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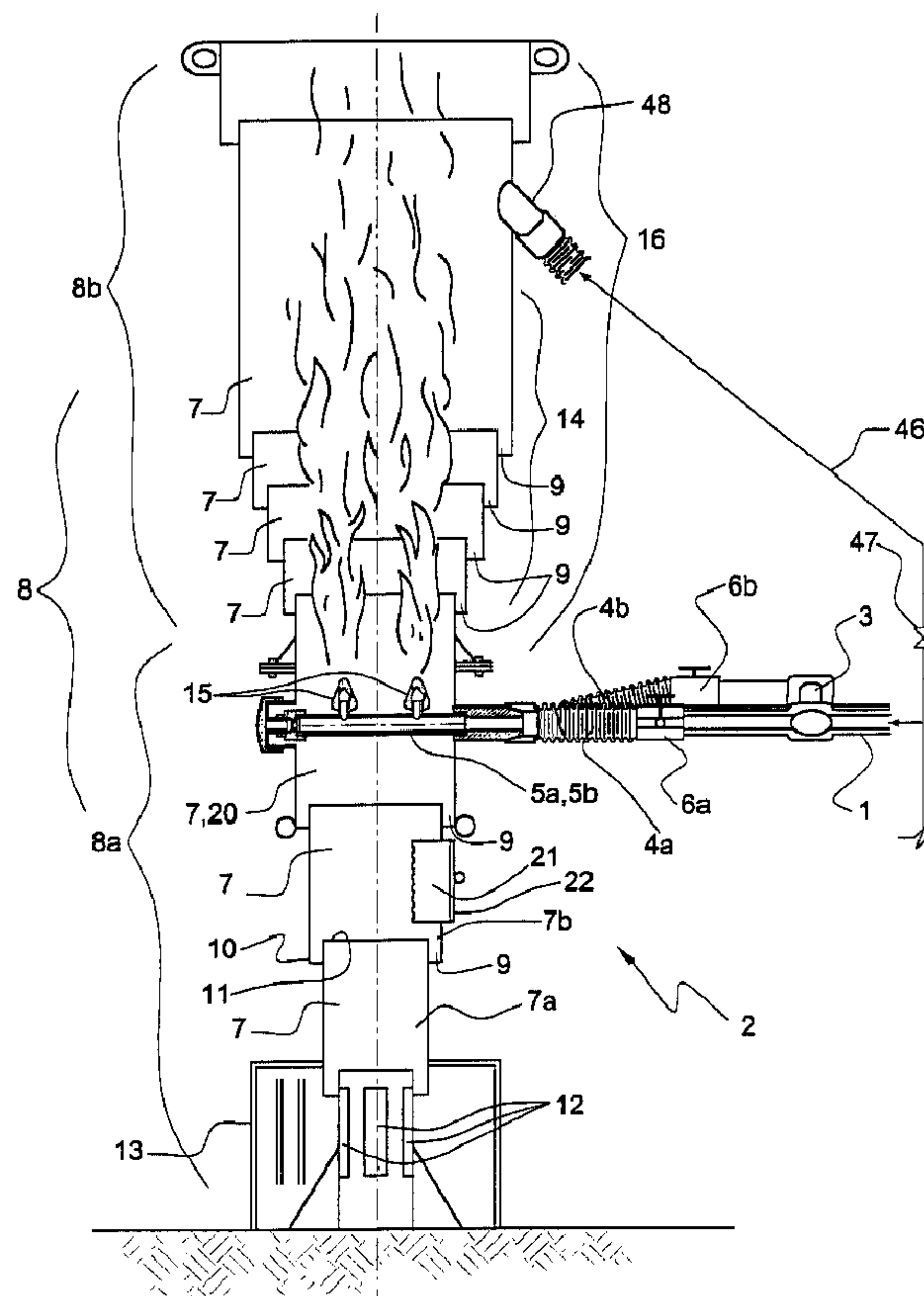
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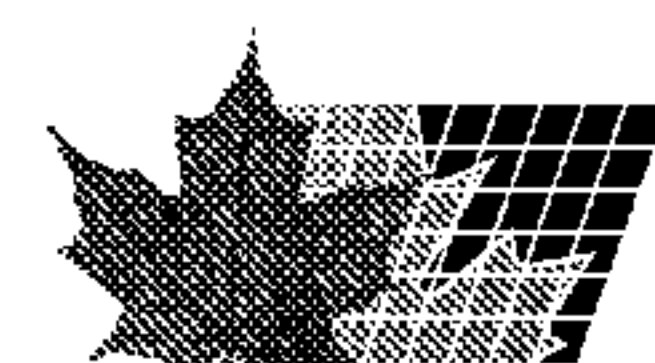
(54) Titre : INCINERATEUR A CHAMBRE DE COMBUSTION PROTEGEE

(54) Title: ENCLOSED GROUND-FLARE INCINERATOR



(57) Abrégé/Abstract:

An improved ground flare is provided including a stack and two or more burner assemblies. In one embodiment, a servicing port is provided for servicing some of the burner assemblies while others remain in operation. A burner conduit and nozzles can



(57) **Abrégé(suite)/Abstract(continued):**

removeably and individually supported in the stack's burner chamber. The lower end of the stack can be formed of one or more axially displaced lower tubular shells forming annular inlets for admitting combustion air. Additional annular inlets along the burner chamber admit additional combustion air for providing secondary combustion air and increasing the efficiency of combustion from the burner assemblies. Additionally, the additional air permits the addition of auxiliary burners above the annular inlets enabling greater waste gas combustion throughput.

1 **ABSTRACT OF THE INVENTION**

2 An improved ground flare is provided including a stack and two or
3 more burner assemblies. In one embodiment, a servicing port is provided for
4 servicing some of the burner assemblies while others remain in operation. A
5 burner conduit and nozzles can removeably and individually supported in the
6 stack's burner chamber. The lower end of the stack can be formed of one or
7 more axially displaced lower tubular shells forming annular inlets for admitting
8 combustion air. Additional annular inlets along the burner chamber admit
9 additional combustion air for providing secondary combustion air and increasing
10 the efficiency of combustion from the burner assemblies. Additionally, the
11 additional air permits the addition of auxiliary burners above the annular inlets
12 enabling greater waste gas combustion throughput.

1 **"ENCLOSED GROUND-FLARE INCINERATOR"**

2

3 **FIELD OF THE INVENTION**

4 The invention relates to improvements to ground flare stacks for
5 burning waste combustible gases generally, and specifically to apparatus enabling
6 changing of a burner while the flare continues to operate on other burners while
7 also improving combustion.

8

9 **BACKGROUND OF THE INVENTION**

10 Ground flares and incinerators are being used more frequently as they
11 are typically more environmentally efficient. Regulations are being tightened with
12 emissions resulting from flaring, venting of tank vapors and venting of BTEX
13 emissions (benzene, toluene, ethylbenzene and xylene) from the glycol dehydrators
14 on natural gas wells.

