Jan. 14, 1958 J. R. McVEIGH 2,819,871

VANE STRUCTURE

Filed Sept. 7, 1954

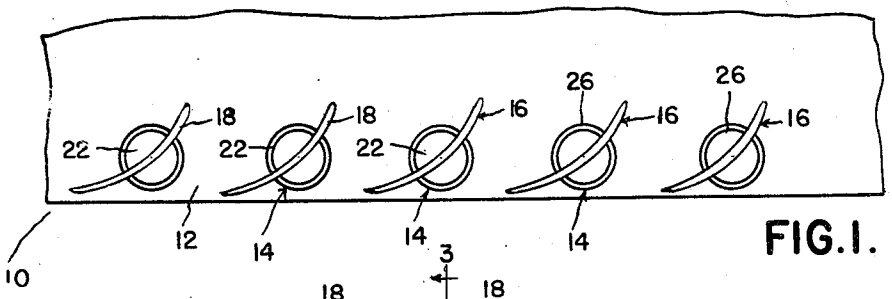


FIG. 1.

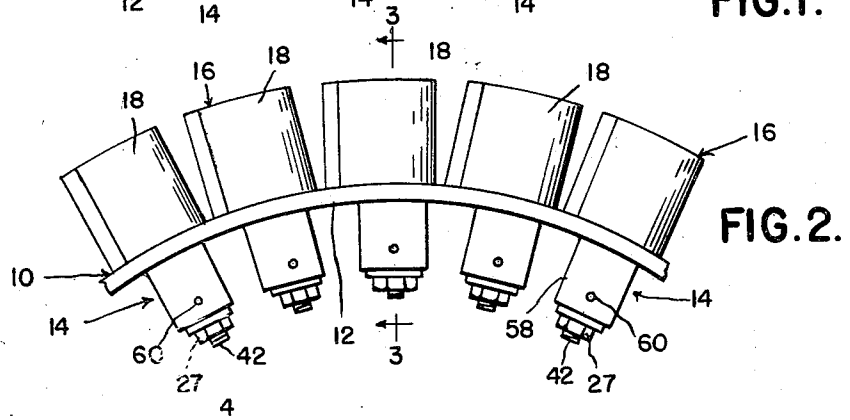


FIG. 2.

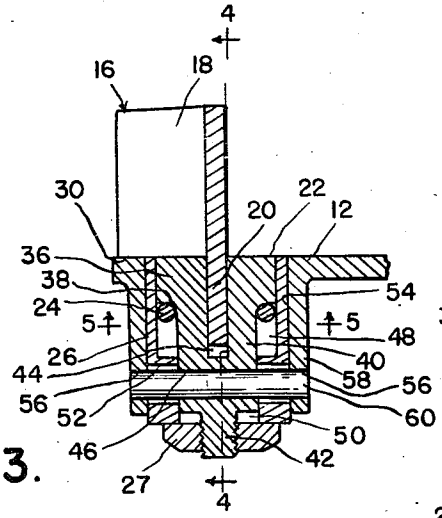


FIG. 3.

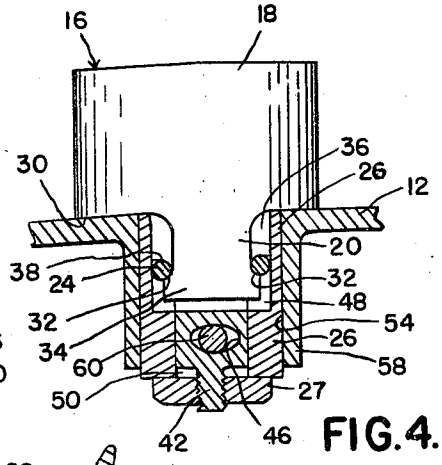


FIG. 4.

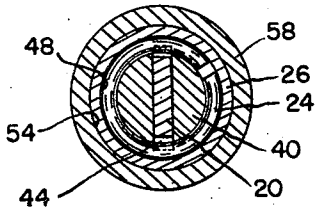


FIG. 5.

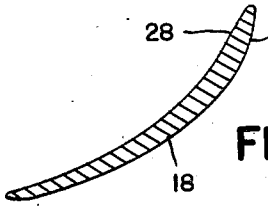


FIG. 6.

