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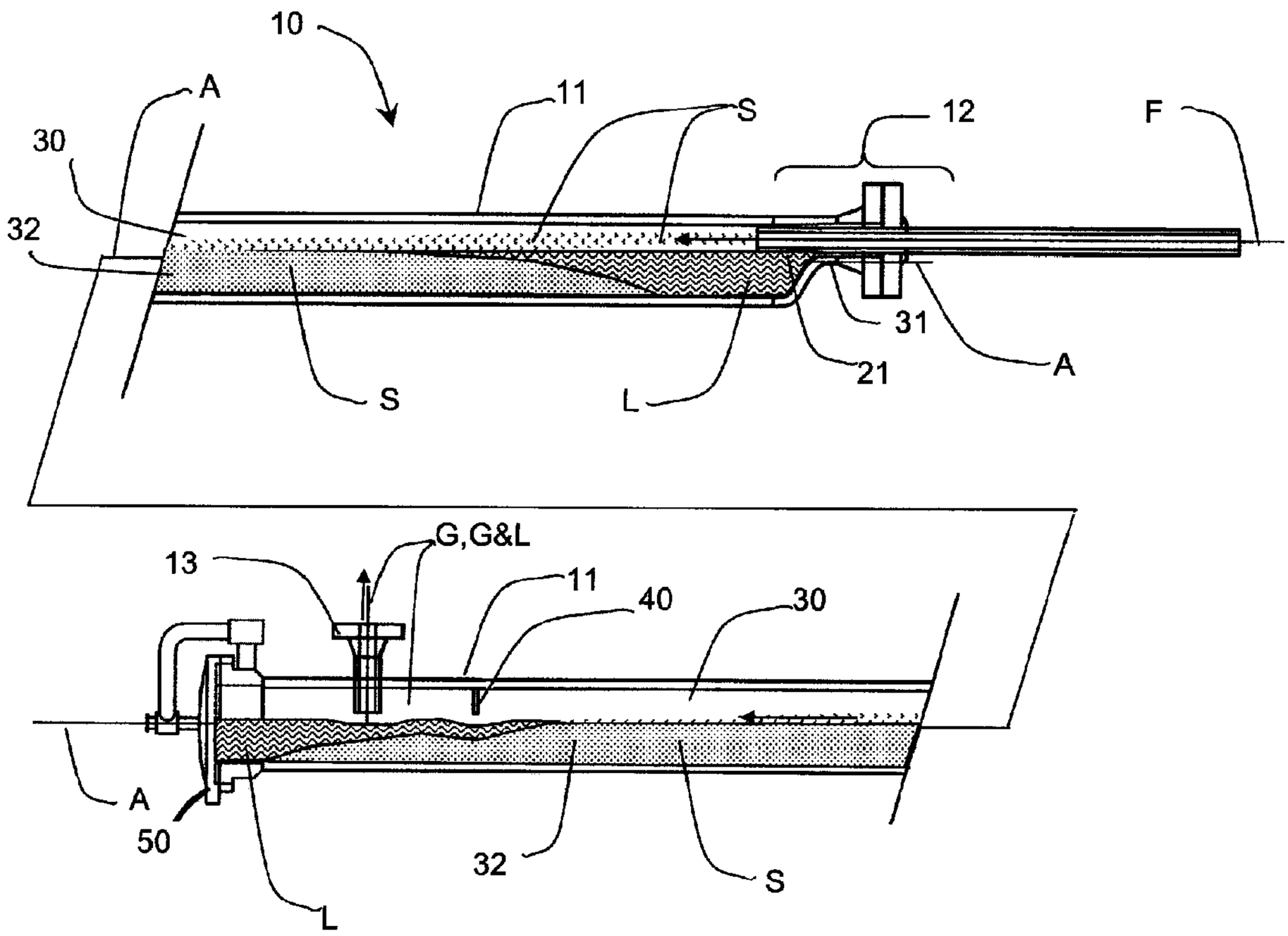
(54) Titre : METHODE ET APPAREIL DE DESENSABLEMENT POUR LA PRODUCTION A LA TETE DE PUITS
(54) Title: METHOD AND APPARATUS FOR DESANDING WELLHEAD PRODUCTION



(57) Abrégé/Abstract:
A desanding vessel is connected to a fluid stream containing entrained particulates flowing from a wellhead. The vessel comprises an upper freeboard volume wherein the fluid velocity drops and particulates fall from suspension. Preferably the fluid stream is introduced offset upwardly from an axis of a horizontally-oriented cylindrical vessel, released particulates falling to accumulate in a lower belly portion. The freeboard volume is maintained using a depending flow barrier spaced from the fluid inlet and adjacent the vessel's outlet. A cleanout enables periodic removal of accumulations.

