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(54) Spray head and spray apparatus provided thereof

(57) The invention relates to a spray head (6), for instance for culture beds, which is provided with a tubular body (18) and a plurality of spray nozzles (22A-22E) arranged distributed in the side wall thereof and directed substantially transversely of the longitudinal axis (A) of the body (18). One or more of the spray nozzles (22A-22E) is herein adapted to generate a relatively flat spray cone. This spray nozzle (22A-22E) can herein take the form of a planar sprinkler. The spray head (6) can comprise a plurality of planar sprinklers, the spraying plane of which is directed parallel to the longitudinal axis (A) of the body (18) but is located at different heights. In addition, one of the planar sprinklers can be directed with its spraying plane substantially transversely of the longitudinal axis (A) of the tubular body (18).

The invention further relates to an apparatus for spraying culture beds which is provided with a carriage displaceable along the culture beds and a plurality of spray heads as described above arranged on the carriage. The carriage can be provided with a post having spray heads arranged thereon at different heights for spraying a number of culture beds placed one above another.

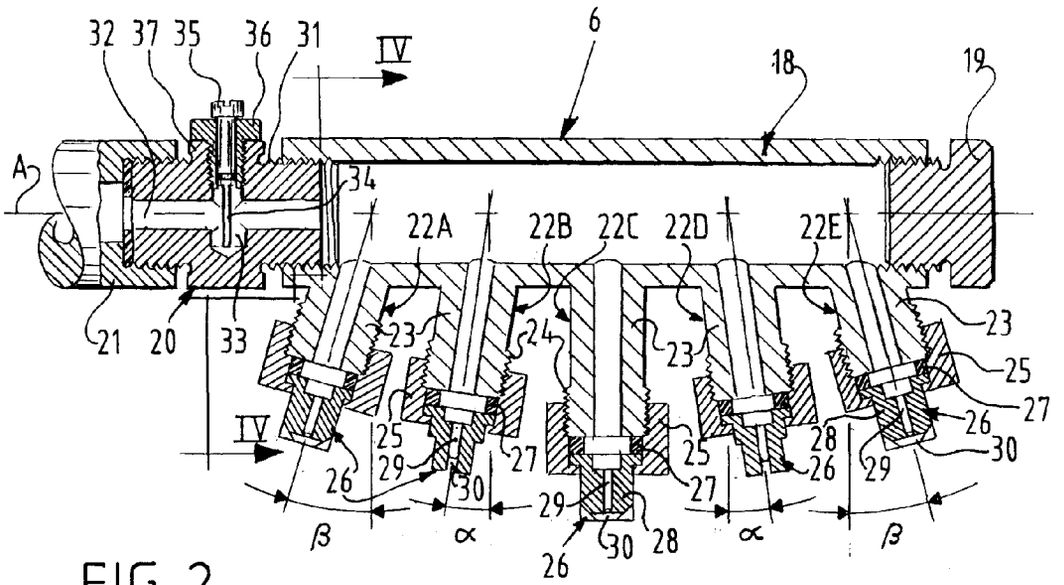

FIG. 2

EP 0 792 693 A1

Description

The present invention relates to a spray head, in particular for spraying culture beds, provided with a tubular body and a plurality of spray nozzles arranged distributed in longitudinal direction of the tubular body in a side wall thereof and directed substantially transversely of the longitudinal axis of the tubular body. Such a spray head is known from the Netherlands patent 185.974.

The known spray head is provided with a tubular feed conduit, in the side-wall of which four spray nozzles are arranged. The spray nozzles protrude from the side wall at different angles to the horizontal. They hereby disperse spraying liquid over different distances as reckoned from the feed tube. Each spray nozzle is therein provided with a narrowed outlet aperture of circular cross section, whereby the spraying liquid is sprayed in the form of a cone. Owing to the different angles of the spray nozzles to the horizontal the spray cones fall on different parts of the culture bed, whereby a more or less uniform spraying of the bed is achieved.