15 Waste gases from the wellsite and gas treatment facilities are
16 incinerated in ground flares at high temperature to ensure that complete combustion
17 takes place. The majority of the combustion takes place within the burning chamber
18 and the stack and, unlike open flares, there is usually no visible flame outside the
19 stack. A ground flare burns its fuel in a chamber in the flare stack and, as a result,
20 combustion is more controlled. Oil and gas industry studies have shown that
21 combustion efficiency drops significantly when combustion takes place outside the
22 stack and worsens as outside wind increases. US Patent 4,652,233 to Hamazaki

1 utilizes a conventional burner extending into the combustion chamber and
2 emphasizes the wind proofing of the stack to ensure efficient combustion.

3 As is the case when waste gases, having fluctuating quality, are
4 burned, the burners sometimes need to be serviced or changed out to a style or
5 size appropriate to the quality and quantity of gas presently being combusted. With
6 the conventional burner systems, the burners cannot be changed while waste gas
7 continues to be burned; instead the facility must be shut in or re-routed to other
8 equipment during servicing.

9 Usually ground flares do not use forced air, relying on induced draft to
10 supply combustion gases. The burners typically utilize a gas header with upwardly
11 extending nozzles for atomization of the waste gas upwardly into the combustion
12 chamber. While it is known to remove one of multiple forced air burners from
13 furnaces without interrupting operation, it is not known to remove a gas header
14 bearing nozzles from a ground flare stack. The vertically oriented nozzles
15 significantly encumber the horizontal in-stack gas header and complicate its
16 removal therefrom.

17 The apparatus disclosed by Hamazaki is complicated, as is the
18 apparatus of other ground flares known to the applicant and they do not disclose
19 means for dealing with the need to change a burner on the fly.

1 While there are numerous incinerators in use currently, the inventor is
2 not aware of any in which the system can be serviced or the burners replaced
3 without the facility owner having to shut down operations and suffering economic
4 losses associated therewith.

5 In another aspect of flare design, the height of stacks generally are
6 often dictated by the results of environmental plume calculations. Conventional
7 flares with external mix result in low flow discharge and must have high stacks to
8 provided sufficient exhaust dispersion. Ground flares and incinerators are typically
9 much shorter than conventional flare stacks and are subject to these plume or
10 dispersion controls. Despite combustion occurring within the burn chamber of a
11 ground flare, regulatory controls can require a ground flare to have a much greater
12 height than is necessary only to satisfy the combustion requirement. Increased
13 flare height results in an economic impact including the amount of material used
14 and stack support.

15 Increased flow discharge from the flare positively affects the stack
16 height requirements; the higher the discharge velocity or flow rate for a given stack
17 size, the lower the stack height.

18 It is known, in the defence industry, to introduce cooling air to a stack
19 through annular openings on exhaust stacks of ships-of-war for reducing their heat
20 signature and thereby avoiding detection by heat-seeking missiles. The exhaust
21 stacks were constructed of ever increasing diameter tubular shells which permitted
22 additional ambient temperature air to co-flow with the hot exhaust, thereby cooling

1 the exhaust stack. The ship's exhaust was fully combusted at that point and the
2 incoming air aided only in the cooling of the stack.

3 In light of the above, it is a desirable characteristic to simplify the
4 apparatus of ground flare stacks, improve combustion and to provide a highly
5 dispersed exhaust from the flare stack without interfering with the operation of the
6 burners.

7

8

SUMMARY OF THE INVENTION

9 An improved ground flare is provided having efficient combustion and
10 a low stack height. The flare's stack has minimal internal components and the
11 arrangement of the burner assemblies permit in-operation servicing of burners.

12 In a broad aspect, the stack comprises burner assemblies and a
13 servicing port so that some of the assemblies can be serviced while others can
14 remain in operation. More particularly, two or more burner assemblies are fitted to
15 the burner chamber, each burner assembly comprising: a substantially horizontal
16 burner conduit having one or more upwardly directed nozzles, the header having a
17 gas inlet end and a closed end. The burner conduit is removably supported in the
18 chamber by sandwiching between and inlet port at the inlet end and a closure port
19 at the closed end. The inlet end of the burner conduit is sealably inserted into a
20 socket in the inlet port so that the waste gases can be conducted therein. The
21 closure port can be opened for physically releasing the burner conduit and
22 supplying sufficient axial movement room for extracting the conduit from the socket,
23 thereby releasing the conduit for hand removal through the servicing port.

1 More preferably, the novel burners are combined with an efficient and
2 simple ground flare stack wherein the lower stack portion comprises one or more
3 axially displaced lower tubular shells, each adjacently higher shell having a greater
4 diameter, all of which are located below two or more burners fitted into a burn
5 chamber. The lower shells are concentrically spaced, forming annular inlets for
6 admitting combustion air. An upper tubular exhaust stack conducts the products of
7 combustion up and away from the burn chamber.

8 Preferably, and aiding in minimizing its height, the tubular exhaust
9 stack further comprises, one or more axially displaced tubular shells which are also
10 concentrically spaced, each higher shell having a greater diameter than the
11 preceding shell for forming annular inlets for admitting additional combustion air for
12 additional mixing with the combustion already occurring. The additional air further
13 increases the efficiency of combustion from the burners therebelow. The additional
14 air further increases the flow of exhaust for improved atmospheric dispersion and
15 for cooling the upper stack.

16 In another aspect of the invention, an improved flare stack is provided
17 having a primary set of burners located in a burn chamber, and a series of axially
18 spaced and concentric tubular shells positioned above the primary burner, therefore
19 permitting the admission of additional air which not only provides secondary
20 combustion air for the primary burners but also provides primary combustion air for
21 one or more auxiliary burners, positioned in the stack above the primary burners
22 amongst the tubular shells.

1 **BRIEF DESCRIPTION OF THE DRAWINGS**

2 Figure 1 is a side cross-sectional view of an improved ground flare
3 stack which implements an embodiment of the present invention. Waste gas
4 conduit and flow is shown in a schematic form;

5 Figure 2 is a partial cross-sectional view of the burner area according
6 to Fig. 1. One of two burners is shown being manipulated in 3 stages A,B,C of
7 removal through the servicing port;

8 Figure 3 is a cross-sectional downward view along line III-III of Fig. 2,
9 showing two side-by-side burners, one of which is being removed, at corresponding
10 stage A of Fig. 2;

11 Figure 4 is an exploded cross-sectional side view of one burner
12 assembly;

13 Figure 5 is a partial cross-sectional side view of an optional pulling
14 operation for a stubborn burner conduit; and

15 Figure 6 is a partial side cross-sectional view of another embodiment
16 illustrating supplemental burners fitted to successively higher shells. Waste gas
17 conduit and flow is again shown in a schematic form.

