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(54) A method of disposing of waste gas and means for carrying out such a method.

(57) A flare stack tip assembly serves to discharge waste gas for disposal by combustion. The assembly has an upper frusto-conical tip structure (8) to which a plurality of injector devices (16) are mounted. Each of the injector devices (16) is supplied with steam which flows through a protected annular passageway (41) therein. The annular flow of steam in each device (16) induces ambient air to flow into an open inlet of the device and to mix with the surrounding steam for discharge into the waste gas passing up through the assembly prior to combustion.

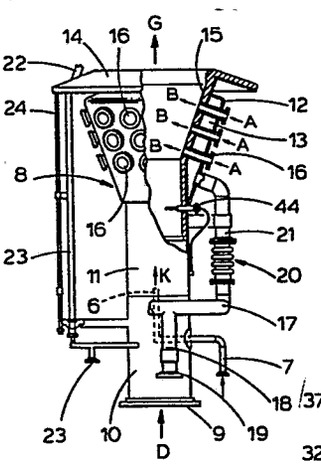

Fig.1

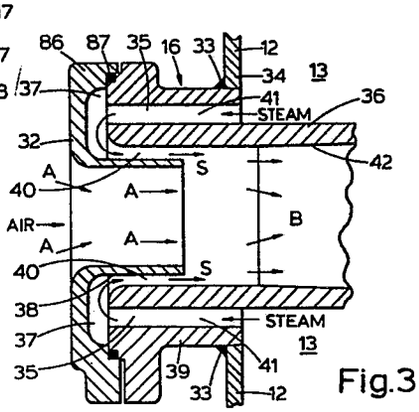

Fig.3

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COMPLETE DOCUMENT

The present invention relates in general to a method of disposing of a dump or waste gas and to means for use in carrying out this method. The invention also relates to flare stack tip assemblies embodying such means.

It is known to introduce steam and air into waste gas in a flare to enable the waste gas to be burnt off without undue smoke and noise. Normally, the flare is elevated although waste gas can be burnt off in a ground flare. One known method and flare tip assembly or arrangement for effecting this form of disposal is described in UK Patent Specification 1 218 189. One disadvantage of this known assembly is that it is necessary to ensure the steam is clean since the steam must flow through a narrow gap which is precisely shaped and dimensioned to create the desired Coanda effect which induces air flow. This involves the use of one or more fine filters. In addition, the steam must be dry because any entrained water droplets can adversely affect the inducement of air flow through the Coanda effect. This may necessitate other ancilliary apparatus.

In accordance with the present invention, a method of waste gas disposal involves the introduction of a mixture of air and steam into waste gas, e.g. flowing through a flare tip assembly, by means of a number of injecting devices each of which uses annular steam flow to induce or inspirate air to enter the device within the annular steam flow other than by the Coanda effect.

The present invention also provides a flare tip assembly having injecting devices arranged to introduce

a mixture of steam and air into a waste gas by the method as described.

In another aspect the invention provides an injecting device for use in the method and flare tip assembly as described. The device serves to inject a gaseous mixture including air into waste gas for disposal by combustion. The device itself comprises a body with an inlet for receiving ambient air and an outlet communicating directly with the inlet for discharging the gaseous mixture into the waste gas. The body, which may be a single or multi-part fabrication, contains a protected passageway which receives an inducing medium, preferably steam, under pressure. The passageway causes the inducing medium to flow annularly and directly towards the outlet. This annular flow induces air to flow into the inlet, other than by the Coanda effect known per se, and initially the air flows within the annulus of inducing medium. The inflowing air then mixes with the inducing medium within the body prior to discharge from the outlet into the waste gas. The passageway can cause the flow of steam to reverse direction although this is not essential. The steam flow preferably emerges via an annular gap decreasingly tapered towards the outlet to enter the throat of a tubular member open to receive air from the inlet. This tubular member can be flared outwardly in diameter to inject the steam/air mixture directly into the waste gas stream during use. The annular gap may be formed between the interior of the aforesaid tubular member and the exterior of another short tubular member. This further tubular member projects inside the first member and is spaced therefrom to form the gap. The further member then provides the inlet. Each injecting device can be fabricated from two components provided with,

or constituting, the respective tubular members as aforesaid. Preferred constructional forms for the injecting device and its steam passageway are described in detail hereinafter. Conveniently, the steam used as inducing medium is supplied to the injecting devices via a steam chamber or chest provided around the tip assembly or via a system of supply conduits.

