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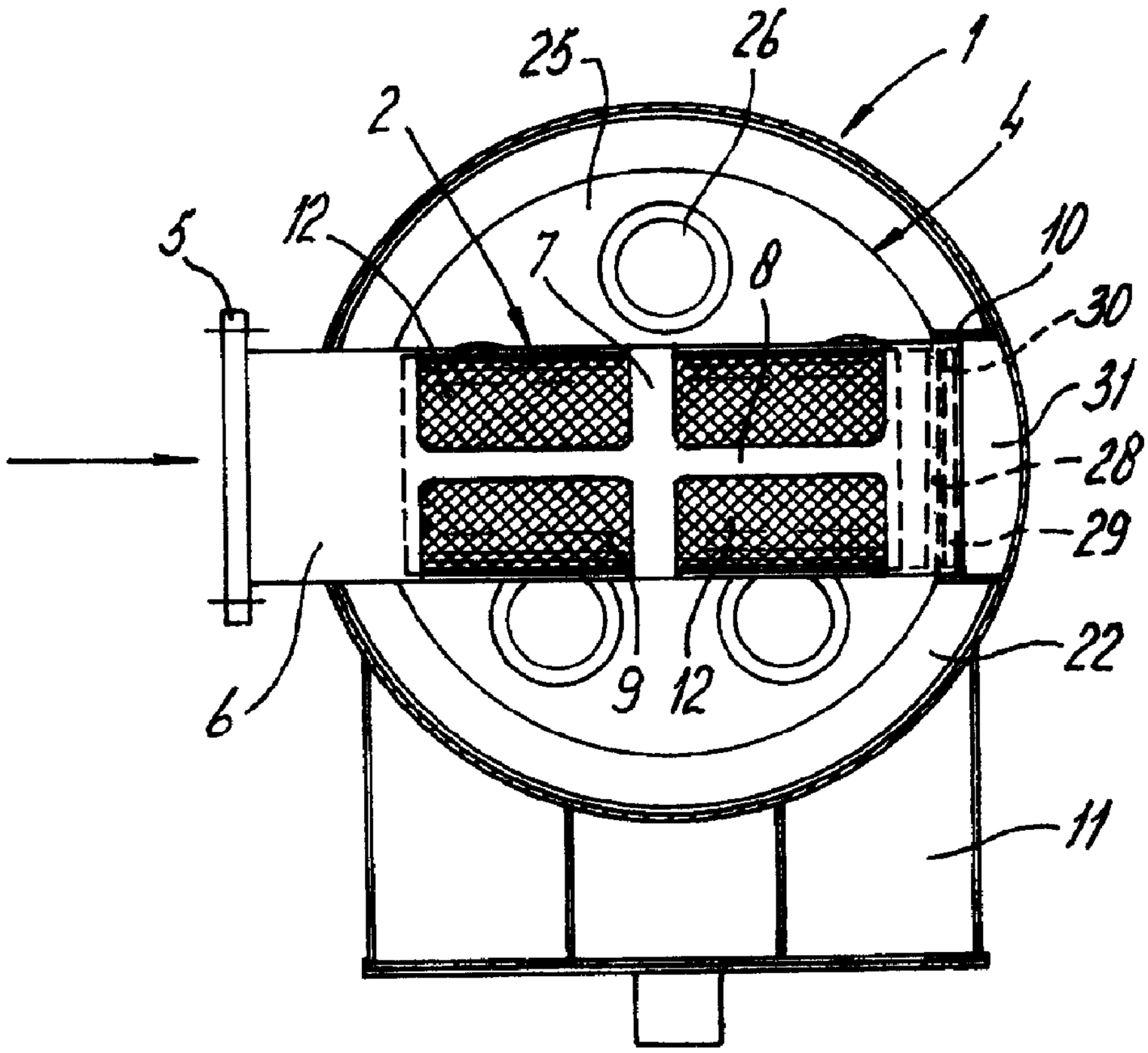
(54) Title: PULSATION DAMPER



