

- [54] **VALVE WITH PERFORATED RIBBON SILENCING ELEMENT**
- [75] Inventor: **Gary D. Parola**, Moraga, Calif.
- [73] Assignee: **Grove Valve and Regulator Company**, Oakland, Calif.
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- [52] U.S. Cl.**251/127, 137/625.28, 137/625.3, 138/42, 181/37**
- [51] Int. Cl.**F16k 47/00**
- [58] Field of Search.....**251/118, 127, 205, 61; 137/625.28, 625.3, 625.37; 181/37, 66, 67; 138/41, 42, 45, 46**

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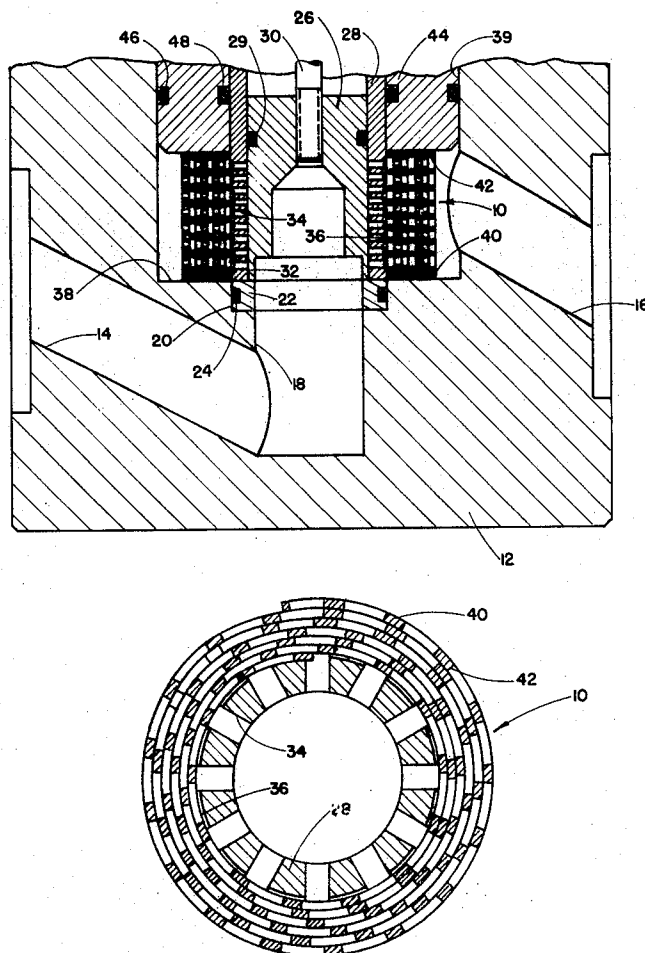
Primary Examiner—Henry T. Klinksiek
Attorney—Melvin R. Stidham

[57] ABSTRACT

The disclosure is of a silent valve in which outlet flow is in a radial direction. Intermediate the valve closure member and the outlet passage is an annular flow retarding member formed by a coiled ribbon of perforated sheet material wrapped onto itself in several layers with holes therethrough overlapping to form communicating orifices. Preferably, the ribbon is sufficiently thick that the holes form expansion chambers producing further energy loss. Holes across the width of the ribbon are uncovered progressively as the closure member moves toward open position.

