630304

AUSTRALIA
Patents Act 1990

PATENT REQUEST: STANDARD PATENT AND NOTICE OF ENTITLEMENT

I/We, being the person(s) identified below as the Applicant, request the grant of a patent to the person(s) identified below as the Nominated Person, for an invention described in the accompanying standard complete specification.

Full application details follow.

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Invention Title:

GAS-LIQUID MIXTURE SPRAY NOZZLE APPARATUS.

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BASIC CONVENTION APPLICATION(S) DETAILS

| Application Number | Country | Country Code | Date of Application |
|---|---|---|---|
| 3-174236 | JP | | 16th July 1991 |

Drawing number recommended to accompany the abstract: 1

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being the applicant in respect of this Application state the following:-

The person(s) nominated for the grant of the patent:

The nominated person would be entitled to have assigned to it a patent granted to any of the actual inventors in respect of the said invention.

The person(s) nominated for the grant of the patent:

The applicant and nominated person is the basic applicant.

The basic application(s) listed above is/are the first application(s) made in a Convention country in respect of the invention.

KYORITSU GOKIN MFG. CO., LTD.

29th August 1991

GRIFFITH HACK & CO

Patent Attorneys for and
on behalf of the applicant.

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(56) Prior Art Documents
AU 41481/89 B05B 07/04
AU 40334/89 B05B 07/04
AU 260733 32321/63 Cl.68.9

(57) Claim

1. A gas-liquid mixture spray nozzle apparatus comprising:

a spray tube having a spraying orifice at a leading end thereof;

a first supply passage for supplying one of a liquid or a gas in a radial direction of the spray tube;

a second supply passage for supplying the other of said liquid or gas in the radial direction;

said first supply passage and said second supply passage being displaced from each other in an axial direction of the spray tube;

a nozzle fixedly disposed inside said spray tube for jetting towards the spraying orifice the gas or liquid supplied from a gas/liquid flow passage formed coaxially or substantially coaxially with said tube axis;

a first gap communicating with said first supply

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passage;

a second gap communicating with said second supply passage;

a first flow passage for communicating said first gap with a gas-liquid mixing chamber formed at a front position of said nozzle;

said first and second gaps and said first flow passage being formed between an outer surface of said nozzle and an inner surface of said spray tube;

a further orifice communicating between an outlet opening of said first supply passage and said spray tube;

said second gap and said gas/liquid flow passage being communicated with each other through a plurality of second flow passages radially spaced about said nozzle, each of said second flow passages having a corresponding outlet facing the gas/liquid flow passage.

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ORIGINAL

COMPLETE SPECIFICATION

STANDARD PATENT

Invention Title:

GAS-LIQUID MIXTURE SPRAY NOZZLE APPARATUS.

The following statement is a full description of this invention, including the best method of performing it known to me:-

# GAS-LIQUID MIXTURE SPRAY NOZZLE APPARATUS

## BACKGROUND OF THE INVENTION

### 1 FIELD OF THE INVENTION

The present invention relates to a gas-liquid mixture spray nozzle apparatus, and more particularly to a spray nozzle apparatus of this type for e.g. spraying water onto a rolled steel or for spraying a chemical in a vegitable field or an orchard, the apparatus including a spray tube having a spraying orifice at a leading end thereof and a first supply passage for supplying a liquid or a gas along a radial direction of the tube and a second supply passage for supplying the gas or the liquid along the radial direction, with the first and second supply passages being displaced relative to each other in said tube axis direction.

### 2 DESCRIPTION OF THE RELATED ART

A gas-liquid mixture spray nozzle apparatus of the above-described type is an attempt to overcome a problem inherent in the conventional apparatus as

disclosed in e.g. the Japanese published utility model gazette No. 63-38932 which apparatus has a first supply passage for supplying one of the gas and the liquid in the radial direction of the spray tube and a second supply passage for supplying the other of the gas and the liquid in the axial direction of the spray tube. That is, the problem concerns the complexity of the tube construction and the difficulty of attachment and detachment of this tube construction for a maintenance operation.

More particularly, as shown in Fig. 6, a spray tube 02 having a substantially uniform inner diameter includes a spraying orifice 01 at its leading end. And, this spray tube 02 is connected with a first supply passage 03 and a second supply passage 04 and further connected with a predetermined tube unit through bushes 05, 06 each having a substantially uniform inner diameter.

