Jan. 12, 1960 J. E. NYROP ET AL 2,920,830

ATOMIZER FOR THE ATOMIZATION OF LIQUID DISPERSIONS IN A REACTION CHAMBER

Filed Dec. 26, 1956 2 Sheets-Sheet 1

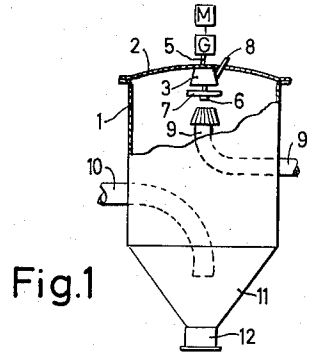


Fig.1

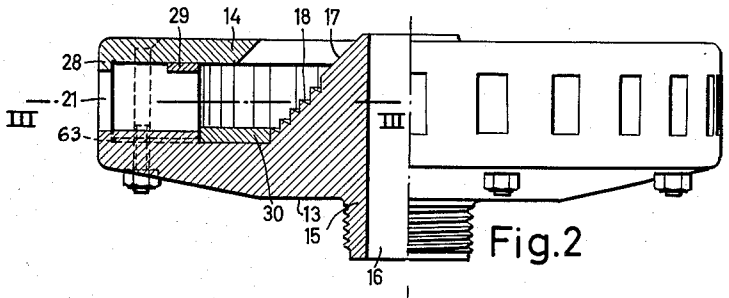


Fig.2

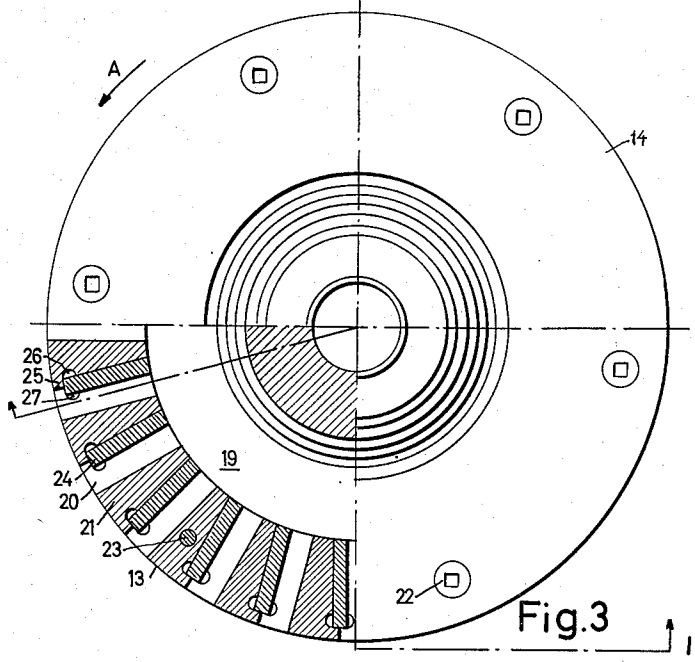


Fig.3

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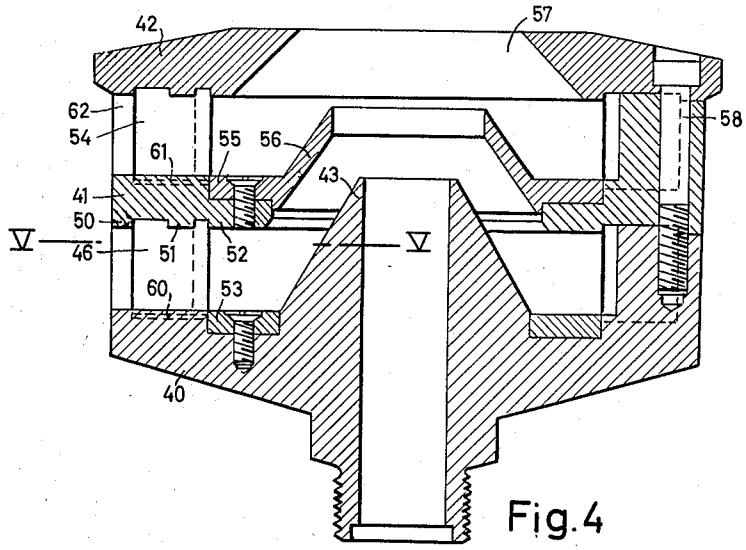


