

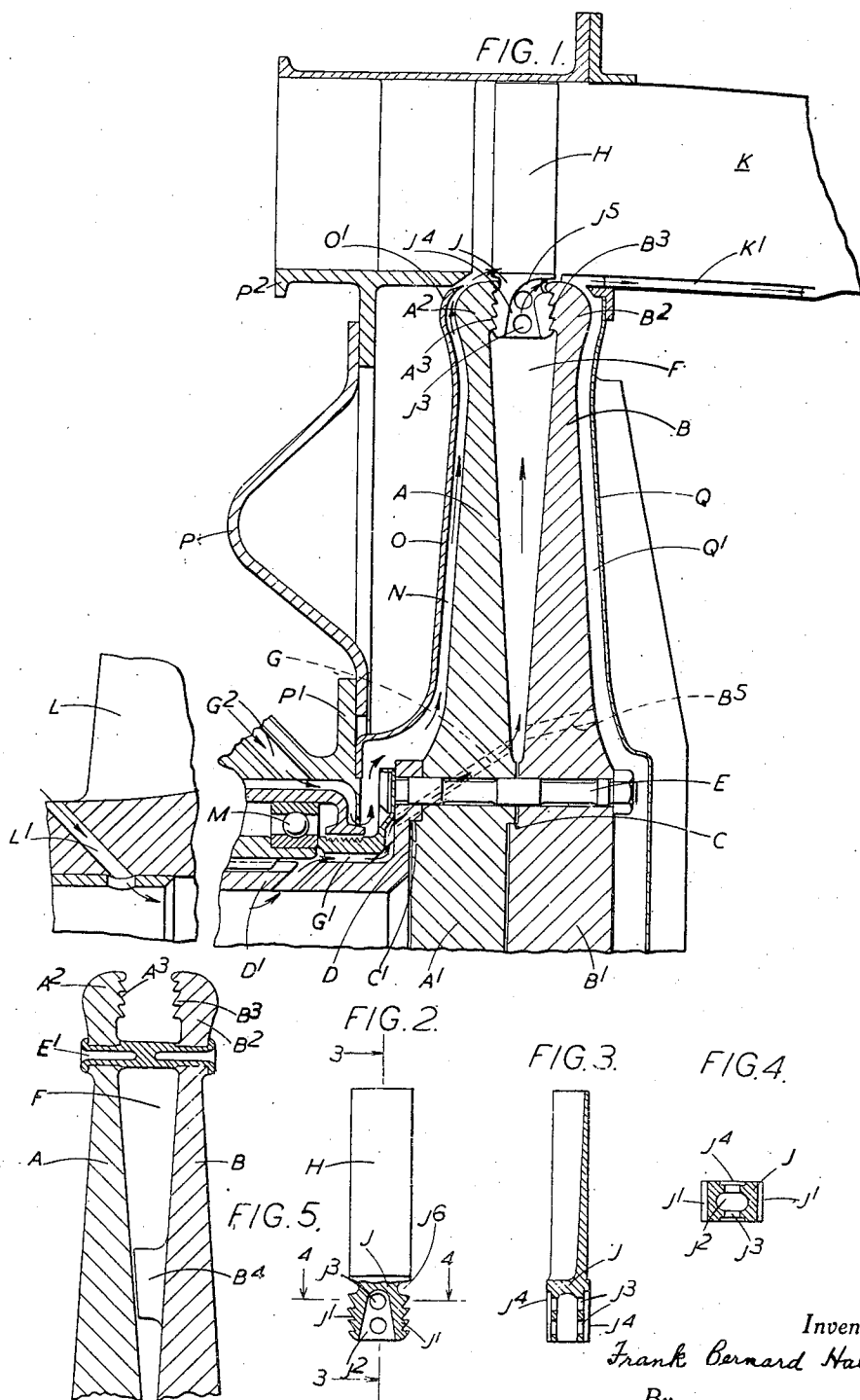
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F. B. HALFORD

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TURBINE

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Inventor
 Frank Bernard Halford
 By
 Loyd Hall Sutton
 Attorney

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TURBINE

Frank Bernard Halford, Edgware, England, assignor to The De Havilland Aircraft Company Limited, Edgware, England, a company of Great Britain

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This invention relates to turbines of the axial flow type and has for its object to provide a construction embodying means for cooling the blades and the rotor while the general structure and the means for fixing the blades are somewhat simplified. The improved turbine rotor is of a known type which is built up of two separate discs connected together with a space between them through which cooling fluid is passed. In such a construction the blades are held in place by serrations which are formed on their root portions and engaged by concentric annular grooves in the opposed faces of the rotor discs.