The known spray head has the drawback that when it is used for spaying crops which are cultivated in culture beds placed one above another, such as is often the case for instance in mushroom culture, a part of the spray cones will, during spraying of a culture bed, fall onto the underside of the culture bed located thereabove and will thereafter drip from this bottom unto the culture bed lying below, whereby the distribution of the spraying liquid is considerably less uniform than could be anticipated on the basis of the arrangement of the spray nozzles. An uneven growth of the sprayed crop hereby occurs, whereby the yield thereof is not optimal.

The invention now has for its object to provide a spray head wherein this drawback does not occur. According to the invention this is achieved in that at least one of the spray nozzles is adapted to generate a spray cone which is relatively flat in cross section. By spraying a relatively flat liquid cone the danger of a part of the spraying liquid striking against the underside of a culture bed located above the bed for spraying is considerably reduced, whereby a more uniform spraying of the culture bed is achieved.

Preferred embodiments of the spray head according to the invention form the subject-matter of the dependent claims 2 to 8.

The invention further relates to an apparatus for spraying culture beds which is provided with a carriage which is displaceable along the culture beds and connected to a source of spraying liquid, and at least one spray head arranged on the carriage. Such a spray apparatus is likewise known from the above mentioned Netherlands patent. The spray apparatus according to the invention is distinguished from the known spray apparatus in that a spray head as described above is applied as spray head.

Preferred embodiments of the spray apparatus according to the invention are described in the dependent claims 10 to 13.

The invention is now elucidated on the basis of an embodiment, wherein reference is made to the annexed drawing, wherein:

fig. 1 shows a partly broken away perspective view of a spray apparatus according to the invention for spraying a number of culture beds placed one above another in racks,
fig. 2 shows a longitudinal section through a spray head according to the invention along the line II-II in fig. 3,
fig. 3 shows a side view of the spray head of fig. 2,
fig. 4 is a partly cross-sectional front view of the spray head along the line IV-IV in fig. 2,
fig. 5 is a partly cut away perspective view of the spray head shown in fig. 2-4, and
fig. 6 is a partly broken away perspective detail view of a spray nozzle for use in the spray head according to the invention.

An apparatus 1 for spraying a number of culture beds 2 placed one above another in a rack 3 (fig. 1) comprises a carriage 4 which is displaceable along the racks 3 with culture beds 2 and which is provided with a post 5 to which a plurality of spray heads 6 is fitted corresponding with the number of culture beds 2 in rack 3. Carriage 4 is further connected over a hose 7 to a source (not shown) of spraying liquid, for instance the mains water supply. Carriage 4 is displaceable along its guide rail 8 arranged in the vicinity of the top of the rack 3 and is provided at the bottom of its post 5 with an arm having a guide wheel 9 which rests against a lower beam of rack 3. In the shown embodiment two racks 3 with culture beds 2 are arranged in a growing area 16, each rack having its own spray apparatus 1. The two spray apparatuses are therein placed along the mutually remote sides of racks 3 and are therefore directed toward each other with their spray heads 6. This ensures that spraying liquid which is sprayed over a culture bed 2 of the one rack lands on the edge of a culture bed 2 of the adjacent rack 3, whereby a better distribution of the spraying liquid is obtained than could be achieved heretofore with a single spray apparatus placed between two racks. Both spray apparatuses 1 further have a collective drive which is formed by a peripherally running drive element 10, which is guided over four guide rollers 11 and driven by a central drive motor 12. Spray apparatuses 1 are herein displaced along culture beds 2 in opposing directions. Elements 10, 11 and 12 of the drive are otherwise suspended from the ceiling 13 of the growing area 16, in order to affect the accessibility thereof as little as possible. Drive motor 12 and liquid feed 7 can be operated by means of electronic control means, for instance in the form of a control computer. Culture beds 2 can hereby be sprayed in accordance with a previously entered spraying program, without the intervention of a grower. Productivity increases sharply as a re-

sult.

The spray heads 6 used are adapted such that the most uniform spraying pattern is obtained. In particular the spray heads 6 are adapted such that the least possible spraying liquid falls onto the bottoms 17 of culture beds 2 located above and drips straight down from these bottoms 17, whereby a very uneven spraying pattern would result. For this purpose the spray heads 6 are provided with spray nozzles with which a spray cone can be generated which is as flat as possible and which can be sprayed over large distances in the relatively low space between two culture beds 2 located one above the other without there being any danger of contact with the bottom of the upper culture tray 2.

