

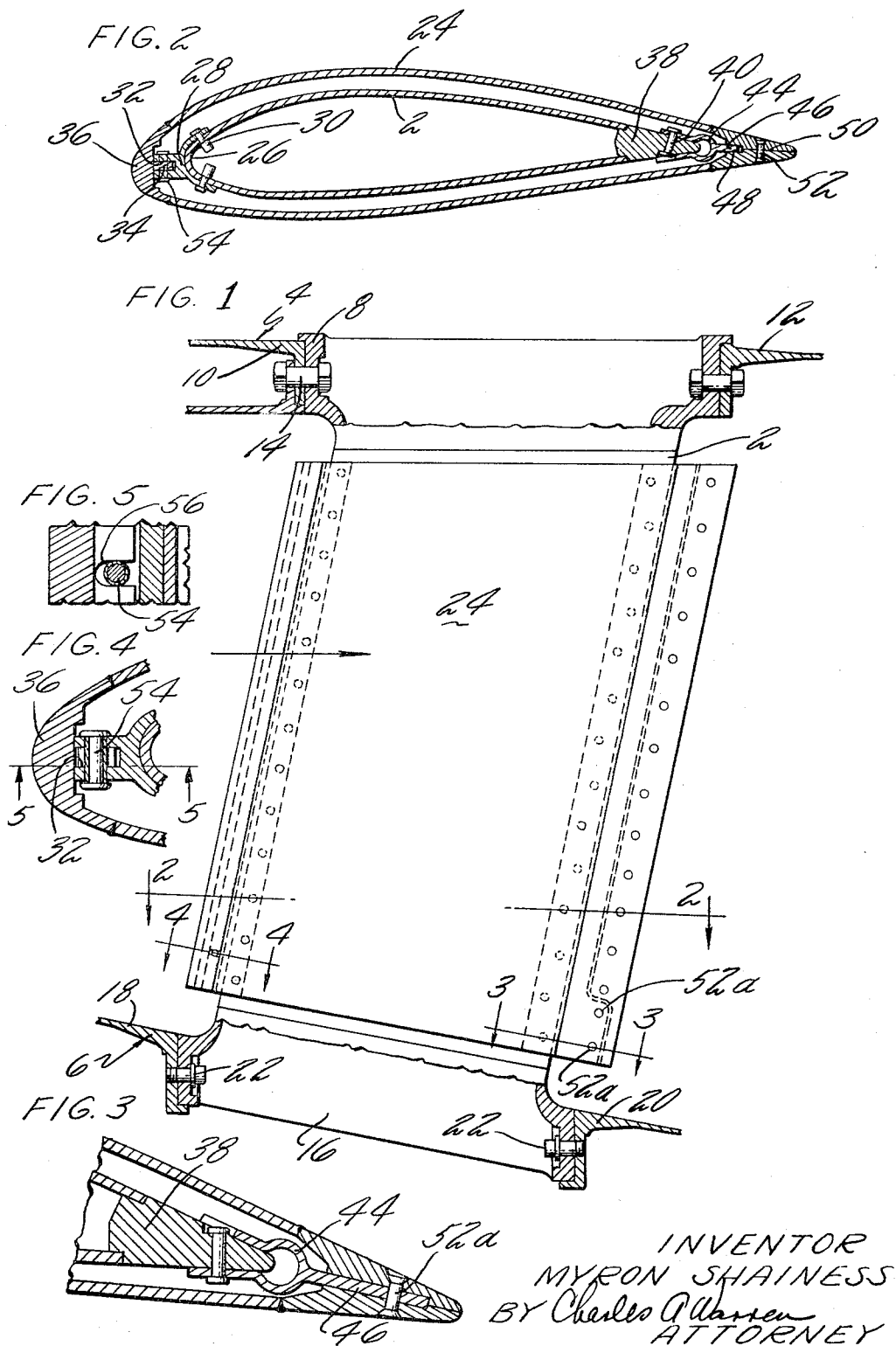
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M. SHAINESS

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HEAT SHIELD FOR TURBINE STRUT

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INVENTOR
MYRON SHAINESS
BY Charles O. Larson
ATTORNEY

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HEAT SHIELD FOR TURBINE STRUT

Myron Shainess, Hartford, Conn., assignor to United Aircraft Corporation, East Hartford, Conn., a corporation of Delaware

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This invention relates to turbine vanes or struts and particularly to heat shields for the strut.

Where the strut or vane is intended to form a load-carrying structure, as shown, for example, in the Nichols and Werstler application, Serial No. 337,407, filed January 13, 1964, it may be desirable to control the rate of heating of the vane when the turbine is put in operation in order to minimize stresses resulting from differential thermal expansion of the several parts. For example, the inner and outer duct wall forming rings heat up more slowly than a strut extending across the gas path since the strut is exposed on both sides to the hot gas whereas the duct wall rings are exposed only on one side. One feature of the invention is a heat shield surrounding the vane or strut to reduce the rate of temperature change in the vane during transient conditions.

