

[54] **GAS PRESSURE REDUCING
RESTRICTORS**

[75] Inventors: **Paul F. Hayner**, Lexington, Mass.;
Richard J. Brockway, Amherst,
N.H.

[73] Assignee: **Sanders Associates, Inc.**, Nashua,
N.H.

[22] Filed: **Nov. 27, 1970**

[21] Appl. No.: **93,193**

[52] U.S. Cl. **138/41, 138/44**

[51] Int. Cl. **F15d 1/02**

[58] Field of Search **138/40, 41, 44, 42**

[56] **References Cited**

UNITED STATES PATENTS

1,404,652 1/1922 Rohnow138/41 X

3,191,630 6/1965 Demyan138/42

Primary Examiner—Herbert F. Ross

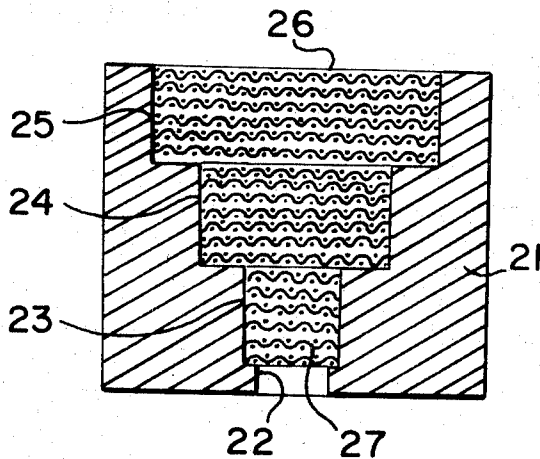
Attorney—Louis Etlinger

[57]

ABSTRACT

A restrictor for reducing the pressure of a fluid comprises essentially many layers of wire mesh in the path of fluid flow and some arrangement for defining a flow path which increases in cross sectional area either continuously or in steps in the direction of flow. Such a path may be defined, for example, by a tapered housing enclosing the layers of mesh, an interiorly stepped housing or a number of constrictions of various sizes positioned within a uniform housing.

4 Claims, 5 Drawing Figures



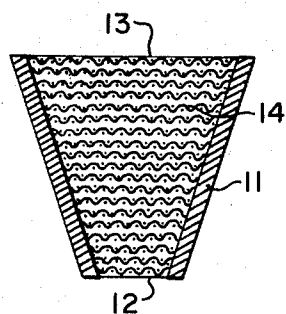


FIG. 1

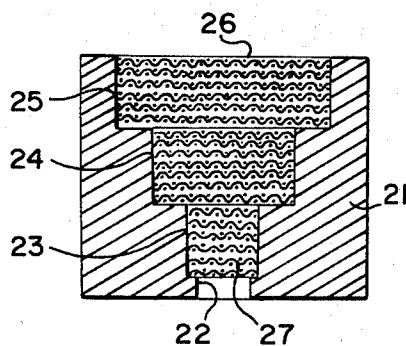


FIG. 2

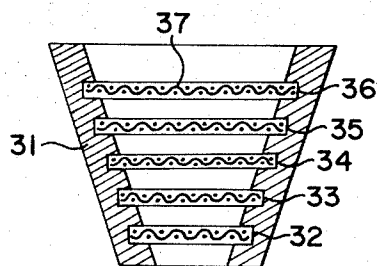


FIG. 3

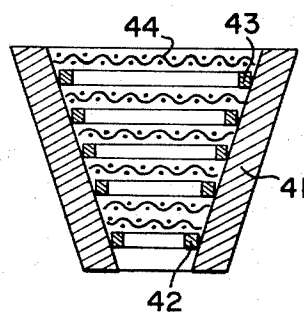


FIG. 4

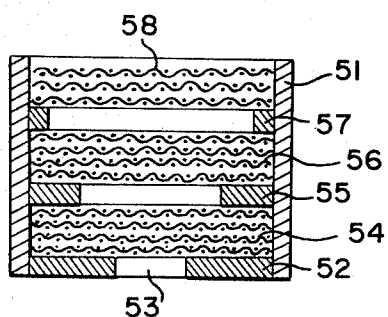


FIG. 5

INVENTORS

PAUL F. HAYNER

RICHARD J. BROCKWAY

By

W. L. Hunter

ATTORNEY

GAS PRESSURE REDUCING RESTRICTORS

FIELD OF THE INVENTION

This invention relates generally to fluid flow restrictors for reducing the pressure of a fluid and particularly to such restrictors which operate quietly.

BACKGROUND

In the art of hydraulics it is frequently necessary to reduce the pressure of a fluid. Such pressure reduction is frequently accomplished by passing the fluid through a single sharp edged orifice. Such a restrictor generates very high fluid velocities. Such high velocities cause rapid wearing of the edge of the orifice and, what is more objectionable in some cases, cause intolerably high noise levels.