Each spray head 6 is formed to this end by a tubular body 18, which is closed at one end by a plug 19 screwed therein and is provided at its other end, which is connected to a branch line 21 of distribution conduit 15, with a pressure control element 20. Tubular body 18 has a plurality, five in the shown embodiment, of spray nozzles 22A-22E protruding from a side wall thereof. Each spray nozzle 22A-22E is herein formed by a tubular protrusion 23 formed integrally with tubular body 18 and provided on its free end with screw thread 24 unto which a retaining nut 25 is screwed. The actual sprinkler 26 is clamped fixedly on tubular protrusion 23 by the nut 25 with interposing of a gasket ring 27. Sprinkler 26 is herein formed by a body 28 in which is arranged a bore 29 decreasing in step-like manner which debouches into a slit-like end part 30. This outlet slit 30 results in the spray cone F formed by each spray nozzle 22A-22E being relatively flat, i.e. its width B is considerably greater than its height H (fig. 6). It is hereby possible to spray a culture bed 2 practically horizontally without loss of spraying liquid against the bottom 17 of a culture bed located above. The sprinklers 26 shown in this example are planar sprinklers, but it will be apparent that other sprinklers resulting in a relatively flat spray cone, such as for instance eliptic sprinklers, can also be applied.

In the shown embodiment three of the five spray nozzles 22 are provided with horizontal sprinklers 26, while the two spray nozzles 22B and 22D are provided with vertically directed sprinklers. An even better spraying pattern is hereby achieved and in particular a good spraying of the part of each culture bed 2 located close to spray head 6 is achieved. The horizontally directed spray nozzles 22A, 22C and 22E then serve herein to spray the parts of the culture bed located further away from spray head 6. In order to prevent the spray cones F which come from horizontal spray nozzles 22A, 22C and 22E from intersecting during "flight" and thereby forming large droplets which hamper uniform spraying, these spray nozzles are arranged at different heights in the side wall of tubular body 18 (fig. 3, fig. 4). In order to obtain an optimum spray pattern the spray nozzles 22A-E are further not placed transversely of the side wall of tubular body 18 but they enclose an angle therewith. These angles lie in the plane of the longitudinal axis A of tubular body 18 as well as transversely thereof. In the embodiment shown both vertically directed spray nozzles 22B and 22D are directed in the plane of longitudinal axis A at an angle α of 7.5° relative to a perpendicular of longitudinal axis A, while both outer horizontally directed sprinklers 22A and 22E even enclose an angle β of 15° with this perpendicular. In addition, the two vertically directed sprinklers 22B and 22D enclose an angle y respectively δ of 4 respectively 8° with the horizontal, whereby their spraying distance is regulated. It will of course be apparent that said angles only represent preferred values and other angles are also possible within the scope of the invention. As a result of the angles α and β in the plane of longitudinal axis A a good covering with the spraying liquid is obtained particularly at the beginning and end of the displacement of carriage 4. It is also possible hereby to spray "behind" columns 38 of racks 3.

In order to enable further control of the distribution of the spraying liquid over this culture bed, the pressure at which the spraying liquid finally enters tubular body 18 is adjustable. Arranged for this purpose is pressure control element 20 which consists of a body which is screwed into tubular body 18 by means of an outer screw thread 31 and has a bore 32 with a widened portion 33 in which a pressure control valve 34 is received. Pressure control valve 34 is operated by a screw 35 which is arranged rotatably in a sleeve 36 which is in turn screwed into a collar 37 of pressure control element 20. By turning screw 35, and thereby valve 34, the passage opening in bore 32 is enlarged or reduced, whereby the ratio between the pressure in tubular body 18 and the pressure in conduits 7, 15 and 21 can be varied. The pressure in the feed conduit, which can amount to for instance 4 bar, can hereby be reduced to 0.2 bar for spraying, whereby spraying liquid can also be distributed over relatively short distances.

The spray apparatus with spray head according to the invention makes it possible to spray a crop very uniformly. If desired, the spraying operation can herein be performed under the control of a program without human intervention. The cost of growing crops hereby decreases while productivity increases.

