provides a housing (45) for a container (46) for a drying agent.
- 10 12. Accumulator (10) according to claim 10, wherein alongside the inflow fitting (41) a suction pipe (51) is provided at the entrance of the of the central pipe (43) through which the refrigerant in gaseous phase after the first separation from the liquid phase is
- 15 suctioned.
13. Accumulator (10) according to claim 12, wherein there is a height difference between the inflow fitting (41) and the suction pipe (51) of the pipes assembly(40).
- 20 14. Accumulator (10) according to claim 13, wherein a screen filter (48) is provided fixed in an expansion vessel (47) arranged along the central pipe (43).
15. Accumulator (10) according to claim 1, wherein the assembly of the refrigerant inlet (31) and outlet (32)
- 25 pipes on the accumulator is performed by means of blocks (33) in which the abovementioned pipes are

-18-

brazed or joined by means of a deformation blocking system, through insertion of the pipe into the corresponding block and subsequent mechanical deformation of the pipe to adhere it against the internal walls of the block thus providing the required sealing, each block (33) being provided with a projecting portion (34) adapted to be inserted into the corresponding connection (14a or 14b).

16. Accumulator (10) according to claim 15, wherein said connections (14a, 14b) are made respectively coaxial to the inflow (41) and outflow (42) fittings.

17. Accumulator (10) according to claim 16, wherein said inflow connection (14a) and the related one inlet pipe (31) are provided intended to be inserted in a transverse manner into the bottom (12).

18. Accumulator (10) according to claim 17, wherein said inflow fitting (41) is made in a substantially cylindrical shape to be fitted into the inflow connection (14a).

19. Accumulator (10) according to claim 16, wherein said inflow fitting (41) has a conical portion (41'), arranged facing the inflow connection (14a), to optimise fluid inflow.

20. Accumulator (10) according to claim 16, wherein said inflow fitting (41) or said outflow pipe or both are provided with a quick connector (44).

-19-

21. Accumulator (10) according to claim 1, wherein a pipes assembly (60) is provided comprising a diffuser diaphragm (49') joined to the pipes assembly and having a diameter slightly smaller than the internal diameter of the tubular element (11), said diffuser diaphragm (49') comprises a section (65) made similar to a seat (67) to accommodate an absorbing element (64).
22. Accumulator (10) according to claim 21, wherein said absorbing element (64) is provided with a framework (69) adapted to be arranged and engaged below abutments (70) provided along the edges of the seat (67).
23. Accumulator (10) according to claim 22, wherein the base of the seat (67) is provided with holes (68) for the passage of the fluid.
24. Accumulator (10) according to claim 23, wherein directly above the section (65) the inflow fitting (41) is mounted provided with a conical portion (41') to be arranged facing the inflow connection (14a).
25. Accumulator (10) according to claim 24, wherein raised along the internal profile of the section (65) is a separation element (63) on which an inflow fitting (41) is possibly fixed and which is provided for withholding the fluid flowing into the accumulator while this passes through the filtering element (64) in such a manner to prevent the fluid from flooding over

-20-

the entire diffuser diaphragm (49).

26. Accumulator (10) according to claim 25, wherein the suction pipe (51), connected from the opposite side of the diffuser diaphragm (49) at the entrance of the central pipe (43), is elevated from said diffuser diaphragm (49), thus performing the suction of the fluid made up of 95% or more of gas, avoiding suction of liquid phases.

27. Accumulator (10) according to claim 26, wherein the suction pipe (51) is made in the form of a cylindrical capsule (61) provided with walls made of a net or a filtering element (62).