ABSTRACT OF THE INVENTION

A desanding vessel is connected to a fluid stream containing entrained particulates flowing from a wellhead. The vessel comprises an upper freeboard volume wherein the fluid velocity drops and particulates fall from suspension. Preferably the fluid stream is introduced offset upwardly from an axis of a horizontally-oriented cylindrical vessel, released particulates falling to accumulate in a lower belly portion. The freeboard volume is maintained using a depending flow barrier spaced from the fluid inlet and adjacent the vessel's outlet. A cleanout enables periodic removal of accumulations.

"METHOD AND APPARATUS FOR DESANDING WELLHEAD PRODUCTION"

FIELD OF THE INVENTION

The present invention relates to apparatus and methodology for the removal of particulates such as sand from fluid streams produced from a well while minimizing erosion of the involved equipment.

BACKGROUND OF THE INVENTION

Production from wells in the oil and gas industry often contains particulates. These particulates could be part of the formation from which the hydrocarbon is being produced, introduced particulates from hydraulic fracturing or fluid loss material from drilling mud or fracturing fluids or from a phase changes of produced hydrocarbons caused by changing conditions at the wellbore (asphalt or wax formation). As the particulates are produced, problems occur due to abrasion, and plugging of production equipment. In a typical startup after fracturing, a stimulated well may produce sand until the well has stabilized, sometimes up to a month.

In the case of gas wells, fluid velocities can be high enough that the erosion of the production equipment is severe enough to cause catastrophic failure. High velocities are typical and are even designed for elutriating particles up the well and to the surface. An erosive failure of this nature can become a serious safety and environmental issue for the well operator. In all cases, particulate production

contaminates surface equipment and produced fluids and impairs the normal operation of the oil and gas gathering systems and process facilities.

In one prior art system, a pressurized tank ("P Tank") is placed on the wellsite and the well is allowed to produce fluid and particulates into this tank until sand production ceases. The large size of the tank usually restricts the maximum operating pressure of the vessel to something in the order of 1,000 – 2,100 kPa. In the case of a gas well, this requires some pressure control to be placed on the well to protect the P Tank. Further, for a gas well, the pressure reduction usually is associated with an increase in gas velocity which in turn makes the sand laden well effluent much more abrasive. Other problems associated with this type of desanding technique are that it is a temporary solution. If the well continues to make sand, the solution becomes prohibitively expensive. In most situations with this kind of temporary solution, the gas vapors are not conserved and sold as a commercial product.

An alternate known prior art system includes employing filters to remove particulates. A common design is to have a number of fibre mesh bags placed inside a pressure vessel. The fibre density is matched to the anticipated particulate size. Filter bags are generally not effective in the removal of particulates in a multiphase conditions. Usually multiphase flow in the oil and gas operations is unstable. Large slugs of fluid followed by a gas mist is common. In these cases, the fibre bags become a pressure drop point and often fail due to the liquid flow through filter. Due to the high chance of failure, the filter may not be trusted to remove particulates in critical applications or where the flow parameters of a well are

unknown. An additional problem with filters in most jurisdictions is associated with cost of disposal. The fibre bags are considered to be contaminated with hydrocarbons and must be disposed of in accordance to local environmental regulations.

Clearly there is a need for more versatile and cost effective system.

SUMMARY OF THE INVENTION

Apparatus is provided which is placed adjacent to the wellhead for intercepting wellhead fluid flow before and prior to entry to any operators equipment including separators, valves, chokes and all other downstream equipment.

A pressure vessel is inserted in the flowsteam by connecting it adjacent to the wellhead and to the input high velocity field piping extending from the wellhead. The vessel contains a freeboard volume having a cross-sectional area which is greater than that of the field piping from whence the fluids emanate. As a result, fluid velocity drops and particulates cannot be maintained in suspension. The freeboard cross-sectional area is maintained through a downcomer weir or depending nozzle at the vessel's exit which ensures that a minimum freeboard volume and cross-sectional area is maintained for the collection of particulates, and promotes maximum use of the freeboard area, thereby reducing the number of times maintenance of the system, by cleaning the freeboard area of accumulated particulates, need be conducted.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a cross-sectional side view of one embodiment of the invention;

Figure 2 is a typical installation for wellsite service, such as that provided on a portable trailer; and

Figure 3 is a performance graph of the achievable gas rates while still achieving particulate removal.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in Fig. 1, a desander 10 comprises a substantially horizontal, cylindrical, pressure vessel 11 having an inlet end 23 adapted for connection to a wellhead piping 9 and fluid stream F, typically gas G and sand S. As stated in the background and below, the fluid stream F may also contain liquid L.