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VANE STRUCTURE

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12 Claims. (Cl. 253—78)

This invention relates to a vane structure particularly applicable to a high temperature gas turbine and more specifically to a nozzle or inlet guide vane and to the means for mounting said assembly.

The vane assembly here disclosed involves a vane section having a tang mounted in a collar encircled shaft or support structure by means of a snap ring, the said structure being held in a turbine ring by a pin or other suitable locking means.

Turbine nozzle vanes often have curved surfaces in order to function more efficiently and effectively. These vanes heretofore have been made by a series of complex and lengthy operations to form, cut and fit the vane into the turbine ring. Considerable and costly equipment has been required for such processing.

The instant invention substantially reduces the cost of manufacture of these vanes and the nozzle vane ring, by virtue of a simplified vane and mount construction. The invention provides for a preformed vane section cut from rolled, extruded, or form ground stock, for a tongue or tang section insertable into the split end of a mounting support, for the retention of the vane in the support by a simple snap ring, for the support of the vane and support assembly in an adapter which is in turn pin mounted in the vane ring. The objects of the invention include the provision of means to achieve this construction, and to accomplish the same in a simple, efficient, economical and practical manner.

These desirable advantages and features of construction are among the principal objects of the invention. Additional objects and structural elements will become more apparent from the description given below. For a visual understanding of the invention, reference is made to the accompanying drawing in which like parts are referred to by like reference numerals throughout the several views illustrating a preferred embodiment of the invention, and in which

Fig. 1 is a top plan fragmentary view of a gas turbine ring embodying the inventive construction.

Fig. 2 is a front elevational view of the ring portion shown in Fig. 1.

Fig. 3 is a vertical sectional view substantially on the line 3—3 of Fig. 2.

Fig. 4 is a vertical sectional view substantially on the line 4—4 of Fig. 3.

Fig. 5 is a horizontal sectional view substantially on the line 5—5 of Fig. 3.

Fig. 6 is a cross-sectional view of a curved and tapered vane which may be embodied in the inventive construction.

As shown in the several views of the drawing, the gas turbine vane ring 10 comprises a ring portion 12, and a series of nozzle or inlet guide vane assemblies 14 mounted in the ring portion.

The vane assembly 14 comprises a vane blade 16, arranged with a blade portion 18 and a tang 20, a blade support or shaft 22, a snap ring 24, an adapter comprising an outer shaft collar or sleeve 26, and a nut 27. Vane

blade 16 is preferably made of a material for withstanding high temperatures such as for instance, bonded titanium carbide. The vane cross-section may be rectangular with flat parallel sides, or it may be, as shown, of a curved cross-sectional character. The vane cross-section may also be tapered along one edge or both edges 28, as shown in Fig. 6.

The nozzle or inlet guide vane 16 has its blade portion 18 arranged with a lower edge 30 designed to rest on or close to the ring portion 12. Tang 20 is formed integrally with the blade portion 18, is substantially continuous therewith, and has two parallel undercut shoulders 32 and a base portion 34. Since vane 16 is designed to be made from a strip of the desired material, tang 20, being substantially central of the vane cross-section, will have the configuration of that portion of the vane blade, the side faces thereof being preferably substantially continuous with the side faces of the blade 18. If the section is rectangular in form, the tang will be preferably rectangular in cross-section; and if the vane blade section is curved, the tongue or tang will therefore be preferably curved in cross section.

The blade support preferably comprises a shaft 22 which is substantially cylindrical in form, and is provided with a flange portion 36, a shoulder 38, a barrel portion 40, of reduced diameter than flange portion 36, and a threaded hub end 42. The flange 36 and a portion of the barrel 40 is axially cut or slotted to provide a tang slot 44. The character of the slot 44, i. e. whether it is a straight or a curved cut, will depend primarily upon the cross-sectional shape of the tongue or tang 20 which will be inserted thereinto. However, it is not essential that slot 44 conform exactly to the cross-sectional character of the tang 20, as it can be easily appreciated that the tang will be firmly clamped and held in the shaft 22 by snap ring 24. A pin hole 46 preferably elliptical in cross-section is drilled through shaft barrel 40 below tang slot 44.

