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(54) Sub nozzle in a jet loom.

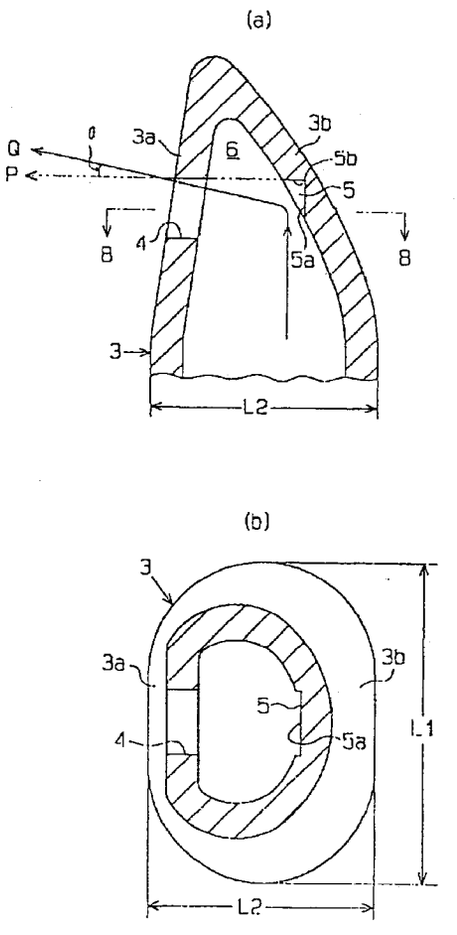
(57) OBJECT

To provide a sub nozzle in an air jet loom which can prevent air jet therefrom from being deviated far away from the axial reference direction of the nozzle hole and also from being influenced by air pressure conditions.

STRUCTURE

A sub nozzle (3) having a pointed distal end has an air injection hole (4) formed through its front wall (3a). Back wall (3b) on opposite side of the nozzle (3) is formed in its interior surface with a stepped portion (5) for deflecting air flow. The stepped portion 6 is formed by a first. surface (5a) in facing relation to the injection hole (4) and a second surface (5b) perpendicular to the first surface (5a). The second surface (5b) of the stepped portion (5) is formed in parallel to the axial reference direction P of the injection hole (4).

Fig. 2



EP 0 541 489 A1

DETAILED DESCRIPTION OF THE INVENTION

INDUSTRIAL FIELD OF UTILIZATION

The present invention relates to a sub nozzle in a jet loom which is operable by air jet to insert a weft through a warp shed.

PRIOR ART

A sub nozzle for use in a jet loom, which is required to move into a shed through a warp sheet while separating that sheet, should have its tip end portion formed as thin as possible to permit easy ingress through the warp sheet. In the weaving loom and the textile industry, sub nozzles are also called auxiliary nozzles.

Publication of unexamined Japanese patent application No. 63-264947 (1988) discloses a sub nozzle in which its distal end portion is flattened, or reduced in thickness, and the back and side walls are recessed on the interior side to make these walls thinner than the front wall through which an air injection hole is drilled. The recesses are provided for the purpose of enlarging the nozzle interior volume thereby to increase the flow velocity of air jet. The nozzle front wall thickness is maintained as it is to secure normal axial length of the air injection hole for preventing an injected air from being dispersed and also from being deviated far away from the axial reference direction which is defined by the direction in wnicn the air injection hole is formed through the nozzle front wall.

PROBLEMS THAT THE INVENTION IS TO SOLVE

The air injection hole of a sub nozzle is located at a slight distance from the tip end of the nozzle and formed in a direction substantially perpendicular to the longitudinal direction of the nozzle. If this injection hole is provided at the tip end of the nozzle, it becomes difficult to direct the hole in the above perpendicular relation. if the spaced distance is too large, on the other hand, the action of air jet from the sub nozzle to assist an inserted weft in flying through the shed is reduced. Thus, the nozzle hole should be located at a slight distance from the tip end of the nozzle.

In such a sub nozzle wherein there is left only a small distance in the nozzle between the interior top wall and the injection hole, the air flowing in the nozzle along its interior back wall tends to be deviated, when it is issued from the nozzle hole, obliquely toward the side of the nozzle tip end with respect to the axial reference direction of the nozzle hole. This phenomenon that the actual direction of air injection fails to coincide with the reference direction makes it difficult to set the nozzle position through adjustment for permitting the air jet to act on the weft properly.

