United States Patent [19]

Grolitsch

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[54] **ATOMIZING DEVICE**

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[52] **U.S. Cl.** **239/499,** 239/224, 239/288.5

[51] **Int. Cl.** **B05b 1/26**

[58] **Field of Search** 239/476, 499, 523, 498, 239/223, 224, 288.5

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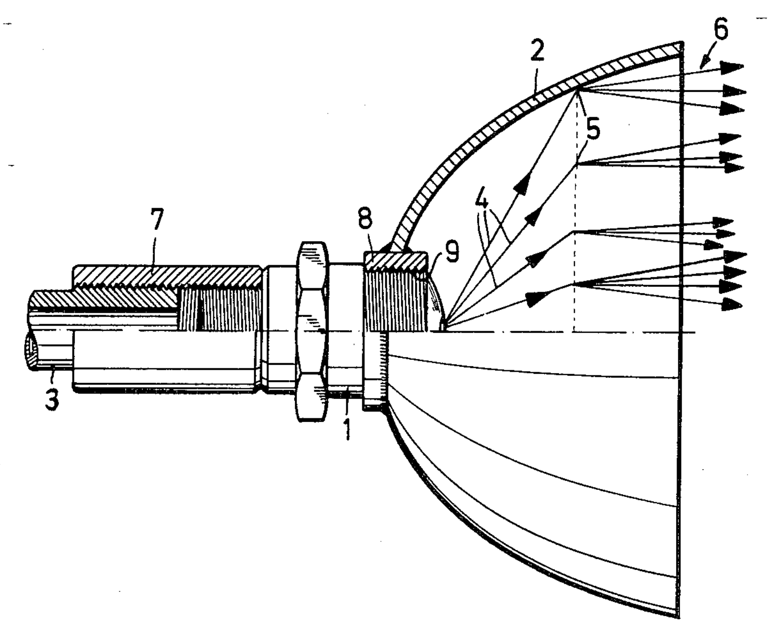
[57] **ABSTRACT**

A device for atomizing materials in which the material is supplied to a nozzle located inside a concave deflector. One of the stream of material to be atomized, and the nozzle, and the deflector rotate, thereby providing for more complete and uniform atomization of the material.

