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(54) **METHOD AND DEVICE FOR INJECTING HIGH PRESSURE WATER FOR FACILITY OR THE LIKE ON ROADSIDE.**

(57) A device for injecting a high pressure water stream of uniform pressure to clean the surface of the wall of a tunnel, which supplies high pressure water via a high pressure water guide pipe (4), injects the water from a nozzle (1) having an elliptical hole (2), supplies compressed air via a guide pipe (5), discharges the air through a passage (7') between the first pipe (8) of hollow rectangular section and the second pipe (9) of hollow rectangular section disposed therein, simultaneously discharges the air via the passage (6') of the second pipe (9), and joins part of the air stream of the passage (7') through an air passage hole (9') to the air stream of the passage (6'). Thus, the injected water stream is discharged as a laminated fluid surrounded by a plurality of air stream layers to obtain a water pressure pattern of uniform pressure on the surface to be cleaned, thereby efficiently cleaning the wall. This device can be utilized for a painting, a removing solvent, etc.

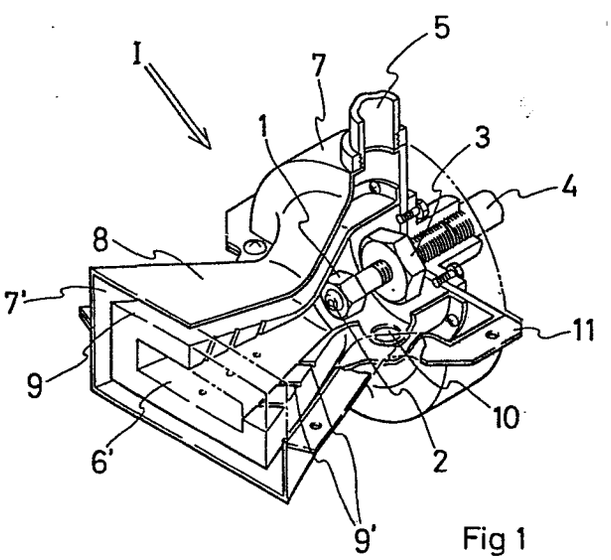

Fig 1

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TITLE MODIFIED
see front page

TITLE OF THE INVENTION

Injection method and equipment of wash water under the high pressure relates to a tunnel structure

TECHNICAL FIELD

Applying for the surface of atomizing body and/or injection equipment

BACKGROUND OF THE INVENTION

The present invention relates to the method of injecting high pressure water to facilities on the industrial field and to surfaces of such members enabling effective washing of these, particularly to route it on facilities in the field of road construction as, for example, the wall of tunnels while travelling a sprayer in relation to the surface thereof so as to finish the same effectively.

In detail, this invention relates to a method of injection to achieve a water pattern under uniform pressure in which a flow of narrow width in the direction of the X-axis is formed with a bar shaped flow extending in the vertical direction of the Y-axis on the surface of an object by a granulating group of high

pressure injection water flows after generating the fluids compressed with compressed air flows discharging out of a rectangular section and further besieging said fluids with other air flows by means of the instruments loaded on the running vehicle.

Most of the conventional nozzles in order to do that washing either inject a pattern of an ellipse, a circle or a ring depending upon the shape and size of holes of a nozzle itself, regardless of the power of feeding water pressure.

Regarding the ellipse pattern, for example, as shown in FIG. 5, a pressure distribution on a collision surface shows the maximum at a center portion thereof and becomes lower at a peripheral portion thereof with more distance from the axis of O reducing the pressure as shown in FIG. 7 even if an angle of the nozzle is constructed to be variable.

Such well-known distribution pattern may simply be understood as an isobaric line of hills in a map (FIG. 8) and, as a result, the non-uniform pressure is apt to occur particularly in the direction of Y-axis of a collision surface, which compels to repeat an excessive operation of the movement of a nozzle in order to obtain a desired washing effect or which compels to suffer such inefficiency and expenditure as mounting a plurality of nozzles to the equipment.

DISCLOSURE OF THE INVENTION

The present invention mainly relates to the method of washing road facilities and the equipment thereof; and to a cylindrical drum consisting of an external and an internal air chamber which constitute such equipment solid-

ly and which are combined with two (2) air injecting pipes and two (2) compressed air passages formed by said concentric pipes.

