Aug. 16, 1949.

V. CRONSTEDT

2,479,039

CAST DISK FOR TURBINE ROTORS

Filed Nov. 6, 1944

2 Sheets-Sheet 1

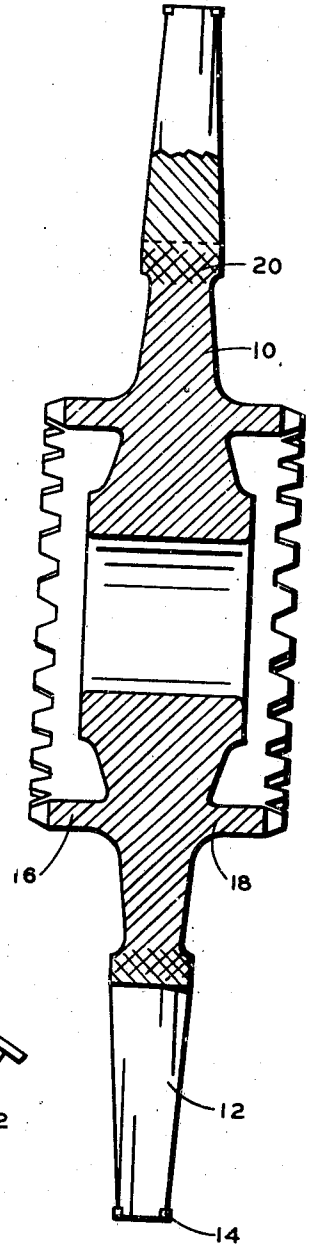
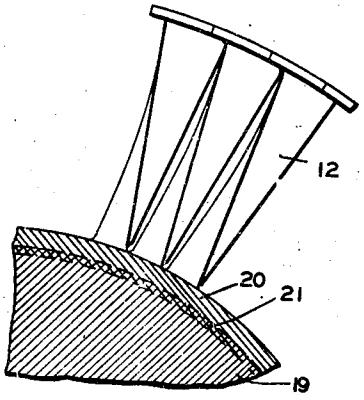


FIG. 1

FIG. 3



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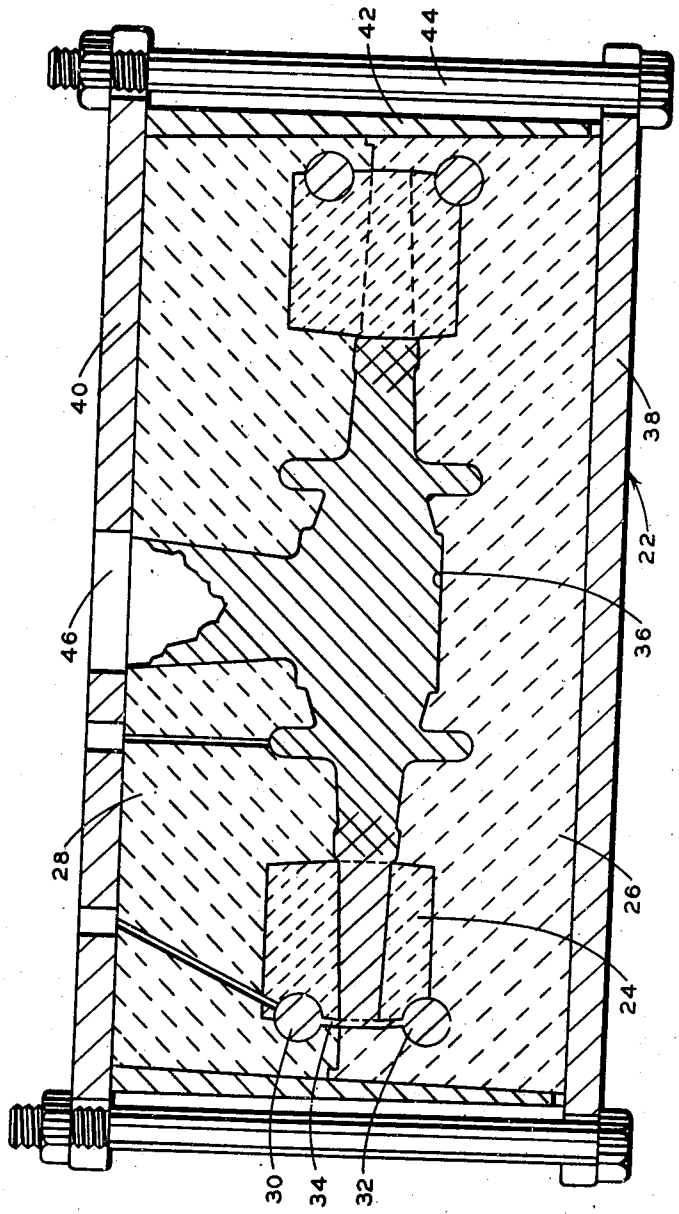