Another feature is a heat shield surrounding a turbine vane and so mounted that it is free to expand around the vane without applying a load to either vane or shield. Another feature is a readily mounted and assembled heat shield which is held in surrounding relation to the strut or vane.

Other features and advantages will be apparent from the specification and claims, and from the accompanying drawing which illustrates an embodiment of the invention.

FIG. 1 is a radial section through a turbine duct in which the vane is positioned.

FIG. 2 is a sectional view along the line 2—2 of FIG. 1.

FIG. 3 is a fragmentary sectional view along the line 3—3 of FIG. 1.

FIG. 4 is a fragmentary sectional view along the line 4—4 of FIG. 1.

FIG. 5 is a fragmentary sectional view along the line 5—5 of FIG. 4.

The invention is shown in connection with a row of radially extending vanes or struts 2, only one of which is shown, which form a connection between an inner annular duct wall 4 and an outer annular duct wall 6. The vanes serve to hold these walls in predetermined spaced relation to define between them a gas path for the flow of hot gas either to a turbine located downstream of the struts or from a turbine located upstream of the struts. In either event the struts are subjected to large temperature changes particularly when the turbine is being started or stopped and the thermal expansion resulting from these temperature changes causes high stresses in the struts and in the duct walls.

Each strut has a shroud element 8 at the inner end by which it is secured within the duct wall, the latter in the arrangement shown being made up of spaced rings 10 and 12 between which the shrouds 8 are positioned and to which the shroud elements are secured as by bolts 14. A similar arrangement is provided at the outer end of the struts where the outer shroud 16 is positioned between spaced rings 18 and 20, being held by bolts 22.

For the purpose of minimizing the heating of the strut and for reducing the rate of heating or cooling of the strut thereby allowing the duct walls to increase in temperature more nearly at the same rate as the increase in temperature of the strut, the latter in accordance with the present invention is surrounded by a heat shield 24. This shield is supported so that it is free to expand without in any way stressing the strut or the shield.

Referring more specifically to FIG. 2, the strut 2 which

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is hollow has a leading end 26 on which is mounted an elongated bracket 28, the latter being held in position as by rivets 30. The bracket has an elongated slot 32 extending longitudinally of the strut and in a position to receive a tongue 34 projecting inwardly from the leading end 36 of the shield 24. Clearance is provided so that movement of the leading end of the shield with respect to the bracket 28 may occur chordwise of the strut or shield.

At the trailing end of the strut the latter has a trailing end element 38 to which is attached, as by rivets 40 and 42, FIGS. 2 and 4, respectively, a guide element 44, the latter having a tongue 46 positioned in a slot 48 formed in the trailing end portion 50 of the shield. The latter is, in effect, made up of a single piece of material which is wrapped around the strut with the opposite edges of the material thickened and forming the trailing end portion of the strut and being held together as by a row of rivets 52. Clearance is provided in the groove 48 for the tongue 46 to permit chordwise movement of the heat shield on the strut at the trailing edge of the latter. The guide element 44 is bifurcated to straddle the trailing edge element 38 of the vane and the rivets 40 extend through one of the bifurcations as shown with the rivets 42 extending through the other bifurcation.

In order to retain the heat shield in radial position on the strut, the bracket 28 adjacent the outer end has a rivet 54 extending across the slot 32 and engaging in a notch 56 formed in the tongue 34. This notch 56 extends axially of the assemblage and thereby locates the leading edge of the heat shield in predetermined radial position with respect to the leading edge of the strut, as will be apparent, without impeding the chordwise movement of the shield with respect to the strut at this point.

At the trailing edge of the strut near the outer end thereof, the projecting rib 46 is extended outwardly as at 58 to be engaged by the two outermost rivets 52a. At this point the groove 48 is also extended toward the trailing edge of the shield as shown at 60 in FIGS. 1 and 4 where the rib 46 is extended. With this arrangement the heat shield is located both axially and radially at this point. It will be apparent that the shield is securely located in surrounding relation to the strut in such a manner that it will remain in the desired position on the strut both radially by the arrangement shown in FIG. 4 and also by the rivet 54 and notch 56. The strut is also located axially by the arrangement shown in FIG. 4 but the axial expansion is not interfered with by reason of the notch 56.

