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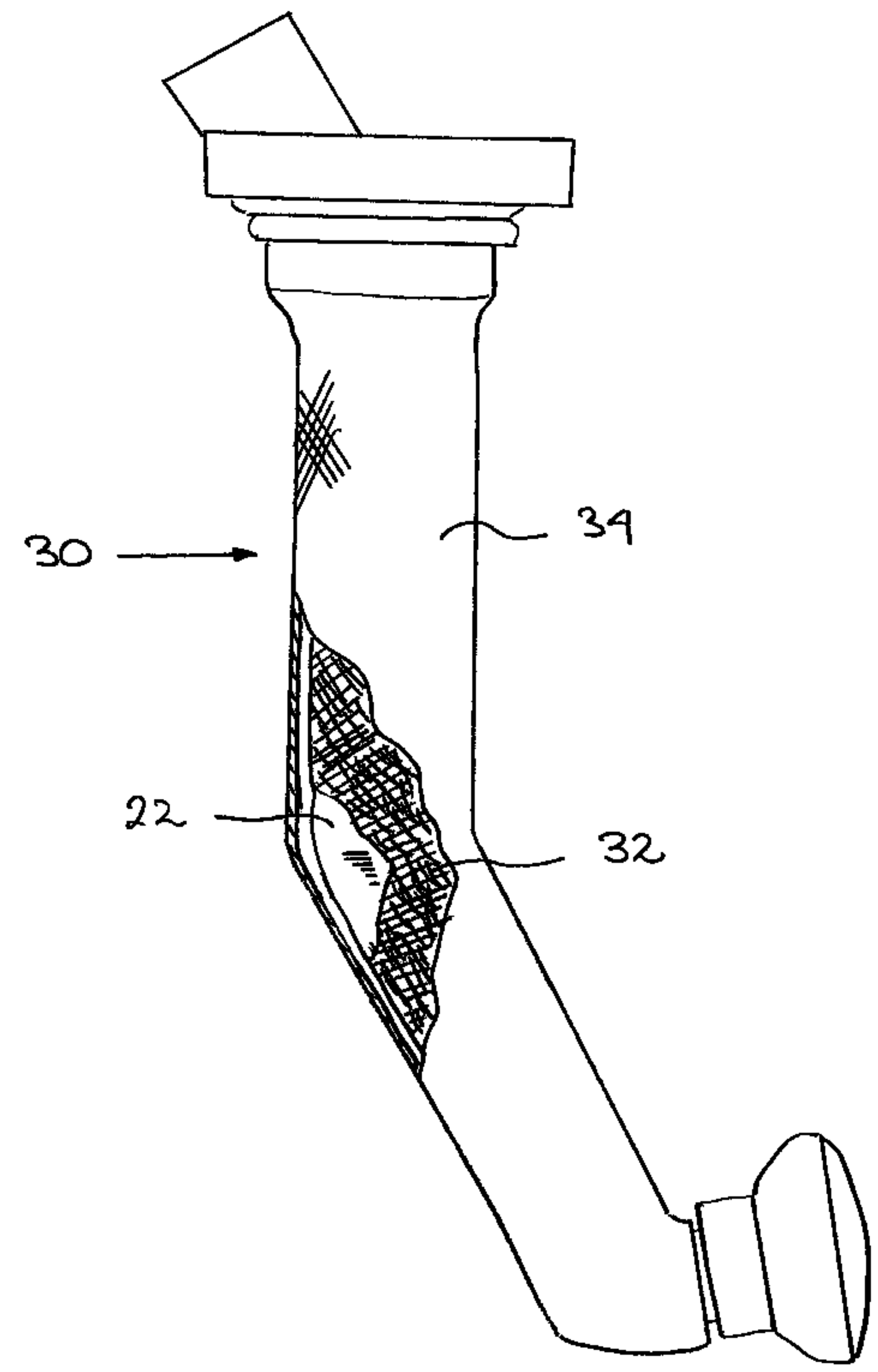
(54) Title: FLEXIBLE HEAT SHIELDS AND METHOD



(57) Abrégé/Abstract:
A heat shield (30) comprises a flexible inner jacket (32) configured and disposed to be fitted around at least a portion of a component, and an outer jacket (34) configured and disposed to be fitted around the inner jacket (32). The outer jacket (34) comprises at least one layer of meshed wires (36) intersected by braze wires (38). The outer jacket (34) is designed to be substantially flexible when fitted over the component during manufacturing to follow non-linear shapes. Once the heat shield (30) is in place, it is preferably heated so as to melt the braze wires (38) to form attachment points (40); upon cooling, the attachment points (40) cause the outer jacket (34) to become somewhat rigid.