Fig.4

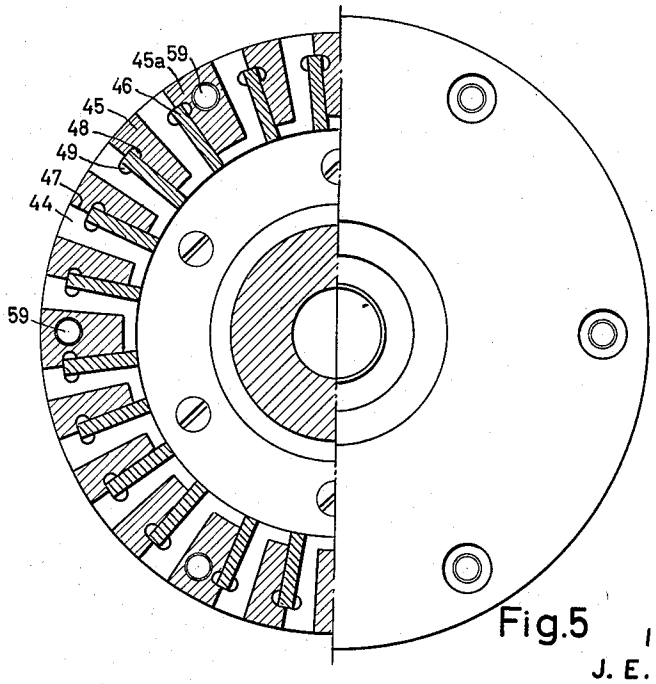


Fig.5

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ATOMIZER FOR THE ATOMIZATION OF LIQUID DISPERSIONS IN A REACTION CHAMBER

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4 Claims. (Cl. 239—222)

The invention relates to an atomizer for the atomization of liquid dispersions in a reaction chamber. The word dispersion includes in this case also molecular dispersions or solutions. More precisely the invention relates to atomizers for said purpose having a rapidly rotating vane wheel in which the liquid is forced out along the surface of a number of vanes, the liquid being flung out from the outer edges of said vanes in a very finely atomized state.

In the reaction chamber the atomized liquid meets a stream of hot air or another gas by which the liquid particles are dried, so that the solids contained in these particles sink downwards in the chamber as a fine powder. The reaction in the chamber may consist merely in a drying process or it may also include a chemical reaction of the atomized liquid suspension with the gas in question.

Owing to the very strong centrifugal forces the liquid particles reach an extremely high velocity especially at the outer parts of the vanes. Therefore, the vanes are exposed to heavy wear by the liquid, especially when the suspension consists of solid particles of hard material.

Wear resistant materials such as hard sintered tungsten carbide are rather expensive and furthermore they are very difficult to machine. It seems, therefore, impossible to make the vane wheels out of such wear resistant materials. It has been proposed to make a vane wheel of a number of tubes of wear resistant materials placed radially and clamped between two wheel plates. Owing to the tubular shape the part of the internal tube wall acting effectively as a vane is rather small and, therefore, the efficiency is very low.

It is an object of the invention to provide a vane wheel for the above purpose with a highly wear resistant surface without reducing the efficiency as compared with that of vane wheels of the first mentioned kind having no means for increasing the resistance to wear.

Another object of the invention is to provide such a wheel in which the means for increasing the resistance to wear are of a very simple shape and therefore also are rather cheap to manufacture.