It has been found that injecting devices constructed in accordance with the invention can reduce the noise hitherto encountered with Coanda effect devices while still maintaining adequate inspiration efficiency. In addition, such devices are relatively cheap to manufacture and do not suffer from operational defects hitherto encountered. More particularly, the steam passageway which characterizes the injecting device of this invention is protected within the device itself. This renders the device largely immune from the effect of wind even with low steam flow rates. This is a further advantage over the prior art Coanda device which is prone to suffer from problems with high winds often encountered at the top of a flare stack. Moreover, there is no longer any requirement for the steam to be dry and "low quality", low pressure wet steam can be employed.

By utilizing a large number of injecting devices in accordance with the invention the waste gas can be thoroughly mixed with air and steam prior to combustion . The subsequent combustion is particularly efficient with reduced noise and steam consumption as is desired.

In contrast to known flare tip assemblies a flare tip assembly constructed in accordance with the invention preferably encourages the combustion to take place partially in the tip structure itself instead of thereabove. This necessitates lining the tip structure with a refractory

material to withstand the high temperatures encountered. Control means can prevent "burn-back" at low waste gas flow rates by increasing the supply of purge gas as known per se.

The invention may be understood more readily, and various other aspects and features of the invention may become apparent, from consideration of the following description.

Embodiments of the invention will now be described, by way of examples only, with reference of the accompanying drawings, wherein : -

Figure 1 is a schematic side view of a flare stack tip assembly constructed in accordance with the invention ;

Figure 2 is a schematic part-sectional side view of a further flare stack tip assembly constructed with the invention;

Figure 3 is a sectional side view of one of the injector devices employed in the assembly of Figure 1 ;

Figure 4 is a sectional side view of one of the injector devices employed in the assembly of Figure 2 ; and

Figure 5 is a side view of the upper part of the assembly depicted in Figure 2.

Figure 1, which is partly broken-away to show interior details, depicts a flare stack tip assembly which is intended for installation at the top of an elevated flare or flare stack. The assembly has a lower tubular member 10 provided with a flange 9 for fixing to the top of the flare stack (not shown) conveying a waste or dump gas (Arrow D). An intermediate tubular member 11

optionally extends between the member 10 and a tip structure 8. The member 10 can be fabricated from any suitable carbon steel while the member 11 is preferably fabricated from a high temperature alloy steel. The tip structure 8 extends partly within the member 11 and is of part frusto-conical shape. The tip structure 8 is here composed of a double-walled component 12 defining a steam chamber 13 therein. The inner wall of the component 12 is extended to or connected to a frusto-conical flame-retention ring 14 at the upper end and is prolonged to fit within the member 11. This inner wall of the component 12 is provided, together with the outer surface of the ring 14, with a cast refractory lining 15. A plurality of injector devices 16 are mounted to the tip structure 8 as described hereinafter.

A steam manifold 17 surrounds the lower region of the assembly and is connectible via a pipe 18 with a flange 19 to a steam supply. The manifold 17 is connected via a further pipe 21 and flexible bellows 20 to the steam chamber 13. A further smaller pipe 7 extends through the member 10 to provide communication between the steam supply and an upstanding nozzle 6 preferably coaxial with the members 10, 11.

One or more pilot gas burners 22 surmount the flame retention ring 14 and are supplied with pilot gas via a pipe line 23. An igniter 24 serves to ignite the pilot gas emitted by the pilot gas burner or burners 22 which, in turn, ignite waste or dump gas discharging through the assembly - arrow G.

The assembly depicted in Figure 2 is similar to the Figure 1 embodiment and like reference numerals are used throughout to denote like parts. In contrast to Figure 1, the steam chamber 13 is omitted and the steam

distribution manifold 17 is connected via conduits 80, 81 to the individual injector devices 16. Figure 5 depicts the disposition of the devices 16 in groups of four around the tip structure 8.

The assemblies depicted in Figures 1 and 2 can be fabricated in a range of sizes compatible with different diameter flare stacks.