The adapter which preferably comprises a shaft collar or sleeve 26 is cylindrical in form and is provided with a counterbore 48 and a bore 50. Counterbore 48 is substantially the diameter of shaft flange 36, so that said blade support is readily supported in said adapter, and bore 50 has substantially the diameter of shaft barrel 40. The shaft flange and barrel 36 and 40, are concentric with collar counterbore and bore, 48 and 50, respectively. The shaft fits into the collar with a close slip fit. Collar 26 is provided with a pin hole 52 through its lower portion, said hole being slightly larger than pin hole 46 in shaft barrel 40 preferably about .020 inches or more larger than the said hole 46. The length of collar 26 may be just slightly longer than the combined length of the shaft flange and barrel.

Vane ring portion 12 is provided with spaced holes 54 to receive the adapter or collar 26, and is provided with openings 56 through the walls 58 of the cylindrical bore 54, into which a pin 60 is pressed.

The vane assembly 14 is arranged with vane blade 16 having its blade portion 18 positioned above the shaft flange 36 and its tang 20 seated in shaft slot 44. The tang base portion 34 does not bottom in the slot 44, but is preferably spaced slightly thereabove. The tang shoulders 32 are arranged below the shaft shoulder 38, and snap ring 24 is slipped over shaft barrel 40 and tang shoulders 32 to seat therebetween, locking the vane blade 16 firmly in shaft 22 and securing same from longitudinal displacement therewith.

The vane blade and shaft are then slipped into collar 26, with shaft barrel 40 passing through collar bore 50, the shaft pin hole 46 being aligned with collar pin hole 52. Nut 27 is threaded onto shaft hub end 42 drawing the shaft shoulder 38 firmly against the snap ring 24

and pressing collar 26 firmly against vane lower edge 30. In this arrangement, the parts are passed into the vane ring cylinder bore 54, the pin holes being there aligned with openings 56. Pin 60 is then passed through these holes to anchor the vane assembly 14 in ring portion 12. Thus, the vane assembly may be positively and frictionally anchored in the gas turbine ring portion 12.

A gas turbine ring can therefore be economically produced by casting the ring portion 12, drilling bores 54 therein, assembling vanes 14 and positively mounting them in the ring 12 as above described. By forming a long strip of vane in the particular cross section desired, cutting off the individual vane blades 16, and providing them with the tangs 20, enables the manufacturer to produce these ring assemblies at substantial savings over current manufacturing practices.

It will also be understood that though the vane blade cross-section may be curved, the tang 20 may, if desired, be ground with flat parallel sides to have a rectangular cross-section therethrough, or said tang may have the same curvature as the blade.

The vane blades and mount construction here disclosed is not limited to use in any particular type of turbine construction, but may be employed in radial, inward, axial or mixed flow turbines without modification, or with various other applications.

It will be apparent to those skilled in the art to which this invention pertains that various modifications and changes may be made without departing from the spirit of the invention or from the scope of the appended claims.

I claim:

1. In a vane ring construction having an annular vane ring and a plurality of vane members, vane mount assemblies adapted to be secured to said vane ring and each comprising a vane support structure, said support structure having a flange provided with a shoulder and an axial slot through said flange and flange shoulder, said vane members each comprising a blade portion and a tang depending therefrom, said tang having a laterally extending base portion provided with shoulders, said tang constructed and arranged to be located in said slot, so that said base portion laterally extends from said slot to provide a space between said tang base shoulder and said flange shoulder, locking means disposed in the space between said flange shoulder and said tang base shoulders for retaining said vane member in said vane mount assembly, and means urging said tang base shoulders and said flange shoulder into rigid engagement with said locking means.

2. In a vane ring construction having an annular vane ring and a plurality of vane members, vane mount assemblies adapted to be secured to said vane ring and comprising substantially a cylindrical vane support structure, said support structure having a flange portion and a barrel portion of reduced diameter defining a shoulder on said flange portion, an axial slot through said flange and a portion of said barrel, said vane member comprising a blade portion and a tang depending therefrom, said tang having a base and undercut edges between said base and said vane blade portion and defining shoulders on said base, said tang constructed and arranged to be located in the slot of said support structure, so that said base laterally extends from said slot to provide a space between said tang base shoulders and said flange shoulder, locking means disposed in the space between said flange shoulder and said tang base shoulders for retaining said vane member in said vane mount assembly, and means urging said tang base shoulders and said flange shoulder into rigid engagement with said locking means.

