

March 26, 1968

J. F. RICHARDS

3,374,858

ACOUSTIC FILTER WITH PLURAL HELICAL PASSAGES

Filed Aug. 24, 1966

2 Sheets-Sheet 1

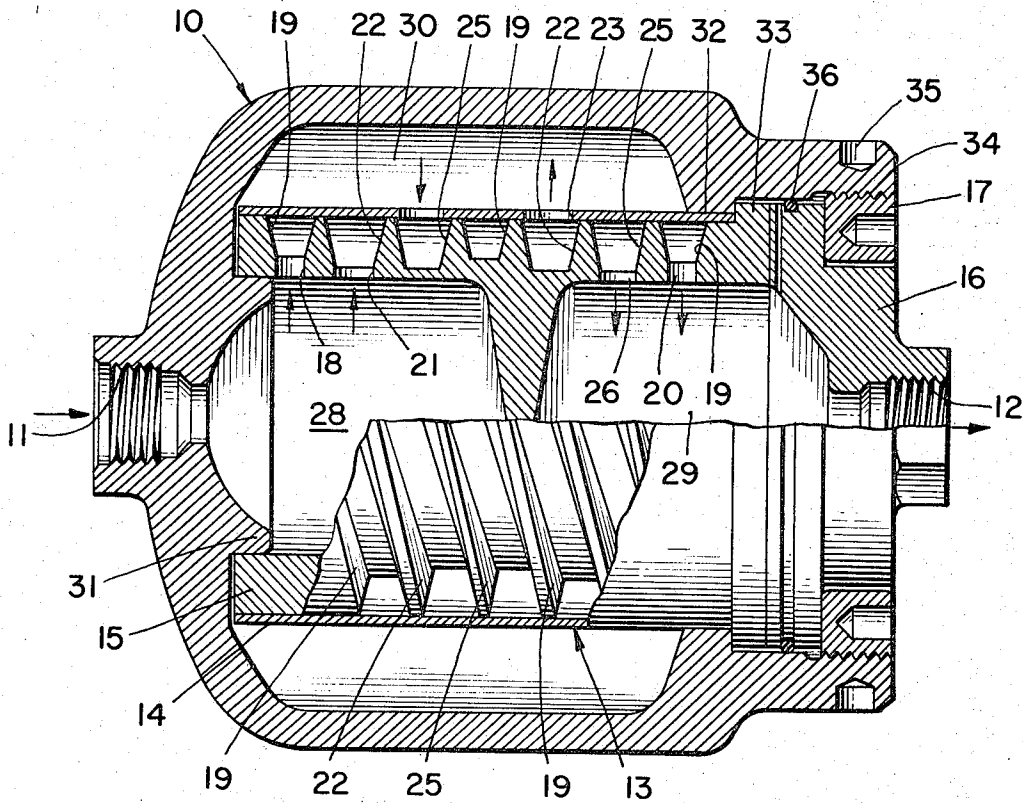


FIG. 1.

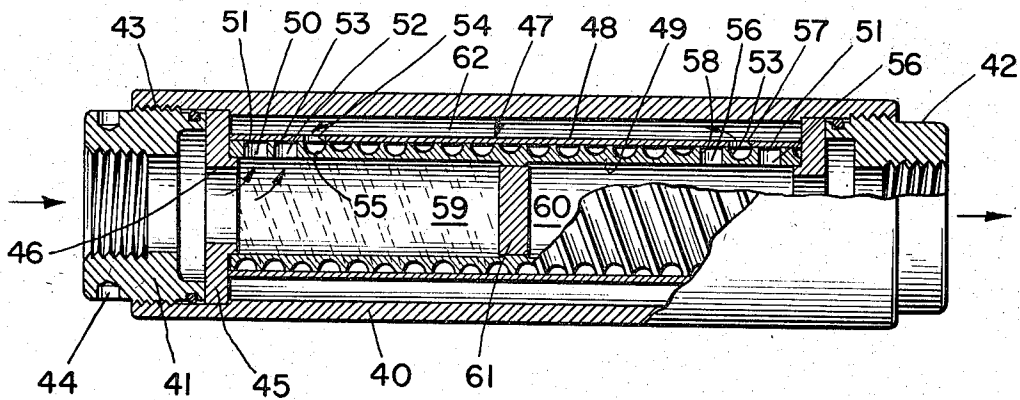


FIG. 2.

