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DASHPOT WITH AIR SEPARATOR

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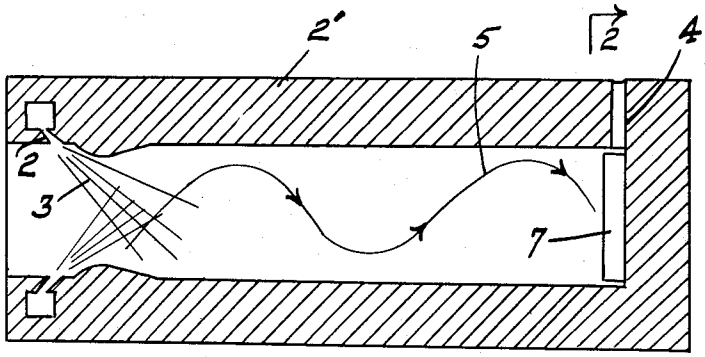

FIG. 1

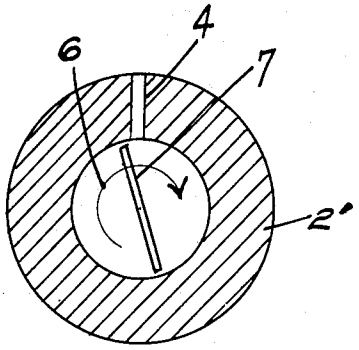

FIG. 2

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DASHPOT WITH AIR SEPARATOR

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4 Claims. (Cl. 188—87)

This invention relates to a dashpot having a cylinder open at one end only to receive a plunger or ram whose movement is to be retarded and finally stopped and which is maintained full of liquid, with the outer portion thereof in a state of spin or circumferential rotation by a stream of jets of liquid, preferably water, projected into the open end of the cylinder, as disclosed in the patent to Waterston No. 2,663,385.

In the operation of a dashpot as described in the said specification, a certain amount of air is entrained or dissolved in the liquid spiraling within the cylinder. This is particularly so during the initial starting up, but even after the dashpot has been in operation for sometime there may be a certain amount of air entrained by the jets of liquid as they enter the cylinder. The presence of such air in the liquid within the cylinder is objectionable since it is more compressible than the liquid introduced into the cylinder to damp or retard the movement of the plunger, and, hence, acts as a resilient cushion which renders the dashpot less effective for its intended purpose.

It also has been discovered that the liquid spiraling along the cylinder walls towards the closed end of the cylinder, on reaching that end, has its direction of movement longitudinally of the cylinder reversed, and it returns towards the open end of the cylinder in the form of a reversely-spiraling core which forms a vortex at the open end of the cylinder, so that when the plunger enters the cylinder the air in the vortical space is forced into the cylinder and acts as a resilient cushion, in the manner described above.

In accordance with the present invention, means are provided whereby (1) air which may be entrained or dissolved in the liquid, on reaching the closed end of the cylinder, is caused to be separated from the liquid and vented from the cylinder, and (2) the circumferential velocity of the liquid, on reaching the closed end of the cylinder, is converted to pressure energy which causes the liquid to flow axially towards the center of the cylinder and thence towards the open end of the cylinder as an axially-flowing core, rather than as a spirally-flowing core. The straight axial flow of the core portion towards the open end of the cylinder prevents any vortex forming at the open end of the cylinder, and also produces a certain amount of kinetic energy directed in a direction in opposition to the movement of the plunger into the cylinder. Thus, the damping or retarding action of the dashpot is materially improved.

More particularly, the above objectives are obtained by baffling means at the closed end of the cylinder, preferably a vane extending from the closed end into the path of the circumferentially-moving liquid, which breaks up the circumferential flow of the liquid and causes it to flow axially towards the open end of the cylinder; and by providing a vent for air at the closed end of the cylinder. The vane preferably is so positioned with respect to the vent that one end is only slightly in advance or upstream