9 Claims, 13 Drawing Figures

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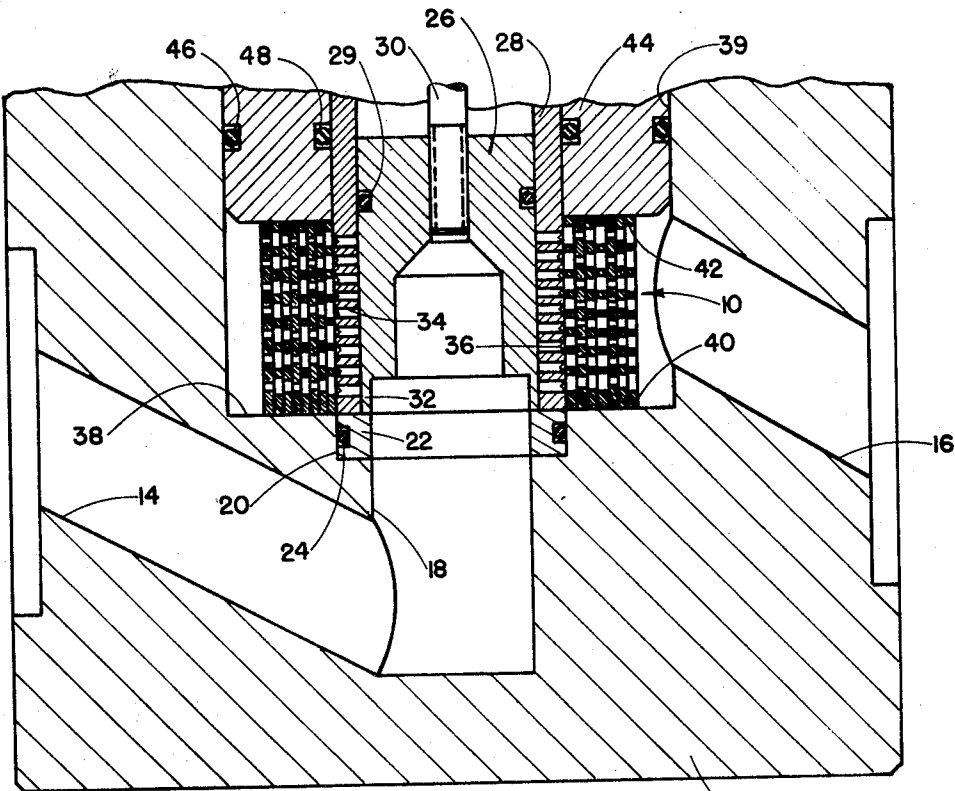


