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L. E. VARADI ET AL
RETAINING MEANS FOR TURBINE SHROUDS AND
NOZZLE DIAPHRAGMS OF TURBINE ENGINES

3,056,583

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2 Sheets-Sheet 1

Fig 1

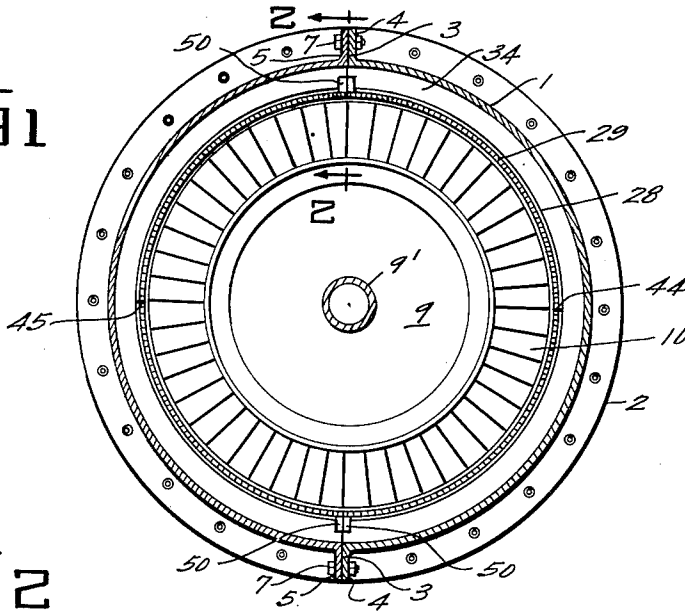
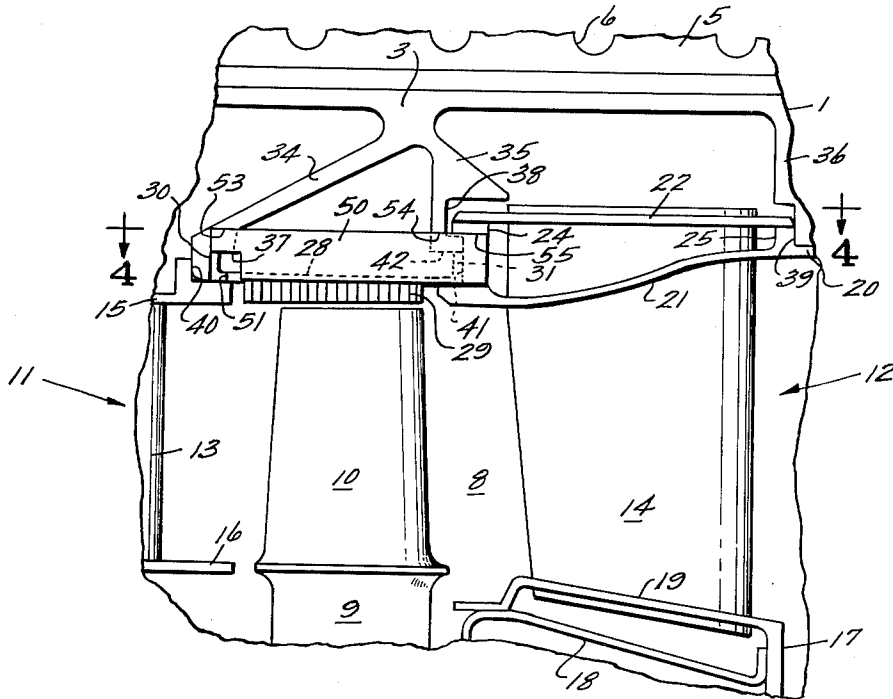


Fig 2



INVENTORS,
LOUIS E. VARADI
THEODORE E. BOURQUE
BY WALTER PEZAREK
Harold A. Levey, Jr.