The high pressure injection water ejected out of the nozzles is actuating simultaneously with each portion communicated therewith and the air flows compressed by said double layers are enabling the particles of injected water to achieve a desired pressure distribution in the form of a bar on the surface of an object to be washed by producing and projecting the granulating flows of energy under uniform pressure, the effect of which is doubled by the above particles of said air flows under a certain prescribed condition.

POSSIBILITIES IN THE INDUSTRIAL APPLICATION

According to the present invention the granulating group forming a high pressure water flow is injected by being supported and besieging with an air flow, which is likely to be double layers in particle dynamics, with a relative velocity equivalent to said granulating group so that ⎍ type shaped and the injection pattern under the uniform pressure may be projected to the surface for that object.

Injection of high pressure water enabling to offer the same function repeatedly in this method may be utilized in this industrial field to which the present invention belongs and further is essential therefor.

BRIEF EXPLANATION OF THE DRAWINGS

FIG. 1 is a perspective view of the injection equipment

embodying the present invention.

FIG. 2 is a sectional view of the equipment in its plane and an operational view thereof.

FIG. 3 is a sectional view in its side elèvation and an operational view thereof.

FIG. 4 shows the functional data embodying the present invention.

FIG. 6 is a view embodying the water pressure distribution pattern obtained in FIG. 4, and

FIGS. 5, 7 and then FIG. 8 show a conventional water distribution pattern, respectively.

BEST ASPECT OF THE EMBODIMENT OF INVENTION

(Description of preferred embodiments of the present invention)

The present invention relates to the method of injecting high pressure water and the equipment thereof for carrying out effective washing of the facilities and such members in the industrial field thereof, particularly to route it on facilities of road construction such as, for example, a wall surface of a tunnel in order to carry out same effectively by travelling an injection equipment.

Prior to this application, concerning a device enabling to collide strongly with an ultra high pressure water flow injected out of a small nozzle, the inventor disclosed a device for mixing the air flow with an

excessive water injection speed than such water flow within a hollow pipe enveloping nozzles.

The method of injection according to the present invention is the newly developed technical thought which was achieved after making again various tests in order to obtain a water pressure pattern which could not be obtained by the above-mentioned disclosure. An object of the present invention is achieved by enabling to rise always an injection flow (FIG. 6) in the form of a bar on a surface of an object to be washed, extending along the vertical line (Y-axis) under the uniform pressure on both the X-axis in the direction of a nozzle and the Y-axis vertical thereto.

Hereinafter, an embodiment of the present invention will be explained with reference to the construction of a nozzle.

FIG. 1 is a perspective view of equipment I according to the present invention, partially shown with a section thereof and FIG. 2 is a longitudinal sectional view through equipment I with an explanatory view of the function thereof.

The equipment I is provided with a first pipe 8 with a hollow rectangular section forming an external portion thereof and with a second pipe 9 with a rectangular section arranged within said first pipe 8. Those pipes 8 and 9 are forming each air flow passages as double layers 7', 6' (FIG. 3) charging therein compressed air from an inlet 5.

The equipment I further provides an air chamber in the form of a cylindrical drum disposed at the back side thereof and the walls of said two pipes 8 and 9 are communicated with said air chamber.

Said air chamber is comprised of a first air room 7 formed at the end side portion of the drum and a second air room 6 located within said first air room 7, thereby permitting one (1) portion of said air flow A (FIG. 3) to flow into said room 7.

Further, a nozzle 1 with a small ellipse hole 2, less than 1 mm diameter, is arranged in the vicinity of the position at which the second air room of said drum and the second pipe 9 are connected to each other.

A pipe 4 for charging high pressure water is injected in relation to a central axis of said drum and a tip portion of said pipe 4 is projected into such drum so as to be connected to a base 3 for supporting nozzle 1.

In this arrangement the base 3 is mounted in screw connection to a screw portion 12 so that said nozzle 1 may be placed a little forward to be flexibly free.

The equipment I has an injection angle β of front view to be $12.5^{\circ} \sim 15^{\circ}$ and an angle α in the side direction to be approximately 2° and then, said air pipes 8 and 9 which form a rectangular section, as mentioned above, are opened in front by maintaining at least degree 7° as shown in the drawings in order to obtain an injection flow pressure pattern in the forms of ⎍ and bar shape which is the purpose of this invention. Therefore, it can be calculated how the compressed air is spreading out and further is proceeding with at least 7° degree when it is injected into the atmosphere. An appearance of said equipment I has a small size of 65 mm x (times) 15 mm for its rectangular section and 90 mm of depth according to the embodiment and it is assembled by means of flanges 11 and 11 on both sides.