The above phenomenon gives rise to another problem. That is, the air issued from the nozzle hole obliquely in the above deviated direction has such a flow velocity distribution that the air flows faster In the upper region of the nozzle hold adjacent the nozzle tip end than in the opposite lower region tnereors Vacuum vortex tends to be created in the latter region and nozzle hole periphery in the former region offers resistance against the air flow. Such tendency becomes more noticeable with an increase in the air jet pressure, and the air injection direction is shifted toward the axial reference direction of the nozzle hole, accordingly. Thus, the above sub nozzle of prior art has a disadvantage in that the air injection direction is influenced by variation in the air injection pressure, hence supply air pressure, and such influence will make it difficult to achieve favorable condition for waft insertion.

Furthermore, in the sub nozzle disclosed in the above-cited Publication No. 63-264947 which has reduced back and side wall thickness by forming recesses so as to enlarge the nozzle interior volume, the air flowing along the back interior wall tends to be drawn toward the recessed back wall. Such air flow in the sub nozzle influences the air pressure distribution in the nozzle, particularly in the space adjacent the uppermost interior wall tip end of the nozzle and shifts the air injection direction toward the axial reference direction.

However, this sub nozzle is still disadvantageous in that the air jet issued from the injection hole is deviated substantially away from the reference direction. This deviation becomes more remarkable with a reduction in thickness (or flattening) of the distal end portion of the sub nozzle. Therefore, the problem associated with troublesome setting of each sub nozzle through adjustment for proper injection direction while taking air pressure conditions taken into consideration remains unsolved.

Therefore, it is an object of the present invention to provide a sub nozzle in an air jet loom which prevents air jet from being deviated far away from the axial reference direction of the nozzle hole and also from being influenced by a change in air pressure conditions.

MEANS SOLVING THE PROBLEMS

To solve the above problems, the invention provides a sub nozzle in a jet loom operable by air jet to insert a weft through a warp shed, wherein said sub nozzle is formed in its interior back wall surface with an air flow deflecting stepped portion, said back wall surface being in facing relation to an air injection hole formed through the front wall portion of said sub nozzle.

OPERATION OF THE INVENTION

Air supplied into the interior of the sub nozzle is deflected toward the nozzle hole by the above air flow deflecting portion. The direction in which the air jet is issued from the nozzle hole can substantially coincide with the reference direction and the injection direction of air jet is very little influenced by a change in the air pressure conditions.

EMBODIMENTS

The following will describe a preferred embodiment of the invention while having reference to FIG. 1 to 7. The figures illustrate the following:

FIG. 1 is front view of a sub nozzle of an embodiment according to the present invention, showing also positional relation between the sub nozzle and a waft guide passage;

FIG. 2(a) is an enlarged sectional view of the sub nozzle taken along lina A-A of FIG. 11 and FIG. 2(b) is a sectional view of the same nozzle taken along line B-B in FIG. 2(a);

FIG. 3 is an enlarged front view of a sub nozzle of a modified embodiment according to the invention;

FIG. 4 is an enlarged sectional.view of the sub nozzle taken along line C-C of FIG. 3;

FIG. 5 is an enlarged front view of a sub nozzle of another modified embodiment according to the invention;

FIG. 6 is an enlarged sectional view of the sub nozzle taken along line D-D of FIG. 5; and

FIG. 7 is an enlarged sectional view of a sub nozzle of still another modified embodiment according to the invention.

The following will describe a preferred embodiment of the invention while having reference to FIG. 1 and FIG. 2.

Reference numeral 1 designates one of a plurality of dents of a reed in a jet loom each having formed at its front a recess 1a. A plurality of such recesses 1a arranged in a row forms a passage S for guiding a weft injected from a main nozzle 2. A weft inserted into the passage S is assisted in flying therethrough by air jets issued from a plurality of sub nozzles 3 (only one nozzle being shown) disposed along the weft guide passage S.

As shown in FIG. 2 (a) and (b), the sub nozzle 3 is formed in a flattened shape so that its width dimension L1 as measured along the extension of warp yarns is greater than the thickness dimension L2 as measured along the weft insertion direction (namely L2 < L1) and the tip end of the sub nozzle 3 is pointed. Such shape permits the sub nozzle 3 to move through a warp sheet smoothly.