According to this convention, the gas and the liquid introduced respectively through the first supply passage 03 and the second supply pasage 04 are caused to hit an inner periphral wall of the spray tube 02 to change their flowing directions, so that the gas and the liquid are mixed with each other in the process of flowing towards the spraying orifice

01. Therefore, for reliably atomizing the liquid, it is essential that a mixing chamber 07 provided on a downstream side of the supply passages be extended as much as possible in the axial direction. This results in an enlargement of the entire nozzle apparatus and an increase in the space where the apparatus is to be installed, whereby the application of the nozzle apparatus tends to be seriously limited.

The present invention attends to this problem and its primary object is to provide an improvement of the gas-liquid mixture spray nozzle apparatus of the above type, the improvement enabling prevention of complexity and easier attachment and detachment of the tube construction for maintenance; thereby forming the entire apparatus compact to be suitable for a great variety of applications.

SUMMARY OF THE INVENTION

According to the present invention there is provided a gas-liquid mixture spray nozzle apparatus comprising:

a spray tube having a spraying orifice at a leading end thereof;

a first supply passage for supplying one of a liquid or a gas in a radial direction of the spray tube;

a second supply passage for supplying the other of said liquid or gas in the radial direction;

said first supply passage and said second supply passage being displaced from each other in an axial direction of the spray tube;

a nozzle fixedly disposed inside said spray tube for jetting towards the spraying orifice the gas or liquid supplied from a gas/liquid flow passage formed coaxially or substantially coaxially with said tube axis;

a first gap communicating with said first supply passage;

a second gap communicating with said second supply passage;

a first flow passage for communicating said first gap

with a gas-liquid mixing chamber formed at a front position of said nozzle;

said first and second gaps and said first flow passage being formed between an outer surface of said nozzle and an inner surface of said spray tube;

a further orifice communicating between an outlet opening of said first supply passage and said spray tube;

said second gap and said gas/liquid flow passage being communicated with each other through a plurality of second flow passages radially spaced about said nozzle, each of said second flow passages having a corresponding outlet facing the gas/liquid flow passage.

Accordingly, embodiments of the present invention provide the following features:

(A) The nozzle for jetting towards the spraying orifice the gas or liquid supplied from a gas/liquid flow passage formed coaxially or substantially coaxially with the tube axis is fixedly disposed inside the spray tube.

(B) Between an outer surface of the nozzle and an inner surface of the spray tube, there are formed a first gap communicating with the first supply passage, a second gap communicating with the second supply passage and a first flow passage for communicating the first gap with a gas-liquid mixing chamber formed at a front position of the spray nozzle.

(C) A further spraying orifice communicating between an outlet opening of the first supply passage and the spray tube.

(D) The second gap and the gas/liquid flow passage of the nozzle are communicated with each other through a plurality of second flow passages radially spaced about the nozzle.

(E) Each of the second flow passages having a corresponding outlet facing the gas/liquid flow passage.

With these features, the embodiments of the invention can achieve the following functions and effects.

(a) Because the features (A) and (B), the liquid or gas introduced from the first supply passage into

the first gap hits the outer peripheral face of the nozzle to change in its flowing direction. This fluid flow passes the first flow passage between the nozzle outer peripheral face and the tube inner peripheral face to enter the gas-liquid mixing chamber. Then, because of the features (A), (B) and (D), the gas or the liquid introduced from the second supply passage into the second gap passes the second flow passage into the gas-liquid mixing chamber to be mixed and atomized with the other fluid. Then, this fluid mixture is discharged through the spraying orifice.

(b) Because of the feature (C), the liquid or gas from the first supply passage increases in its flow velocity as being constricted through the orifice. The increased flow velocity results in increase in the speed of the liquid or gas molecules as well in the Reynolds number, which increase expedites generation of turbulent flow.

(c) Because of the features (D) and (E), the liquid or gas from the plurality of second flow passges are caused to collide each other within the gas-liquid mixing chamber. This collision further promotes the turbulent flow generation. Because of the above-described function (a), the liquid and the gas introduced into the gas-liquid mixing chamber are

atomized while being mixed with each other to be discharged through the spraying orifice. Then, because of the functions (b), (c), the liquid and the gas are rendered into the turbulent flow before entering the mixing chamber, the atomization of the introduced liquid is facilitated.

Therefore, the present invention has achieved the intended improvement of the gas-liquid mixture spray nozzle apparatus, which improvement enables prevention of complexity and easier attachment and detachment of the tube construction for maintenance, thereby forming the entire apparatus compact to be suitable for a great variety of applications.