Claims

1. Spray head, in particular for spraying culture beds, provided with a tubular body and a plurality of spray nozzles arranged distributed in longitudinal direction of the tubular body in a side wall thereof and directed substantially transversely of the longitudinal axis of the tubular body, **characterized in that** at least one of the spray nozzles is adapted to generate a spray cone which is relatively flat in cross section.

2. Spray head as claimed in claim 1, **characterized in**

that at least one of the spray nozzles takes the form of a planar sprinkler.

3. Spray head as claimed in claim 2, **characterized in that** a plurality of spray nozzles is embodied as planar sprinkler, the spraying plane of which is directed in each case substantially parallel to the longitudinal axis of the tubular body, and the planar sprinklers are arranged at different heights in the side wall of the tubular body.

4. Spray head as claimed in claim 2 or 3, **characterized in that** at least one of the planar sprinklers is directed with its spraying plane substantially transversely of the longitudinal axis of the tubular body.

5. Spray head as claimed in any of the foregoing claims, **characterized in that** the spray nozzles in the plane of the longitudinal axis of the tubular body enclose different angles to the side wall of the body.

6. Spray head as claimed in any of the foregoing claims, **characterized in that** the spray nozzles enclose different angles to the plane of the longitudinal axis of the tubular body.

7. Spray head as claimed in any of the foregoing claims, **characterized** by means for adjusting a desired pressure of the spraying liquid in the tubular body.

8. Spray head as claimed in claim 7, **characterized in that** the pressure adjusting means are formed by a pressure control valve at least partially closing an inlet aperture of the tubular body.

9. Apparatus for spraying culture beds which is provided with a carriage which is displaceable along the culture beds and connected to a source of spraying liquid, and at least one spray head as claimed in any of the foregoing claims arranged on the carriage.

10. Spray apparatus as claimed in claim 9 for spraying a number of culture beds placed one above another in a rack, **characterized in that** the carriage supports at least one post which is provided at different heights with means for mounting at least one spray head.

11. Spray apparatus as claimed in claim 9 or 10, **characterized in that** the carriage is provided with drive means for displacement thereof along the culture beds in addition to feed means for feeding spraying liquid to the or each spray head, wherein the drive means and the spraying liquid feed means are both connected controllably to an electrical control means.

12. Spray apparatus as claimed in claim 11 for two adjacently placed culture beds or culture racks filled with culture beds, **characterized in that** a spray apparatus is associated with each culture bed or each culture rack and the spray nozzles of both spray apparatuses are directed toward each other.

13. Spray apparatus as claimed in claim 11, **characterized in that** both spray apparatuses have a collective drive in the form of an uninterrupted drive element connecting both spray apparatuses to each other and to a drive motor.