The equipment I is constructed as described above in order to carry out the present invention; the operation and functioning of this equipment will be explained with reference to FIGS. 2 and 3.

In the present embodiment, an operational distance between a wall surface (an object to be washed) of a large-typed tunnel (Experimental place: Ohtsuki Tunnel, in Japan; 499 meter in length and 7 meter in height) and the equipment I can be arranged to be a close distance using conventional means. Accordingly, it was possible to arrange an operational distance of 550 mm to 100 mm.

Now, the equipment was operated by means of an engine, a high pressure pump and an air compressor (respectively not illustrated) loaded on a vehicle.

High pressure water W_1 was arranged to have 500 kg/cm^2 at that time and was fed to a nozzle 1 out of a charging pipe 4 under pressure. Thus, the injection water flow W_2 was injected out of an ellipse hole 2 (0.8 mm) of the nozzle as shown by a dotted line.

Simultaneously therewith, the greater portion a_1 of the compressed air flow A out of a charging pipe 5 was forcedly discharged into the first passage 7' out of a circumferential side surface of said first air room 7 of the drum at the speed of 5 $kg/cm^2 \sim 8$ kg/cm^2 equivalent to that of said injection water flow W_2.

Such air flow speed as mentioned above is unable to increase its speed over that of the water flow because it is required to avoid the decrease of an injection energy produced by atomizing particles of the injection water flow W_2 under abrasion function including the atmospheric air.

So, the remaining portion a_2 of the air flow A flows into the air passage 6' formed inside the second pipe 9 disposed frontward through the second air chamber 6 of the drum. In this action, the air flow a_1 of said passage 7' is shunted into the inside passage 6' through air passage holes 9', 9' in plurality having downward sloping on the wall of the pipe 9; accordingly, each of the particles of said injection flow W_2 forms a mixed flow (water particles) bound all the more in the direction of a vertical axis of the passage 6' in view of a dynamic theory.

In other words, it becomes possible to obtain a desired pattern of pressure on the surface of an object because the particles in energy (W_2 + a_2) of injecting water flow W_2 within the second pipe 9 of a rectangular section, are besieged in the addition with a_1 layer to that said granulating flows are injected forcedly.

Curve of a illustrated in FIG. 4 was obtained as a result of measuring said distribution pattern on the surface of an object to be washed with respect to the above-mentioned function.

Irrespective of changes of an operational distance within a tunnel such as, for example, 100 mm to 550 mm, curve a on the surface was logically long in the shape of } to the direction of Y-axis, in addition, shows a short width of axis, such as 5 cm, 4 cm and 3 cm in X-axis, while on the other hand, uneven curve phenomenon is shown even in such a case as above.

However, it is clear that this is equivalent to a logical curve a (uniform pressure and narrow and flat distribution) as shown in the left side in FIGS. 2 and 3.

It can well be presumed that the under-mentioned effect in accompany with a distribution difference of a pattern b (a dotted curve of FIG. 4) on the surface of an object to be washed has been brought when a method of this invention would not be executed out.

Namely, an injection water flow may produce the above-mentioned pressure pattern a according to a method of the present invention, enabling the running efficiency for improving the stability thereof and further the particles of an injection water flow do not naturally diffuse in atomization and accordingly much loss of the energy may be prevented.

It is to be understood that the action and effect in the present invention will not be limited to the embodiment mentioned above.

As a result of various experiments including applications in other fields such as a painting works, removal of adhered solvents and so on, it has been found that an injection water flow W_2 depending upon an object may be controlled and adjusted quantatively when the relationship between established number of plural holes formed on the air passages 9', 9' and the diameters thereof or the perforated angle thereof, or between an opening angle of the air passages and the injection distance is selected in all particulars as desired within a range from 100 kg/cm^2 to 1,000 kg/cm^2 of high pressure water.

WHAT IS CLAIMED IS:

1. In an injection action of high pressure water, the method of injecting granulating flows which formed a water flow having a limited angle of injection and, the compressed air flows a_1 and a_2 of the concentric layer being arisen and projected so as to bind the particles of an injecting water flow W_2 inward and, at the same time, said injecting particles are besieged with said a_1 layer and projected to the surface of an object to be washed.

