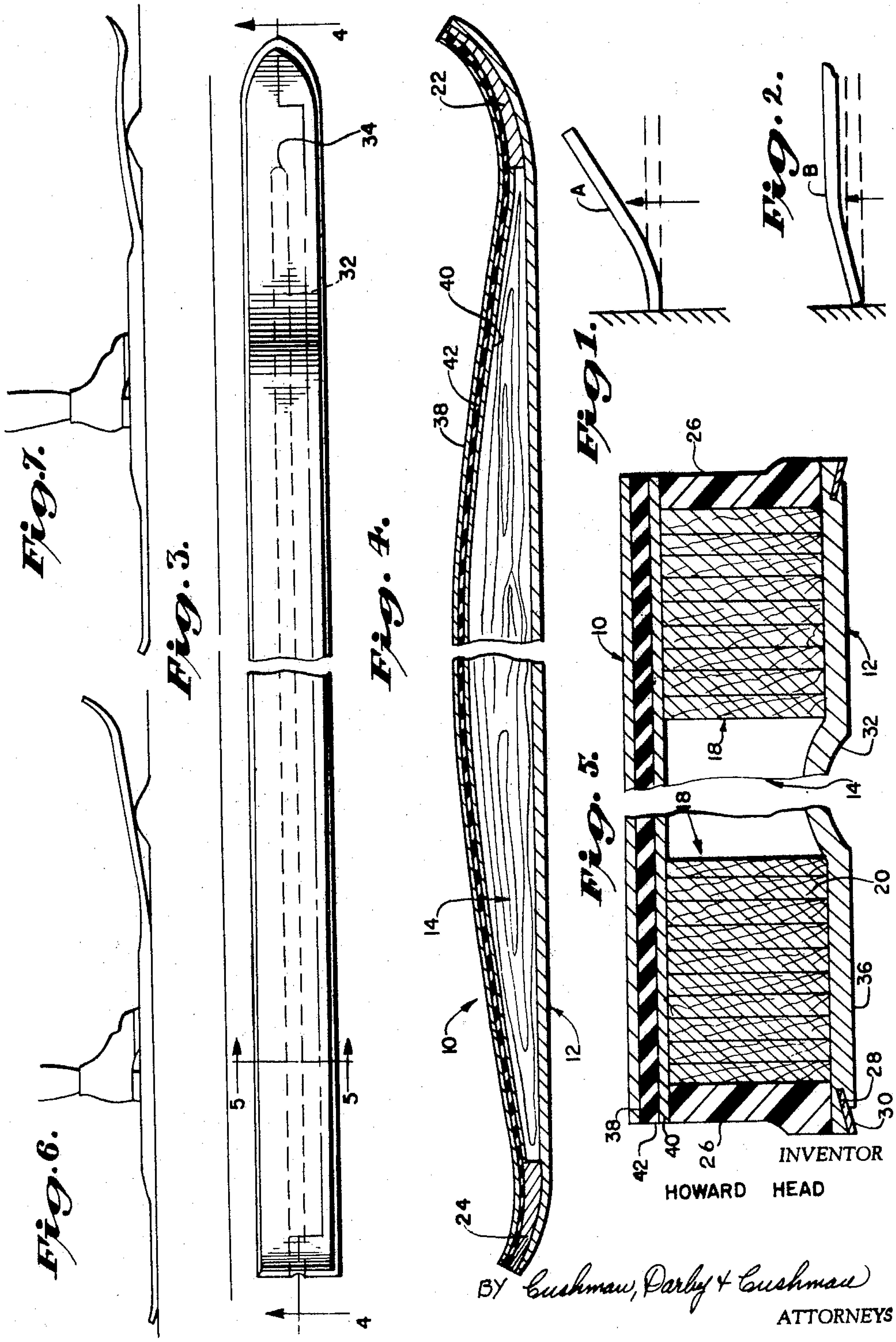
Aug. 8, 1961 H. HEAD 2,995,379

SKI

Filed Dec. 30, 1958 2 Sheets-Sheet 1



INVENTOR

HOWARD HEAD

BY Cushman, Darby & Cushman

ATTORNEYS

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Filed Dec. 30, 1958 2 Sheets-Sheet 2

Fig. 8.

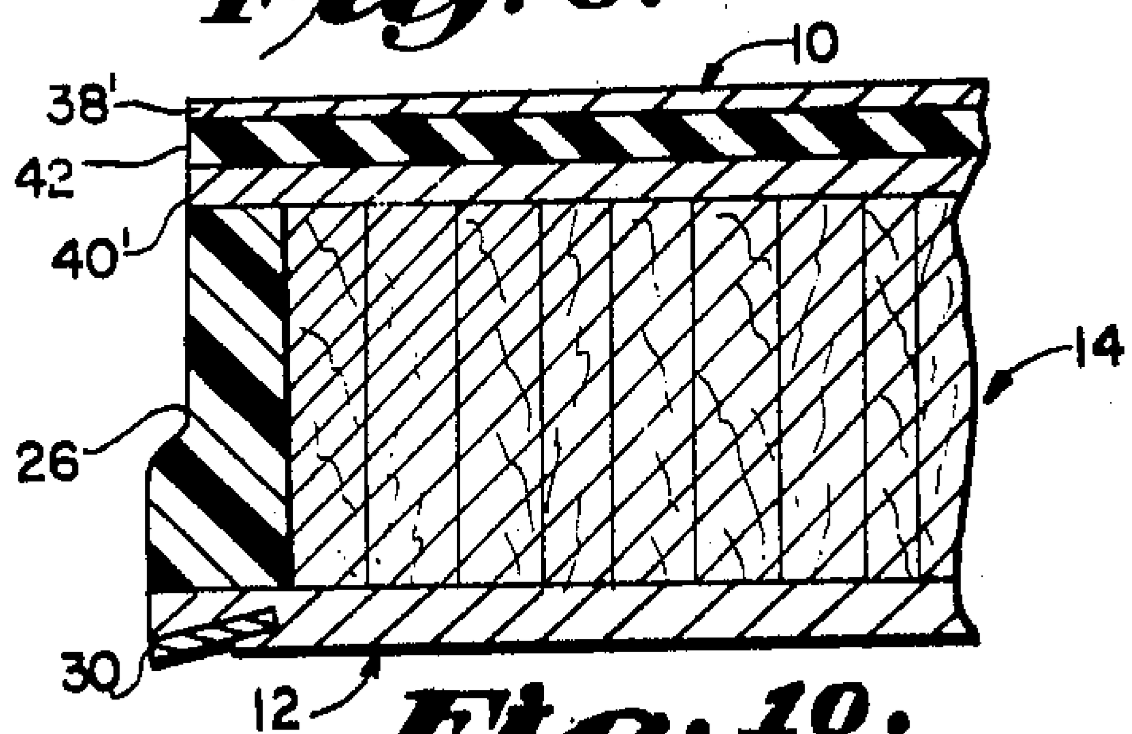


Fig. 9.