The front and back walls 3a, 3b of the sub nozzle 3 are formed at angles with respect to the nozzle longitudinal direction so as to converge toward each other. As shown clearly, the back wall 3b is formed with a greater angle than the front wall 3a. The front wall 3a has formed therethrough an air injection hole 4 directed toward the weft insertion guide passage S. In FIG. 2(a), dash-and-dot line P represents the axial reference direction of the nozzle hole 4.

The interior surface of the back wall 3b is formed with a stepped portion 5 for deflecting air flow in the sub nozzle. The stepped portion 5 includes first surface 5a which is substantially parallel to the front wall 3a and second surface 5b which is perpendicular to the first surface 5a. The second surface 5b of the stepped portion 5 is positioned substantially level with the uppermost edge of the nozzle hole periphery and extends parallel to the axial reference direction P of the nozzle hole 4.

The air flow deflecting stepped portion 5 may be formed by electric discharge machining or cutting with a drill or an end mill. That is, an electric discharge electrode, drill or end mill is inserted into the sub nozzle 3 through the air injection hole 4 and electric discharging with the desired intensity or cutting with the desired size of dimensions is applied to the interior back wall surface so as to form the required stepped portion 5 as shown in FIG. 2 (a), (b).

A region 6 present in the sub nozzle 3 above an imaginary line connecting the uppermost edge of the nozzle hole periphery and the second surface 5b of the stepped portion 5 defines a space where air is packed. Air flowing in the sub nozzle 3 along its back wall 3b impinges against the second surface 5b of the stepped

portion 5 and deflected toward the injection hole 4. The air-packed space 6 in the sub nozzle 3 serves to guide the deflected air to direct toward the upper region in the injection hole 4 without being disturbed.

If it were not for the air deflecting stepped portion 5 in the sub nozzle 3,, the air flow velocity at the upper portion of the nozzle hole 4 is greater than that at the lower portion thereof, so that the pressure of injected air at the upper portion is reduced. In the above embodiment, however, the air flow deflected by the stepped portion 5 increases the pressure at the upper portion in the nozzle hole 4.

As a result, the air pressure in the nozzle hole 4 can be evenly distributed radially of the hole 4. Therefore, the direction Q in which the air jet is issued from the nozzle hole 4 can be shifted closer to the direction P than in the prior art sub nozzle and the air injection angle Θ of the line Q with respect to the line P can be substantially reduced. Thus, the air injection angle can be maintained substantially constant irrespective of variation in the injection pressure.

Because the air injection angle can be thus maintained substantially constant in the above embodiment, the air jet from the sub nozzle 3 can act effectively on a weft flying in the weft passage S. Therefore, the period of time during which air is being injected from the sub nozzle can be set shorter than heretofore, thus making possible reduction of air consumption. Furthermore, even air pressure distribution in the injection hole 4 serves to reduce the pressure loss, which can permit energy saving by reducing the pressure of air in an air tank from which air under pressure is supplied to the respective sub nozzles.

Though it has been necessary heretofore for each sub nozzle to be adjusted to change its nozzle hole direction depending on various conditions such as nozzle position, air injection pressure, etc., the sub nozzle 3 according to the above embodiment requires no such conventional adjustment because the air injection angle Θ can be maintained substantially constant.

It has been customary to manufacture various kinds of sub nozzles with subtle differences in the direction of their nozzle holes. With use of the sub nozzle 3 according to the above embodiment having constant air injection angle Θ, however only a single kind of sub nozzles may be made. This can contribute to improvement in the productivity and yield rate in the manufacture of sub nozzles.

Publication of unexamined Japanese patent application No. 59-36750 (1984) discloses a sub nozzle having a porous material disposed in the nozzle interior adjacent the air injection hole for preventing a change in the air injection angle due to a change in the supply air pressure. With this sub nozzle, however, its porous material offers resistance against the air flow thereby to decrease the flow velocity of air jet. The sub nozzle according to the invention can solve such disadvantage of the prior art and fulfill the requirements of maintenance of a constant injection angle and of the desired flow velocity of air jet.

It is to be understood that the present invention can be practiced in other various ways than the above-described embodiment, as exemplified below.

(1) FIGS. 3 and 4 show a sub nozzle 8 having two nozzle holes 9 one beside the other in the front wall 8a and two air flow deflecting stepped portions 10 (only one being shown in FIG. 4) each formed in the interior back will and corresponding to the associated injection hole 9, respectively. Alternatively, the two air deflecting portions 10 may be connected to form a elongated step extending between both air injection holes 9.