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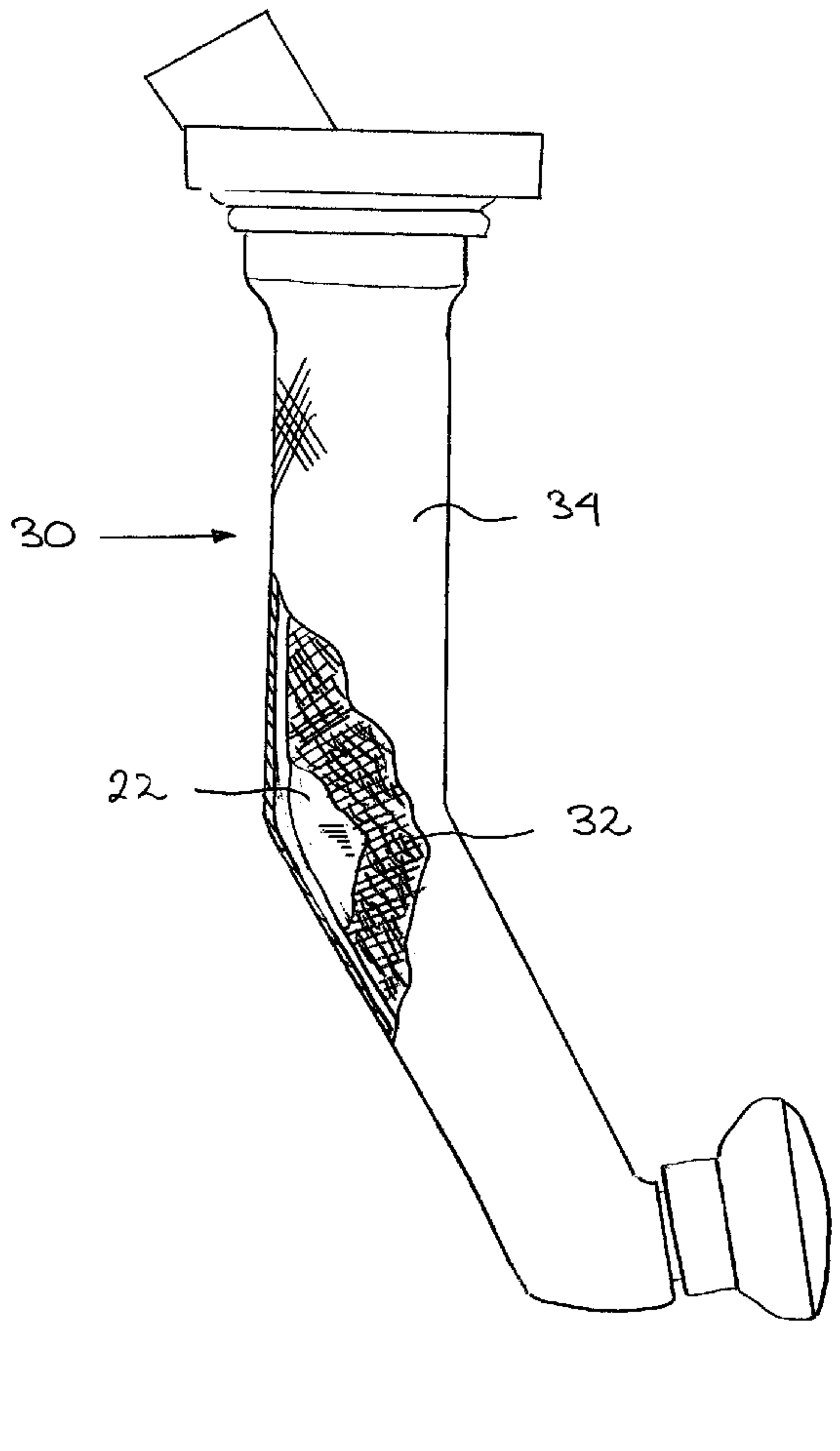
(54) Title: FLEXIBLE HEAT SHIELDS AND METHOD



(57) Abstract: A heat shield (30) comprises a flexible inner jacket (32) configured and disposed to be fitted around at least a portion of a component, and an outer jacket (34) configured and disposed to be fitted around the inner jacket (32). The outer jacket (34) comprises at least one layer of meshed wires (36) intersected by braze wires (38). The outer jacket (34) is designed to be substantially flexible when fitted over the component during manufacturing to follow non-linear shapes. Once the heat shield (30) is in place, it is preferably heated so as to melt the braze wires (38) to form attachment points (40); upon cooling, the attachment points (40) cause the outer jacket (34) to become somewhat rigid.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

FLEXIBLE HEAT SHIELDS AND METHOD

TECHNICAL FIELD

[0001] The invention relates generally to heat shields and, more particularly, to an improved flexible heat shield well adapted for use in gas turbine engines and to a method of providing a heat shield on a component.

BACKGROUND OF THE ART

[0002] To mitigate the overheating of fuel nozzles in gas turbine engines and similar components subjected to intense heat, a heat shield is typically installed so as to provide thermal insulation and keep the component from overheating.

[0003] Many challenges face engineers in the design of heat shields. For instance, some of the components on which heat shields must be installed may have a non-linear geometry. Hence, the installation of a heat shield on such component is complex and costly. Another challenge is the fact that some components, for instance components in gas turbine engines, are under intense vibrations during operation. These vibrations can force a heat shield out of a component or out of its optimum position.

[0004] Accordingly, there is a need to provide an improved heat shield and an improved method of installing a heat shield on a component.

SUMMARY OF THE INVENTION

[0005] In one aspect, the present invention provides a heat shield for a component, the heat shield comprising:

[0006] a flexible inner jacket configured and disposed to be fitted around at least a portion of the component, the inner jacket comprising at least one layer of meshed thermal insulation material; and

[0007] a flexible outer jacket configured and disposed to be fitted around the inner jacket, the outer jacket comprising at least one layer of meshed wires intersected by braze wires.

[0008] In another aspect, the present invention provides a heat shield for a component, the component having at least one portion to be covered by the heat shield, the heat shield comprising:

[0009] a flexible thermal insulation inner jacket covering the portion of the component; and

[0010] an outer jacket covering the inner jacket between two opposite ends of the heat shield, the outer jacket comprising meshed wires wherein at least some junctions between wires of the meshed wires are attached by attachment points made from braze wires.

[0011] In another aspect, the present invention provides a method of installing a heat shield on a component, the method comprising:

[0012] providing a flexible inner thermal-insulation jacket and a flexible outer jacket between two ends of the component, the outer jacket being made of meshed wires and further comprising a plurality of braze wires intersecting the meshed wires;

[0013] securing ends of the outer jacket over the ends of the component;

[0014] heating the braze wires to melt it and form attachment points; and then

[0015] cooling the attachment points until they solidify.

[0016] Further details of these and other aspects of the present invention will be apparent from the detailed description and figures included below.

DESCRIPTION OF THE DRAWINGS

[0017] Reference is now made to the accompanying figures depicting aspects of the present invention, in which:

[0018] Fig. 1 shows a generic gas turbine engine to illustrate an example of a general environment in which the invention can be used;

[0019] Fig. 2 is a schematic side view of a fuel nozzle without a heat shield;

[0020] Fig. 3 is perspective and partially cut-away view showing the fuel nozzle of Fig. 2 being provided with a heat shield in accordance with a preferred embodiment of the present invention;

[0021] Fig. 4a is a schematic view of meshed wires intersected by braze wires before the braze wires are melted;

[0022] Fig. 4b is a view similar to Fig. 4a, showing the meshed wires with attachment points resulting from a melting of the braze wires;

[0023] Fig. 5a is a view similar to Fig. 4a, showing braze wires disposed in another fashion; and

[0024] Fig. 5b is a view similar to Fig. 5a, showing the meshed wires with attachment points resulting from a melting of the braze wires.