therefrom with respect to the circumferentially-moving liquid. The baffling effect of the vane causes eddy currents to be formed in the moving stream of liquid on the downstream side of the vane. Such eddy currents cause dissolved and entrained air to be thrown out of the liquid, and when the vane is positioned with one end just upstream from the vent opening, some of the air thrown out of the liquid immediately passes from the cylinder through the vent opening before it is again entrained, the core of liquid within the cylinder will still contain bubbles of entrained air which linger in the cylinder. The presence of these air bubbles can be explained by the fact that liquid projected into the cylinder is spinning circumferentially with considerable velocity and thus has a high kinetic energy while its pressure is low as previously indicated, the projected liquid, by virtue of centrifugal action, travels along the inner wall of the cylinder to the closed end of the cylinder, comes against the closed end of the cylinder, is directed inwards towards the axis of the cylinder, and, still spinning or rotating, returns axially, rather than spirally, of the cylinder, towards the open end of the latter. Since the projected liquid meets little resistance in its passage, its kinetic energy remains high while its pressure is comparatively low, so that, while air brought to the vicinity of the vent hole will escape from the vent hole, air reaching the inner core depends on pressure for its ejection, and lingers in the core since the pressure gradient of the liquid in the core is insufficient to expel the air towards the open end of the cylinder. A portion of this air gradually rises in the core portion of the liquid and passes into the outer circumferentially-spiraling layer of the liquid which again carries it to the closed end of the cylinder, where more of it passes out through the vent opening. Thus, there is a constant discharge of entrained or dissolved air from the cylinder through the vent opening.

A practical embodiment of the invention is illustrated diagrammatically in the accompanying drawings in which Fig. 1 is a longitudinal section of the cylinder and Fig. 2 is a cross section through the cylinder on the plane 2—2.

In the drawings, 2′ denotes the cylinder, 2 denotes nozzles at the open end of the cylinder directing jets 3 of fluid into the cylinder to maintain the cylinder full of liquid with the outer portion thereof in a state of circumferential rotation or spin, and 4 denotes a vent hole at the closed end of the cylinder. The line 5 indicates the helical path pursued by the outer circumferential portion of the liquid travelling inwards of the cylinder, towards its closed end, and the arrow 6 indicates the direction of spin or rotation of that portion of the liquid, 7 denotes a radial vane located at the closed end of the cylinder and so orientated that one end of it is at a small angle in advance, i. e., upstream, of the vent hole 4 in relation to the direction of spin or rotation of the liquid.

In practice, fluid having a high kinetic energy and a low pressure moving towards the closed end of the cylinder 1 comes against the vane 7, with the result that eddy currents are set up in the liquid at the downstream side of the vane. Such eddy currents cause some of the entrained and dissolved air in the liquid to be separated therefrom. The air so separated rises and passes from the cylinder through the vent opening 4. The baffling effect of the vane reduces the circumferential velocity of the rotating liquid and converts such velocity, or kinetic energy, into pressure energy. This results in the circumferentially-circulating outer portion of the liquid being forced radially inwardly at the closed end of the cylinder and then directed back towards the open end as a core portion flowing axially, rather than spirally. Consequently, there is no tendency for a vortex to be formed at the open end of the cylinder. Also, the axial portion of the liquid flowing towards the open end of the cylinder

has a certain kinetic energy which, on striking the leading end of the plunger, is converted to pressure energy. This pressure energy is exerted against the plunger and, thus, further increases the damping or retarding effect of the liquid in the cylinder. Since the core portion of the liquid flowing towards the open end of the cylinder is of relatively low pressure, some of the air therein will rise and pass into the circumferentially-spiraling outer layer flowing towards the closed end of the cylinder and thus returned to that end for discharge through the vent opening **4**. The remaining air in the core portion eventually passes out of the cylinder at its open end along with the core portion of the fluid.

What is claimed is:

1. A dashpot including a cylinder open at one end and closed at its other end, said cylinder being adapted to receive a plunger whose movement is to be retarded, said cylinder having a vent opening at its closed end and at least one tangential, liquid-injecting nozzle at its open end, whereby liquid introduced into the cylinder is caused to move spirally adjacent the cylinder wall towards

the closed end thereof, and baffling means at the closed end of the cylinder for impeding the circumferential movement of the liquid at that end of the cylinder.

2. A dashpot as defined in claim 1 in which the baffling means is a vane extending from the closed end of the cylinder into the cylinder space.

3. A dashpot as defined in claim 2 in which one end of the vane is positioned slightly beyond or downstream of the vent opening with respect to the direction of the spiraling motion of the liquid in the cylinder.

4. A dashpot as defined in claim 1 in which the vane extends substantially in a radial direction.

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