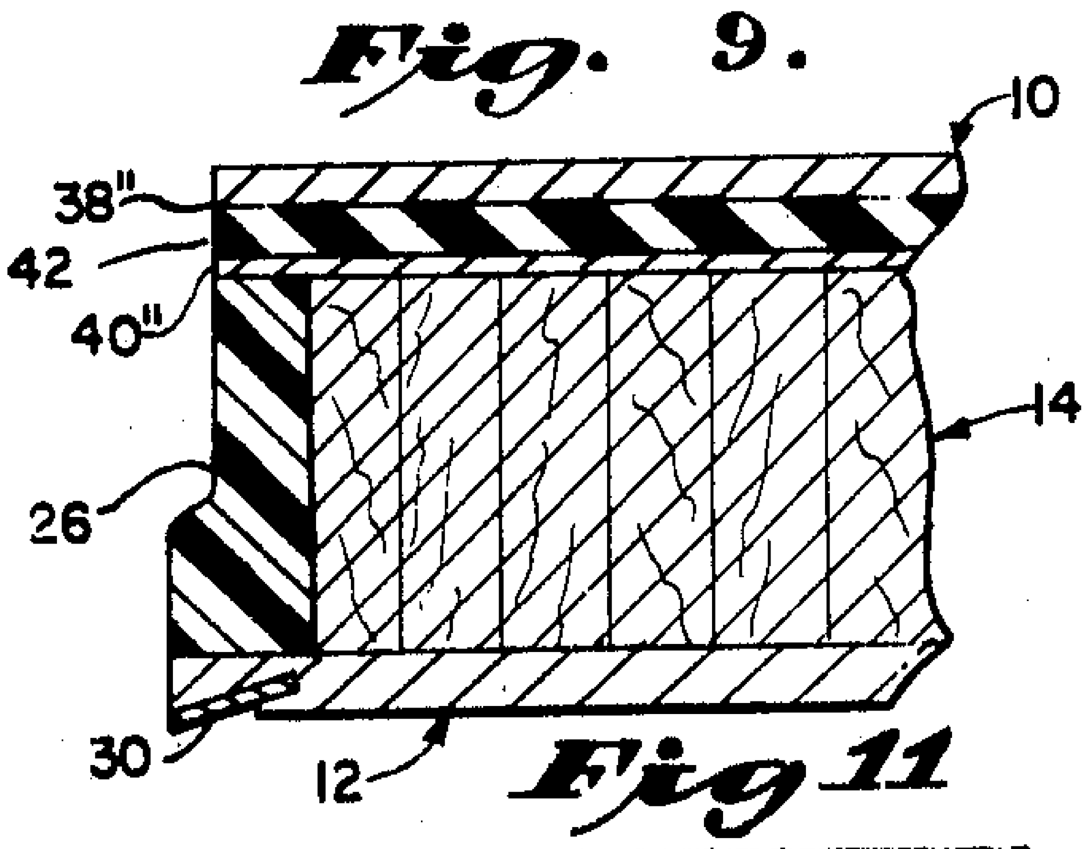


Fig. 10.

