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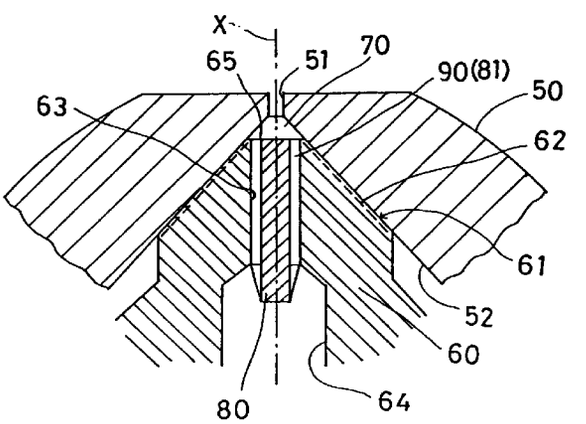
(54) RETURN TYPE SPRAY NOZZLE

(57) In a return type spray nozzle, a small hole (90) for return is provided in a distributor (60) so as to be eccentric relative to the central axis (X) of a small hole (51) for spray, a liquid fuel supplied to a spray stand-by chamber (70) is jetted from the small spraying hole (51) of a spray nozzle body (50), and a part of the liquid fuel is returned through the small hole (90) for return. The small hole (90) for return is defined as a through gap formed in a boundary region between a central through hole (63), which is formed near the center of a tip end of the distributor (60) so as to be coaxial with the central axis (X) of the small hole (51) for spray, and a core body (80), which is different in cross-sectional shape from and fitted into the central through hole (63), by the central through hole (63) and the core body (80).

FIG.2



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Description

Technical Field

The present invention relates to a return type spray nozzle, more detailedly to the return type spray nozzle suitably usable for such liquid fuel burners as home hot-water and heating appliances with comparatively small burning capability and with the needs of fine, accurate, and large turndown ratio.

Background Art

As shown in schematic diagram Fig.11, a return type spray nozzle is a nozzle that sprays out the liquid fuel coming to a return type spray nozzle 4 through a supply line 3 by means of a pump 2 attached to a tank 1 for the use of burning, and at the same time, sends a part of the liquid fuel back to a return path 5 without spraying. The liquid fuel returned to the return path 5 is returned to the tank 1 and the like as shown in Fig.11, or, on the way, is made again to circulate to the inlet side of the pump 2 on the supply line 3. The return amount is adjusted by a return amount control valve 6.

As shown in vertical sectional and structural view Fig.12, said usual return type spray nozzle has a spray nozzle body 10 and a distributor 20 inserted into the inner hole 11 of the spray nozzle body 10. At the center of the top part of the spray nozzle body 10, a spray opening 12 is provided. In the distributor 20 ; a return aperture 21 that penetrates the center of the top flat surface 25 of the distributor 20, and plurality of fuel supplying slit-ducts 23 that are formed at the shoulder part 22 of the distributor 20 that contacts with the inner hole 11 of said spray nozzle body 10. The liquid fuel sent out of the pump 2 enters a spray waiting chamber 30 via the inner holes 11 in the spray nozzle body 10 and via said fuel supplying slit-ducts 23, and then sprays out of the spray opening 12. Part of the above liquid fuel is returned from the spray waiting chamber 30 through the return aperture 21.

However, in the usual return type spray nozzle as shown in Fig.12, the position of the return aperture 21 of the distributor 20 and the position of the spray opening 12 of the spray nozzle body 10 may fall in the same axis, and also, the center of the revolving vortex produced by the mighty liquid fuel introduced into the spray waiting chamber 30 through said plurality of slit-ducts 23 may fall in the return aperture 21. In such a case, especially when overlapped by spray amount decrease due to liquid fuel return flow increase, there has been such a problem that external air has been mixed, together with said liquid fuel, into the return aperture 21 through the center of said revolving vortex.

Hereupon, as a return type spray nozzle to solve the above problem, the invention of Japan Patent Laid-open No. 1990-217706 is provided. Figs.13 and 14 show the constitution of that invention. Fig.13 is a vertical sectional and structural view of the principal part of the nozzle, and Fig.14 is a plan view of the distributor 20. And in this invention, in the vicinity of the center of the flat surface 25 of the top of the distributor 20, and in the positions deviated from the center axis X of the spray opening 12 that is provided in the center of the top part of the spray nozzle body 10, return apertures 24 that penetrate the top thickness of the distributor 20 are provided.

By that the return apertures 24 are provided being deviated from the center axis X of said spray opening 12, external air invading through the spray opening 12 and through the center of revolving vortex of the liquid fuel in the spray waiting chamber 30 can be prevented from being mixed with the fuel entering the return apertures 24.

Plurality of the return apertures 24 are provided in symmetrical arrangement around the center axis X (2 apertures in Figs. 13 and 14). Generally, in Figs. 13 and 14, the same part materials, parts, and elements as those explained in Fig.12 are shown with the same symbols.

Now, in case of using the return type spray nozzle as shown in Figs.13 and 14, especially in case of utilizing it in a relatively large burner ; spray amount as a whole becomes much, so that the hole diameters of the spray opening 12 and the return apertures 24 become relatively large.

In the above case, drilling process for these opening and apertures raises no much issue ; however, in case of obtaining household burners of small capacity, the diameters of the spray opening 12 and return apertures 24 need to be smaller. Especially, in case of installing the return apertures 24 at the positions deviated from the center axis X, it is necessary to install such plurality of return apertures 24 at symmetrical positions taking care of balancing ; in such a case, it is also necessary to make the diameter of individual return apertures 24 pretty small. For instance, when the diameter of the circular flat surface 25 of the top of the distributor 20 is more than 3 to 4 mm, and when installing the return apertures 24 of about 1 to 1.5 mm on the same flat surface 25, it is possible to directly perform drilling process of the return apertures 24 on the above flat surface 25. However, when installing still smaller return apertures 24, like 0.3 to 0.4 mm or so, on the smaller diametrical flat surface 25 of the top part of said distributor 20, it becomes difficult to directly perform drilling process of the return apertures 24 of such a small diameter ; and even when such a drilling process was feasible, the drilling equipment incurred a cost-benefit problem.

Accordingly, the present invention aims at providing such a return type spray nozzle as enabling to solve said existing problem and to obtain small return apertures at the locations deviated from the center axis of the spray opening securely, easily and at a low cost, thereby enabling to prevent external air from being involved in return apertures and obtaining fine, accurate and large turndown ratio at small capacity burning.