Preferrably, the plurality of second flow passages can be arranged in a vortex pattern where the passages cross each other in the radial direction of the nozzle. With this additional feature, the gas or the liquid introduced through these second flow passages flows in a spiral pattern within the gas/liquid flow passage, thus further increasing the velocity of the gas or liquid flowing along the inner peripheral face of the flow passage. This increased flowing velocity further promotes the generation of tubulent flow inside the gas/liquid flow passage and consequently promotes the atomization of the fluid

inside the gas-liquid mixing chamber.

Further ~~and other objects,~~ features and effects of the invention will become more apparent from the following more detailed description of the embodiments of the invention with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side view in partial section showing a gas-liquid mixture spray nozzle apparatus according to one preferred embodiment of the present invention,

Fig. 2 is a section taken along a line 2-2 in Fig. 1,

Fig. 3 is a section taken along a line 3-3 in Fig. 1,

Fig. 4 is a perspective view of a nozzle,

Fig. 5 is a section view showing major portions of a gas-liquid mixture spray nozzle apparatus according to a further embodiment of the invention, and

Fig. 6 is a side view in section showing a conventional apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of a gas-liquid mixture spray nozzle apparatus relating to the present invention will now be described in particular with reference to the accompanying drawings.

As shown in Figs. 1 through 4, a gas-liquid mixture spray nozzle apparatus relating to one embodiment of the invention is used for e.g. spraying water onto a rolled steel for cooling it. In this apparatus, at a base of a spray tube 2 having a spraying orifice at a leading end thereof, there are provided a first supply passage 3 for supplying liquid (e.g. water) along a radial direction of the tube 2 and a second supply passage 4 for supplying gas (e.g. air) along the radial direction, with the two passages 3, 4 being displaced from each other in a direction of a tube axis X.

Inside the spray tube 2 and at a position facing outlet openings of the first and second supply passages 3, 4, a nozzle 6 is detachably screwed for jetting the gas towards the spraying orifice 1 from a gas flow passage 5 formed coaxially relative to the tube axis X. Further, between an outer surface ~~peripheral face~~ of the nozzle 6 and an inner ~~peripheral face~~ surface of the spray tube 2, there are formed an annular first

gap 7 communicating with the first supply passage 3, an annular second gap 8 communicating with the second supply passage 4 and an annular first flow passage 10 for communicating the first gap 7 with a gas-liquid mixing chamber 9 disposed forwardly of the nozzle 6.

The spray tube 2 includes a nozzle tip 1a forming the spraying orifice 1, a tube member 9a forming the gas-liquid mixing chamber 9, a female screw portion 11a for screwing the nozzle 6 and a base case 11 having the first and second supply passages 3, 4. The nozzle tip 1a and the tube member 9a are fixedly screwed with each other; whereas, the tube member 9a and the base case 11 are integrally engaged with each other by welding.

The first flow passage 10 is configurated as an annnular funnel-shaped flow passage. In a direction extending normal to the tube axis X, this passage 10 has a cross section smaller in area than the first gap 7. Further, because of the configuration, the passage 10 functions to guide and jet the liquid supplied into the first gap 7 towards a forward side of the nozzle 6 along the tube axis X.

For forming the first supply passage 3, a first bush 14 for connecting with a liquid (water) tube 12 into which the liquid is supplied under pressure by

means of e.g. a pump, is fixedly screwed into a female screw hole 11b formed in the base case 11. Further, an orifice 15 is defined at a top portion of this first bush 14.

With this formation of the orifice 15 in the first bush 14, a change in the constricting amount depending on the liquid supply amount can be readily coped with by replacing the bush 14 with a further bush having an orifice 15 formed for the desired constricting amount. Accordingly, the construction of this embodiment is more advantageous in terms of costs than e.g. a construction where the orifice 15 is formed in the base case 11 per se.

The second supply passage 4 is formed on an upstream side along the tube axis X relative to the first supply passage 3; and to this passage 4, there is screwed a second bush 16 for connecting a gas (air) tube 13 into which gas such as air is supplied under pressure by means of e.g. an air compressor.

The gas flow passage 5 of the nozzle 6 is stepwise constricted towards the downstream side in the tube axis direction X, such that the passage 5 has a stepwise decreasing cross section toward said side. And, this gas flow passage 5 is communicated with the second gap 8 through four second flow passages 18

defined in a peripheral wall 17 of the nozzle. The first gap 7 and the second gap 8 are air-tightly separated from each other by means of a sealing rubber ring 19.

