May 10, 1949. N. A. DUNNELLS ET AL 2,469,458

BLADE FORM FOR SUPERCHARGER IMPELLERS

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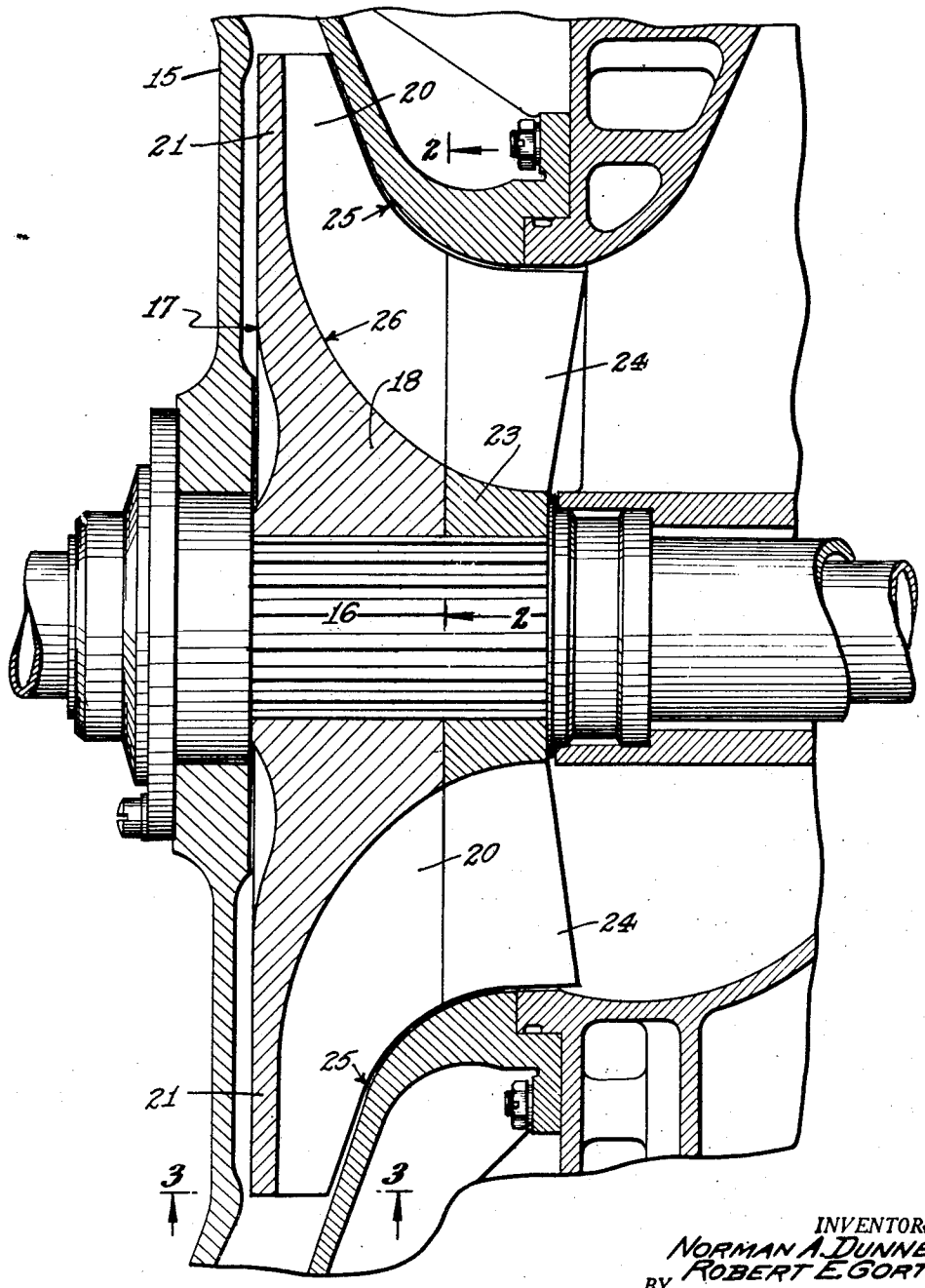
Fig. 1.