A fluid inlet 12 comprises a nozzle 21 extending into an upper freeboard 30 volume adjacent the top of the vessel 11. An eccentric fitting 31 shifts the axis A of the vessel 11 downward to form a belly storage portion 32 for receiving and temporarily storing sand S. The nozzle 21 extends beyond the end of the vessel 11 and into the freeboard 30 which minimizes localized wear. Gas G containing sand S enters through the fluid inlet 12 and is received by a larger cross-sectional area of the freeboard 30. The velocity slows and sand falls out of suspension. The freeboard 30 is maintained using means to ensure that the particulate free fluid is collected by an outlet 13 from mid-vessel.

This is achieved using either flow barrier such as a weir 40 as shown or by inserting the fluid outlet into the vessel 11, away from the vessel wall.

As shown in Fig. 1, if a weir 40 is used, it is spaced from the fluid inlet 12 and positioned between the fluid inlet 12 and the fluid outlet 13.

As shown in Fig. 1, both a weir 40, and a fluid outlet 13, having a downwardly extending portion which extends into the vessel 11, are used as a flow barrier in a preferred embodiment.

The fluid outlet 13 for the vessel 11 is preferably perpendicular and upward, drawing from the lower level of the freeboard 30 volume.

A quick release pressure-vessel compatible cleanout 50 is provided for sand removal access. The vessel 11 must be depressurized before opening and cleaning out particulates. Manual cleanout is performed although automated cleanout could be incorporated without diverging from the intent of the invention.

A typical vessel 11 may be a 6" diameter, schedule 160 shell having a capacity for 8 million cubic feet of gas G per day and a corresponding and typical collection rate of 1.5 gallons of particulates per day.

The advantages of the system include:

- As the desander is more cost effective than a "P Tank", the desander can be economically placed on a well for long term (substantially permanent) sand protection;
- With a pressure rating that allows it to operate at the wells conditions, minimal pressure drop is experienced across the vessel. The desander is designed to exceed ASME code for

pressure vessels. This permits the sand to be removed from the flow stream without becoming erosive.

- Since the vessel is passive and has no moving parts, plugging caused by particulates is not an issue. Sand is removed mechanically from the vessel at regular intervals. By removing the sand prior to it entering the producing system, contamination of equipment and produced fluids is avoided.
- The vessel is capable of handling multiphase production and has demonstrated the ability to remove sand from both gas and oil streams. This results in a wider application than the filter methods.

THE EMBODIMENTS OF THE INVENTION FOR WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A desanding vessel for removing particulates in a fluid stream, comprising:

a fluid inlet adjacent a first end of the vessel and adapted for receiving the fluid stream, the fluid inlet discharging the fluid stream at an inlet velocity into a freeboard portion at a top of the vessel, the fluid stream in the freeboard portion having a cross-sectional area greater than that of the inlet for creating a freeboard velocity less than the inlet velocity such that contained particulates fall out of suspension;

a fluid outlet from the vessel, the fluid outlet being spaced horizontally from the fluid inlet; and

a flow barrier, depending from the top of the vessel and having a lower edge so as to direct the fluid stream below the flow barrier before the fluid stream discharges from the fluid outlet for maintaining the freeboard portion and forming a belly storage portion therebelow, the flow barrier further being positioned between the fluid inlet and fluid outlet and spaced from the fluid inlet so as to cause accumulation of particulates in the belly portion prior to the flow barrier.

2. The desanding vessel of claim 1 wherein the flow barrier is a downcomer weir.

3. The desanding vessel of claim 1 or 2 wherein the vessel is cylindrical having a substantially horizontal axis.

4. The desanding vessel of claim 1 or 2 wherein the vessel is cylindrical having a substantially horizontal axis extending substantially the length of said vessel wherein the fluid inlet discharges the fluid stream into the freeboard portion of said vessel via an inwardly extending fluid introduction means.

5. The desanding vessel of claim 4 wherein the fluid inlet discharges the fluid stream into the freeboard portion via said fluid introduction means along a fluid path which is substantially parallel to the axis.

6. The desanding vessel of claim 5 wherein the fluid inlet is offset above the axis of said vessel.

7. The desanding vessel of any one of claims 4 - 6 wherein the fluid inlet comprises an eccentric fitting for aligning said fluid introduction means offset from and above said axis, so that fluid is introduced into the vessel above said axis.