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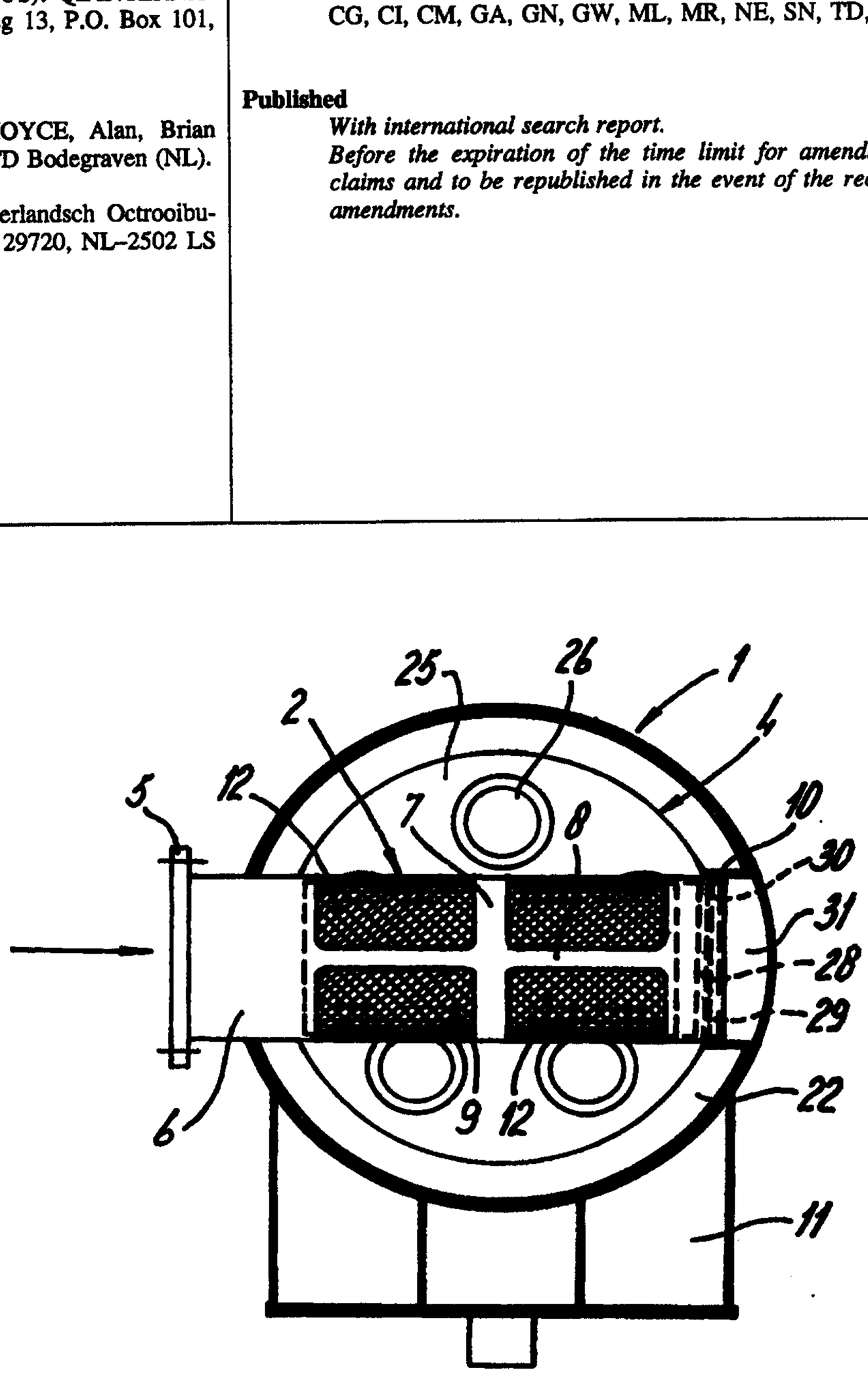
(54) Title: PULSATION DAMPER

(57) Abstract

Pulsation damper for damping low–frequency gas pulses emanating from a compressor of the Root blower type. In a vessel, an inlet and an outlet are arranged, at least one of which is designed as a diffuser. In order to increase the strength of the diffuser, it is proposed to remove parts from pipe material of relatively high thickness, so that windows are formed. These windows, with relatively large openings, are then covered with plates of perforated material. These are preferably situated on the upstream side of the pipe.



Pulsation Damper

Field of Invention

The present invention relates generally to a pulsation damper and more specifically to a pulsation damper having a diffuser.

Background

A damper of this kind is known from U.S. Pat. No. 5,563,382 and serves to damp gas pulses with a frequency of less than 100 Hz and preferably between 10 and 20 Hz. In doing so, it is necessary to satisfy the requirements of various standards, of which the API standard is the most important. This standard prescribes that the peak-to-peak pulsation with respect to the average absolute pressure is never more than 2% of the average sound level.

On the other hand, of course, it is prescribed that the pressure loss through a damper of this nature is as low as possible. For a low-pressure system which operates, for example, between 2 and 3 bar, this means that a maximum pressure loss of 15-20 millibar is permissible.

Currently, the market is demanding an ever increasing improvement in the silencing action, i.e. that the average sound level be limited to an ever greater extent. This results, on the one hand, from the wish to cause less environmental pollution and, on the other hand, from the mechanical load which is caused by pressure pulses in devices which are connected downstream of the sound absorber.

Moreover, it is required that large sound absorbers should have a particularly long service life, i.e. should function for at least five years without maintenance. Since dampers of this kind are produced from standard steel grades, corrosion and the like play an important role. It is also important that in the event of possible damage caused by long-term load the damaged components should be easy to replace.

An aspect of the present invention provides a pulsation damper which has improved damping characteristics without its design being complicated to any significant

extent. Another aspect of the invention increases the service life of diffuser pipes of this nature. One way of damping sound waves is to arrange a diffuser either in the inlet or in the outlet. In the prior art, a diffuser of this nature comprises a pipe-like part which is provided with a perforation. In this case, the total surface area of the free passage of the perforations is at least equal to the total inlet or outlet surface.

Owing to the relatively small openings, perforations of this kind are particularly exposed to corrosive conditions. In practice, it has been found that, in particular, perforated parts of pipes rupture under the pressure wave load after a relatively short time.

Summary of Invention

Aspects of an embodiment of the invention are provided with a pulsation damper for damping low-frequency gas pulses. The damper comprises a vessel having an inlet, an outlet and a silencing member arranged in the vessel. At least the inlet or the outlet has a diffuser. The diffuser has a pipe-like part with first openings. The pipe-like part comprises a member, which has a number of second openings and is delimited by reinforcement bodies which extend around the circumference. At least one of the second openings is covered by a plate, where the plate has the first openings, which are smaller than the second openings.