FIG-1-

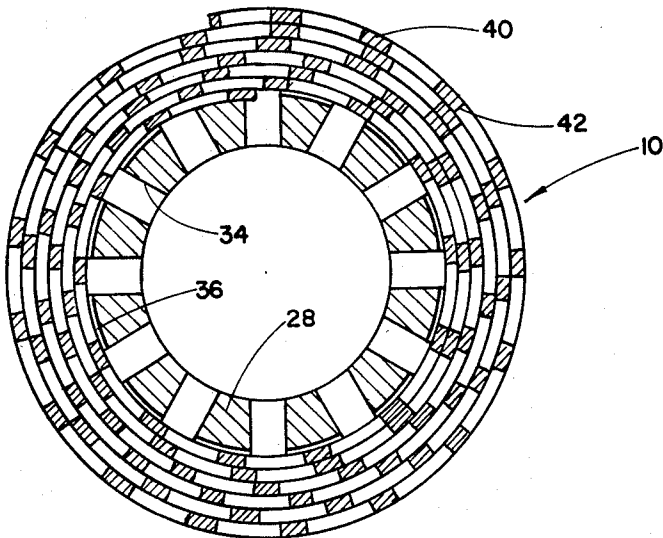
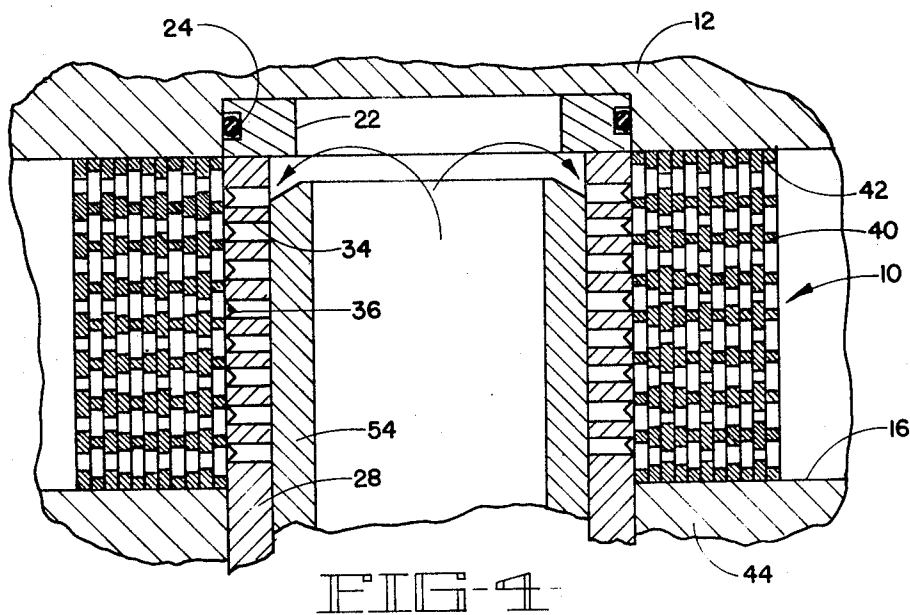
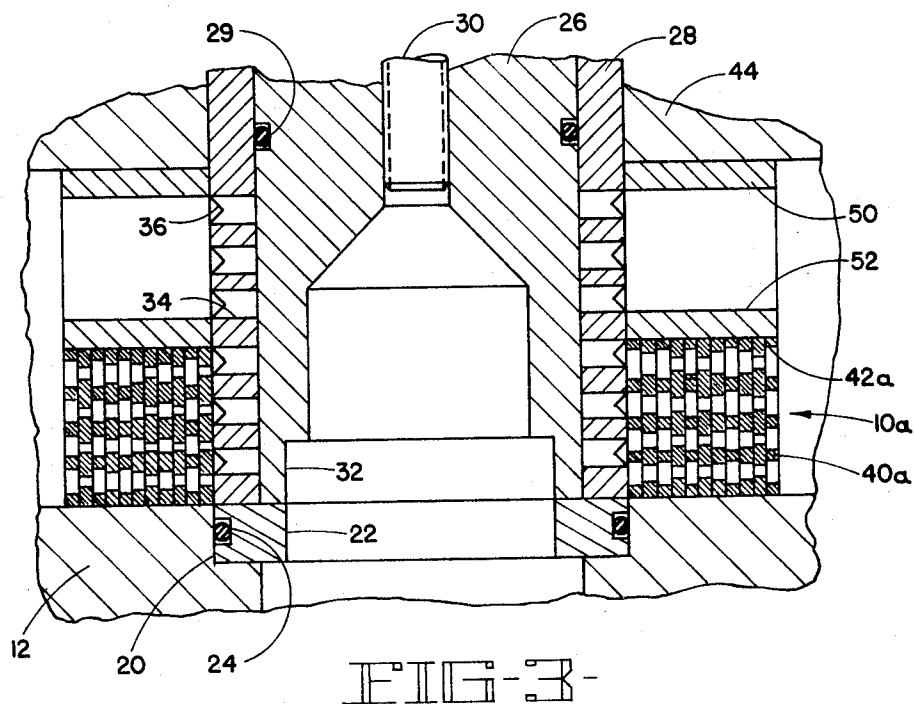
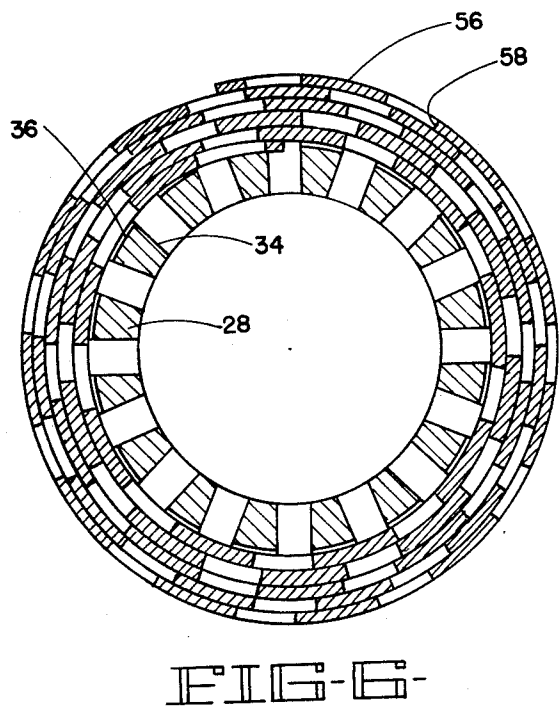
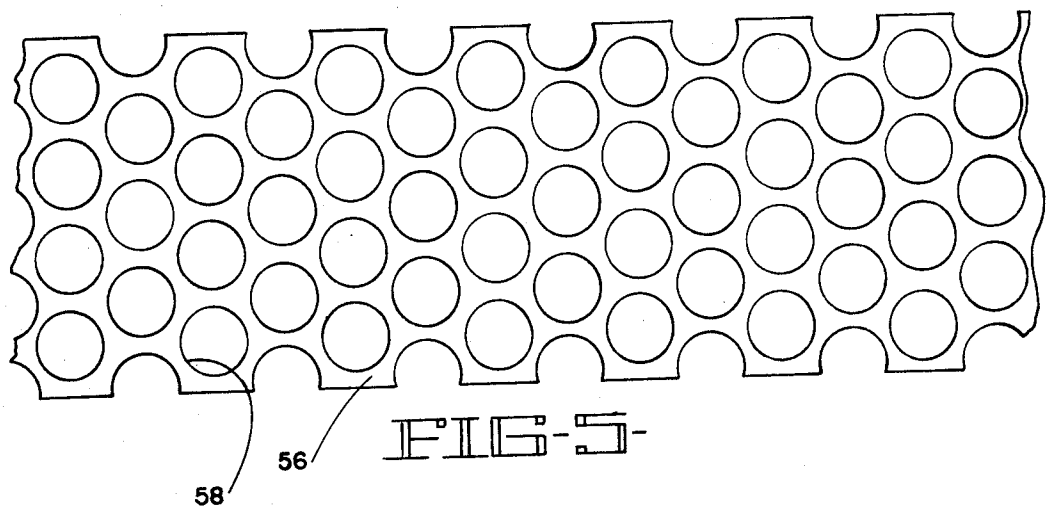