8. The desanding vessel of any one of claims 1 – 7 further comprising a cleanout port for periodically accessing and removing said particulates accumulated in the belly portion.

9. The desanding vessel of claim 8 further comprising:

means for de-pressurizing the vessel before opening the cleanout port.

10. A substantially elongate, horizontal vessel for removal of particulates entrained in a fluid stream emanating from a petroleum well, comprising:

a fluid inlet adjacent a first end of the vessel, adapted for receiving the fluid stream and discharging the fluid steam at an inlet velocity into an upper region of said vessel, such vessel having a greater cross-sectional area than said fluid inlet such that said fluid stream entering said vessel slows to a velocity less than said inlet velocity and particulates fall out of suspension and collect on a lower region of said vessel;

a fluid outlet from the vessel, positioned in the upper region of said vessel for directing said fluid stream having particulates substantially removed therefrom from the vessel;

a flow barrier, positioned in a path of flow of said fluid stream from said fluid inlet to said fluid outlet, said flow barrier directing the path of flow of said fluid stream thereunder; and

a belly portion for accumulating said particulates prior to said flow barrier.

11. The vessel of claim 10 wherein the flow barrier is a downcomer weir for maintaining the upper region of said vessel.

12. The desanding vessel of claim 10 or 11 wherein the vessel is cylindrical having a substantially horizontal axis.

13. The vessel of claim 11 or 12 wherein the vessel is cylindrical having a substantially horizontal axis extending substantially the length of said vessel wherein the fluid inlet discharges the fluid stream into the upper portion of said vessel via an inwardly extending fluid introduction means.

14. The vessel of claim 13 wherein the inlet discharges the fluid stream into the upper portion via said fluid introduction means along a fluid path which is substantially parallel to the axis.

15. The vessel of claim 14 wherein the fluid inlet is offset above the axis of said vessel.

16. The vessel of any one of claims 13 - 15 wherein the fluid inlet comprises an eccentric fitting for aligning said fluid introduction means offset from and above said axis, so that fluid is introduced into the vessel above said axis.

17. The vessel of any one of claims 10 - 16 further comprising a cleanout port for periodically accessing and removing particles accumulated in the belly portion.

18. The vessel of claim 17 further comprising means for de-pressurizing the vessel before opening the cleanout port.

19. A substantially elongate, horizontal vessel for removal of particulates entrained in a fluid stream emanating from a petroleum well, comprising:

an upper region;

a lower belly region;

a fluid inlet adjacent a first end of the vessel, adapted for receiving the fluid stream having an inlet velocity and discharging the fluid stream into said upper region of said vessel, said upper region having a greater cross-sectional area than said fluid inlet such that said fluid stream slows to a velocity less than said inlet velocity and particulates fall out of suspension and collect on said lower belly region of said vessel;

a fluid outlet from the vessel, spaced horizontally from the fluid inlet and situated proximate a second opposite end of said vessel, positioned in said upper region of said vessel; and

a flow barrier extending downwardly through said upper region so as to direct the fluid stream below the flow barrier before the fluid stream discharges from the fluid outlet, the flow barrier being positioned between the fluid inlet and fluid outlet and spaced from the fluid inlet to permit accumulation of said particulates in said lower belly region prior to the flow barrier.

20. The vessel of claim 19 wherein the flow barrier is a downcomer weir.

21. The vessel of claim 19 or 20 wherein the vessel is cylindrical having a substantially horizontal axis.

22. The vessel of claims 19 or 20 wherein the vessel is cylindrical having a substantially horizontal axis extending substantially the length of said vessel wherein the fluid inlet discharges the fluid stream into the upper portion of said vessel via an inwardly extending fluid introduction means.

23. The vessel of claim 22 wherein inlet discharges the fluid stream into the upper region via said fluid introduction means along a fluid path which is substantially parallel to the axis.

24. The vessel of claim 23 wherein the fluid inlet is offset above the axis of said vessel.

25. The vessel of any one of claims 22 - 24 wherein the fluid inlet comprises an eccentric fitting for aligning said fluid introduction means offset from and above said axis, so that fluid is introduced into the vessel above said axis.

26. The vessel of any one of claims 20 - 25 further comprising a cleanout port for periodically accessing and removing said particulates accumulated in the belly portion.