19 Claims, 15 Drawing Figures



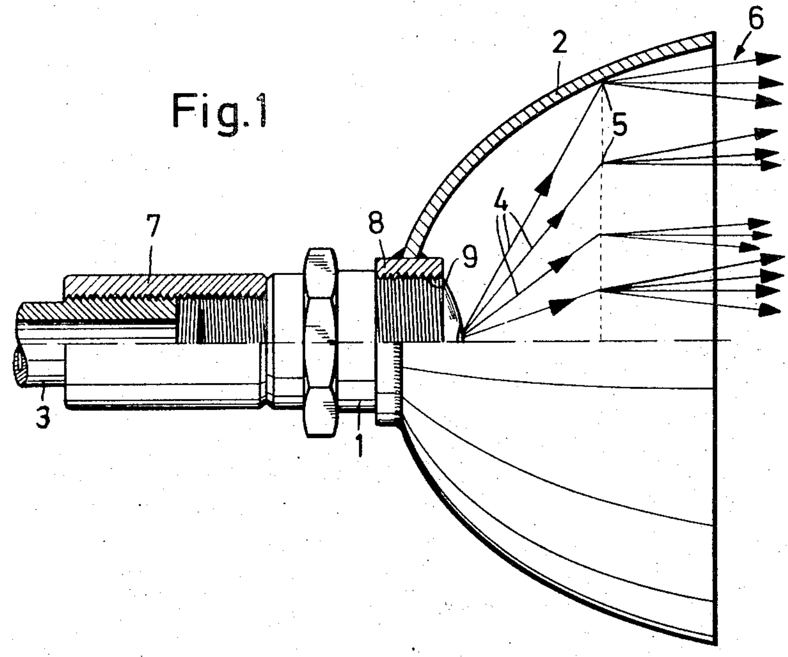


Fig.1

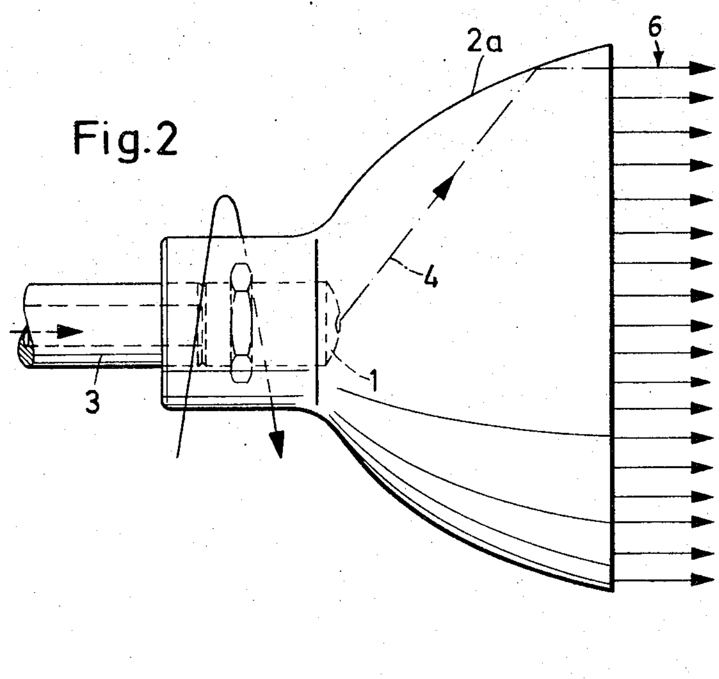


Fig.2

Fig.3

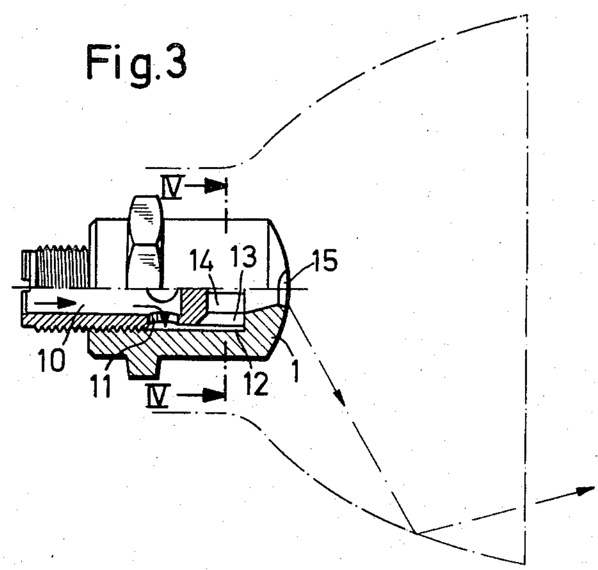


Fig.4

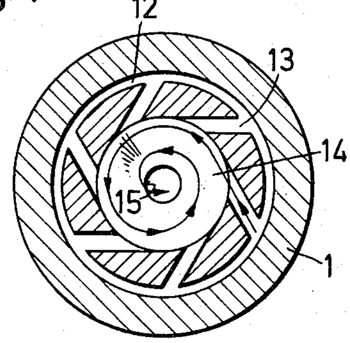


Fig.5

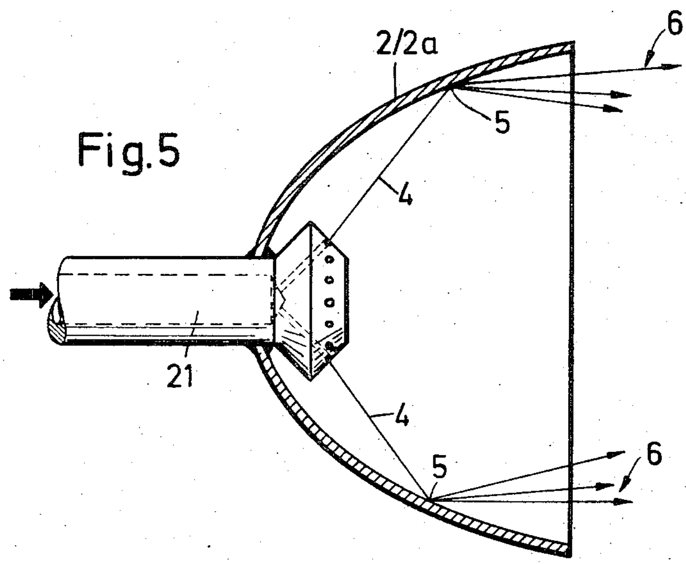


Fig.6

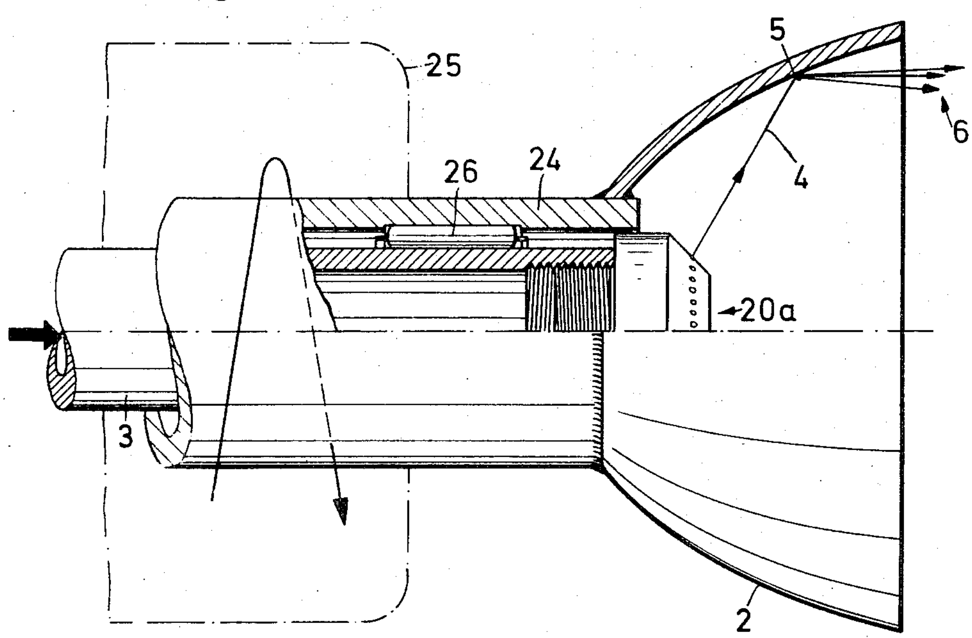


Fig. 7

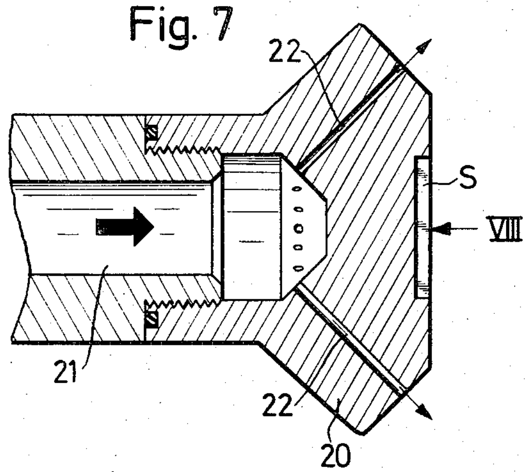
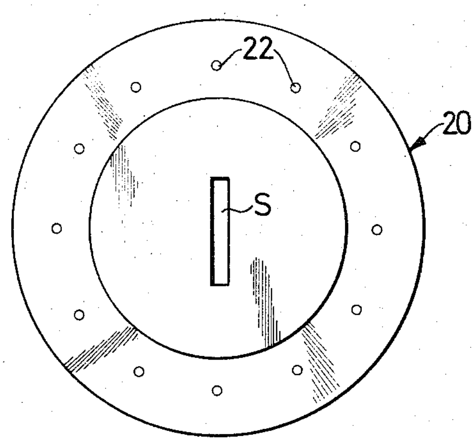