According to this invention a built-up rotor for a turbine of the above-mentioned type has each blade formed in one piece with the root part rectangular in cross-section having on two opposite side faces serrations adapted to be engaged and held by the concentric grooves in the faces of the rotor discs, while each of the other two opposite side faces is flat and has in it a groove running in a general longitudinal direction with respect to the blade, the grooves in these faces of the roots of adjacent blades, when they are assembled, together forming passages through which the cooling fluid from the space between the rotor discs can pass away between the blade roots. Each blade root is formed hollow with lateral openings into the grooves in the opposite side faces. The cooling fluid used is preferably air, but under certain circumstances water may be employed alone or in conjunction with air, as for instance temporarily during overload, or at starting. Vanes of suitable shape may be disposed in the space between the discs being conveniently formed on the face of one or each of the discs. These vanes will act somewhat as an impeller on the cooling fluid and aid in its flow through the space this flow being also assisted in some degree by centrifugal force. Cooling fluid, for example air, may also be caused to flow over the outer face of the disc which is on the leading or up-stream side of the rotor and between that face and a disc or baffle of sheet metal which is suitably mounted on an adjacent fixed part and at a small distance away from the face of the rotor. This air issuing from a narrow annular opening is directed towards the blades. Air may also be caused to flow over the outer face of the disc on the down-stream side of the rotor.

The accompanying drawing shows by way of example constructions which may be employed in carrying the invention into practice. The improved turbine rotor as here illustrated is more especially intended for use in apparatus of a gen-

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erally known type which comprises a compressor which is driven by the turbine and delivers air into a chamber wherein fuel is burnt and whence the hot gases pass to act on the turbine.

5 In this drawing—

Figure 1 is a sectional elevation of one half of a turbine rotor constructed in accordance with this invention the section being in the plane in which lies the axis of the rotor. The blade is here shown in elevation and not in section.

10 Figure 2 is an elevation of one of the blades as seen in Figure 1, but with the root portion of the blade in section, this section being taken longitudinally through the root and in a radial plane as it would appear if seen in the section in Figure 1.

15 Figure 3 is a longitudinal section through the blade on the line 3—3 in Figure 2 looking in the direction of the arrows, this section being in a plane normal to the rotor axis.

20 Figure 4 is a transverse section through the root of the blade on the line 4—4 in Figure 2 looking in the direction of the arrows.

25 Figure 5 is a sectional elevation similar to Figure 1, but showing a portion only of the rotor and illustrating certain features.

The rotor is built up of two substantially similar discs AB with solid centre portions A¹B¹ which are formed as to their abutting faces so as to interengage as at C for centering purposes. The one disc A is also formed similarly at C¹ to engage with a flange D on the end of a shaft D¹. In cross-section each disc tapers as seen in Figure 1 towards its periphery so that the outer portion is thinner, but the actual marginal parts A²B² in section are somewhat enlarged and externally rounded giving a rather bulbous edge to each disc. As a result of the thinning of each disc towards its margin and when they are bolted up together and to the shaft flange D by bolts E there is left between the discs a space F which in cross-section tapers with its widest part between the outer parts of the discs. Into the inner part of this space one or more holes G lead through the hub A¹ of the disc A which lies on the side of the rotor nearest to the impeller of the compressor to which the rotor is coupled through the shaft D¹.

30 In the inner side or face of the enlarged marginal parts A²B² of the discs there are cut two or more grooves A³B³ which run circumferentially. When the discs are brought together face to face these grooves will engage serrations of corresponding form and number in the root portions of the blades which are thus held in place. In

addition to the bolts E passed through and clamping together the hubs of the discs, and at the same time connecting these to the flanged end of the shaft D¹, it may be convenient to connect the discs towards their peripheries by rivets E¹ formed so that they also constitute distance pieces as shown in Figure 5. These rivets are spaced apart around the discs in their thinner parts and near the bulbous peripheries A²B².