27. The vessel of claim 26 further comprising means for de-pressurizing the vessel before opening the cleanout port.

28. A system for removing particulates entrained in a fluid stream emanating from a petroleum well, comprising:

a substantially elongate, horizontal pressure vessel , comprising:

(i) an upper region;

(ii) a lower belly region;

(iii) a fluid inlet situated proximate a first end of said vessel and the upper region thereof, adapted for receiving said fluid stream having an inlet velocity and discharging the fluid stream into said upper region of said vessel, said upper region having a greater cross-sectional area than said fluid inlet such that said fluid stream slows to a velocity less than said inlet velocity and particulates fall out of suspension and collect in said lower belly region of said vessel;

(iv) a fluid outlet from the vessel, situated at a second end of said vessel opposite said first end;

(v) a flow barrier, extending downwardly through said upper region and situated proximate said fluid outlet so as to direct the fluid stream below the flow barrier immediately before the fluid stream travels upwardly and discharges from the fluid outlet, positioned between the fluid inlet and fluid outlet and spaced from the fluid inlet to permit accumulation of said particulates in said lower belly region;

(vi) a clean-out port proximate said second end, to permit access to said vessel to remove particulates collected in said belly region during a cleaning step;

(vii) means for depressurizing said vessel during said cleaning step; and

an inlet flow valve, situated proximate said fluid inlet on said pressure vessel; and

an outlet flow valve, situated proximate said fluid outlet on said pressure vessel.

29. The system for removing particulates as claimed in claim 28, wherein said fluid inlet discharges said fluid stream into said vessel along substantially a horizontal longitudinal axis of said vessel.

30. A method for removing particulates contained in a fluid stream flowing from an existing wellhead, comprising:

receiving the fluid stream at a fluid inlet, the fluid stream being discharged therefrom to a freeboard portion at a top of a vessel, the fluid stream in the freeboard portion having a freeboard velocity less than an inlet velocity of said fluid stream so that said particulates fall out of suspension;

discharging the fluid stream from a fluid outlet spaced horizontally from the fluid inlet; and

further comprising the interim step prior to discharging said fluid stream from said fluid outlet of:

directing the fluid stream below a flow barrier depending from the top of the vessel for maintaining the freeboard portion and forming a belly storage portion therebelow, the flow barrier being positioned between the fluid inlet and fluid outlet and the flow barrier being spaced from the fluid inlet; and

accumulating the particulates in the belly portion prior to said flow barrier so that fluid stream at the fluid outlet is substantially free of particulates.

31. The method of claim 30 wherein the vessel is cylindrical having a substantially horizontal axis, the method further comprising the step of :

discharging the fluid stream into the freeboard portion along a fluid path which is substantially parallel to the vessel's axis and offset above the vessel's axis.

32. The method of claim 30 or 31 further comprising periodically accessing the vessel and removing said particulates accumulated in the belly portion.

33. The method of claim 32 further comprising depressurizing the vessel prior to the periodic accessing and removing of said particulates accumulated in the belly portion.

34. The method of claims 30 or 31 further comprising periodically depressurizing the vessel prior to accessing and removing said particulates accumulated in the belly portion prior to the flow barrier.