As shown in Figure 3, each injector device 16 used in the Figure 1 assembly is composed of two separate components 31, 32. The primary component 31 has a main tubular portion 36 projecting towards, and communicating with, the interior of the tip structure 8 of the assembly of Figure 1. The portion 36 can be flared to increase in diameter at its outlet towards the centre of the tip structure 8. The component 31 also has a base region 39 which can be welded, as at 33, to an aperture provided in the outer wall 34 of the tip structure component 12 in the Figure 1 assembly. An annular gap 35 of constant width is provided in the base region 39 of the component 31 parallel to its tubular portion 36. The secondary component 32 has a base region 86 fixed to the main component 31. An O-ring 87 is provided between the mating parts of the components 31, 32. The component 32 has a tubular portion 38 extending within the equivalent portion 36 of the primary component 31 and spaced therefrom to form another annular gap 40 of constant width. The tubular portions 36, 38 are open to atmosphere at the left hand side of Figure 3. The base region 86 of the secondary component 32 is provided with a recess 37 which establishes communication between the annular gaps or spaces 35 and 40. A steam passageway 41 is thus provided by the gaps 35, 40 and the intermediate recess 37. In the Figure 1 assembly, steam is introduced to the passageway 41 from

the steam chamber 13.

Figure 4 depicts one of the injector devices 16 as used in the Figure 2 assembly and for convenience like reference numerals denote like parts to Figure 3. The main portion 36 of the component 31 can be welded exteriorly into an aperture in the wall of the tip structure 8 of the Figure 2 assembly. In contrast to the device 16 shown in Figure 3 the device 16 employed in the Figure 2 assembly has a tapered gap 40 between the portions 36, 38 of the components 31, 32 forming a constriction in the flow path of the steam causing increased velocity. In the device of Figure 4 the steam is introduced to the passageways 41 by way of an annular chamber 88 in the component 31 which leads via a connection on a lateral boss projection 82 to the conduits 80, 81 (Figure 5).

During use, in performing the method of the invention, waste gas is supplied to the tip assembly (arrow D, Figures 1 and 2) and is initially mixed with steam (arrow K, Figures 1 and 2) supplied via the nozzle 6. The steam supplied to the passageway 41 in each device 16 is under pressure to flow along a path as illustrated to emerge as a final annular flow which passes along the interior surface 42 of the tubular portion 36 of each device as represented by arrow S in Figures 3 and 4. This steam flow induces air to enter the devices 16 via the open tubular portions 38 of the components 32, as also represented in Figures 3 and 4 by arrows A. The air mixes with the steam in each of the devices 16 and a mixture of steam and air is discharged by each device 16 (arrows B, Figures 1, 2, 3 and 4) into the tip structure 8 to meet the upflowing main gas stream. The mixture of gas, air and steam is then combusted and the flame is designed to burn partly within the upper region of the tip

structure 8. This extreme upper region of the tip structure 8, provided with the lining 15, thus, effectively forms a combustion chamber.

A temperature sensing device 44 can be mounted to the tip structure 8 as shown in Figures 1 and 2, to provide a signal indicative of the temperature therein. This signal can be used to initiate control means controlling the supply of waste and/or purge gas to the assembly. This control system is especially useful in preventing "burn-back" where the waste gas being burnt off is flowing at a low critical rate since an increase in the supply of purge gas used to prevent air passing back down the flare stack can be initiated to ensure combustion is maintained only in the extreme upper region of the tip structure 8.

CLAIMS:

1. A device for injecting a gaseous mixture including air into waste gas for disposal by combustion; said device comprising a body with an inlet for receiving ambient air and an outlet communicating directly with the inlet for discharging the gaseous mixture; characterized in that a passageway (41) is provided in the body and is accessible to receive an inducing medium under pressure, such as steam, the passageway (41) being protected within the body and arranged to cause the inducing medium to flow annularly (40) and directly towards the outlet, the annular flow of inducing medium serving to induce air to flow into the inlet, other than by the Coanda effect known per se, and initially within the inducing medium for mixture with the inducing medium within the body.

2. A device according to claim 1, wherein the body is constructed from two components, one component (31) having a tubular portion (36) which forms the outlet and another coaxial external region (39), the tubular portion (36) and the external region (39) being separated by a gap (35) which forms an entry part of the passageway (41).