(2) FIGS. 5 and 6 show a sub nozzle 11 having at the upper end portion a plurality of injection holes 12a-12e in the front wall 11a. in such sub nozzle, air deflecting stepped portions 13a, 13b are formed in alignment with the upper two rows of injection holes 12a, 12b. In this embodiment the air pressure at the upper rows of injections holes is increased, so that the air pressure distribution in the plurality of holes can be generally uniform.

(3) FIG. 7 shows an embodiment of a sub nozzle 14 having an air injection hole 15 in the front wall portion 14a, wherein the air deflecting stepped portion 16 is provided by forming a recess in the interior back wall in the region below the level corresponding to the uppermost edge of the air injection hole 15 so that the thickness of back wall 14b is reduced in that region.

EFFECT OF THE INVENTION

As it is apparent from the foregoing description, the air flow deflecting stepped portion formed in the interior back wall of a sub nozzle in facing relation to the air injection hole formed through the front wall of the sub nozzle can prevent the air jet from the hole from being deviated far away from the axial reference direction of the nozzle hole and maintain the air jet direction substantially constant irrespective of a change in the air pressure conditions.

To provide a sub nozzle in an air jet loom which can prevent air jet therefrom from being deviated far away from the axial reference direction of the nozzle hole and also from being influenced by air pressure conditions.

A sub nozzle 3 having a pointed distal end has an air injection hole 4 formed through its front wall 3a. Back

wall 3b on opposite side of the nozzle 3 is formed in its interior surface with a stepped portion 5 for deflecting air flow. The stepped portion 6 is formed by a first. surface 5a in facing relation to the injection hole 4 and a second surface 5b perpendicular to the first surface 5a. The second surface 5b of the stepped portion 5 is formed in parallel to the axial reference direction P of the injection hole 4.

The stepped portion shown in the drawings show all a sharp stair step like profile. It is understood, that the stepped portion formed can also have smooth rounded edges. In particular the edge formed by the surfaces 5a and 5b may be smoothed and rounded, and it may even given a particular curved surface shape. But also the other edges of setps may be smoothed.

DESIGNATION OF REFERENCE NUMERALS

3, 8, 11, 14 .... Sub nozzles; 3a, 8a, 11a, 14a .... Front walls; 3b, 8b, 11b, 14b .... Back walls; 4, 9, 12a-12e, 15 .... Air injection holes; 5, 10, 13a, 13b, 16 .... Air flow deflecting stepped portions.

Claims

1. A sub nozzle (3) in a jet loom operable by air jet to insert a weft through a warp shed, wherein said sub nozzle (3) is formed in its interior back wall surface (3b) with an air flow deflecting stepped portion (5, 5a, 5b), said back wall surface (3b) being in facing relation to an air injection hole (4) formed through the front wall portion (3a) of said sub nozzle (3).

2. A sub nozzle (3) in a jet loom operable by air jet to insert a weft through a warp shed, wherein said sub nozzle (3) is formed in its interior back wall surface (3b) with an air flow deflecting stepped portion (5, 5a, 5b), said back wall surface (3b) being in facing relation to at least one air injection hole (4) formed through the front wall portion (3a) of said sub nozzle (3).

3. A sub nozzle as claimed in claim 2, said air flow deflecting stepped portion of the interior back wall surface (3b) including one single step (5, 5a, 5b), being in facing relation to one singel air injection hole (4).

4. A sub nozzle (3) as claimed in claim 2, said air flow deflecting stepped portion (5, 5a, 5b) of the interior back wall surface (3b) including one single step, being in facing relation to more than one air injection hole (4).

5. A sub nozzle (11) as claimed in claim 2, said air flow deflecting stepped portion of the interior back wall (11b) surface including a number of steps (13a. 13b), each being in facing relation to one or more air injection holes (12a, 12b, 12c 12d).

6. A sub nozzle (14) as claimed in any of claims 1 to 5, said step or steps being step like recesses (16) in the interior back wall (14b).

7. A sub nozzle as claimed in any of claims 1 to 6, said step or steps having a smoothed, rounded shape.

8. A sub nozzle (3) as claimed in any of claims 1 to 7, wherein the front wall portion (3a) that includes the injection hole/holes (4) and/or the back wall portion (3b) that includes the step/steps (5, 5a, 5b) are forming an angle with respect to the nozzle longitudinal direction.