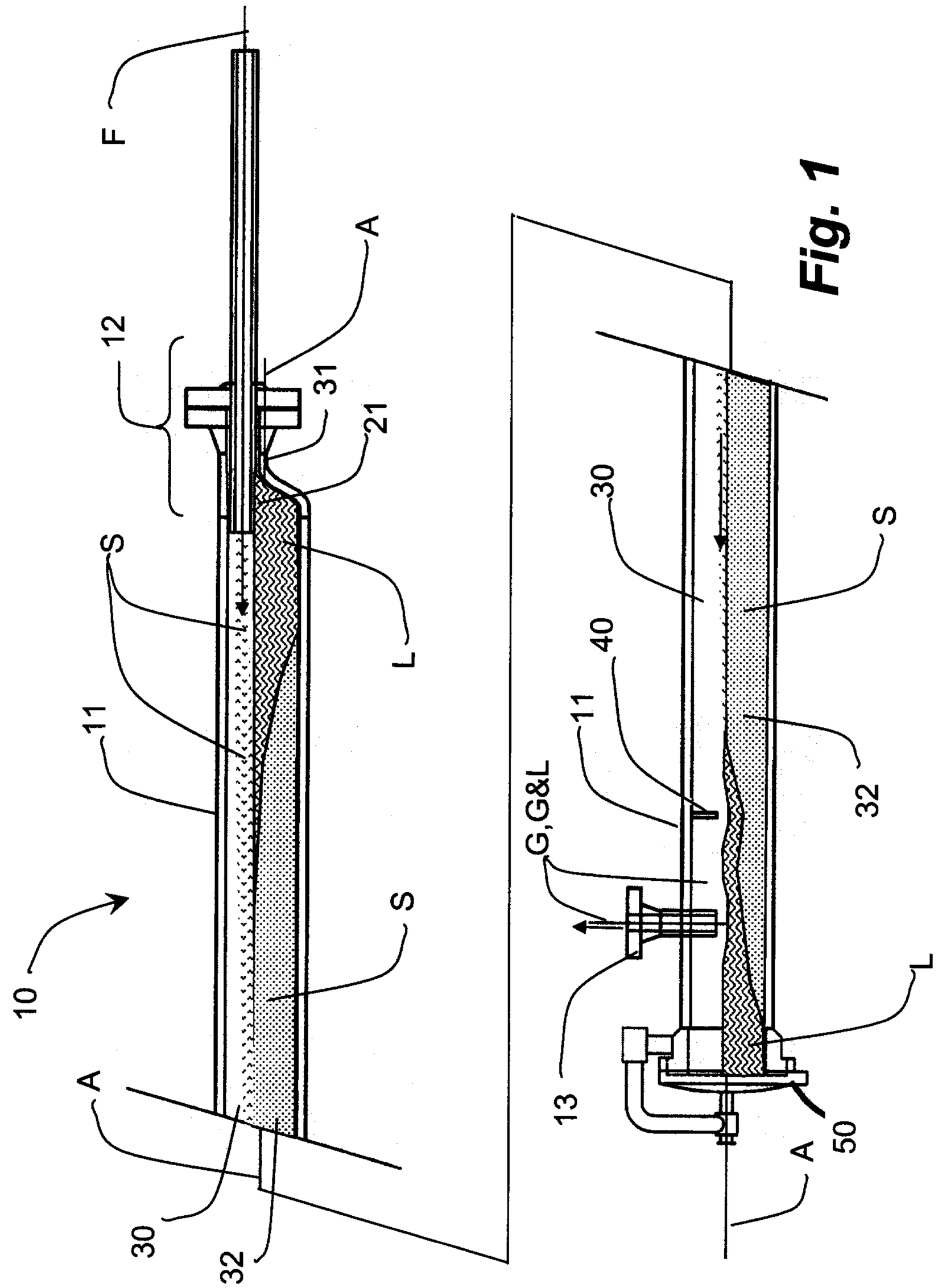


Fig. 1

