Feb. 11, 1958 W. SHIRLEY 2,823,075

DISTRIBUTORS FOR FLUIDS

Filed Feb. 23, 1954 2 Sheets-Sheet 1

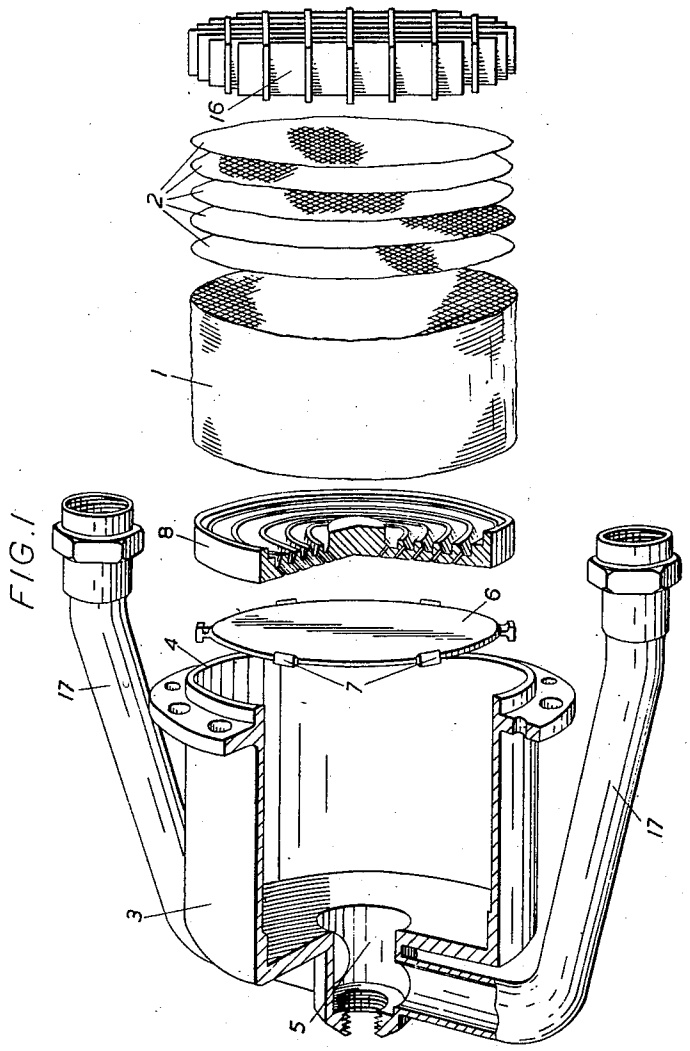


FIG. 1

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Feb. 11, 1958 W. SHIRLEY 2,823,075

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Filed Feb. 23, 1954 2 Sheets-Sheet 2

FIG. 2.

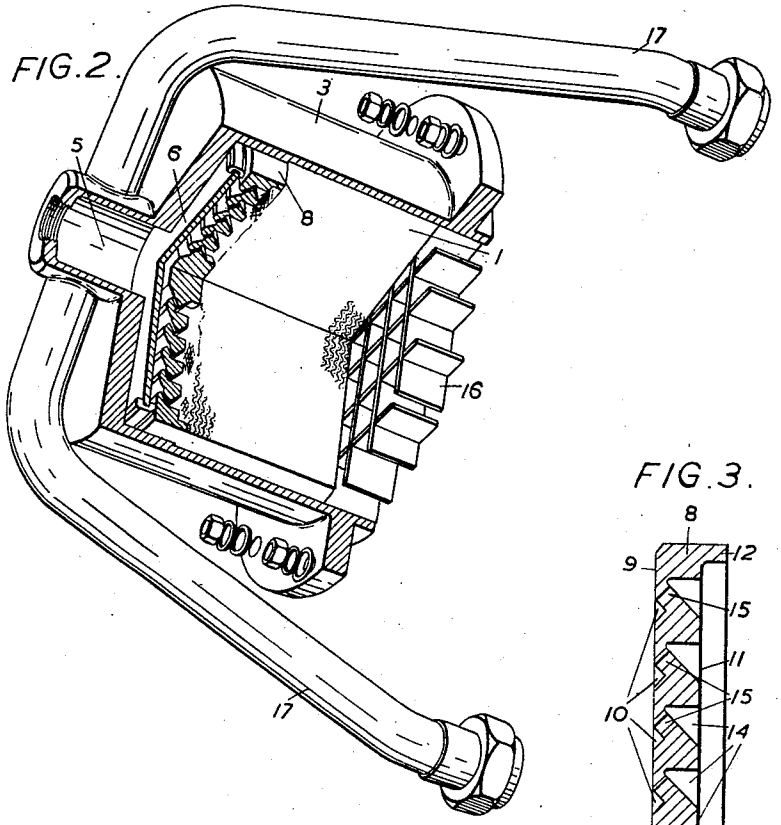
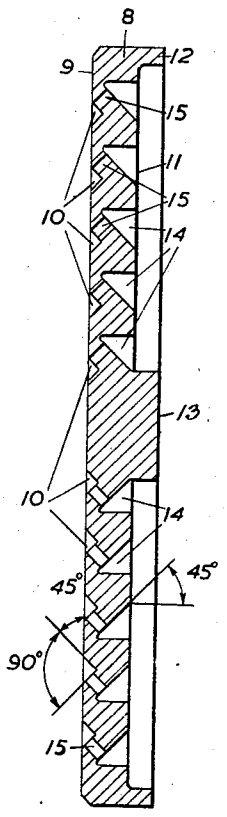


FIG. 3.