2. In an injection action of high pressure water, the method of injecting water pattern with uniform pressure according to claim 1, wherein when the granulating flows of water and air (W_2 + a_2) are injected at the same velocity with that of air flow a_1 passing through an external air passage (7') having a hollow rectangular section, and wherein the water pattern under the uniform pressure forming a flow of narrow breadth in the direction of X-axis, and extending to the vertical direction of the Y-axis, is projected to the surface according to claim 1.

3. In the method of injection according to claim 2 and claim 1, the method of injection, wherein the distance of an object to be washed and, the opening angles of the compressed air flow passages (6' and 7') may be arranged to be variable.

4. In equipment of injecting high pressure water, the injection equipment according to the preceding claims 1 to 3 which consist of an air chamber with first and second air rooms of concentric drum, air pipes

(8 and 9) having a hollow rectangular section, compressed air passages (6' and 7') being of rectangular shape in double layers besides, said air passages (6' and 7') being solidly disposed in front of said air chamber, an inlet for charging high pressure water and nozzle hole (2) arranged to penetrate the axial center of said drum frontward, and in addition, an angle of the water flow to be injected out of nozzle hole (2) is limited from 12.5^{o} to 15^{o} in the direction of Y-axis.

5. The equipment of injecting high pressure water according to claim 4, wherein more air passages (9' and 9') having downward sloping are provided on the surface of the wall of a second pipe with a hollow rectangular section so as to provide a passage for injecting air flow a_2 and injecting water flow W_2.