INVENTOR.
JOHN F. RICHARDS
BY

Elliott & Pastoriza
ATTORNEYS

March 26, 1968

J. F. RICHARDS

3,374,858

ACOUSTIC FILTER WITH PLURAL HELICAL PASSAGES

Filed Aug. 24, 1966

2 Sheets-Sheet 2

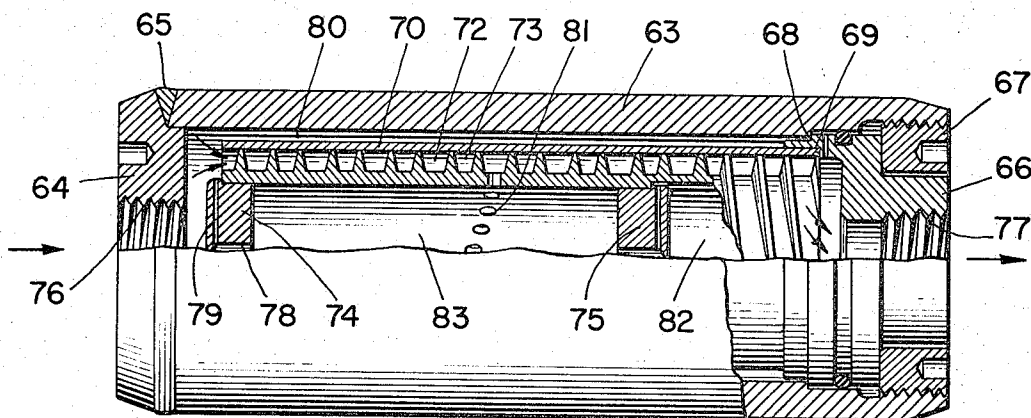


FIG. 3.

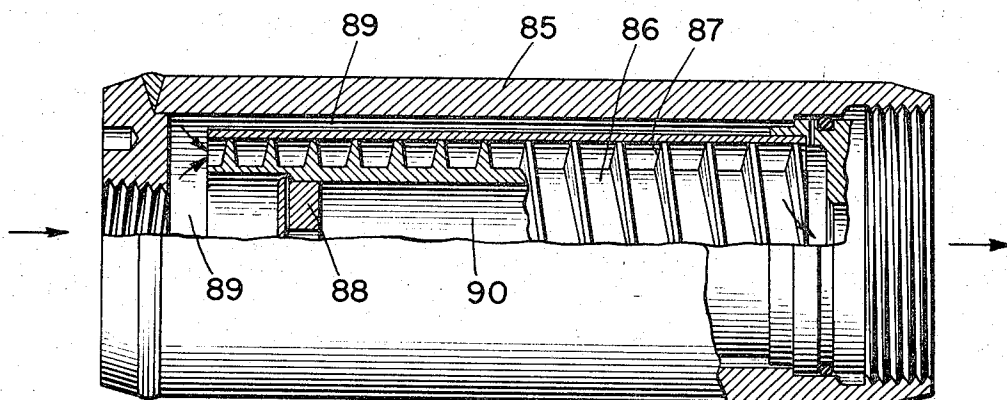


FIG. 4.