18

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Having reference to Fig. 1, waste gas is directed through gas conduit 1 to a ground flare 2. The gas conduit 1 forms a header 3 which splits into two or more burner feed lines 4a,4b. A first burner 4a feed line supplies a first burner 5a and the second feed line 4b supplies a second burner 5b. First and second valves 6a,6b permit selection and use of the first or the second burners 5a,5b respectively. Both burners can be selected simultaneously. The lines 4a,4b shown extending between the valves 6a,6b and the burners 5a,5b are flexible.

The present invention involves minimizing the overall flare height, maximizing combustion efficiency, and maximizing serviceability.

The Flare

The ground flare 2 comprises a stack 8 having a bottom portion 8a and an upper portion 8b. The bottom portion 8a is formed of one or more tubular shells 7,7.

Combustion air enters the system from several areas. First, air enters through a plurality of circumferentially spaced vents 12 cut into the stack's bottom portion 8a. The vents 12 are sized to ensure that sufficient air can be delivered in relation to the capacity of the nominal quantity of waste gas being fed. A windbreak 13 of various possible designs is provided around the vents 12 to direct air into the stack's bottom portion 8a, and not directly through.

1 In one embodiment, the stack's bottom portion is a single shell (not
2 shown) and the only entry of air is through vents 12.

3 In the embodiment shown in Fig. 1, the stack's bottom portion 8a is
4 formed of a plurality of concentric tubular shells 7, each shell 7a,7b ... being
5 displaced spaced axially. Each upwardly adjacent shell 7b has a greater diameter
6 than the preceding shell 7a so that an annular space 9 is formed between adjacent
7 shells 7b,7a. The lower edge 10 of the adjacently higher shell 7b overlaps the
8 upper edge 11 of the lower shell 7a.

9 Secondly, combustion air enters through the annular spaces 9
10 between the adjacent shells 7 of Fig. 1. The entry of annular air is optionally aided
11 by modifying one or more of the lower edges 10 of the upper or bottom portion
12 shells by adding a hoop 10a of circular cross-section (Fig. 2). The one or more
13 hoops 10a act as a bell-mouth intake for smoothing the incoming secondary
14 combustion annular air so as to result in an improved intake of secondary air.

15 This annular air is provided in several stages described below.

16 One or more of the shells 7 above the burners 5a,5b form a burn
17 chamber 14. One or more nozzles 15 are fitted to the burners 5a,5b for distributing
18 the waste gas in a manner suitable for most efficient combustion. The nozzles 15
19 ensure atomization of the waste gases and direct and discharge combustible waste
20 gases upwardly into the burn chamber 14. Combustion air from the annular spaces
21 9 mix with the waste gases as they exit the nozzles 15. An exhaust stack 16 is
22 fitted to the burner chamber 14 for removing products of combustion. Conventional

1 pilot, ignition systems and flame sensors (not shown) initiate and monitor
2 combustion above the burners 5a,5b.

3 The sizing of the nozzle 15 and burners 5a,5b and corresponding air
4 flow from the vents 12 and annular spaces 9 are conventionally designed for
5 matching the quantity of discharged gases and entrained air to complete the
6 combustion within the burn chamber.

7 When the flare 2 is in operation, a draft is created in the stack 8,
8 drawing air upwardly and in through the vents 12 and annular spaces 9. At the
9 lower end of the stack, generally below the burners, the vents 12 and the annular
10 spaces 9 admit primary combustion air.

11 Annular spaces 9 above the burners admit secondary combustion air
12 for burners 5a,5b; one, for improved efficiency of combustion, and secondly, for
13 admitting volume-building air for improved dispersion and stack cooling.

14 The system may be clad with noise reduction materials (not shown) to
15 reduce noise to meet industry regulations.

16

17 The Burners

18 The construction of the burners 5a,5b and their installation into the
19 stack 8 enable on-the-fly servicing. Accordingly, two or more burners 5a,5b are
20 provided so that one burner 5b can continue discharging waste gases while the
21 other burner 5a is being serviced.

1 Having reference to Figs. 1 and 3, the two burners 5a,5b are shown in
2 a laterally side-by-side arrangement and horizontally extending orientation.

3 The burners 5a,5b are supported and installed into a burner support
4 shell 7,20. Each burner 5a,5b has a substantially identical set of components.

5 A burner service port 21 is provided at the same elevation or below
6 the burners, illustrated in Figs 1 and 2 as being located in the next lower shell 7b
7 under the burner shell 20. The port 21 has an access door 20 sized to permit a
8 burner 5a,5b, including nozzles to be passed therethrough.

9 Best shown in Figs. 3 and 4, each burner 5a,5b is an assembly 23
10 comprising a burner conduit 25 having one or more outlet ports 26. The burner
11 conduit 25 has an inlet end 27 and a closed end 28. The burner conduit's inlet end
12 27 is fitted has a circumferential groove fitted with an O-ring 29 for sealing
13 connection to its respective waste gas feed line 4a,4b, the connection being
14 detailed below. The upwardly directed nozzles 15 connect to the outlet ports 26
15 and extend upwardly.

16 As shown in Fig. 3, two pairs of ports are formed in the wall of the
17 burner shell, one pair 30,31 for supporting each burner assembly 23. The first and
18 second ports 30,31 of a pair are located axially inline and on opposing sides of the
19 burner shell 20. The first port 30 is formed of a machined first nipple 32 mounted to
20 the burner shell 20.

21 The second port 31 is formed of a second nipple 33 mounted
22 opposing the first nipple 32 so that their axes align. Nipples 32,33 are threaded
23 outboard of their connection to shell 20.

1 The burner conduit 25 is positioned in the burner shell 20 and is
2 sandwiched between cap 35 and first nipple 32.

3 As shown in Fig. 4, first nipple 32 provides a threaded connection to
4 the feed lines 4a,4b of Fig. 1 and forms an inner cylindrical bore or inlet socket 36
5 for accepting the conduit's inlet end 27.

6 End cap 35 is threaded onto the second nipple 33 which advances a
7 spacer fitting 40 onto the conduit's closed end 28, driving the inlet end 27 and o-ring
8 seal 29 into the complementary inlet socket 36 of the first nipple 32. The socket 36
9 is formed with an internal shoulder 41 for forming a stop, limiting the insertion depth
10 of the inlet end 27.

11 The spacer fitting 40 comprises several parts, one of which is an
12 adjustable nipple 42 for manipulating axial length so that, when sandwiched, the
13 burner conduit 25 is positively inserted and sealed within the inlet socket 36. An
14 optional annular stabilizer ring 45 (only shown in Fig. 4) aids centering fitting 40 in
15 second nipple 33.

16 In other words, end cap 35 drives the spacer fitting 40 onto closed end
17 28 of the burner conduit 25 which, in turn, drives the conduit's inlet end 27 into the
18 socket 36 and against its shoulder 41, sandwiching the conduit therebetween for
19 support and for ensuring sealed operation.

1 When one burner 5a needs to be removed for servicing or
2 modification, then valve 6a for the feed line 4a to that burner 5a is closed while
3 valve 6b for the other feed line 4b continues to remain open for continued
4 combustion of waste gas. A secondary bypass line 46 and valve 47 are generally
5 provided to permit process upset high-volume release of waste gas directly into a
6 port 48 in the stack's upper portion 8b (Fig. 1).