3. In a vane ring construction having an annular vane ring and a plurality of vane members, vane mount assemblies adapted to be secured to said vane ring and comprising a substantially cylindrical vane support structure, said support structure having a flange portion and a barrel portion of reduced diameter defining a shoulder on said flange portion, an axial slot through said flange and a portion of said barrel, said vane members each comprising a blade portion and a tang depending therefrom, said tang having a base and undercut edges between said base and said vane blade portion and defining shoulders on said base, said tang constructed and arranged to be located in the slot of said support structure, so that said base laterally extends from said slot to provide a space between said tang base shoulders and said flange shoulders, locking means disposed in the space between said flange shoulder and said tang base shoulders for retaining said vane member in said vane mount assembly, and means urging said tang base shoulders and said flange shoulder into rigid engagement with said locking means, said vane tang undercut edges aforesaid defining shoulders on said vane blade portion, said vane mount assemblies aforesaid each having a collar arranged over said support structure and against said blade portion shoulders to enclose the support structure, the vane tang, and the locking means, and means securing said support structure in said collar.

4. In a vane ring construction having an annular vane ring and a plurality of vane members, vane mount assemblies adapted to be secured to said vane ring and comprising a substantially cylindrical vane support structure, said support structure having a flange portion and a barrel portion of reduced diameter defining a shoulder on said flange portion, an axial slot through said flange and a portion of said barrel, said vane members each comprising a blade portion and a tang depending therefrom, said tang having a base and undercut edges between said base and said vane blade portion and defining shoulders on said base, said tang constructed and arranged to be located in the slot of said support structure so that said base portion laterally extends from said slot to provide a space between said tang base shoulders and said flange shoulder, locking means disposed in the space between said flange shoulders for and said tang base shoulder retaining said vane member in said vane mount assembly, and fastening means urging said tang base shoulders and said flange shoulder into rigid engagement with said locking means, said vane tang undercut edges aforesaid defining shoulders on said vane blade portion, said vane mount assemblies aforesaid each having a collar arranged over said support structure and against said blade portion shoulders to enclose the support structure, the vane tang, and the locking means, and means securing said support structure in said collar, said support structure having a threaded hub end depending from said barrel portion and projecting beyond said collar, and said fastening means comprising a threaded element adapted to be secured to said threaded end and to bear against said collar to retain said collar in firm engagement with said blade portion shoulders aforesaid.

5. In a vane ring construction having an annular vane ring and a plurality of vane members, vane mount assemblies aadpted to be secured to said vane ring and comprising a substantially cylindrical vane support structure, said support structure having a flange portion and a barrel portion of reduced diameter defining a shoulder on said flange portion, an axial slot through said flange and a portion of said barrel, said vane members each comprising a blade portion and a tang depending therefrom, said tang having a base and undercut edges between said base and said vane blade portion and defining shoulders on said base, said tang constructed and arranged to be located in the slot of said support structure so that said base portion laterally extends from said slot to provide a space between said tang base shoulders and said flange shoulder, locking means disposed in the space between said flange shoulder and said tang base shoulders for retaining said vane member in said vane mount assembly, and fastening means urging said tang base

shoulders and said flange shoulder into rigid engagement with said locking means, said vane tang undercut edges aforesaid defining shoulders on said vane blade portion, said vane mount assemblies aforesaid each having a collar arranged over said support structure and against said blade portion shoulders to enclose the support structure, the vane tang, and the locking means, and means securing said support structure in said collar, said support structure having a threaded hub end depending from said barrel portion and projecting beyond said collar, and said fastening means comprising a threaded element adapted to be secured to said threaded hub end and to bear against said collar to retain said collar in firm engagement with said blade portion shoulders aforesaid, said annular vane ring aforesaid having spaced openings arranged for the insertion of said vane mount assemblies therein, and means securing the support structures and the collars of said vane mount assemblies in said spaced openings.