DETAILED DESCRIPTION

[0025] Fig. 1 illustrates an example of a gas turbine engine 10 of a type preferably provided for use in subsonic flight, generally comprising in serial flow communication a fan 12 through which ambient air is propelled, a multistage compressor 14 for pressurizing the air, a combustor 16 in which the compressed air is mixed with fuel and ignited for generating an annular stream of hot combustion gases, and a turbine section 18 for extracting energy from the combustion gases. This figure illustrates an example of the environment in which the present invention can be used.

[0026] Fig. 2 shows a fuel nozzle 20 without a heat shield. This fuel nozzle 20 is an example of a component having a portion with a non-linear geometry on which can be provided the flexible heat shield in accordance with the present invention. The fuel nozzle 20 is located adjacent to the combustor 16 of the gas turbine engine 10. It comprises a stem 22 that requires the presence of a heat shield. This stem 22 has many angles with irregular sections. In this case, a heat shield 30 is provided between two opposite ends of the stem 22 that are, in this case, in the form of collars 24, 26. These collars 24, 26 are preferably used as connecting points for the heat shield.

[0027] Fig. 3 shows a heat shield 30, in accordance with a preferred embodiment of the present invention, as installed on the stem 22 of the fuel nozzle 20 shown in Fig. 2. In this case, almost the entire stem 22 is cover by the heat shield 30.

[0028] The heat shield 30 comprises a flexible inner jacket 32 configured and disposed to be fitted around the stem 22. This inner jacket 32 comprises at least one layer of meshed thermal insulation material, preferably a layer of woven ceramic fibres. Entrapped air inside the ceramic fibres contributes in the increase of the thermal insulation of the material. Adding many layers would increase the thermal insulation of the heat shield 30. The pattern of the meshed material or the material selected for the layer is something which may be determined to fit the specific operating parameters. It should also be noted that the expression "meshed thermal insulating material" is intended to be construed in a broad sense and includes every technique producing a flexible fabric-like layer of thermal insulating material, such as weaving, braiding or otherwise interlacing material.

[0029] Preferably, the inner jacket 32 is manufactured to be substantially cylindrical. The fact that the inner jacket 32 is flexible makes it easily to fit on non-linear parts. Yet, the inner jacket 32 may not have necessarily a purely cylindrical shape, especially in the case of a component having a complex geometry.

[0030] The heat shield 30 also comprises an outer jacket 34 configured and disposed to be fitted around the inner jacket 32. The outer jacket 34 is used to provide some protection and strength to the inner jacket 32. It also allows maintaining the inner jacket 32 in place. The outer jacket 34 comprises at least one layer of meshed wires 36 intermittently intersected by braze wires 38, as depicted schematically in Figs. 4a and 5a. The pattern of the meshed material or the material selected for the meshed wires is something which may be determined to fit the specific operating parameters. It should also be noted that the expression "meshed wire" is intended to be construed in a broad sense and includes every technique producing interwoven wires, such as weaving, braiding or otherwise interlacing.

[0031] As shown in Figs. 4a and 5a, the meshed wires 36 are intermittently intersected by braze wires 38. The braze wires 38 intersect the meshed wires 36 at some points. The outer jacket 34 is designed so that it is substantially flexible when fitted over the component during manufacturing to follow non-linear shapes. However, once the heat shield 30 is in place, the heat shield 30 is preferably heated (e.g. in a high temperature oven or the like) so as to melt the braze wires 38 to from attachment points 40. Hence, once heat is applied and the braze wires reach the melting point, the braze flows by surface tension to produce attachment points 40 where two or more meshed wires intersect. These attachment points 40 are shown in Figs. 4b and 5b. Once cooled, the attachment point 40 cause the outer jacket to become somewhat "rigidified".

[0032] The braze wires 38 preferably have a melting temperature well above the operating temperature at the location where they will be used. For instance, a heat shield designed to operate in an environment of 1000-1200°F, a preferred melting temperature is about 1800°F. The meshed wires 36 are also made of a highly heat resistant material that can withstand the temperature of its operating environment. The material has a melting point higher than that of the braze material.

[0033] Various patterns of meshed wires can be selected for the design of the outer jacket 34, as shown in Figs. 4a and 5a. Similarly, the number and position of the braze wires 38 depend on the actual requirements in terms of rigidity and durability. The density of the attachment points 40 can also vary around the heat shield 30. For instance, the density of the attachment points 40 at the ends of the heat shield 30 is preferably higher that the density at the intermediate portion.

[0034] The mechanical connection between the heat shield 30 and a component must be strong enough to resist the operational environment, such as the usual harsh environment encountered in gas turbine engines. Among other things, the heat shield 30 used in a gas turbine engine must be able to withstand intense vibrations. A preferred solution to this problem is to use the outer jacket 34 itself to tie ends of the heat shield 30 onto the component. One way of achieving this goal is to maintain the ends of the outer jacket 34 in position until the outer jacket 34 is stiffened by the attachment points 40. Spot welding some of the meshed wires 36 together is the preferred technique used. Alternatively, one can use an external clamping ring (not shown) to urge the ends of the outer jacket 34 of the heat shield 30 onto clamping surfaces of the component during assembly. Using a permanent clamping ring, which will stay on the heat shield 30 after the manufacturing process, is also possible.