7 The access door 22 to the burner service port 21 is opened and the
8 end cap 35 is removed. Access is therefore provided to the spacer fitting 40 and it
9 is removed from the closed end 28 of the burner conduit 25.

10 A service technician reaches in through the service port 21 to axially
11 slide the burner conduit's inlet end 27 out of the inlet socket 36. The closed end 28
12 of the burner conduit 25 can be moved temporarily into port 31 and nipple 33 so as
13 to permit the conduit's inlet end 27 to be axially extracted from inlet socket 36.

14 As shown in Fig. 5, if seal of the O-ring 29 in the socket 36 is too tight
15 or debris has jammed the inlet end 27, then a puller 43 can be utilized. A half-
16 coupling 44 is conveniently mounted to the burner conduit's closed end 28 for
17 engaging the puller 44 and facilitating removal of the burner conduit 25.

18 Once the burner conduit 25 is loosened and released axially from the
19 inlet socket 36, the burner conduit 25 is manipulated downwardly, shown as stages
20 A,B,C in Fig. 2, for removal through the service port 21. Fig. 3 illustrates a plan
21 view of an intermediate stage of burner conduit removal.

1 While the burner conduit 25 is being removed, combustion continues
2 and air continues to flow into the stack 8 from the vents 12 and annular spaces 9.
3 The environment beside or below the burners 5a,5b is relatively cool due to the in-
4 rushing combustion air making in-operation replacement of a burner possible.

5 Replacement of a cleaned or modified burner 5a is in the reverse
6 order. Simply, the service technician reinserts the burner conduit 25 into the stack
7 through the port 21 and places the inlet end 27 into the inlet socket 36. The closure
8 fitting 35 is placed over the conduit's closed end 28 and the closure cap 35 is
9 tightened, driving the conduit's inlet end 27 and O-ring 29 into sealing engagement
10 with the inlet socket 36.

11 If the length of a replacement burner conduit 25 is slightly different
12 than the removed serviced conduit, then the spacer fitting adjustment nipple 42 is
13 lengthened or shortened accordingly so that the action of the closure of the cap 35
14 properly sandwiches the replacement burner conduit 25 between the first nipple 32
15 and end cap 35.

16

17 The Auxiliary Burners

18 Having reference to Fig. 6, another embodiment is shown in which
19 additional advantage is gained due to the increased availability of additional
20 combustion air flowing in through the annular spaces 9. One or more auxiliary
21 burners 55,55a,55b, which can be of conventional design, are positioned in the
22 stack's upper portion 8b for incineration of even more waste gas from the gas
23 conduit 1. Annular air AA, as referenced and illustrated on Fig. 6, flows in through

1 the annular spaces 9. As stated above, this additional annular air AA acts as
2 secondary combustion air for burners 5a,5b, but in practice, so much air is
3 entrained that it can also act as primary combustion air for the auxiliary burners
4 55,55a,55b.

5 An auxiliary burner 55 can be added at each shell 7 and at least
6 above an annular space 9 so as to be provided with primary annular combustion air
7 AA entering therethrough.

8 A plurality of auxiliary burners 55a,55b are fed from a header 53. The
9 hoop 10a is formed with a bore 50. Accordingly, the hoops 10a can conveniently
10 form the header 53, the bore 50 being of sufficient internal diameter to distribute
11 and supply the necessary volumetric flow to the auxiliary burners 55,55a,55b. The
12 header 53 can be located at the lower edge 10 (at 10a) of each shell for also aiding
13 in air flow, or can be located elsewhere (at 10b) for serving only as header 53.
14 More particularly, the gas conduit 1 is also fed to auxiliary burner 55 and header 53
15 through a feed lines 54a,54b. Corresponding valves 56a and 56b enable selective
16 use of one or more of the auxiliary burners 55 or 55a and 55b.

17 Using the flare stack of the present invention, high volumes of waste
18 can be cleanly incinerated having temperatures in the burn chamber of about 1100°
19 C while the incorporation of large additional volumes of annular air contribute to
20 increased dispersion and achieve same with stack surface temperatures which are
21 typically at temperature of less than 250° C.

22

1 Dispersion

2 As stated above, the additional air entrained through the annular
3 spaces 9 aids significantly in dispersion. Increased dispersion is highly desirable in
4 reducing ground level concentration – a factor in meeting air quality regulations.
5 One of the non-atmospheric factors for affecting the dispersion is the effective
6 height of the stack. Conventional flare stacks use their great physical height to
7 effect dispersion. Another physical stack design factor, other than stack height,
8 which impacts on the effective stack height includes exhaust momentum. An
9 increase in the volume of exhaust gases exiting the stack increases its velocity, its
10 momentum, its maximum ascent and thus further dilutes the exhaust's
11 concentration in the atmosphere, minimizing the ground level concentration and
12 thereby better achieving applicable environmental guidelines. A ground-flare
13 incinerator is particularly well served by implementing apparatus for improved
14 dispersion as it lacks the greatest possible contributor to dispersion – physical
15 height. The stacked shells of the present invention improve the effective stack
16 height through providing a marked increase in exhaust volume. Tests performed
17 using a flare similar to that of Fig. 1 have demonstrated volumetric increases in the
18 exhaust gases of 2 - 3.5 times that generated from combustion alone.

19

1 **THE EMBODIMENTS OF THE INVENTION FOR WHICH AN**
2 **EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS**
3 **FOLLOWS:**
4

5 1. A ground flare stack for incinerating waste gases, the stack
6 having a lower tubular portion and an upper tubular exhaust portion, comprising:

7 a tubular burn chamber located intermediate the lower and upper
8 portions and having combustion air intakes located below the burn chamber,

9 one or more primary burner assemblies fitted within the burn
10 chamber, the burner assemblies accepting waste gases and discharging the
11 waste gases into the burn chamber for mixing with the combustion air for
12 creating exhaust gases; and

13 the tubular exhaust stack having one or more axially displaced
14 tubular exhaust shells, each upwardly adjacent exhaust shell having a greater
15 diameter than the preceding exhaust shell, the exhaust shells forming a
16 contiguous bore and being concentrically spaced for forming one or more
17 annular inlets for admitting additional annular air into the stack for discharge with
18 the exhaust gases;

19 wherein each axially displaced tubular exhaust shell has a lower
20 edge at the annular inlet which is fitted with a bell-mouth intake so as to result in
21 an improved intake of additional annular air.

22
23 2. The ground flare stack as recited in claim 1 wherein the
24 annular inlets admit sufficient additional annular air for improved dispersion of
25 the exhaust gases into the atmosphere.

1 3. The ground flare stack as recited in claim 1 or 2 further
2 comprising:

3 one or more auxiliary burners fitted within the tubular exhaust stack
4 above at least one of the one or more annular inlets, the annular inlets admitting
5 additional annular air as primary combustion air for the one or more auxiliary
6 burners to the stack.