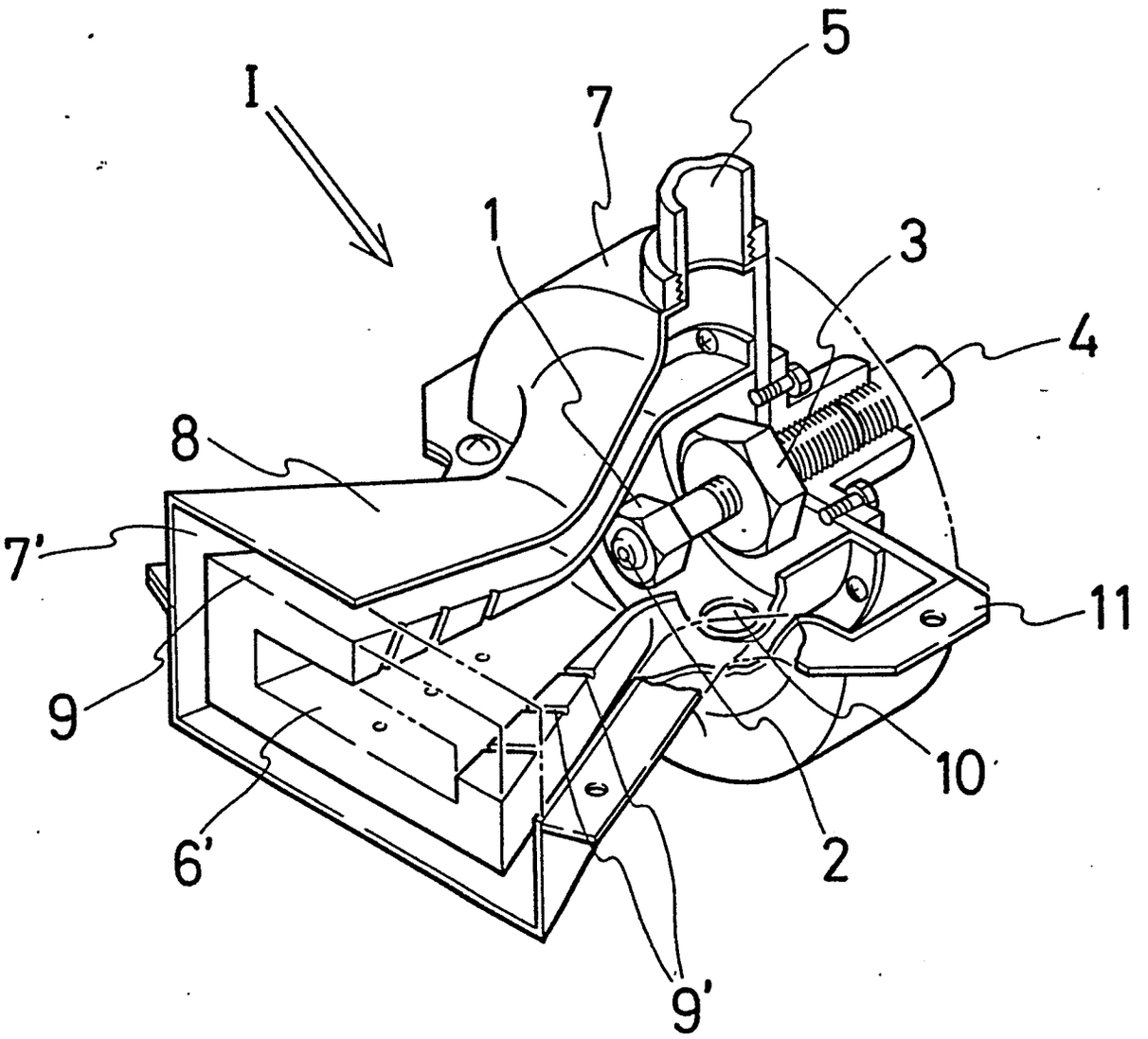

Fig 1

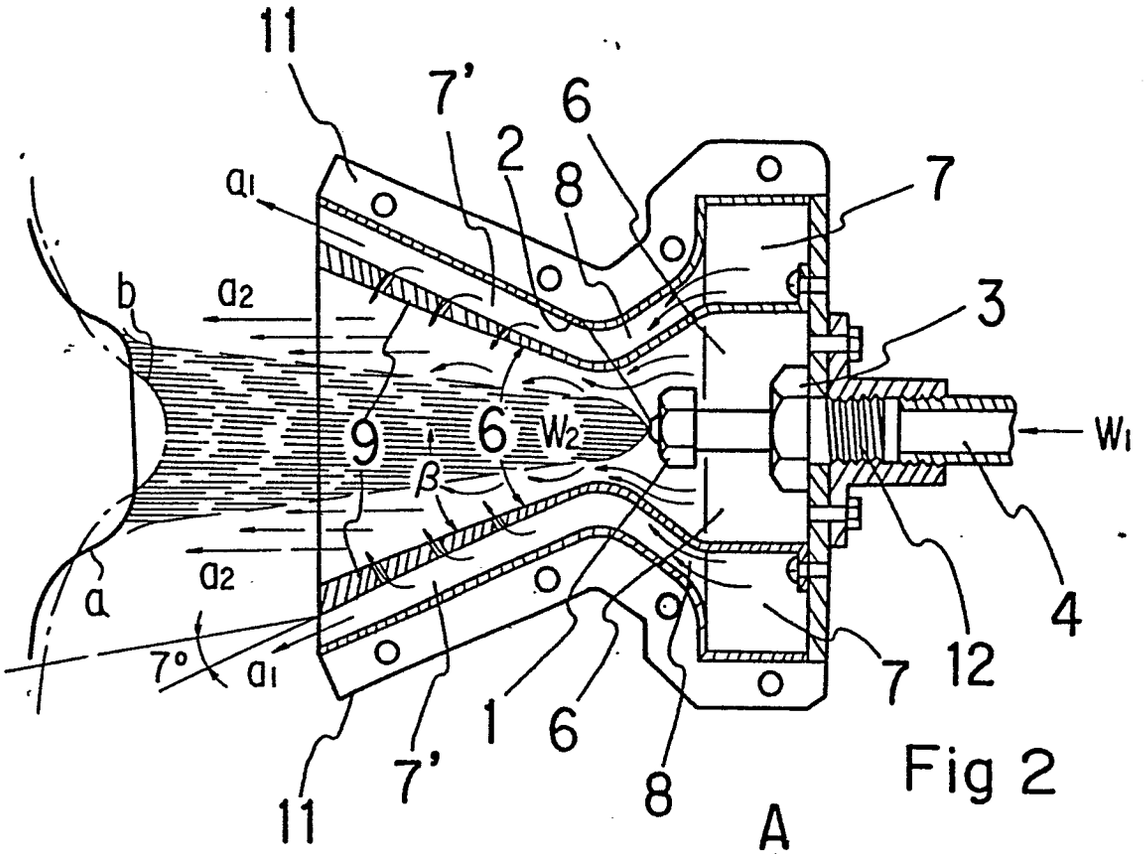
11
7'
6
2
8
7
a1
b
a2
3
9
6
W2
W1
β
a
a2
7°
a1
4
12
7
1
6
7'
11
8