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DISTRIBUTORS FOR FLUIDS

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Claims priority, application Great Britain February 27, 1953

6 Claims. (Cl. 299—121)

This invention relates to distributors for distributing fluids substantially evenly over the cross-sectional area of a passage or path, or over some element, for example for the purposes of chemical treatment of the fluid, and is particularly concerned with distributors of the perforated or slotted plate type, including one or more passages for passing fluid from the upstream to the downstream side of the plate.

It is an object of the invention to provide an improved distributor of the kind referred to which will be simple to manufacture and will provide substantially even distribution of the fluid over the required cross-sectional area within a minimum distance in the direction of flow.

According to the present invention a distributor for distributing a fluid stream comprises a distributor plate formed on the downstream side with one or more grooves, and having a number of passages leading from the upstream side of the plate into the groove, or grooves, and each arranged to direct a stream of fluid against one of the sides of the respective groove.

The passages are conveniently in the form of small bore drillings spaced along the length of the groove or grooves.

The groove or grooves are preferably formed with side walls inclined to one another, and diverging in a downstream direction.

Moreover the side walls of the groove or grooves are preferably inclined to one another at an angle of approximately 45°, while the passages are inclined to a perpendicular to the plane of the plate, one side wall of each groove being approximately perpendicular to the plane of the plate, thus forming an impingement surface for the stream of fluid issuing from each passage.

According to another preferred feature of the invention the passages are inclined at an angle of approximately 45° to the side walls of the groove or grooves which constitute the impingement surfaces, and open into and are perpendicular to the opposite side walls of the groove or grooves.

The passages may lead from the sides of grooves formed in the upstream side of the plate member, which sides are normal to the axes of the passages.

In a preferred construction the distributor includes two or more grooves on the downstream side of the plate member, arranged substantially parallel to or concentric with one another, the distance between the grooves in a direction parallel to the plane of the plate member being such in relation to the width of the grooves and the angle of divergence of the fluid issuing from the grooves, that the fluid from one groove mingles with fluid issuing from the adjacent groove or grooves closely adjacent to the downstream side of the plate member.

According to another preferred feature of the invention the distributor includes a baffle plate or the equivalent on the upstream side of the distributor plate, and spaced therefrom, and arranged to direct the flow of fluid generally across the surface of the upstream side of the plate, and the passages are formed with a component of direction in a direction opposite to the direction of fluid flow at the entrance to each passage.

The invention is particularly applicable to treatment units for the chemical treatment of fluids, for example to catalytic steam generating units for rocket motors. Thus according to another aspect of the invention a treatment unit for treating a fluid stream comprises a casing having inlet and outlet openings at opposite ends thereof, a treatment bed (preferably of the catalytic type) housed in the casing, and a distributor plate as set forth, mounted in the casing upstream of the treatment bed.

The invention may be performed in various different ways, but one specific embodiment, as applied to a distributor plate for use in conjunction with a catalytic steam generating bed in a rocket motor, will now be described by way of example with reference to the accompanying drawings, in which

Figure 1 is an exploded perspective view partly broken away of the complete steam generating bed,

Figure 2 is a perspective view partly broken away of the assembled bed, and

Figure 3 is an enlarged sectional view of the distributor plate.

The bulk and weight of such a steam generating bed must be as low as possible, while the capacity of the bed to provide efficient decomposition of hydrogen peroxide at a high rate of flow must be as large as possible. It is therefore desirable that the distributor should be capable of providing a substantially even distribution of fluid over the cross sectional area of the bed, and that this even distribution should occur within a minimum distance downstream of the distributor, to avoid wastage of space.

The catalytic bed **1** which comprises a number of circular gauze discs **2**, coated with a catalyst, is housed in a cylindrical casing **3** having a large opening **4** at one end, constituting the discharge passage for the products of decomposition, and a smaller inlet opening **5** in the opposite end wall. A baffle plate **6** is arranged in the casing closely downstream of the inlet opening **5**, this plate extending substantially across the whole cross-sectional area of the casing, but having a number of lugs **7** circumferentially spaced round its edge, forming peripheral slots to permit the flow of fluid around the edge of the plate.

A distributor plate **8** is arranged parallel to but separated by a small distance from the baffle plate **6** (and is thus downstream of the baffle plate, and upstream of the catalytic bed **1**), and comprises a single unitary circular plate fitting closely within the casing **3**. The upstream side **9** of the distributor plate (the left hand side of Figure 3) is machined generally flat, but is provided with a series of five concentric grooves **10** of V-cross section. The sides of these grooves are inclined to one another at 90°, both sides being at 45° to the plane of the plate, and the depth of the grooves is approximately $\frac{1}{10}$", while the radial distance between the grooves is approximately $\frac{1}{2}$".