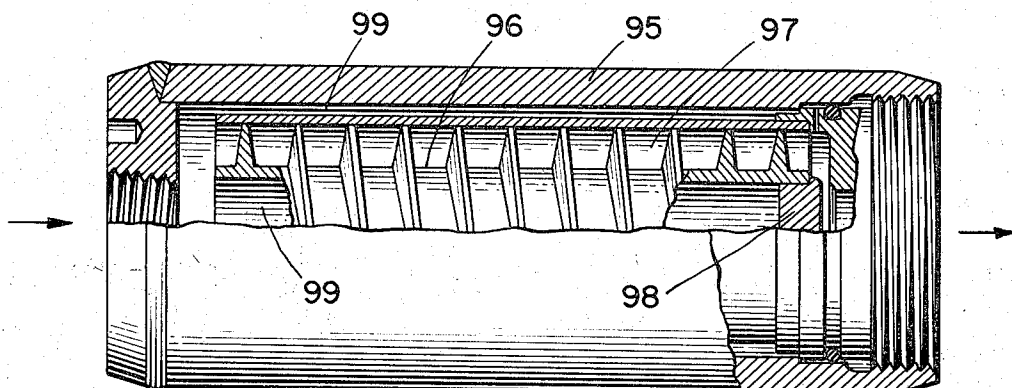


FIG. 5.

INVENTOR.

JOHN F. RICHARDS

BY

Elliott & Pastoriza
ATTORNEYS

1

3,374,858

ACOUSTIC FILTER WITH PLURAL HELICAL PASSAGES

John F. Richards, Santa Paula, Calif., assignor to
Wilhelm S. Everett, Ventura County, Calif.
Filed Aug. 24, 1966, Ser. No. 574,642
6 Claims. (Cl. 181—59)

This invention generally relates to an apparatus for alleviating pressure surges in fluid conveying systems, such apparatus being known in the art as fluid surge alleviators or acoustic filters, and more particularly concerns an improved apparatus for reducing fluid pressure surges in gas and liquid lines resulting, for example, from exerting pressure upon or receiving pressure from fluids. Such pulsations or surges and the resultant line noises and vibrations are inherently present in fluid conveying systems which embody reciprocating pumps, compressors, reciprocating engines, or equivalent apparatus.

Many conventional pulsation dampeners merely serve to cushion out the pulsations of the fluid by incorporating structures, for example, resulting in resistance to fluid flow with the consequent disadvantage of frictional and pressure losses. On the other hand, the approach of the present invention is to employ in certain embodiments a principle of cancelling out the surges through division and subsequent reuniting of the flow such that the pressure drop is relatively insignificant although a high degree of attenuation is achieved.

The apparatus of the present invention is designed to be an improvement over the fluid surge alleviator set forth in Patent No. 2,993,559, patented July 25, 1961, and entitled, "Fluid Surge Alleviator" as well as Reissue Patent No. 24,390, reissued Nov. 12, 1957, and entitled "Adjustable Surge Alleviator." The patentee in the aforementioned patent and reissue patent is the assignee in the present application. The aforementioned patent and reissue patent, although disclosing structures setting forth the general principle of parallel flow as set forth in certain of the preferred embodiments of present application, do not disclose the improved construction embodied in the present surge alleviator enabling certain functional features not heretofore attainable.

An object of the present invention is to provide an improved fluid surge alleviator or acoustic filter which is susceptible of convenient manufacturing procedures and which inherently enables greater surge alleviating and filtering capacity in a unit having smaller overall dimensions.

Another object of the present invention is to provide and improved acoustic filter which incorporates no moving parts and which may be designed so as to be susceptible of attenuating pulsations in a particular frequency range.

A further object of the present invention is to provide an improved acoustic filter which is of simple and rugged construction and which embodies a relatively maintenance free structure with no moving parts.

A still further object of the present invention is to provide an improved acoustic filter which may be economically produced and installed and which is effective to reduce line vibrations and accompanying acoustical noises.

A still further object of the present invention is to provide an acoustical filter which not only serves to silence line chatter or vibrations caused by fluid pressure pulsations, but also smooths out flow sufficiently to enable the use of pressure sensitive equipment, for example differential meters and the like.