The perforated part of the diffuser is reinforced by means of reinforcement bodies extending along the circumference. These are preferably realized by starting from a pipe and forming windows in this pipe with large openings by, for example, cutting, while reinforcement bodies of this nature extending along the circumference remain in place between the openings. Naturally, in a design of this nature longitudinal bodies are present in order to provide sufficient strength in the axial direction. In a design of this nature, the perforation can be realized in a particularly simple manner by arranging perforated plates on the openings or windows obtained in this way. Depending on the design of the diffuser, perforated plates of this nature will be arranged on the inside or outside of the pipes. If the diffuser is an inlet diffuser, the gas pressure from the inside of

the pipe will act outwards, so that it is preferable to arrange a perforated plate of this nature on the inside. For an outlet diffuser, this situation is precisely reversed.

According to an advantageous embodiment, both an inlet diffuser and an outlet diffuser are provided.

In order to promote the damping action further, it is proposed to provide perforations only on that part of the diffuser pipe which faces away from the associated outlet or inlet respectively. In other words, if an inlet diffuser is used, the perforations are directed away from the outlet, and if an outlet diffuser is used, the perforations are directed away from the inlet.

The damping members described above may comprise any structure known in the prior art. Preferably, however, a so-called multipipe damper is used. This comprises a pipe-supporting structure which is completely closed, through which pipe-supporting structure there extend a number of pipes which connect the two closed-off chambers in the vessel to one another. According to the invention, this pipe-supporting structure comprises two curved plate parts which lie at a distance from one another. In this case, the curvature is always directed away from the adjoining plate part in question, so that a "hamburger-like" structure is produced. Possibly, a further sound-absorbing material, such as bituminous material, may be arranged between these two plates.

In another aspect, a pulsation damper for damping low-frequency gas pulses is provided. The damper comprises a vessel having an inlet, an outlet and a silencing member arranged in the vessel. At least the inlet is provided with a diffuser. The diffuser comprises a tubular member which has a plurality of first openings. The tubular member comprises a plurality of second openings and has reinforcement bodies which extend around a circumference of the tubular member. Also, at least one of the second openings is covered by a plate, where the plate is provided with the first openings which are smaller than the second openings.

In the damper, the tubular member may be provided in a region of the first openings with longitudinal reinforcement bodies which extend in an axial direction thereof.

In the damper, the plate may be arranged upstream, in a direction of flow of the gas, of the reinforcement bodies.

In the damper, the inlet diffuser may have a portion facing towards the outlet and a portion facing away from the outlet, where only the portion facing away from the outlet may be provided with the first openings.

In the damper, the inlet and the outlet may each be provided with a diffuser.

In the damper, the silencing member may comprise: a structure closing off the vessel substantially completely over a cross-section; a plurality of pipes, connecting on either side of the cross-section and extending through the structure; and two plates forming a portion of the closing structure and disposed at a distance from one another in a longitudinal extent of the vessel.

In the damper, at least one of the plates may be curved and curve away from the other plate.

In the damper, both plates may be curved and curve away from the other plate.

In the damper, a chamber formed between the plates may be filled with sound-absorbing material.

In the damper, at least the inlet may have a diffuser comprising a tubular member provided with a plurality of first openings. Also, the diffuser may have a portion facing towards the outlet and a portion facing away from the outlet, where only the portion facing away from the outlet is provided with the first openings.

In the damper, an outlet diffuser may be provided having a portion facing towards the inlet and a portion facing away from the inlet and only the portion facing away from the inlet is provided with the first openings.

In the damper, at least the inlet may be provided with a diffuser comprising a tubular member having a plurality of first openings. Also, the end of the tubular member may be closed; and a perforated plate may be arranged in the end part of the tubular member delimiting an extra damping chamber.

Brief Description of Drawings

The invention will be explained in more detail below with reference to an exemplary embodiment which is depicted in the drawing, in which:

Fig. 1 shows a side view, partially in section, of the pulsation damper according to the invention;

Fig. 2 shows a cross-section on line II-II in Fig. 1;

Fig. 3 shows a cross-section on line III-III in Fig. 1;

Fig. 4 shows a cross-section on line IV-IV in Fig. 1, and

Fig. 5 shows a detail of the inlet of the vessel.

Detailed Description of Embodiments

Fig. 1 shows a pulsation damper. It consists of a vessel 1 which may have any size known in the prior art for the purpose of damping low-frequency vibrations. The inlet 2 of this vessel is connected, optionally directly and in a manner which is not shown in more detail, to a compressor of the Roots blower type. The outlet 3 is connected, in a manner which is not shown in more detail, to further devices.

A so-called multipipe damper 4 is arranged between the inlet 2 and the outlet 3.

In the exemplary embodiment which is shown here, both the inlet and the outlet comprise a diffuser. The inlet is provided with an inlet flange 5 to which a pipe member 6 is connected. A receiving ring 10 is welded to the opposite side of the vessel. The free open end of the pipe member 6 projects into this ring. As a result, variations in length both during assembly and during operation can be accommodated because the connection

between the pipe member and receiving ring 10 is a sliding joint. In the vicinity of the end, the pipe member 6 is provided with comparatively large openings 12, for example by being cut, circumferential bodies 7 and longitudinal bodies 8 being delimited between the openings. These bodies consist of the same material as the pipe member. A perforated plate is arranged in the pipe member at the location of these openings 12. This plate is denoted by 9. At the location of the perforation, the surface of the openings 12 comprises preferably 50-70% of the circumferential surface area of the pipe. The perforated plate 9 can be attached to the pipe member 6 by means of welding. It can be seen from Figure 1 that the perforated plate 9, like the opening 12, extends only on the "left-hand side" of the pipe body 6. This means that gas which flows in is initially directed to the left, so that the distance which it has to cover in order to reach the outlet 3 is as great as possible.