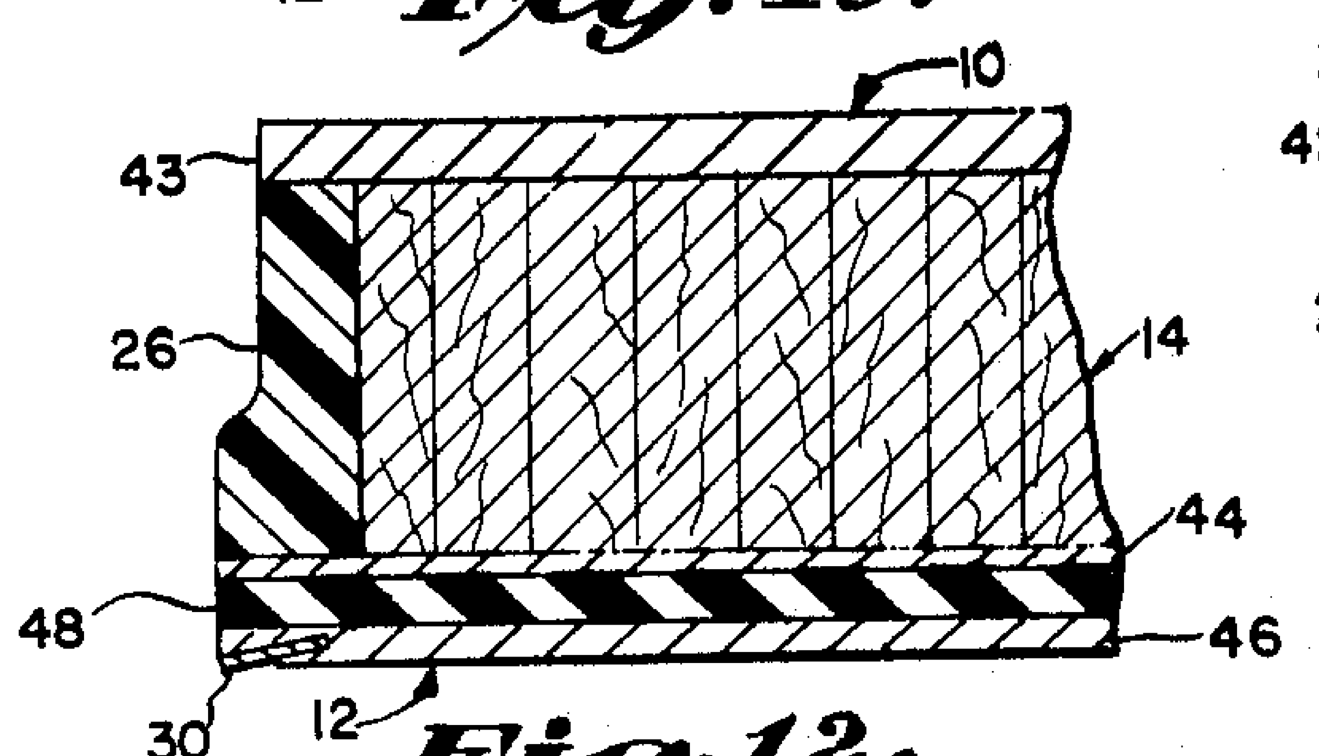


Fig 11

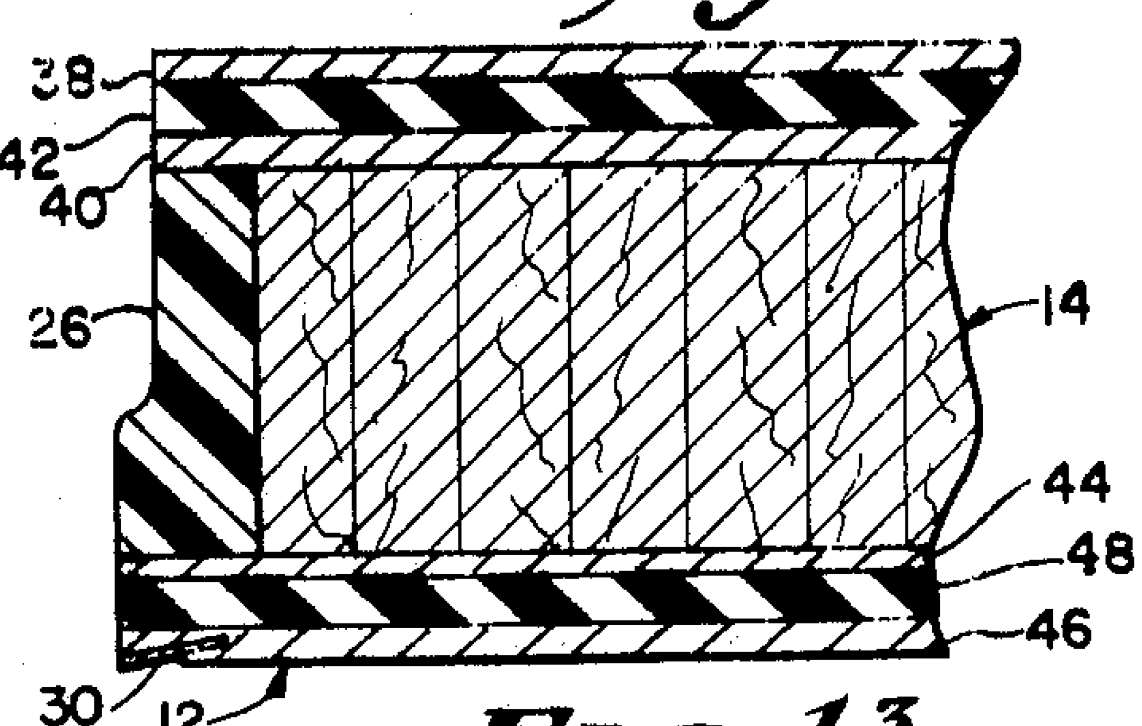


Fig. 12.

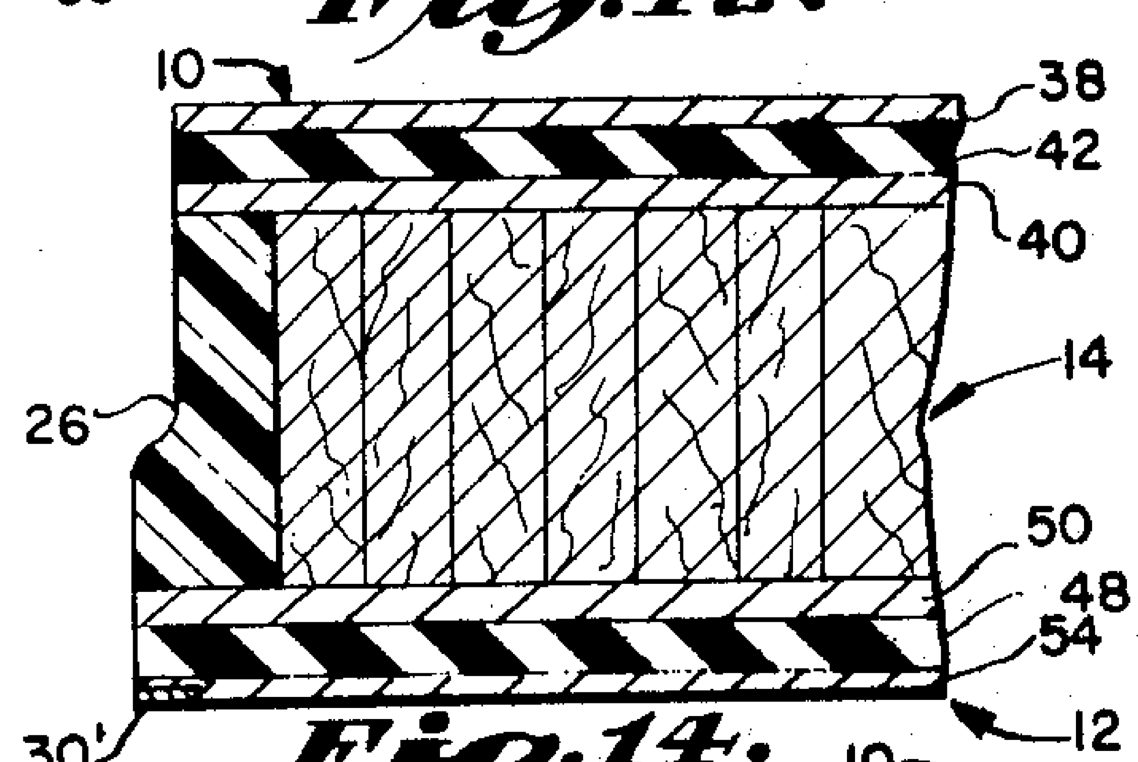


Fig. 13.

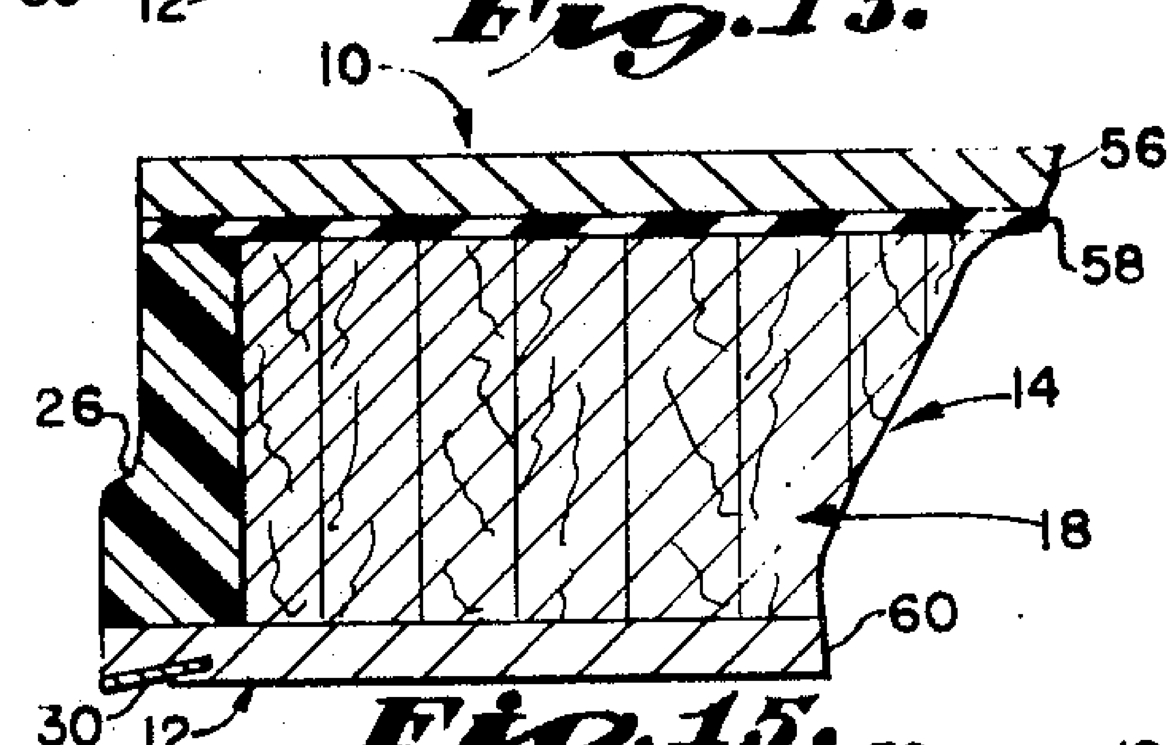


Fig. 14.