28. Method for the implementation of an accumulator (10) for an automotive refrigeration system said accumulator comprising a tubular casing element (11) adapted to accommodate a pipes assembly (40, 60) within which the refrigerant flows, and being provided with a bottom (12) adapted to close a first end (11') of the tubular element (11) and provided with a pair of connections (14a, 14b) respectively for the refrigerant inlet (31) and outlet (32) pipes, and closable in a sealed manner at a second end (11'') of the tubular element (11) opposite to the first, by means of a cap (20), the method comprising the steps of:

- 25 - Preparing the tubular element (11);
- Inserting and fitting the pipes assembly (40,60) into

-21-

the tubular element (11);

- Assembling the cap (20) to the tubular element (11) arranging an insertion portion (21) of the cap (20) ending with a circumferential abutment (22) in contact
5 with an end portion (13) of the end (11'') of the tubular element (11);

- Subjecting said portions (21, 13) to a magnetic impulse explosive welding.

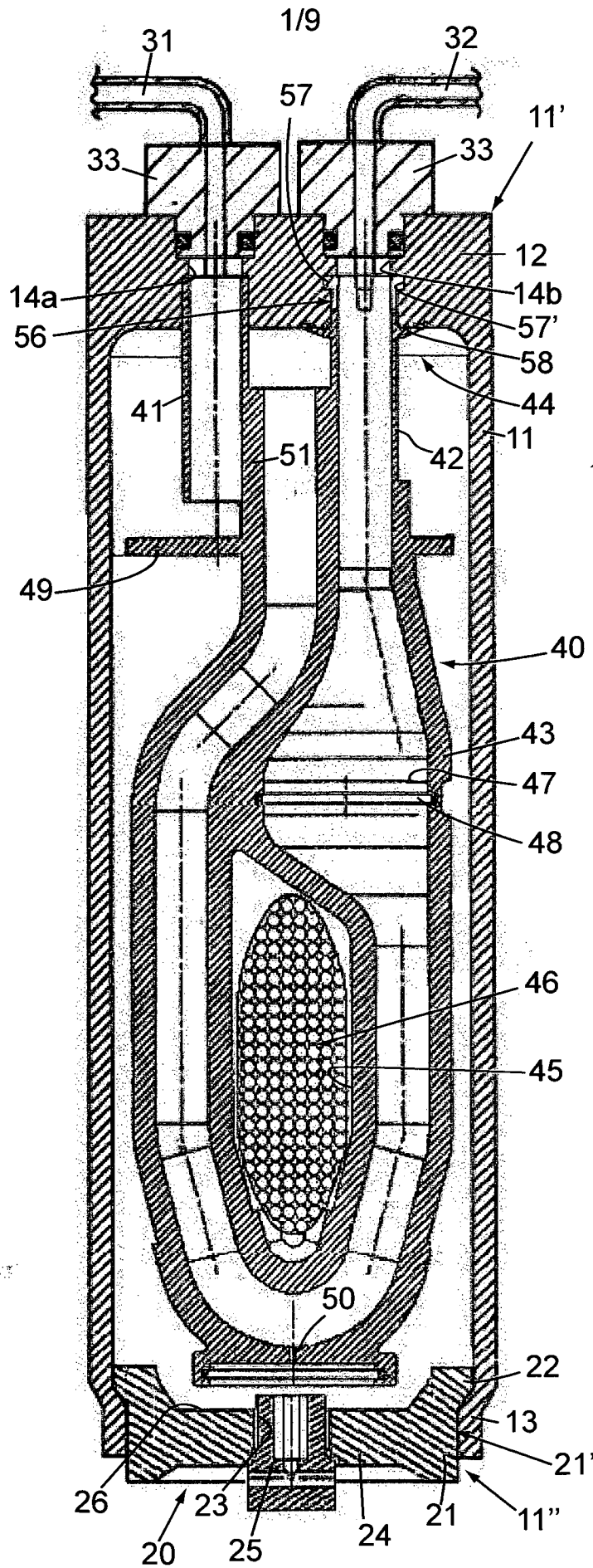


Fig. 1a

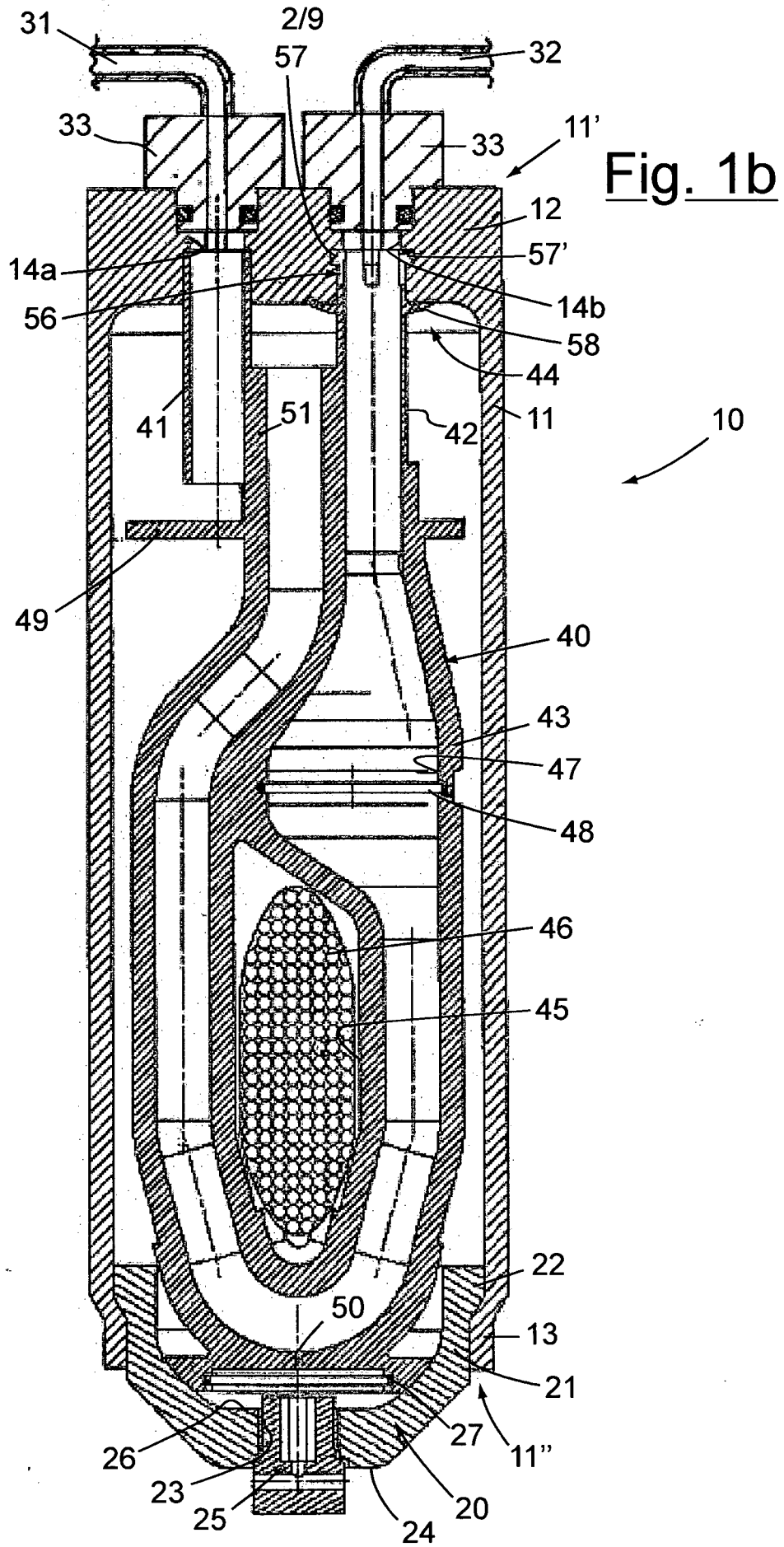
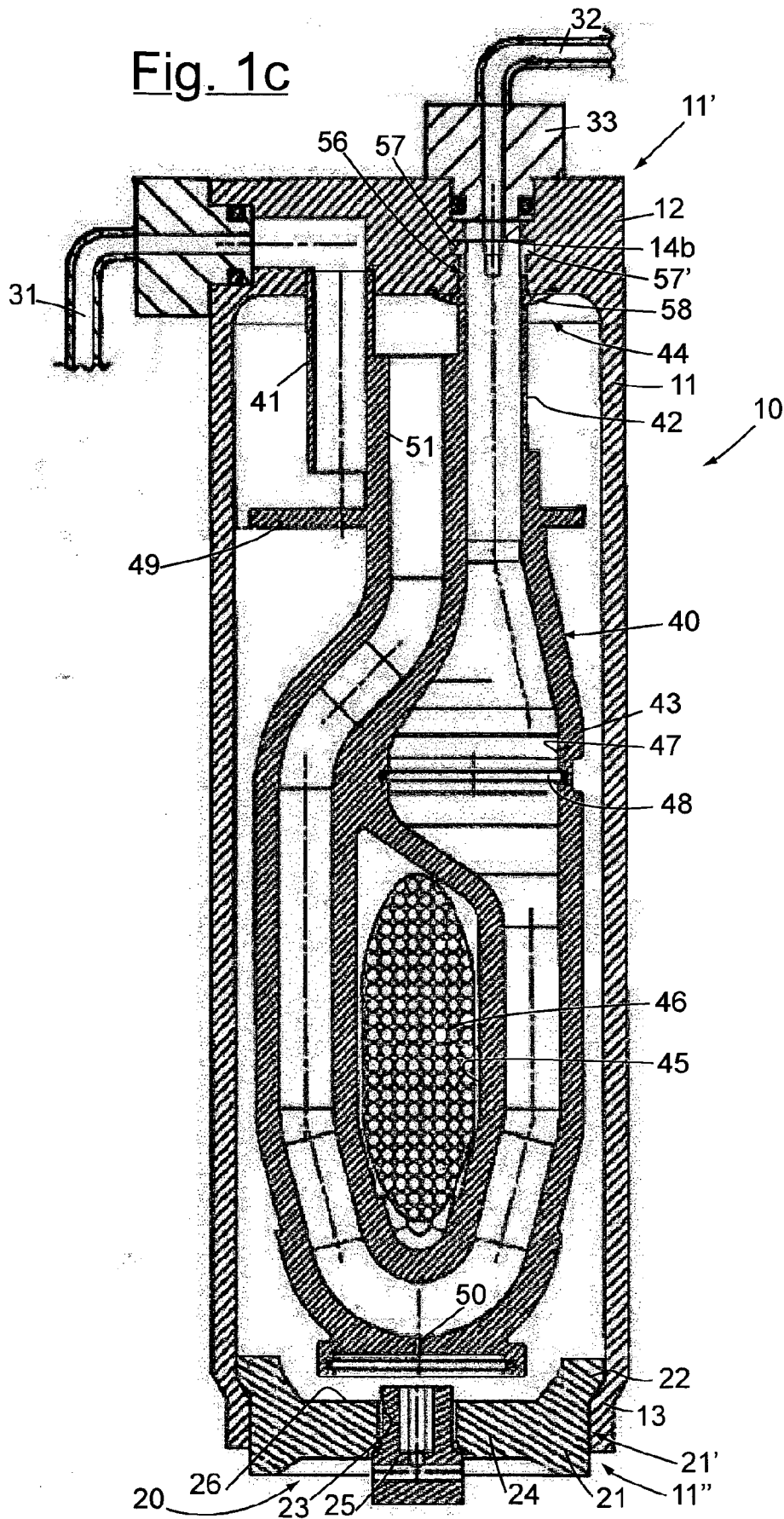