Disclosure of Invention

To achieve the above object, the return type spray nozzle of the present invention, consists essentially of a spray nozzle body and a distributor inserted into the inner hole of said spray nozzle body, the center of the top part of said spray nozzle body being equipped with a spray opening, the vicinity of the center of the top part of said distributor being equipped with return apertures at the locations deviated from the center axis of said spray opening, the outside of the shoulder part of said distributor being equipped with fuel supplying slit-ducts that supply liquid fuel sent into the inner hole in said spray nozzle body to a spray waiting chamber located in front of the top part of said distributor, said liquid fuel sent into said spray waiting chamber then being blown out through said spray opening from the spray waiting chamber, at the same time part of said liquid fuel in said spray waiting chamber being made to return through said return apertures instead of being blown out through said spray opening, said return apertures of said distributor being formed as penetrating gaps created at the boundary area between a central penetrating hole and a core-body that is inserted rigidly into the central penetrating hole, by that the central penetrating hole is formed, in the vicinity of the center of the top part of the distributor, coaxially with the center axis of the spray opening and the core-body is inserted, with its incoordinate sectional shape, into said central penetrating hole. The above constitution is the first feature of the return type spray nozzle according to the present invention.

In addition to the above first feature, the return type spray nozzle of the present invention makes it the second feature that the return apertures are formed as penetrating gaps created at the boundary area between the central penetrating hole and the core-body, by that the core-body whose outside surface is concavely and multiplicately striped is inserted rigidly into the central penetrating hole.

In addition to the above first feature, the return type spray nozzle of the present invention makes it the third feature that the return apertures, by concave stripes, are formed as penetrating gaps created at the boundary area between the central penetrating hole and the core-body, by that the core-body is inserted rigidly into the central penetrating hole whose inside surface is concavely and multiplicately striped.

In addition to any of the above-mentioned first to third feature, the return type spray nozzle of the present invention makes it the fourth feature that the plurality of return apertures are arranged symmetrically around the center axis.

In addition to said first feature, the return type spray nozzle of the present invention makes it the fifth feature that a ring-shaped return aperture is formed as a penetrating gap at the boundary area between the core-body and the central penetrating hole, by that the core-body that has the similar-figure and smaller diameter, as compared with the central penetrating hole, is inserted rigidly into the central penetrating hole.

According to the first feature of the present invention ; the return apertures are formed as penetrating gaps created at the boundary area between the central penetrating hole that is formed in the vicinity of the center of the top part of the distributor coaxially with the center axis of the spray opening and the core-body that is inserted into the central penetrating hole with its incoordinate sectional shape ; namely the return apertures are formed as penetrating gaps created on account of the different sectional shapes ; so that small diametrical return apertures can be formed easily at the locations deviated from the center axis. As the diameters of said central penetrating hole and the core-body themselves can be made to be relatively large, drilling process is easy. Further, the working for making the sectional shapes of both the central penetrating hole and the core-body incoordinate can be easily done ; namely, the working of longitudinal concave or convex striping, shaving, scratching, pressing inside the central penetrating hole or outside the core-body, can be easily performed. Accordingly, it is possible to form the return apertures at far less difficulty and cost as compared with the case wherein small holes should be directly drilled through the distributor.

The return apertures can be made to be plural like two, three, and four ; but only one will also do. When making the apertures plural, it is favorable to arrange them symmetrically around the center axis for the sake of attaining balanced imbibing returning flow ; however, such symmetricalness is not essential needs.

Installing the return apertures being at the positions deviated from the center axis can prevent the air coming from the spray opening and passing through the center part of the vortex flow in the spray waiting chamber from invading the return apertures.

Further, by means of utilizing the gap between the central penetrating hole and the core-body that is inserted rigidly into the above hole, the adequately small diametrical return apertures can be securely, simply, and easily obtained ; so that, the return apertures can be all the more surely protected from being invaded by the air.

In addition, it is easy for the return apertures to be formed plurally, and for returning fuel quantity to be increased that much ; so that, it is easy to make turn-down ratio large.

Inserting the core-body into the central penetrating hole can be performed by the use of, for instance, expansion fit, shrinkage fit, ultrasonic fit, and other known technology.

According to the second feature of the present invention ; the longitudinal concave stripes on core-body outside surface can be formed by scratching, shaving, cutting, and pressing the relevant stripe positions.

And, in addition to the operation and effect by the first feature, the core body whose outside surface is concavely and multiplicately striped is inserted rigidly

into the central penetrating hole ; as a result, the return apertures by the above concave stripes are formed as the penetrating gaps created at the boundary area between the core-body and the central penetrating hole ; resultingly, adequately small diametrical return apertures that are deviated from the center axis can be obtained, the return apertures can be securely protected from being invaded by the air, and at the same time, capability adjustment at small capacity burning can be surely performed.

According to the third feature of the present invention, the concave stripes of the central penetrating hole inside surface can be formed like the case of the core-body outside surface. And, in addition to the operation and effect by the first feature, the core-body is inserted rigidly into the central penetrating hole whose inside surface is concavely and multiplicately striped ; as a result, the return apertures by the above concave stripes are formed as the penetrating gaps created at the boundary area between the core-body and the central penetrating hole ; resultingly, adequately small diametrical return apertures that are deviated from the center axis can be obtained, the return apertures can be securely protected from being invaded by the air, and at the same time, capability adjustment at small capacity burning can be surely performed.

According to the fourth feature of the present invention ; in addition to the operation and effect by any of the above first to third feature, the plurality of return apertures are installed symmetrically around the center axis. So that, the liquid fuel, from the spray waitng chamber , that is returned to the return apertures becomes well balanced, and as a result, the place-based overs-and-shorts of the liquid fuel in the spray waiting chamber can be removed, and stable spraying from the spray waiting chamber can be performed.

According to the fifth feature ; in addition to the operation and effect of the above first feature, the small diametrical and ring-shaped return aperture can be obtained at the position deviated from the center axis, and so, the return aperture can be securely protected from being invaded by the air, and at the same time, capability adjustment at small capacity burning can be surely performed.

Brief Description of Drawings

Fig.1, Fig.2, Fig.3, and Fig.4 show the first preferred embodiment of the present invention ; Fig.1 is a partially cutaway side view illustrating the overall outline of the return type spray nozzle, Fig.2 is a vertical sectional and structural view of the principal part of the return type spray nozzle, Fig.3 is a plan view of the principal part of the distributor, and Fig.4 is a perspective view of the core-body.

Fig.5 and Fig.6 show the second preferred embodiment of the present invention ; Fig.5 is a plan view of the principal part of the distributor of the return type spray nozzle, and Fig.6 is a perspective view of the core-body.

Fig.7 and Fig.8 show the third preferred embodiment of the present invention ; Fig.7 is a vertical sectional and structural view of the principal part of the distributor of the return type spray nozzle, and Fig.8 is a plan view of the principal part of the distributor.