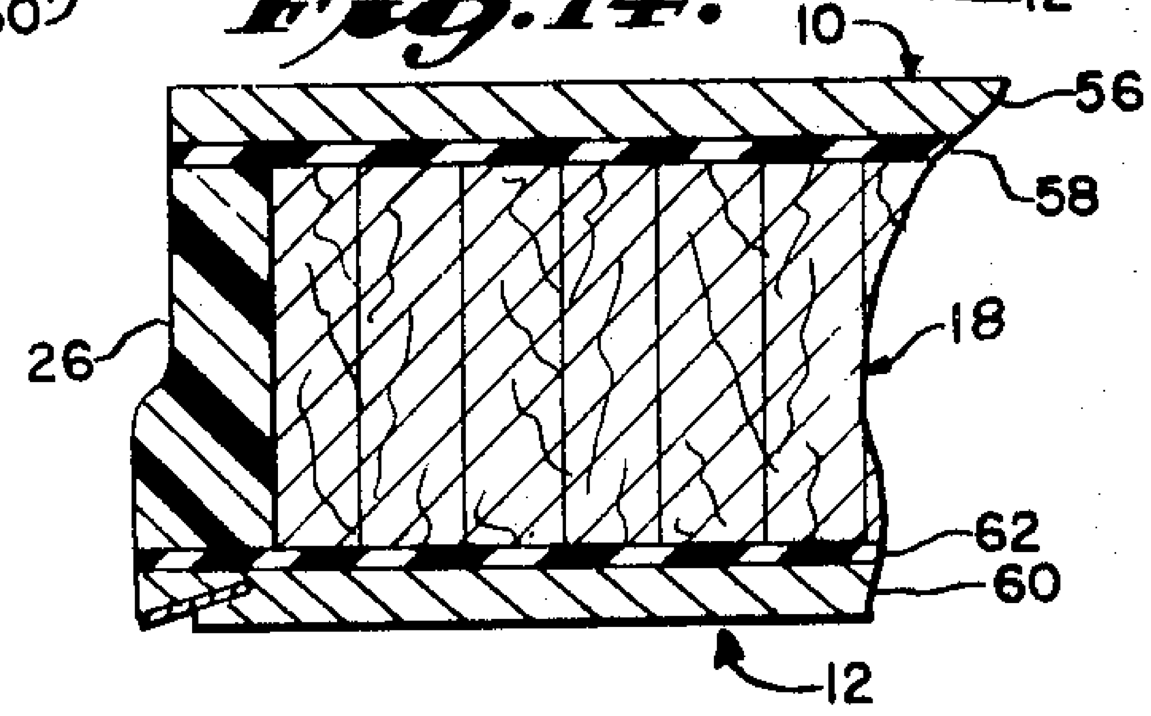
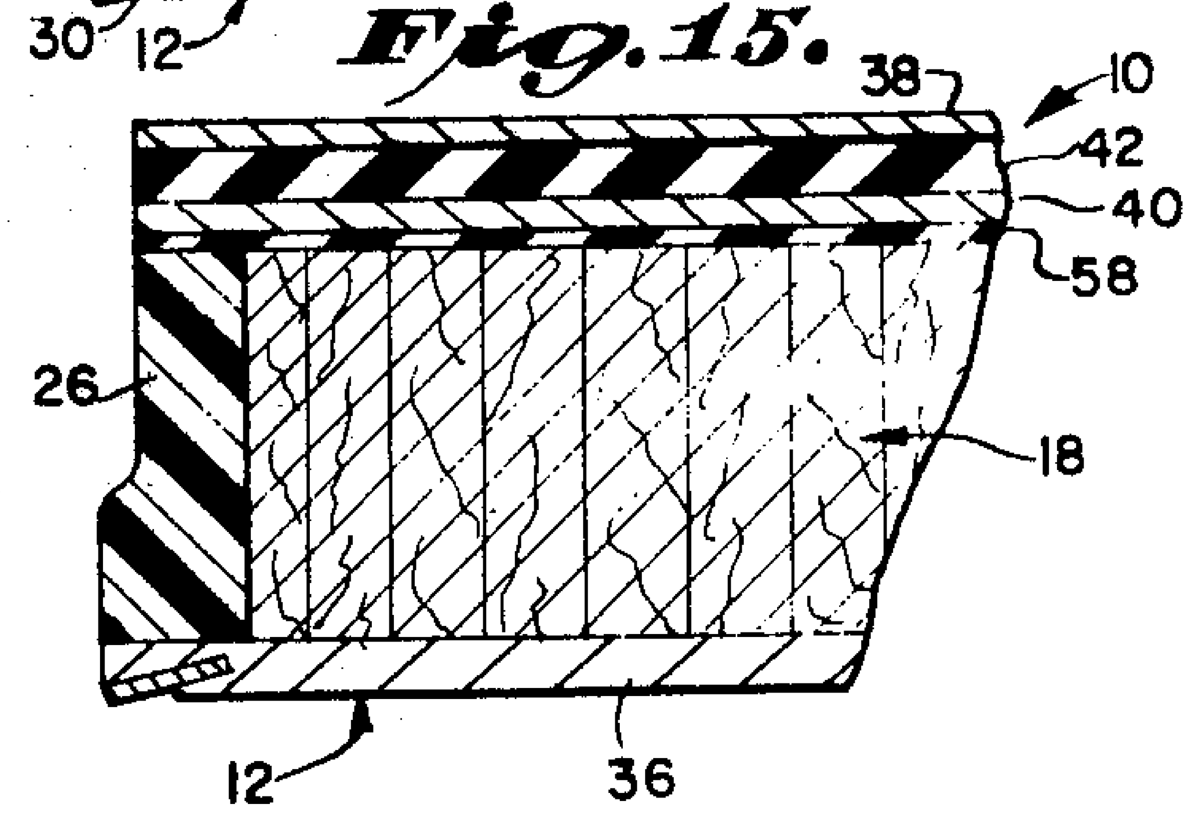


Fig. 15.



INVENTOR

HOWARD HEAD

BY Cushman, Darby & Cushman

ATTORNEYS

United States Patent Office

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2,995,379

SKI

Howard Head, Baltimore, Md.
(15 W. Aylesbury Road, Timonium, Md.)

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6 Claims. (Cl. 280—11.13)

This invention relates to improvements in skis.

More particularly, this invention relates to improvements in laminated skis which are made up of a sandwich of metal with a core of end-grain plywood, or other light weight material, disposed therebetween, such as the skis illustrated in the patent to Pierce, 2,525,618 and to Head, 2,694,580.

Skis of a given length and width (which dimensions depend upon the height and weight of the skier and the specific use to which the skis are to be put) may vary considerably in bending rigidity and in torsional rigidity. As a general rule a "stiff" ski, having a relatively high bending rigidity (along its longitudinal axis) is preferred by a strong fast skier, particularly on hard or icy snow, whereas a ski "softer" in bending rigidity has a tendency to perform better on softer snow. A ski which has a high torsional rigidity is easier for the novice to turn but if the ski is to be used for racing, a more precise control is obtained if the ski has a somewhat reduced torsional rigidity. This occurs because a ski having a high torsional rigidity will ride up over an obstruction encountered by one edge of the ski whereas in the same situation a ski with a lower torsional rigidity will have a tendency to rotate about its longitudinal axis so that at least a part of the transverse section of the ski located at the point of contact with the obstruction remains, or at least tends to remain, in contact with the snow.

It will now be understood that the ideal bending rigidity of a given ski depends upon the use to which it is to be put (e.g., whether it is to be used for jumping, or straight or slalom racing) or upon the characteristics of the snow where the skis are to be used, and, finally, upon the "feel" preferred by the individual using the skis. Similarly, the ideal torsional rigidity of a given ski will depend upon the purposes to which the ski is to be put and the characteristics of the snow upon which it is to be used, and the personal perferences of the skier.