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BLADE FORM FOR SUPERCHARGER IMPELLERS

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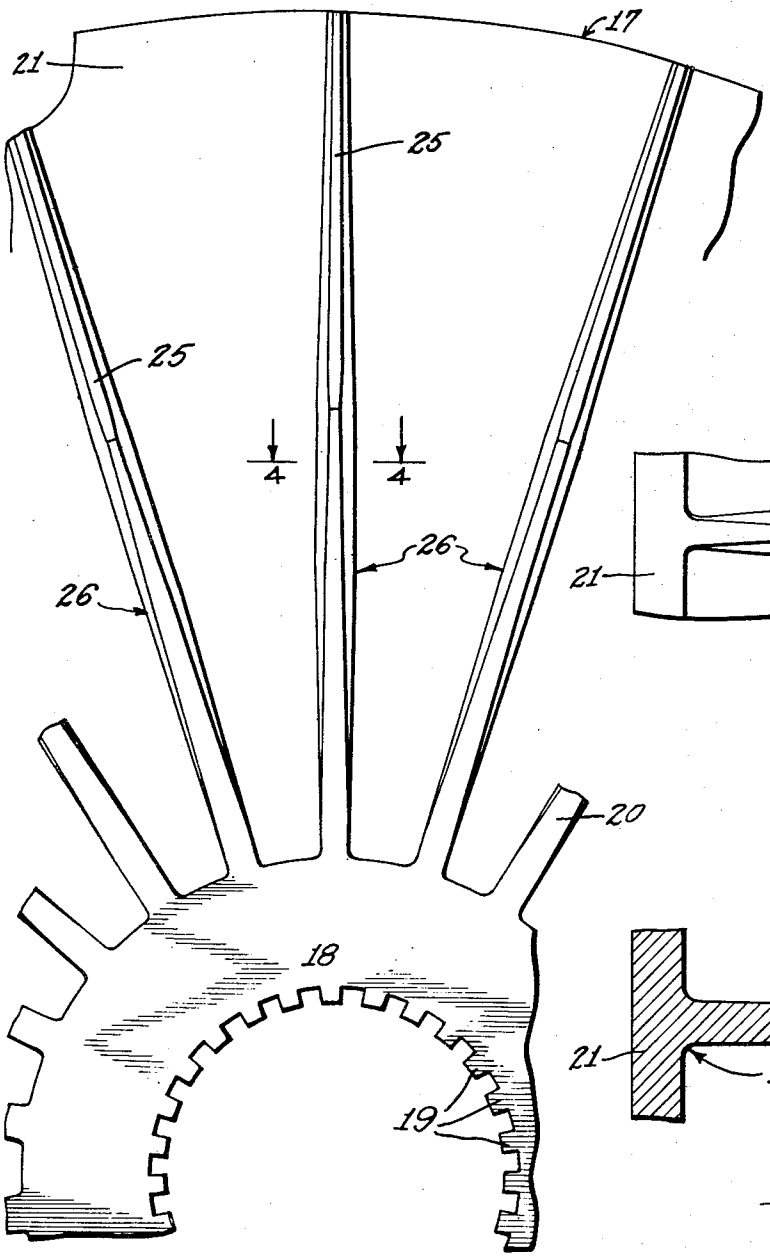

Fig. 2.

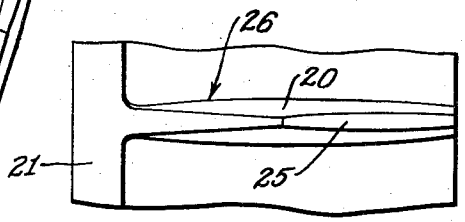

Fig. 3.

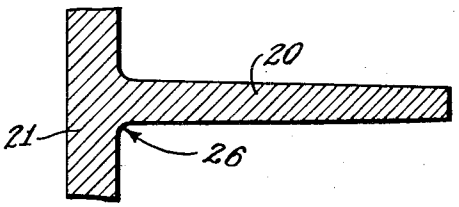

Fig. 4.

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BLADE FORM FOR SUPERCHARGER IMPELLERS

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Fig. 5.