With the design described here, it is possible to make use of a comparatively inexpensive perforated plate, sufficient strength nevertheless being provided by the presence of circumferential bodies 7 in combination with longitudinal bodies 8. If, following a prolonged service life, the perforated plate were to be damaged and need to be replaced, it is possible, in a simple manner, to remove the welded joint connecting it to the pipe member 6 and to use a new perforated plate.

Two rings 28, 29, between which a perforated plate 30 is arranged, are located in the end part of pipe member 6. In this way, an extra damping chamber 31 is delimited. This is shown in detail, cut away, in Fig. 5. This design provides a further damping effect.

The outlet diffuser arranged in outlet 3 is designed in a corresponding manner to the inlet diffuser. It comprises an outlet flange 15, pipe member 16 provided with circumferential bodies 17 and longitudinal bodies 18. Here, owing to the direction of flow of the gas, 15 the perforated plate 19 is attached to the outside of the pipe member. The pipe member 16 is again attached with the aid of a receiving ring 20. The outlet diffuser shown here is not provided with the components 28-30, but it should be understood that these components may be arranged therein.

Moreover, the vessel contains silencing members comprising two curved tube plates 24, 25 which are connected, via supports 22, to the circumference of the vessel. Apart from a water drain 23, both the plates are completely sealed. Open pipes 26 extend through these tube plates. It can be seen from the drawings that the plates 24 and 25 are of convex design. A filling 27 may be situated between these tube plates. This filling then preferably consists of a sound-absorbing material and is obtained, for example, by filling with bituminous material.

Although the tube plates 24 and 25 are shown at a certain distance apart in the present exemplary embodiment, it should be understood that they may also be attached to one another.

Tests on the damper described above have shown that the variation in the average absolute pressure can easily be reduced from the level of 2% which has hitherto been customary to 1%. At certain frequencies, a reduction to 0.5% has even been observed. Naturally, this is dependent on the design of the remaining components of the pulsation damper. With the design described here, it has been found that the pressure loss through the damper lies entirely within the demands set. Naturally, these demands are dependent on the absolute pressure which is present in the damper.

Although the invention is described above on the basis of a preferred embodiment, it will be understood by persons skilled in the art that numerous modifications may be made to this embodiment without departing from the scope of the present application for which rights are sought in the appended claims.

What is claimed is:

1. A pulsation damper for damping low-frequency gas pulses, comprising a vessel having an inlet, an outlet and a silencing member arranged in the vessel, at least the inlet being provided with a diffuser comprising a tubular member which is provided with a plurality of first openings, the tubular member comprising a plurality of second openings and having reinforcement bodies which extend around a circumference of the tubular member, at least one of the second openings being covered by a plate, the plate being provided with the first openings which are smaller than the second openings.

2. The pulsation damper according to claim 1, wherein the tubular member is provided in a region of the first openings with longitudinal reinforcement bodies which extend in an axial direction thereof.

3. The pulsation damper according to claim 2, wherein the plate is arranged upstream, in a direction of flow of the gas, of the reinforcement bodies.

4. The pulsation damper according to claim 1, wherein the inlet diffuser has a portion facing towards the outlet and a portion facing away from the outlet and only the portion facing away from the outlet is provided with the first openings.

5. The pulsation damper according to claim 1, wherein the inlet and the outlet are each provided with a diffuser.

6. The pulsation damper according to claim 2, wherein the inlet and the outlet are each provided with a diffuser.

7. The pulsation damper according to claim 3, wherein the inlet and the outlet are each provided with a diffuser.

8. The pulsation damper according to claim 4, wherein the inlet and the outlet are each provided with a diffuser.

9. The pulsation damper according to claim 1, wherein said silencing member comprises:

a structure closing off said vessel substantially completely over a cross-section;

a plurality of pipes, connecting on either side of said cross-section and extending through said structure; and

two plates forming a portion of said closing structure and disposed at a distance from one another in a longitudinal extent of said vessel.

10. The pulsation damper according to claim 9, wherein at least one of said plates is curved and curves away from the other plate.

11. The pulsation damper according to claim 9, wherein both plates are curved and curve away from the other plate.

12. The pulsation damper according to claim 9, wherein a chamber formed between said plates is filled with sound-absorbing material.

13. The pulsation damper according to claim 1, wherein:

the inlet diffuser has a portion facing towards the outlet and a portion facing away from the outlet and only the portion facing away from the outlet is provided with the first openings.

14. The pulsation damper according to claim 13, wherein an outlet diffuser is provided having a portion facing towards the inlet and a portion facing away from the inlet and only the portion facing away from the inlet is provided with the first openings.

15. The pulsation damper according to claim 1, wherein in the inlet diffuser:

the end of said tubular member is closed; and

a perforated plate is arranged in the end part of the tubular member delimiting an extra damping chamber.