With conventional homogeneous skis, or with the laminated skis which have been proposed in the past, the bending rigidity and torsional rigidity have been so interrelated that a change in one has been necessarily accompanied by a corresponding change in the other. For example, an increase in the bending rigidity of a given ski construction is accompanied by a somewhat similar (although not necessarily proportional) increase in the torsional rigidity. As a general rule, conventional wood skis having a given bending rigidity have been considerably softer in torsional rigidity than laminated metal skis having similar dimensions and bending characteristics.

It is within the contemplation of this invention to provide a laminated ski construction wherein the bending rigidity and torsional rigidity are (within the ranges suitable for skis) completely independent of one another, so that skis embodying this construction, and having identical overall dimensions, may have identical bending rigidity and widely varying torsional rigidity or, on the other hand, may have identical torsional rigidity and widely varying bending rigidity.

When a conventional homogeneous ski, or one of the

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laminated skis which have been proposed in the past, squarely strikes an obstruction extending above the level of the snow, the forward portion of the ski deflects upwardly in the manner of a cantilevered beam (with the "fixed" end being the portion of the ski directly under the skier's foot) which has a single upwardly directed load applied at a point intermediate the fixed end and the free end. The deflection which occurs results from both the normal bending stresses (i.e., the tension and compression bending stresses) and the shearing stresses, imposed upon the ski by its encounter with the obstruction.

It is known that if a theoretical weightless cantilevered beam having infinite shear stiffness is subjected to pure bending forces at a point intermediate the free and fixed end, all of the deflection takes place by extension and compression of the lower and upper fibers, respectively as a result of normal stresses. In such a case the portion of the beam outboard of the applied force will tend to assume a straight line which is tangent to the curvature of the beam at the point of applied load. Such a beam is shown diagrammatically in FIGURE 1, with the bending force being applied at point A. The relaxed position of the beam is shown in phantom.

It is also accepted that if a theoretical weightless cantilevered beam, having exactly opposite properties, that is to say, outer fibers which are infinitely rigid in tension and compression and having a core infiinitely soft in shear, is subjected to a load at a point intermediate the fixed end and the free end, all of the deflection will result from shear stresses. In such a case a portion of the beam between the fixed end and the applied load will extend in a straight line running at an angle to the course of the beam in its relaxed position. The portion of the beam between the point of applied load and the free end thereof will tend to extend along a line parallel with the original course of the beam. Stated otherwise, the free end will tend to "snake" or curve back towards the original course of the beam. Such a beam is shown diagrammatically in FIGURE 2, with the load being applied at point B. The relaxed position of the beam is shown in phantom.

Every cantilevered beam having a load applied intermediate its fixed and free ends responds to both the bending or normal stresses and the shearing stresses, and attempts to assume the positions dictated by each group, although in a homogeneous beam the response to the former is so much greater (generally about 100 to 1) that in most circumstances the latter are ignored in calculating the characteristics of the beam under that load.[1] In the case of the forward end of a conventional ski, either of homogeneous wood or metal laminated construction, encountering an obstruction, the effective ski rigidity is so great that the forward end of the ski merely bends upwardly and the theoretic tendency of the portion having already passed over the obstruction to "snake" is too slight to be noticed by the skier.

It is within the contemplation of this invention to construct a laminated ski wherein this tendency is greatly emphasized so that when the forward portion of a ski strikes an obstruction the end of the ski will not merely bend upwardly but rather will show a substantial tendency to "snake" over the obstruction, with the portion of the ski between the free end and the obstruction tending

[1] See Laurson & Cox, "Mechanics of Materials," second edition, John Wiley & Son, 1948, pp. 155, 345.

to curve downwardly to regain contact with the snow. It will be obvious to one familiar with the skiing art that such an action will decrease the amount of time that a substantial part of the forward portion of the ski striking an obstruction is out of contact with the snow and hence will result in a marked decrease in the amount of time that the skier passing over the obstruction is without proper control.

It has been discovered that a laminated ski obtaining the above mentioned characteristics in accordance with this invention will also demonstrate another very desirable characteristic in that there is a marked increase in the dampening effect of the ski to vibrations along a vertical plane parallel to the longitudinal axis. As will be evident to anyone familiar with skiing, such vibrations are uncomfortable and tend to interrupt the snow-ski contact with a resulting reduction in control available to the skier.

It is therefore an object of this invention to provide a laminated ski construction wherein the bending rigidity and torsional rigidity are completely independent.

It is another object of this invention to provide a laminated ski wherein a substantial portion of the total deflection resulting from the ski encountering an obstruction is shear deflection, as opposed to bending deflection.

It is another object of this invention to provide a laminated ski which will have a marked tendency to "snake" over an obstruction.

It is yet another object of this invention to provide a laminated ski having an improved internal dampening characteristic.

These and other objects of this invention will be fully understood from the following detailed description of a typical preferred form and application of the invention, throughout which description reference is made to the accompanying drawings in which:

FIGURE 1 is a diagrammatic view of a theoretical weightless cantilevered beam, having infinite shear stiffness, being subjected to pure bending forces at a point intermediate the free end and fixed end;

FIGURE 2 is a diagrammatic view of a theoretical weightless cantilevered beam having a core infinitely soft in shear stiffness, being subjected to a load at a point intermediate the free end and the fixed end;

FIGURE 3 is a view in top plan of a ski embodying th present invention;

FIGURE 4 is a view in partial section taken along line 4—4 of FIGURE 3;

FIGURE 5 is a view in partial section taken along line 5—5 of FIGURE 3;

FIGURE 6 is a diagrammatic view illustrating the action of a ski of conventional construction when its forward portion encounters a bump;

FIGURE 7 is a diagrammatic view illustrating the action of a ski incorporating the present invention when its forward portion encounters a bump;

FIGURE 8 is a partial section similar to FIGURE 5 except that it illustrates a modification of the invention;

FIGURE 9 is a partial section similar to FIGURE 5 except that it illustrates another modification of the invention;

FIGURE 10 is a partial section similar to FIGURE 5 except that it illustrates another modification of the invention;

FIGURE 11 is a partial section similar to FIGURE 5 except that it illustrates another modification of the invention;

FIGURE 12 is a partial section similar to FIGURE 5 except that it illustrates another modification of the invention;

FIGURE 13 is a partial section similar to FIGURE 5 except that it illustrates another modification of the invention;

FIGURE 14 is a partial section similar to FIGURE 5 except that it illustrates another modification of the invention; and

FIGURE 15 is a partial section similar to FIGURE 5 except that it illustrates another modification of the invention.

Referring now to the drawings, FIGURES 3–5 illustrate in detail the preferred embodiment of the new and improved ski. The ski therein illustrated is generally similar to that shown in Head, 2,694,580, in that it consists of a pair of facing sheets, generally indicated at 10 and 12, spaced from one another by a core section, generally indicated at 14. The core section includes a pair of transversely spaced rails, generally indicated at 18, with each core rail being formed of a number of adhesively connected sections 20 of edge-grain plywood having a thickness along the grain equal to the space between the top and bottom facing sheets 10 and 12. As best shown in FIGURE 4, the core section defines the over all vertical contour of the ski, which varies in thickness along its length, with the thinnest portions being at the ends.

The core rails 18 are adhesively secured to the interior facing surfaces of the top and bottom facing sheets 10 and 12, respectively, along lines spaced from the longitudinal edges thereof. The core rails do not extend for the full length of the ski, but rather terminate at points closely adjacent the ends thereof where metal inserts 22 and 24 are adhesively installed between the facing sheets 10 and 12.