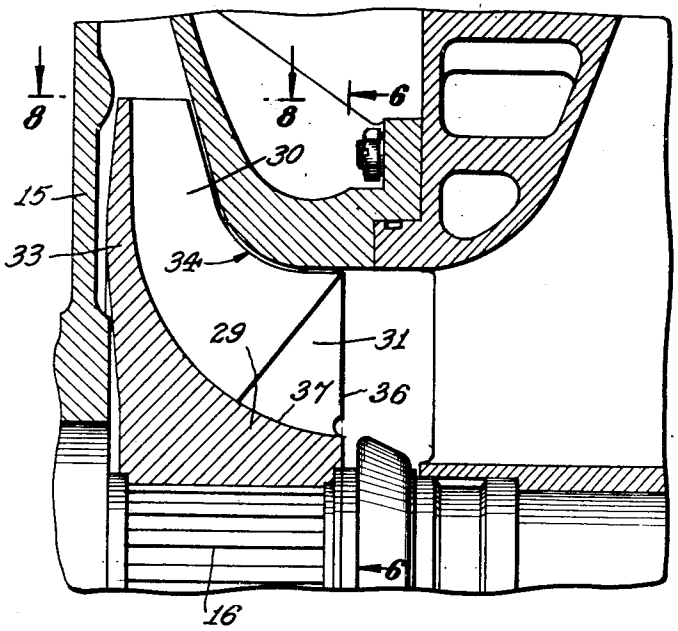


Fig. 6.

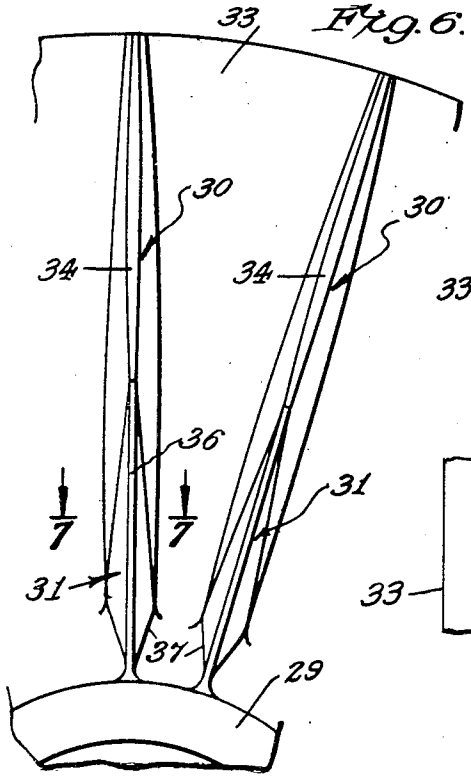


Fig. 7.

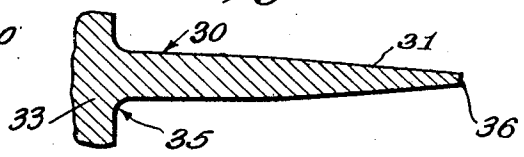
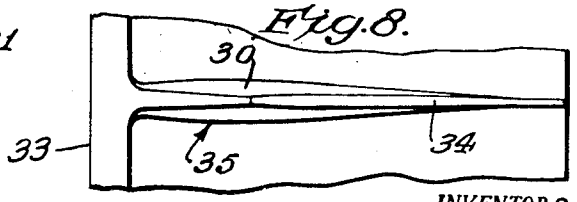


Fig. 8.



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BLADE FORM FOR SUPERCHARGER IMPELLERS

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Fig.9.