FIG-2-

INVENTOR
GARY D. PAROLA
BY *Melvin R. Stiller*
ATTORNEY



INVENTOR
GARY D. PAROLA
BY *Malvin R. Stiller*
ATTORNEY



INVENTOR
GARY D. PAROLA
BY *Melvin R. Seidha*
ATTORNEY

Patented March 27, 1973

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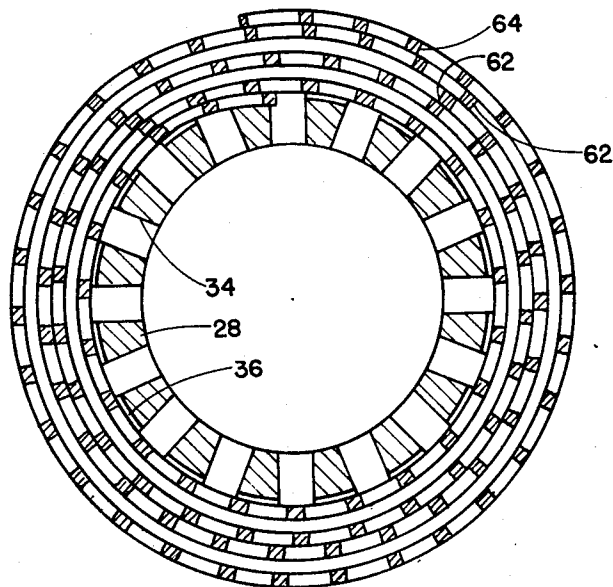
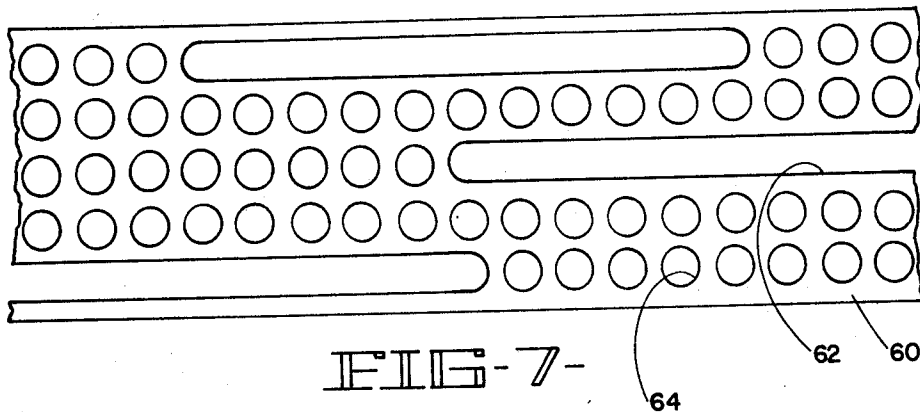
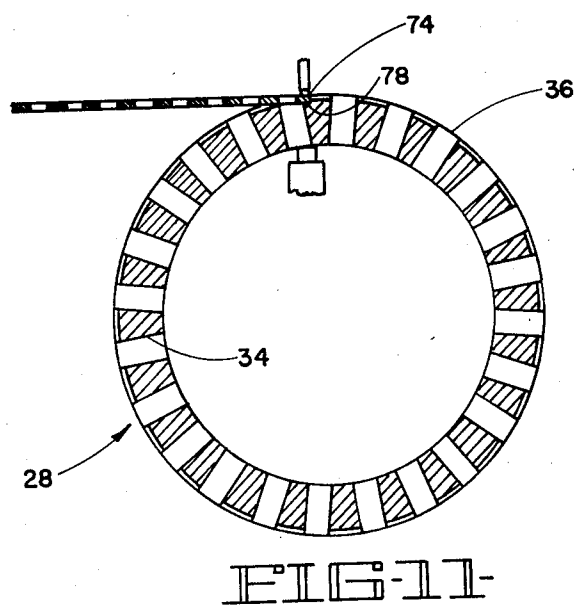
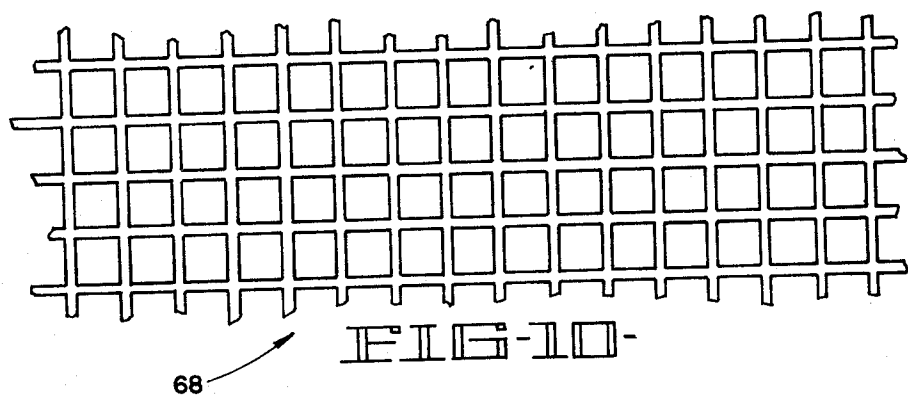
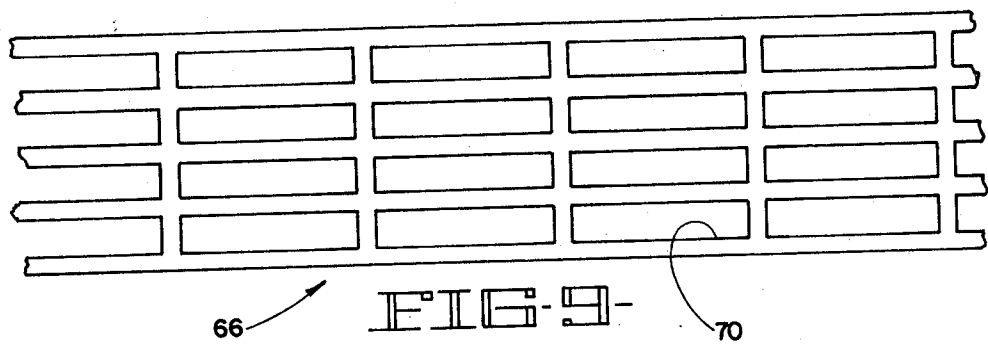
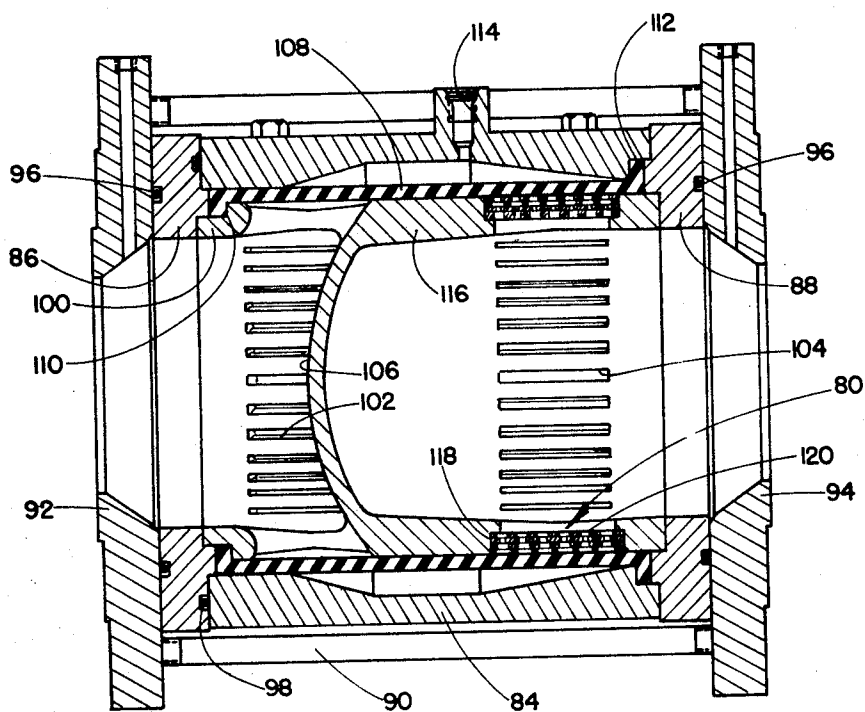