Each blade H springs from a rectangular root J the exterior of which carries on two opposite sides the serrations J¹ engaged by the grooves A³B³ in the discs. Each blade root is preferably hollow as at J² with its interior tapering from the opening in the end towards the inner end. To facilitate the flow of the cooling fluid which conveniently may be air and assist in its effect holes J³ run transversely through the root from the flat sides so that when the blades are in place as seen in Figure 1 the general direction of these holes is circumferential. In each opposite flat face of the root there is a groove J⁴ which is seen in Figure 1, the first part of this groove running substantially radially and narrowing to a part J⁵ which curves laterally and opens through the neck J⁶ of the blade just above the root and beyond the last of the serrations J¹ which are engaged by the grooves B³ in the disc B. These grooves J⁴J⁵ in the abutting faces of the roots of adjacent blades register and together form passages through which the cooling air from the space F between the discs can flow out and in the downstream direction so that the air can there mingle with the hot gases which have acted on the turbine blades and are passing away through the annular passage K. On its way to this passage the air is led through a shallow annular duct K¹ which lies along a part of the wall of the passage K.

In Figure 5 there is shown one of a series of vanes B⁴ formed for example on the inner face of the disc B which may be arranged in the space F to assist in the flow of cooling fluid through this space.

The hollow shaft D¹ on the end of which the rotor is mounted is carried in bearings and this shaft is connected in some convenient manner with the impeller L of a compressor. Air bled for example by passages such as L¹ from the intake of the compressor is allowed to flow through the preferably hollow shaft D¹ between the impeller and rotor through the passages G in the hub of the rotor disc A into the space F between these discs. This air finds its way in the longitudinal direction at G¹ inside the bearing M near the rotor, but air can also enter at G² and flow outside this bearing and thence into a space N formed between a fixed disc O and the face of the rotor disc A. The peripheral part O¹ of this fixed disc O is curved over towards the rounded edge A² of the rotor disc A in such a way as to leave a narrow annular passage through which the air that has flowed outwards over the face of the rotor disc A can escape and pass between the blades H above their roots.

The turbine is enclosed in a suitable casing which on one side is constituted by a plate P in which is at least one corrugation running circumferentially and provided to allow for expansion. This plate extends between the fixed part P¹ which carries the bearing M for the turbine rotor and an annular member P² which carries the guide blades or nozzles of the turbine. On its other side the turbine is preferably closed in by a plate Q

which lies within the annular outflow passage K for the gases leaving the turbine. If desired air may be caused to flow radially in the space Q¹ over the outer face of the disc B. This air may enter the space Q¹ by way of holes B⁵ through the disc B or otherwise as found convenient.

At starting or during periods of overload water may be introduced with the cooling air or temporarily in place of it with a view to increasing the cooling effect.

While the two discs A and B of which the rotor is built up are formed substantially similar in all their main features it is desirable that there shall be sufficient dissimilarity between them to obviate the setting up of resonance.

What I claim as my invention and desire to secure by Letters Patent is:

1. A built-up rotor for an axial flow turbine comprising in combination two discs, a shaft on which said discs are mounted coaxially, means by which said discs are connected together and to the shaft, said discs when so mounted providing a space between them which extends radially from the hubs of the discs to their peripheral parts, at least two concentric annular grooves formed in the inner face of each disc towards its periphery, blades each of which is formed in one piece with its root part, each root part being rectangular in cross-section and having on two opposite side faces serrations adapted to be engaged and held by the said concentric grooves in the faces of the rotor discs, each of the other two opposite side faces of the said root part being flat and having in it a groove running in a general longitudinal direction with respect to the blade and then transversely to an outlet and exteriorly of the root, the grooves in the faces of the roots of adjacent blades when assembled together forming passages through which cooling fluid from the space between the rotor discs can pass away between the blade roots, the root of each blade being hollow and in communication with the space between said discs and having lateral openings from the interior into the said grooves in the two opposite side faces of the root, and means whereby cooling fluid is caused to flow into and radially through the space between the said discs.

2. A built-up rotor for a turbine as defined in claim 1 having vanes on the inner face of at least one of the said discs each of these vanes running radially and extending across the space between the discs.

3. A built-up rotor for a turbine as defined in claim 1 and having an approximately plane fixed disc mounted near but spaced in the axial direction from the outer face of that one of the said rotor discs which lies on the leading side of the rotor to provide a passage for the radial flow of cooling fluid therebetween, and means whereby some of the cooling fluid is caused to flow through the space between the said fixed disc and the adjacent face of the rotor disc.

4. A built-up rotor for a turbine as defined in claim 1 and having an approximately plane fixed disc mounted near but spaced in the axial direction from the outer face of that rotor disc which lies on the down-stream side of the rotor to provide a passage for the radial flow of cooling fluid therebetween, and means whereby some of the cooling fluid is caused to flow through the space between the said fixed disc and the adjacent face of the rotor disc.

FRANK BERNARD HALFORD.