A still further object of the present invention is to provide an acoustic filter or fluid surge alleviator which

2

incorporates a design such that it may be precisely tuned to attenuate pressure pulsations of a given frequency and yet which will have minimum overall dimensions.

A still further object of the present invention is to provide an improved acoustic filter which may be used in series with acoustic filters of the same type.

These and other objects and advantages of the present invention are generally achieved by providing an improved acoustic filter having a closed housing with a fluid inlet and fluid outlet therefrom. The housing includes first partition means defining inlet and outlet chambers. In certain embodiments, the housing may be provided with a second partition means defining an intermediate chamber separated from the inlet chamber and the outlet chamber. In one embodiment, no outlet chamber is provided.

As an important feature of the present invention, a first helical passage means communicates with the housing from the inlet chamber to the outlet chamber or from the inlet chamber to the fluid outlet if no outlet chamber is provided. A second helical passage means may be provided to communicate from the inlet chamber to the intermediate chamber if the latter is included; and a third helical passage means is, in certain embodiments, provided to communicate from the intermediate chamber to the outlet chamber.

Thus, with the construction described, and in one preferred embodiment, a part of the fluid will flow from the inlet chamber to the outlet chamber through the first helical passage means while the other portion of the fluid will flow through the second helical passage means from the inlet chamber to the intermediate chamber and thereafter through the third helical passage means from the intermediate chamber to the outlet chamber to therein reunite with the fluid flowing directly from the inlet chamber to the outlet chamber through the first helical passage means. Thus, the parallel flow referred to in the heretofore mentioned patent and reissue patent is achieved.

A better understanding of the present invention will be had by reference to the drawings, illustrating preferred embodiment, and in which:

FIGURE 1 is a view of one form of an acoustic filter according to the present invention partially shown in longitudinal section and partially in side elevation.

FIGURE 2 is a longitudinal elevation of another embodiment of the acoustic filter of the present invention, also partially broken away as indicated.

FIGURE 3 is a longitudinal elevation of another embodiment of the acoustic filter of the present invention, also partially broken away as indicated.

FIGURE 4 is a longitudinal elevation of still another embodiment of the acoustic filter of the present invention, also partially broken away as indicated; and

FIGURE 5 is also a longitudinal elevation of another embodiment of the acoustic filter of the present invention, also partially broken away as indicated.

The housing 10 is closed off at its outlet end by a cover 16 which is held in place by an annular nut 17. The cover 16 also acts to retain the manifold assembly 13 in place within the housing 10. The manifold assembly 13 embodies, as hereafter described, a plurality of helical fluid passages forming an important feature of the present invention. Thus, looking first towards the lefthand end of the manifold assembly 13 (as viewed in FIGURE 1), it is seen that there is an inlet opening 18 communicating with a helical passage 19 which spirals twice circumferentially around the inner sidewalls of the sleeve 14 before communicating with an outlet opening 20. Next to the opening 18 is an inlet opening 21 which communicates with a helical passage 22 which makes one complete turn within the sleeve 14 before communicating with an out-

3

let opening 23. A further opening 24 is provided on the exterior sidewalls of the manifold assembly 13 and communicates with a helical passage 25 which also makes one complete turn before exhausting through an opening 26.

An internal wall or partition 27 is provided as a part of the manifold assembly and partially defines an inlet chamber 28 on the lefthand side thereof and an outlet chamber 29 on the righthand side thereof. Thus, the inlet openings 18 and 21 communicate with the inlet chamber 28 while the outlet openings 20 and 26 communicate with the outlet chamber 29.

The liner 14 defines with the housing 10 an annular intermediate chamber 30. The outlet opening 23 and the inlet opening 24 communicate with the intermediate chamber 30.

For manufacturing and assembly purposes, the housing 10 is provided with an annular shoulder 31 around which the manifold assembly 13 is received. In order to further secure the manifold assembly 13 in place, the housing is also provided with another annular shoulder 32 near its outlet end 12 which co-functions with an increased diameter flange 33 provided on the manifold 15 as well as with the sleeve 14.

The nut 17, heretofore referred to, is threaded at 34 to the housing 10 and may be screwed in place by the use of pin wrench openings 35. If desired, an O-ring 36 may be provided to seal the cover 16 with the housing 10, thereby avoiding fluid leakage.

The acoustic filter shown in FIGURE 1 may be readily fabricated and assembled by initially pressing or shrink-fitting the sleeve 14 over the manifold 15 to form the manifold assembly 13. Thereafter, the manifold assembly 13 may be pressed or shrink-fitted within the housing 10 over the annular shoulder 31 and within the annular shoulder 32. Finally, the manifold assembly 13 is held in place by installing the cover 16 and tightening it with the threaded nut 17.

The operation of the improved acoustic filter, according to the present invention, although generally apparent from the foregoing description, may now be described in further detail. The acoustic filter is installed in series with a fluid line such that fluid will flow into the inlet chamber 28 through the inlet connection 11. Thereafter, a part of the fluid will enter the opening 18 and flow through the helical passage 19 directly to the outlet chamber 29. The helical passage 19, thus, may be considered a series passage. Another portion of the fluid entering the inlet chamber 28 will flow through the opening 21 into the helical passage 22 to pass into the chamber 30 through the opening 23 communicating therewith. Thereafter, fluid in the chamber 30 will pass back into helical passage 25 through opening 24 to outlet opening 26 in the outlet chamber 29. Thus, the fluid flowing through passages 22 and 25 is flowing in parallel to the series flow through passage 19. After the fluid from these various helical passages is reunited in outlet chamber 29, it will again flow into the main line through the outlet opening 12.

In contrast to the constructions set forth in the heretofore mentioned patents, the present construction employs helical flow paths or ducts which substantially lengthen the effective length of the enclosed passages to, in turn, achieve more effective dampening. From the standpoint of effective filtering action, it is desirable that the length of the fluid passages relative to the cross-sectional area thereof be maintained at a maximum and yet that the cross-sectional area of the fluid passage be of a sufficient size so as not to create undue frictional or pressure losses. The present construction enables the lengthening of the fluid passages while at the same time increasing the cross-sectional area enough to offset pressure losses such that the overall ratio may be increased with more effective results.

Furthermore, it will be noted that the helical ducts or fluid passages create a fly wheel or rotational inertia in addition to translational inertia which, it has been found,

4

is effective to increase the dampening or filtering effect of the acoustic filter.

Thus, the acoustic filter shown in FIGURE 1 is able to bring about improved results relative to the construction set forth in the cited patents, while at the same time not increasing the overall dimensions of this structure.

Another embodiment is set forth in FIGURE 2 illustrating a different construction but embodying similar principles.

In FIGURE 2, there is shown an improved acoustic filter having a housing 40 with identical end plugs 41 and 42 at either end thereof. Since the end plugs 41 and 42 are identical, a description of one will suffice for both.

The end plug 41 is provided with threads 43 to screw into the housing 40. It is further provided with tool openings 44 for tightening it in place.

The end plug 41 is designed to engage a retaining ring 45 which embodies an annular shoulder 46 over which is fitted a manifold assembly 47 similar to the manifold assembly 13 described in conjunction with FIGURE 1. A similar retaining ring co-functions with the end plug 42 at the other end of the manifold assembly 47.

The manifold assembly 47 comprises a liner 48 encircling a manifold structure 49.

The manifold assembly 47 is provided with an inlet opening 50 which communicates with a series duct or passage 51. The assembly 47 is also provided with an internal opening 52 communicating with an inlet passage 53, while the external sidewall thereof is provided with an opening 54 communicating with a passage 55.