Fig. 8



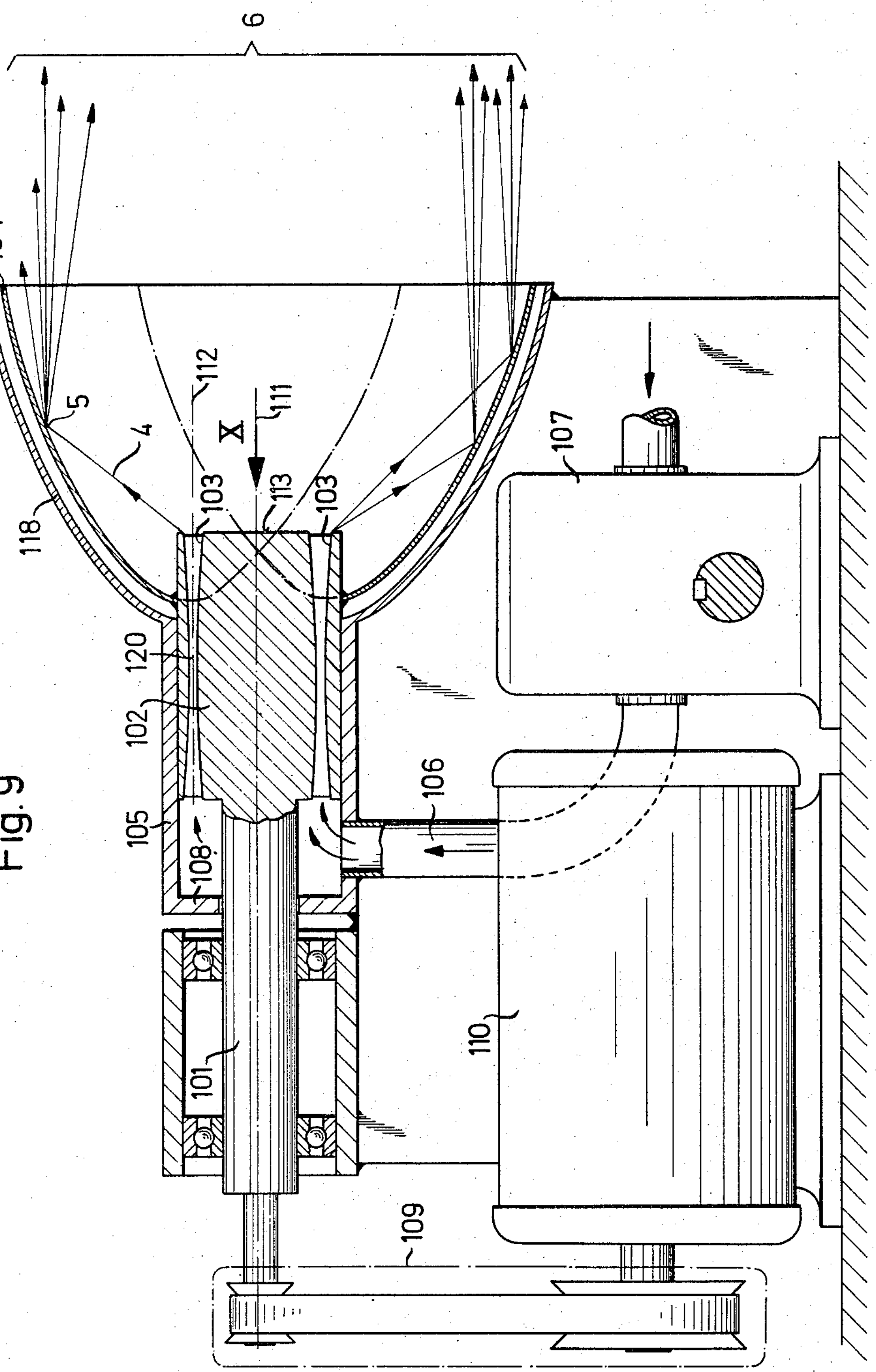
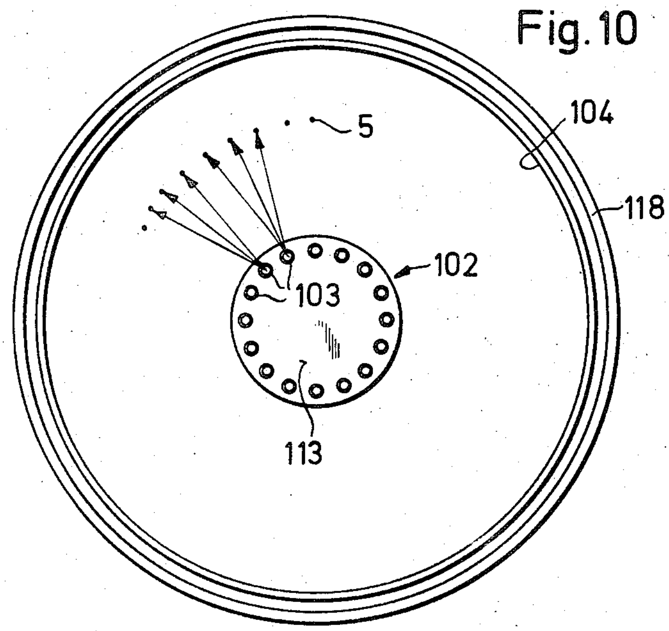

