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FLUID SILENCING IMPROVEMENTS FOR PUMPS
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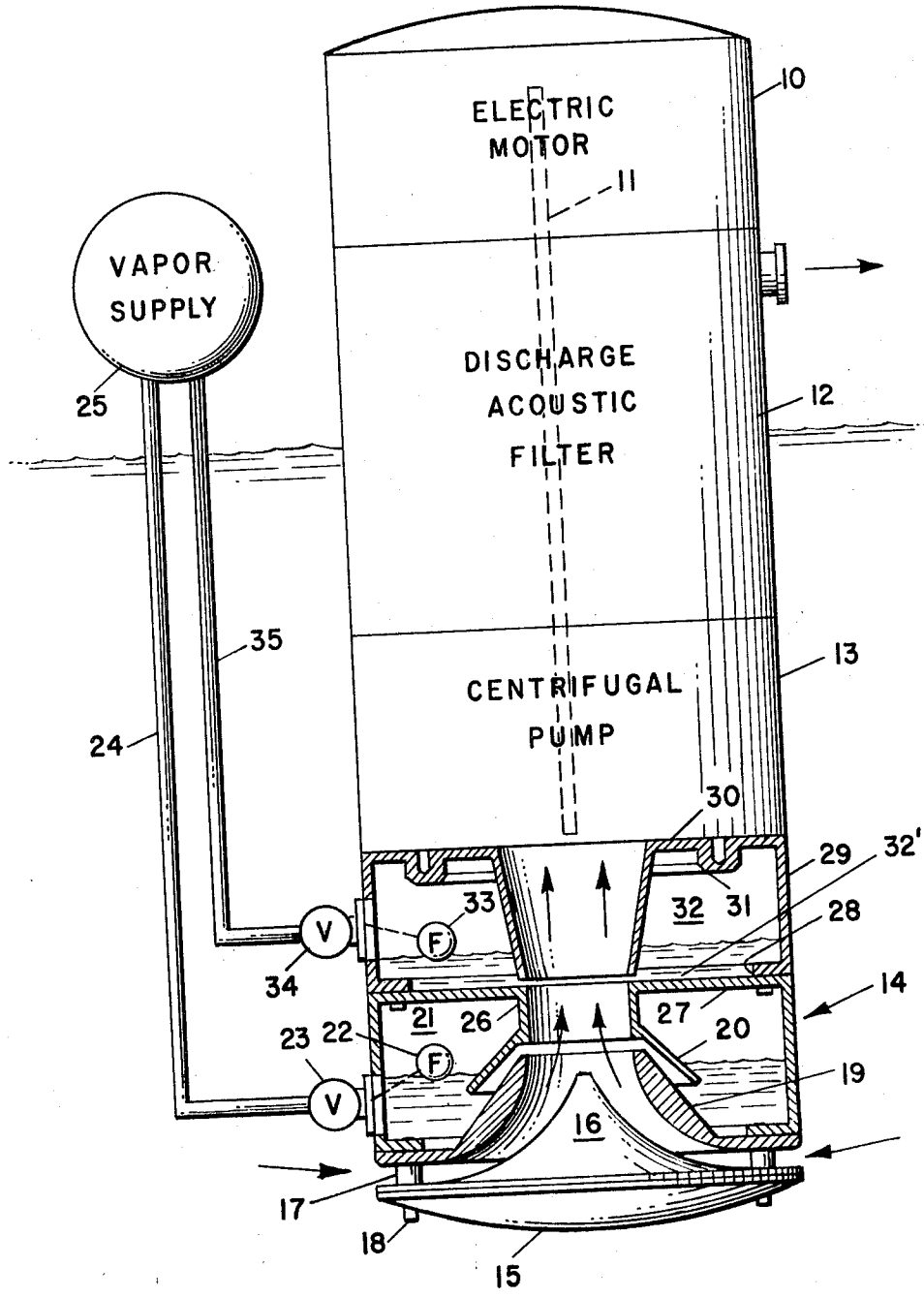

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FLUID SILENCING IMPROVEMENTS FOR PUMPS

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This invention generally relates to fluid silencing devices which may advantageously be employed for coupling to various types of pumps. More particularly, the invention relates to an improved silencing device or acoustic filter especially adapted for in-line use with the suction side of a centrifugal, turbine, or positive displacement pump to dampen out noises and pressure pulsations caused thereby, but which may also have application in any type of fluid system wherein pressure pulsations characterize the movement of the fluid such that undesirable noise or sound is produced.

Centrifugal pumps or turbine pumps, for example usually create undesirable noise levels in view of their inherent pulsating type action. As well as causing vibrations and valve chatter in the pipe line systems, interfering with pressure-sensitive meters and the like, such pulsations cause direct noises which may be bothersome to human comfort, particularly in confined areas. Furthermore, such noises may result in the detection of desirably silent apparatus.

With these thoughts in mind, it is an object of the present invention to provide an improved acoustic filter of compact construction for use in-line on the suction side of centrifugal or turbine pumps or with other equivalent apparatus.

Another object of the present invention is to provide an improved acoustic filter which is simple in its construction, embodies a limited number of movable parts, and which may readily be repaired or replaced through convenient disassembly and assembly procedures.