FIG-8-

INVENTOR
GARY D. PAROLA
BY *Melvin R. Sudha*
ATTORNEY



INVENTOR
GARY D. PAROLA
BY *Melvin R. Fisher*
ATTORNEY



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FIG-12-

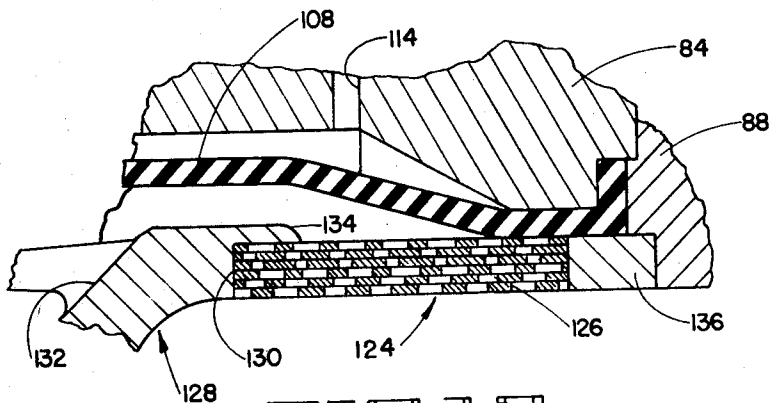


FIG-13-

INVENTOR
GARY D. PAROLA
BY *M. R. Siddha*
ATTORNEY

VALVE WITH PERFORATED RIBBON SILENCING ELEMENT

BACKGROUND OF THE INVENTION

This invention relates to a silent valve, and more particularly, to a valve provided with means for greatly retarding the velocity of fluid flow through it when the valve is opened.

Fluid flowing at high velocity, as through a valve, may generate an objectionably high noise level. This may be particularly objectionable in certain installations, as for example, in gas systems on naval vessels, such as submarines. In addition, high velocity fluid flow through the valve is likely to cause erosion, particularly if vapor or oil droplets are entrained in the fluid stream.

OBJECTS OF THE INVENTION

It is an object of this invention to provide a valve which is capable of silent operation.

It is an object of this invention to provide a valve structure with means for greatly retarding the velocity of fluid flow therethrough.

It is a further object of this invention to provide a device for retarding fluid flow, which has progressively increasing flow capacity as the valve moves toward full open position.

It is a further object of this invention to provide a flow path with a multiplicity of small expansion chambers.

It is a further object of this invention to provide a device for retarding fluid flow which has progressively increasing flow capacity along the flow path.

Other objects and advantages of this invention will become apparent from the description to follow, particularly when read in conjunction with the accompanying drawings.

BRIEF SUMMARY OF THE INVENTION

In one embodiment of this invention, a central inlet flow port is closed by an axially operated valve closure plug engaging a seat. A valve operating stem is moved in opposite directions to open and close the valve. One or more outlet passages are located radially outward of the valve closure plug in spaced relationship thereto, and interposed between the plug and the outlet passage is an annular, flow retarding member in which the plug is guided.

The flow retarding member comprises a coiled ribbon of sheet material wrapped into a plurality of layers. The ribbon has openings over its surface with the dimensions across the openings being greater than the spaces between them to insure overlapping communication. Of course, there are more openings in the outer layers by reason of the greater circumferences thereof, to provide progressively increasing flow paths from inside to outside of the coiled ribbon. If the ribbon is thick enough, each hole becomes an expansion chamber. Hence, there are energy losses through friction, turning of the flow stream expansion through progressively increasing flow paths, and repetitive expansion in the individual expansion chambers. The resultant high energy loss greatly reduces the average velocity and, hence, the sound level. The valve plug may be guided in the coiled ribbon itself, or the ribbon may be wound onto a perforated guide sleeve. In any

event, as openings across the width of the sleeve are uncovered by the valve closure plug during opening movement, flow is directed through the holes and through the sleeve in radially outward expanding flow paths.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial vertical section view of a valve embodying features of this invention;

FIG. 2 is a horizontal section view of a guide sleeve and perforated ribbon silencer comprising features of this invention;

FIGS. 3 and 4 are partial vertical section views of other valve embodiments incorporating features of this invention;

FIG. 5 is a plan view of a perforated ribbon comprising a feature of this invention;

FIG. 6 is a vertical section view of the perforated ribbon of FIG. 5 wrapped on a valve guide sleeve;

FIG. 7 is a plan view of another ribbon embodiment;

FIG. 8 is a horizontal section view of the ribbon of FIG. 7 wrapped on a guide sleeve;

FIGS. 9 and 10 are plan views of other ribbon embodiments;

FIG. 11 illustrates a method of applying perforated ribbon to a guide sleeve;

FIG. 12 is a vertical section view of another valve embodiment incorporating features of this invention; and

FIG. 13 is a partial section view of a variant of FIG. 12.

