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(71) Applicant: **UNITED TECHNOLOGIES CORPORATION**
Hartford, CT 06101 (US)

(72) Inventors:
- **Dube, Bryan P.**
  Columbia CT 06237 (US)
- **Butcher, Randall J.**
  Newington CT 06111 (US)

(74) Representative: **Leckey, David Herbert**
Frank B. Dehn & Co.
St Bride's House
10 Salisbury Square
London EC4Y 8JD (GB)

(54) **Turbine airfoil platform extension for low buttress stress**

(57) A blade (100) is provided for use in a gas turbine engine. The blade (100) has a platform (102), an airfoil portion (104) extending radially from a first side (106) of the platform (102), and an attachment portion (108) extending from a second or underside side (110) of the platform (102). The attachment portion (108) includes a buttress (116) which abuts the second side (110) of the platform (102). The blade is provided with additional material (140) on the second side (110) of the platform (102) for redistributing load away from the buttress (116).

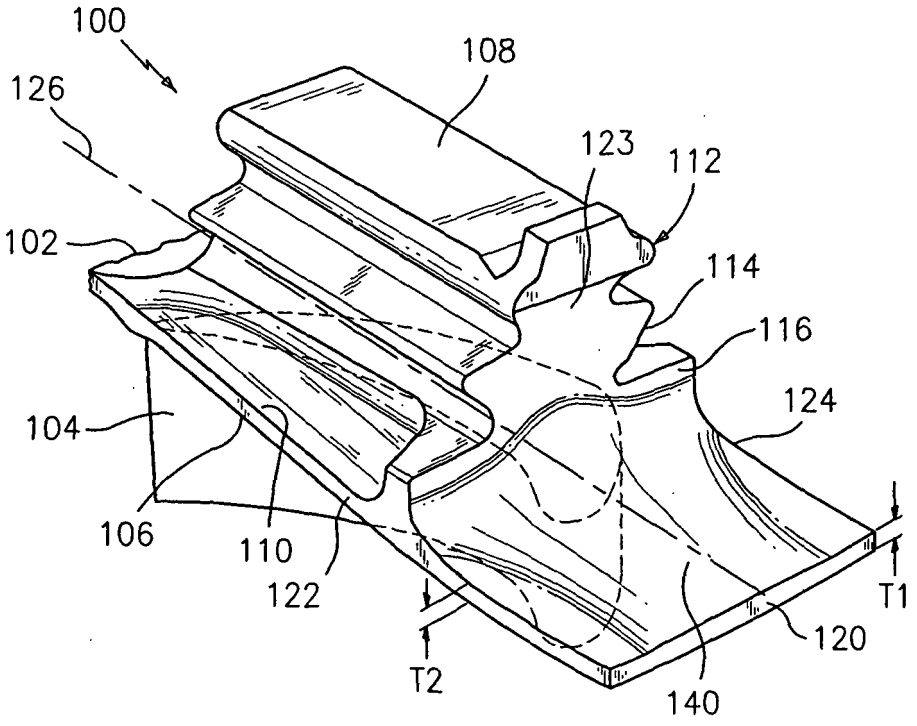

FIG. 4

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Description

BACKGROUND OF THE INVENTION

(1) Field of the Invention

[0001] The present invention relates to a turbine blade having a platform provided with additional material for reducing stress acting on the blade by distributing loads away from a buttress portion of the turbine blade.

(2) Background of the Invention

[0002] Referring now to FIGS. 1 through 3 of the drawings, there is shown a turbine blade construction used in gas turbine engines. The turbine blade 30 has a platform 32, an airfoil portion 34 (only a portion of which is shown) radially extending from the platform 32, and an attachment portion 36. The attachment portion typically includes a dovetail portion 38 for connecting the blade 30 to a rotating disk (not shown), a neck portion 40, and a buttress portion 42 which extends between the neck portion 40 and an underside 44 of the platform 32. The lower speeds and temperatures faced by certain blades allow the airfoil portion to have short root necks and buttresses that adjoin to serrations. The buttress portion 42 serves to minimize secondary flow leakage. Blades which face higher stress and temperature have airfoils which use side plates to cover the leakage area between the buttress and the serrations.