FIG. 2

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CAST DISK FOR TURBINE ROTORS

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Application November 6, 1944, Serial No. 562,252

2 Claims. (Cl. 253—39)

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This invention relates to the manufacture of the disks from which the turbine rotor is made.

Multi-stage turbine rotors have been made up of a shaft having integral disks to the peripheries of which rows of blades are fastened, generally by blade fastenings which hold the blades individually on the disk. Since each blade must be separately made and separately placed on the rotor, the blading of the rotor is an expensive process. A feature of the invention is a turbine disk having blades cast integrally with the remainder of the disk.

Where the turbine operates at extremely high temperatures it is desirable to have the blades made of a different material from the remainder of the disks. For example, the blade is preferably of a material which is extremely heat resistant, although the disk need not be as heat resistant, but should have substantial ductility to withstand the high stresses. A feature of the invention is the manufacture of a turbine disk having the blade material different from that of the remainder of the disk and with the blades and disks all made in one piece. This may be accomplished by first pouring the blade material into the centrifugal mold and then, while this material is still molten, pouring the disk material.

A feature of the invention is the centrifugal casting of the disk, and integral blades to provide the desired characteristics in the material of the blades and disk, and also to obtain a satisfactory surface finish on the blades. Another feature is the use of an investment for at least a part of the mold in which the casting is made, thereby producing the desired blade shape and permitting the casting of the disk and blades within said tolerances.

Other objects and advantages will be apparent from the specification and claims, and from the accompanying drawings which illustrate an embodiment of the invention.

Fig. 1 is a sectional view through the rotor disk.

Fig. 2 is a sectional view through the mold in which the disk is cast.

Fig. 3 is a fragmentary sectional view at right angles to the sectional view of Fig. 1.

The turbine disk may form one of a number of disks positioned in end to end relation in forming the rotor for a multi-stage turbine, one example of which is shown in the copending application of Soderberg, Serial No. 550,899, filed August 23, 1944, which issued on February 8, 1949 as Patent No. 2,461,242. As shown the rotor disk includes an annular blade supporting portion 10 from the periphery of which the blades 12 extend. Shrouds

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14 may connect the tips of the blades together, preferably in groups of blades. The central portion 10 may, as shown, be a formed disk to withstand the stress applied to the disk and may have lateral flanges 16 and 18 which are engaged with similar flanges on the adjoining disks which make up the completed rotor.

The blades are cast integrally with the rotor, thereby eliminating any junction either in the form of blade fastenings or welded attachment of the blades to the disk. As shown, the disk or hub 10 has a central hub 19 which may be of a material particularly adapted for the disk such as a high-stress material and the blades may be of a different material suitable for turbine blades, such as a castable heat-resistant material, there being an annular ring 20 between the central hub and the blades and integral with both the hub and blades where the ring and hub are integrally connected, there is a narrow band 21 in which the materials mutually alloy and form a gradation from the blade and ring material to the hub material. It will be understood that the materials of both hub and blades may be selected from heat resistant alloys generally of the nonferrous type known to be suitable for these purposes.