6
104
112
111
X
5
4
118
103
113
103
107
120
102
106
105
108
110
101
109

Fig. 9

Fig. 10



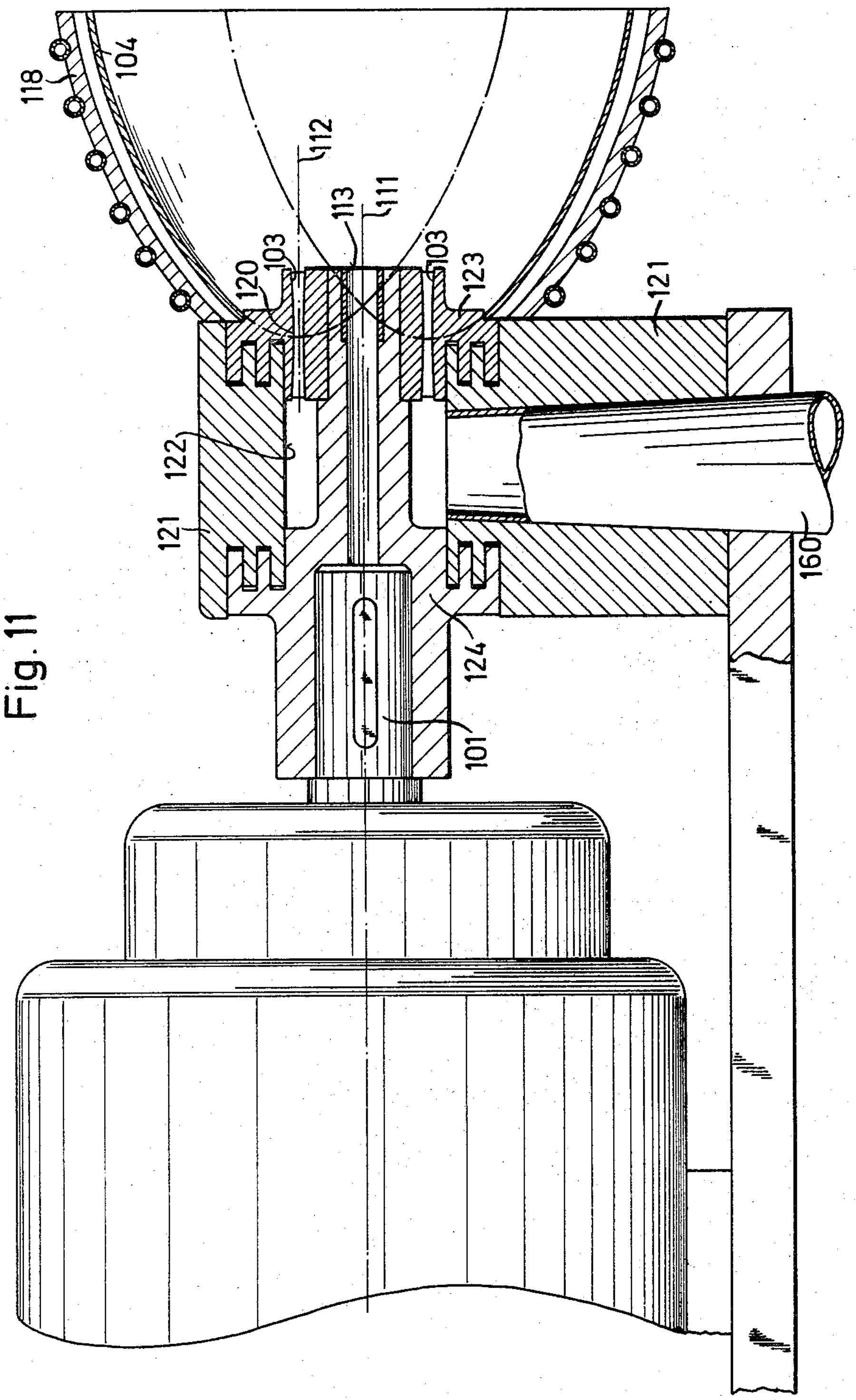


Fig. 11

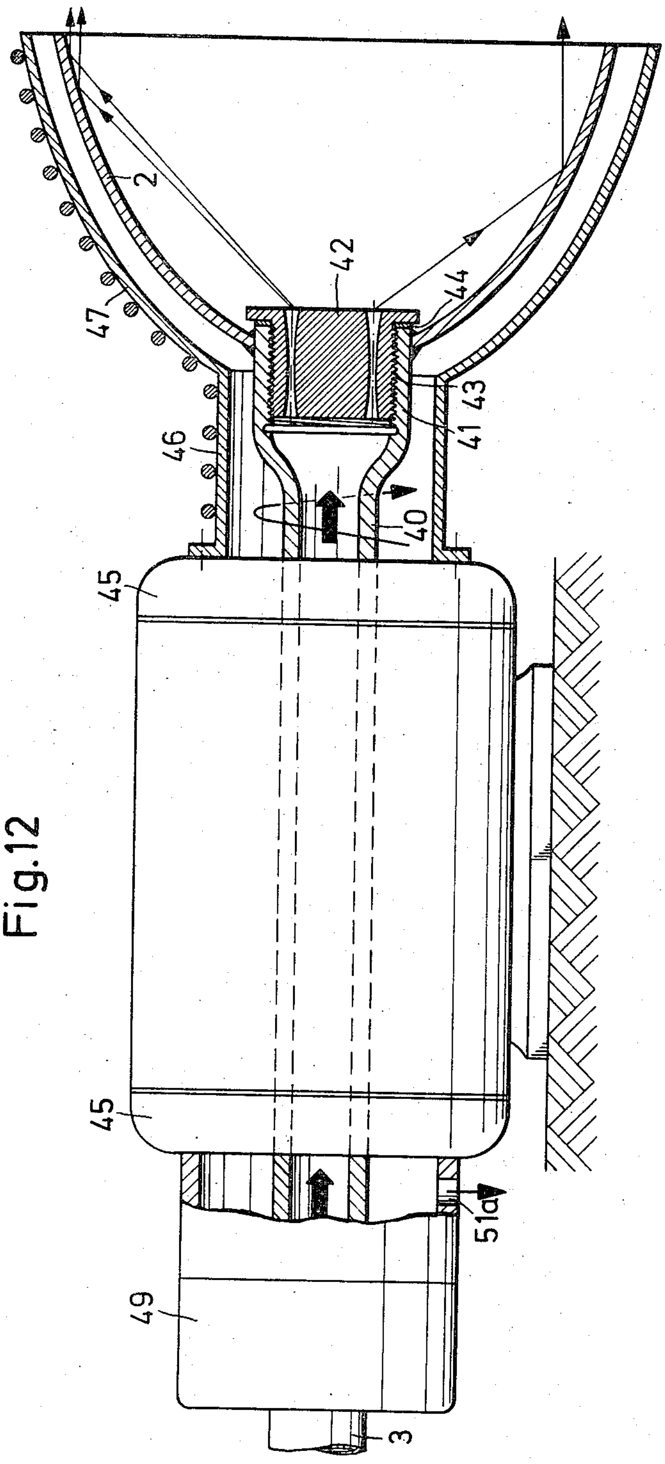


Fig.12

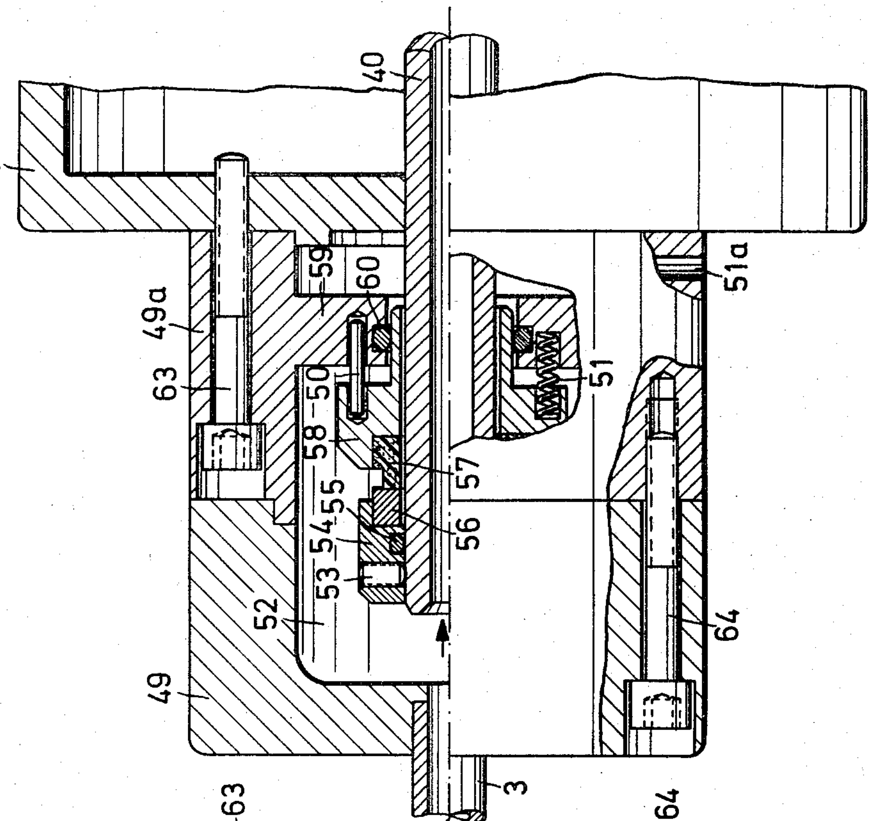


Fig.13

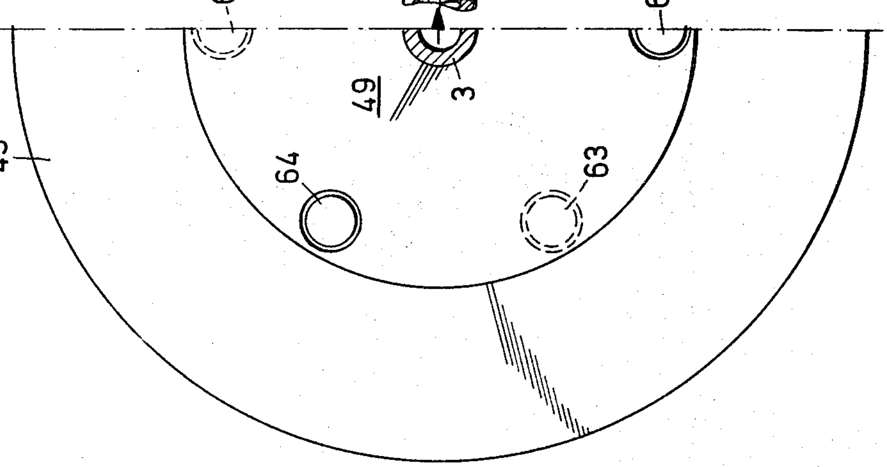


Fig.13a

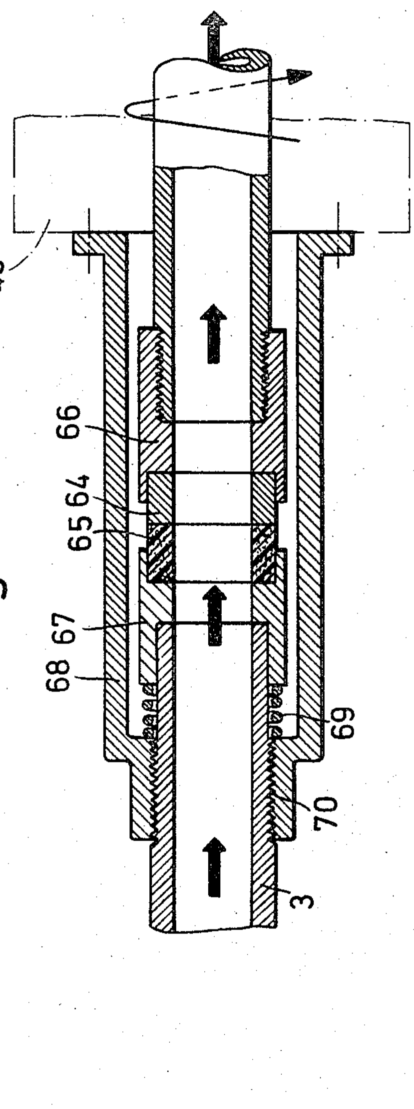


Fig.14

ATOMIZING DEVICE

The invention relates to a device for atomizing liquid or paste-like substances.

