前向進口台階對導向葉片端壁區域膜冷卻有效性之影響

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摘 要

造成燃氣輪機第一級導向葉片（靜葉片）前端與外環基座同時龜裂之原因，目前工業界還沒有徹底掌 握。雖然葉片內部冷卻及膜冷卻之設計可能尚有缺失，然而造成此一缺失之原因有可能是忽略了燃氣導 管出口處受熱膨脹而產生移位時，第一級導向葉片流場與膜冷卻有效性變化的影響。 由於第一級導向葉片之破壞經常被發現是發生在前端、尾端與靠近根部處，以及端壁基座環上，而要 探討這些地方的外部熱傳，對於該區流場的認識非常必要。諸多研究成果已指出，靠近葉片端壁處之流 場為極複雜的三維流，含有蹄形渦漩，通道渦漩，及角落渦漩等二次流的交互作用，而這些渦漩之形成 方式，與上游之邊界層之發展情形亦有密切的關係。因為燃氣導管出口與第一級靜葉片環形基座之對合 情形不同時，明顯地會影響葉片端壁處三維流場之發展，所以忽略燃氣導管受熱膨脹而移位，對靜葉片 近端壁處外部膜冷卻有效性之估算，似乎在考慮上有欠周詳。 本研究以實驗方式探討氣輪機燃氣導管出口處受熱膨脹而移位時對第一級導向葉片基部流場與膜冷卻 有效性變化的影響。實驗之靜葉片模型採兩個半葉片為之，而測試段模型之設計乃藉CFD模擬來決定半葉 片與通道兩側之間隙，以使半葉片模型之壓力分布近似於葉片陣列之情形。燃氣導管之熱膨脹移位相對 於靜葉片環形基座之非對合情形以一前向進口階梯代表之。膜冷卻有效性之量測則採用穩態熱傳液晶熱 像法。 實驗結果顯示，當燃氣導管之出口與葉片環形基座之對合發生易位時，第一級導向葉片端壁前端之膜 冷卻有效性變的比較差;在吸力面受三維流影響之低效率（三角型）區域明顯變大，顯示三維流之結構受 到改變，靜葉片破壞之機率相對提昇。

關鍵詞 : 導向葉片，前向進口階梯，膜冷卻有效性，穩態熱傳，液晶熱像法

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