7

8 4. The ground flare stack as recited in any one of claims 1 to 3
9 wherein the bell mouth intake comprises a hoop of a circular cross-section.

10

11 5. The ground flare stack as recited in claim 4 wherein the two
12 or more of the one or more auxiliary burners are fed waste gas from a header.

13

14 6. The ground flare stack as recited in claim 5 wherein the
15 hoop is tubular and has a bore so that the hoop's bore forms the header.

16

17 7. The ground flare stack as recited in claim 4, 5 or 6 wherein
18 each hoop supports one or more of the auxiliary burners which are fit through the
19 annular inlets formed between the shell fitted with the hoop and an upwardly
20 adjacent shell.

21

1 8. The ground flare stack as recited in any one of claims 1 to 7
2 wherein the stack's lower tubular portion comprises one or more axially
3 displaced tubular base shells below the burn chamber, each upwardly adjacent
4 base shell having a greater diameter than the preceding lower base shell, the
5 base shells forming a contiguous bore and being spaced concentrically for
6 forming one or more annular inlets for admitting combustion air for forming a
7 combustible mixture of air and waste gases.

8

9 9. The ground flare stack as recited in any one of claims 1 to 8,
10 further comprising:

11 one or more pairs of waste gas inlet ports and closure ports, the
12 inlet and closure port of each pair being located on opposing sides of the burn
13 chamber,

14 a service access port located in the stack at an elevation equal to
15 or below the waste gas inlet ports wherein

16 two or more of the one or more burner assemblies are fitted within
17 the burn chamber between the inlet and closure ports, the burner assemblies
18 accepting waste gases from the inlet port and discharging waste gases into the
19 burn chamber for mixing with the combustion air and producing exhaust gases,
20 each assembly being capable of having its waste gas blocked thereto and being
21 individually removable from the stack through the service access port while the
22 other assembly or assemblies continue to discharge waste gas into the stack.

23

1 10. The ground flare stack as recited in claim 9 wherein the
2 removable burner assemblies further comprise a substantially horizontal burner
3 conduit having a gas inlet end, a closed end and one or more upwardly directed
4 waste gas discharge nozzles, wherein the conduit is removeably supported in
5 the burn chamber by sandwiching it between the waste inlet and closure ports,
6 the inlet end of the burner conduit being sealably inserted into a socket in the
7 inlet port so that the waste gases are conducted therein, the closed end bearing
8 against the closure port, the closure port which can be opened to release the
9 closed end of the burner conduit and thereby supply sufficient movement room
10 for accepting the closed end of the conduit while extracting it from the socket,
11 thereby releasing the conduit for hand removal through the servicing port.

12

13 11. The ground flare stack as recited in claim 10 wherein the
14 inlet end of the burner conduit comprises a tubular conduit having an annular o-
15 ring adjacent its end for sealing within a complementary socket formed in the
16 inlet port.

17

18 12. The ground flare stack as recited in claim 11 wherein the
19 burner assembly further comprises a spacer fitting for extending between the
20 closed end of the burner conduit and the closure fitting for sandwiching the
21 burner conduit and driving the annular o-ring of the conduit's inlet end into the
22 inlet port socket.

23

1 13. The ground flare stack as recited in any one of claims 1 - 12
2 wherein the air intakes comprise vents.

3

4 14. The ground flare stack as recited in claim 8 wherein the air
5 intakes comprise vents and one or more of the one or more annular inlets.

6

7 15. The ground flare stack as recited in claim 8 wherein the air
8 intakes comprise one or more of the one or more annular inlets.

9

10 16. The ground flare stack as recited in any one of claims 3, 7 or
11 8 wherein one or more of the one or more annular inlets are located along the
12 burn chamber for admitting combustion air.

13

14 17. A ground flare stack for incinerating waste gases, the stack
15 having a lower tubular portion and an upper tubular exhaust portion, comprising:

16 a tubular burn chamber located intermediate the lower and upper
17 portions and having combustion air intakes located below the burn chamber,

18 one or more primary burner assemblies fitted within the burn
19 chamber, the burner assemblies accepting waste gases and discharging the
20 waste gases into the burn chamber for mixing with the combustion air for
21 creating exhaust gases;

22 the tubular exhaust stack having one or more axially displaced
23 tubular exhaust shells, each upwardly adjacent exhaust shell having a greater
24 diameter than the preceding exhaust shell, the exhaust shells forming a

1 contiguous bore and being concentrically spaced for forming one or more
2 annular inlets for admitting additional annular air into the stack for discharge with
3 the exhaust gases;

4 one or more auxiliary burners fitted within the tubular exhaust stack
5 above at least one of the one or more annular inlets, the annular inlets admitting
6 additional annular air as primary combustion air for the one or more auxiliary
7 burners to the stack; and

8 wherein each axially displaced tubular exhaust shell has a lower
9 edge at the annular inlet which is fitted with an intake comprising a tubular hoop
10 having a bore forming a header, wherein the one or more auxiliary burners are
11 fed waste gas from the header.