ATTORNEY-

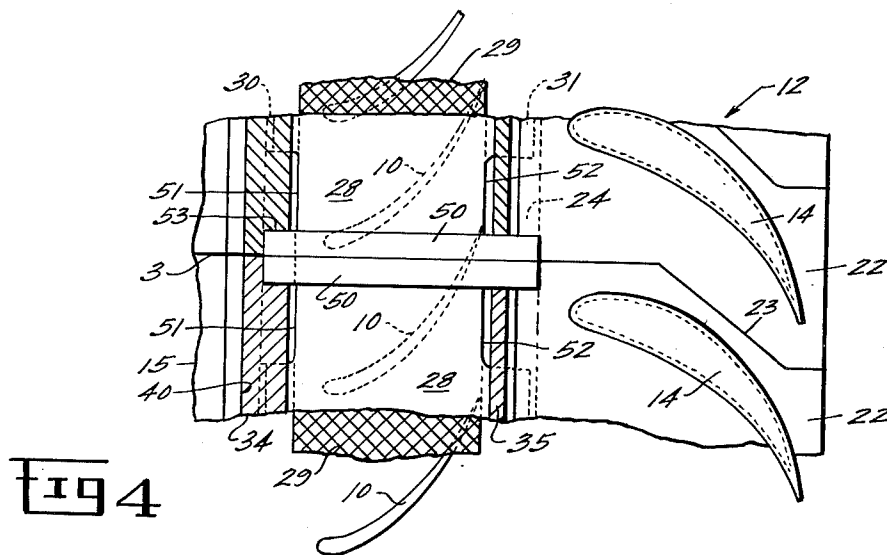
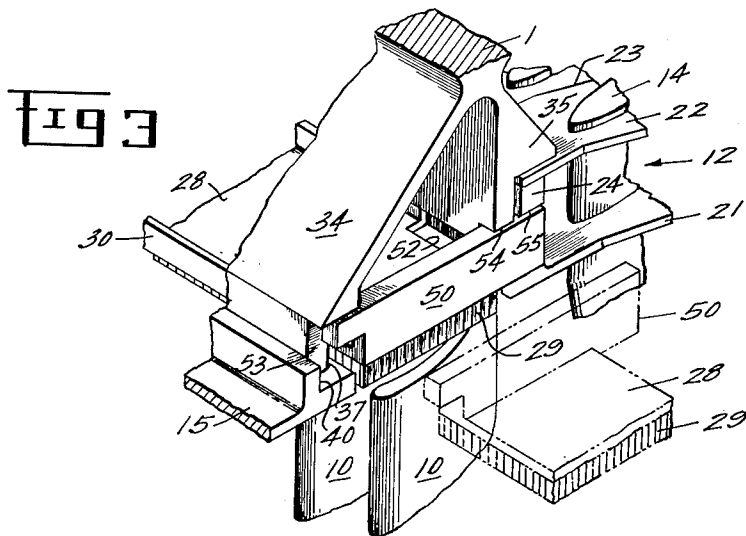
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INVENTOR.
LOUIS E. VARADI
THEODORE E. BOURQUE
BY WALTER PESAREK
Harold A. Levy Jr.

ATTORNEY-

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RETAINING MEANS FOR TURBINE SHROUDS AND NOZZLE DIAPHRAGMS OF TURBINE ENGINES

Louis Ernest Varadi, Danvers, Theodore Edmond Bourque, Beverly, and Walter Pesarek, Swampscott, Mass., assignors to General Electric Company, a corporation of New York

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2 Claims. (Cl. 253—78)

This invention relates to turbine engines, and more particularly to improved means for locating and retaining turbine shrouds and nozzle diaphragms in turbine engines.

It is a general practice to mount nozzle diaphragms and turbine shroud rings in the longitudinally-split casings of turbine engines by means of circumferentially extending rabbets formed in the casing halves. The nozzle diaphragms and shroud rings are split into arcuate segments, which are inserted into the rabbets at the split surfaces of the casing and slid circumferentially into assembled position. In view of the gas loading applied to a nozzle diaphragm in the operation of the engine, it is necessary to provide some retaining means to prevent circumferential sliding of the diaphragm during operation. Such circumferential sliding would result in misdirection of the working fluid to the succeeding turbine stage, and would thus interfere with efficient operation of the engine. It is also desirable to provide means to retain a turbine shroud ring in its assembled circumferential position. Shroud rings are preferably designed for rub-in by the tips of the turbine buckets during the operation of the engine, because reduced effective tip clearance and leakage may be secured thereby. Circumferential movement of a shroud ring after it has been subjected to the initial rub-in would result in further rubbing of the ring to a non-circular form, and consequently in increased tip clearance and leakage.