Fig.9 and Fig.10 show the fourth preferred embodiment of the present invention ; Fig.9 is a vertical sectional and structural view of the principal part of the distributor of the return type spray nozzle, and Fig.10 is a plan view of the distributor of the return type spray nozzle.

Fig.11 and Fig.12 show an existing example ; Fig.11 is a overall outline of the return type spray nozzle, and Fig.12 is a vertical sectional and structural view of the principal part of the return type spray nozzle.

Fig.13 and Fig.14 show another existing example ; Fig.13 is a vertical sectional and structural view of the principal part of the return type spray nozzle, and Fig.14 is a plan view of the distributor of the return type spray nozzle.

Best Mode for Carrying Out the Invention

In Fig.1, as in Fig.11, a supply line 3 and a return path 5 of liquid fuel including petroleum are connected to a return type spray nozzle 4.

The head part of said return type spray nozzle 4 is equipped with a spray nozzle body 50, and a distributor 60 is installed inside the spray nozzle body 50.

Said spray nozzle body 50 is quick-connectably-disconnectably screwed on the top part of the external cylindrical case 41 of the return type spray nozzle 4. And the distributor 60 is inserted rigidly into the top part of the internal cylinder 42 of the return type spray nozzle 4. The internal cylinder 42 and said external cylindrical case 41 are quick-connectably-disconnectably screwed fixedly on each other coaxially. 43 stands for a filter. The petroleum that originated from a tank 1 (not shown in Fig.1, but shown in Fig.11) and came into the return type spray nozzle 4 through the supply line 3, is then sent forward between the external cylindrical case 41 and the internal cylinder 42, and after getting rid of mixtures with the help of a filter 43, is further sent forward, and is supplied into a spray waiting chamber 70 in front of the distributor 60 after passing through inside the inner hole of the spray nozzle body 50, namely, through the gap between the spray nozzle body 50 and the distributor 60. The petroleum supplied to the spray waiting chamber 70 is blown out from the spray opening 51 of the spray nozzle body 50 and used for burning. Part of the petroleum, from the spray waiting chamber 70, is returned into the internal cylinder 42 after passing through (later described) return apertures 90 of the distributor 60, and is further returned into the return path 5. Petroleum amount to be returned is adjusted by a return amount control valve 6. The above adjustment is automated by the use of a (not shown) controller in response to necessary heating value.

Referring to Figs.2, 3, and 4, the details will be given hereunder. A spray opening 51 is installed at the center of the top part of said spray nozzle body 50 ; and the center axis X of this spray opening 51 is not only the center axis of the spray nozzle body 50, but also the center axis of the return type spray nozzle 4 itself.

Said distributor 60 is inserted into the inner hole of said spray nozzle body 50, and the outside shoulder part 61 of the distributor 60, that is pushingly contacted with the conical inner hole 52 in the vicinity of the top of the spray nozzle body 50, is provided with plurality of fuel supplying slit-ducts 62. In this example, four slit-ducts are provided ; however, three slit-ducts 62 will do as well, or only one slit-duct will also do. Slit-duct quantity is not especially limited to certain number ; however, it is favorable that plurality of slit-ducts are provided around the center axis X keeping good balance. The petroleum is supplied to the spray waiting chamber 70 in front of the top part of the distributor 60 after passing through said fuel supplying slit-ducts 62.

The spray waiting chamber 70 is the space that is situated in the vicinity of the top part of the conical inner hole 52 of the spray nozzle body 50, and is the space that is surrounded by the wall of said conical inner hole 52 and the top flat surface 65 of said distributor 60. The center of the above space of the chamber 70 is the center axis X itself.

In the vicinity of the top part of said distributor 60, a central penetrating hole 63 is formed coaxially with said center axis X. This central penetrating hole 63 continues to an expanded penetrating hole 64 of the distributor 60, and the expanded penetrating hole 64 connects with said internal cylinder 42 (see Fig.1).

A core-body 80 is inserted into the central penetrating hole 63 of said distributor 60. In the preferred embodiment illustrated in these Figs.1 to 4, said core-body 80 consists of a rod-shaped body with plurality of longitudinal concave stripes 81 being formed on outside surface. Because this core-body 80 is inserted into the central penetrating hole 63, penetrating gaps surrounded by the concave stripes 81 and the inside surface of the central penetrating hole 63 are established at the boundary area between the central penetrating hole 63 and closest core-body 80. This penetrating gaps construct return apertures 90. Namely, because the sectional shape of the core-body 80 that is inserted into the central penetrating hole 63 becomes incoodinate with the sectional shape of the hole 63 at the positions of the concave stripes, the return apertures 90 can be established ; moreover, that return apertures 90 can be established at the positions deviated from the center axis X.

Actually, said core-body 80 is made to be a little larger than said central penetrating hole 63. And still the core-body 80 can be tightly and rigidly inserted into the hole 63 by means of ultrasonic vibration, shrinkage fit, or expansion fit. Further, the concave stripes 81 to be formed longitudinally outside the core-body 80, can be formed by means of scratching, shaving, or pressing. The work is only to form adequately small sized concave stripes outside the core-body 80, so, as compared with drilling holes, the work can be carried out very simply, easily and certainly.

By arranging plurality of said concave stripes 81 in circumferential and symmetrical positions, balanced arrangement of the return apertures 90 can be obtained. Further, by obtaining such a balanced arrangement, petroleum returning can be attained keeping petroleum existential balancing in the spray waiting chamber 70. And further, it is possible to make the turndown ratio at burning adjustment adequately large by having the diameters of individual return apertures 90 small and having the holes open area of the return apertures 90 as a whole adequately large.

Referring to Figs.5 and 6, the second preferred embodiment of the present invention will be shown hereunder ; Fig.5 being a plan view of the principal part of the distributor and Fig.6 being a perspective view of the core-body.

In this embodiment, as the core-body 80 to be inserted into the central penetrating hole 63 of the distributor 60, a rod-shaped-body whose horizontal section is approximately triangular is adopted. By using such a core body 80, and by inserting such a core-body 80 into said cylindrical inside surfaced central penetrating hole 63, the return apertures 90 can be formed as the penetrating gaps at the boundary area between the core-body 80 and the central penetrating hole 63 closest to the core-body 80. In this preferred embodiment, each side of triangle pole serves for the concave stripes 81.

Other construction, operation and the like is the same as the case of the first embodiment.

Referring to Figs.7 and 8, the third preferred embodiment of the present invention will be shown hereunder ; Fig.7 being a vertical sectional and structural view of the principal part of the distributor and Fig.8 being a plan view of the principal part of the distributor.