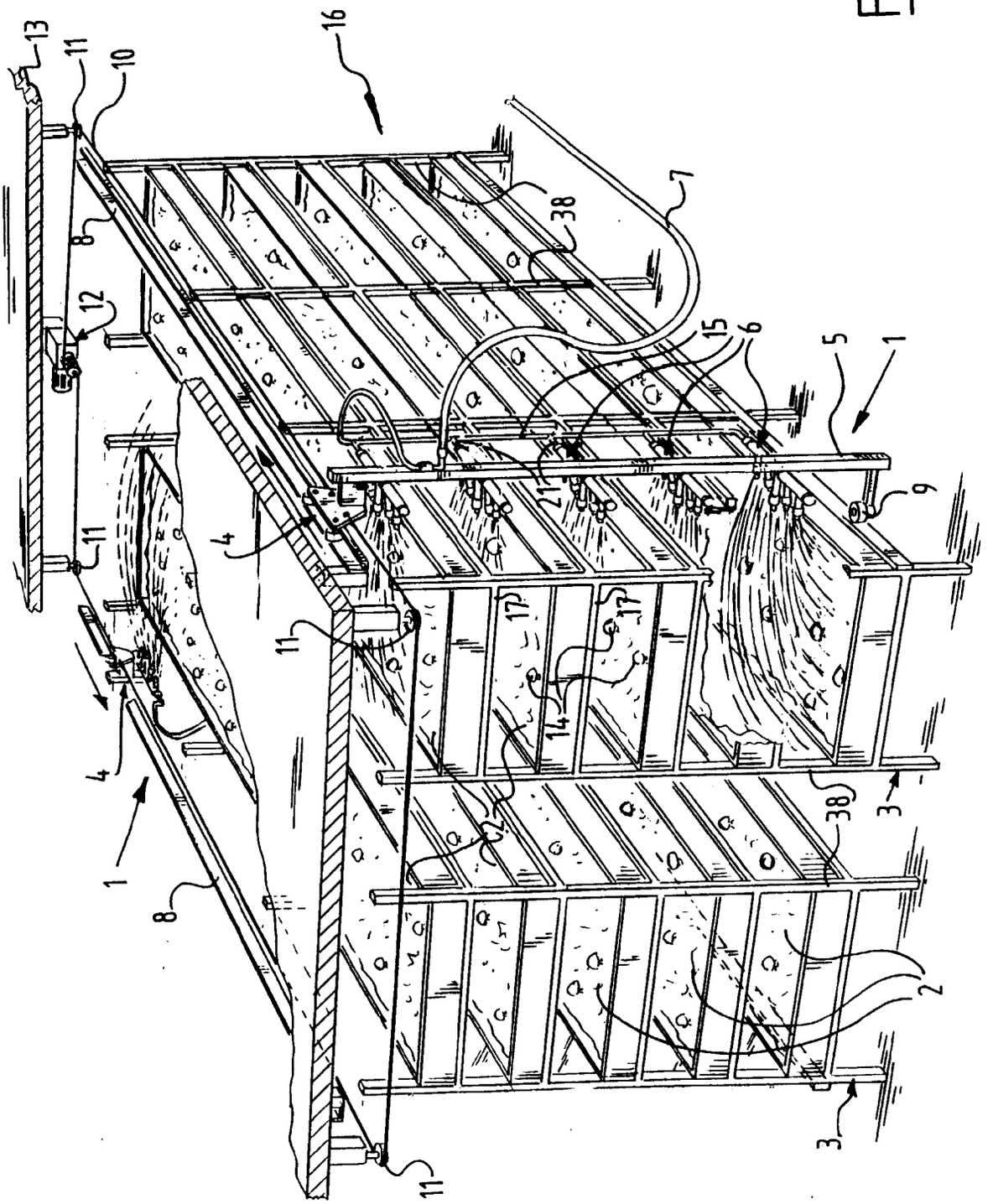

FIG.1

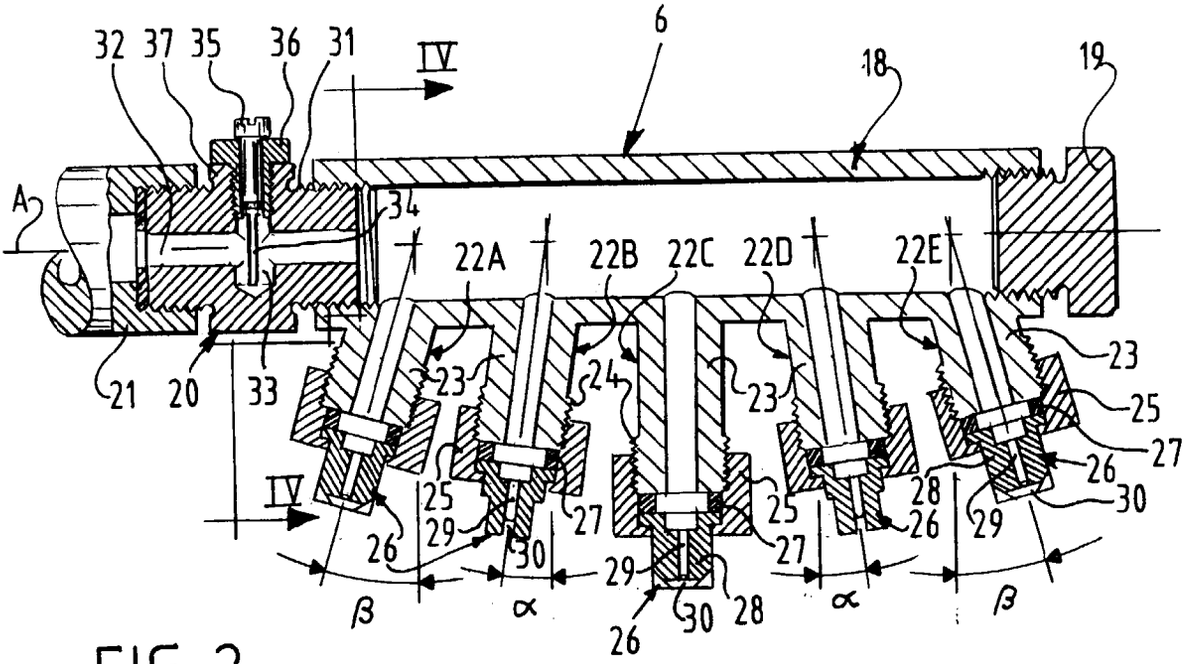

FIG. 2