Fig. 1c



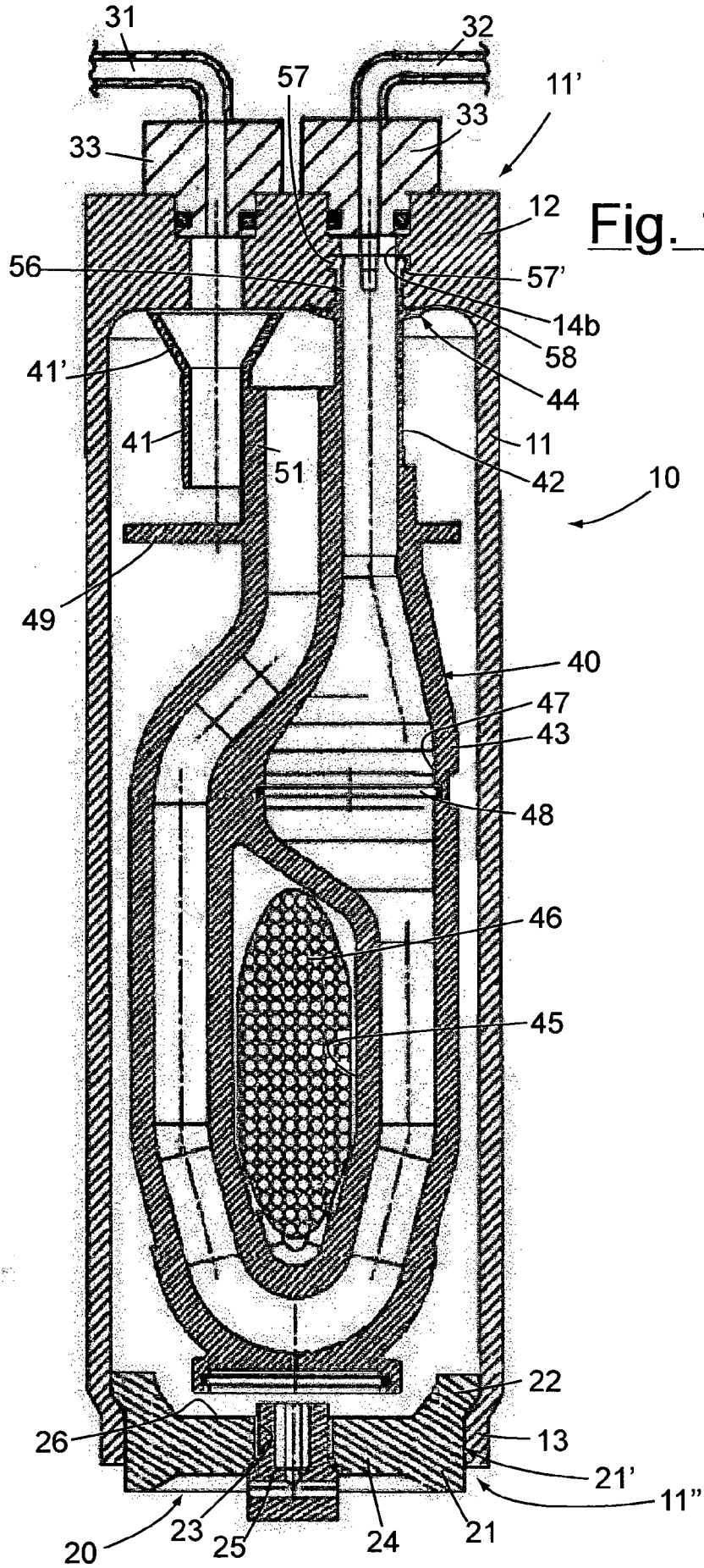


Fig. 1d