Another kind of restrictor known in the past comprises a number of long, narrow passageways such as many small diameter tubes bound together or many small holes drilled in a solid block. Among other disadvantages, such restrictors are expensive to manufacture.

OBJECTS OF THE INVENTION

It is a general object of the present invention to provide an improved fluid flow restrictor.

Another object is to provide a restrictor which is quiet in operation.

Another object is to provide a restrictor which can be manufactured easily and inexpensively.

SUMMARY OF THE INVENTION

Briefly stated, a restrictor in accordance with the invention comprises a plurality of layers of crossed or woven wire mesh positioned in the path of fluid flow, together with an arrangement, such as a tapered or stepped housing, for constraining the fluid to flow through the layers along a path, the cross-sectional area of which increases, either continuously or in steps.

BRIEF DESCRIPTION OF THE DRAWING

For a clearer understanding of the invention, reference may be made to the following detailed description and the accompanying drawing, in which:

FIG. 1 is a cross section view of a preferred embodiment of the invention;

FIG. 2 is a cross section view of another embodiment of the invention;

FIG. 3 is a cross section view of another embodiment of the invention;

FIG. 4 is a cross section view of another embodiment of the invention; and

FIG. 5 is a cross section view of yet another embodiment of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring first to FIG. 1, a tapered housing 11 defines a fluid flow path, the cross sectional area of which increases in the direction of flow, that is, from the inlet 12 at the bottom to the outlet 13 at the top. The cross section of the housing 11 at right angles to that shown in FIG. 1 is preferably, although not necessarily, circular so that the housing 11 is in the shape of a hollow frustum of a cone. The interior is filled with a plurality of layers of wire mesh 14, each positioned

transversely to the direction of fluid flow, each circular in shape, and each of a slightly different size so as to fit within the housing 11. Although the mesh may be of crossed wires or small rods, it is preferred at present to use a mesh of woven wire as shown.

Each passageway in the wire mesh constitutes a small restrictor and these restrictors are, collectively, arranged in various series and parallel combinations because of the random orientation of the mesh and the stacking of one layer upon another. As the fluid flows from the inlet 12 to the outlet 13, its pressure is reduced as it flows through each passageway. However, the pressure drop through any one passageway is not sufficient to generate high velocity and noise. Any turbulence is quickly dissipated in heating the fluid. If the restrictor is used for a gaseous fluid such as steam or air, the increased cross-sectional area in the direction of flow is a very important feature because it provides an increasing volume for the gas which expands as its pressure is reduced. Such an increasing cross-sectional area is also very useful in the case of liquids because it provides for a low exit velocity which is conducive to low noise.

A restrictor such as shown in FIG. 1 may be made quite easily. For example, one may cut many pieces of wire mesh into circles of the same diameter and stack them one upon another. They may then be brazed to hold them together and the resulting stack may be machined into a frusto-conical shape. The stack may then be inserted into a housing such as the housing 11 of FIG. 1.

Referring now to FIG. 2, there is shown another embodiment of the invention in which a generally cylindrical housing 21 is formed with a plurality of axial bores 22, 23, 24, and 25. The lowermost bore 22 constitutes the inlet and the remaining bores are of increasing diameter up to the outlet 26. The bores 23, 24 and 25 are each filled with a plurality of layers of wire mesh such as the layer 27 shown in connection with bore 23. Each layer is the appropriate diameter to substantially fit its associated bore. The lowermost bore 22, constituting the inlet, is long enough axially to constitute support for the wire mesh within the bore 23. Although but three different diameter stacks of wire mesh have been shown, it is obvious that the housing 21 may be made with many more bores. Operation is substantially the same as the embodiment of FIG. 1, except that the increasing cross-sectional area from inlet 22 to outlet 26 is in steps rather than continuous.

Another embodiment of the invention is shown in FIG. 3 wherein a housing 31 is in the form of a hollow frustum of a cone. The housing is preferably formed in two parts divided along the conical axis. The two portions are formed with a plurality of concentric grooves 32-36 inclusive, each of which supports one or more layers of wire mesh such as the layer 37 shown in the groove 36. After the wire mesh is inserted the two sections of the housing are, of course, fastened together. Operation of this embodiment is also similar to that of FIG. 1 except that there is a space between the various layers of wire mesh.

Yet another embodiment of the invention is shown in FIG. 4 wherein the housing 41 is again in the form of a hollow frustum of a cone. A plurality of washers such as those shown at 42 and 43 are arranged within the hous-

ing 41 and are of such size as to engage the inner surfaces at various positions along the axis as shown. One or more layers of wire mesh, such as layer 44, is positioned above the washer 43 and also positioned between each adjacent pair of washers. Preferably the washers are close enough together so that the layers in between may all be of the same diameter. Operation of this embodiment is substantially the same as that of the previously described embodiments.

