

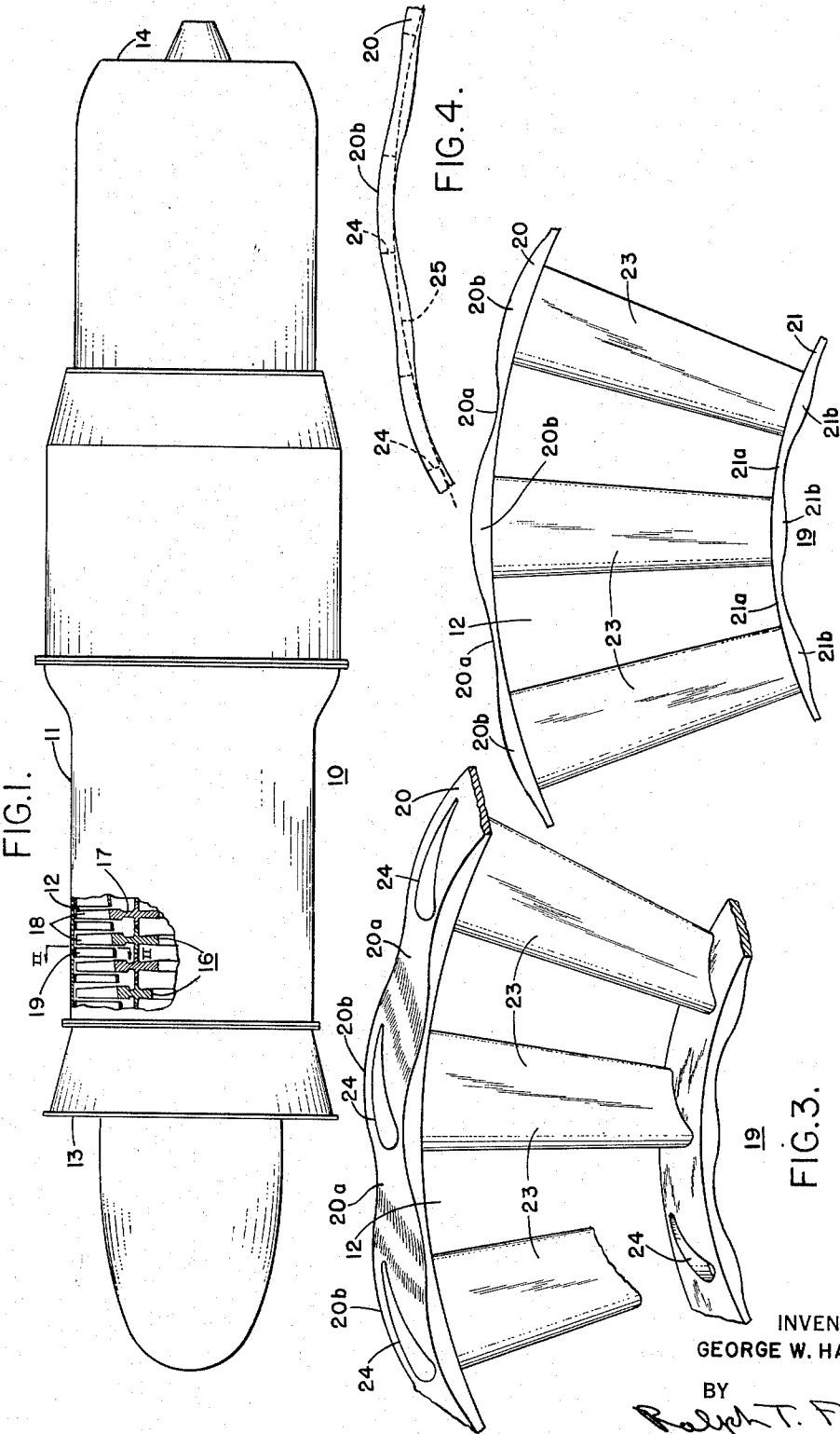
Nov. 22, 1955

G. W. HARDIGG

2,724,544

STATOR SHROUD AND BLADE ASSEMBLY

Filed May 25, 1951



INVENTOR
GEORGE W. HARDIGG

BY
Ralph T. French
ATTORNEY

1

2,724,544

STATOR SHROUD AND BLADE ASSEMBLY

George William Hardigg, Ridley Park, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application May 25, 1951, Serial No. 228,176

2 Claims. (Cl. 230—132)

This invention relates to rotary elastic fluid apparatus such as compressors and turbines, and particularly to a stationary vane row assembly for an axial-flow compressor.

In the construction of an axial-flow compressor for an aviation gas turbine engine, the stationary blade or vane assemblies, which are interposed in complementary halves between the rotary blade stages, usually comprise concentric semicircular straps or shrouds of steel which are joined together by circumferentially spaced, radially disposed vanes. The vane ends are formed into tenons which are fitted into suitably formed openings or slots punched in the respective shrouds, and the entire assembly may then be either brazed or welded together. With the vane assemblies mounted in the compressor, the shrouds serve to furnish boundaries for the air flow through the machine, to support the load which the air stream imposes on the vanes, and to impart rigidity to the vane structure to prevent the unsupported inner portion thereof from deflecting axially toward rubbing engagement with the adjacent rotary blades.

It is one object of the present invention to provide an improved stationary vane assembly of the foregoing character having weight-saving features of construction.