Fig 2

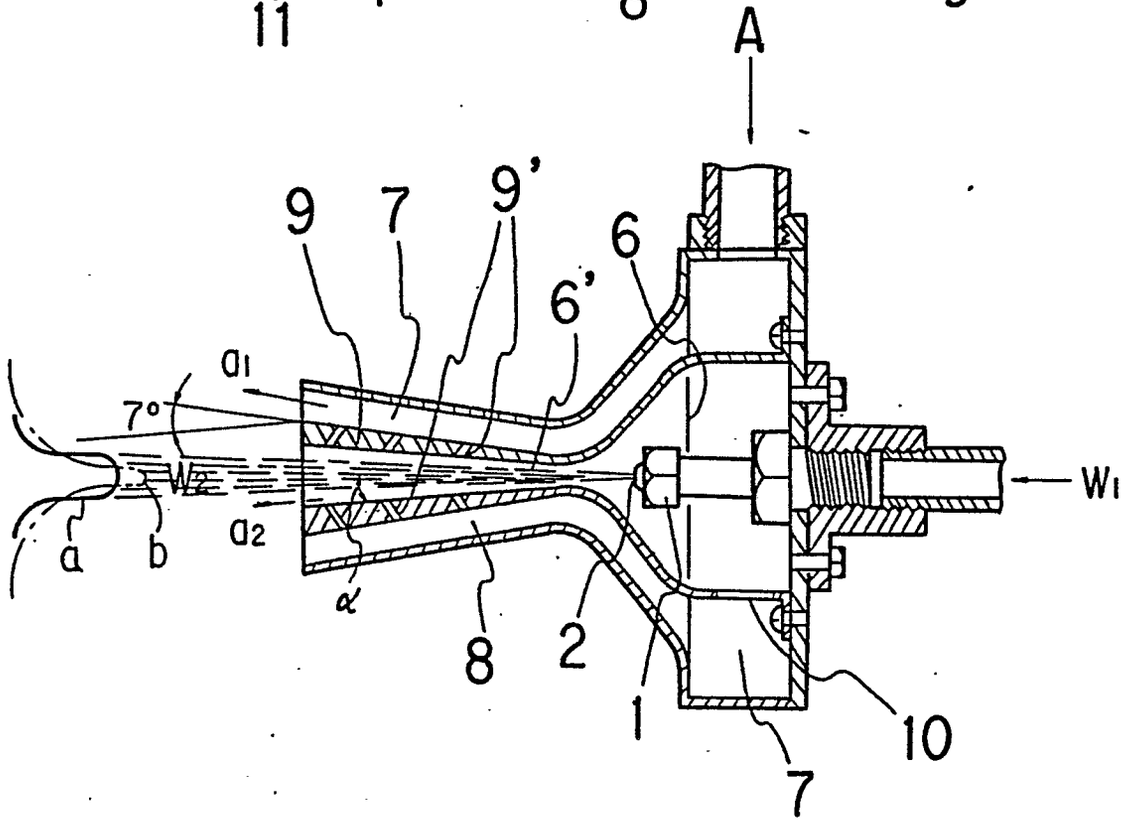
A
9
7
9'
6
6'
a1
7°
W2
W1
a
b
a2
α
8
2
1
10
7