16. The pulsation damper according to claim 15, wherein the inlet and the outlet are each provided with a diffuser.

fig-1

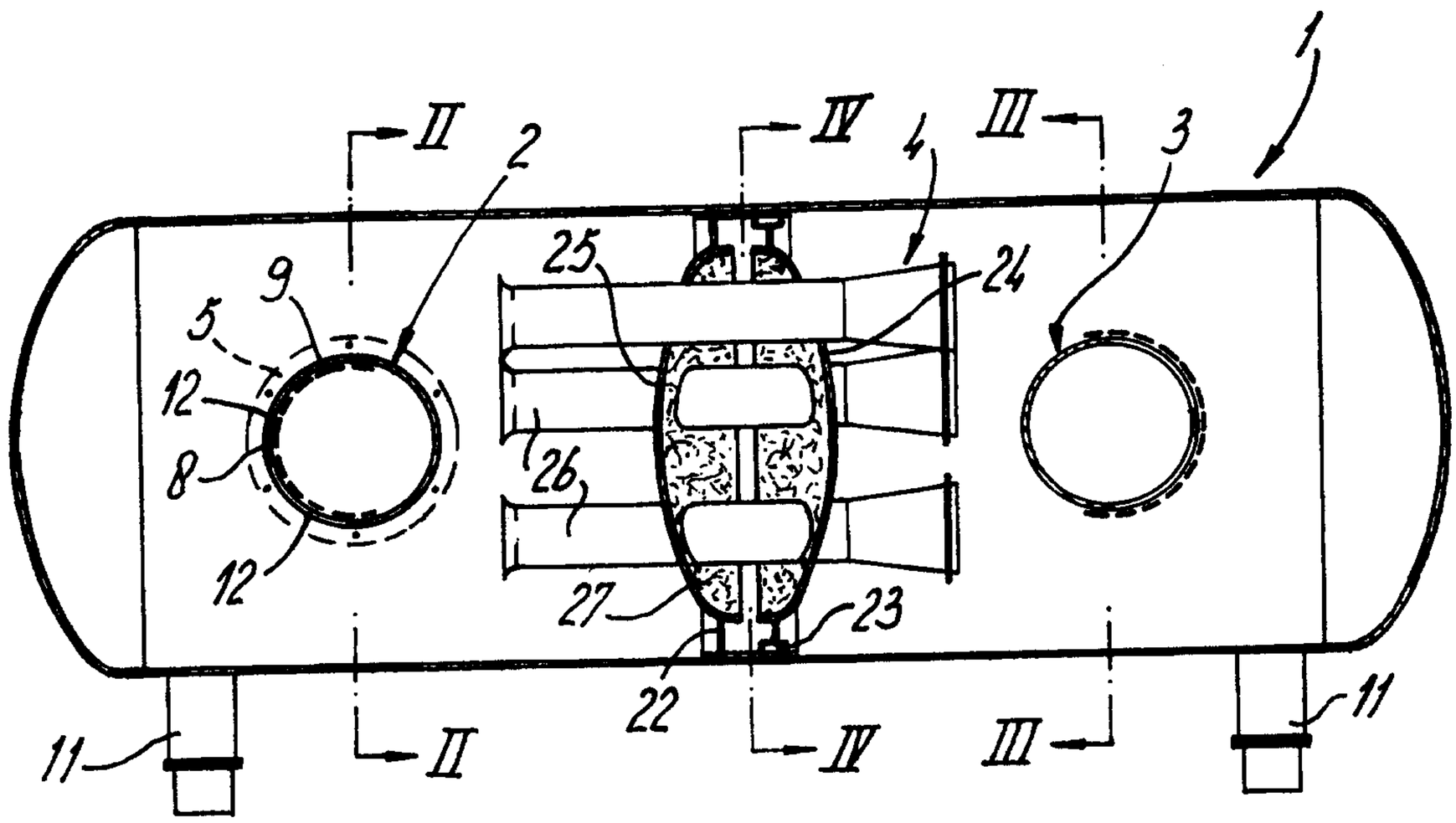