With reference to Fig. 2, the disk may be made by casting it in a single piece in a mold 22. For best results, the part of the mold in which the blades are formed may be a core 24 made of investment material which can be baked dry and hard at an elevated temperature and which will impart to the blades the desired surface finish and will permit the blades to be formed within the desired tolerances and dimensions. The drag 26 and cope 28 of the mold in the arrangement shown may be either conventional in the mold of material or may, if desired, also be made of an investment material which may be the same as that of the core 24.

The core is formed by placing blade patterns in position in the core box and thereafter placing the investment material around the inserts. The investment is hardened and the inserts are removed, either by withdrawal if the contour of the blades permits, or by melting the inserts out. Risers 30 and 32 in the form of rings may be provided adjacent the peripheries of the end of the blade being connected to the blades by passages 34 formed in the mold. These risers permit the discharge from the casting of any impurities that may have been picked up by the material as it is poured into the opening in the mold. When the mold is assembled an end opening 36

is formed between the cope and the drag and within the core 24 which corresponds in shape to the desired rough dimension of the disk, the parts of the mold being clamped between plates 38 and 40 during the casting process. The peripheries of the mold may be supported by a sleeve 42 and bolts 44 hold the the plates 38 and 40 in assembled relation.

As above stated, the rotor disk is preferably cast centrifugally so that the mold is rotated about its axis during and subsequent to the pouring of the molten metal into the mold. The metal of the blades, ring, and hub is introduced centrally of the mold through opening 46 and since the mold is rotating is forced outwardly into the core 24 and under the influence of the centrifugal force developed by the mold rotation fills the openings in the core to produce blades of the desired contour.

The cast disk may be entirely of one material in which case enough of the desired material is introduced into the mold in one operation. It may be advantageous, however, to introduce into the mold first sufficient blade material to fill the spaces within the core 24 and a short distance toward the center of the mold from the core to form the blades and the ring 19 integral therewith and, thereafter, to pour into the mold, hub material enough to fill the remainder of the space in the mold. It is desirous to have the first of the hub material poured in just as the last of the blade material is being poured, thereby causing the small amount of alloying of the materials and giving the small area or band 19 of mutually alloyed materials, as shown in Fig. 1.

After the disk has been cast and the mold and investment material are removed from the disk the hub and ring portions of the disk may then be machined to the desired contours and dimensions of the disk of Fig. 1.

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 cast one piece disc for a turbine rotor having a central hub of cast high-stress material, a surrounding ring of a cast heat-resistant material of different composition than the high-stress material of the hub, said ring being integral with, and located at and extending radially from, the periphery of the hub, and blades extending from the periphery of the ring and integral therewith, said blades being formed of the same cast heat-resistant material as the ring, and said ring having its periphery continuous.

2. A cast one piece disc for a turbine rotor having a central hub of cast high-stress material, a surrounding ring of a cast heat-resistant material of different composition than the high-stress material of the hub, said ring being integral with, and located at and extending radially from, the periphery of the hub, and blades extending from the periphery of the ring and integral therewith, said blades being formed of the same cast heat-resistant material as the ring, said ring having its periphery continuous, and a cast joint integrally connecting said ring and hub together, said joint consisting of an alloying of said high-stress and heat-resistant materials.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
550,948	Croft	Dec. 10, 1895
839,560	Davis	Dec. 25, 1906
901,459	MacDonald	Oct. 20, 1908
901,960	Farquhar	Oct. 27, 1908
1,008,478	Hopson et al.	Nov. 14, 1911
1,546,011	De Bats	July 14, 1925
1,943,720	Campbell	Jan. 16, 1934
2,058,479	Lysholm	Oct. 27, 1936
2,079,473	Wade	May 4, 1937
2,200,287	Lysholm	May 14, 1940
2,270,822	McCarroll et al.	Jan. 20, 1942
2,299,860	Stoody et al.	Oct. 27, 1942