[0035] The above description is meant to be exemplary only, and one skilled in the art will recognize that changes may be made to the embodiments described without department from the scope of the invention disclosed. For example, heat shielding using the present invention is not limited to fuel nozzles since it can be advantageously used with many other components. Other shapes than cylindrical shapes can be used in the design of the heat shield. Using a flat or otherwise non-tubular heat shield is also possible. The insulation material is not limited to ceramic fibres. Stiffening is not necessary but if desired may be achieved by other ways as well, such as intermittent or spot welds, high temperature epoxies, etc. Securing the outer jacket on the component can be done using an external ring or other techniques which mounted the outer jacket 34 to the ends 24, 26 of the stem 22. A same heat shield may be manufactured using meshed wires made of several different materials and braze wires also made of several different materials. Wires need not to be used at all, as other configurations of strip-like material may be used. Any suitable method of holding the strips together into a cohesive but flexible material or fabric may be employed. Still other modifications which fall within the scope of the present invention will be apparent to those skilled in the art, in light of a review of this disclosure, and such modifications are intended to fall within the appended claims.

AMENDED CLAIMS

[received by the International Bureau on 03 February 2006 (03.02.2006); original claims 1 to 13 replaced by new claims 1 to 13 (2 pages)]

1. A heat shield for a component, the heat shield comprising:

   a flexible inner jacket configured and disposed to be fitted around at least a portion of the component, the inner jacket comprising at least one layer of meshed thermal insulation material; and

   a flexible outer jacket configured and disposed to be fitted around the inner jacket, the outer jacket comprising at least one layer of meshed wires intersected by braze wires.

2. The heat shield as defined in claim 1, wherein the thermal insulation material comprises ceramic fibres.

3. The heat shield as defined in claim 1, wherein the inner and outer jackets are substantially cylindrical.

4. The heat shield as defined in claim 1, wherein component is a stem part of a fuel nozzle.

5. The heat shield as defined in claim 1, wherein the inner and outer jackets have a non-linear shape.

6. A heat shield for a component, the component having at least one portion to be covered by the heat shield, the heat shield comprising:

   a flexible thermal insulation inner jacket covering the at least one portion of the component; and

   an outer jacket covering the inner jacket between two opposite ends of the heat shield, the outer jacket comprising meshed wires wherein at least some junctions between wires of the meshed wires are attached by attachment points made from braze wires.

AMENDED SHEET (ARTICLE 19)

7. The heat shield as defined in claim 6, wherein at each end of the heat shield, the outer jacket is secured to the component.

8. The heat shield as defined in claim 7, wherein the outer jacket comprises opposite end portions where the attachment points are provided at a higher density than that of an intermediary portion between the end portions.

9. The heat shield as defined in claim 6, wherein the inner and outer jackets have a non-linear shape.

10. A method of installing a heat shield on a component, the method comprising:

providing a flexible inner thermal-insulation jacket and a flexible outer jacket between two ends of the component, the outer jacket being made of meshed wires and further comprising a plurality of braze wires intersecting the meshed wires;

securing ends of the outer jacket over the ends of the component;

heating the braze wires to melt it and form attachment points; and then

cooling the attachment points until they solidify.

11. The method as defined in claim 10, wherein the inner jacket and outer jacket are provided simultaneously on the component.

12. The method as defined in claim 10, wherein the inner jacket is provided on the component before the outer jacket.

13. The method as defined in claim 10, wherein securing the ends of the outer jacket over the ends of the component comprises:

spot welding together some of the meshed wires before the braze wires are melted.

AMENDED SHEET (ARTICLE 19)