Still another object of the present invention is to provide an improved suction type acoustic filter, particularly of a type which may be advantageously employed with pumps and compressors and which may be readily fabricated without the need of special tooling and without the need of extra-precise tolerances being maintained.

Still another object of the present invention is to provide an improved pump and acoustic filter combination, in which the pump pulsations and the noises resulting therefrom may be substantially eliminated or sufficiently dampened such that they are not appreciably detectable, annoying to the human ear, and will not cause vibration or chatter in the pipeline systems.

These and other objects and advantages of the present invention are generally achieved by providing an acoustic filter for use on the upstream or suction side of a centrifugal pump or equivalent apparatus, including a cylindrical casing with means defining an inlet circumferential opening proximate to one end thereof.

Tubular wall means are disposed within the casing to define a passage extending axially from the other end of the casing to a point near the one end embodying the inlet opening. Other wall means are disposed within the casing to define an annular passage of gradually decreasing radius communicating from the circumferential opening to the point where the axial passage terminates within the casing.

In accordance with a feature of the present invention, an annular chamber is defined within the casing, radially exteriorly of the axial passage. The chamber communicates with the axial passage near the point that the annular passage connects with same, the axial passage forming a venturi throat section with respect to the chamber

at said point, whereby fluid is drawn from the chamber into the axial passage as it flows therethrough.

Preferably, a second volume or chamber communicates with the axial passage also near the throat section of the venturi; such second volume or chamber is in series with the first volume or chamber so that increased attenuation or dampening of the pulsations characterizing the fluid will be accomplished in a manner that will become clearer as the specification proceeds.

A better understanding of the present invention will be had by reference to the drawing, showing a partially schematic sectional view of the improved suction acoustic filtering device according to the present invention embodied in an application wherein it is coupled to a centrifugal pump. (It will be understood that the term centrifugal pump is used illustratively since the present invention is also applicable to turbine and positive displacement pumps or equivalent apparatus as heretofore mentioned.)

Referring now to the drawings, there is shown therein a group of components including an electric motor **10** having connected thereto a shaft **11** which extends axially through a discharge acoustic filter **12** into a centrifugal pump **13**. Such components are well known and thus have been shown schematically.

As heretofore mentioned, the present invention however, is primarily directed towards the suction side of the centrifugal pump **13**. Towards this end, there is provided a suction acoustic filter **14** which embodies a lower cover **15** covering the bottom end of a lower flow guide **16**. The flow guide **16** is coupled with spacers **17** and bolts **18** to an upper flow guide **19**. Thus, the spacers **17** maintain the lower flow guide **16** in a given spaced relationship to the upper flow guide **19**. With such a construction, it will be appreciated that fluid may enter circumferentially into the annular passage defined between the lower flow guide **16** and upper flow guide **19** without any appreciable turbulence.

Under normal operating conditions, the acoustic filter **14** would normally be submerged in the particular fluid being pumped through the centrifugal pump **13**. Although the fluid line is indicated as somewhat higher than the pump, it may vary and in many applications would merely be to a level extending anywhere from a point above the circumferential inlet opening to a point near the height of the centrifugal pump or at the height of the discharge acoustic filter.

A conical-shaped structure **20** co-functions with the upper surface of the upper flow guide **19** to define a passage which communicates with a volume or chamber **21** having disposed therein a float **22**. The float **22** is connected to a normally open valve **23** disposed in a line **24** leading to atmosphere or to a vapor supply **25** as indicated.

The conical-shaped structure **20** forms the end portion of a tubular member **26** or axial passage which defines a venturi throat section adjacent structure **20** and communicates at its upper end with the inlet (not shown) to the centrifugal pump **13**. The operation of the float **22** and coupled valve **23**, as well as the function of the chamber **21**, will be described further as the specification proceeds.

A second volume or chamber is defined partially by an end wall **27** closing off the first chamber **21**. Assuming the first chamber and second chamber are formed from separate structural components, a ring member **28** may be provided for studs or bolts interconnecting the units. The second annular chamber will in turn be defined end wall **30** has provided therein a stud circle **31** for coupling the acoustic filter **14** to the centrifugal pump **13**. The second chamber is indicated by the numeral **32**.

Thus, the chamber **32** includes end walls **27**, **30**, and the sidewalls **29**, as well as the upper portion of tubular member **26**. The second chamber or volume similarly

has disposed therein a float 33 designed to operate a valve 34 connected in a line 35 extending to the vapor supply 25 as heretofore indicated. The second chamber 32 communicates through the opening 32' with the passage 26.

The present inventon may perhaps be more clearly understood by a description of its operation in the present application.

As heretofore mentioned, normally the acoustic filter portion 14 of the apparatus shown will be disposed in a sump or below the fluid level such that fluid will normally be disposed in the chambers 21 and 32. As a consequence, as soon as the electric motor is started to drive the shaft 11 and the centrifugal pump 13, fluid will be drawn into the circumferential inlet opening in a manner as indicated by the arrows and thereafter up into the tubular axial passage 26. It will be appreciated that the fluid smoothly flows into the annular passage around the flow guide 16 with a gradually decreasing radius such that minimum turbulence occurs. Furthermore, by providing the cover 15, the noises caused by the centrifugal pump with its pulsing action will be cushioned since the greater noise level directed in the axial direction is blocked.