Yet another embodiment of the invention is shown in FIG. 5 wherein a generally hollow cylindrical housing 51 has a disc 52 of substantially the same diameter fastened to the bottom thereof and formed with a central bore 53 to define the inlet of the device. Above the disc 52 are a plurality of layers 54 of wire mesh. Above these layers is another disc 55 formed with a central opening larger than the opening 53. This disc may simply rest on the layers 54 or alternatively may be fastened to the interior of the housing 51. Above this disc 55 are another plurality of layers 56 of wire mesh and above them is another disc 57 with a still larger diameter opening. Above this disc is yet another layer 58 of wire mesh. Although but three separate layers of wire mesh have been shown, it is obvious that the number may be increased as desired. Operation is substantially the same as that of the previously described embodiments. It is to be noted that in each case there is defined an inlet and an outlet and a fluid path, the cross-sectional area of which increases, either continuously or in steps, in the direction of fluid flow. In each case a plurality of layers of wire mesh are inserted transverse to the direction of flow so that pressure may be reduced gradually without creating noise as explained more fully in connection with FIG. 1. Each embodiment may be used with either gaseous or liquid fluids. In each embodiment it has been assumed that the cross section at right angles to that shown is circular and while a circular cross section is preferred at present, it is not essential. Other shaped cross sections, such as square, hexagonal, etc., may be used.

Although a number of preferred embodiments have been described in considerable detail for illustrative purposes, many modifications will occur to those skilled in the art. It is therefore desired that the protection afforded by Letters Patent be limited only by the true scope of the appended claims.

What is claimed is:

1. A restrictor for reducing the pressure of a fluid, comprising
 - a housing formed to define a fluid inlet and a fluid outlet,
 - a plurality of layers of wire mesh positioned within said housing between said inlet and said outlet transversely to the direction of fluid flow therethrough, and
 - means including said housing for defining a fluid flow path from said inlet to said outlet, the cross-sectional area of which path increases in the direction of fluid flow in the region between that layer farthest upstream and that layer farthest downstream characterized in that
 - said housing is formed with a series of central bores the diameters of which are successively larger in the direction from inlet to outlet and in which said layers of wire mesh comprise a like series of groups

of layers of suitable diameters to fit into each of said bores.

2. A restrictor for reducing the pressure of a fluid, comprising
 - a housing formed to define a fluid inlet and a fluid outlet,
 - a plurality of layers of wire mesh positioned within said housing between said inlet and said outlet transversely to the direction of fluid flow therethrough, and
 - means including said housing for defining a fluid flow path from said inlet to said outlet, the cross-sectional area of which path increases in the direction of fluid flow in the region between that layer farthest upstream and that layer farthest downstream characterized in that
 - said housing has the shape of a hollow frustum of a cone and is formed with a plurality of co-axial interior annular slots and in which said layers of wire mesh comprise a like plurality of groups of layers positioned in said slots.
3. A restrictor for reducing the pressure of a fluid, comprising
 - a housing formed to define a fluid inlet and a fluid outlet
 - a plurality of layers of wire mesh positioned within said housing between said inlet and said outlet transversely to the direction of fluid flow therethrough, and
 - means including said housing for defining a fluid flow path from said inlet to said outlet, the cross-sectional area of which path increases in the direction of fluid flow in the region between that layer farthest upstream and that layer farthest downstream characterized in that
 - said housing has the shape of a hollow frustum of a cone and which includes a plurality of washers of successively larger inside and outside diameters positioned within and in engagement with the interior surface of said housing and in which said layers of wire mesh are of circular shape and of various suitable diameters to fit within said housing between said washers.
4. A restrictor for reducing the pressure of a fluid, comprising
 - a housing formed to define a fluid inlet and a fluid outlet,
 - a plurality of layers of wire mesh positioned within said housing between said inlet and said outlet transversely to the direction of fluid flow therethrough, and
 - means including said housing for defining a fluid flow path from said inlet to said outlet, the cross-sectional area of which path increases in the direction of fluid flow in the region between that layer farthest upstream and that layer farthest downstream characterized in that
 - said housing is in the form of a hollow cylinder and which includes a plurality of discs positioned within the said housing in co-axial, spaced apart relationship, each of said discs being formed with a central, circular aperture, each aperture being of a different diameter, and with discs having successively larger apertures being positioned along said flow path in the direction from inlet to outlet, and

5

6

in which said layers of wire mesh all have substan-
tially the same diameter and are positioned
between said discs.

* * * * *

5

10

15

20

25

30

35

40

45

50

55

60

65