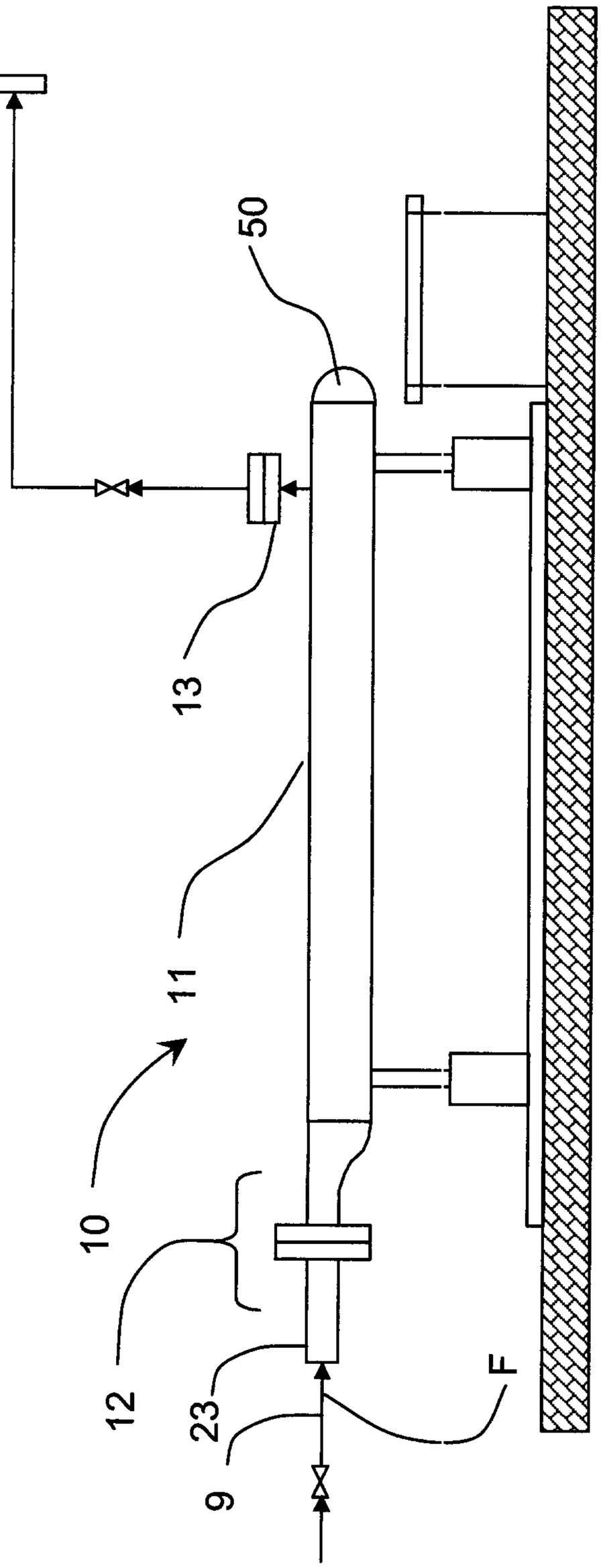
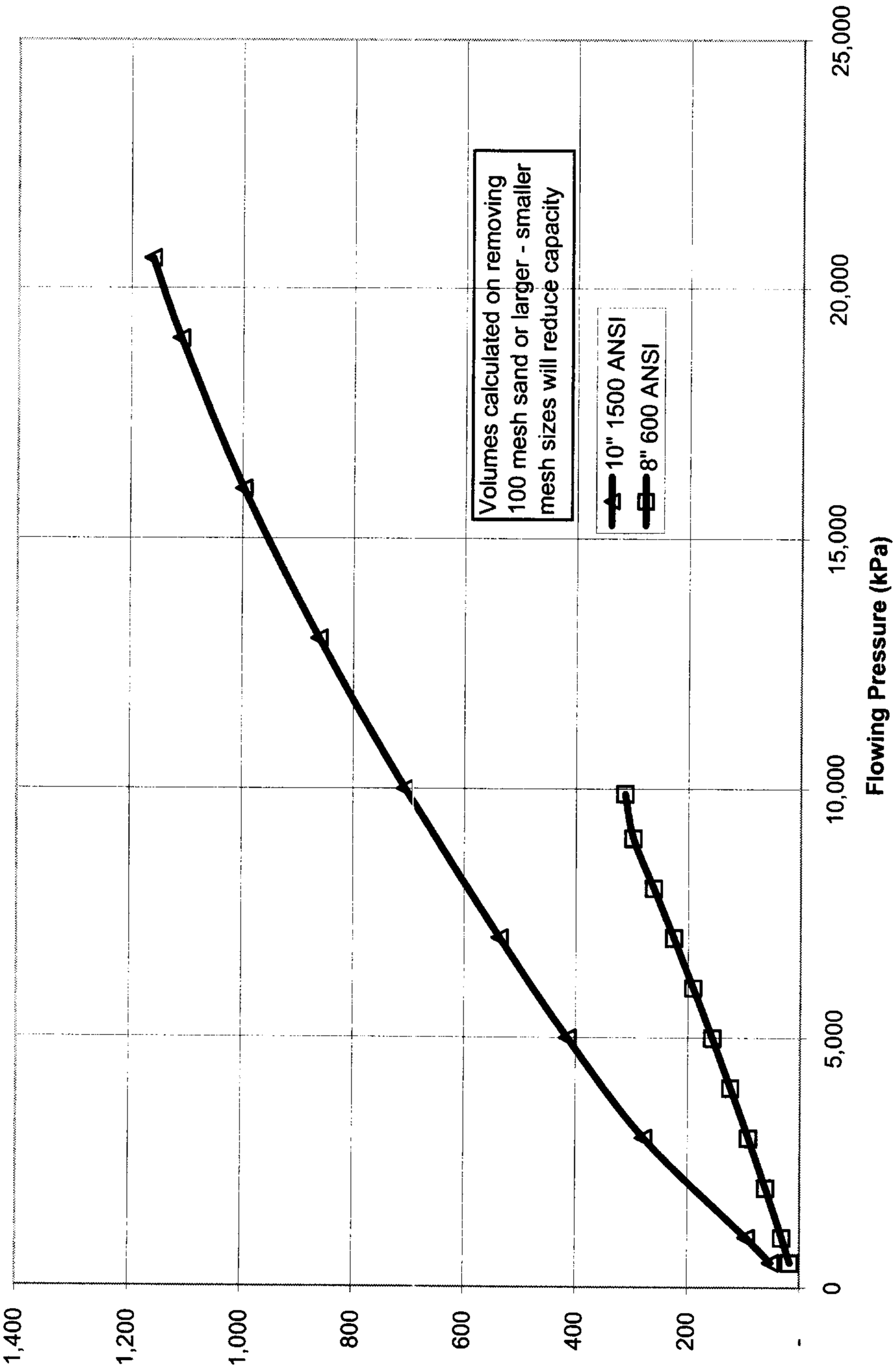