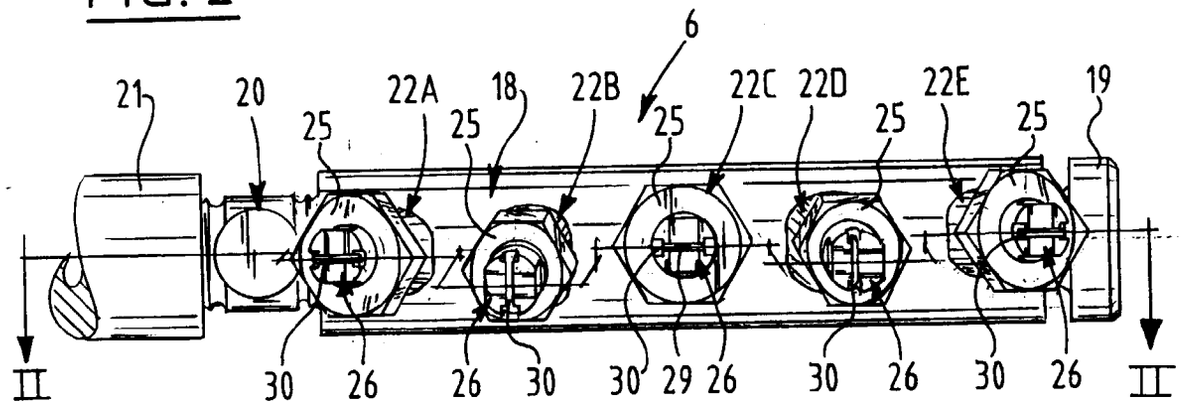

FIG. 3

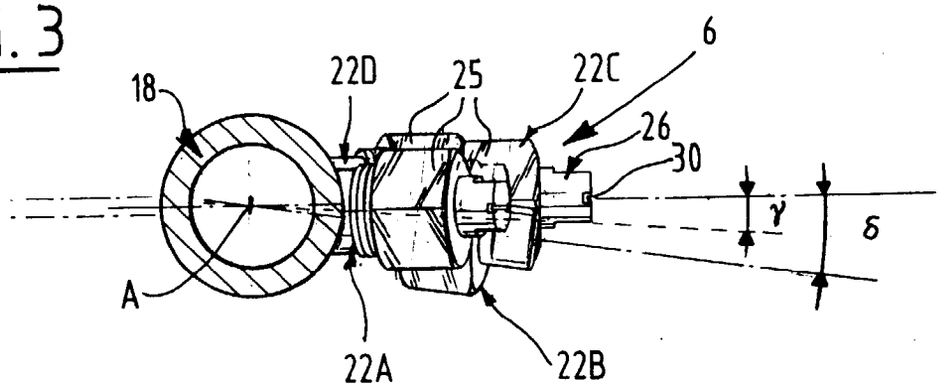

FIG. 4