The spaces between the interior facing surfaces of the facing sheets 10 and 12 and the outsides of the core rails 18 are occupied by side rails 26, which extend for substantially the full length of the ski, that is to say, from the rearmost edge of the forward insert 22 to the forwardmost edge of the rear insert 24. The side rails can be made of any material which is wear resistant, impervious to water, and which can be adhesively bonded to the facing sheets 10 and 12 and the core rails 18 so as to complete a moisture proof enclosure around the plywood. In this preferred embodiment such side rails are made of an abrasion resistant phenolic resin.

The bottom facing sheet 12 is formed with marginal slots 28 wherein hard steel strips 30 are installed in the usual manner to define cutting edges which, as is well known in the ski art, greatly improves the "grip" of the ski with the snow, particularly during turns. However, other arrangements for mounting the strips 30, and for securing them to the bottom facing sheet, or some other member may also be used in connection with the present invention.

It should here be emphasized that the particular configuration of the strips 30, or the manner in which they are mounted, does not form a part of this invention, rather this invention may be used with an almost infinite variety of strip arrangements. The bottom facing sheet is also characterized by a longitudinal flute or groove 32 formed therein which extends from a point 34, just behind the forward metal insert 22, rearwardly to the end of the ski. It will now be understood that the spacing between the rails 18 is such as to provide clearance for the flute 32.

The lowermost surface of the facing sheet 12 may be covered by a thin cover or coating to give the ski desirable running characteristics, such as a coating of plastic or a thin layer of metal having an anodized lower surface. In the ski illustrated in FIGURES 3–5, the lowermost surface of the lower facing sheet 12 is anodized as at 36, so that the provision of such a covering or coating is unnecessary. It should also be understood that the upper surface of the top facing sheet 10 may be similarly, or contrastingly covered or coated to improve the appearance or wear resisting qualities thereof.

The ski which has been generally described hereinabove is identical, for all here practical purposes, to the ski shown in my earlier Patent No. 2,694,580. However, in that patent the top and bottom facing sheets are each illustrated as being composed of a single sheet of aluminum. The (here material) difference between that ski and the ski illustrated in FIGURES 3–5 is that in the latter case the top facing sheet **10** is not an integral sheet of metal, but rather is composed of two juxtaposed metal sheets **38** and **40** which are spaced apart by, and bonded to, a layer of rubber **42**.

To fully appreciate the effect of the inclusion of rubber layer **42**, one must recall that a ski made in accordance with the teaching of my earlier Patent No. 2,694,580, and having a top facing sheet composed of an integral sheet of metal, is quite stiff in shear, and hence tends to have the characteristics of a beam infinitely stiff in shear. When the front portion of such a ski encounters an obstruction, the ski acts as if it were cantilevered at a point directly below the skier's foot and had a vertical load applied at the point of contact and assumes a curve approximating that described hereinabove as being characteristic of the deflection of a cantilevered beam which is so constructed as to have infinite shear stiffness and which is loaded, at that point, with pure bending stresses. That is to say, the ski will tend to curve upwardly to the level of the obstruction and then extend in a straight line tangent to that curve, at that point. Any tendency to "snake," caused by the shear stresses present, is too slight to be noticed or measured. An exaggerated diagrammatic illustration of this reaction by such a ski is shown in FIGURE 6.

The inclusion of an intermediate layer of rubber **42** in an otherwise identical top facing sheet **10**, that is to say, a top facing sheet having the same total thickness of metal, serves to greatly reduce the over all shear stiffness of the beam defined by the ski and hence gives it a marked and measurable tendency to deflect in a manner described hereinabove as being characteristic of a point loaded cantilevered beam which has a core infinitely soft in shear. Thus, when the forward part of the ski encounters an obstruction, the portion between the point of contact and the free end of the ski will tend to "snake" or curve back toward the original course of the ski. An exaggerated diagramtic illustration of this reaction by a ski constructed in accordance with this invention is illustrated in FIGURE 7.

It should be pointed out that the inclusion of an intermediate layer of rubber **42** in the composite top facing sheet **10** does not appreciatively affect the over all bending stiffness of the ski as compared with a ski which has the same total thickness of identical metal in an integral top facing sheet. The reason for this becomes clear when one considers the nature of rubber and of its physical reactions to stress. Rubber is unlike metals in that it does not follow Hooke's law and hence does not have uniform modulus of elasticity in all ranges up to its elastic limit. Rather, the modulus of elasticity, and the modulus of elasticity in shear, of rubber is a non-linear function of the stress to which it is subjected. Generally speaking, these moduli increase with the stress up to the elastic limit, which is almost identical with the yield and failure points. Thus, a stress-strain diagram of rubber results in an increasingly steep curve up to the failure point.

Because of this characteristic of rubber, it will be seen that upon the deflection of the ski encountering the obstruction, the shearing forces between metal strips **38** and **40** soon stretch the rubber **42** (which has a modulus of elasticity in shear, or G. of approximately 50 to 500 p.s.i.) to a point where it has a modulus of elasticity in shear sufficiently great so that the resistance to further shear-strain is equal to the shear stresses created by the tendency of the sheets **38** and **40** to assume different curves. Once this point is reached, the bending stiffness of the composite top facing sheet **10** is virtually identical with that of an integral top facing sheet having the same total thickness of metal, and hence a ski constructed in the manner illustrated in FIGURES 3–5 will have the same bending characteristics as a ski constructed in accordance with my earlier patent and which has the same total thickness of identical metal in its top facing sheet.

In the illustrative preferred embodiment of this invention, the rubber layer **42** extends for the full length of the ski, although all the practical benefit of the "snaking" effect can be obtained if the sheet of rubber only extends over a substantial portion of the length of the ski, e.g., from a point approximately one foot from the rear end of the ski to a point approximately one foot from the heel of the skier, and from a point approximately one foot from the toe of the skier to a point approximately one foot from point **34**, or if it extends over the two feet of ski nearest the tip and the two feet nearest the rear end of the ski. However, in the discussions that follow it will be assumed that the layers of rubber described will extend the entire length of the ski, as is illustrated in FIGURE 4.

In the preferred illustrative embodiment shown in FIGURES 3–5, the metal layers **38** and **40** are each composed of sheets of aluminum having a thickness of 30 mils. The rubber layer **42** is composed of Neoprene gum rubber having a thickness of 50 mils. In some instances, the gum rubber sheet **42** may have a layer of cloth embedded therein. The lower facing sheet is composed of aluminum having a thickness of 60 mils, i.e., the total thickness of the sheets **38** and **40**, although in some instances the strips **30**, or the covering or coating affixed to the lower facing sheet, may make such a contribution to the strength of the lower portion of the ski as to warrant the use of a somewhat thinner sheet of metal as a lower facing sheet **12**. On the other hand, in some instances it may be desirable to have the thickness of metal in the lower portion of the ski exceed that of the upper portion. In FIGURES 3–5, and the figures that follow, the thickness of these layers are disproportionately (relative to the other elements of the ski) large for purposes of clear illustration.