In this preferred embodiment, by forming concave stripes 63a of the distributor 60 on inside surface of the central penetrating hole 63, plurality of the return apertures 90 can be formed around the center axis X at the positions deviated from the center axis X. Namely, firstly, by forming plurality of the concave stripes 63a on inside surface of the central penetrating hole 63, and secondly by inserting the core-body 80 rigidly into said central penetrating hole 63, the penetrating gaps surrounded by said concave stripes 63a and the core-body 80 external surface can be formed at the boundary area between the core-body 80 and the central penetrating hole 63 closest to the core-body 80, and this penetrating gaps serve for the return apertures 90.

Actually, said core-body 80 is made to be a little larger than said central penetrating holes 63. And still the core-body 80 can be tightly and rigidly inserted into the hole 63 by means of ultrasonic vibration, shrinkage fit, or expansion fit. Further, the concave stripes 63a to be formed longitudinally inside the central penetrating hole 63 can be formed by means of scratching, shaving,

or pressing. The work is only to form adequately small sized concave stripes inside the central penetrating hole 63, so, as compared with drilling holes, the work can be carried out very simply, easily and certainly.

By arranging plurality of said concave stripes 63a at circumferential and symmetrical positions, balanced arrangement of the return apertures 90 can be obtained. Further, by obtaining such a balanced arrangement, petroleum returning can be attained keeping petroleum existential balancing in the spray waiting chamber 70.

This preferred embodiment basically brings about the same operation and effect as the aforementioned case wherein the concave stripes 81 are formed on the core-body 80 side.

In the above first to third preferred embodiment, it should be added that the concave stripes 63a which are formed in the central penetrating hole 63 and the concave stripes 81 which are formed on the core-body 80 will do as far as these stripes are plural, without restriction of the number. The shapes and sizes of stripes 63a and 81 can also be freely selected.

Usually, the length of the core-body 80 should be a match for the length of the central penetrating hole 63 ; however, the former needs not to be strictly the same as the latter, namely, being a little shorter or longer is allowed.

In addition, in the above first to third preferred embodiment ; by forming concave stripes 63a or 81 in the central penetrating hole 63 or in the core-body 80, the penetrating gaps can be formed at the boundary area between the central penetrating hole 63 and the core-body 80 inserted closestly and rigidly into the hole 63 ; thereby, the return apertures 90 can be established. However, it is not necessarily concave stripes 63a or 81 that are formed in said central penetrating hole 63 or on said core-body 80.

In short, if any penetrating gaps due to disagreement of the sectional shapes of both the core-body 80 and the central penetrating hole 63 should be formed at the boundary area between the central penetrating hole 63 and the core-body 80 inserted closestly into the hole 63, the same penetrating gaps can serve for the return apertures 90. So that, instead of said concave stripes 63a or 81, other mutual shape difference due to concaveness, convexness, and all other varieties can be utilized. In addition, tangible manufacturing methods for forming shape disagreement are not to be limited to aforementioned techniques.

Referring to Figs.9 and 10, the fourth preferred embodiment of the present invention will be shown hereunder ; Fig.9 being a vertical sectional and structural view of the principal part of the distributor and Fig.10 being a plan view of the distributor.

In the aforementioned preferred embodiments, the core-body 80 is inserted closestly, excepting the part of the stripes 63a or 81, into the central penetrating hole 63 of the distributor 60. As compared with the above embodiments , in this embodiment ; the core-body 80 that has the similar figure and smaller diameter, as compared with the central penetrating hole 63, is inserted rigidly into the central penetrating hole 63 of the distributor 60 ; thereby, a single continual ring-shaped penetrating gap is established at the boundary area between the core-body 80 and the central penetrating hole 63. And this gap serves for the return aperture 90.

The method for fixing the core-body 80 is ; firstly, the length of the core-body 80 is made to be longer than that of the central penetrating hole 63, and secondly, the above longer part of the core-body 80 is made to shoot forth into the expanded penetrating hole 64, and thirdly, the hind part of the core-body 80 that shoots forth, out of the central penetrating hole 63, into the expanded penetrating hole 64 is fixed to the inner wall of this expanded penetrating hole 64 by the use of a fixture 100 in order that the returning flow may not be disturbed. This fixture 100 may be three outstanding pieces unitedly attached to the hind part of the core-body 80 with mutual angle being 120 degrees. In that case, the core-body 80 with three outstanding pieces (as the fixture 100) being unitedly attached should be inserted from the side of expanded penetrating hole 64 and be fixed. Or, said fixture 100 may be such supporters as unitedly attached to the expanded penetrating hole 64 itself. In this case, three supporters that are extended from the positions (with mutual angle being 120 degrees) of inside wall of the expanded penetrating hole 64 toward the center axis X become the fixture 100, and these supporters support the core-body 80 from its circumference. Further, said fixture 100 may be a thing quick-connectable-disconnectable to either the core-body 80 or the expanded penetrating hole 64. In this case, the core-body 80 may be firstly inserted rigidly into the fixture 100, and then both of them may be inserted into the expanded penetrating hole 64 ; or, the fixture 100 may be firstly inserted rigidly into the expanded penetrating hole 64, and then the core-body 80 may be inserted into both of them.

As other method for this preferred embodiment, it is possible that ; firstly, the fixture 100 as shown in Fig.9 is not provided, or small well-balanced projections are provided (in addition to the fixture 100) on the circumference outside the part of the core-body 80 that is inserted into the central penetrating hole 63 ; secondly, when the core-body 80 is inserted into the central penetrating hole 63, said projections are made to contact with here and there inside the central penetrating hole 63 ; thirdly, thus aforementioned ring-shaped penetrating gap is made to be secured.

It is favorable that the central penetrating hole 63 explained in the above-mentioned preferred embodiments be made to be a circular sectional hole ; however, the hole 63 is not necessarily circular, but it may be nearly circular hole or may be a polygonal-sectional hole. Similarly, it is favorable that the core-body 80 be made to be a circular sectional body added by such a little deformation as the concave stripes 81 or other means ; however, the body 80 may be basically a polyg-

onal-sectional one other than a circular sectional one, added by some deformation means.

The length of the core-body 80 is not especially restricted.

The diameter of the spray opening 51 is, for instance, not more than about 1 mm for a small capacity usage. It can be changed in response to targeted burning capacity, and is not especially limited.

In the present invention, it can be easily performed that the diameter of the return apertures 90 is formed to be not more than 1 mm, for instance about 0.3 to 0.4 mm , for a small capacity usage. With regard to the diameter of the return apertures 90 also, the size can be selected in response to the capacity, without being especially limited.

In addition to the above, it is naturally necessary for the return apertures 90 to be formed at the positions deviated from the center axis X, however, other arrangements, shapes, and others are not especially restricted.