[0003] Some turbine blades have a relatively large leading edge platform which is necessary to minimize flowpath leakage between the blade and vane. The large overhang of the platform, high rotor speed, short root neck, and relatively high temperature create a stress concentration where the upper serration meets the suction side and pressure side buttresses.

[0004] In order to reduce the stress on the buttress, there is needed a way to redistribute the load path away from the buttress.

SUMMARY OF THE INVENTION

[0005] A turbine blade of the present invention is provided with a system for redistributing a load path away from the buttress portion of the turbine blade.

[0006] In accordance with the present invention, a blade is provided which broadly comprises a platform, an airfoil portion extending radially from a first side of the platform, and an attachment portion extending from a second side of the platform. The attachment portion includes a buttress which abuts said second side of the platform. The blade is provided with means for redistributing loads away from the buttress.

[0007] Other details of the turbine airfoil platform platypus for low buttress stress, as well as other advantages thereto, are set forth in the following detailed description and the accompanying drawings wherein like reference numerals depict like elements.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

FIG. 1 is a side view of a portion of a prior art turbine blade;
FIG. 2 is a perspective view from the bottom of a leading edge portion of a platform and buttress used in a prior art turbine blade;
FIG. 3 is a view showing the load path in a prior art turbine blade;
FIG. 4 is a perspective view from the bottom of a turbine blade in accordance with the present invention;
FIGS. 5 and 6 are side views of a turbine blade in accordance with the present invention;
FIG. 7 is a bottom view of the turbine blade of FIGS. 4 through 6 showing the load path distribution in the turbine blade of the present invention; and
FIG. 8 is a contour map of an exemplary system for distributing the load path in a turbine blade.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0009] Referring now to FIGS. 4 through 8, there is shown a portion of a turbine blade 100 in accordance with the present invention. The turbine blade 100 has a platform 102, an airfoil portion 104 radially extending from a first side 106 of the platform 102, and an attachment portion 108 extending from a second side or underside 110 of the platform 102. The attachment portion 108 includes a dovetail portion 112 for securing the turbine blade 100 in a slot (not shown)

in a rotor (not shown), such as a disk. The attachment portion 108 further includes a neck portion 114 between the dovetail portion 112 and the second side 110 of the platform 102. Still further, the attachment portion 108 has a buttress 116 between the second side 110 of the platform 102 and the leading end of the neck portion 114. During operation, the buttress 116 as previously discussed is subject to stress.

[0010] The platform 102 has a leading edge 120, a suction side 122, a leading edge root face 123, and a pressure side 124. The platform leading edge 120 has a thickness T1. The suction side 122 and the pressure side 124 each have a thickness T2. The platform further has a central longitudinal axis 126.

[0011] In accordance with the present invention, the leading edge of the platform 102 is provided with additional material 140 so as to redistribute the load away from the buttress 116 towards the center of the leading edge root face 123. This additional material 140 is preferably the same material that is being used to form the platform 102 and the turbine blade 100. The additional material 140 may be formed during the casting of the turbine blade 100. In a preferred embodiment of the present invention, the additional material 140 has a shape similar to that of a platypus bill.

[0012] Referring now in particular to FIG. 8, there is shown a contour map of an exemplary additional material formation which comprises a system for redistributing the loads away from the buttress 116. The thicknesses of the additional material 140 for the various points 1 - 24 shown in FIG. 8 are listed in Table I. The thicknesses are given as normalized percentages with the largest thickness at the thickest point 5 being 100%.