3. A device according to claim 2, wherein the other component (32) has a tubular portion (38) forming the inlet, the tubular portion (38) of the other component (32) extending within the tubular portion (36) of the one component (31) and being spaced therefrom to form an annular space (40) forming an exit part of said passageway (41) and a region (86) fixed to the one component (31) and having a recess (37) which forms an intermediate part of the passageway (41).

4. A device according to claim 5, wherein the annular space (40) is tapered to decrease in width towards the outlet.

5.. A device according to claim 1, wherein the passageway (41) has an exit part formed as an annular gap (40) between inner and outer tubular members (36, 38) which tapers to decrease in size towards the outlet and the emerging inducing medium enters the throat of the outer tubular member (36) which is open to the inlet formed by the inner tubular member.

6. A flare stack tip assembly for disposing of waste gas; said assembly being composed of a tubular member (10) for fixing to the top of a flare stack to receive the waste gas (D) and a tip structure (8) of frusto-conical shape to which a plurality of non-Coanda air injecting devices (16) are mounted, the injecting devices (16) having inlets open to atmosphere to receive ambient air and outlets for discharging a mixture of air and steam (B) into the waste gas (D); characterized in that each injecting device contains a protected passageway (41) which communicates with a supply of steam (17, 18) caused to flow through an annular exit space (40) of the passageway 41 to induce the ambient air to flow into the inlet and within the steam emerging from the exit space (40) to mix therewith prior to discharge into the waste gas.

7. An assembly according to claim 6, wherein a further pipe supplies steam to a nozzle (6) which is located within the assembly to introduce steam to the waste gas prior to the action of the injecting devices.

8. A flare tip assembly according to claim 7 or 8, wherein the inner wall of the structure (8) has a refractory lining (15), the upper region of the structure (8)

forms a combustion chamber in which some combustion of the waste gas takes place and there is further provided at least one external pilot burner (22) which serves to ignite the waste gas mixture emerging from the structure (8).

9. A method of waste gas disposal which comprises introducing a mixture of air and steam into the waste gas with the aid of injecting devices characterized in that each device (16) uses internal annular steam flow to induce or inspirate ambient air to enter the device within the annular steam flow and other than by the Coanda effect.

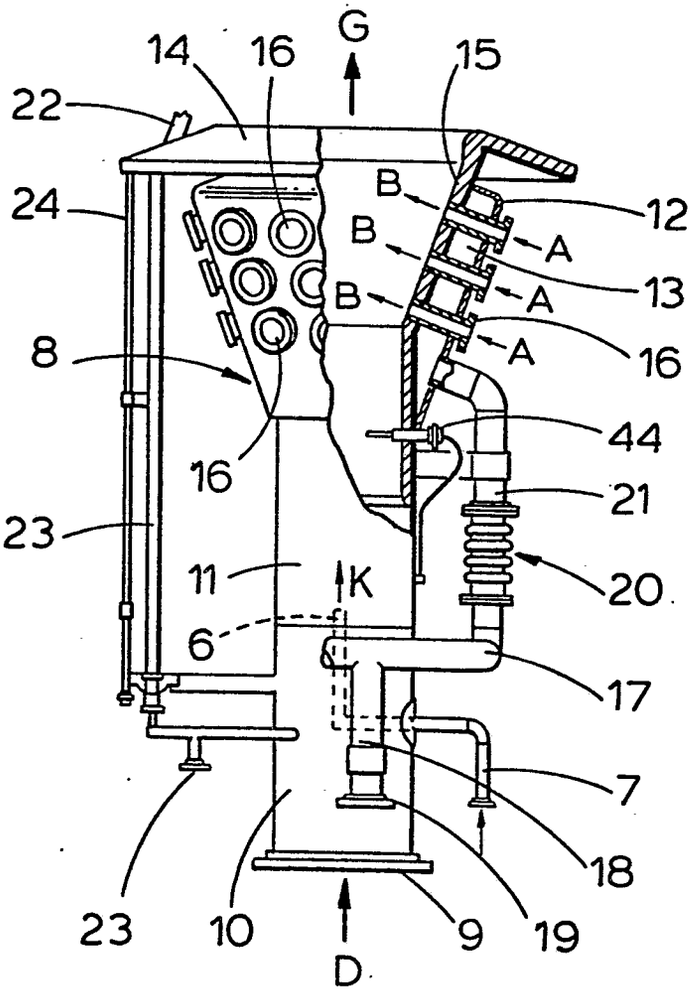
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Fig. 1

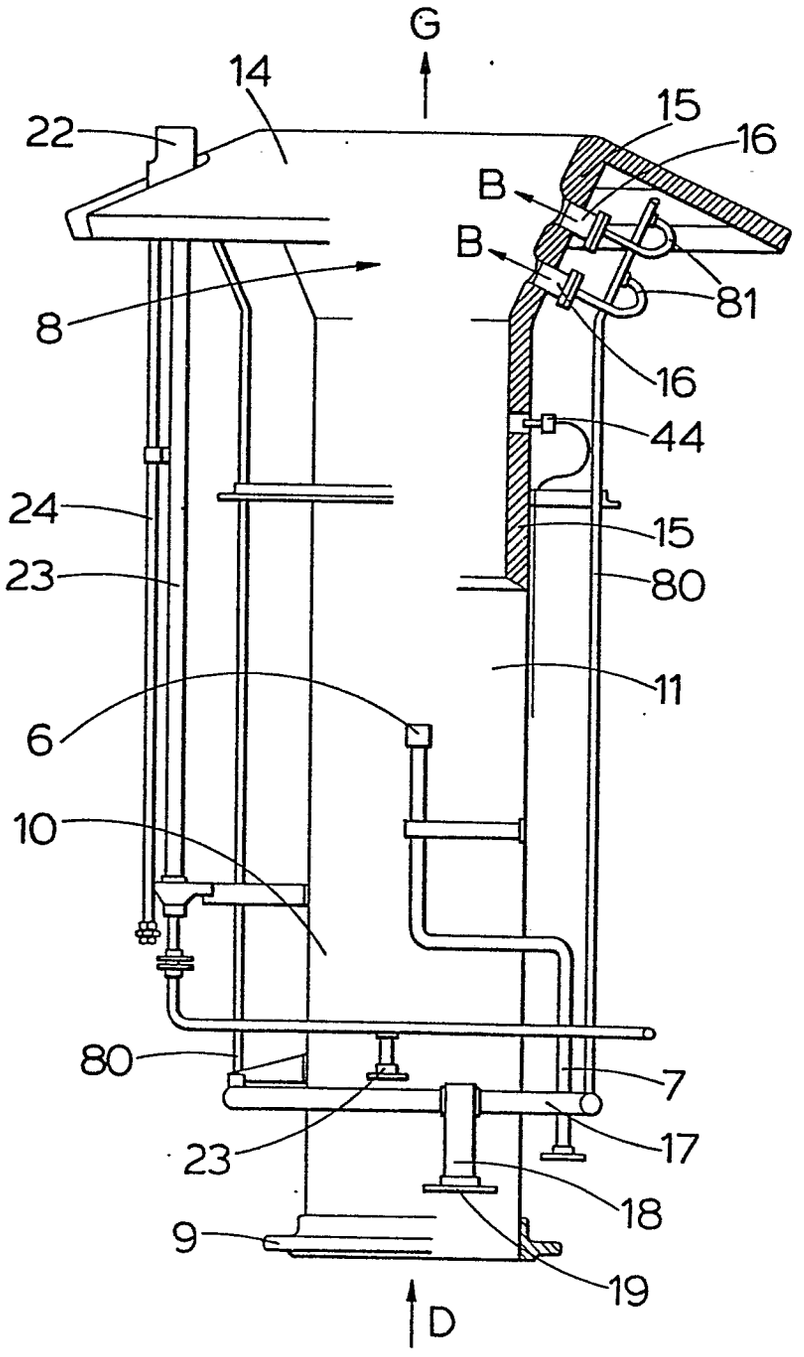

Fig.2

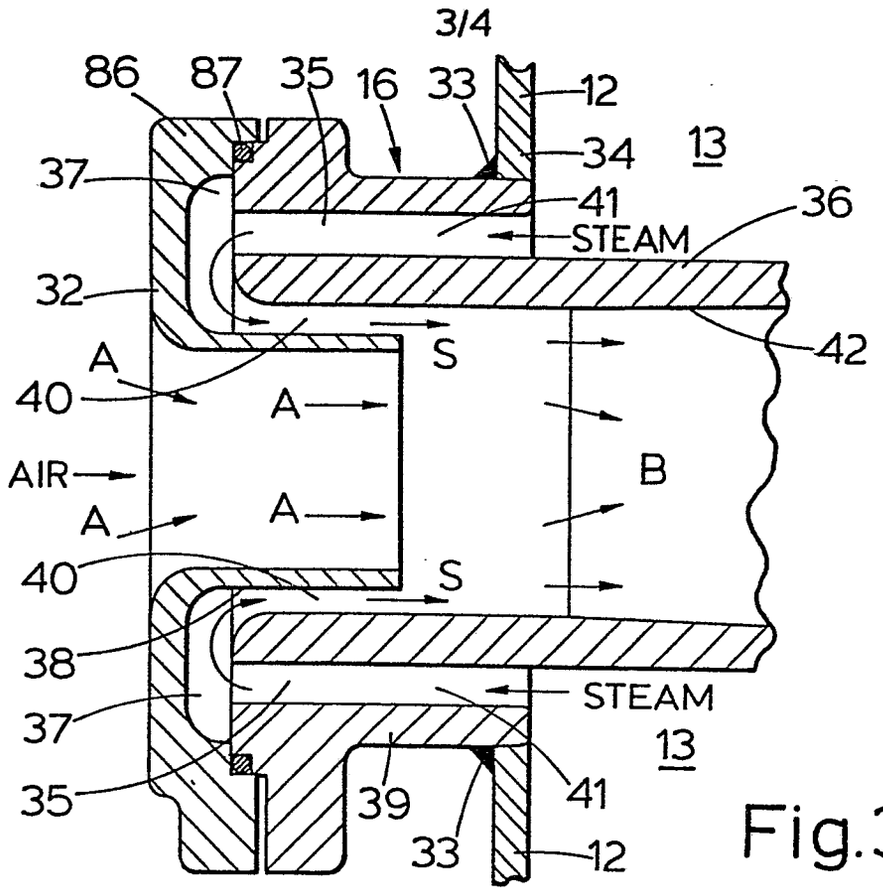
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