Such atomizing devices are used for many purposes. In most cases, the atomizer is required to produce as finely divided and uniform a mist as possible.

This is particularly important in the production of crystalline fatty powders, that is to say in the conversion of melted fat or fat mixtures into a fatty powder. What is required is a crystalline fatty powder that is as fine and uniform as possible and is always free-running. A fatty powder of this nature can be mixed with any powdery substance to form a homogeneous blend. It is therefore particularly suitable for adding to milk substitutes, flours ready for baking and other such materials.

In many instances, aqueous liquids containing solids are atomized at high temperatures, the water being evaporated (atomization drying). The quality of the resultant product then depends largely on the atomising process, which determines in particular the degree of fineness and the uniformity of the product.

Hitherto, a wide variety of spray nozzles have been imployed for atomizing liquids or melts. Centrifugal devices have also been used for atomizing, especially for atomizing liquids in drying towers, in which the liquid is fed without the application of pressure to the centre of a disc or dish rotating about a vertical axis, from which the liquid is thrown off radially. In this connection, reference may be made to German Pat. Nos. 559,141 and 733,017. In such devices as these, the liquid fed will form a film on the rotating dish under the action of centrifugal force. This film becomes thinner as it moves radially towards the rim of the dish or disc since the same amount of fluid must cover a greater area. At the rim the size of the particles finally thrown off will depend upon the film thickness at the rim.

The purpose of the invention is to provide atomizing devices which are simple in design but which will supply material that is more finely divided when atomized, that is to say they will provide a finer powder, than other existing atomizers. It is also sought to ensure that the atomizing device, while occupying little space, shall have a high output, and that the atomized material shall emerge like a light beam, in the form of a group of parallel rays or jets, so that the atomized material is confined to a relatively small space. It is also intended to provide infinitely variable control of the particle fineness, from the finest dust to small pellets.

This the invention achieves by virtue of the fact that there is fitted, at the centre or apex of a concave or bell-shaped reflector, an atomizing device from which the particles emerge at high velocity along the generator line of the curved surface of a cone so as to assume the shape of an "atomization cone," striking the inner face of the concave reflector, off which they bounce after undergoing further subdivision.

According to the invention, therefore, two-stage atomisation is provided, so that the emergent particles are correspondingly one stage finer. The particles from the initial atomization are further subdivided, each first-stage particle being converted into a multiplicity of smaller particles. The particle fineness is thus several times greater — i.e., the individual particles are several times smaller — than those produced by the devices in use hitherto.

It is particularly advantageous that as the finely atomised particles leave the device, that is to say the reflector, they are confined to a substantially cylindrical beam. The amount of space occupied by the stream of particles is thus reduced to a minimum. Accordingly, the atomized material, having been constrained into a beam of parallel rays, can be further processed intensively over a small area. The further processing can take the form of cooling, crystallizion, or drying.

In the operation of an atomizing device such as herein proposed, it is essential that the particles should emerge from the initial atomizer at the apex of the reflector at a high velocity and also that they should not impinge on the reflector at a shallow angle to ensure that the particles do not, slide along the reflector, but become further subdivided as they bounce off it. Thus not only must the atomization cone be converted into a cylinder, but also the particles must, first and foremost, be atomized further through impact with the reflector.

In accordance with the invention, a very considerable improvement in the mode of operation results from high-speed rotation of the concave reflector about its axis of symmetry. Thus, instead of the incident particles being bounced off a stationary surface, that surface is moved rapidly, and transversely to the direction of movement of the particles concerned. As the particles strike the face of the reflector which is moving transversely to their path, the action of impact on the reflector is accompanied by a spinning action as well. The incident particles become sheared, rubbed or torn apart into a number of correspondingly finer particles. Moreover, the effects of rotational spin and impact on the rotating reflector tends to produce spherical particles rather than particles of other shape. With the spin achieved by high particle impact velocity and high-speed rotation of the reflector, the liquid in the atomised substance forms a complete film around any solid particles present in the substance. This film or coating is advantageous in such cases where for example, a fatty liquid coating acts as a protection against changes caused by oxidation of the solid particles. Examples of these are Lacto bacillus acidophilus, albumen components and so on.

It is also suggested that the primary atomizer should be a nozzle containing a number of holes or passages lying within the curved surface of a cone and leading into a common feed passage. From each such hole or passage, the substance to be atomized emerges substantially in the form of a jet, all the jets collectively forming the requisite "atomization cone."

A further proposal is that the device for producing the "atomization cone" shall consist of a nozzle body. cylindrical in shape, which projects into the reflector and can rotate coaxially with the latter, the said body containing a number of eccentric passages running from end to end of the body and extending substantially parallel to the axis of the reflector or in alignment with the second third of the atomizing reflector. One end of the rotary nozzle body extends into a space for feeding the liquid under pressure, while the other end or other part projects into the reflector.

The liquid leaves the nozzle passages with an axial velocity component which is largely determined by the pressure. Superimposed on this component is a radial component of velocity which is largely determined by the speed of the cylindrical body, so that finally the desired atomization cone is produced. If the passages mentioned are in alignment with the second third of the atomising reflector, there is the further advantage that the streams of particles leaving the passages even when rotation is stopped will still strike the reflector and be further atomized by it.

The angle of divergence of the atomization cone can be regulated by a combined variation of the pressure and speed of rotation. The speed can be varied up to a level of about 25,000 revolutions per minute and the pressure in the feed space can be varied up to a level of 30 atmospheres or so. Since the angle of divergence of the atomization cone can be regulated, so, too, can the zone in which the main part of atomization cone strikes the reflector. This in turn means that the effective peripheral speed of the reflector at the moment of impact, can be varied to alter the desired degree of atomization, of the substance.

In one simple example embodying the principle of the invention, the reflector is mounted without freedom to rotate on the periphery of the cylindrical nozzle body projecting into it, so that the reflector and the nozzle rotate at the same speed and in the same direction. However, arrangements can also be made in which the reflector and the nozzle to rotate at different speeds or even in opposite senses.

Factors of importance in the atomization of a substance are the form of the individual holes or passages in the cylindrical body and the ratio between the total cross-sectional areas of the feed and of the atomising holes or passages. In this connection, it is proposed that each passage, starting from its downstream end, should first be conically narrowed and then conically opened out again towards its upstream end. Passages so shaped reduce flow resistance at entry and, by jet interruption, promote the primary atomizing action at the exit. The final form or structure of the atomized material can also be affected by the cross-sectional shape of the holes or passages, which may be round or oval, or even retilinear, e.g. oblong-rectangular, square, triangular or slot-shaped.