Fig. 2

FIG. 3


Volumes calculated on removing 100 mesh sand or larger - smaller mesh sizes will reduce capacity
10" 1500 ANSI
8" 600 ANSI
Flowing Pressure (kPa)
25,000
20,000
15,000
10,000
5,000
0
Gas Rate ($10^3 m^3/d$)
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1,200
1,000
800
600
400
200
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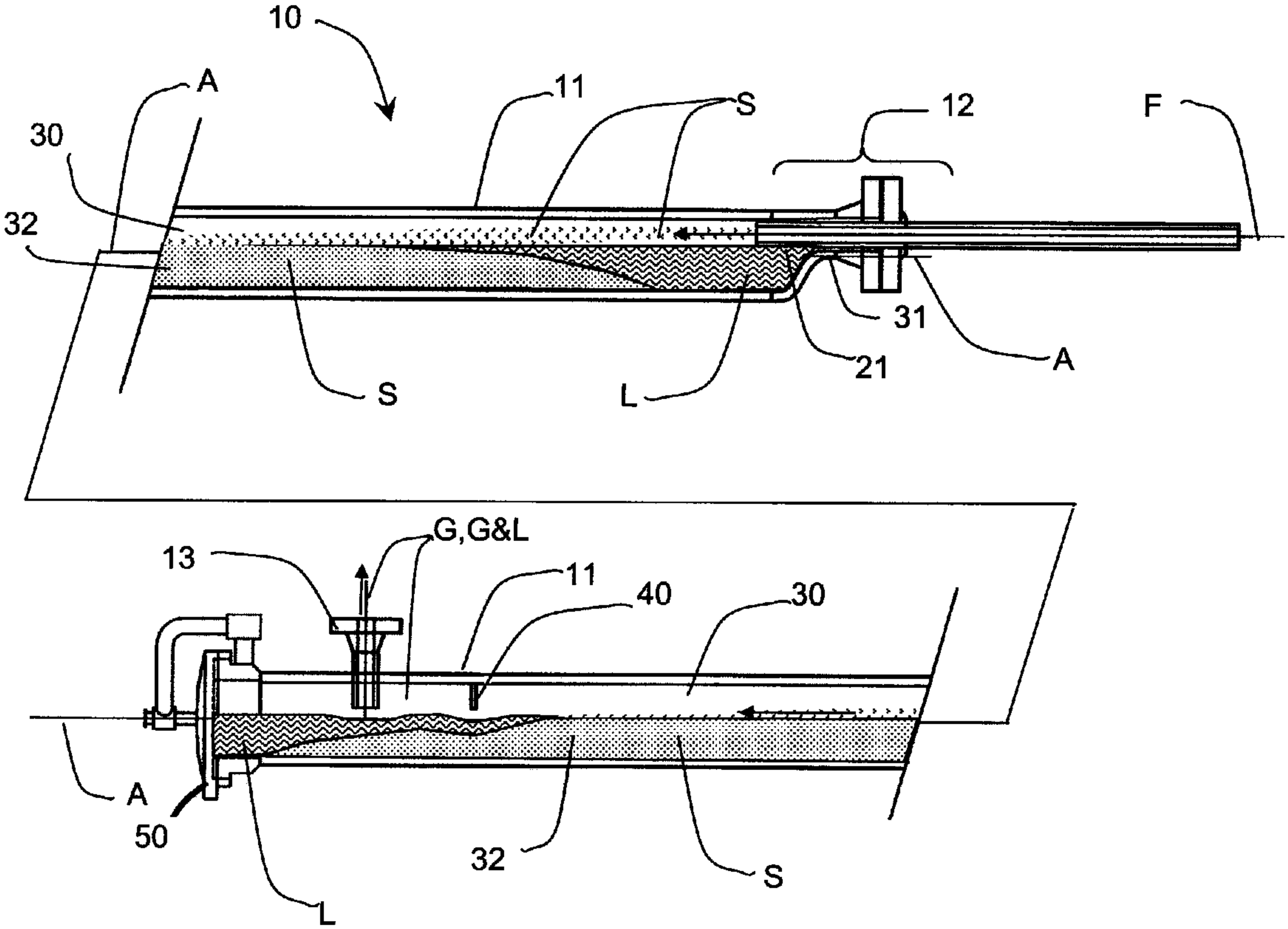
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