PRIOR ART

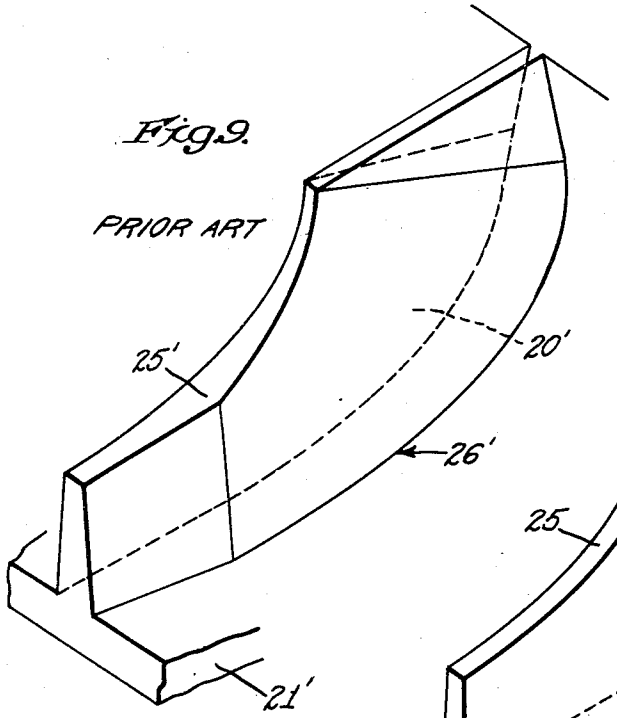
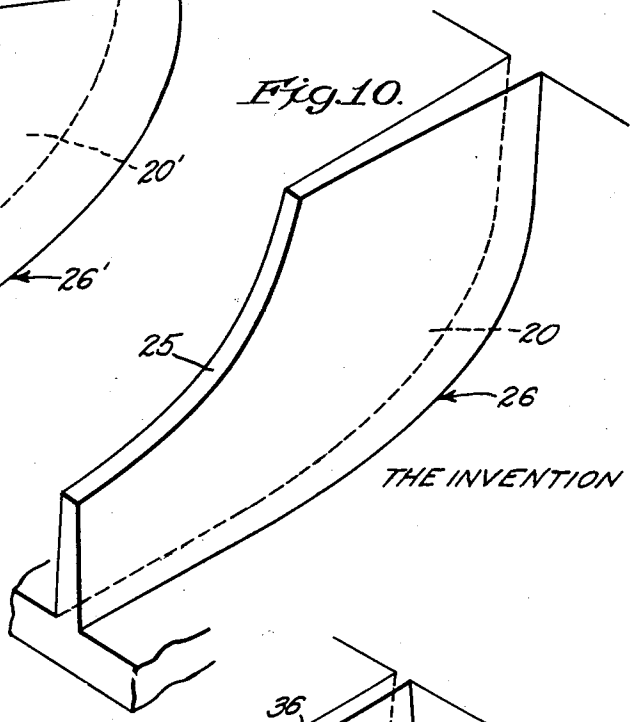
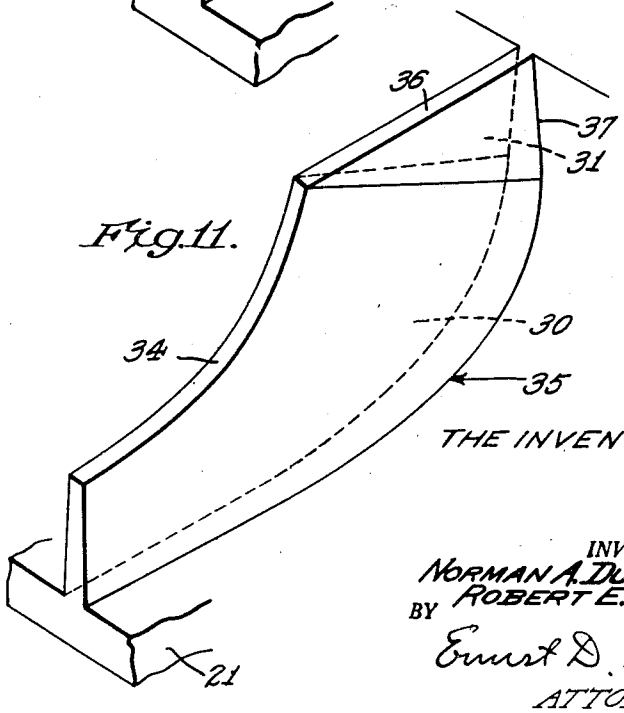


Fig.10.



THE INVENTION

Fig.11.