Another object of the invention is the provision of shroud elements for such an assembly having relatively thin portions interposed between the heavier punched portions thereof which receive the vanes, for minimizing the total weight of steel utilized, without appreciably reducing the rigidity or strength of the vane assembly.

A further object is to provide a shroud and vane structure in which the shrouds are crimped intermediate the vane-receiving slots therein, the air flow surfaces of the shrouds being machined or otherwise formed to present smooth cylindrical boundaries, so that the thickness of each shroud varies, comprising portions of maximum thickness at the points of vane support and intervening webs of minimum thickness, which may be about one-half the maximum. Features of the improved shrouding thus constructed subsist in the efficient distribution of mass to conserve weight, the retention of the desired smooth air flow surfaces, and the maintenance of adequate strength and rigidity in the apertured vane supporting areas.

These and other objects are effected by the invention as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a longitudinal view, partly in section, of a typical aviation gas turbine power plant, the compressor of which is adapted to be equipped with stationary vane and shroud structure constructed in accordance with the invention;

Fig. 2 is an enlarged detail fragmentary sectional view taken along the line II—II of Fig. 1 and showing the improved vane and shroud structure;

Fig. 3 is a fragmentary perspective view of the vane and shroud structure; and

2

Fig. 4 is a diagrammatic view illustrating one mode of formation of a stationary vane shroud embodying the invention.

As shown in Fig. 1, a typical gas turbine power plant 10, which is adapted to be mounted in an aircraft (not shown), may comprise a generally cylindrical casing structure 11 having formed therein an axial-flow passage 12 which extends from a frontal air intake 13 to a rearwardly disposed jet nozzle 14, and conventional operating elements for effecting acceleration of fluid mass flow through the passage 12, including an axial-flow compressor 16. Other operating elements of the engine 10 not shown in the drawing include the usual combustion apparatus and a turbine for driving the compressor 16. In operation, air entering the intake 13 is supplied under pressure by the compressor 16 to support combustion of fuel in the combustion apparatus, for which the resultant motive gases are expanded through the turbine and discharged by way of the nozzle 14 in the form of a jet establishing a propulsive thrust.

The compressor 16 further comprises a rotor 17 carrying a plurality of stages of radially extending blades including blades 18, which are interposed between annular assemblies of stationary vanes including an assembly 19. A portion of the vane assembly 19 is illustrated in enlarged detail in Fig. 2 of the drawing, and comprises an outer arcuate shroud 20 and an inner arcuate shroud 21 which is held concentric with respect to the outer shroud by a plurality of radially disposed vanes 23, the end or tenon portions of which are engaged in slots 24 formed in the respective shrouds, as shown in Fig. 3.

According to the invention, each of the shrouds 20 and 21 is of varying thickness and is formed to provide areas of maximum mass in which the vane slots 24 are formed, interposed between areas of reduced mass between the vanes. As best shown in Fig. 2, the outer shroud 20 comprises thin web portions 20a interposed between relatively thick portions 20b, forming a smooth uniformly arcuate inner surface and an undulating outer surface, the outer surface, as shown, may be concave along the web portions 20a and convex along the portions 20b, thus providing the maximum mass of material adjacent the tenon-receiving slots 24. Similarly, the inner shroud 21 has a smooth peripheral surface and an undulating inner surface, forming alternate thin web portions 21a and thick portions 21b, so that the through passage 12 is defined between substantially smooth cylindrical walls. It will be understood that, in mounting the shroud and vane assembly 19 in the compressor 16, the outer shroud 20 will be engaged in a suitable annular groove (not shown) formed in the casing structure 11.

Any suitable method may be employed to form the above-described shrouds 20 and 21. For example, as illustrated diagrammatically in Fig. 4, the outer shroud 20 may be rolled or otherwise formed into a generally circular shape but with a series of crimps or corrugations which are equally spaced to correspond to the desired vane spacing. Upon the punching of the shroud to form the tenon slots 24, the shroud may be suitably mounted in a matrix and the inner side machined to form the relatively thin web portions and to provide a smooth circular surface, as indicated by the dotted line 25, the material thus cut away representing the desired saving in weight.

While the invention has been shown in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof.

What is claimed is:

1. An integral arcuate shroud member for an elastic fluid cooperative annular vane assembly, comprising a plurality of regularly distributed web portions of mini-

3

mum thickness interposed between and formed integral with a plurality of relatively thick portions, the thickness of said shrouds being uniform in any plane of section parallel to the axis of said assembly, each of said thick portions having extending therethrough a vane receiving opening, said web portions and said thick portions of the member presenting a smooth continuous arcuate surface on one face and an undulating surface on the opposite face.

2. The structure recited in claim 1 in which said any section is rectangular in shape and progressively increases in width from the center of said web portions to the center of said relatively thick portions.

4

References Cited in the file of this patent

UNITED STATES PATENTS

1,187,449	De Wein	June 13, 1916
1,932,278	Lacey	Oct. 24, 1933
2,278,041	Allen	Mar. 31, 1942
2,402,418	Kroon	June 18, 1946
2,475,772	Allen et al.	July 12, 1949
2,488,875	Morley	Nov. 22, 1949
2,625,013	Howard et al.	Jan. 13, 1953

FOREIGN PATENTS

234,463	Germany	Oct. 16, 1910
478,104	Great Britain	Jan. 12, 1938