DESCRIPTION OF PREFERRED EMBODIMENT

The Embodiment of FIGS. 1 and 2

Referring now more particularly to FIGS. 1 and 2, the silencing device 10 of this invention may be incorporated in a valve body 12 having inlet and outlet passages 14 and 16 bored therein. A vertical bore 18 brings the inlet passageway into communication with a counterbore 20 in which is received a valve seat 22 of a suitable plastic, with an O-ring 24 sealing around the counterbore 20. A valve closure member 26 is slidably received in a valve guide sleeve 28 with suitable sealing means such as an O-ring 29, sealing around the closure member 26. The closure member 26 may be moved upward from the closed position in which it is shown by movement of a valve stem 30 by any suitable means (not shown). In the closed position shown, the annular end 32 of the closure member 26 firmly engages the valve seat 22 to seal off the inlet passage 14, 18.

The guide sleeve 28 has a series of flow openings 34 around its circumference and extending along a portion of its length corresponding approximately to the diameter of the outlet passage 16. Grooves 36 around the outer surface of the guide sleeve 28 connect the openings 34 for better distribution of pressure around the circumference of the sleeve 28.

Carried on the bottom 38 of a large bore 39 is the silencer 10, comprising a coil of perforated ribbon 40 with a plurality of rows of holes 42 which are large enough to insure that those in successive wraps of the ribbon coil will be in communication, thus providing a series of restricted orifices intermediate a series of expansion chambers, the sizes of which are determined by

the diameter of the holes and the thickness of the ribbon. The repetitive fluid expansion provided by the restricted orifices and the expansion chambers greatly retards flow and causes energy loss for silent operation.

A retainer sleeve 44 is secured above the ribbon by any suitable means (not shown) to hold the ribbon coil 10 in place. O-rings 46 and 48 provide a seal between the retainer ring 44 and the large bore 39 and between retainer ring and the valve guide sleeve 28.

As shown in FIG. 2, the holes 42 in the ribbon are of substantially the same size and are formed in spaced rows along the length of the ribbon. However, when viewed in any vertical section as in FIG. 1, they appear to be of varying sizes because any particular cross-section will intersect the holes at different chords thereof.

The Embodiment of FIG. 3

In FIG. 3, the silencer coil 10a is of a shorter axial length and interposed between it and the retainer ring 44 is a full flow ring 50 having large capacity openings 52 therethrough. Hence, as the valve closure 26 moves axially away from the seat 22, it progressively exposes more and more openings 34 of the guide sleeve and, hence, more and more openings 42a in the perforated ribbon 40a. Then, after the initial opening of the valve 26, with the sudden rush of high pressure fluid retarded and silenced by the perforated ribbon coil 10a, the valve may be opened to full flow capacity through the large openings 50 in the full flow ring 50.

The Embodiment of FIG. 4

In FIG. 4, the perforated ribbon silencer coil 10 is disposed in a valve body 12a similar to that shown in FIG. 3, but having a tubular valve closure 54 through which fluid flows from an inlet passageway (not shown) to the openings 34 in the valve guide sleeve 28. In this embodiment, the perforated ribbon coil 10 extends completely across the length of the outlet passage 16 as in FIG. 1.

The Embodiment of FIGS. 5 & 6

In FIGS. 5 and 6, the perforated ribbon 56 has holes 58 therein which are arranged in staggered rows. Hence, with the ribbon coiled, a hole 58 in one row may actually overlap two holes of an adjacent, staggered row so that there is even greater expansion, with correspondingly greater energy loss.

The Embodiment of FIGS. 7 and 8

In the perforated ribbon 60 of FIG. 7, there are provided a number of elongated slots 62 in at least some of the rows, in addition to the holes 64, in order to provide greater expansion and distribution of pressure around the circumference of the ribbon in various layers thereof. The slots 62 are preferably formed of lengths equal to the circumference of the wrapped ribbon at the particular layer in which it will be disposed in order to provide pressure distribution completely around the silencer coil.

The Embodiment of FIGS. 9 and 10

In FIGS. 9 and 10, there are shown other perforated ribbon configurations 66 and 68, other than those with circular holes as previously described. For example, the

ribbon may comprise a series of slots 70 of rectangular or other configurations as in FIG. 9, or may simply be formed with square holes 72 or of screening or the like as shown in FIG. 10.

The Embodiment of FIG. 11

Whatever ribbon configuration is selected, the ribbon may be applied to the guide sleeve 28 as shown in FIG. 11 by spot welding one end 74 of the ribbon 76 to a tapered groove 78 cut along the length of the guide sleeve 28 and thereafter by simply wrapping the ribbon 76 around in a plurality of layers.