In one simple form of construction, the passages run axially through to the rear end of the cylindrical nozzle body, which extends into a pressure cylinder into which the liquid is fed under pressure.

The reflector can advantageously have a plug and socket connection with the cylindrical nozzle body, which is held fast against rotation. In this way, reflectors of different designs and more particularly having different angles of divergence can be readily mounted on the same feed cylinder or, vice versa, different feed cylinders differing more particularly in the design of the passages they define, can be mounted on one and the same reflector. In place of the plug and socket coupling just mentioned, a screwed connection or the like may be provided. In this connection it is also proposed that a reflector be welded in each instance to a hollow cylinder such as can be plugged or screwed to the cylindrical nozzle body and secured against turning, the respective passages therein being interchangeable for various exit cross-sections. This enables a wide range of variations to be derived from a single atomizing device.

It is further proposed that the intake ends of the feed passages in the cylinder be arranged to terminate in a common annular space, with which the feed connection communicates. This annular space may be provided in the hollow body or stator surrounding the cylinder. Alternatively, the annular space may be provided in the form of an annular groove, for example in the periphery of the cylinder itself. Another proposal in this connection is the provision of a stator having a through-bore, so that the two parts of a rotor, one comprising the passages and the other the reflector can be coupled to the driving shaft, by being plugged into opposite sides of the bore. In conjunction with this arrangement, one or more concentric circular grooves are provided in the two ring-shaped end faces of the stator, so that ring-like protruberances on the facing ends of the rotor parts can be inserted into the grooves to form a labyringth seal. Means of relieving axial pressure should preferably also be provided.

In view of the high speed of rotation (up to about 25,000 r.p.m.) and the high pressure (up to 30 atomospheres), sealing naturally presents a very difficult problem. One very satisfactory solution to this, included in the scope of the invention, lies in the use of a suitable high-speed motor (up to 25,000 r.p.m.) having a hollow shaft. The nozzle body defining axial passages and the reflector are both fitted to one end of the shaft, while the other end of the shaft extends through a seal into a chamber from which the material to be atomized is fed under pressure.

Feeding the liquid by the method here proposed, through the hollow motor shaft, makes it possible to dispense with one of the two seals otherwise required, in addition to which the rearward end of the shaft can be very satisfactorily sealed in the special antechamber. For this purpose, a sliding ring seal or a rotation coupling is proposed. For this, where the shaft passes through the antechamber, it is provided with a ring of hard metal, which cooperates with a sliding carbon ring mounted on the shaft, or vice versa. These two sliding rings, of hard metal and carbon, are forced together by spring pressure to produce the sealing action. Sealing from the inside outwards is to be preferred, because contamination of the product can never arise if a leak should develop through wear.

Practical examples of the invention are described hereunder with the aid of the accompanying drawings, from which further important details and features will emerge and in which:

FIG. 1 shows a side view, partly in section, of the first example (stationary);

FIG. 2 shows a side view of another example (with rotary reflector);

FIG. 3 shows the spin nozzle provided in FIGS. 1 and 2, in axial section;

FIG. 4 is a cross-section of the spin nozzle, along the line IV—IV in FIG. 3;

FIG. 5 shows another example, in axial section, with a different typeof atomizer nozzle (stationary);

FIG. 6 a further example fitted with the same atomiser nozzle as in FIG. 5 (with rotary reflector);

FIG. 7 shows the atomizer nozzle used in FIGS. 5 and 6, in axial section;

FIG. 8 is an end view of the atomizer nozzle, as seen by an observer looking in the direction of the arrow VIII in FIG. 7;

FIG. 9 shows a fifth example (rotary), likewise in axial section;

FIG. 10 is an axial view in the direction of the arrow X in FIG. 9;

FIG. 11 is a modification of the example shown in FIG. 9, in axial section;

FIG. 12 shows another example in axial section, with basically the same atomizer nozzle as in FIGS. 9 and 11;

FIG. 13 shows how the shaft in FIG. 12 is sealed;

FIG. 13a is an end elevation of the example in FIG. 13; and

FIG. 14 shows another method of sealing the shaft.

In FIG. 1, the invention is illustrated in the form of a simple example. A spin nozzle, 1 is provided for primary atomization while a reflector, 2, coaxially surrounds the nozzle 1. The liquid to be atomized is supplied through a feed connection 3. The particles leave the spin nozzle 1 in a high-velocity steam, in the form of an "atomization cone," 4. The individual jets making up the cone 4 strike the inner face of the reflector 2. The particles, as they impinge at an appropriate velocity on points 5 in the incidence zone of the reflector bounce off the reflector in a disintegrated form; each of the incident particles being subdivided into several smaller particles. Reduction in size thus takes place in two stages: firstly at the spin nozzle 1 in the central primary atomizer and then at the reflector 2 which surrounds the nozzle. The particles bouncing off the reflector 2 emerge from it substantially parallel to the axis of the reflector, the nett effect being that the atomization cone produced by the nozzle is converted into an atomization cylinder 6.

The spin nozzle 1 and the feed connection 3 are screwed together by means of a sleeve, 7. The reflector 2 is mounted concentrically on a screw threaded bush, 8, which is screwed on to a matching screw thread on the outside of the nozzle 1.

The example of the invention shown in FIG. 1 is of stationary type, both the spin nozzle 1 and the reflector 2 mounted on it do not rotate. This constitutes an extremely simple atomizer. The reflector 2a shown in FIG. 2, however, rotates at high speed about its axis of symmetry. The atomizer nozzle 1 and reflector 2a are remains stationary, so that the reflector 2 rotates in relation to the nozzle 1. Otherwise, the design and arrangement of the atomizer nozzle 1 and reflector 2a are the same as in FIG. 1. Thus, here again, the material to be atomized is passed in the direction of the arrow through the feed connection 3 to the atomizer nozzle 1, from which it emerges in the form of an atomization cone 4. The atomization cone 4 impinges on the inner face of the reflector 2a. In the zone of incidence of the reflector, the particles are further broken down and simultaneously deflected parallel to the reflector axis, to emerge from the atomizer in the form of a substantially cylindrical stream of material, 6.

Because of the rotation of the reflector 2a, a special spinning action takes place. This time, the incident particles do not bounce off a motionless face as in FIG. 1 but instead, the plane of contact is moving transversely to the direction of motion of the incident particles. Hence, at the moment of impact of a particle, a spinning action is imparted in addition to the bouncing action, so that each particle is intensively sheared, rubbed and torn apart. Atomization with the rotary reflector 2a is thus finer, and more intensive. Moreover, as already mentioned, the particles tend to become predominantly spherical and the liquid portion of the atomized substance provides a coating for any solid particles in the substance.

As already stated, the atomized particles are required to emerge from the primary atomizing nozzle 1 in the form of an atomization cone, 4. Hence, any nozzle capable of providing such a cone is suitable for use in embodiments herein described. Spin nozzles of a conventional type, such as those indicated in FIGS. 1 and 2, are suitable. The construction of such nozzles can be seen in more detail from FIGS. 3 and 4, from which also their mode of operation will be apparent. In FIGS. 3 and 4 the substance to be atomized passes from a central feed passage 10 into an outer annular space, 12, by way of holes 11, and then through tangential passages, 13, to a circulating space, 14. There is thus imparted to the liquid in the circulating space 14 a strong rotary action, with which the individual liquid particles finally the concentric discharge aperture 15 in the shape of the desired atomization cone 4. In this way, the emergent particles already posses spin or rotational impetus, which promotes the subsequent atomization resulting from impact with the reflector 2 or 2a.