12

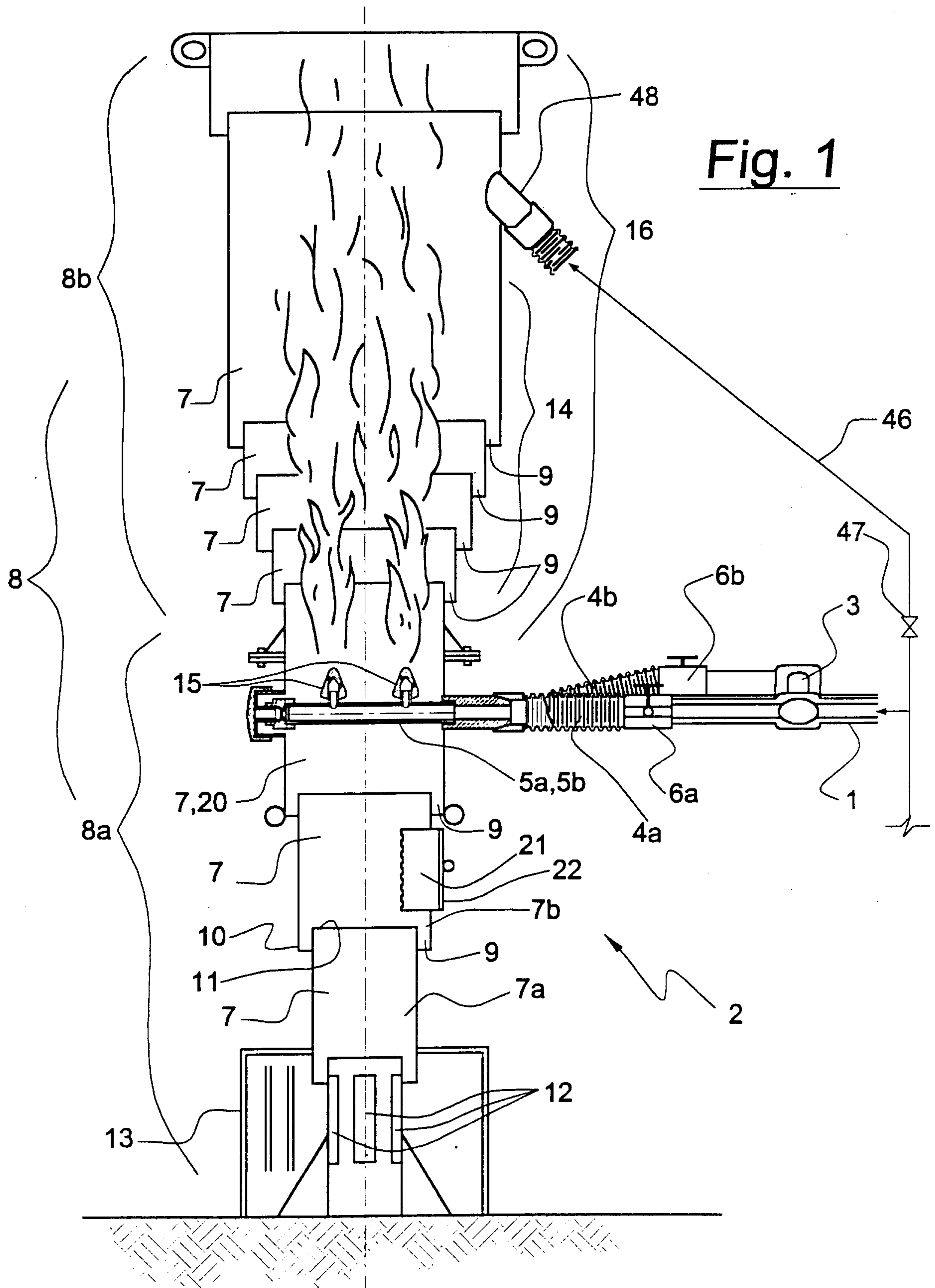
13 18. The ground flare stack as recited in claim 17 wherein the
14 annular inlets admit sufficient additional annular air for improved dispersion of
15 the exhaust gases into the atmosphere.

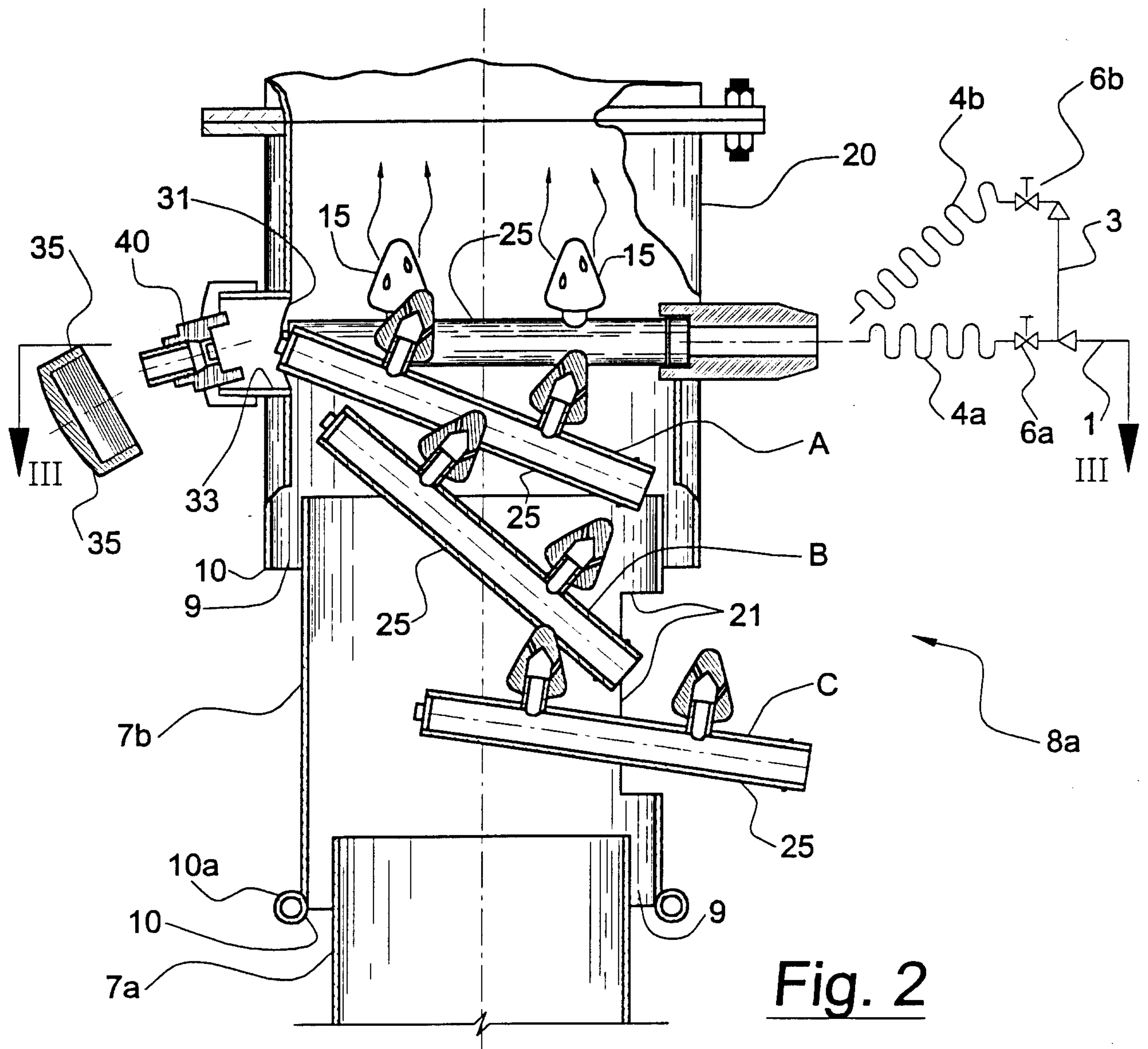
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17 19. The ground flare as recited in claim 17 or 18 wherein each
18 hoop supports two or more of the one or more of the auxiliary burners which are
19 fit through the annular inlets formed between the shell fitted with the hoop and an
20 upwardly adjacent shell.

21

22 20. The ground flare as recited in any one of claims 17 to 19
23 wherein each intake is a bell-mouth intake so as to result in an improved intake
24 of additional annular air.