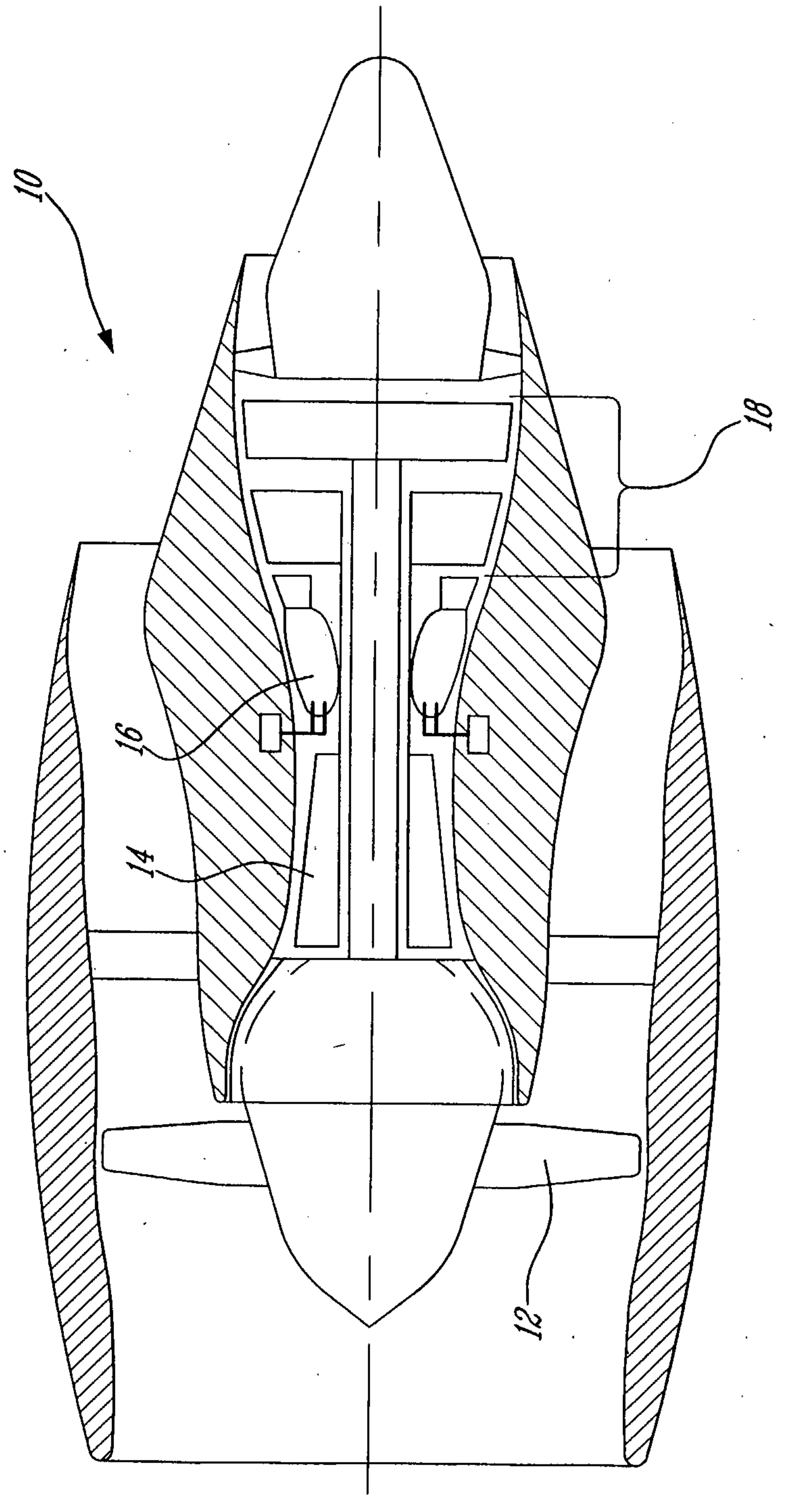

FIG. 1

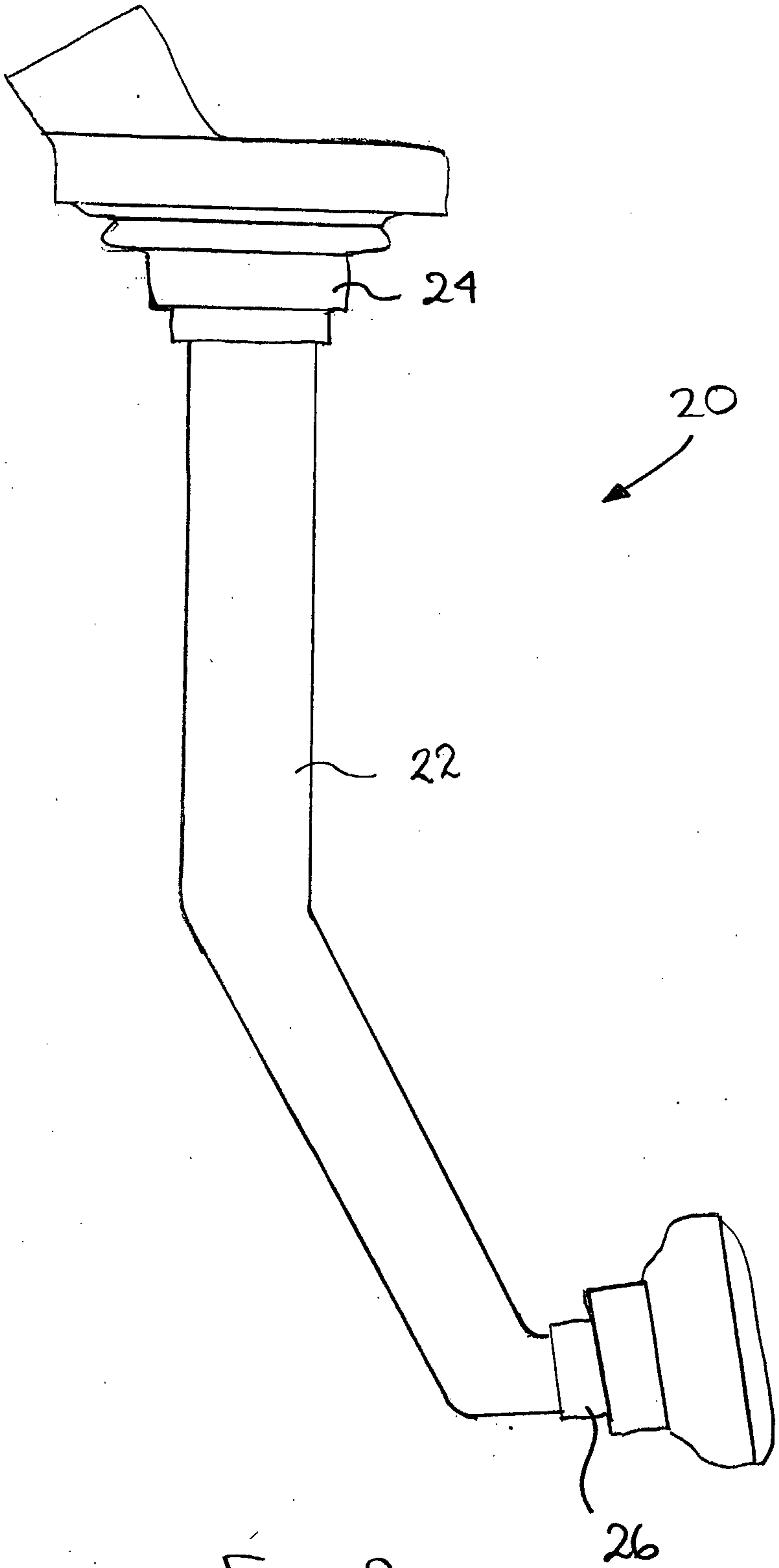