A further purpose of the invention is to provide said means in such a manner that they are easy to remove and replace when they have become too worn, as even the most wear resistant material will in time become worn. Still another purpose of the invention is to indicate a certain shape as well as a manner of mounting wear resistant elements in the wheel so as to allow each element to be mounted in several different but coincident positions.

The invention will now be further described by way of examples with reference to the accompanying drawings showing some preferred embodiments of an atomizer according to the invention without limiting the scope of the invention such as it is specified in the claims.

In the drawings:

Fig. 1 illustrates diagrammatically an atomization chamber with an atomizer, as seen in front-elevation partially in section.

Fig. 2 shows one embodiment of a vane wheel for the atomizer according to the invention as seen in side elevation, party in section, and

Fig. 3 shows the same wheel as seen in a plan view partly in section along the line III—III in Fig. 2.

Fig. 4 shows another embodiment of the wheel as seen in side elevation partly in section through the axis, and

Fig. 5 shows the same wheel as seen in a plan view, partly in section along the line V—V in Fig. 4.

Fig. 1 illustrates an atomizer for the manufacture of dried powders comprising a drying or reaction chamber 1, from the roof 2 of which an atomizer is suspended.

The atomizer shaft 5 is driven by a motor M through a gear, both motor and gear being shown diagrammatically only, and an atomizer wheel is secured to the end 6 of the shaft 5.

The liquid which is to be atomized, and which contains a solid substance in a dissolved or suspended state, is supplied to the atomizer wheel 7 through a tubular supply pipe 8.

A gaseous medium such as hot air or other heated gas is fed into the chamber 1 through a supply pipe 9. The minute particles of liquid thrown out from the atomizer wheel 7 sink downward through the chamber 1 and are dried by said hot gaseous medium and if desired, a simultaneous reaction can be made to take place between the gaseous medium and the liquid or the particles contained therein.

In the following the gaseous medium is referred to as air but it should be understood that any other gaseous medium may be used depending on the reactions desired.

The air is removed through an air outlet 10, and the powder deposited in the conical bottom 11 of the chamber 1 is removed through a powder outlet 12.

The vane wheel illustrated in Figs. 2 and 3 consists of a lower part 13 and an upper part 14.

The lower part is in the form of a circular body with a central bore 16 for securing it on the shaft 5 shown in Fig. 1.

The upper side of the lower part 13 contains a milled recess 19 surrounding the shaft and thereby forming a chiefly conical distribution member 17, said member having a step-like surface as shown at 18. From this recess or annular chamber 19 a number of grooves 20 extend radially outward from the annular chamber 19 to the outer circumference of the wheel, which grooves are separted from each other by means of partitions or vanes 21 projecting from the body of the wheel.

The upper part 14 have the shape of an annular plate secured to the lower part and forced against the partitions 21 by means of bolts and nuts 22 so that the grooves 20 are closed from above, so as to make ducts with a chiefly rectangular cross section.

In the embodiment shown six sets of bolts and nuts are employed for the fastening together of the lower part 13 and the upper part 14, and the six corresponding holes in the power part 13 are made in six of the partitions 21, as illustrated by hole 23 in Fig. 3.

In operation the wheel rotates at a very high speed in the direction indicated by the arrow A in Fig. 3, and on the leading surface of each partition 21 a rectangular plate 24 of wear-resistant, hard sintered material, for example sintered tungsten carbide other sintered carbides or mixtures or carbides alumina ceramic or other similar material, is provided.

Securing of each of these plates 24 is carried out in the following manner:

Along the leading surface of each partition a groove or slide way is provided in the base of the body of the

wheel 7. The width of said grooves is equal to the thickness of the plate 24. Said grooves extend outward from the annular chamber 19, but terminate short of the periphery of the lower part 13.

On the leading surface of each partition 21 at the periphery of the wheel there is a projection at right angles to the surface as shown at 25, which projection 25 protrudes beyond the outer edge of the corresponding plate 24, and, as seen in Fig. 3, covers approximately half of the thickness of the plate.