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Patented May 10, 1949

2,469,458

UNITED STATES PATENT OFFICE

2,469,458

BLADE FORM FOR SUPERCHARGER IMPELLERS

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Application September 24, 1945, Serial No. 618,300

5 Claims. (Cl. 230—134)

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This invention relates to impellers for the superchargers of internal combustion engines and has for its object to improve the construction and operating characteristics of such devices.

Another object of the invention is to increase the fundamental natural frequency of the impeller blades, which is a critical factor in supercharger impeller construction.

Other objects are to decrease the weight of the blades and other moving parts of a supercharger impeller without decreasing their strength or increasing their susceptibility to vibration; to improve the rotational and vibrational stress distributions therein; and to provide a smoother rate of change of impeller air passage progressing from the impeller entrance to the exit thereof.

Various other objects and advantages will be apparent as the nature of the invention is more fully disclosed.

The conventional method of forming supercharger impeller blades is by milling with a pair of suitable cutters which straddle the blade being formed, leaving a blade of basically uniform thickness at the root and variable thickness at the open end, by virtue of the variation of blade height along its length. Such a blade is customarily thinned at the inlet edge to facilitate bending into the airstream. It is also customarily thinned at the discharge edge to give a more nearly continuous discharge circumferentially.

Our invention marks a distinct departure from the foregoing conventional practice in that we construct an impeller by cutting the blades with tapered sections, such as to form a blade having substantially uniform thickness at the open edge and with the thickness at the root along substantially the entire or major part of the length thereof variable as a function of blade height. The blades may be formed in various ways and with either tapered or flat cutters. A modification of our method may be introduced if the blade thickness produced by the first or basic cut is too great at some location such as the entering edge, in which case further thinning cuts may be made in a similar manner to the prior art.

We have found that impeller blades constructed in accordance with our invention will have a higher fundamental natural blade frequency for a given blade cross-section at the maximum blade height, together with a lighter weight per blade, better rotational and vibrational stress distributions, and a smoother rate of change of impeller air passage progressing from impeller entrance to exit. The lighter weight of our impeller blades also makes possible further reductions of the size and weight of the web and hub portions of the impeller proper without decreasing strength or increasing susceptibility to vibration, thereby affording a lighter overall impeller to meet a given operating requirement than is afforded by the conventional prior art construction.

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Although the novel features which are characteristic of this invention are set forth more in detail in the claims appended hereto, the nature and scope of the invention may be better understood by referring to the following description, taken in connection with the accompanying drawings, forming a part thereof, in which certain specific embodiments have been set forth for purposes of illustration.

In the drawings:

Figure 1 is a longitudinal sectional view through the casing of an internal combustion engine containing a supercharger impeller constructed in accordance with the present invention;

Fig. 2 is a fragmentary plan view of the impeller, partly broken away, taken on the line 2—2 of Fig. 1;

Fig. 3 is a transverse section taken on line 3—3 of Fig. 1, looking at the outer edge of one of the impeller blades;

Fig. 4 is a transverse section through said impeller blade, taken on line 4—4 of Fig. 2;

Fig. 5 is a longitudinal section corresponding with Fig. 1, but illustrating a modification of the invention;

Fig. 6 is a fragmentary plan view taken on line 6—6 of Fig. 5;

Fig. 7 is a transverse section taken on line 7—7 of Fig. 6;

Fig. 8 is a fragmentary edge view on line 8—8 of Fig. 5, looking at the outer edge of one of the impeller blades;

Fig. 9 is a perspective view of a conventional impeller blade constructed in accordance with the prior art;

Fig. 10 is a similar view of an impeller blade constructed in accordance with the present invention; and

Fig. 11 is a similar view of another embodiment of an impeller blade constructed in accordance with the present invention.

In the following description certain specific terms are used for convenience in referring to the various details of the invention. These terms,

however, are to be interpreted as broadly as the state of the art will permit.

Fig. 1 shows the stationary casing 15 of an internal combustion engine, in which the rotatable engine shaft 16 is journaled in any suitable manner.

The impeller 17 comprises a hub 18 which may be secured to shaft 16 by splines 19 shown in Fig. 2, and a plurality of blades 20 and a connecting web portion 21.

