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ELIMINATING DAMAGE OF RETAINING RINGS BY USING REDESIGNED “PROFILED” KEYS

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SIEMENS

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Joseph A. (Joe) Silvaggio, Jr., is A Fellow Engineer and Manager of Pump Projects and Engineering at Siemens Demag Delaval Turbomachinery, Inc., Trenton, New Jersey. His past experience at Demag Delaval includes the areas of aerodynamics, flow analysis, seal development, design of centrifugal compressor stage elements, centrifugal pump design and flow analysis, boiler feedpump design and analysis, and testing of steam turbines.

Mr. Silvaggio is a member of Sigma Tau and Pi Tau Sigma. He is also an active member of ASME and has held several offices in the Trenton, New Jersey, section. At present, he is on two ASME Performance Test Code Committees and is a member of the Board on Performance Test Codes.

Mr. Silvaggio holds both B.S. and M.S. degrees (Mechanical Engineering) from the University of Pennsylvania. He has written and coauthored numerous technical publications, and is a member of the International Pump Users Symposium Advisory Committee.

ABSTRACT:

Retaining rings are used to locate pump impellers axially on the shafts of high speed, high pressure Siemens Delaval boiler feed pumps. Upon repairing and refurbishing the inner barrels, the retaining rings were found to be badly worn and in some instances broken. This damage was eliminated by using a “profiled” key. This case study discusses the pump design, the location and function of the retaining rings, the location and function of the keys and the failures observed. The reason for redesigning the key to a “profiled” is presented. The new key design shields the leading edge of the retaining from impinging water and this is discussed in detail. No damaged retaining rings were observed after implementing “profiled” keys.

Problem Statement

- Damage to the retaining rings (used to axially locate the impellers relative to the shaft) was observed on boiler feed pumps that were running for up to 10 years with reliable service.
- These boiler feed pumps are high speed, high pressure pumps that supply water to the boilers of power plants of 500 to 800 megawatts.
- The damage (wear and in some cases breakage) impacted the reliability of the pump.
- The method applied to prevent this damage was the redesign of the keys to a “profiled” key which is the subject of this case study.

Pump Type

- The type of pump for this case study is a high pressure double case type pump. It is a high speed, turbine driven boiler feed pump in power plants of 500 to 800 megawatts.

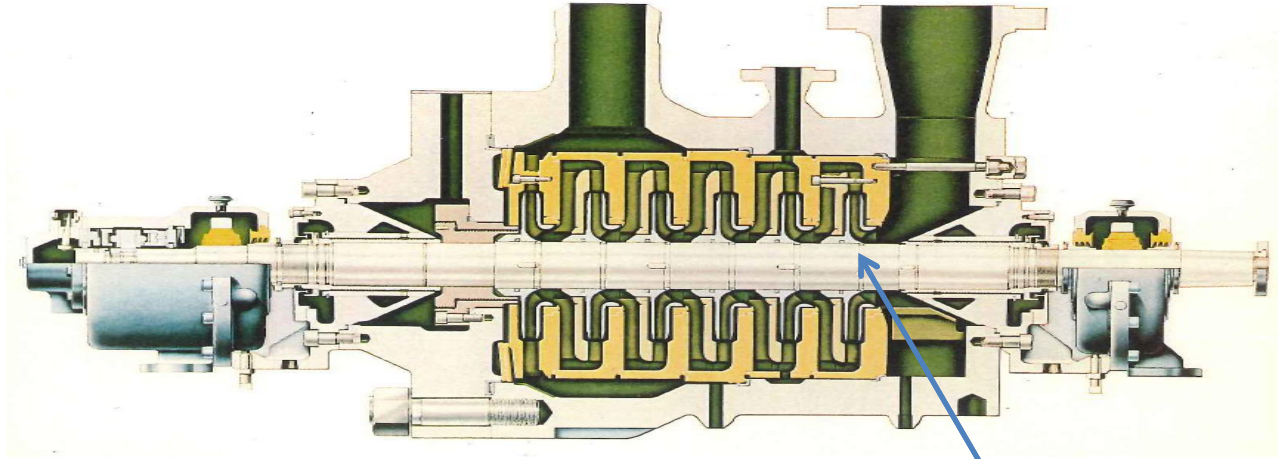
Case Study Outline

- