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(54) ADJUSTABLE AXIAL FLOW CAVITATION SUPPRESSING FLOW IMPEDANCE

(71) We, UNITED KINGDOM ATOMIC ENERGY AUTHORITY, London a British Authority, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to liquid flow control devices and it is concerned with the problem of cavitation, especially cavitation arising from impedances inserted in fluid flow channels in order to regulate the pressure drop in said channels.

In the context of nuclear reactors it is known to put impedances (or gags) in the coolant flow channels associated with the reactor core so that pressure drop can be regulated in the channels and thereby coolant flow can be related to heat generation in the channels. Known forms of gags have customarily been of the orifice plate type and these give rise to cavitation, especially with large flows and large pressure drops across the gags. Cavitation in a gag can set up vibration which may cause fatigue failures in components and also set up noise to interfere with measuring instruments dependant on noise detection.

According to the invention an axial flow cavitation suppressing impedance comprises

(a) an elongate tubular body member,

(b) a series of flow-defining plates inside and transverse to the axis of a the body member, the series being formed from a first and a seecond set of plates arranged so that a plate of one set alternates, as viewed in the direction of flow, with a plate of the other set wherein the first set of plates are of mesh form to define a flow which is cavitation suppressed by virtue of eddy-induced pressure drops developed in the downstream spaces and the second set of plates are apertured to define the presented flow area of the impedance.

One form of the invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a longitudinal sectional view, and

Figure 2 is a sectional view along the line II—II in Figure 1.

Referring to the drawings an adjustable axial flow cavitation suppressing flow impedance 1 is shown in which an elongate tubular body member 2 houses a set of fixed annular plates 3. The plates 3 are equally spaced apart by their thickened rims 4 which contact the inner surface of the body member 2 and are secured to the rims 4 of adjacent plates 3 by screws 5. The complete set of plates 3 is secured in the body member 2 by screws 6 engaging the end plate 3 with a shoulder 7 formed inside the body member 2.

Each plate 3 comprises a backing plate 8 having twelve equally spaced apertures 9 machined in it. The apertures 9 are conveyed by a thin woven wire mesh 10. The wire mesh 10 is secured in position by being trapped between the backing plate 8 and an insert plate 11. The plate 11 is welded into the backing plate 8 and is provided with ports matching the apertures 9 in the backing plate 8.

In front of each plate 3, with respect to the direction of liquid flow indicated by the arrow A, there is located one of a set of masking shutter plates 12 which has flow ports (not shown) matching the apertures 9 in the associated plate 3. The masking plates 12 are mounted on a rotatable shaft 13 which is axially supported within the body member 2 by end support members 14 and 15 having locating extensions 16 and 17 which extend to the inner surface of the body member 2. The shaft 13 is splined, the splines engaging with complementary lugs extending inside the central apertures in the masking plates 12. The ends of the shaft 13 are supported within the end support members 14 and 15 by thrust and journal bearings 18.

The shaft 13 is actuated by a reciprocable body 19 fitted with a rack 20 which engages a pinion 21 on the end of the shaft 13, so that linear movement of the body 19 rotates the shaft 13. The body 19 extends into a sealed housing 22 in the pressure vessel 2. The sealed housing 22 prevents leakage of any liquid along the spindle 19.

In operation, movement of the body 19 allows the masking plates 12 to occupy, in one extreme, a position in which their ports are in alignment with the wire mesh covered apertures 9 in their associated plates 3 to give the maximum presented flow area through the apertures 9 and in the other extreme a posision in which the masking plates 12 almost fully mask the wire mesh covered aperture 9 to give a minimum presented flow area. Between these extremes a variety of precisely presented flow areas are attainable. Thus the shaft 13 need only rotate over a small arc (typically 15°) to adjust the impedance from maximum to minimum.

Preselection of presented flow areas of impedances offered by the valve 1 may be made when constructing the device by varying the spacing of the plates 3 or by making the spacing non-uniform along the length of the shaft 13. In addition the mesh or weave of the wire mesh 10 can be altered and the effective area and shape of the apertures 9 and the ports in the masking plates 12 can also be varied. The number of plates 3 and associated masking plates 12 may also be altered. The downstream spaces between meshes 10 are such as to allow, in the apertures 9 and flow ports of the plates 12 the development of eddy-induced pressure drops.

The flow impedance 1 described above is suitable for use in liquid metal flows and in this context is of value to provide gags in the fuel channels associated with the core of a nuclear reactor operating in the fast neutron region and cooled by liquid sodium.

WHAT WE CLAIM IS:—

1. An axial flow cavitation suppressing impedance comprising:

(a) an elongate tubular body member,

(b) a series of flow-defining plates inside and transverse to the axis of the body member, the series being formed from a first and a second set of plates arranged so that a plate of one set alternates, as viewed in the direction of flow, with a plate of the other set and a downstream space exists between plates of the first set wherein the first set of plates are of mesh form to define a flow which is cavitation suppressed by virtue of eddy-induced pressure drops developed in the downstream spaces and the second set of plates are apertured to define the presented flow area of the impedance.

2. A flow impedance as claimed in claim 1 to which the mesh is a woven wire mesh.

3. A flow impedance as claimed in claim 1 wherein the mesh is contained in windows and the plates of the second set act as masking shutters upstream of the windows, which second set is adjustable in rotary position so that the impedance can be adjusted in use.

4. An axial flow cavitation suppressing impedance substantially as hereinbefore described with reference to the accompanying drawings.

5. An axial flow cavitation suppressing flow impedance as claimed in any preceding claim when provided a gag to a fuel channel in the core of a nuclear reactor.

6. An adjustable cavitation suppressing flow impedance as claimed in any of claims 1—4 when providing a gag in a fuel channel in the core of a nuclear reactor operating in the fast neutron region and cooled by liquid sodium.

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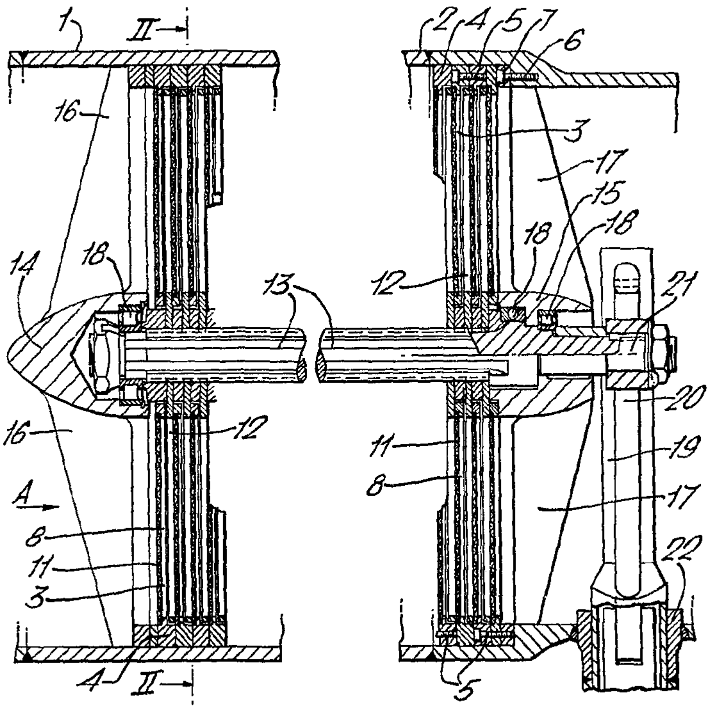
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

FIG. 1.



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Sheet 2

FIG.2.