The four second flow passages 18 are displaced with 90 degree phase difference with each other in the peripheral direction of the nozzle 6 and are oritended to the tube axis X. Further, outlet openings of these second flow passages 18 facing the gas flow passage 5 are aligned or substantially aligned on a same plane relative to the tube axis X.

The base case 11 is screw-fixed by means of a bolt 21 to a tube unit A comprised of the liquid tube 12 and the gas tube 13 integrally welded to each other through a connecting plate 20. Further, the first and second bushes 14, 16 are communicated respectively with the liquid tube 12 and the gas tube 13, so as to supply the liquid and the gas into the nozzle apparatus.

In place of the plurality of the second flow passages 18 formed in the nozzle peripheral wall 17 employed in the foregoing embodiment, as shown in Fig. 5, it is conceivable to form the second flow passages 18 arranged in a vortex pattern to extend to cross each other in the radial direction of the nozzle 6.

In this case, the rest of the construction can be the same as those of the foregoing embodiment.

Some other embodiments of the invention will be specifically described next.

(a) The orifice provided for the first supply passage can be formed integrally with the spray tube.

(b) It is not essential for the present invention to configurate the first flow passage as a constricted flow passage.

(c) In the further embodiment illustrated in Fig. 5, each of the second flow passages 18 can be formed either straight or curved.

(d) In the above-described embodiments, the functions of the first supply passage and the second supply passage can be switched over so that the former supplies the gas (air) while the latter supplies the liquid (water).

(e) The gas-liquid mixture spray apparatus of the invention can be used not only for spraying water but also for spraying any other kind of liquid such as a chemical liquid.

(f) Similarly, the apparatus of the invention can be used with any other kind of gas than the air employed in the above embodiments.

The invention may be embodied in other specific

forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A gas-liquid mixture spray nozzle apparatus comprising:

a spray tube having a spraying orifice at a leading end thereof;

a first supply passage for supplying one of a liquid or a gas in a radial direction of the spray tube;

a second supply passage for supplying the other of said liquid or gas in the radial direction;

said first supply passage and said second supply passage being displaced from each other in an axial direction of the spray tube;

a nozzle fixedly disposed inside said spray tube for jetting towards the spraying orifice the gas or liquid supplied from a gas/liquid flow passage formed coaxially or substantially coaxially with said tube axis;

a first gap communicating with said first supply passage;

a second gap communicating with said second supply passage;

a first flow passage for communicating said first gap with a gas-liquid mixing chamber formed at a front position of said nozzle;

said first and second gaps and said first flow passage being formed between an outer surface of said nozzle and an inner surface of said spray tube;

a further orifice communicating between an outlet opening of said first supply passage and said spray tube;

said second gap and said gas/liquid flow passage being communicated with each other through a plurality of second flow passages radially spaced about said nozzle, each of said second flow passages having a corresponding outlet facing the gas/liquid flow passage.

2. A gas-liquid mixture spray nozzle apparatus as defined in claim 1, wherein said spray tube includes a nozzle tip forming said spraying orifice, a tube member forming said gas-liquid mixing chamber, a female screw portion for screwing said nozzle and a base case having said first and second supply passages.

3. A gas-liquid mixture spray nozzle apparatus as defined in claim 2, wherein said nozzle tip and said tube member are fixedly screwed with each other and said tube member and said base case are integrally

engaged with each other.

4. A gas-liquid mixture spray nozzle apparatus as defined in ~~Claim 1~~ any one of claims 1 to 3, wherein said first flow passage is configurated as an annnular funnel-shaped flow passage, said first flow passage having, in a direction extending normal to said tube axis, a cross section smaller in area than said first gap, said first flow passage being capable of guiding and jetting the liquid supplied into said first gap towards a forward side of said nozzle along said tube axis.

5. A gas-liquid mixture spray nozzle apparatus as defined in Claim 2, wherein for forming said first supply passage, a first bush for connecting with a liquid tube into which the liquid is supplied is fixedly screwed into a female screw hole formed in said base case.

6. A gas-liquid mixture spray nozzle apparatus as defined in Claim 5, wherein said further orifice is defined at a top portion of said first bush.

7. A gas-liquid mixture spray nozzle apparatus as defined in Claim 5, wherein said second supply passage

is formed on an upstream side along said tube axis relative to said first supply passage, to said second supply passage, there being screwed a second bush for connecting a gas tube into which the gas is supplied.

8. A gas-liquid mixture spray nozzle apparatus as defined in any one of claims 1 to 7 wherein said ~~gas~~ gas/liquid flow passage is stepwise constricted towards the downstream side in said tube axis direction, such that said ~~gas~~ gas/liquid flow passage has a stepwise decreasing cross section toward said side.