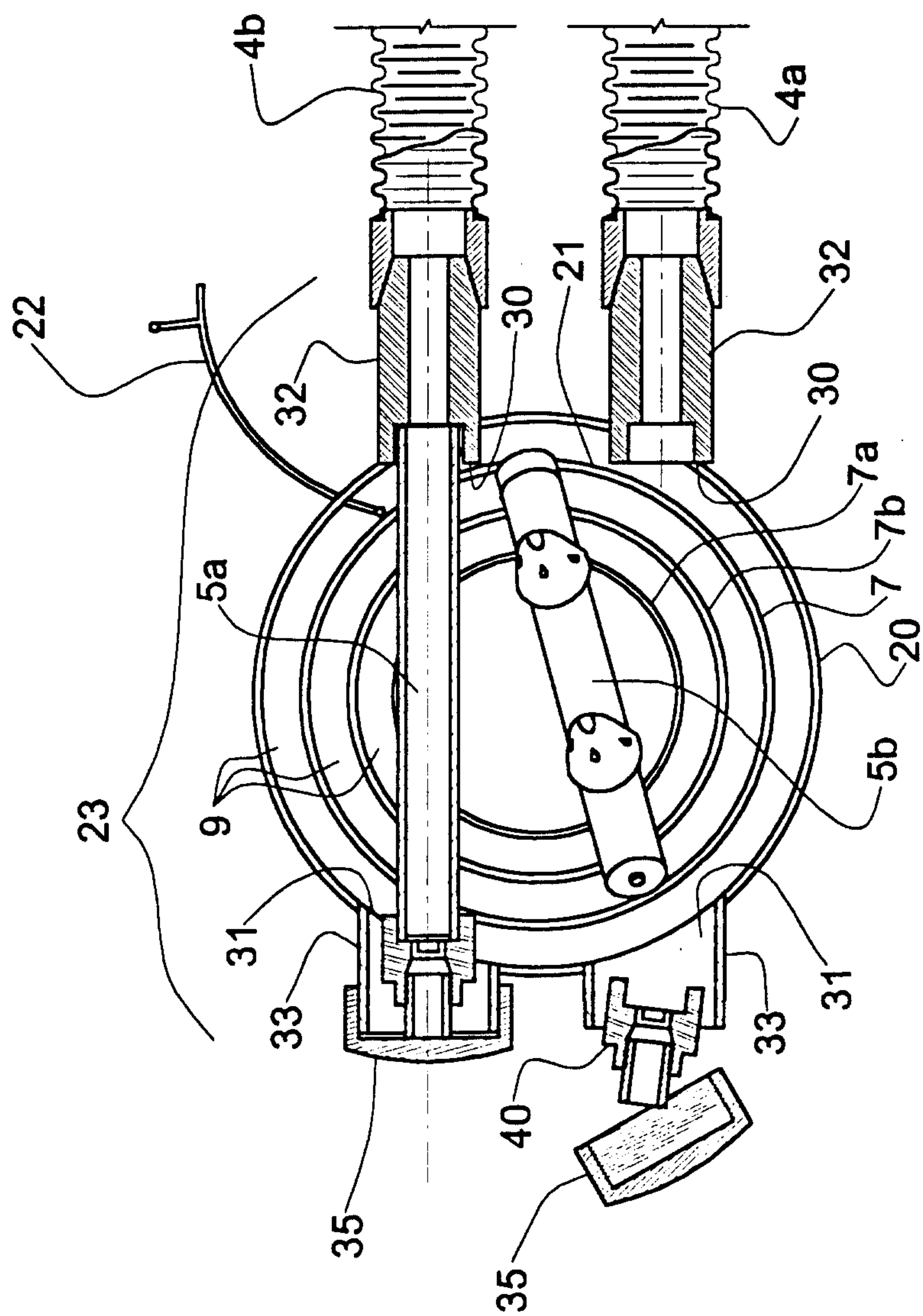


Fig. 3

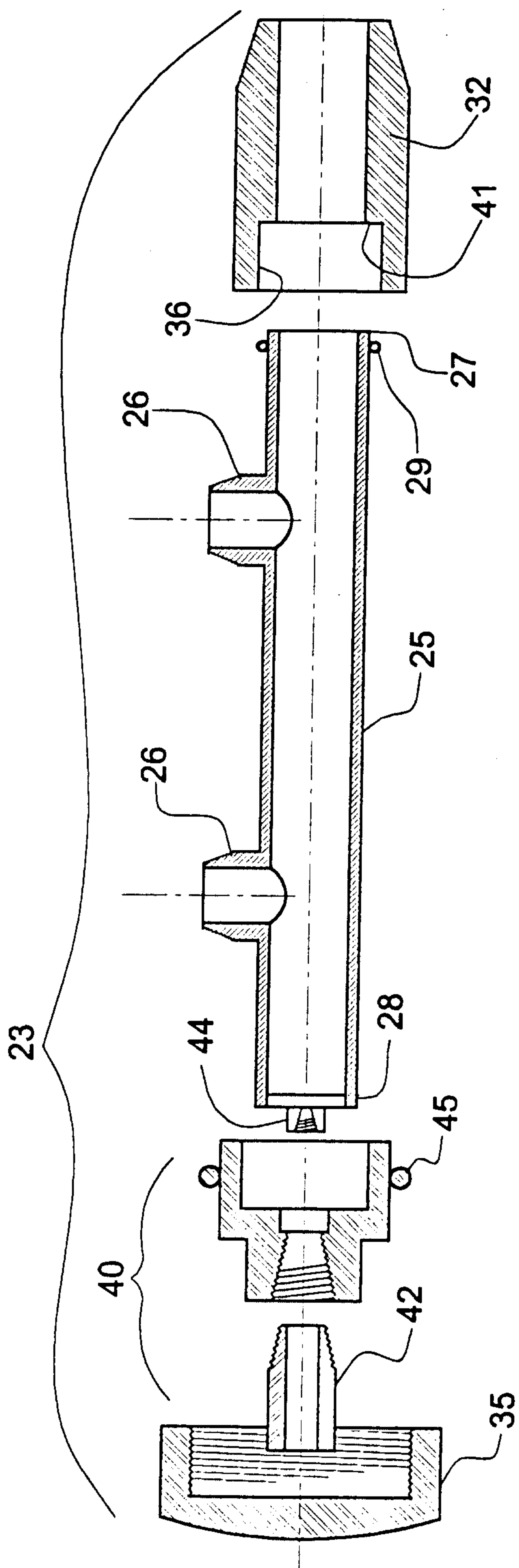


Fig. 4