TABLE I

PT NO.	1	2	3	4	5	6	7	8
THICKNESS	41.8	53.8	70.6	93.5	100	73.5	57.1	45.3
PT NO.	9	10	11	12	13	14	15	16
THICKNESS	34.1	43.5	52.4	57.7	55.9	48.2	38.8	31.2
PT NO.	17	18	19	20	21	22	23	24
THICKNESS	30.0	34.7	38.9	40.6	38.8	34.1	30.0	27.1

[0013] The thicknesses 1 - 24 are taken along three lines A, B, and C in the region between the front root face 121 and the leading edge 120. Line A is located closest to the buttress 116 at a normalized distance of about 13.51% from the front root face 121. Line B is located at a normalized distance of about 47.30% from the front root face 121 and line C is located at a normalized distance of about 88.59% from the front root face 121.

[0014] As can be seen from FIG. 8, the thickness of the additional material 140 on the second side 110 gradually increases from both the suction side 122 and the pressure side 124 towards a maximum point 5 (on line A), 13 (on line B), and 21 (on line C), which maximum point is preferably offset from the central longitudinal axis 126. As can also be seen from FIG. 8, the thickness of the platform 102 on the second side 110 gradually increases from points along line C, nearest to the leading edge 120, to the point 5.

[0015] The additional material 140 is advantageous in that it distributes loads, both stress and strain, away from the buttress 116 towards the center of leading edge root face 123. This is different from conventional blades where the loads are funneled into the middle and distributed along the entire width of the leading edge of the platform.

Claims

1. A blade (100) for use in a gas turbine engine comprising:

a platform (102), an airfoil portion (104) extending radially from a first side (106) of the platform (102), and an attachment portion (108) extending from a second side (110) of the platform (102);
said attachment portion (108) including a buttress (116) which abuts said second side (110) of the platform (102); and
means (140) for redistributing load away from the buttress (116).

2. The blade of claim 1, wherein said platform (102) has a suction side (122) and a pressure side (124) and wherein said load redistributing means (140) comprise means for directing the load outwardly towards a center of a leading edge root face (123).

3. The blade of claim 1, wherein said platform (102) has a leading edge (120) and a thickness (T1) at said leading

edge (120) and wherein said load redistributing means includes a first region having a first thickness greater than said thickness at said leading edge and a second region having a second thickness greater than said first thickness.

4. The blade of claim 3, wherein said platform (102) has a central longitudinal axis (126) and said first and second regions are offset from said central longitudinal axis (126).

5. The blade of claim 4, wherein said first region is near the leading edge (120) of said platform and said second region abuts said buttress (116).

6. The blade of any preceding claim, wherein said platform (102) has a suction side (122) with a thickness (T2) and said means for redistributing said load comprises a third region offset from a central point of said buttress (116) and said thickness in said third region is greater than said thickness (T2) at said suction side (122).

7. The blade of claim 6, wherein said platform (102) has a thickness which increases from said suction side (122) to said third region.

8. The blade of claim 6 or 7, wherein said platform (102) has a pressure side (124) with a thickness (T2) and said thickness at said third region is greater than said thickness (T2) at said pressure side (124).

9. The blade of claim 8, wherein said thickness of said platform (102) increases from said pressure side (124) to said third region.

10. The blade according to any preceding claim, wherein said load redistributing means comprises additional material (140) located on the second side (110) of the platform (102).

11. The blade according to any preceding claim, wherein said second side (110) is an underside of said platform (102).

12. A turbine blade (100) comprising:

a platform (102) having a first side (106), a second side (110), a pressure side (124), a suction side (122) and a leading edge (120);
an airfoil portion (104) radially extending from said first side (106) of said platform (102);
an attachment portion (108) including a neck portion (114) extending from the second side (110) of said platform (102);
a buttress (116) positioned adjacent an intersection of said neck portion (114) and said second side (110);
a system for distributing loads away from said buttress (116);
said distributing system comprising additional material (140) formed on the second side (110) of said platform (102).