Recesses 26 and 27, which in Fig. 3 are shown as having a semi-circular form, serve to ensure that the abutment with the plate 24 takes place along the plane surface of its outer edge and not on the corners. It has been shown that in case of an abutment at the corners of the plates, they are often liable to fracture due to the very large centrifugal force during rotation.

This will bring the wheel out of balance and cause vibrations which will destroy it very rapidly.

As is seen in Fig. 2 the upper part 14 has along its outer circumference a flange 28 facing downward, against which the plates 24 abut with the upper part of the front edge, as well as a projection for guiding each plate at the innermost part of the top edge of the plate.

The upper part 14 is, as stated, held tight against the projection partitions 21 on the lower part 13, and these partitions are so high that there will be no jamming of the fitted plates 24 upon tightening of the bolts 22, said plates being in so far as the construction has been hitherto described, freely slidable in the direction of the distribution member 17, but prevented from moving outwards by the projection 25 and the flange 28.

To prevent the plates from moving inwards there is a flat ring 30 forming a locking means located in the bottom of the annular chamber 19. The outer circumference of said ring 30 abuts with the lower part of the outer edge of the plates 24, holding them in the correct position.

It will be seen that the plates 24 can be replaced very easily in the event that they become damaged, and it will further be understood that each plate 24, due to its rectangular form can be brought into place in four different, but mutually coincident positions.

The regular form of the plates 24 means that the wear-resistant parts consisting of very hard material, for example tungsten carbide or other wear-resistant sintered products, which are very difficult to work, can be manufactured in the simplest possible manner.

Due to this method of mounting the plates in the wheel, they are not exposed to dangerous stresses during rotation, and further they are effectively secured so that there is no risk of their being thrown out during rotation.

Although use of wear-resistant, hard sintered materials provides a durability of many hundred times the durability of hard steel, of which vane wheels of the type described are normally manufactured, atomizing of suspensions of strongly abrasive solid particles, for example kaolin suspensions, will in time cause noticeable wear, but since this wear takes place chiefly on the outer extremity of the leading surface, said possibility of installing the plates in four different positions means that they can be turned three times when they have become too worn, and in this manner their lifetime is quadrupled. Since the materials dealt with are rather expensive this is of major importance.

Figs. 4 and 5 illustrate an embodiment in which the atomizer wheel is in the form of a tandem wheel, consisting of three parts, viz. two parts 40 and 41 corresponding to parts 13 and 14 in Figs. 2 and 3, and a further annular part 42.

The part 40 or the lower part corresponds for the most part to the lower part 13 shown in Figs. 2 and 3, the most significant difference being that the conical distribution member 43 has an even surface and not a step-like surface as with the corresponding distribution member in Figs. 2 and 3.

As in Fig. 2 the lower part 40 contains grooves 44 with partitions 45, on the leading edges of which rectangular plates 46 are provided, consisting of wear-resistant, hard sintered material, such as tungsten carbide, alumina ceramic or the like, set in grooves and held from being ejected by a projection 47 on each partition 45, and recesses 48 and 49 are provided to ensure that the rectangular plates 46 receive the centrifugal forces brought on by the rapid rotation on their front edges and not on their corners.

The underside of part 41 or the middle part has a form corresponding to the upper part shown in Figs. 2 and 3, and with its downward extending projections 50 and 51 corresponding to the projection 28 and 29 in Fig. 2.

The middle part 41 has a projection 51 in each duct corresponding to projection 29 and has further a downwardly facing flange 52 inside the rectangular plates 46, said flange 52 having an effect on the upper edge of the rectangular plates 46 similar to the effect of the ring 30 shown in Fig. 2, thus supplementing the effect of the corresponding ring 53, secured inside the plates 46 at their lower part.

The upper surface of the middle part 41 has the same form as the part of the upper surface of lower part 40 which lies outside the annular element 53, and is likewise provided with partitions as indicated by 62 in Fig. 4.