The series passage or duct 51 communicates with an opening 56, the first parallel passage 53 communicates with an outlet opening 57; and the other parallel passage 54 communicates with an outlet opening 58.

The manifold assembly 47 is divided into an outlet chamber 59 and an outlet chamber 60 by an internal wall 61 analogous to the wall 27 of the acoustic filter of FIGURE 1. Similarly, an annular chamber 62 is provided between the manifold assembly 47 and the housing or casing 40 analogous to the intermediate chamber 30 in the acoustic filter of FIGURE 1.

The operation of the acoustic filter of FIGURE 2 is similar to that of FIGURE 1 except that the fluid passages are shown with more turns. The construction of FIGURE 2 has certain advantages from a manufacturing standpoint since the unit is identical at both ends and identical end plugs and retaining rings may be employed.

FIGURES 3, 4, and 5 relate to acoustic filters somewhat similar to the construction of FIGURE 2 although embodying differently constructed heads or end plugs. The important feature of employing the helical passages or passage instead of rectilinear tubes is still employed, however, in each of these embodiments.

Referring to FIGURE 3, there is shown an improved acoustic filter having a housing 63 with a fixed head 64 at one end which may be welded, as at 65, to the housing 63. At its other end, the housing 63 encloses a removable head or end plug 66 held in place by a threaded nut 67. The end plug 66 may be provided with shoulders 68 and 69 to cooperate, respectively, with the housing 63 and a sleeve 70. The sleeve 70 encircles a barrel-type manifold 71 which may be provided with helically grooved passages 72 and 73.

For the purpose of forming inlet and outlet chambers, as hereinafter described, the manifold 71 has fitted therein bulkhead partitions 74 and 75. The acoustic filter is provided with inlet openings 76 and 77 for connection into a fluid line in the same manner as the acoustic filters of FIGURES 1 and 2.

Each of the partitions 74 and 75 is provided with bleed holes to allow for escape of air. Thus, the partition 74 has an axially extending opening 78 communicating with a radial passage 79.

In the design of FIGURE 3, fluid passes through the inlet opening 76 into an inlet chamber 80. The inlet cham-

ber 80 is partially defined by the annular space between the sleeve 70 and the housing 63 and also includes, of course, the space immediately adjacent to the inlet opening 76 on the left hand side of the partition 78 as viewed in FIGURE 3. Thereafter, the fluid will pass through end openings shown by the arrows to communicate with passages 72 and 73 which open directly into the inlet chamber. Since these openings are not shown they may readily be visualized by viewing the manifold 71 as a bolt with two different sized threads which terminate at either end of the sleeve 70. Thus, the fluid will enter directly into the passages 72 and 73 and flow out the opposite end of the manifold 71.

The passage 72 is provided with a plurality of circumferential openings 81. The passages 72 and 73 exit into outlet chamber 82 and communicate in their intermediate portions with an intermediate chamber 83.

If desired, a plug may be inserted in one of the openings 81 so that the inlet to the chamber 83 from the passage 72 is separated from the outlet therefrom. However, under most flow conditions, the chamber 83 is completely filled so that at least theoretically it is not necessary to have the inlet to the chamber 83 through openings 81 separated from the outlet.

The fluid flowing through passage 73 will bypass the intermediate chamber 83 and flow directly into the outlet chamber 82 on the outlet side of the partition 75.

Thus, with the construction of FIGURE 3, a three chamber, three duct type of construction is employed wherein a series-parallel flow is achieved similar to that of FIGURES 1 and 2.

In FIGURE 4, a similar unit construction is employed for the acoustic filter; in consequence, a detailed description will not be given. The acoustic filter of FIGURE 4 includes a housing 85 provided with an inner manifold 86 having helical passages 87 therein. The manifold 86 is secured over a bulkhead or inner partition 88 which defines on the left hand side thereof an inlet chamber 89 and on the right hand side thereof an outlet chamber 90. The inlet chamber 89 also includes an annular portion encircling the sleeve and between the sleeve and the housing 85.