In the embodiment illustrated in Fig. 1, an inducer comprising a hub 23 and blades 24 is splined or otherwise secured to the shaft 16 in advance of the impeller 17. The impeller blades 20 and inducer blades 24 are closely matched and aligned with each other.

The present invention resides in forming the impeller blades 20 with substantially uniform thickness at their open edges 25, and with a thickness at the inner portion or root 26 which is variable as a function of the blade height. This construction is illustrated in Figs. 2, 3 and 4, but can best be understood by comparing the conventional prior art practice of Fig. 9 with our novel construction which is drawn to similar scale in Fig. 10.

To facilitate comparison of the prior art construction of Fig. 9 with our new construction shown in Fig. 10, the corresponding parts in the two views are given similar reference numbers but with "primes" affixed to those in Fig. 9. Now, the conventional method of forming the prior art impeller blade 20' of Fig. 9 is to mill it with a pair of cutters which straddle the blade and form it with a basically uniform thickness at and along the root 26' and a variable thickness at the open edge 25', by virtue of the inherent variation of blade height along its length.

In contrast to this, it will be seen by referring to Fig. 10 that we cut out blade 20 having a tapered section, with a substantially uniform thickness at and along the open edge 25 and with the thickness at and along the root portion 26 variable as a function of the blade height. The blades may be formed with either flat or tapered cutters, and it will be understood that after being formed in the manner disclosed the blades may be bent in any desired manner to suit any particular installation.

Figs. 5 to 8 inclusive, and Fig. 11 show a modification of the invention, employing an impeller comprising a hub 29, blade sections of which portion 30 and portion 31 are formed by two separate cutting operations, and impeller web portion 33. The open edge 34 of the impeller blade is formed with a substantially uniform thickness, while the root portion 35 varies in thickness as a function of the blade height, as previously described. Inlet edge 36 is thinned a predetermined amount and root portion 37 varies in thickness accordingly.

With further reference to Fig. 9, it will be understood that the thicknes of the root portion along the major portion of the length thereof is substantially constant. The thickness of the open edge of the blade is variable along substantially the entire or major part of the length thereof. According to the embodiments of the invention shown in Figs. 10 and 11 the thickness of the open edge portion along substantially the entire length thereof is uniform or substantially uniform. The thickness of the blade along the root portion is variable along substantially the entire or major portion of the length thereof.

Such thickness at the root portion is variable as a function of blade height.

Although certain specific embodiments have been shown and described herein for purposes of illustration, it will be evident to those skilled in the art that the invention is capable of various modifications and adaptations within the scope of the appended claims.

What is claimed is:

1. A supercharger impeller having blades formed with a substantially uniform thickness at their open edges and with a root thickness which is variable as a function of the blade height in that the root thickness is less at portions of lesser height and greater at portions of greater height.

2. A supercharger impeller having tapered blades with a substantially uniform thickness at their open edges and with a root thickness which is variable as a function of the blade height in that the root thickness is less at portions of lesser height and greater at portions of greater height, whereby to decrease the weight and to increase the fundamental natural frequency of the supercharger impeller.

3. An impeller for a supercharger having blades shaped to provide a substantially uniform thickness at the open edge portions thereof and said blades being further shaped in the root portions with a thickness which varies as a function of the blade height along substantially the major portion of the length of the root portion of the blade in that the root thickness is less at portions of lesser height and greater at portions of greater height.

4. An impeller for a supercharger having blades each of which has a substantially uniform thickness at its open edge portion and with its root portion having a thickness at the root which is variable along substantially the entire length of the root portion thereof as a function of the blade height in that the root thickness is less at portions of lesser height and greater at portions of greater height, whereby to provide higher fundamental natural frequency of the blade and to afford improved rotational characteristics and improved vibrational stress distribution.

5. A supercharger impeller having blades provided with open edge portions and root portions, said open edge portions having substantially uniform thickness along substantially the major portion of the length thereof and said root portions having a variable thickness along the major portion of the length thereof, said variable thickness at the root being a function of blade height in that the root thickness is less at portions of lesser height and greater at portions of greater height.

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