Accordingly, when the turbine engine in which this invention is incorporated is set in operation and hot gases flow over the shield surrounding the strut, the shield will substantially reduce the rate at which the strut is heated so that the thermal expansion of the strut will be more nearly at the same rate as the thermal expansion of the inner and outer duct walls thereby minimizing thermal stresses within the device. Under extreme conditions it will be understood that the strut itself may be cooled by the circulation of a cooling fluid through the strut thereby further reducing the rate of thermal expansion.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and described, but may be used in other ways without departure from its spirit as defined by the following claims.

I claim:

1. A turbine strut having an operative portion of airfoil cross section and end shroud elements for the support of the vane, and a heat shield surrounding at least a part of the operative portion of the airfoil in spaced relation thereto, said shield being airfoil shape in cross section and having means at leading and trailing edges engaging with the vane to hold the shield in spaced relation to

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the vane, said means comprising in part a grooved element extending lengthwise of the leading edge of the vane and a projecting element internally of the shield and lengthwise thereof at the leading edge to engage the grooved element.

2. A turbine strut as in claim 1 in which a rivet extends through the grooved element and engages the projecting element to hold the shield in lengthwise position on the vane.

3. A turbine vane for use in a high temperature environment, including an operative central portion over which the turbine fluid is directed, said portion being substantially airfoil shape in cross section and end shroud elements at opposite ends of the operative portion, said shroud elements holding the vane in position, and a shield around the central portion and in spaced substantially concentric relation thereto, and cooperating guide means on the central portion and within the shield to hold the vane and shield in predetermined relation, said guide means providing for relative movement substantially chordwise of the shield to provide for thermal expansion, said guide means at the leading edge including a connector secured to the leading edge of the vane and having a slot therein, and a projection longitudinally of and interiorly of the shield at the leading edge to fit in said slot.

4. A turbine vane as in claim 3 in which the connector has a rivet thereon extending through the slot adjacent one end and engaging said projection to hold the shield in position longitudinally of the vane.

5. A turbine vane for use in a high temperature environment, including an operative central portion over which the turbine fluid is directed, said portion being substantially airfoil shape in cross section and end shroud elements at opposite ends of the operative portion, said shroud elements holding the vane in position, and a shield around the central portion and in spaced substantially concentric relation thereto, and cooperating guide means on the central portion and within the shield to hold the vane and shield in predetermined relation, said guide means providing for relative movement substantially chordwise of the shield to provide for thermal expansion, said guide means at the trailing edge including a connector mounted on the vane and having a longitudinally extending rib thereon extending from the connector substantially in a chordwise direction, and a slot longitudinally of and interiorly of the shield at the trailing edge to receive the projecting rib.

6. A turbine vane as in claim 5 in which the shield and rib have at least one through rivet adjacent one end of the vane to hold said shield and vane in predetermined longitudinal relation.

7. A shielded turbine vane construction for high temperature environments including a vane having a central portion located in the path of fluid through the turbine, end shroud elements for the attachment of the vane to

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the supporting structure, and a shield around and in spaced relation to the central portion, said shield being substantially airfoil in cross section, and being a one-piece element comprising of leading edge, side surfaces extending therefrom and trailing edge elements at the ends of the side surfaces, said trailing edge elements having cooperating surfaces and together forming the trailing edge for the shield, and rivets holding the trailing edge elements together when the shield is in position around the vane, said trailing edge elements being separable for positioning the shield around the vane, said vane having a leading edge guide means and the shield having a cooperating guide means adapted for assembly by relative movement in a chordwise direction.

8. A shielded turbine vane construction for high temperature environments including a vane having a central portion located in the path of fluid through the turbine, end shroud elements for the attachment of the vane to the supporting structure, and a shield around and in spaced relation to the central portion, said shield being substantially airfoil in cross section, and being a one-piece element comprising of leading edge, side surfaces extending therefrom and trailing edge elements at the ends of the side surfaces, said trailing edge elements having cooperating surfaces and together forming the trailing edge for the shield, and rivets holding the trailing edge elements together when the shield is in position around the vane, said trailing edge elements being separable for positioning the shield around the vane, said trailing edge elements being notched lengthwise to form when assembled a slot, and a longitudinally extending guide element on the vane for positioning in the slot.

9. A shielded turbine vane as in claim 8 in which the guide element on the vane is extended adjacent one end of the vane to project between the trailing edge elements and to be engaged and held in position by at least one of the rivets holding the trailing edge elements together.

10. A shielded turbine vane as in claim 9 in which the shell also has a leading edge guide element and the vane has a cooperating guide element extending lengthwise of the shell and having relative movement in a chordwise direction.

11. A shielded turbine vane as in claim 10 in which a pin is located in the cooperating guide elements to restrict the lengthwise movement of the shell on the vane at this point.

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MARTIN P. SCHWADRON, *Primary Examiner*.

55 SAMUEL LEVINE, *Examiner*.

E. A. POWELL, JR., *Assistant Examiner*.