Fig 3

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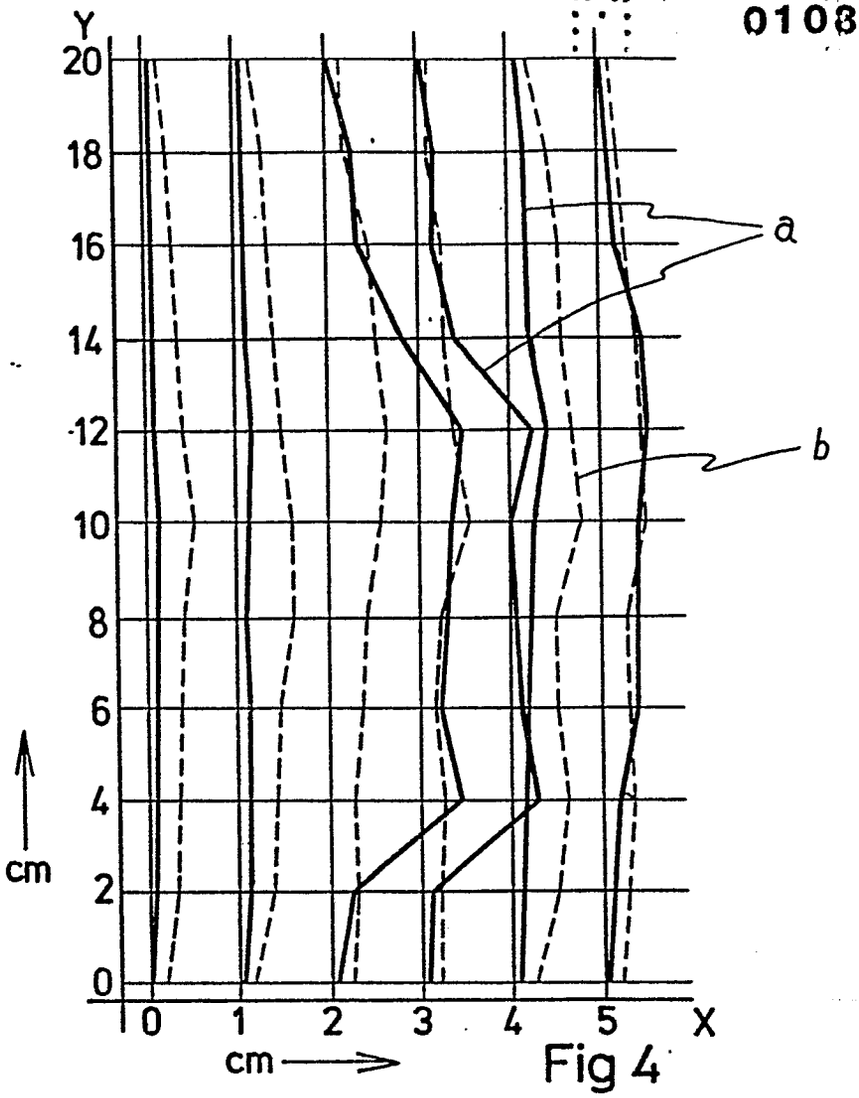

Fig 4

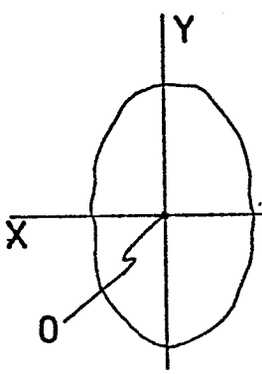

Fig 5

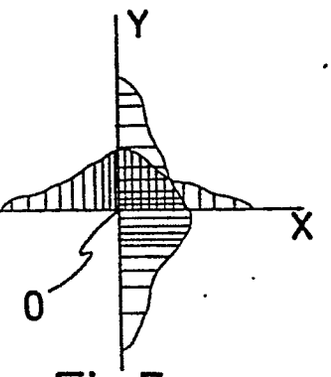

Fig 7

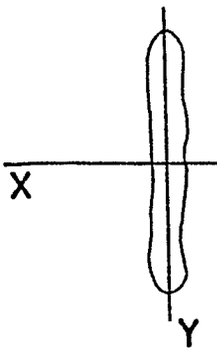

Fig 6

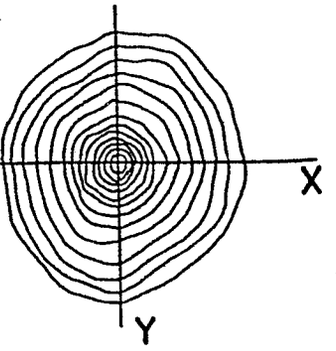

Fig 8

INTERNATIONAL SEARCH REPORT

International Application No. PCT/JP80/01543

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [2]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[3] B05B 7/08, E01H 1/10

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
I P C	B05B 7/00 - 7/08, E01H 1/10

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

Jitsuyo Shinan Koho 1926 - 1982
Kokai Jitsuyo Shinan Koho 1971 - 1982

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category*	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
A	JP,Y2, 53-4671 (Kawasaki Heavy Industries, Ltd.) 6. February. 1978 (6.02.78)	1

* Special categories of cited documents: [15]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
September 3, 1982 (03.09.82)	September 20, 1982 (20.09.82)
International Searching Authority [1]	**Signature of Authorized Officer [20]**
Japanese Patent Office	