9. A sub nozzle (3) as claimed in any of claims 1 to 8, wherein the front wall portion (3a) that includes the injection hole/holes (4) and/or the back wall portion (3b) that includes the step/steps (5, 5a, 5b) have a flattend inner and/or outer surface shape.

10. Air jet loom with one or more sub nozzles (3, 11) as claimed in any of claims 1 to 9.

Fig. 1

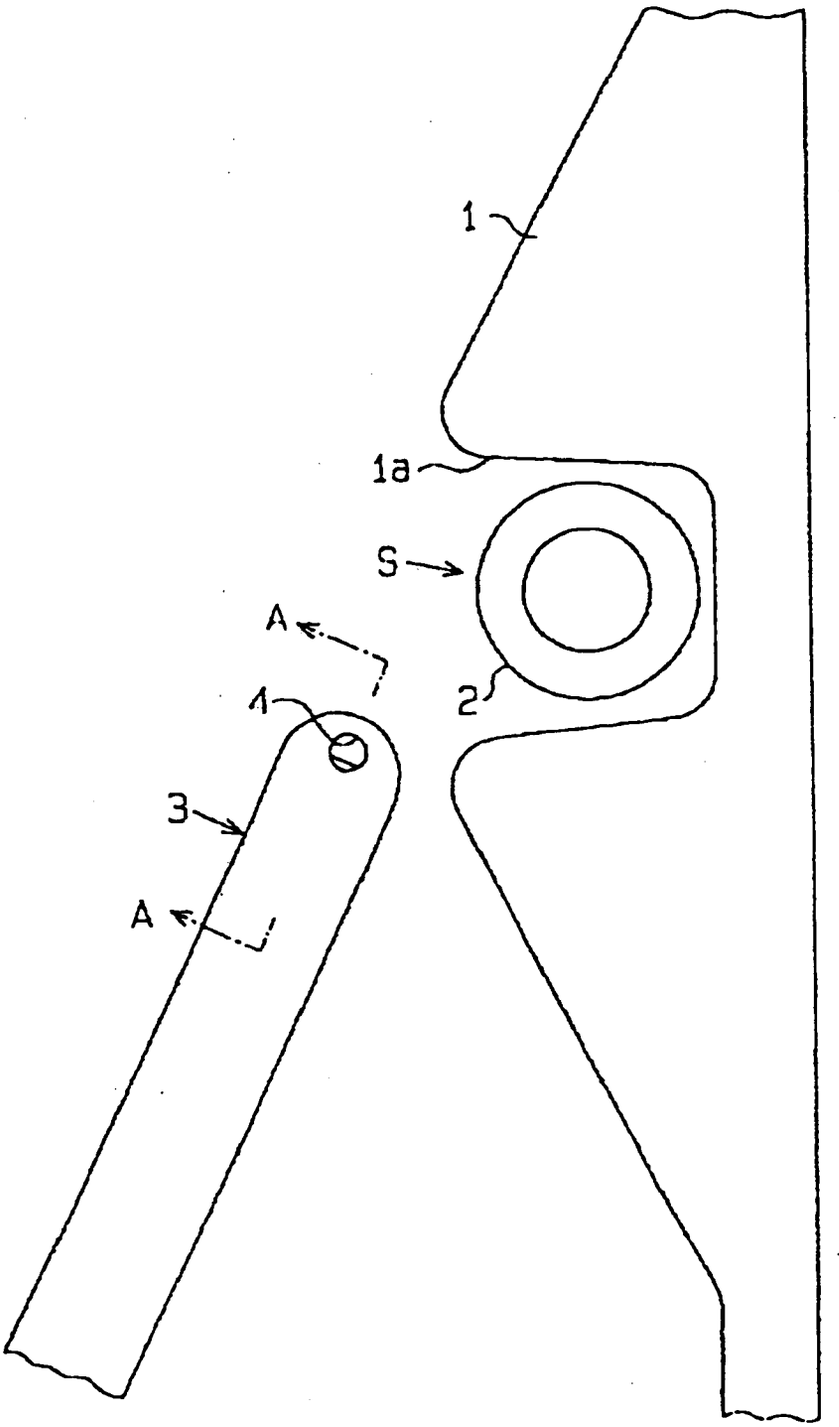
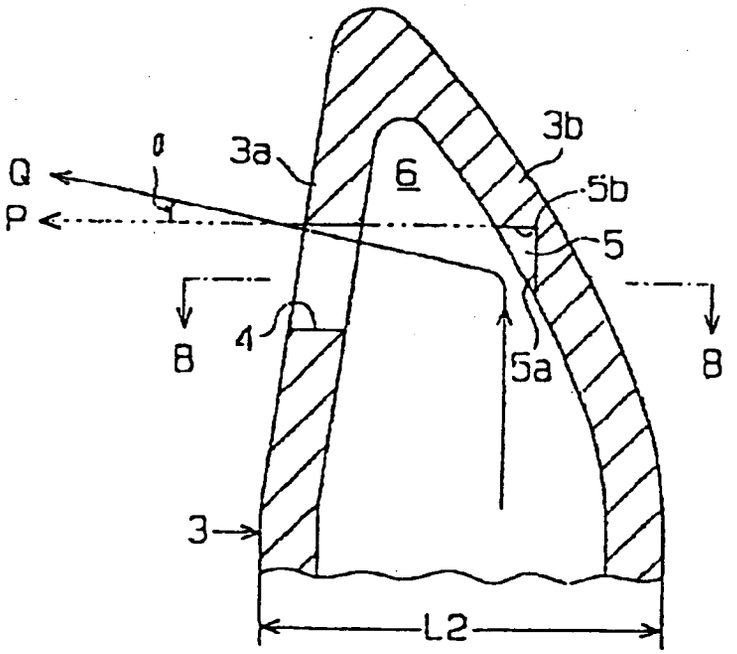