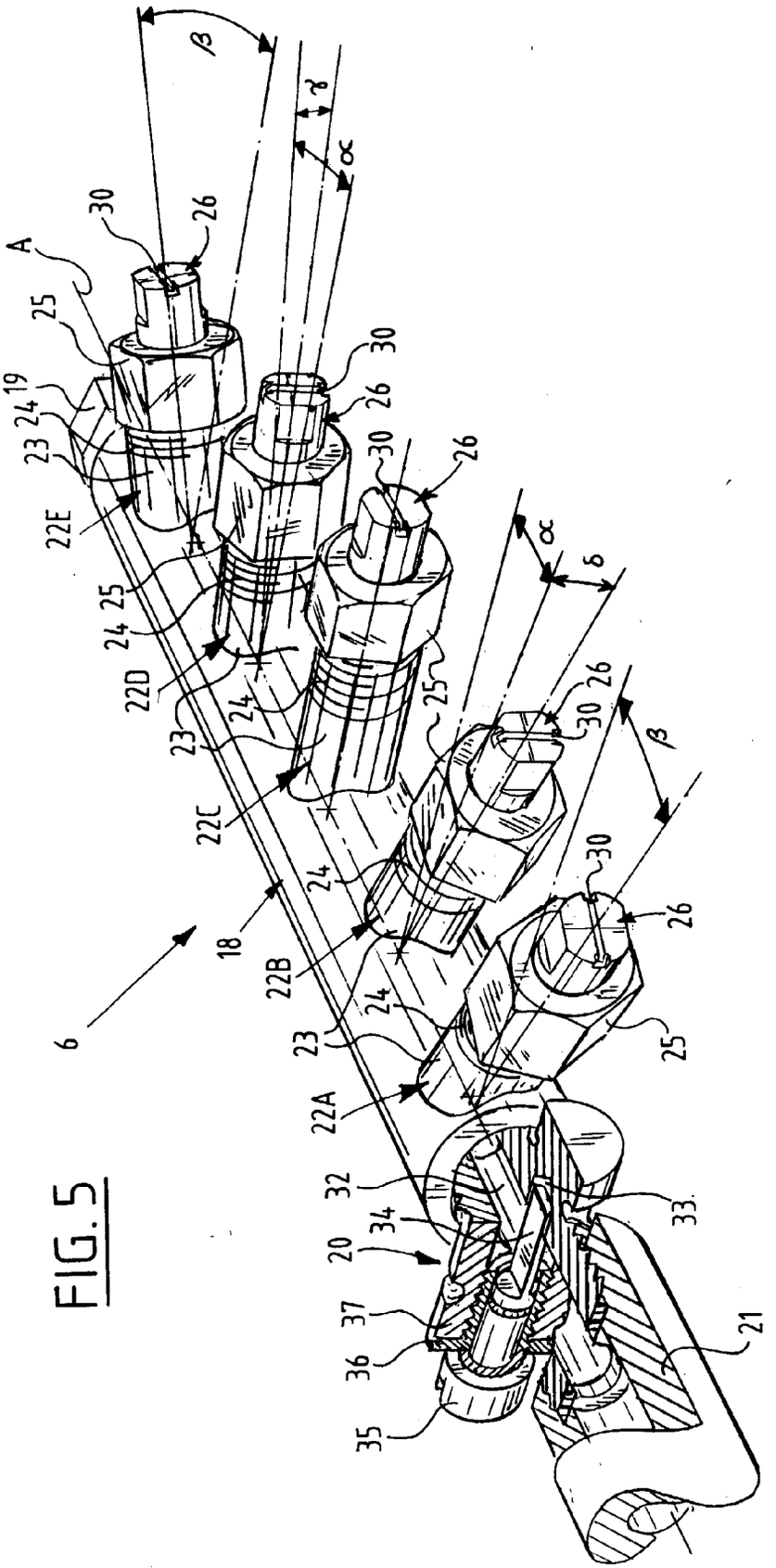
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FIG. 5