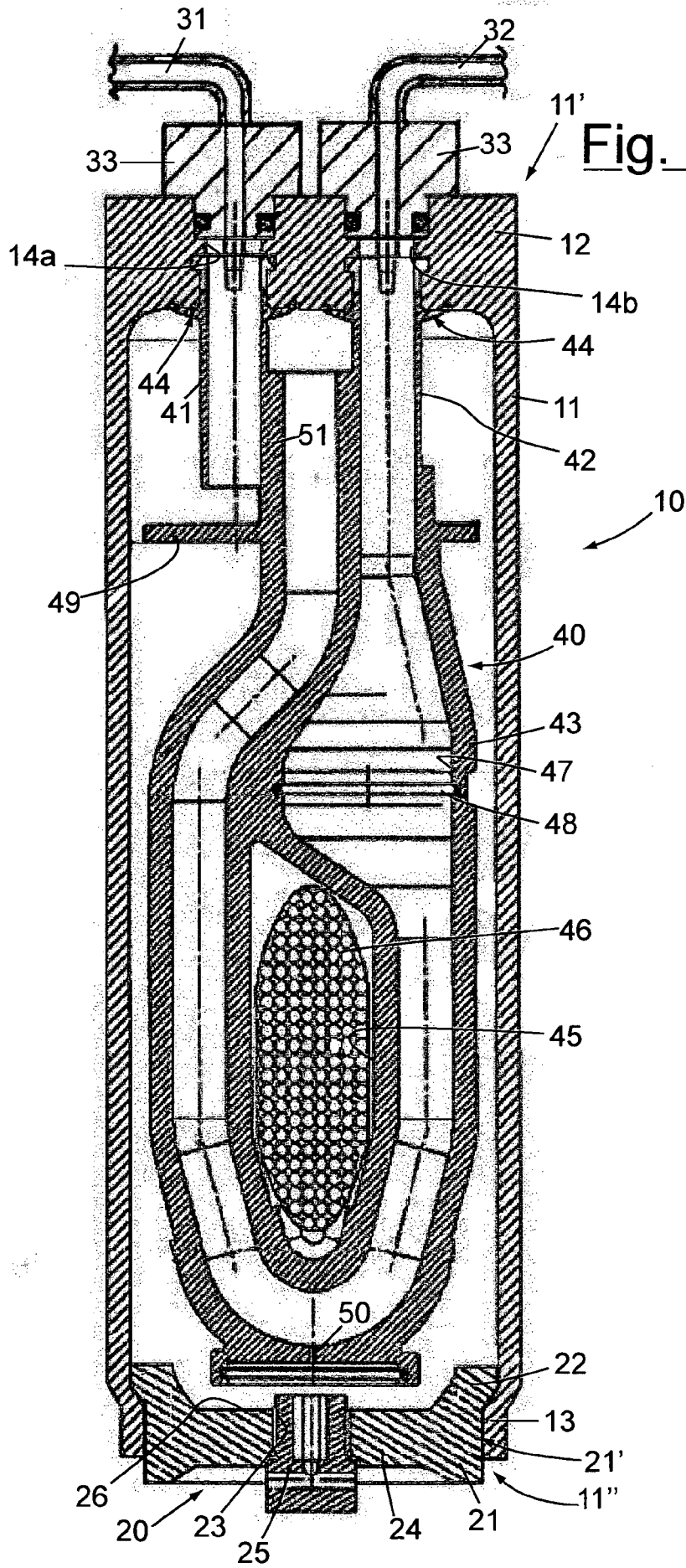


Fig. 1e

6/9

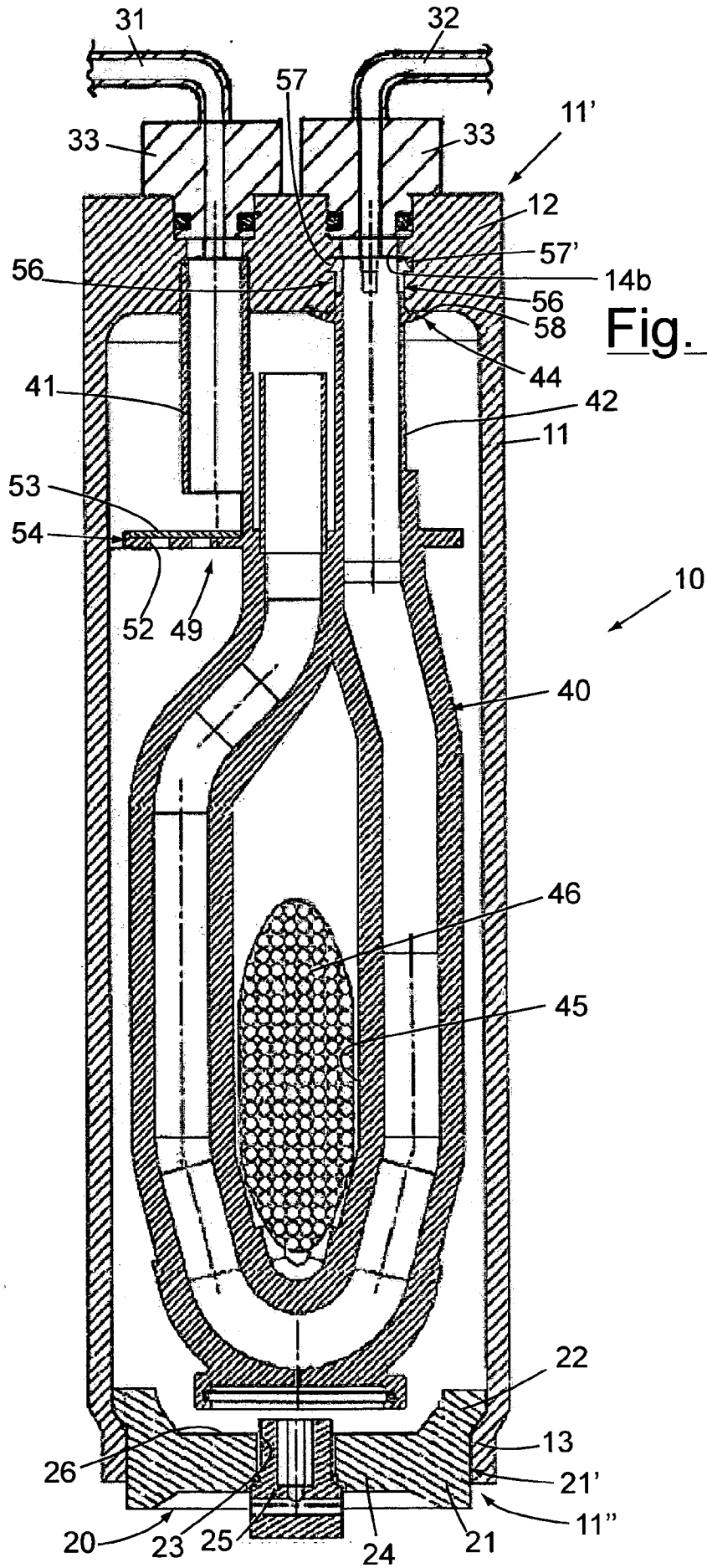


Fig. 1f

7/9

Fig. 2

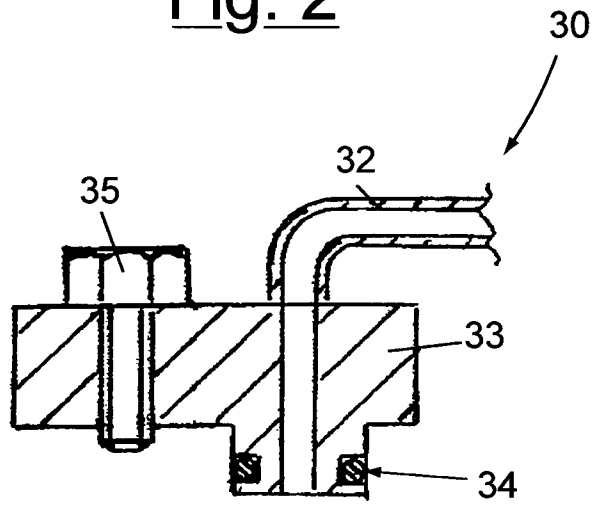


Fig. 3