The Embodiment of FIG. 12

In FIG. 12, the silencing device 80 is applied to a flexible tube type valve 82 comprising a cylindrical body tube 84 with annular closure plates 86 and 88 clamped thereto by means of studs 90 engaging through inlet and outlet flange plates 92 and 94. O-rings 96 provide a seal between the closure plates 86, 88 and the flange plates 92, 94 and another O-ring 98 is provided to seal between the inlet closure plate 86 and the body tube 84. Carried within the valve body is a core tube 100 having inlet and outlet flow slots 102 and 104 with a barrier 106 being disposed across the core 100 intermediate the two circumferential rows of slots. A flexible tube 108 having an inwardly disposed flange 110 on the inlet side and outturned flange 112 on the outlet end which seals between the body tube 84 and the outlet closure plate 88.

In operation, a pilot pressure fluid is introduced into the body tube around the flexible tube 108 through the fitting 114. Normally, the pilot pressure is sufficient to hold the flexible tube into firm engagement with the sealing surface 116 around the barrier 106. However, when this pressure is reduced, it may be overcome by upstream pressure allowing the tube to expand and enable flow around the barrier 106 and into the outlet slots 104.

In accordance with this invention, an annular recess 118 is formed around the core of a width slightly greater than the length of the outlet slots. A perforated ribbon 120 is wrapped around the recessed circumference of the core tube to cover the outlet slots and form, as in the other embodiments herein described, a coiled silencer 80 having a series of restrictive orifices and expansion chambers.

The Embodiment of FIG. 13

In accordance with FIG. 13, a silencing coil 124 with staggered holes 126 therethrough may be mounted on the core 128 with the upstream end seated in a recess 130, which is formed around the inside of the barrier 132. An overlapping portion 134 of the barrier 132 covers holes 126 adjacent the upstream end of the coil and the flexible tube 108 covers the downstream end to reduce the effective length of the silencing coil which is exposed to flow around the barrier. By reason of the staggered disposition of adjacent rows of holes the flow can, in effect, radiate outward to exit internally over the full length of the coil. Hence, there is an expanding flow capacity from the outer diameter to the inner diameter of the silencing coil 124. A stiffener ring 136 is provided at the downstream end of the core 128.

While this invention has been described in conjunction with preferred embodiments thereof, it is obvious that modifications and changes may be made by those skilled in the art, without departing from the spirit and scope of the invention.

What is claimed is:

1. A valve structure comprising:

a body having a centrally disposed inlet port,
an outlet port,

a flow passageway in said body from said inlet port
toward said outlet port,
at least a portion of said passageway extending radi-
ally,

an annular flow retarding member in said portion of
the passageway,

a valve closure member operable to expose said flow
retarding member progressively across its width
for flow therethrough,

said flow retarding member comprising:

a sleeve formed of a plurality of layers of sheet
material,

a multiplicity of through openings in each layer of
said sleeve, the dimensions across said openings
being greater than the spacing between them
whereby openings in adjacent layers overlap.

2. The valve structure defined by claim 1 wherein:

at least one of said layers is relatively thick whereby
each through opening therein functions as an ex-
pansion chamber for fluid entering the orifice
formed with an opening it overlaps.

3. The valve structure defined by claim 1 wherein:

said flow retarding sleeve is formed by a coiled rib-
bon of perforated sheet material.

4. The valve structure defined by claim 3 wherein:
said sheet material is screening.

5. The valve structure defined by claim 1 including:

a flow distributing slot in at least one of said layers
extending substantially around the circumference
thereof.

6. The valve structure defined by claim 1 wherein:

said closure member is a valve plug movable axially
to cover and uncover said inlet port, and including:
a cylindrical guide sleeve on which said flow retard-
ing sleeve is carried,

said guide sleeve having a plurality of holes
therethrough to provide flow paths from within
said guide sleeve outward through the through
openings in said flow retarding sleeve.

7. The valve structure defined by claim 1 wherein:

said flow retarding sleeve is adjacent said inlet port
and extends along less than the full stroke of valve
plug movement, and including:

means providing high capacity flow after said valve
plug moves beyond said flow retarding sleeve.

8. The valve structure defined by claim 1 wherein:

said closure member is a flexible sleeve and includ-
ing:

a barrier between said inlet and outlet ports normally
snugly embraced by said flexible sleeve, and
said flow retarding sleeve is disposed downstream of
said barrier.

9. The valve structure defined by claim 1 including:

means around one end of said barrier and blocking
flow into through openings adjacent said one end.

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