It will be obvious that a ski constructed in accordance with this invention will have a smaller amount of torsional rigidity than an otherwise identical ski which has an integral metal top facing sheet having a total thickness equal to the sum of the thicknesses of sheets **38** and **40**. This occurs because the uppermost sheet **38** is only connected to the remainder of the ski by a material which has a low modulus of elasticity in shear, or modulus of rigidity, as it is sometimes called, when subjected to small amounts of shear strain. Inasmuch as a ski is, by its nature, only a few inches wide, no portion of the rubber is subjected to such shear strain as to increase its modulus of rigidity to a point where the rubber absorbs all of the stress resulting from the tendency towards relative movement between the upper sheet **38** and lower sheet **40** and hence the upper sheet **38** never contributes its full potential strength towards the over all torsional rigidity of the ski.

It will now be understood that skis constructed in accordance with this invention, and having the same total thickness of metal in the composite top facing sheet **10**, and hence having the same bending rigidity, can vary considerably in torsional rigidity, depending upon the ratio of the thickness of the bottom sheet **40** and the top sheet **38**. The total torsional rigidity of a given ski will be a function of this ratio and hence a ski having a ratio of thicknesses of top and bottom facing sheets, **38'** and **40'**, similar to that shown in FIGURE 8 will have a considerably greater torsional rigidity than a ski having a ratio of top and bottom sheets, **38''** and **40''**, similar to that illustrated in FIGURE 9.

It will now be understood that in the design of a specific ski to be constructed in accordance with this invention, the total thickness of the metal to be employed in the top and bottom facing sheets is calculated on the basis of the bending stiffness desired. Then the respective thicknesses of sheets **38** and **40** (which will have a total thickness as determined by the calculation already made) are determined upon the basis of the desired amount of torsional rigidity.

As the amount of "snake" effect to be obtained is a function of the composite modulus of rigidity of the portion of a vertical section of a ski between the rubber layer and the bottom extremity of the ski, this effect will increase as a function of the ratio of the thickness of metal layer **38** to the thickness of metal layer **40**.

In FIGURE 10 there is illustrated another embodiment of this invention wherein the top facing sheet **10** is composed of an integral sheet of metal **43** and the bottom facing sheet **12** is composed of two juxtaposed metal sheets **44** and **46** which are spaced apart by a layer of rubber **48**. Its performance will be comparable to that of a ski similar to the one illustrated in FIGURE 9 as long as metal sheet **44** has a thickness equal to that of sheet **40″** of FIGURE 9 and the total thickness of metal in the respective top facing sheets **10** and bottom facing sheets **12** are the same. Any variances in the ratio of thicknesses of metal layers **46** and **44** will have the same effect as the variances in thicknesses of sheets **38** and **40** of FIGURE 5, as has been explained.

In FIGURE 11 there is illustrated yet another embodiment of the invention which has, in effect, a combination of the features of the ski illustrated in FIGURES 3–5 and the ski illustrated in FIGURE 10. That is to say, there is a strip of rubber **42** located between juxtaposed metal sheets **38** and **40** of the top facing sheet **10** and also a strip of rubber **48** located between juxtaposed metal sheets **44** and **46** of bottom facing sheet **12**. Such a ski will, if all total thicknesses of metal are equal, exhibit a somewhat greater "snaking" effect than that demonstrated by either the ski illustrated in FIGURES 3–5 or the ski illustrated in FIGURE 10. The reason for this becomes apparent when one recalls that a beam having a core infinitely soft in shear will have the most marked tendency to "snake." The ski illustrated in FIGURE 11 comes closer to being a beam which has such a core. Moreover, such a ski will have less torsional rigidity than the ski shown in FIGURE 10.

In FIGURE 12 there is shown a ski having its top facing sheet **10** constructed in a manner similar to that of the skis illustrated in FIGURE 5 and FIGURE 11, and with the bottom facing sheet **12** similar to that illustrated in FIGURE 10 with the exception that the uppermost metal layer **50** in the bottom facing sheet **12** is considerably thicker than the lowermost sheet **54**, although their combined thickness (i.e., the total thickness of metal in the bottom facing sheet **12**) is identical to that of the skis illustrated in all the previous figures. As has been already explained in connection with FIGURES 8 and 9, such a ski would have a greater torsional rigidity than the ski illustrated in FIGURE 11, and a somewhat reduced "snake" effect, although it would have substantially identical bending characteristics. It will be observed that in this ski, the strip **30′** is mounted flat against the bottom surface of the ski because there is insufficient room for an oblique slot as has been illustrated hereinbefore. However, as has been explained, this invention may be utilized in combination with any strip arrangement which is dimensionally feasible.

In all the embodiments of the invention so far described, the combination of the metal layers contacting the core section **14**, and the side rails **26** have formed, when viewed in section, a box and hence have presented considerably greater torsional rigidity than would be obtained if one of these metal layers was absent. It is well-known that a structure which, when viewed in section, presents a closure, whether it be a box, a triangle or a circle, or some other form, has considerably greater torsional rigidity than a structure having a section which is open. This principle is best demonstrated by comparing the torsional rigidity of a box beam and a channel beam having identical weight per unit of length.

In the instant case, the wood rails **18** have a relatively small modulus of elasticity in shear, the G for plywood wood being in the area of 5,000 to 100,000 p.s.i. (depending upon the direction of grain of the wood, and other factors) whereas the modulus of elasticity in shear of the aluminum sheets facing the core is in the order of 4,000,000 p.s.i. and the modulus of rigidity of the thermosetting plastic side rails is in the order of 1,000,000 p.s.i. If the side rails are constructed of thermoplastic material, the G of the rails will be in the order of 3,000 to 300,000 p.s.i. Hence, the contribution of the wood to the torsional rigidity of the box defined by a vertical section of the structure, and described immediately hereinabove, is relaively small.

It will, therefore, be seen that if the ski is constructed, in accordance with this invention, in the manner illustrated in FIGURE 13, with a top facing sheet **10** consisting of a layer of aluminum **56** adhesively secured to a facing sheet of rubber **58**, with the latter being adhesively secured directly to the uppermost surfaces of the wood rails **18** and the side rails **26**, and with the bottom facing sheet **12** consisting of a single metal sheet **60** similar to that illustrated in FIGURES 5, 8 and 9, the torsional rigidity of the ski will be markedly below that of any of the skis described thus far and, further, the tendency of this ski to "snake" will be appreciably greater than in any of these skis. As long as the thickness of metal in sheets **56** and **60** is identical to the total thicknesses of metal in the top and bottom facing sheets **10** and **12**, respectively, of the skis already discussed, the bending characteristics of this ski will be substantially identical with that of the others.

It follows from this that if the top and bottom facing sheets **10** and **12**, respectively, are constructed with a layer of rubber between the metal layers and the wood core, the resulting ski would exhibit the characteristics of that shown in FIGURE 13 to an even greater degree. Such a ski is illustrated in FIGURE 14, and has a layer of rubber **62** between the metal sheet **60** and the wood rails **18**, and has an upper facing sheet identical to that shown in FIGURE 13.

Another variation which will now be understood is that shown in FIGURE 15, which includes an upper facing sheet similar to that shown in FIGURES 3–5, i.e. including metal sheets **38** and **40** in contact with the opposed surfaces of rubber sheet **42**, the facing sheet being secured to a thin rubber sheet **58** which is, in turn, adhered to the side rails **26** and the wood rails **18**. In short, this is a combination of the ski illustrated in FIGURES 3–5 with the ski illustrated in FIGURE 13. Again, this modification results in a ski which has a "softer" core (i.e., having a lower composite modulus of elasticity in shear) and will demonstrate a decreased torsional rigidity, an increased tendency to "snake," but the same bending characteristics as long as the total amount of metal in the top and bottom facing sheets **10** and **12**, respectively, is the same as that presented in the skis which have already been discussed.