13. The turbine blade according to claim 12, further comprising;
said additional material (140) beginning at a first point near said leading edge (120) and increasing in thickness to a second point abutting said buttress (116);
said additional material (140) beginning at a third point adjacent said suction side (122) and increasing in thickness from said third point to said second point; and
said additional material (140) further beginning at a fourth point adjacent said pressure side (124) and increasing in thickness from said fourth point to said second point.

14. The turbine blade according to claim 13, further comprising said platform (102) having a central longitudinal axis (126) and said second point being offset from said central longitudinal axis (126).

15. The turbine blade according to claim 14, wherein said first point is offset from said central longitudinal axis (126).

16. The turbine blade according to any of claims 12 to 15, wherein said airfoil portion (104) is an overhung airfoil portion.

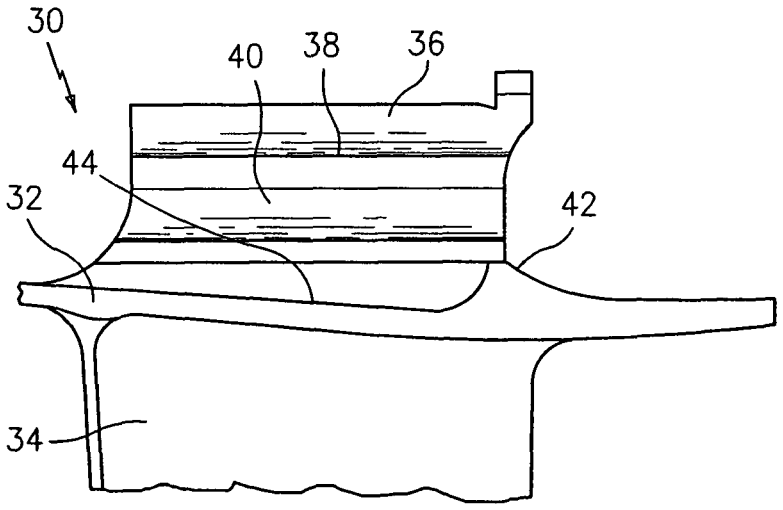

FIG. 1
(PRIOR ART)

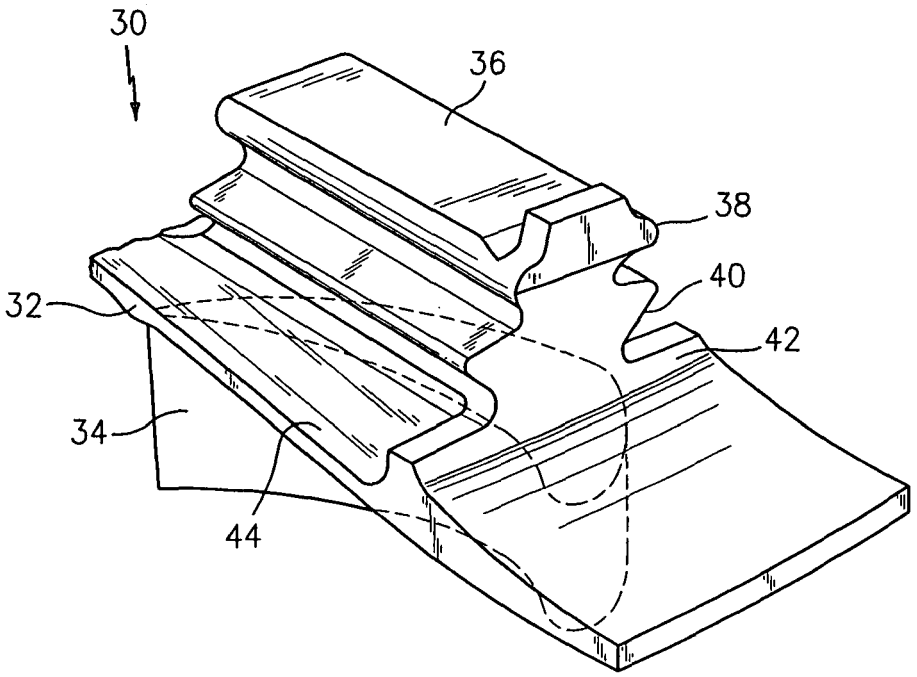

FIG. 2
(PRIOR ART)