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fig-2

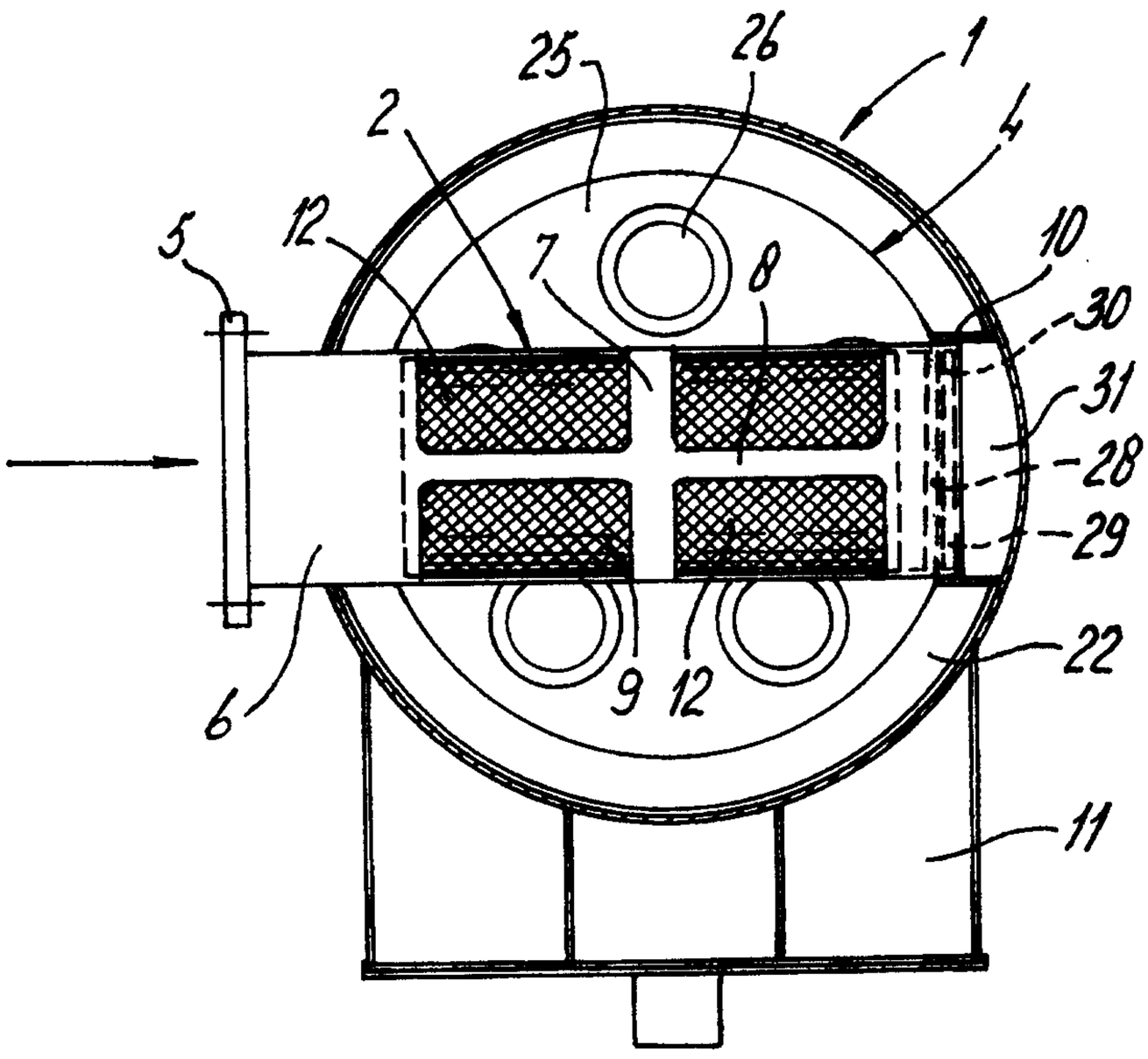
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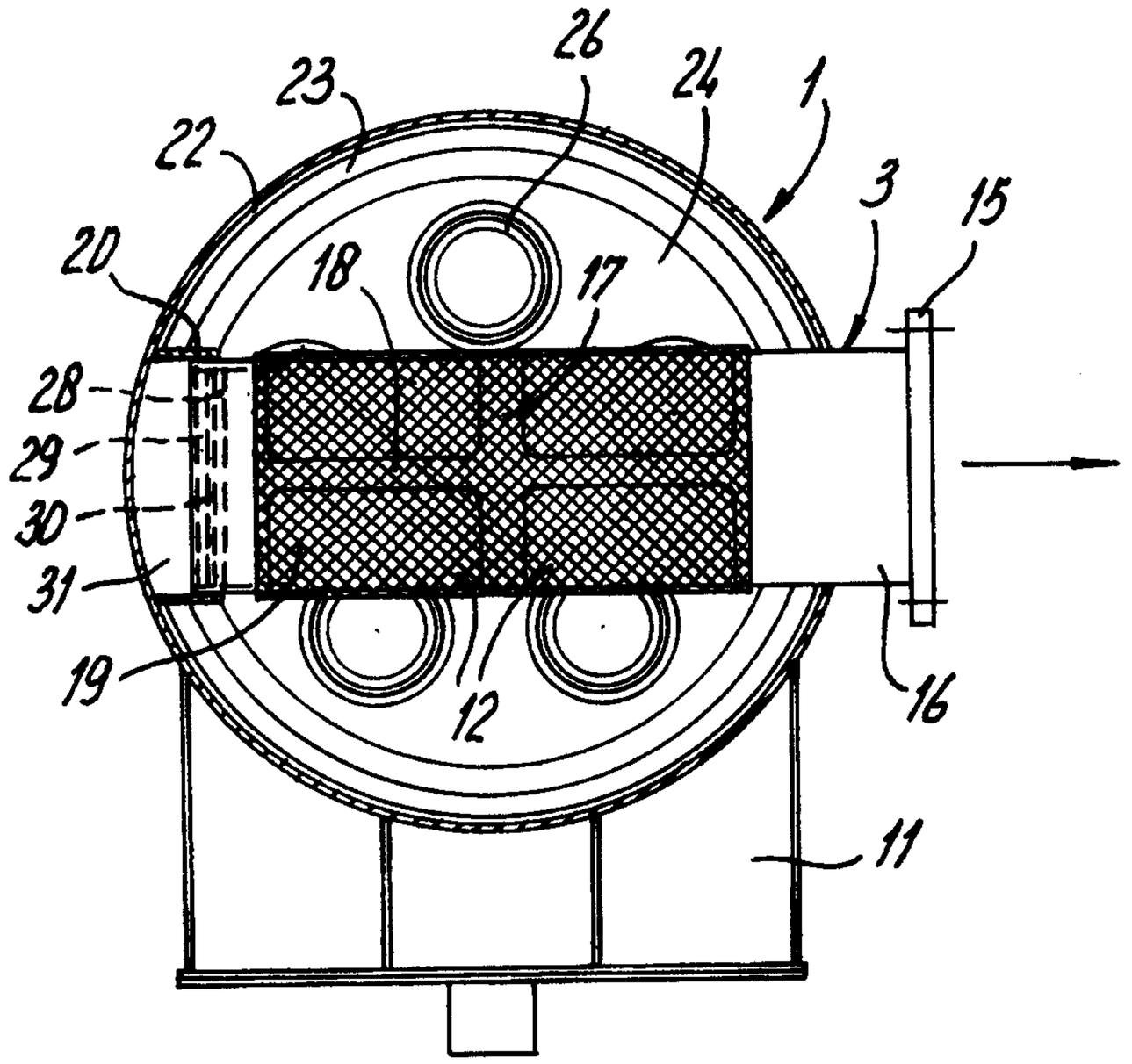
Fig - 3