6. In a vane ring construction having an annular vane ring and a plurality of vane members, vane mount assemblies adapted to be secured to said vane ring and comprising a substantially cylindrical vane support structure, said support structure having a flange portion and a barrel portion of reduced diameter defining a shoulder on said flange portion, an axial slot through said flange and a portion of said barrel, said vane members each comprising a blade portion and a tang depending therefrom, said tang having a base and undercut edges between said base and said vane blade portion and defining shoulders on said base, said tang constructed and arranged to be located in the slot of said support structure so that said base portion laterally extends from said slot to provide a space between said tang base shoulders and said flange shoulder, locking means disposed in the space between said flange shoulder and said tang base shoulders for retaining said vane member in said vane mount assembly, and fastening means urging said tang base shoulders and said flange shoulder into rigid engagement with said locking means, said vane tang undercut edges aforesaid defining shoulders on said vane blade portion, said vane mount assemblies aforesaid each having a collar arranged over said support structure and against said blade portion shoulders to enclose the support structure, the vane tang, and the locking means, and means securing said support structure in said collar, said support structure having a threaded hub and depending from said barrel portion and projecting beyond said collar, and said fastening means comprising a threaded element adapted to be secured to said threaded hub end and to bear against said collar to retain said collar in firm engagement with said blade portion shoulders aforesaid, said annular vane ring aforesaid having spaced tubular members depending therefrom and arranged for the insertion of said vane mount assemblies therein, said support structure and collar of each vane mount assembly and each vane ring tubular member having pin holes bored in axial alignment therethrough, and a pin located in said aligned pin holes throughout the extent thereof.

7. In a vane ring construction having an annular vane ring and a plurality of vane members, vane mount assemblies adapted to be secured to said vane ring and comprising a substantially cylindrical vane support structure, said support structure having a flange portion and a barrel portion of reduced diameter defining a shoulder on said flange portion, an axial slot through said flange and a portion of said barrel, said vane members each comprising a blade portion and a tang depending therefrom, said tang having a base and undercut edges between said base and said vane blade portion and defining shoulders on said base, said tang constructed and arranged to be located in the slot of said support structure so that said base portion laterally extends from said slot to provide a space between said tang base shoulders and said flange shoulder, and locking means disposed in the space between said flange shoulder and said tang base shoulders for retaining said vane member in said vane mount assembly, and fastening means urging said tang base shoulders and said flange shoulder into rigid engagement with said locking means, said vane tang undercut edges aforesaid defining shoulders on said vane blade portion, said vane mount assemblies aforesaid each having a collar arranged over said support structure and against said blade portion shoulders to enclose the support structure, the vane tang, and the locking means, and means securing said support structure in said collar, said support structure having a threaded hub end depending from said barrel portion and projecting beyond said collar, and said fastening means comprising a threaded element adapted to be secured to said threaded hub end and to bear against said collar to retain said collar in firm engagement with said blade portion shoulders aforesaid, said annular vane ring aforesaid having spaced tubular members depending therefrom and arranged for the insertion of said vane mount assemblies therein, said support structure and collar of each vane mount assembly and each vane ring tubular member having pin holes bored in axial alignment therethrough, and a pin located in said aligned pin holes throughout the extent thereof, said threaded means aforesaid adapted to draw said support structure against said pin in one direction and to force said collar against said pin in the opposite direction, whereby to lock said collar and said support structure firmly on said pin.

8. In a vane ring construction having an annular vane ring and a plurality of vane members, vane mount assemblies adapted to be secured to said vane ring and comprising a substantially cylindrical vane support structure, said support structure having a flange portion and a barrel portion of reduced diameter defining a shoulder on said flange portion, an axial slot through said flange and a portion of said barrel, said vane members each comprising a blade portion and a tang depending therefrom, said tang having a base and undercut edges between said base and said vane blade portion and defining shoulders on said base, said tang constructed and arranged to be located in the slot of said support structure so that said base portion laterally extends from said slot to provide a space between said tang base shoulders and said flange shoulder, and an annular locking ring disposed around said barrel in the space between said flange shoulder and said tang base shoulders whereby to retain said vane member in said vane mount assembly, and means urging said tang base shoulders and said flange shoulder into rigid engagement with said locking ring to prevent longitudinal and lateral separation of said vane member and said vane mount assembly.

9. In a vane ring construction having an annular vane ring and a plurality of vane members, vane mount assemblies adapted to be secured to said vane ring and comprising a substantially cylindrical vane support structure, said support structure having a flange portion and a barrel portion of reduced diameter defining a shoulder on said flange portion, an axial slot through said flange and a portion of said barrel, said vane members each comprising a blade portion and a tang depending therefrom, said tang having a base and undercut edges between said base and said vane blade portion and defining shoulders on said base, said tang constructed and arranged to be located in the slot of said support structure so that said base portion laterally extends from said slot to provide a space between said tang base shoulder and said flange shoulder, locking means disposed in the space between said flange shoulder and said tang base shoulders for retaining said vane member in said vane mount assembly, said vane tang undercut edges aforesaid defining shoulders on said vane blade portion, said vane mount assemblies aforesaid each having a collar arranged over said support structure and against said blade portion shoulders to enclose the support structure, the vane tang,

and the locking means, and means securing said support structure in said collar, said vane tang having side surfaces substantially continuous with the side surfaces of the blade portion.