This applies especially when the reflector 2a rotates as indicated in FIG. 2. Impact then occurs by the combination of two different spinning actions, namely the rotational impetus of the incident particle and a second such impetus imparted to it at the moment of contact with the rotating reflector 2a. Both of these spinning forces are arranged to differ in magnitude and direction.

FIG. 5 shows an arrangement similar to FIG. 1, but having a different primary atomizer nozzle. This nozzle, 20, is shown in longitudinal section and to an enlarged scale in FIG. 7. Running through the body 20 of the nozzle is an axial feed passage, 21, from which a number of smaller radially outwardly directed branch passages, 22, extend to describe the sloping face of a cone. The liquid fed to the nozzle body is thus uniformly distributed to all the radially directed passages 22 so that the liquid leaves the nozzle 20, as an atomization cone 4. The individual particles thereupon strike the reflector 2, off which they bounce - further distintegrating in the process - and form a continuous stream of material, 6, as indicated in FIGS. 1 and 2. A slot S for screw driver facilitates changing of different nozzles to feed-channel 21.

The example in FIG. 5 is stationary, that is to say of a non-rotary design. It has a relatively high output. In a modification the nozzle 20 and the reflector 2 mounted on it, can both be rotated together.

The example shown in FIG. 6, like the one in FIG. 5, has an atomizer nozzle, 20a with a plurality of passages which define the sloping face of a cone (FIGS. 7 and 8). It differs from FIG. 5 in that the reflector 2 can be rotated at high speed, for which purpose the reflector 2 is mounted on the end of the shaft 24 of a suitable high-speed electric motor, 25. The shaft 24 is hollow. Through it runs the feed connection 3, along which the liquid is fed in the direction of the arrow. A bearing 26, is provided between the feed connection 3 and the hollow shaft 24. The nozzle 20a is screwed into the end of the feed pipe by means of its screw-threaded shank, 27.

Next comes the example shown in FIG. 9. In the examples already described, the primary atomizer nozzle 1, 20 or 20a was stationary (non-rotary), whereas the reflector 2 could be either stationary or rotary. The nozzle 1, 20 or 20*a* could also be made to rotate but even if stationary it provided the requisite atomization cone. In FIG. 9, on the other hand, a special atomizer nozzle is provided to which the reflector is made rigid by welding, for example. In other words, nozzle and reflector will rotate together. The nozzle contains a number of substantially parallel coaxial passages, from which liquid fed to it will emerge coaxially. By virtue of the simultaneous rotation and the consequent centrifugal force exerted on the liquid as it passes along the passages, the desired atomization cone is produced and impinges on the reflector as this rotates with it.

The details shown in FIG. 9 are as follows:

Mounted on the end of the shaft **101** is a cylinder, **102**, through which run a number of coaxial passages, **103**, and the front (right-hand) end of which projects into a parabolic reflector, **104**, that lies coaxial with the said cylinder.

The rear portion of the cylinder **102** is surrounded by a hollow cylinder, **105**, into which the liquid to be atomised is fed by a pump **107** through a pipe connection **106**. The shaft end projecting from a cylinder cover **108** is connected to a driving motor **110** through infinitely variable driving gear **109**.

The reflector **104** in this example is parabolic, being generated by the rotation of a parabola about an axis, **111**, which lies parallel to and at a distance from the parabola axis **112**, the axis of rotation **111** of the parabola being at one and the same time the axis of rotation of the cylinder **102** and of the shaft **101**. One may thus think of the parabolic reflector **104** as being composed of an infinite number of narrow parabolic segments.

Every passage **103** lies within the axis of a parabola and leads to the focus of the parabola concerned, since the end face **113** of the cylinder **102**, in which the passages **103** terminate, lies in the focal plane of the paraboloid.

The mode of operation of the atomizer will be readily understood. The cylinder **102** driven by the motor **110** rotates along with the paraboloid **104**, while the liquid is fed by the pump **107** into the hollow cylinder **105**. Within each passage **103**, the liquid is imparted with an axial velocity component by the pressure provided. Superimposed on this axial velocity component is a radial velocity component arising from the centrifugal force due to rotation.

The two components jointly produce a jet, or a "beam" of jets, **4**, thrown obliquely outwards.

Here again, then, the result is the desired atomization cone, **41**, which undergoes distintegration upon impact with the reflector **104** in the zone of incidence **5**. The stream of material **6** leaving the device is substantially cylindrical.

The parabolic reflector **104** is surrounded by a rigid heating shell, **118** from which heat is radiated under thermo-static control to the rotating parabolic reflector **104**.

Both the pressure and the speed should preferably be capable of infinite variation over a predetermined range. In the example shown, there are 16 axial passages **103**, but these can be replaced by passages differing in number and diameter.

The passages **103** contain a central constricted portion, **120**, from which the passages open out in opposite directions. At the inlet end, this counteracts any excessive rise in pressure, which would reduce the efficiency of the atomizer. Beyond the constriction, increased speed of flow results in a pressure drop, imparting to the nozzle a suction or Venturi action. This shape also promotes the rolling action of the particles within the substance to be atomized and so can promote the "coating" effect.

The paraboloid or reflector may also — where it is desired to widen or narrow the area of atomization — be widened or constricted towards its discharge end.

As FIG. 11 shows, the atomizer is in three axially arranged parts namely a stationary part or stator, **122**, into which two further parts, **123** and **124**, can be inserted from opposite ends and hence assembled axially, these forming the rotor of the device.

One of the rotor members, **123**, contains passages distributed round its periphery and carries the paraboloid **104**. At the inlet end of these passages **103** is an annular groove or similar recess, which communicates with a feed passage, **160** for the liquid to be atomized. The other rotor member, **124**, fits over the stub end **101** of the driving shaft.

To provide a seal between the stator **121** and the two rotor members **123** and **124**, there are radial labyrinth seals, each end of the stator containing concentric grooves which are engaged by complementary protruberances on the respective rotor members **123** and **124**.

As regards the arrangement and design of the atomiser nozzle and reflector, in the example shown in FIG. 12 these parts are similar to those shown in FIGS. **9**, **10** and **11**; the reflector is mounted on and constrained against rotation with respect to the atomiser nozzle. The nozzle is fitted at the apex of the reflector to extend coaxially with and into the reflector, and contains a number of coaxial passages running right through it. The nozzle and reflector rotate together at high speed. Unlike the examples shown in FIGS. **9** and **11**, the nozzle and reflector are mounted directly at one end of the driving shaft, which is a hollow shaft through which the liquid to be atomized is fed.

In this arrangement, the hollow shaft **40** has its free end opened to form a socket, **41**, into which the cylindrical body **42** of the nozzle is screwed at **43**. The arrangement and form of the passages in the cylinder **42** are as in FIG. **9**. A packing between the end of the socket at **43** and a flange on the body **42** of the nozzle is numbered **44**. The casing of the motor **45** carries a heatable cylindrical extension, **46**, and an external shell, **47**, to which heat can likewise be applied. This outer shroud **46/47** protects the atomizer cylinder **42** and reflector 2 and enables their temperature to be regulated.