The reverse (downstream) side **11** of the distributor plate **8** is also machined generally flat, with the exception of a thin axial flange **12** at the periphery, and a central boss **13**, which project about 0.19" from the face of the plate. The thickness of the plate between the two faces **9** and **11** is about 0.36". The flat portion of the downstream face **11** is also provided with a series of five concentric grooves **14**, the side walls of each groove when viewed in cross section being inclined to one another at an angle of 45°. The outer side wall of each groove **14** is perpendicular to the plane of the plate, while the inner side wall is inclined at 45° thereto, and the depth of the grooves is approximately 0.26". The outer side wall of each groove **14** on the downstream face **11** of the plate is at a slightly greater radial distance from the centre of the plate than the outer side wall of the corresponding groove **10** on the upstream side of the plate.

A number of small bore drillings **15** are provided between each groove **10** in the upstream side of the plate and the corresponding groove **14** on the downstream side. Each drilling is inclined at an angle of 45° to the plane of the plate, and is perpendicular to the outer side wall of the respective groove **10** in the upstream side of the plate, and emereges into the corresponding groove **14** on the downstream side of the plate at a point spaced a short distance from the base of that groove. The drillings **15** are thus perpendicular to the inclined inner side walls of the grooves **14** on the downstream side of the plate and are inclined at an angle of 45° to the outer side walls of these grooves which are perpendicular to the plane of the plate.

The number and spacing of the drillings may vary, but in one example where the diameters of the concentric grooves **10** in the upstream face **9** of the plate **8** are approximately 1", 2", 3", 4" and 5" respectively, 12, 20, 30, 40 and 60, drillings are provided in the respective grooves. The diameter of the drillings in this case may be 0.073".

The radial spacing between the grooves **14** on the downstream side of the plate is ½", as with the grooves on the upstream side, and the shape of the grooves is such that the projected surface of each side wall of these grooves **14** intersects the projected surface of the adjacent side wall of the adjacent groove **14** at a distance of approximately 0.19" downstream of the downstream face **11** of the plate, that is to say in the plane of the rim of the flange **12**.

Thus it will be seen that with this construction of distributor plate, the fluid, which after passing around the edges of the baffle plate **6**, is initially travelling radially inwards along the upstream side **9** of the distributor plate **8**, flows through the drillings **15** in a direction which is inclined radially outwards, and impinges on the outer side wall of the grooves **14** in the downstream face of the plate. The resultant "spray" of fluid is of widely divergent form, and is intermingled with the "spray" leaving adjacent grooves, at a short distance downstream of the plate.

The catalytic bed **1** lies directly downstream of the distributor plate **8**, making contact with the rim of the flange **12** and the boss **13** on the plate, and the bed is held in position by a grid member **16** which is supported externally by means not shown.

The fluid is delivered to the inlet opening through two supply conduits **17**.

It will be understood that although the invention has been particularly described with reference to concentric grooves, other forms and arrangements of grooves may be employed. For example the grooves may be parallel to one another, or intersecting, or they may be in the form of a single spiral groove.

Furthermore it is contemplated that the drillings leading from the upstream side of the distributor plate to the grooves in the downstream side of the plate may have a tangential component of direction.

What I claim as my invention and desire to secure by Letters Patent is:

1. A distributor for distributing a fluid stream comprising a substantially flat integral distributor plate having an upstream face and a downstream face, the said plate having formed on its downstream face a plurality of approximately concentric coplanar circular grooves, each groove having an inner side and an outer side, and a plurality of rectilinear passages leading from said upstream face of said plate into the respective grooves, the major rectilinear axis of each passage intersecting the said outer side of its respective groove at an acute angle in substantially an axial plane of the grooves, each said passage opening through the inner side of its respective groove at a location spaced from and opposed to the outer side thereof to direct a stream of fluid at an acute angle against the said outer side.

2. A distributor as claimed in claim 1 in which the sides of the grooves are inclined to one another at approximately 45° and diverge in a downstream direction, the outer sides of the grooves being approximately normal to the plane of the downstream face of the plate, and the passages being arranged approximately perpendicular to the inner sides of the grooves.

3. A distributor as claimed in claim 1 in which the distributor plate is formed with a groove in its upstream face and in which said passages lead from said groove in the upstream face of said plate into the grooves on the downstream face of said plate.

4. A distributor as claimed in claim 1 including a wall adjacent the upstream side of the distributor plate and spaced therefrom to direct the flow of fluid generally across the surface of the upstream side of the plate and in which each passage is substantially straight and the direction of fluid flow through each passage has a component in a direction opposite to the direction of fluid flow at the entrance to the passage.

5. A distributor as claimed in claim 1 in which the passages emerge into the grooves at points spaced from the deepest parts thereof.

6. A distributor as claimed in claim 2 in which the passages emerge into the grooves at points spaced from the deepest parts thereof.

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