Industrial Application

The present invention consists of the above-mentioned construction and operation, and in accordance with the return type spray nozzle described in claim itm 1, the return apertures of the distributor is formed as the penetrating gaps created at the boundary area between the central penetrating hole and the core-body that is inserted rigidly into the central penetrating hole, by that the central penetrating hole is formed, in the vicinity of the center of the top part of the distributor, coaxially with the center axis of the spray opening and the core-body is inserted, with its incoodinate sectional shape, into said central penetrating hole, therefore :

The adequately small diametrical return apertures necessary for small capacity burning can be formed easily, and at the positions deviated from the center axis.

Further, the diameters of the central penetrating hole and the core-body themselves can be made to be relatively large, so that drilling can be easily processed.

Further, making the sectional shape of the central penetrating hole incoordinate with that of the core-body can be easily performed by adding longitudinal concave or convex stripes, shaving, scratching and pressing, upon the inside surface of the central penetrating hole or the outside surface of the core-body. Accordingly, the return apertures can be formed far easily and at far low cost as compared with the case wherein small holes should be directly drilled on the distributor.

Further, it is easy to make plurality of the return apertures to be formed, and to make the return amount to be increased that much ; therefore, turndown ratio can be easily increased.

Naturally, by providing the return apertures at the positions deviated from the center axis, the air coming from the spray opening and entering through the center of the vortex in the spray waiting chamber can be prohibited from further invading the return apertures. In addition, by utilizing the gaps between the central penetrating hole and the core-body that is inserted into the central penetrating hole, the adequately small diametrical return apertures can be obtained securely, simply and easily. So that invasion of the air upon the return apertures can be prohibited further securely.

Further, in accordance with the return type spray nozzle described in claim item 2, and in addition to the effect by the construction described in said claim item 1, the core-body whose outside surface is provided with concave stripes is inserted rigidly into the central penetrating hole ; as a result, the return apertures by said stripes are formed as the penetrating gaps at the boundary area between the core-body and the central penetrating hole, so that, the adequately small diametrical return apertures can be obtained at the positions deviated from the center axis, the return apertures can be protected securely from invasion of the air, and as a result, adjustment of capacity at small burning capacity can be surely performed.

Further, in accordance with the return type spray nozzle described in claim item 3, and in addition to the effect by the construction described in said claim item 1, the core-body is inserted rigidly into the central penetrating hole whose inside surface is provided with concave stripes ; as a result, the return apertures by said stripes are formed as the penetrating gaps at the boundary area between the core-body and the central penetrating hole, so that, the adequately small diametrical return apertures can be obtained at the positions deviated from the center axis, the return apertures can be protected securely from invasion of the air, and as a result, adjustment of capacity at small burning capacity can be surely performed.

Further, in accordance with the return type spray nozzle described in claim item 4, and in addition to the effect by the construction described in any of said claim items 1 to 3, plurality of return apertures are provided symmetrically around the center axis, so that the liquid fuel to be returned from the spray waitng chamber to the return apertures becomes well-balanced, and accordingly, the liquid fuel in the spray waiting chamber is kept from overs and shorts due to the location in the chamber, and as a result, stable spraying from the spray waiting chamber can be performed.

Further, in accordance with the return type spray nozzle described in claim item 5, and in addition to the effect by the construction described in said claim item 1, the small diametrical ring-shaped return aperture can be obtained at the position deviated from the center axis, and as a result, the return aperture can be protected securely from invasion of the air, and as a result, adjustment of capacity at small burning capacity can be surely performed.

Claims

1. Return type spray nozzle characterized to comprise : a spray nozzle body (50) and a distributor (60)

inserted into the inner hole of the spray nozzle body (50), the center of the top part of said spray nozzle body (50) being equipped with a spray opening (51), the vicinity of the center of the top part of said distributor (60) being equipped with return apertures (90) at the locations deviated from the center axis (X) of said spray opening (51), the outside of the shoulder part (61) of the distributor (60) being equipped with fuel supplying slit-ducts (62) that supply liquid fuel sent into the inner hole in said spray nozzle body (50) to a spray waiting chamber (70) located in front of the top part of the distributor (60), the liquid fuel sent into said spray waiting chamber (70) then being blown out through said spray opening (51) from the spray waiting chamber (70), at the same time, part of said liquid fuel in said spray waiting chamber (70) being made to return through said return apertures (90) instead of being blown out through said spray opening (51) ; further, the return apertures (90) of said distributor (60) being formed as penetrating gaps created at the boundary area between a central penetrating hole (63) and a core-body (80) that is inserted rigidly into the central penetrating hole (63), by that the central penetrating hole (63) is formed, in the vicinity of the top part of the distributor (60), coaxially with the center axis (X) of said spray opening (51) and the core-body (80) is inserted, with its incoordinate sectional shape, into said central penetrating hole (63).

2. Return type spray nozzle as defined in claim item 1, wherein the return apertures (90) based on undermentioned concave stripes (81) are formed as penetrating gaps created at the boundary area between the central penetrating hole (63) and the core-body (80), by that the core-body (80) whose outside surface is concavely and multiplicately striped (81) is inserted rigidly into the central penetrating hole (63).

3. Return type spray nozzle as defined in claim item 1, wherein the return apertures (90) based on undermentioned concave stripes (63a) are formed as penetrating gaps created at the boundary area between the central penetrating hole (63) and the core-body (80), by that the core-body (80) is inserted rigidly into the central penetrating hole (63) whose inside surface is concavely and multiplicately striped (63a).

4. Return type spray nozzle as defined in any of claim items 1 to 3, wherein plurality of the return apertures (90) are arranged symmetrically around the center axis (X).

5. Return type spray nozzle as defined in claim item 1, wherein a ring-shaped return aperture (90) is formed as a penetrating gap at the boundary area between the core-body (80) and the central penetrating hole (63), by that the core-body (80) that has the similar figure and smaller diameter, as compared with the central penetrating hole (63), is inserted rigidly into the central penetrating hole (63).