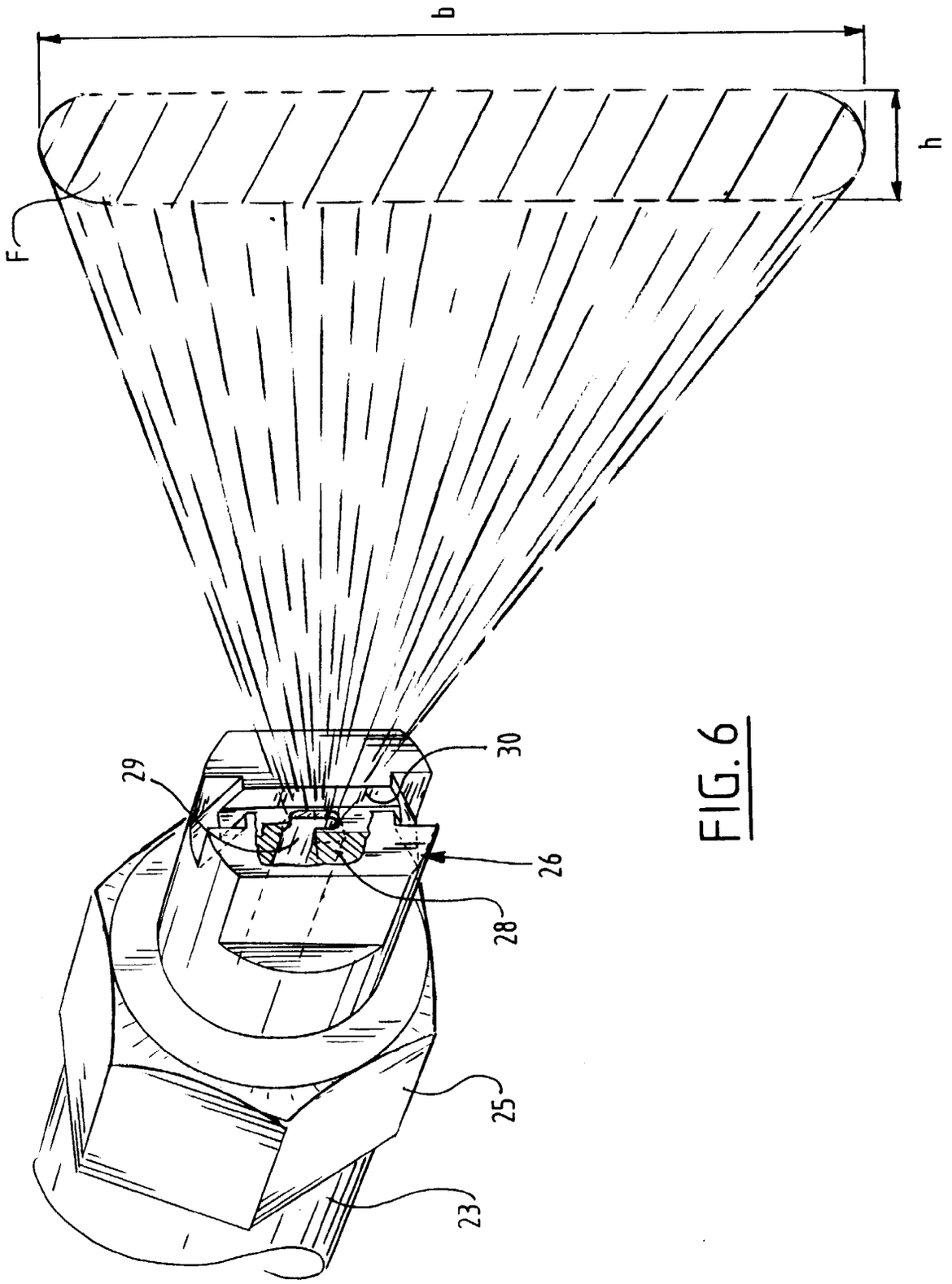

FIG. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 20 0559

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 4 095 746 A (ANDERBERG THOMAS A ET AL) 20 June 1978 * column 3, line 29 - line 30 *	1,2	B05B1/04 B05B1/14
X	GB 717 464 A (SPRAYING SYSTEMS CO.) 27 October 1954 * the whole document *	1,2,4,6	
A	US 2 254 751 A (PARADISE) 2 September 1941 * the whole document *	3,5	
D,A	NL 185 974 C (DOFRA B.V.) 3 September 1990 * the whole document *	1,6,9	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	5 June 1997	Juguet, J

CATEGORY OF CITED DOCUMENTS

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