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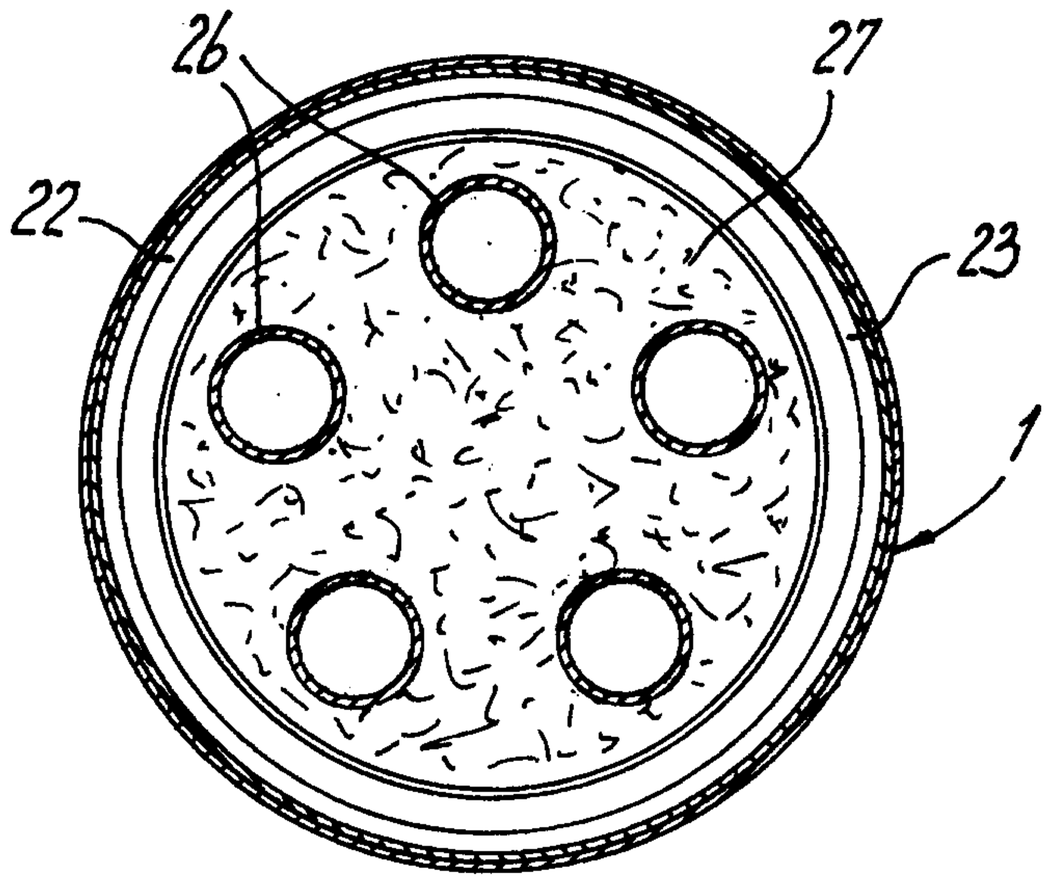
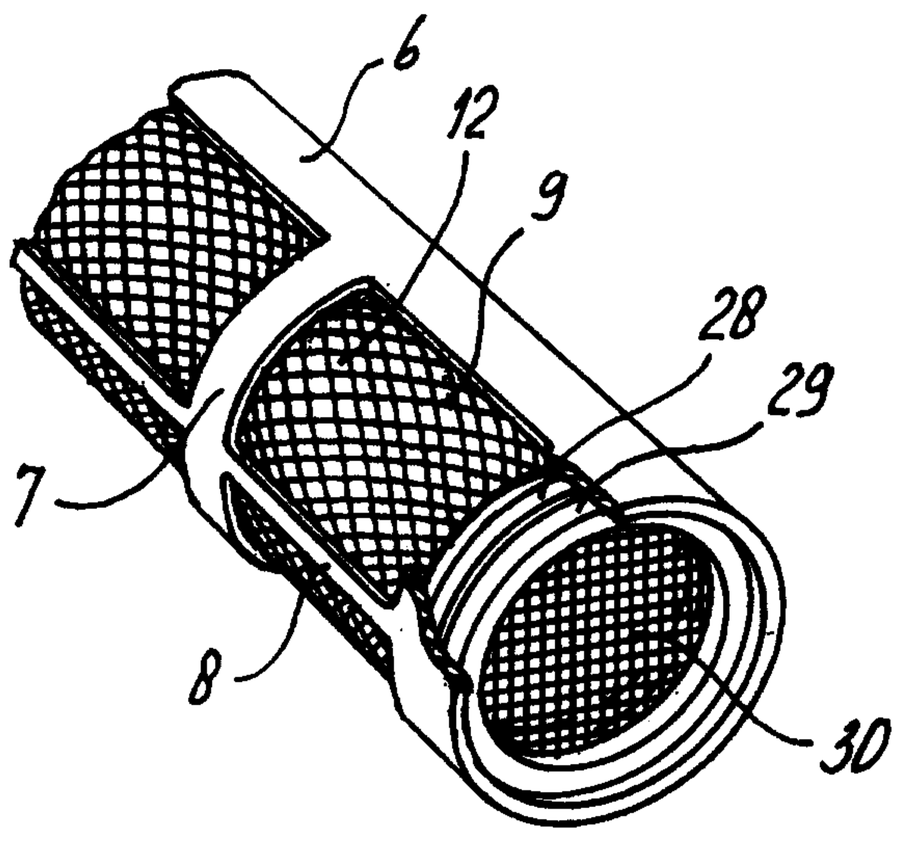