It is the primary object of our invention to provide improved retaining means for circumferentially locating a nozzle diaphragm and a shroud ring in a turbine engine casing.

It is a further object of our invention to provide improved means for retaining an axially-spaced shroud ring and nozzle diaphragm in a circumferential position with a single locking member, whereby a simplified construction is afforded.

It is still a further object of our invention to provide improved retaining means for nozzle diaphragms and shroud rings which may be readily disassembled for inspection or replacement of the parts.

Briefly stated, in accordance with a preferred embodiment thereof, we may carry out our invention by segmenting a rabbeted casing and ring structures including a shroud ring and a nozzle diaphragm, and by securing a retaining member or key upon the circumferential end of a segment of one of the ring structures. The nozzle diaphragm and shroud ring segments are received in a conventional manner in rabbets at the split line of the casing, and are circumferentially slidable into assembled positions. The key is arranged to circumferentially overlap circumferential end surfaces of the casing half and the other of the ring structures, in the assembled position of the parts. Slots are milled in the casing and in the other of the ring structures to receive the key, so that the key fits flush with the circumferential end surface of the casing half. Upon assembly of the complete nozzle diaphragm and shroud ring in the casing halves, the casing may be assembled in a conventional manner, and the engagement of the key between the casing halves restrains the nozzle diaphragm and shroud rings against rotation. The segments of the nozzle diaphragm and shroud ring may readily be removed for inspection or replacement by

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separating the casing halves and sliding the segments circumferentially out of the rabbets.

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which we regard as our invention, it is believed that the invention will be more clearly understood from the following description of a preferred embodiment thereof, referring to the accompanying drawings, in which:

FIG. 1 is a sectional end view of a turbine engine having retaining means made according to the invention, looking along the rotational axis of the engine;

FIG. 2 is a fragmentary sectional view taken along line 2—2 in FIG. 1, looking in the direction of the arrows;

FIG. 3 is a fragmentary pictorial view of the structure shown in FIG. 2, and;

FIG. 4 is a fragmentary sectional plan view taken along line 4—4 in FIG. 2, looking in the direction of the arrows.

Referring to the drawings, a conventional turbine casing 1 is formed with a circumferential flange 2 for attachment to an adjacent casing section, and is split diametrically and longitudinally into 180° segments which form abutting circumferential end surfaces 3 at the split line. The casing halves are provided with radial flanges 4 and 5 which abut in the plane of the surfaces 3, and are formed with longitudinally-spaced holes 6 for receiving fasteners 7 to secure the casing halves in assembled relation. The casing encloses an annular gas path 8 in which is rotatably mounted a shaft 9' and a turbine wheel 9. The turbine wheel carries a plurality of buckets 10 spaced circumferentially thereabout. The turbine buckets are arranged in serial flow relation between nozzle diaphragms generally designated 11 and 12, which include circumferentially spaced rows of nozzle partitions 13 and 14, respectively. The diaphragm 11 includes an outer mounting ring 15 and an inner mounting ring 16, which are secured to the partitions 13 to form a unitary structure, and also serve to define a portion of the gas path 8. The diaphragm 12 includes an inner composite mounting ring 17, which comprises bands 18 and 19, and an outer composite mounting ring 20, which comprises bands 21 and 22. The partitions 14 extend radially through the bands 19, 21, and 22, and are brazed or otherwise suitably secured thereto. We prefer to circumferentially segment the outer band 22 with a plurality of staggered cuts 23, but this is not necessary to the practice of the invention and forms no part thereof. The bands 21 and 22 are joined to form a box-section structure by an annular ring member 24 and by a circumferential flange 25 formed in the band 21.

An annular shroud ring 28 is provided to enclose the gas path about the tips of the turbine buckets 10. A honey-comb or expanded metal rubbing ring 29 is brazed within the shroud ring for rubbing engagement with the tips of the buckets 10, to provide a minimum leakage path around the buckets. The axial edges of the shroud ring 28 are formed with radially extending flanges 30 and 31 for the purposes of stiffening and supporting the shroud ring.