As the fluid flows into the passage 26 and the venturi section embodied therein, its increased velocity and accompanying dynamic head will tend to decrease the static pressure and in turn cause fluid from the chambers 21 and 32 to be drawn into its flow path leading to the centrifugal pump. Thus, the fluid in the chamber 21 will gradually decrease in level with the result that vapor from the vapor supply 25 will be drawn through the normally open valve 23 in the line 24 into the chamber 21; at a certain point as the fluid decreases in level, the float valve 22 will operate to close off the valve 23 and prevent further vapor from entering into the chamber 21.

With proper design considerations, the fluid level in the chamber 21 and the vapor therein will collectively provide a degree of compressibility in that chamber which will tend to dampen out most pulsations on the downstream side of the centrifugal pump. Of course, the impedance action or characteristic of the passage 26 will also be co-functioning with the chamber 21 towards this end. Similarly, the chamber 32, which also communicates through the opening 32' with the venturi throat section of the passage 26 will co-function therewith as part of a filter network to dampen out the fluid pulsations created by the centrifugal pump. The chamber 32 and its related valve 34 operate in the same manner as the chamber 21 and valve 23.

Of course, the vapor supply may actually consist of atmospheric air depending upon the fluid being pumped. If air does not mix with the particular fluid being pumped and does not tend to become significantly entrained therein or to cause other harmful effects, the tubes 24 and 35 may merely extend to a point such that they communicate with air. In the alternative, when explosive fluids are being pumped, for example, it is desirable to use a vapor supply in an enclosed vessel (which may be the vapor area above the liquid level in the tank in which the device is mounted) at a low pressure such that it will function in an equivalent manner to atmospheric air without the possibility of undesirable intermixture of fluids.

Under certain pressure conditions, the bulk modulus of elasticity of the fluid, taking into consideration the volume of the chamber, and the drop in pressure caused by the venturi, may eliminate the necessity of a separate vapor supply. Thus, under low pressure conditions, the bulk modulus of elasticity of some fluids decreases sufficiently to give the fluid itself a "spongy" characteristic, assuming a sufficient volume.

Where compact conditions require the chambers 21 and 32 to be relatively small in size, however, it is usually desirable to include the flow control valves and vapor supply as indicated.

Although a centrifugal pump has been indicated, it will be appreciated, as hereinbefore mentioned, that the suction acoustic filter may be used with other types of pumps, for example, a turbine unit, or the like. Furthermore, although it is desirable that the suction acoustic filter be mounted as close to the centrifugal pump as possible, it is possible to have it mounted at a somewhat different location on the upstream side of the centrifugal pump. However, the effectiveness is somewhat decreased.

It will be appreciated that the construction for the suction acoustic filter is particularly adaptable for and advantageously employed with the in-line series of components as indicated in the illustrative application. It will also be evident that these components may be readily dissassembled for cleaning and maintenance purposes. Thus, the present invention conforms with the objects as herein stated. Of course, many minor changes and variations may be made in the structural details without departing from the spirit and scope of the invention as set forth in the following claims.

What is claimed is:

1. An acoustic filter comprising: a cylindrical casing; means defining a circumferential inlet opening proximate one end of said casing; first tubular wall means within said casing defining a passage extending axially from the other end of said casing towards a point near said one end; second wall means within said casing defining an annular passage of gradually decreasing radius communicating from said circumferential opening to said point; and, an annular chamber within said casing defined in part by said first wall means and positioned radially exteriorly of said first wall means, said annular chamber communicating with said first wall means near said point, said first wall means forming a venturi section with respect to said chamber at said point, whereby fluid is drawn from said chamber into said first wall means, and wherein said chamber functions to absorb pulsations that may characterize said fluid.

2. An acoustic filter, according to claim 1, and float valve means communicating with a source of low pressure gas mounted in said chamber, said float valve means operating to close off said chamber to said gas supply upon the fluid level therein reaching a certain given point.

3. An acoustic filter comprising: a cylindrical casing; means defining a circumferential fluid inlet opening proximate one end of said casing; first tubular wall means within said casing defining a passage extending axially from the other end of said casing to a point near said one end, said first wall means embodying a venturi section; second wall means within said casing defining an annular passage of gradually decreasing radius communicating from said circumferential opening to said point; a first annular chamber within said casing formed radially exteriorly of said first wall means and communicating therewith near said point and with said venturi section; a second annular chamber within said casing at a different axial location therein and communicating with the venturi section of said axial passage, said venturi section of said first tubular wall means functioning to draw fluid from said annular chambers therein, whereby said chambers function as means of absorbing pulsations which may characterize the fluid flowing through said filter.

4. An acoustic filter, according to claim 2, and float valve means in both of said annular chambers, said float valve means communicating with a source of low pressure gas, said float valve means being designed to shut off communication between said chambers and said source of low pressure gas upon the fluid level therein reaching a certain point.

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