FIG.1

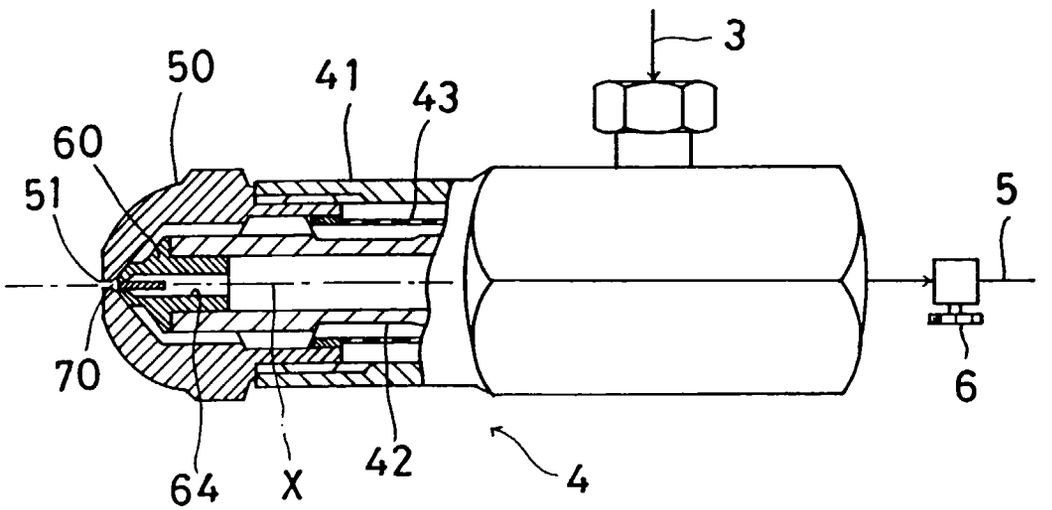


FIG.2

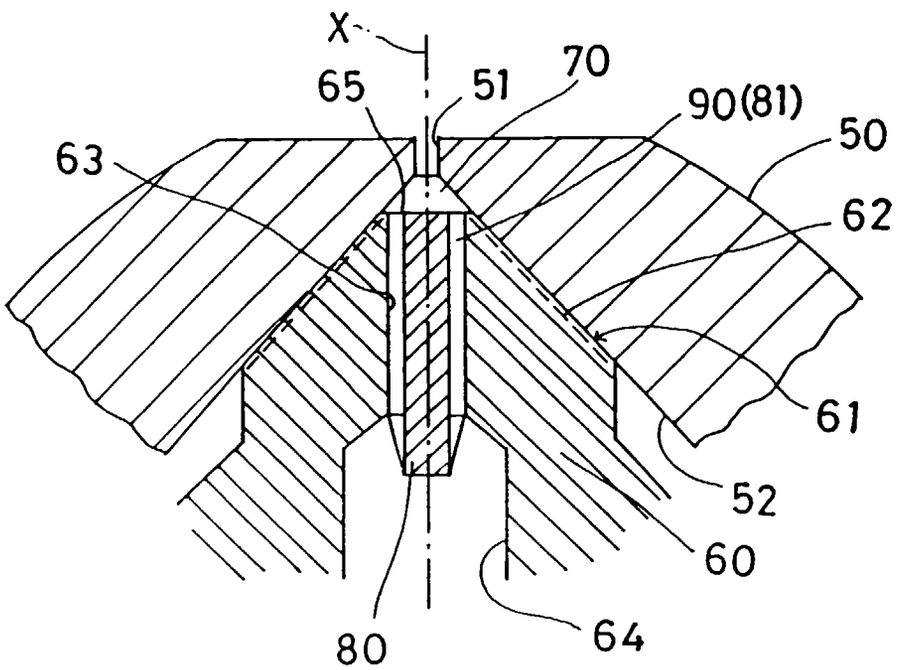


FIG.3

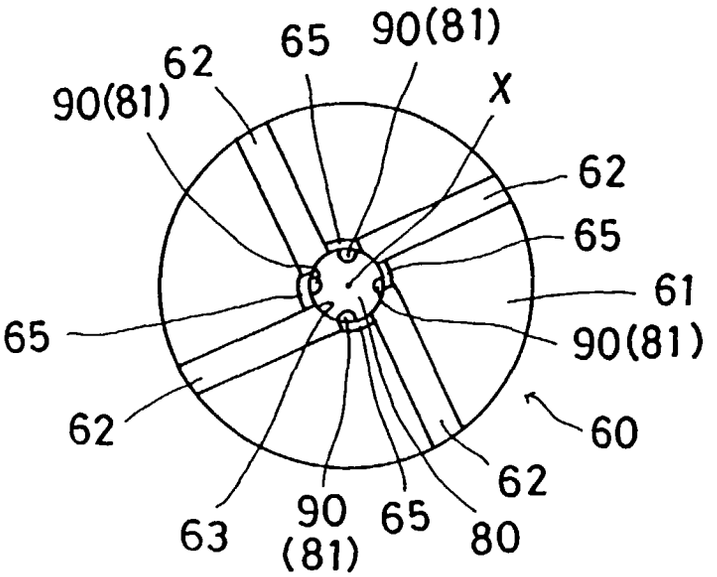

90(81)
65
62
90(81)
X
62
65
61
90(81)
60
62
80
65
90
(81)
63
62
65

FIG.4

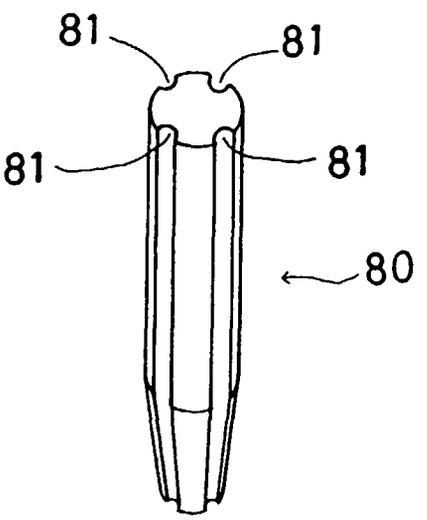

81
81
81
81
80

FIG.5

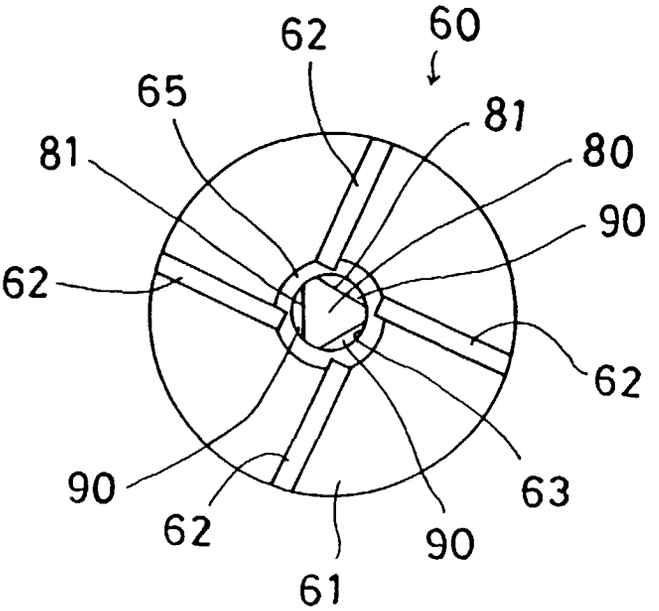


FIG.6

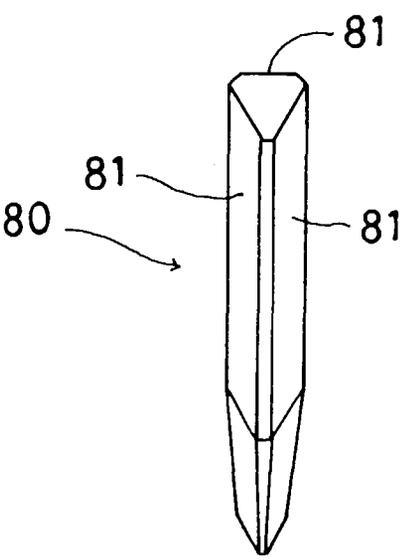


FIG.7

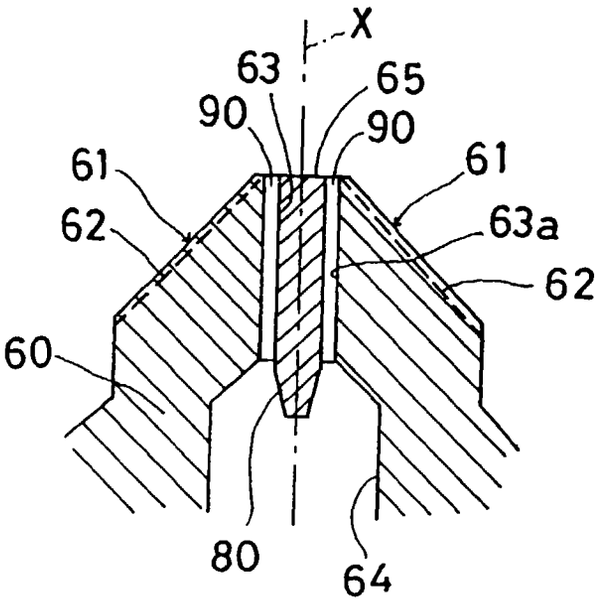

X
63
65
90
90
61
61
62
63a
62
60
80
64

FIG.8

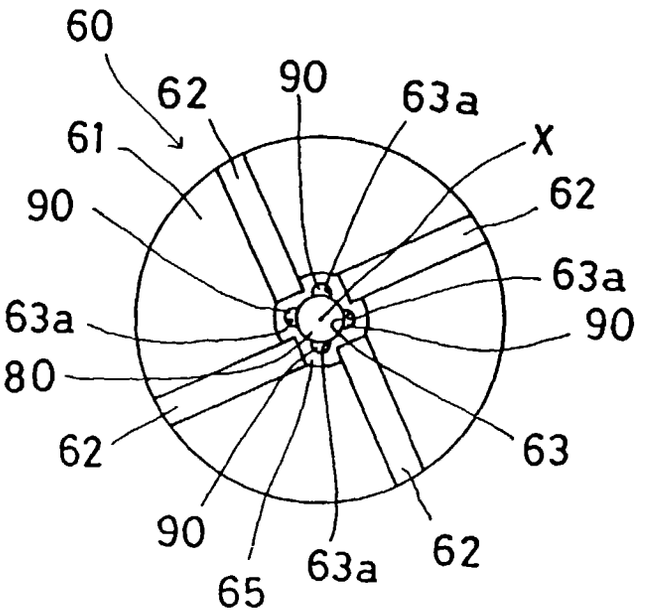

60
62
90
63a
61
X
90
62
63a
63a
90
80
62
63
90
65
63a
62

FIG.9

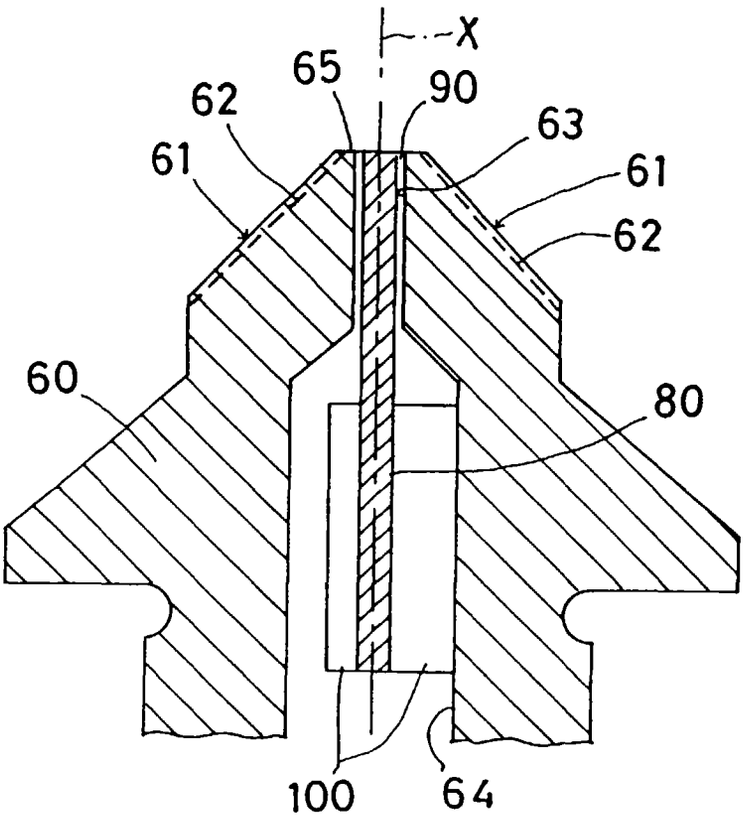