Fig. 2

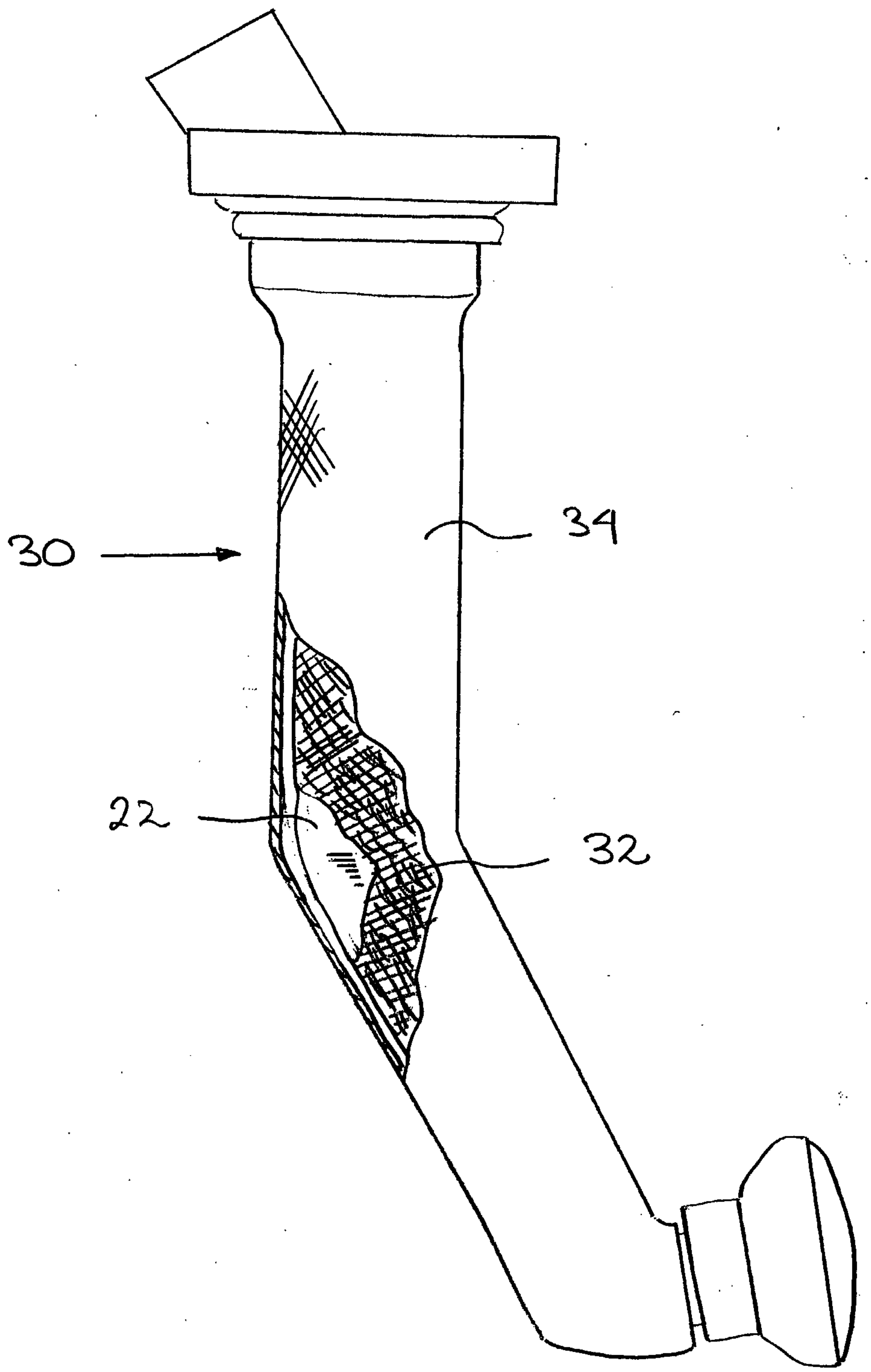

Fig. 3

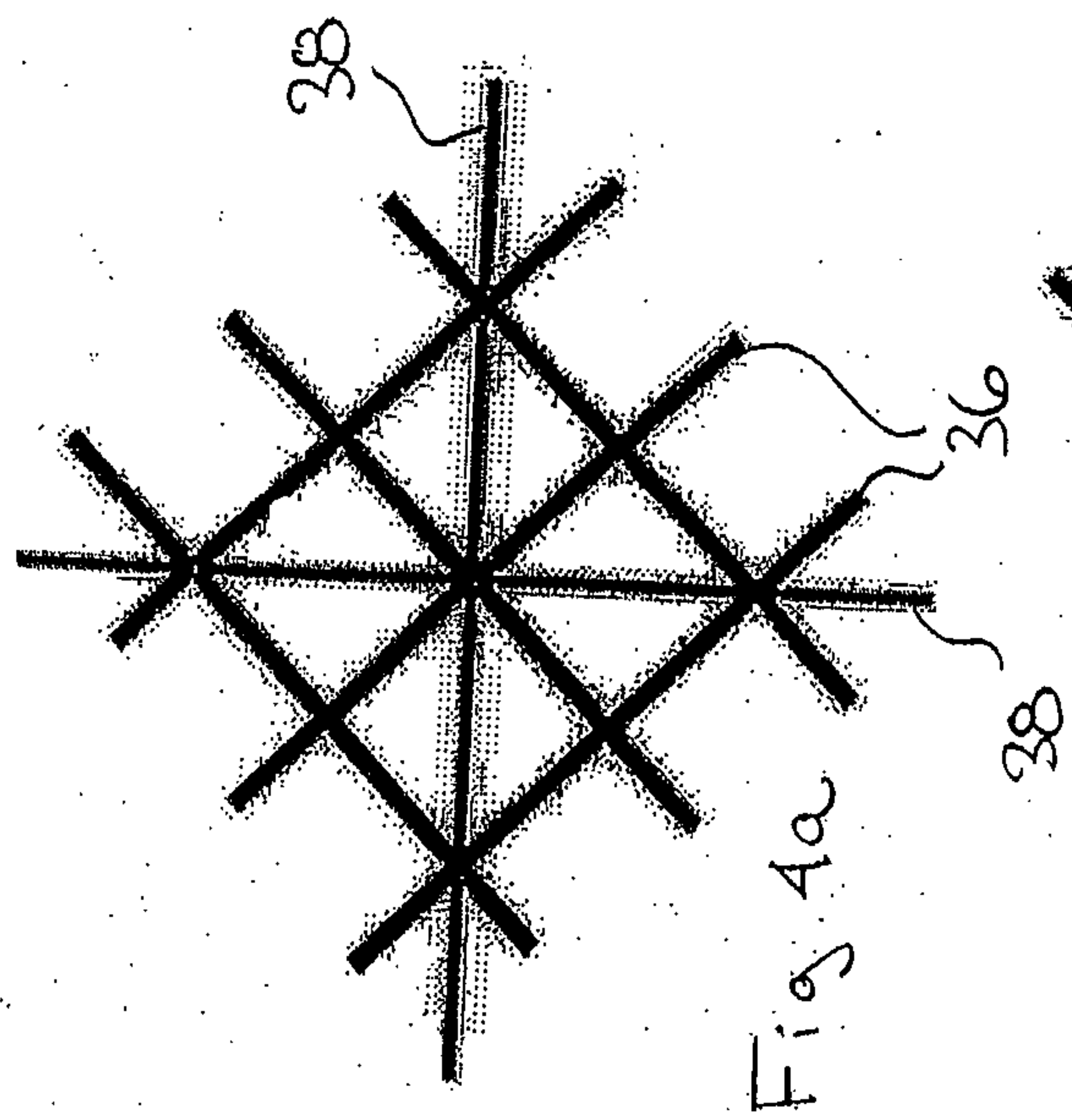