This example thus dispenses with the reduction gearing provided in FIG. **9**, instead of which the motor **45** provides the requisite high-speed rotation directly. Feeding the liquid through the hollow shaft further simplifies the design, especially as regards the provision of a seal. In the examples shown in FIGS. **9** and **11**, each requires sealing at two places where parts are moving in relation to each other. However, as indicated in FIG. **12**, the liquid is fed through the hollow motor shaft, so that the parts moving in relation to each other require sealing at only one point, namely between the (left-hand) end of the hollow driving shaft and the adjacent stationary feed connection **3**. For this purpose, a suitable seal of conventional type, such as a labyringth seal, may be provided. As a further feature of the invention, however, it is proposed that a sliding ring seal be provided between the rotating shaft end **40** and the nonrotating feed connection **3**. This seal is housed in an antechamber, **52**, into which the feed connection **3** extends.

FIG. **13** provides further details of this sliding ring seal:

Secured to the end of the shaft **40** with grub screws, **53**, is a fixing ring **54** ring-sealed at **55** around the shaft **40**. The fixing ring **54** carries a packing ring, **56**, made of steel, the end face of which bears against the end face of a carbon ring **57**, with which it forms a seal. The carbon ring **57** itself is mounted on a fixing ring, **58**, which has limited travel in relation to the shaft **40** and is guided by pins, **50**, with freedom to move longitudinally in relation to the end **59** of the casing. Compression springs, **51**, act between the casing **59** and fixing ring **58**, so that the carbon ring **57** is held continuously against the counter-ring **56** to maintain the seal. A further ring, **60**, of similar cross-section to the ring **55**, is inserted between end **59** of the casing and ring **58**.

In the absence of a perfect seal between the hollow shaft **40** and the casing end **59**, any fluid leaking past it will flow away to the outside through the passage **51***a*.

The casing of the antechamber **52** is in two parts. The first part, **49***a*, is secured to the motor casing **45** by recessed bolts, **63**. The second part, **49**, of the seal housing is held by similar recessed bolts, **64**, to the first part of the housing, **49***a*, in which the feed connection **3** terminates.

The rotation coupling shown in FIG. **14** is basically of the same nature. Whereas the sliding ring seal in FIGS. **13** and **13***a* may be described as providing a seal "from the outside," the rotation coupling in FIG. **14** provides a seal "from the inside." Here again the seal is effected between a carbon ring **64** and a counter-ring, **65** by contact between the end faces of both.

As shown, the counter-ring **65** is mounted in a fixing ring or sleeve, **66**, bolted to the hollow motor shaft **40**. The carbon ring **64** is mounted in a carrier ring **67**, which is held with freedom to move longitudinally in a seal housing, **68**, fixed to the motor casing **45**. The carrier ring is acted upon by a compression spring, **69**, which thus forces the carbon ring **64** against the counter-ring **65**. The feed connection **3** is screwed to the seal housing by means of the screw thread **70**.

Modifications may be made within the scope of the appended claims.

What I claim is:

1. In an atomizing device; a concave reflector having a central axis of symmetry and closed on one axial side and open on the other axial side, conduit means for supplying fluid under pressure to a point on said axis near the closed side of said reflector, atomizing means at said point operable to atomize the fluid supplied thereto into particles, said atomizing means supplying said particles at high velocity along a conical path which has the apex at said atomizing means and the base intersecting the surface of said reflector in a region axially between the atomizing means and the open side of the reflector whereby the particles are further broken up by the impingement thereof against said surface.

2. An atomizing device according to claim **1** in which the concave reflector is adapted to be rotated at high speed about its axis of symmetry.

3. A device according to claim **1** in which said atomizing means comprises a nozzle placed coaxially in relation to the reflector.

4. A device according to claim **3** in which said nozzle comprises a plurality of passages communicating at one end with said conduit means and at the other end opening into the space inside the reflector.

5. A device according to claim **3** in which said nozzle comprises a cylindrical nozzle body rotatable on the axis of said reflector, said passages comprising a plurality of circumferentially spaced passages passing axially through said body from end to end and lying substantially parallel to the reflector axis, one end of the nozzle body communicating with said conduit means while the other end is disposed inside said reflector.

6. A device according to claim **5** in which the reflector is nonrotatably connected to the periphery of the nozzle body.

7. A device according to claim **5** in which the passages in the nozzle body taper inwardly at the upstream ends and then taper outwardly at the downstream ends to form Venturi shaped passages.

8. A device according to claim **5** in which the said passages in cross section are noncircular.

9. A device according to claim **5** which includes a drive shaft connected to the upstream end portion of the nozzle body, a hollow cylinder sealingly engaging said nozzle body and shaft and forming a chamber in which the upstream end of said nozzle body is disposed, said conduit means being connected to said cylinder and opening into said chamber.

10. A device according to claim **3** in which said nozzle is rotatable up to a speed of approximately 25,000 revolutions per minute and the pressure of the fluid to be atomized is at a pressure of approximately 30 atmospheres at the upstream side of the nozzle.

11. A device according to claim **10** in which said reflector is fixed to said cylindrical nozzle body.

12. A device according to claim **5** which includes a stator having a bore, a rotor part closing each end of said bore, said rotor parts being fixed together and forming with said stator a chamber, one of the said rotor parts having said passages therein and having said reflector mounted thereon, a drive shaft connected to the other rotor part, said conduit means communicating with said chamber, the upstream ends of said passages in said nozzle body opening into said chamber.

13. A device according to claim **12** which includes labyrinth seal means between said stator and each rotor part.

14. A device according to claim **4** in which the sum of the areas of the cross-sections of the downstream ends of said passages is smaller than the cross-sectional area of said conduit means.

15. A device according to claim **5** which includes a high-speed motor having a hollow shaft, the nozzle body and reflector being mounted on one end portion of the shaft, housing means forming a hollow chamber into which the hollow shaft extends, said conduit means communicating with said hollow shaft inside said chamber, and seal means in said chamber operatively sealing between said hollow shaft and said conduit means.

16. A device according to claim **15** in which said seal means includes a sliding ring seal in said chamber and comprising a ring of hard metal nonrotatably carried by the housing means where the shaft enters the housing means, and ring means mounted on the hollow motor shaft and including a carbon ring engaging said nonrotatable ring.

17. A device according to claim **16** in which said ring means comprises a first ring secured to the end of said hollow shaft inside said chamber, a seal ring sealing said first ring to said shaft, a steel second ring engaging the side of said first ring which faces said nonrotatable ring, said carbon ring being disposed between said second ring and said nonrotable ring, said nonrotatable ring supporting said carbon ring, means sealingly connecting said nonrotatable ring to said housing means while permitting axial movement of the nonrotatable ring in the housing means, and spring means acting between said housing means and said nonrotatable ring and urging the nonrotatable ring toward said carbon ring.

18. A device according to claim **15** in which said seal means comprises a first ring in screw thread engagement with the end of said hollow shaft inside said chamber, a steel sealing ring on the outer end of said first ring, a second ring coaxial with said first ring and reciprocably mounted on said conduit means inside said chamber, a carbon ring on the outer end of said second ring and engaging the said steel ring, and a spring biasing said second ring toward said carbon ring.

19. A device according to claim **1** which includes a shell surrounding at least said reflector, and means for heating said shell.

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