FIG.10

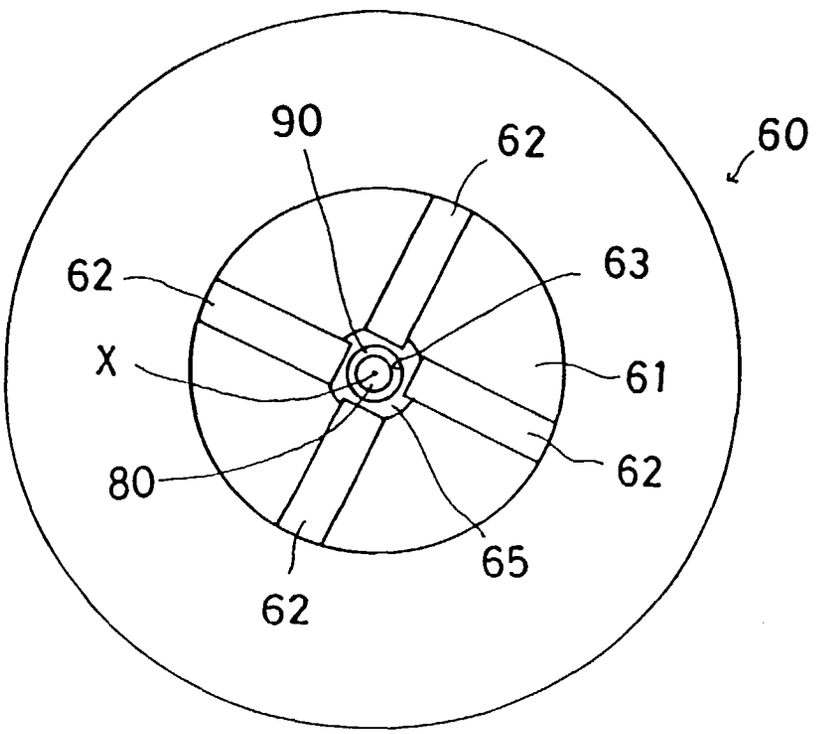


FIG.11

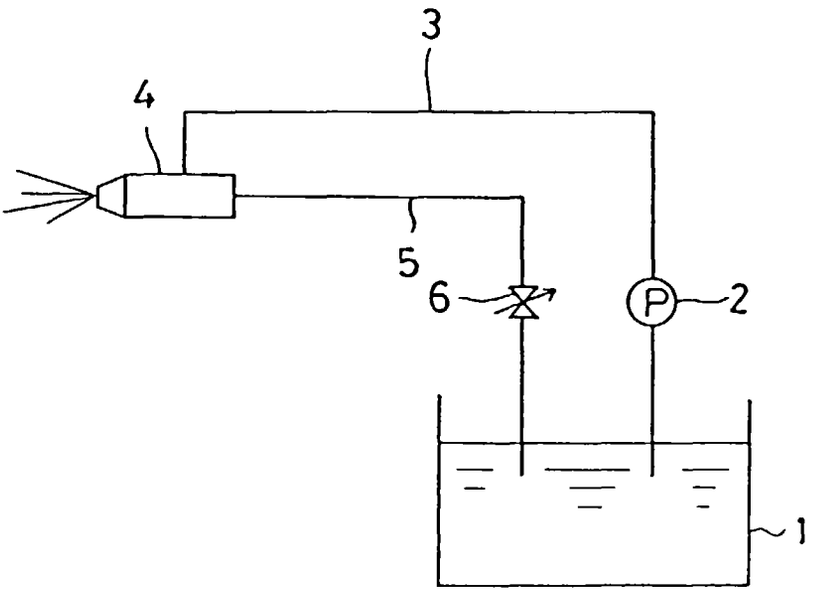


FIG.12

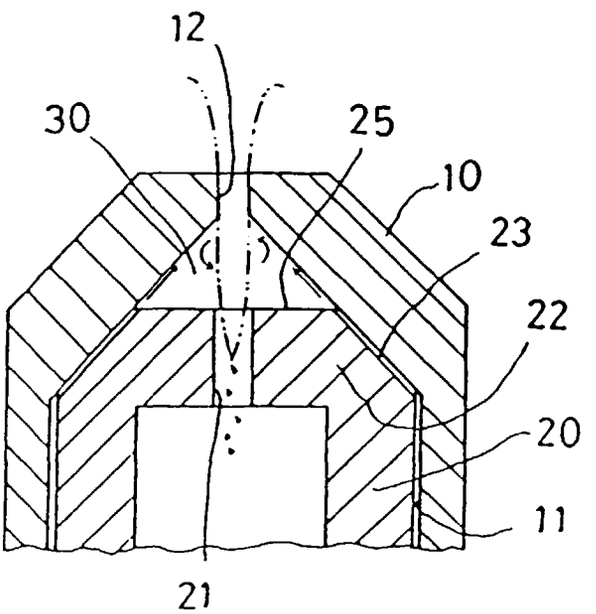


FIG.13

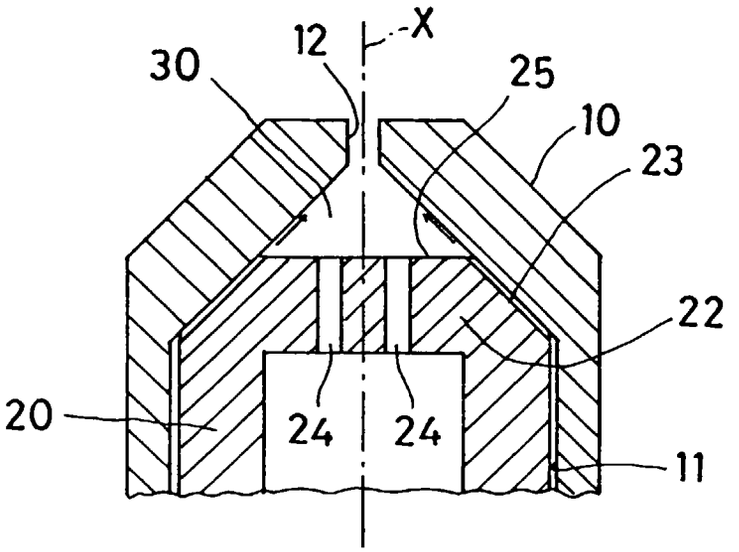
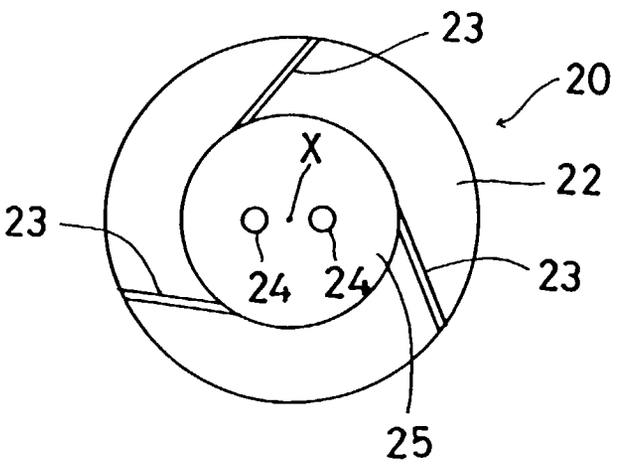


FIG.14



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP96/03557

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl^6 F23D11/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl^6 F23D11/36-11/38

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926 - 1995
Kokai Jitsuyo Shinan Koho 1971 - 1995
Toroku Jitsuyo Shinan Koho 1994 - 1997

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP, 50-66840, A (Babcock-Hitachi K.K.), June 5, 1975 (05. 06. 75), Fig. 1 (Family: none)	1
A		2 - 5
Y	JP, 05-79211, U (Toto Ltd.), October 29, 1993 (29. 10. 93), Fig. 2 (Family: none)	1
A		2 - 5
A	JP, 04-295505, A (Noritz Corp.), October 20, 1992 (20. 10. 92), Figs. 1 to 5 (Family: none)	1 - 5
A	JP, 04-295506, A (Noritz Corp.), October 20, 1992 (20. 10. 92), Figs. 1 to 8 (Family: none)	1 - 5

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
March 4, 1997 (04. 03. 97)	March 18, 1997 (18. 03. 97)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)