Fig.3

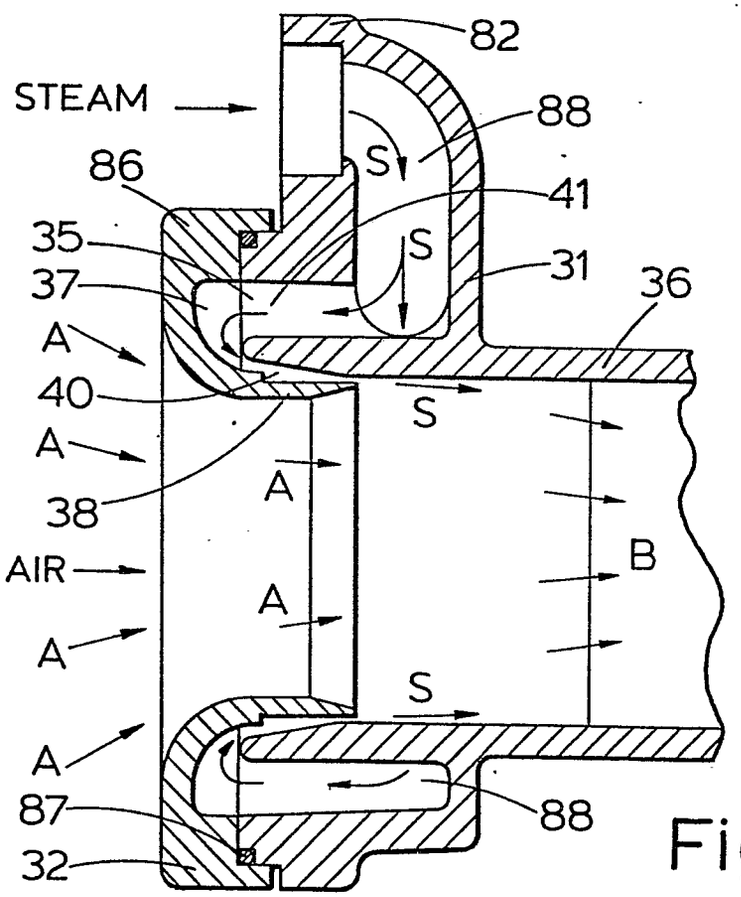
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Fig.4