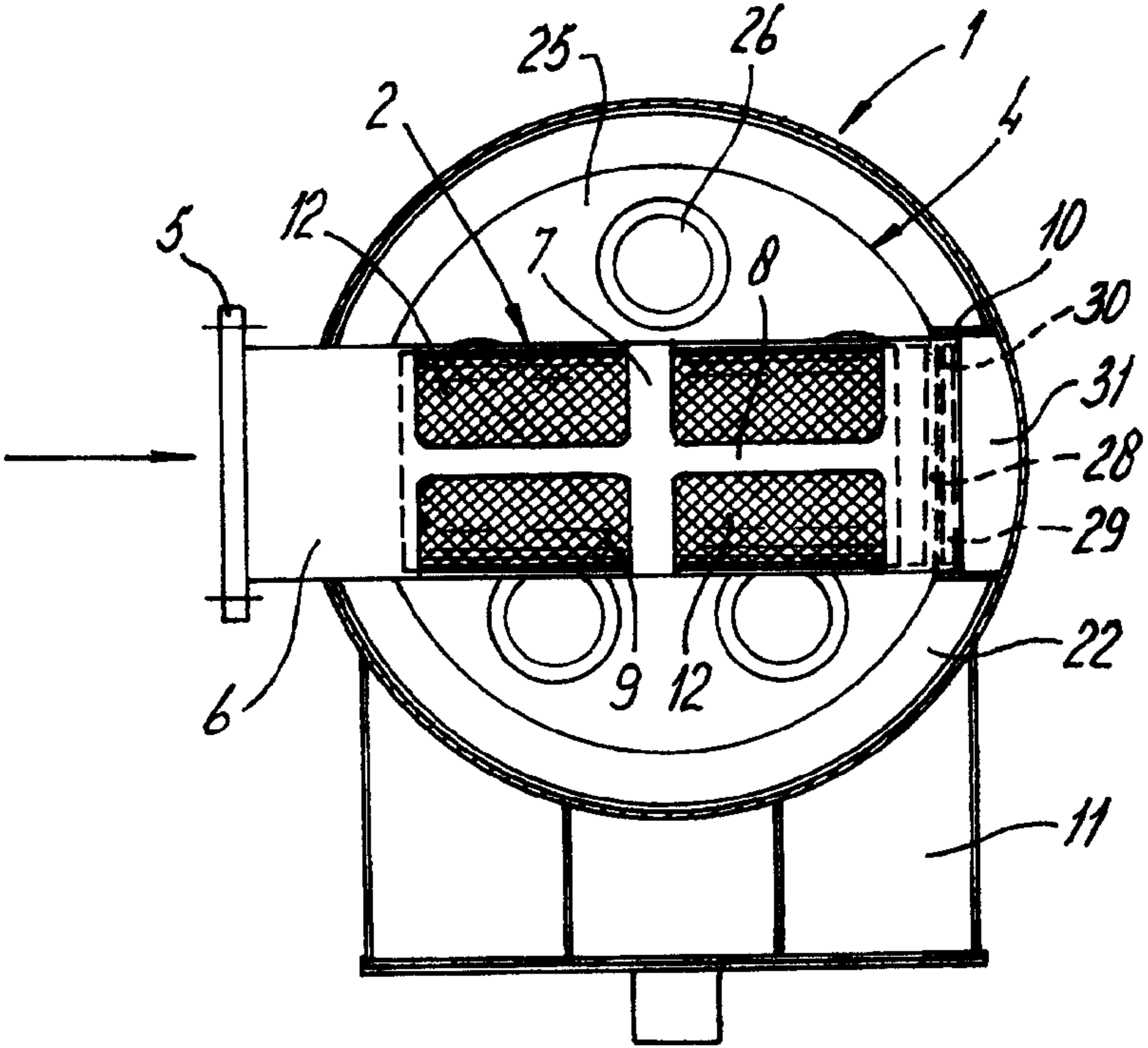


fig-5

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