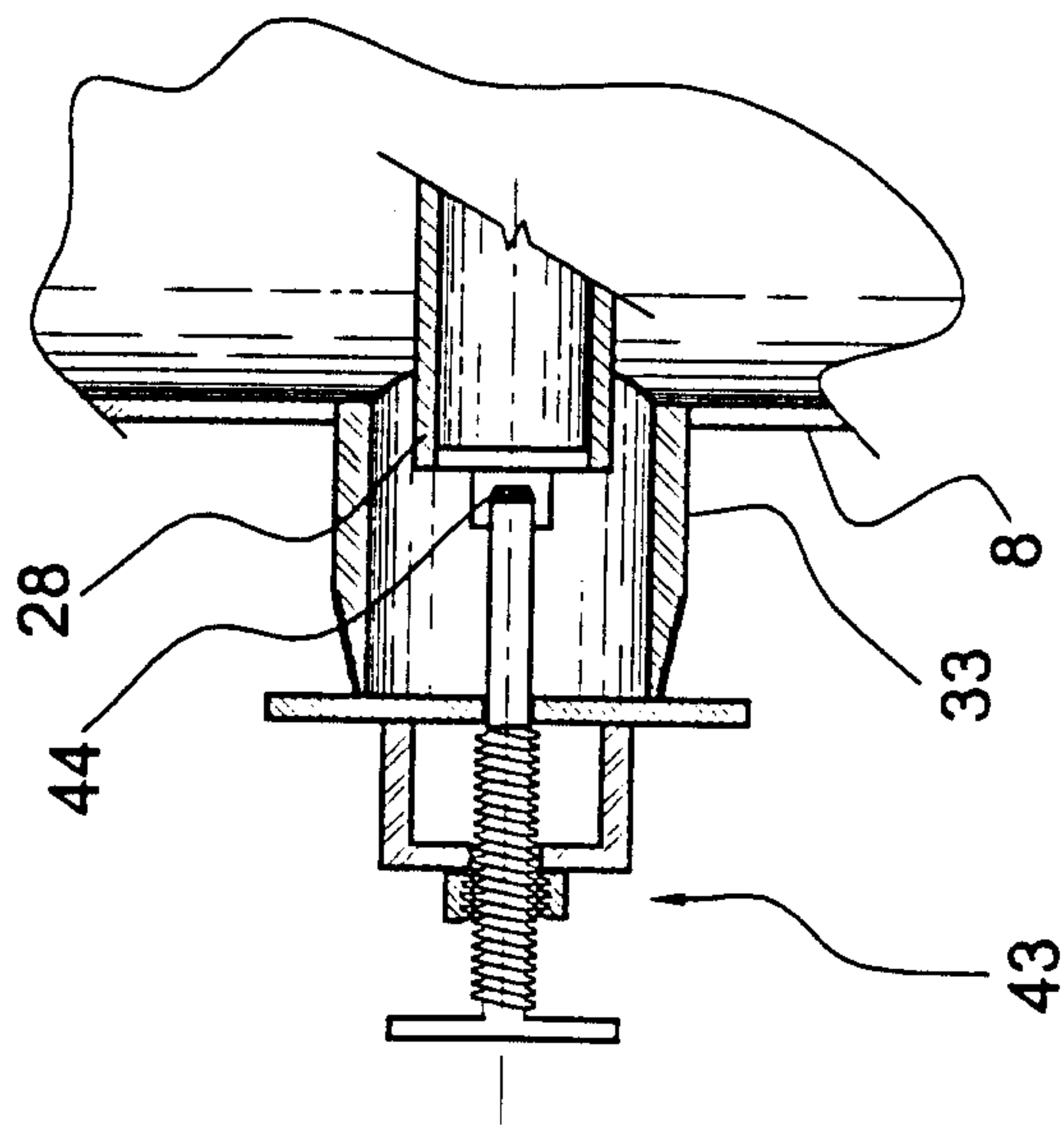


Fig. 5

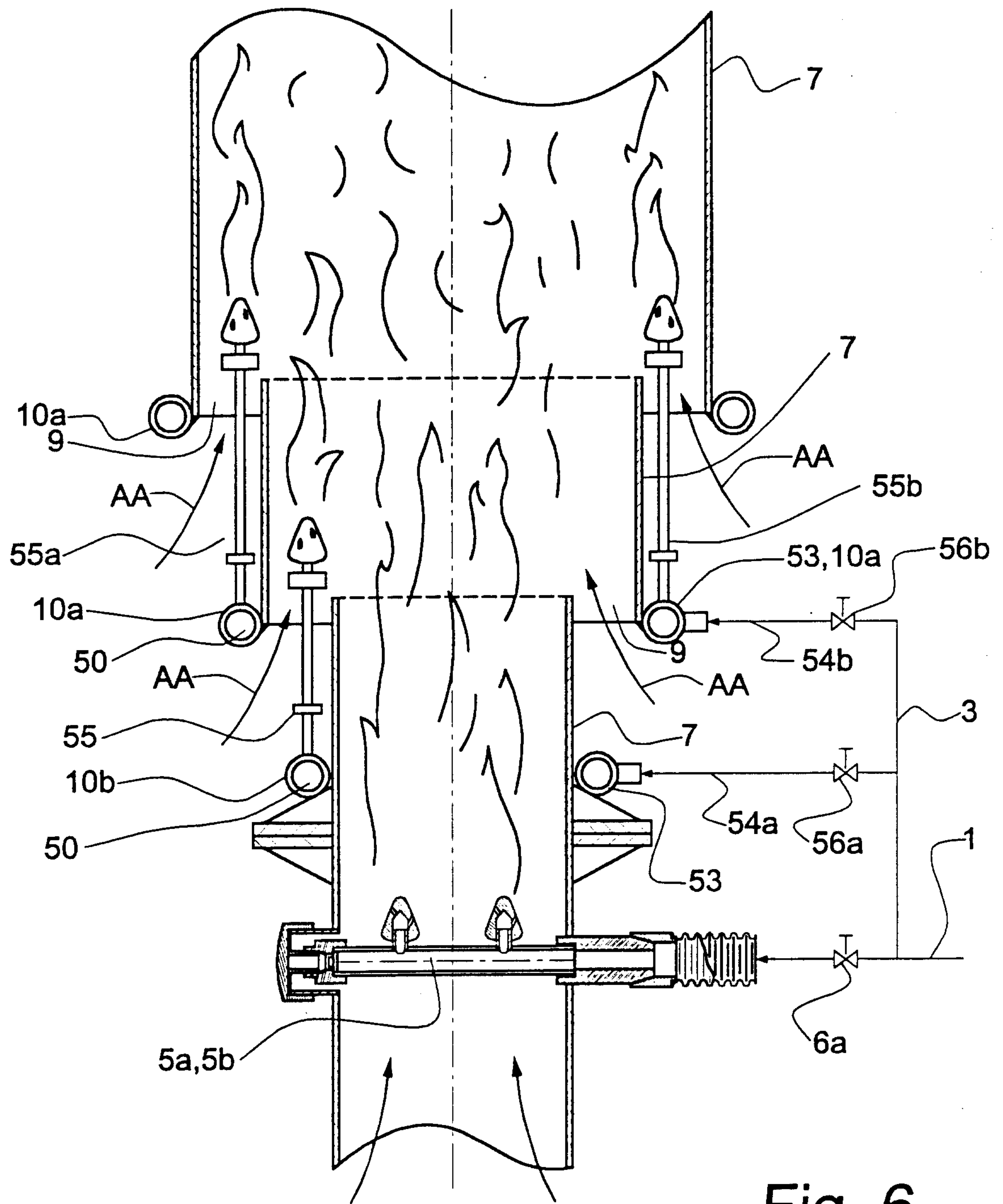


Fig. 6