It will now be understood that a characteristic of the present invention consists of constructing a ski having a pair of metal layers vertically spaced from one another, with each layer residing at a level at, or adjacent to, a vertical extremity of a vertical cross section of the ski, with a core located therebetween. The core, together with any neighboring elements fixed against movement relative thereto, has a relatively low composite modulus of rigidity as compared with that of the ski illustrated in my previous Patent No. 2,694,580, wherein the core is fixed to the top and bottom facing sheets and obtains torsional rigidity from all of the metal layers in the ski. This core, together with the neighboring elements fixed against movement relative thereto, is separated from the above mentioned metal layers (located at the vertical extremities of the ski) by layers of rubber, although there may also be other layers of rubber in the ski, as has been explained.

With the above in mind, it will also be understood that when one wishes to construct a ski having a given bending stiffness, the torsional rigidity and the amount of "snake" effect can be controlled by the utilization of any of the designs discussed hereinabove or, by the use of any combinations or variations thereof.

It has been observed that the presence of the rubber, or rubber-like material, layers in the skis which have been described, or in variations thereof, imparts a marked dampening effect to the ski so that the tendency of the ski to vibrate from shocks is materially lessened. The quantum of this tendency is a function of the amount of rubber present and increases as the torsional rigidity of the core, together with the elements fixed to the core, decreases. Stated otherwise, the quantum of this tendency is an inverse function of the composite modulus of rigidity of the core proper and the elements fixed against movement relative to it.

In interpreting the above remarks about relative characteristics of various materials, it should be borne in mind that the modulus of elasticity in tension of aluminum is approximately 10,000,000 pounds per square inch and that the modulus of elasticity of wood in tension varies from approximately 500,000 p.s.i. to 1,500,000 p.s.i. The modulus of elasticity in tension of the thermosetting plastic side rails here used is in the order of 3,000,000 p.s.i. If the side rails are constructed of thermoplastic material, their E would be in the range of 10,000 to 1,000,000 p.s.i.

It should be understood that in every instance hereinabove where I have spoken of rubber, I have meant my remarks to extend to synthetic rubber or rubber-like materials having the characteristics described.

For example, a so-called "rubber glue," or "rubber adhesive" (as opposed to the "hard glue" normally used in ski construction) can be used to join the metal of a layer of the facing sheets to the core rails **18** (e.g., instead of the rubber layer **58** in FIGURE 13), as long as such an adhesive has the strength and moduli of elasticity characteristics as have been described hereinabove.

Further, while I have spoken of the metal layers as being composed of aluminum, because this is a readily available light metal, it should be understood that it is within the contemplation of the invention to use magnesium or some other light metal. Moreover, in instances where one metal layer is quite thin, that metal layer might be composed of some heavier metal, such as steel. In such a case the ratio between the total thickness of metal at the other vertical extremity of the ski will be altered, in accordance with well-known principles used in calculations involving the use of strengths of materials to determine the proper construction of composite beams.

This application is a continuation-in-part of my presently pending application Serial No. 688,081 filed October 3, 1957, now abandoned.

Having described only a typical preferred form and application of my invention, I do not wish to be limited or restricted to specific details herein set forth but wish to reserve to myself any variations or modifications that may appear to those skilled in the art and falling within the scope of the following claims.

I claim:

1. A wood and metal laminated ski having an accentuated tendency to have its forward end snake over a small obstruction encountered by the forward portion thereof, said ski including a wooden core, and metallic facing sheets forming a sandwich for said wooden core, said ski being characterized by having at least one of said facing sheets comprising at least two metallic layers and by having forward areas wherein a layer of rubberlike material is disposed between said metallic layers to completely separate at least a portion of the outermost metallic layer from the corresponding portion of the metallic layer residing directly inwardly therefrom, said portion of said outermost metallic layer being freed by said rubberlike layer from substantial participation in the torsional rigidity of the ski as a whole under the torsional forces encountered in the normal use of the ski, said rubberlike layer being bonded to said outermost metallic layer and to the metallic layer residing directly inwardly therefrom, said rubberlike layer being sufficiently thin to avoid preventing said portion of said outermost metallic layer from substantially complete participation in the bending rigidity of the ski as a whole under the longitudinal bending stresses encountered in the normal use of the ski.

2. A wood and metal laminated ski having an accentuated tendency to have its forward end snake over a small obstruction encountered by the forward portion thereof, said ski including a wooden core, and metallic facing sheets forming a sandwich for said wooden core, said ski being characterized by having forward areas wherein a layer of rubberlike material is disposed between at least a portion of one facing sheet and said wooden core to completely separate said portion of said facing sheet from the portion of said wooden core residing directly inwardly therefrom, said portion of said facing sheet being freed by said rubberlike layer from substantial participation in the torsional rigidity of the ski as a whole under the torsional forces encountered in the normal use of the ski, said rubberlike layer having its outwardly facing side bonded to said portion of said facing sheet and having its inwardly facing side bonded to the material residing directly inwardly therefrom, said rubberlike layer being sufficiently thin to avoid preventing said portion of said facing sheet from substantially complete participation in the bending rigidity of the ski as a whole under the longitudinal bending stresses encountered in the normal use of the ski.

3. A laminated ski construction including vertically spaced facing sheets comprised of metal, a core comprised of material having a modulus of elasticity in shear in the approximate range of 5,000 to 100,000 p.s.i. located intermediate said facing sheets, at least one of said facing sheets comprising two layers of metal spaced by a layer of material having a modulus of elasticity in shear in the approximate range of 50 to 500 p.s.i., said last mentioned layer having one surface bonded to its corresponding layer of metal and having its second surface bonded to its corresponding layer of metal.

4. A laminated ski construction including vertically spaced facing sheets comprised of metal having a modulus of elasticity in shear in the area of 4,000,000 p.s.i., a core comprised of material having a modulus of elasticity in shear in the approximate range of 5,000 to 100,000 p.s.i. located intermediate said facing sheets, each of said facing sheets comprising two layers of metal spaced by a layer of material having a modulus of elasticity in shear in the approximate range of 50 to 500 p.s.i., said last mentioned layer having one surface bonded to its corresponding layer of metal and having its second surface bonded to its corresponding layer of metal.

5. A laminated ski construction including vertically spaced facing sheets comprised of metal, a core comprised of material having a modulus of elasticity in shear in the approximate range of 5,000 to 100,000 p.s.i. located intermediate said facing sheets, each of said facing sheets being spaced from said core by a layer of material having a modulus of elasticity in shear in the approximate range of 50 to 500 p.s.i., each of said last mentioned layers having one surface bonded to its corresponding facing sheet and having its second surface bonded to said core.

6. A laminated ski construction including vertically spaced facing sheets comprised of metal, a core comprised of wood located intermediate said facing sheets, one of said facing sheets comprising two layers of metal spaced by a layer of material having a modulus of elasticity in shear in the approximate range of 50 to 500 p.s.i., said last mentioned layer having one surface bonded to its corresponding layer of metal and having its sec-

ond surface bonded to its corresponding layer of metal, one of said facing sheets being spaced from said core by a layer of material having a modulus of elasticity in shear in the approximate range of 50 to 500 p.s.i., said last mentioned layer having one surface bonded to its corresponding facing sheet and having its second surface bonded to said core.

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