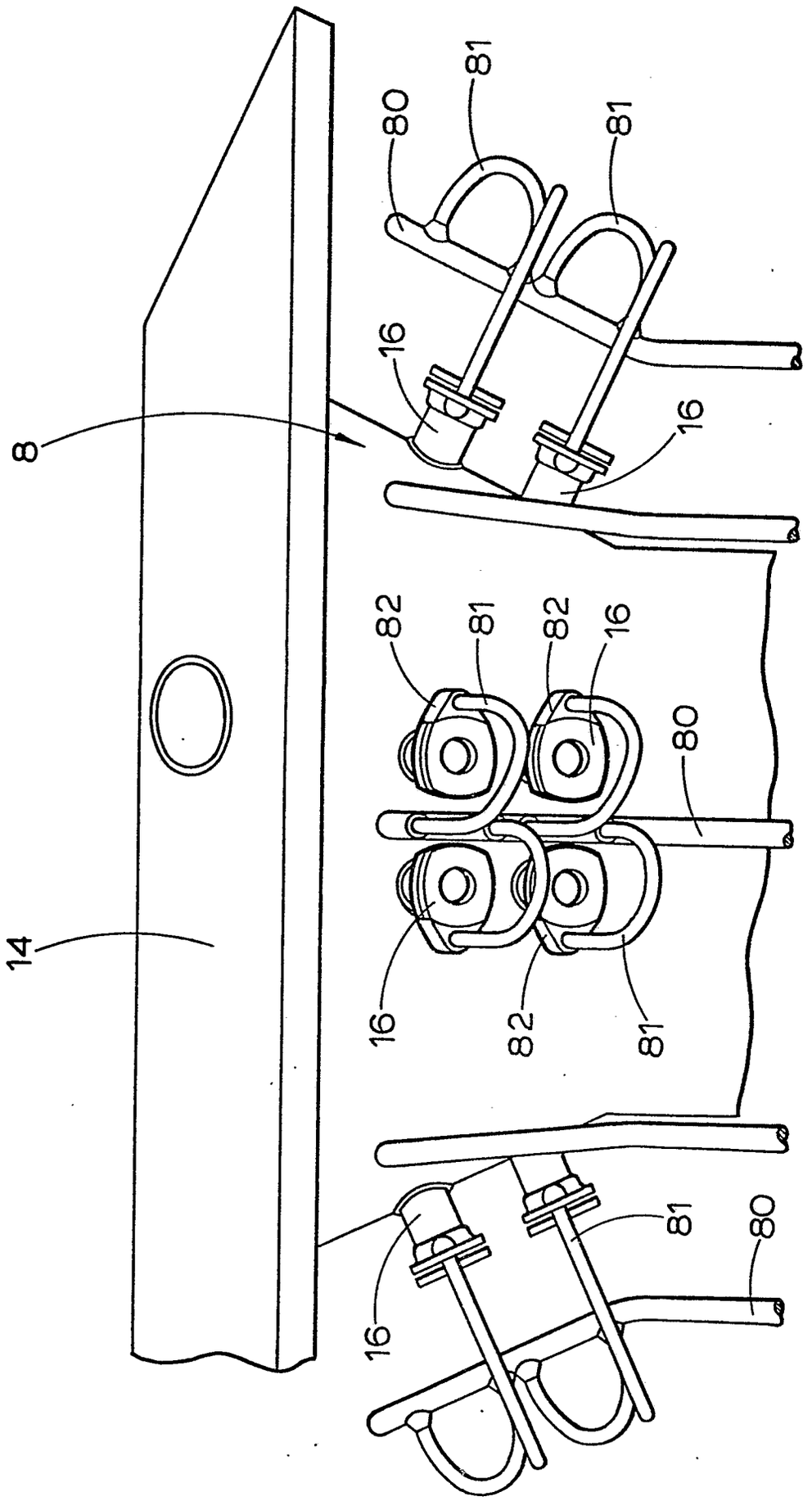

Fig. 5