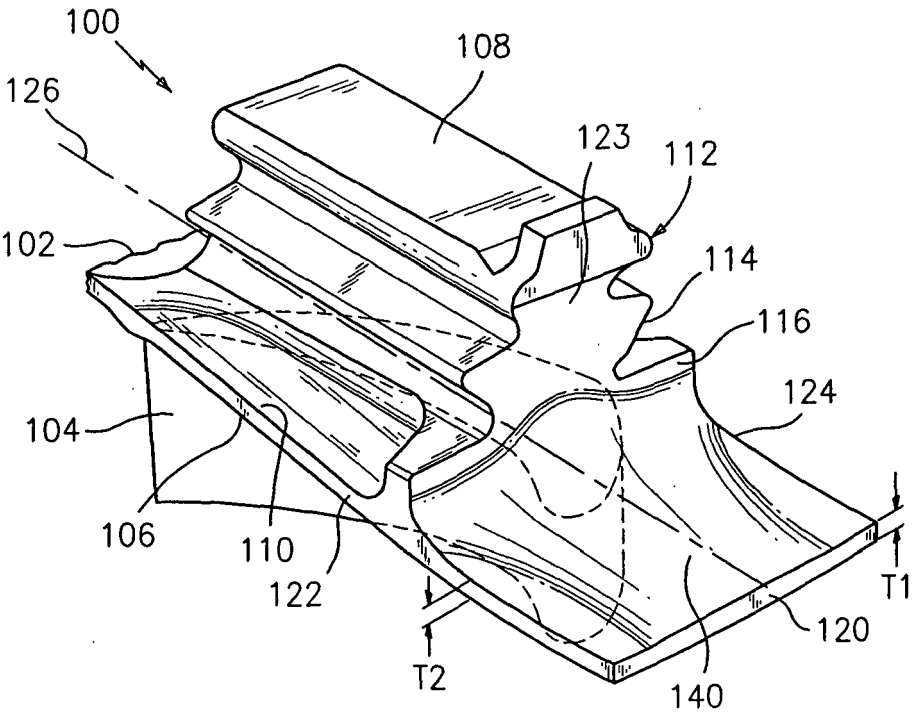

FIG. 4

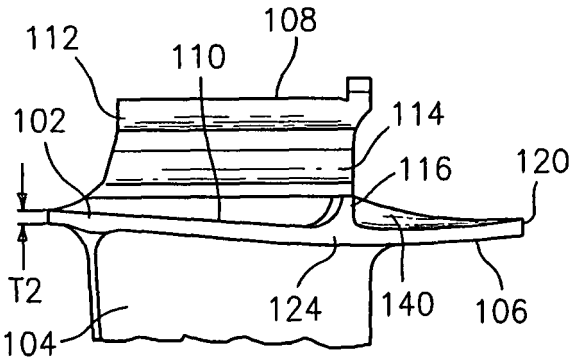

FIG. 5

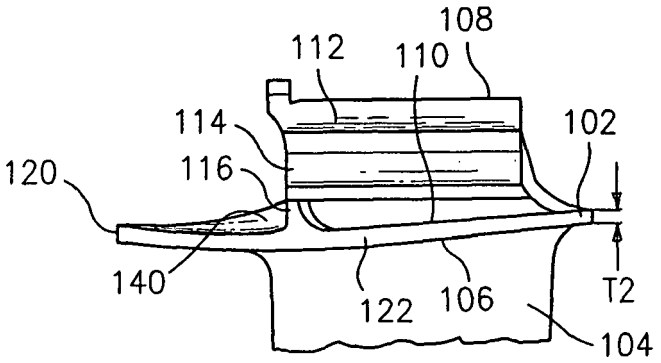

FIG. 6

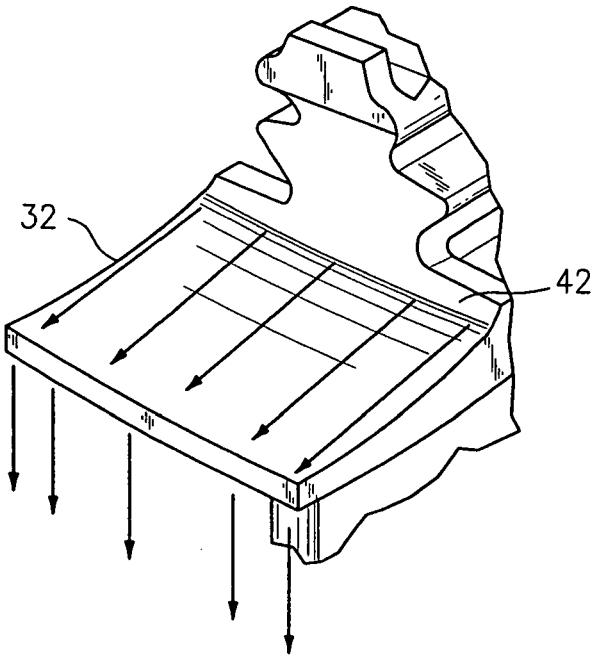

FIG. 3
(PRIOR ART)