The underside of the further or upper part 42 in the corresponding zone is formed similar to the underside of middle part 41, and in the ducts produced between middle part 41 and upper part 42 rectangular plates 54 are provided in the same manner as are the plates 46 between lower part 40 and middle part 41. The plates 54 are of the same or a similar material as that of the plates 46.

The upper part 42 has in every significant respect a form corresponding to upper part 14 shown in Fig. 2.

An annular locking element 55 similar to the ring 53 is provided on middle part 41 inside the plates 54, but in contrast to the ring 53, the annular element has a sloping flange 56 at its internal circumference, so as to make a hollow conical body.

The external conical surface of this flange or body 56 makes up the distribution surface for liquids which are supplied through the central opening 57 in upper part 42 through one or more liquid supply pipes, not shown. From this conical distribution surface the liquid is thrown out against the plates 54, which work in the manner of vanes, and due to the centrifugal force the liquid in the form of a thin film is forced along the surface of these plates out to the extreme edge, where it is ejected as finely divided particles. Another part of the liquid to be atomized is fed through supply pipes, also not shown, downward through the hollow conical body 56 to the distribution member 43, from which the liquid is thrown out to the plates 46, and ejected in atomized form.

The three parts 40, 41 and 42 are held together by means of bolts through upper parts 42 and middle part 41 and screwed into threaded holes in lower part 40. One of these bolts is shown in Fig. 4 as 58, and at 59 in Fig. 5 two of said holes are shown.

It is seen from Fig. 5 that the partitions 45*a* containing the holes 59 extend over a large part of the circumference of the wheel than the intermediate partitions 45 which do not contain bolt-holes. Since the bolts are distributed evenly as in Fig. 3 this variation in the extent of the partitions presents no problem in the balancing of the wheel.

To clamp plates 24 in Fig. 2 or plates 46 and 54 in Fig. 4 without any risk of damaging them by fastening the bolts 22 or 58, respectively, a strip of lead or other similarly yieldable or plastic material may be placed beneath the plates as indicated by dotted lines at 63 in

Fig. 2 and 60 and 61 in Fig. 4. In this case the partitions 21 or 45 and 62, respectively, should of course be correspondingly higher, but owing to the yieldability or plasticity of said strip a slight jamming of the plates 20 or 46 and 54 is allowable.

We claim:

1. Atomizer for the atomization of liquid dispersions into a reaction chamber comprising a shaft, an atomization wheel secured to said shaft, driving means connected with said shaft for rotating the same, vanes upon said wheel with an annular chamber surrounding said shaft inside said vanes, tubular means projecting into said chamber for supplying a liquid to be atomized, said wheel comprising two circular parts facing each other in the axial direction of said wheel, one of said parts being secured to said shaft, the other of said parts being secured to the first of said parts and having an annular shape, one of said parts having grooves in its surface facing the other of said parts, said grooves extending from said annular chamber radially outward to the outer circumference of the wheel, partitions separating each of said grooves from a neighboring groove, said partitions constituting said vanes, a slide way along each vane, a rectangular plate of wear-proof material inserted in each of said slide ways, a projection provided at the outer edge of each vane, said projections constituting abutments for the outer edge of each of said plates and locking means desposed in engagement with said plates for locking them in their position abutting said projections.

2. An atomizer as claimed in claim 1 wherein said locking means comprises a ring located inside of said plates.

3. An atomizer as claimed in claim 1 wherein a strip of yieldable material is provided at the bottom of each of said slide ways.

4. An atomizer as claimed in claim 1 wherein an additional annular part is provided facing one of said two parts, additional grooves being provided on said additional and one of said parts, partitions separating each of said last named grooves constituting additional vanes, a rectangular plate of wear resistant material covering one face of each of said additional vanes and locking means disposed in engagement with each of said last named rectangular plates for retaining them against one face of said additional vanes.

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