For mounting the nozzle diaphragms and the shroud ring therein, the casing is provided with a plurality of flanges 34, 35, and 36 which extend radially inwardly and are formed with circumferentially extending rabbets 37, 38, and 39, respectively. The ring 15 of the diaphragm 11 is also formed with a rabbet 40, and the ring 24 is formed with a circumferentially undercut groove 41. The shroud ring 28 is received by the rabbets 37 and 40, and upon the radially outer surface of the band 21 within the groove 41, in circumferentially-slidable engagement. A circumferential lip 42 defined by the rabbet 38 extends axially into the groove 41 for supporting the nozzle diaphragm 12 in axial abutment against the flange 36 in the

rabbit 39; the nozzle diaphragm is thus also supported in circumferentially-slidable relationship by the casing rabbets.

The shroud ring 28 is preferably split into 90° segments, as shown by the split lines at 44 and 45 in FIG. 1, but may alternatively be divided into 180° segments in the same manner as the casing.

Our improved retaining means includes a plurality of retaining members or keys 50, each of which is brazed or otherwise suitably secured to the shroud ring 28 at the circumferential end of a segment which lies adjacent to a surface 3 of a casing half. The keys may alternatively be secured to the nozzle diaphragm 12, upon the circumferential ends of the segments of the ring 24. As shown, four keys 50 are provided, one key being secured to each 90° segment of the shroud ring at a circumferential end thereof. This arrangement is preferable for facilitating alignment in the assembly of the parts, but is not essential to the practice of the invention; a single key attached to a circumferential end of a segment will suffice. The ring 28 and the flanges 30 and 31 thereof are cut out at the circumferential ends thereof to form recesses 51 and 52, respectively, to afford flexibility for seating the keys in assembling the shroud ring in the casing.

In order to permit the keys to be seated flush with the circumferential end surfaces of the segments of the casing and the nozzle diaphragm, slots are milled at 53 in the flange 34, at 54 in the flange 35, and at 55 in the ring 24 of the nozzle diaphragm. The keys are received within the milled slots to overlie the circumferential ends of the casing and diaphragm segments. Following the assembly of the diaphragm and shroud segments in the casing halves, the casing is assembled about the turbine and secured by the fasteners 7. In the assembly, pairs of keys 50 abut circumferentially across the split plane of the casing, as best seen in FIG. 1.

The keys 50 serve to restrain the segments of the shroud ring 28 and the nozzle diaphragm 12 against rotation in the casing. If it is desired to disassemble the parts for inspection or service, the segments may be readily removed by circumferentially sliding them out of the casing rabbets, subsequent to disassembly of the casing halves.

While we have shown and described a preferred embodiment of our invention by way of illustration, various changes and modifications will readily occur to those skilled in the art. We therefore intend to cover in the appended claims all such changes and modifications as may fall within the true spirit and scope of the invention.

What we claim and desire to secure by Letters Patent of the United States is:

1. In a turbine engine, a segmented annular casing, a segmented shroud ring and a segmented turbine nozzle diaphragm, said casing formed with rabbets extending circumferentially therein, said rabbets receiving said shroud ring and said diaphragm in abutting and circumferentially slidable engagement for supporting said shroud ring and said diaphragm axially and radially in said casing, and a retaining member secured to a circumferential end of a segment of said shroud ring, segments of said casing and said diaphragm each being formed with slots upon circumferential ends thereof corresponding to said circumferential end of said shroud ring, said retaining member received by said slots in circumferentially overlying relation to said segments of said casing and said diaphragm to restrain said shroud ring and said diaphragm in an assembled position against circumferential movement relative to said casing.

2. In a turbine engine, a segmented annular casing, a segmented shroud ring and a segmented turbine nozzle diaphragm, said casing formed with rabbets extending circumferentially therein, said rabbets receiving said shroud ring and said diaphragm in abutting and circumferentially slidable engagement for supporting said shroud ring and said diaphragm axially and radially in said casing, and a plurality of retaining members secured respectively to a plurality of circumferential ends of segments of said shroud ring, segments of said casing and said diaphragm each being formed with slots upon circumferential ends thereof corresponding to said circumferential ends of said shroud ring, said retaining members received by said slots in circumferentially overlying relation to said segments of said casing and said diaphragm in an assembled relation of said shroud ring and said diaphragm with said casing, pairs of said retaining members secured respectively to circumferentially adjacent ends of segments of said shroud ring being in circumferential abutment, whereby said shroud ring and said diaphragm are restrained against circumferential movement relative to said casing.

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