9. A gas-liquid mixture spray nozzle apparatus as defined in any one of claims 1 to 8, wherein said first gap and said second gap are air-tightly separated from each other by means of a sealing means.

10. A gas-liquid mixture spray nozzle apparatus as defined in any one of claims 1 to 9 wherein said plurality of second flow passages are arranged in a vortex pattern where said passages cross each other in the radial direction of said nozzle.

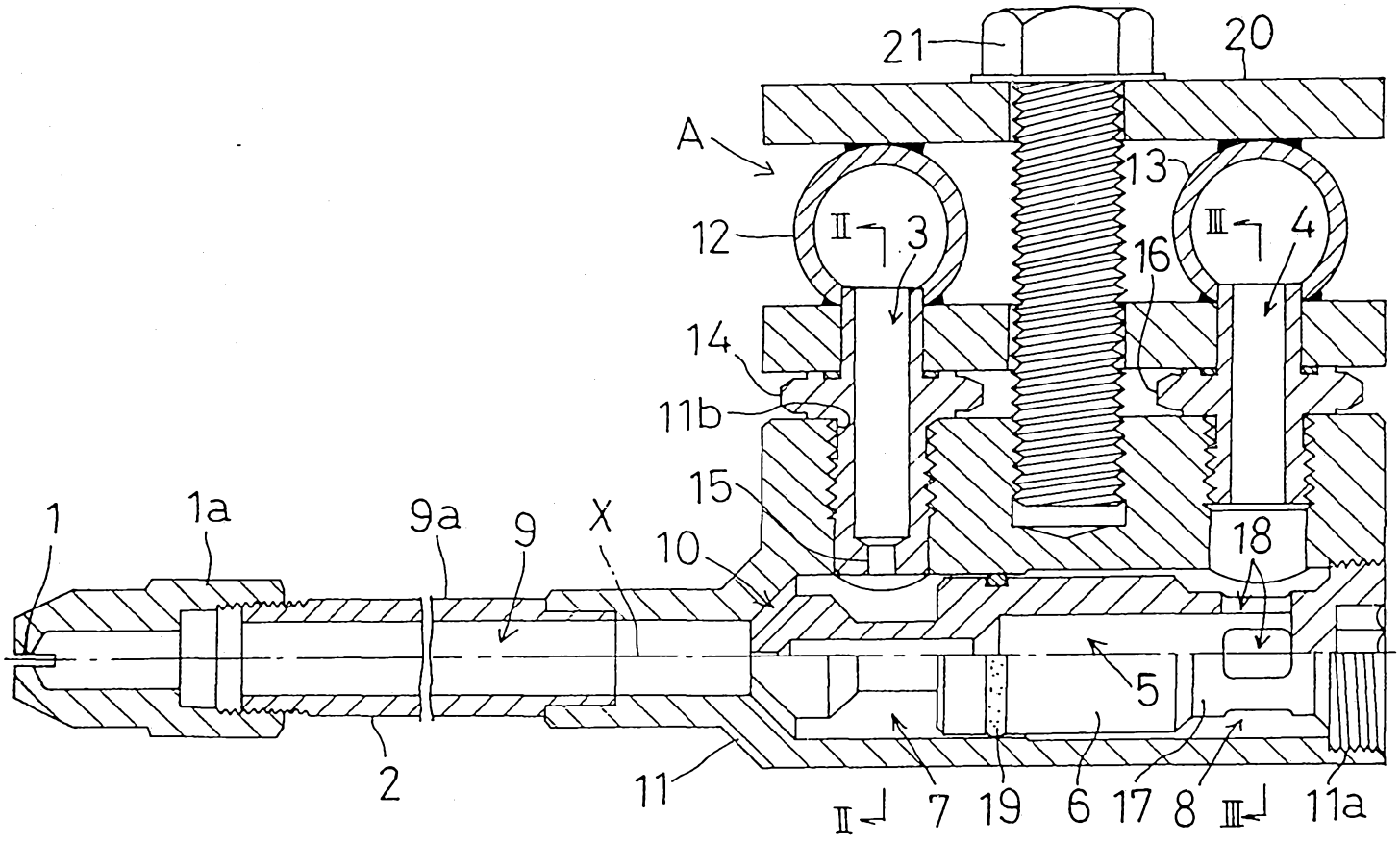
11. A gas-liquid mixture spray nozzle apparatus substantially as herein described with reference to and as illustrated in any one or more of Figures 1 to 5 of the accompanying drawings.