Fig. 4a

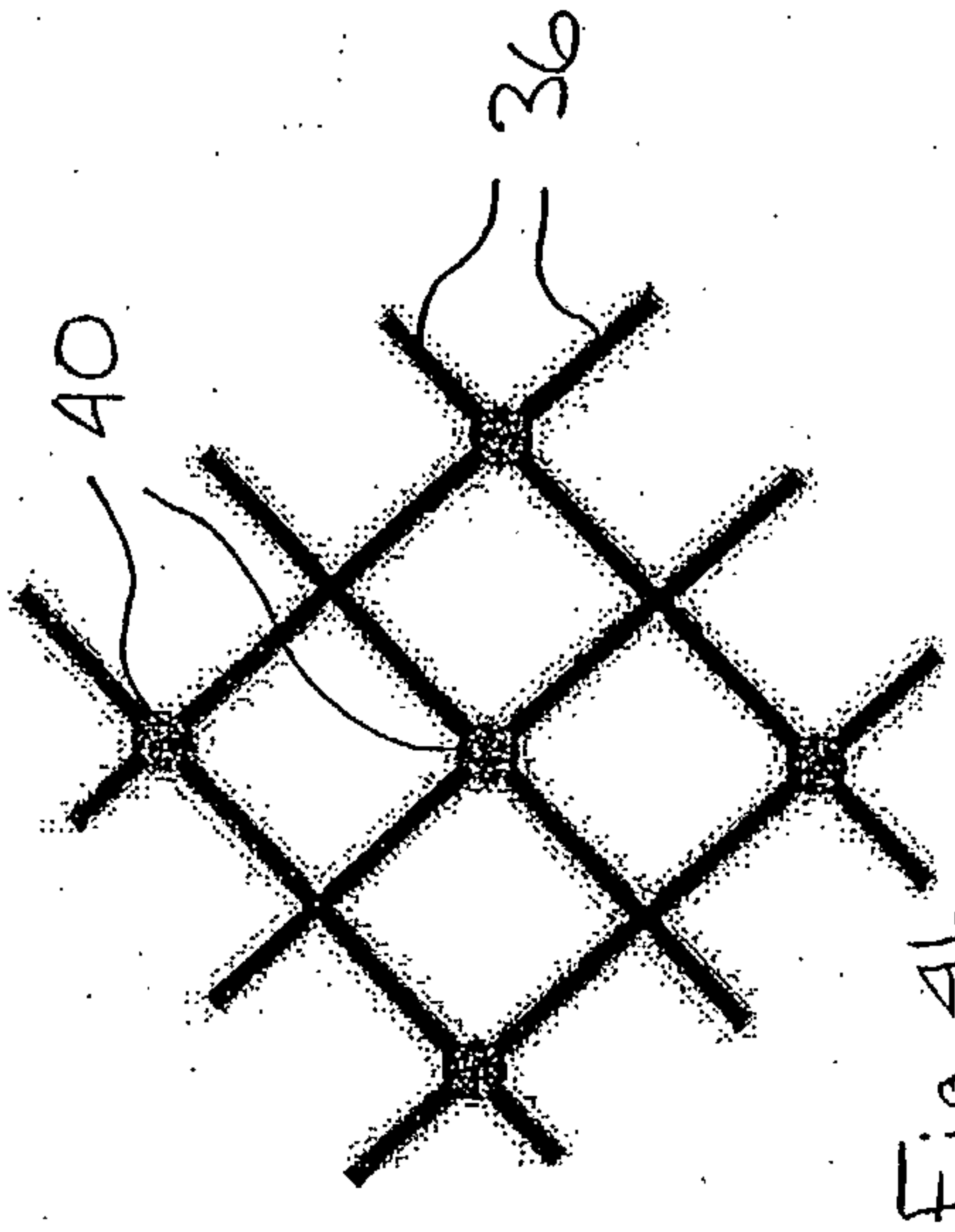

Fig. 4b

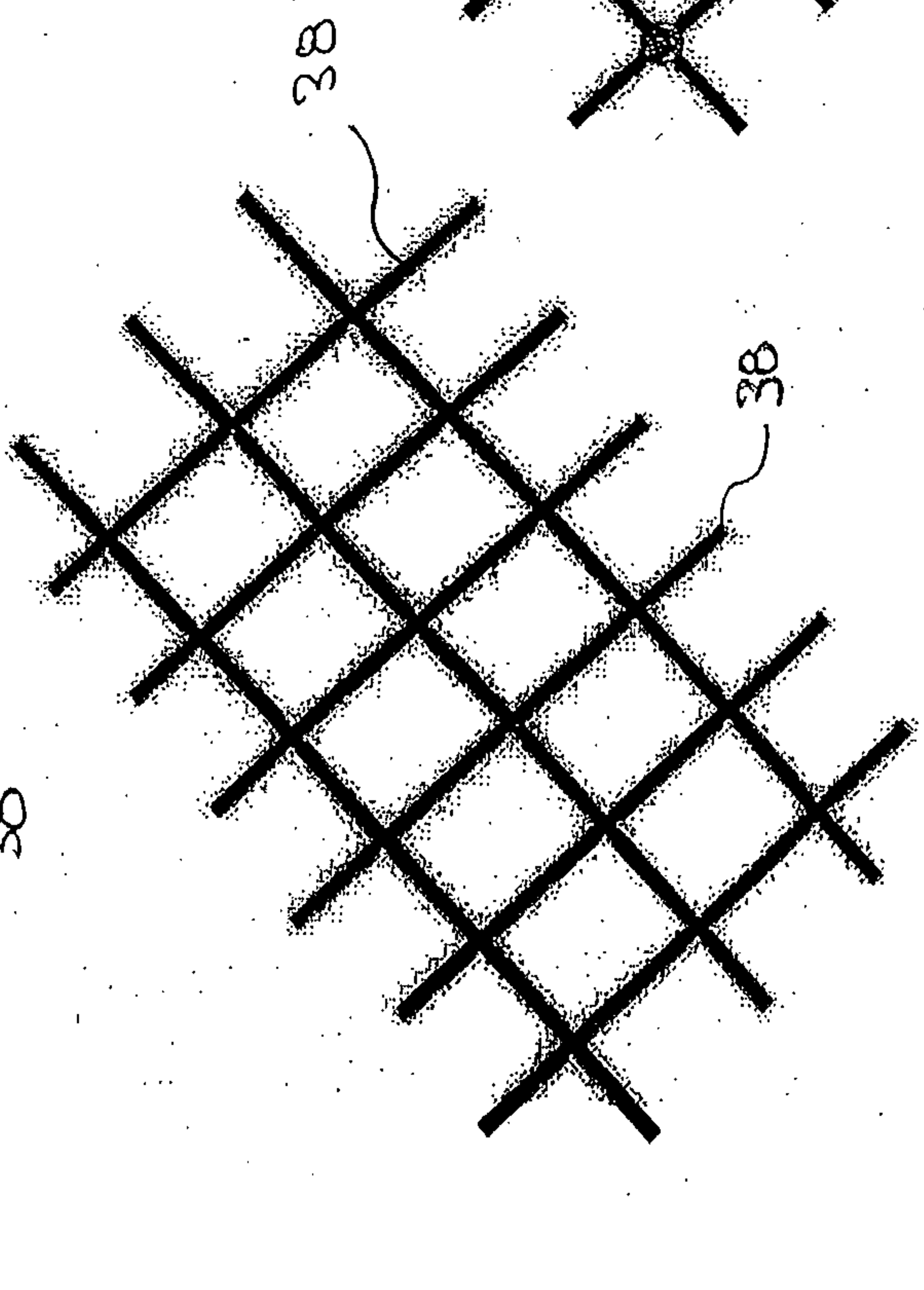