10. In a vane ring construction having an annular vane ring and a plurality of vane members, vane mount assemblies adapted to be secured to said vane ring and comprising a substantially cylindrical vane support structure, said support structure having a flange portion and a barrel portion of reduced diameter defining a shoulder on said flange portion, an axial slot through said flange and a portion of said barrel, said vane members each comprising a blade portion and a tang depending therefrom, said tang having a base and undercut edges between said base and said vane blade portion and defining shoulders on said base, said tang constructed and arranged to be located in the slot of said support structure so that said base portion laterally extends from said slot to provide a space between said tang base shoulders and said flange shoulder, and an annular locking ring disposed around said barrel in the space between said flange shoulder and said tang base shoulders whereby to retain said vane member in said vane mount assembly, and means urging said tang base shoulders and said flange shoulder into rigid engagement with said locking ring to prevent longitudinal and lateral separation of said vane member and said vane mount assembly, said annular locking ring lying within the peripheral edges of said support structure flange, a collar comprising a two step internal bore, one step of said bore arranged over said flange and locking ring means, said other step of said bore of reduced diameter and arranged over said barrel portion aforesaid.

11. In a vane ring construction having an annular vane ring and a plurality of vane members, vane mount assemblies adapted to be secured to said vane ring and comprising a substantially cylindrical vane support structure, said support structure having a flange portion and a barrel portion of reduced diameter defining a shoulder on said flange portion, an axial slot through said flange and a portion of said barrel, said vane members each comprising a blade portion and a tang depending therefrom, said tang having a base and undercut edges between said base and said vane blade portion and defining shoulders on said base, said tang constructed and arranged to be located in the slot of said support structure so that said base portion laterally extends from said slot to provide a space between said tang base shoulders and said flange shoulder, locking means disposed in the space between said flange shoulder and said tang base shoulders for retaining said vane member in said vane mount assembly, and means urging said tang base shoulders and said flange shoulder into rigid engagement with said locking means, said vane tang undercut edges aforesaid defining shoulders on said vane blade portion, said vane mount assemblies aforesaid each having a collar arranged over said support structure and against said blade portion shoulders to enclose the support structure, the vane tang, and the locking means, and means securing said support structure in said collar, said vane tang having side surfaces longitudinally continuous with a section of said blade portion and having a substantially identical contour to said blade section.

12. In a vane ring construction having an annular vane ring and a plurality of vane members, vane mount assemblies adapted to be secured to said vane ring and comprising a substantially cylindrical vane support structure, said support structure having a flange portion and a barrel portion of reduced diameter defining a shoulder on said flange portion, an axial slot through said flange and a portion of said barrel, said vane members each comprising a blade portion and a tang depending therefrom, said tang having a base and undercut edges between said base and said vane blade portion and defining shoulders on said base, said tang constructed and arranged to be located in the slot of said support structure so that said base portion laterally extends from said slot to provide a space between said tang base shoulders and said flange shoulder, locking means disposed in the space between said flange shoulder and said tang base shoulders for retaining said vane member in said vane mount assembly, and means urging said tang base shoulders and said flange shoulder into rigid engagement with said locking means, said vane tang undercut edges aforesaid defining shoulders on said vane blade portion, said vane mount assemblies aforesaid each having a collar arranged over said support structure and against said blade portion shoulders to enclose the support structure, the vane tang, and the locking means, and means securing said support structure in said collar, said vane tang having side surfaces longitudinally continuous with a section of said blade portion and having a substantially identical contour to said blade section, said slot in said support structure being of substantially identical contour in cross-section to said tang located therein.

References Cited in the file of this patent

UNITED STATES PATENTS

1,187,428	Homersham	June 13, 1916
1,720,754	Baumann	July 16, 1929

FOREIGN PATENTS

937,883	France	Apr. 30, 1948