In the construction of FIGURE 4, no intermediate chamber is employed, and instead, the outlet chamber is extended towards the left hand portion of the unit. Thus, fluid enters the single helical passage 87 to pass directly towards the outlet opening and into the outlet chamber. Thus, with this construction the helical passage is adapted to a more conventional two cell type acoustic filter.

In FIGURE 5, which again employs the same mechanical construction as FIGURES 3 and 4, there is shown a housing 95 provided with a manifold 96 having a helical passage 97 therein. The manifold 96 encircles a bulkhead 98 which defines a single chamber 99 both radially within and radially outside of the manifold 96. In this construction, the helical passage has been adapted to a single cell-single duct type acoustic filter wherein an inlet chamber is provided but no outlet chamber is employed.

It will be appreciated that various constructions may be employed comprising the essential feature of the present invention of providing helical passages for the purpose of dampening out pulsations.

From the foregoing, it will be appreciated that applicant has provided an improved acoustic filter which is economical to manufacture and assemble, is rugged in its construction, maintenance-free, and is susceptible of embodying a design yielding appreciably greater acoustic filtering and surge dampening resulting in a relatively smaller overall package from a dimensional standpoint without

detracting from the other features and advantages achieved by the aforementioned patented constructions.

It will be appreciated, although five embodiments have been shown, that various modifications and changes may be made without departing from the basic spirit and scope of the invention as set forth in the following claims.

What is claimed is:

1. An improved acoustic filter for decreasing pressure pulsations in a fluid line comprising: a closed housing having an inlet port and an outlet port connected in series with said line; first partition means defining with said housing an inlet chamber and an outlet chamber communicating, respectively, with said inlet port and outlet port; second partition means defining with said housing an intermediate chamber separated from said inlet chamber and said outlet chamber; a first helical passage extending circumferentially within said housing from said inlet chamber to said outlet chamber; a second helical passage extending circumferentially within said housing from said inlet chamber to said intermediate chamber; a third helical passage extending circumferentially within said housing from said intermediate chamber to said outlet chamber.

2. An improved acoustic filter, according to claim 1, in which said inlet chamber and outlet chamber are in axial alignment.

3. An improved acoustic filter, according to claim 1, in which said intermediate chamber is annular in shape and surrounds, at least partially, said inlet chamber and said outlet chamber.

4. An improved acoustic filter for dampening out pressure surges in a fluid line, said acoustic filter comprising: a closed, generally cylindrical housing having an inlet opening at one end and an outlet opening at the other end; a first partition means disposed in said housing and extending in a radial direction, said first partition means defining with said housing an inlet chamber communicating with said inlet opening and an outlet chamber communicating with said outlet opening, said chambers being in axial alignment; second partition means of cylindrical form concentric with said housing positioned within said housing and defining therewith an annular intermediate chamber therebetween separated from said inlet and outlet chambers; a first helical passage extending circumferentially within said second partition means from said inlet chamber to said outlet chamber; a second helical passage extending circumferentially and communicating from said inlet chamber to said intermediate chamber; and a third helical passage means communicating between said intermediate chamber and said outlet chamber.

5. An acoustic filter, according to claim 4, in which an annular manifold structure is disposed within said second partition means, said annular manifold structure having a central partition wall defining with the housing and manifold structure said inlet and outlet chambers, and in which said fluid passages are formed in said annular manifold structure.

6. An acoustic filter, according to claim 4, in which said cylindrical housing is closed by threaded end plugs and in which said end plugs defining said inlet and outlet openings.

References Cited

UNITED STATES PATENTS

1,494,066 5/1924 Pasche-Huguenin -- 181—67 XR

FOREIGN PATENTS

1,200,459 6/1959 France.

242,743 11/1925 Great Britain.

ROBERT S. WARD, JR., *Primary Examiner*.