Fig. 5a

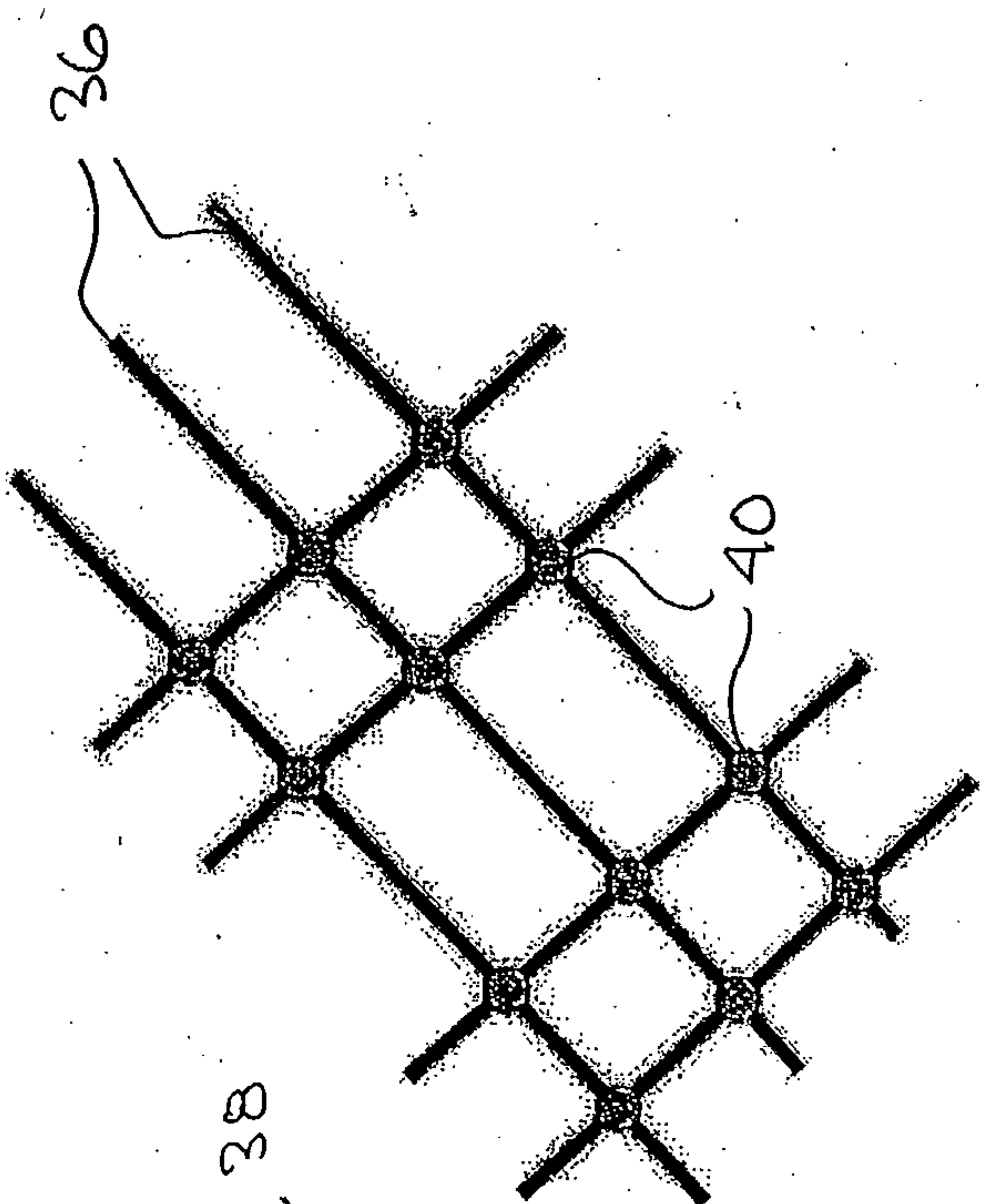

Fig. 5b


30
34
22
32