Fig. 2

(a)



(b)

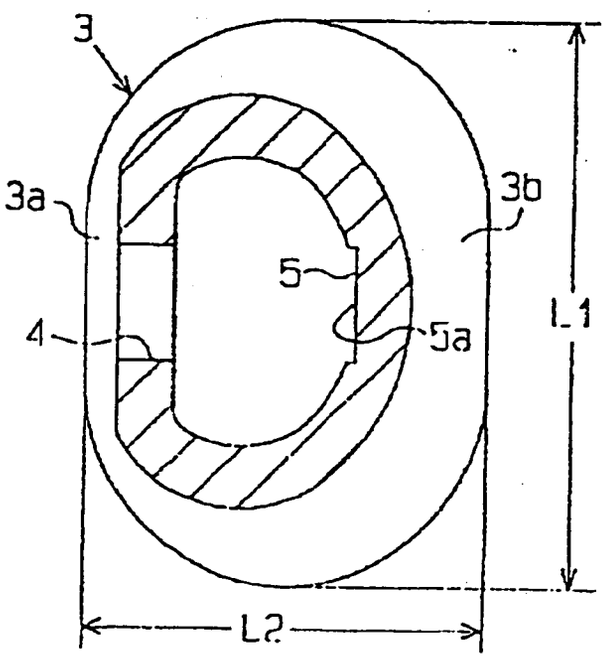


Fig. 3

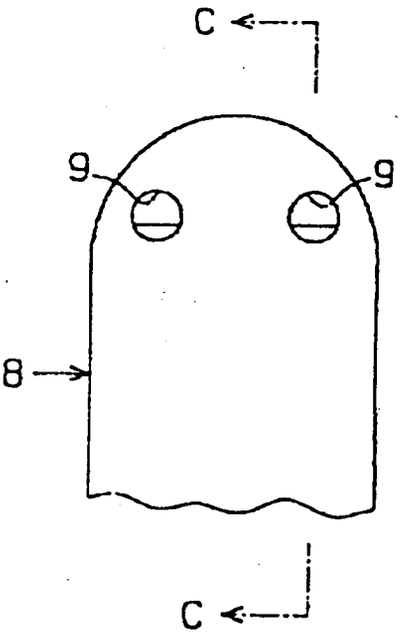


Fig. 4

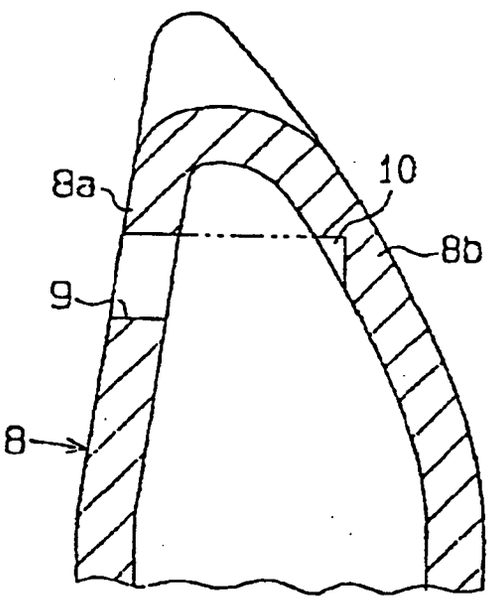


Fig. 5

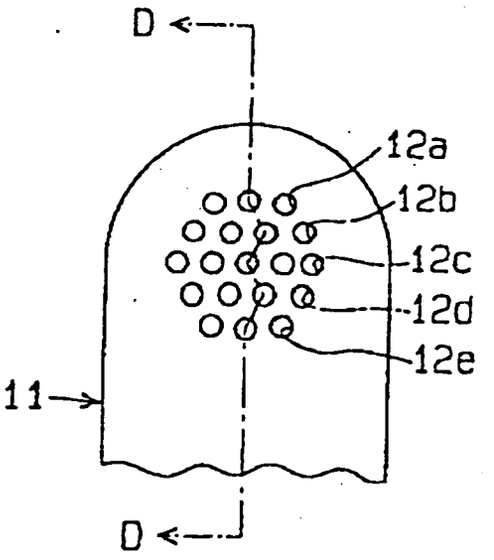


Fig. 6

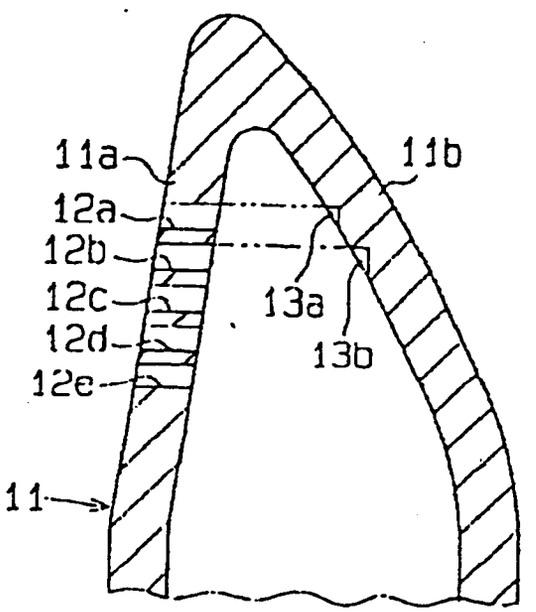
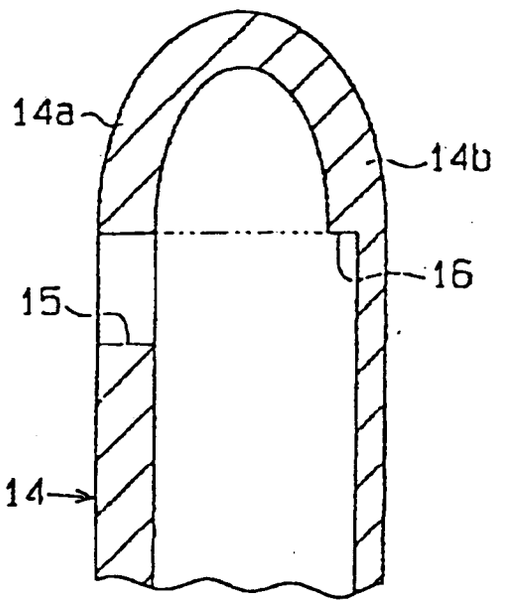


Fig. 7



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EUROPEAN SEARCH REPORT

Application Number
EP 92 81 0841

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.5)
X	EP-A-0 268 794 (PICANOL) * column 9, line 49 - column 10, line 10; figures 9,10 *	1-3,8-10	D03D47/30
A	US-A-4 915 141 (NITTA) * figures 8-12 *	1,2,8-10	
A	DE-A-3 204 363 (GÜNNE) * figures 3,4 *	1,2,8-10	
A	EP-A-0 355 164 (NIPPON TUNGSTEN)		
A	EP-A-0 145 824 (SULZER)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

D03D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	04 MARCH 1993	BOUTELEGIER C.H.H.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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