Dated this 21st day of July 1992.

KYORITSU GOKIN MFG. CO. LTD.
By Its Patent Attorneys:

GRIFFITH HACK & CO.
Fellows Institute of Patent
Attorneys of Australia.

FIG. 1


21
20
A
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II
3
III
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16
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11b
15
1
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2
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II
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19
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17
8
III
11a

FIG. 2

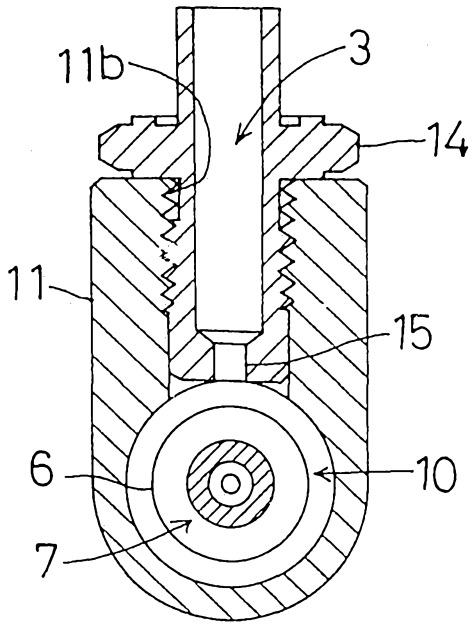


FIG. 3

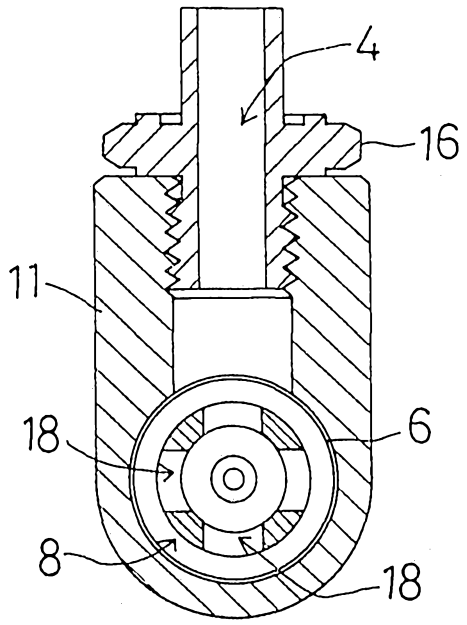

FIG.4

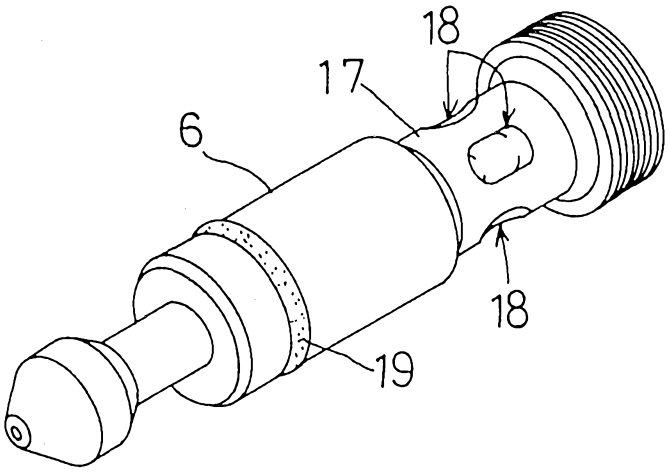


FIG.5

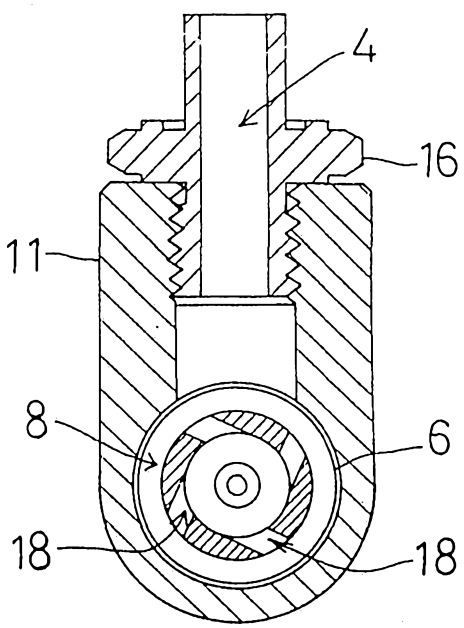

FIG.6(PRIOR ART)