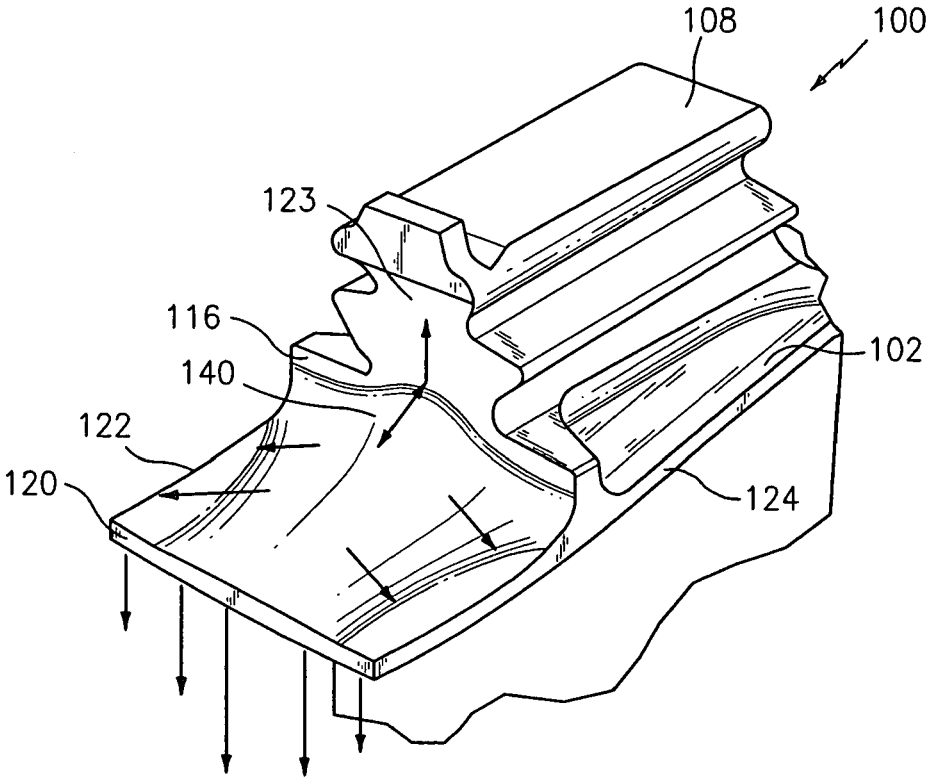

FIG. 7

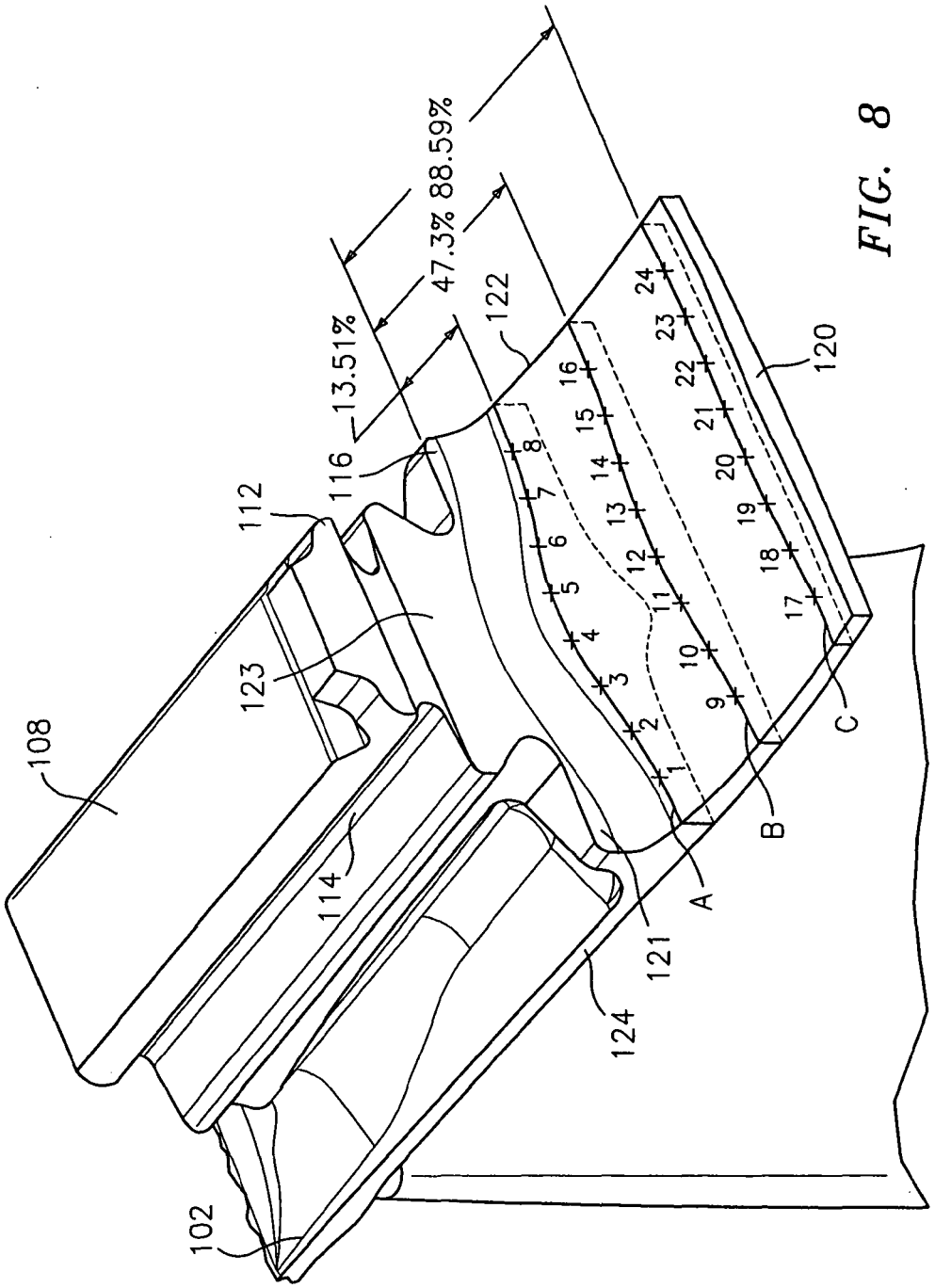
13.51%
47.3%
88.59%
102
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FIG. 8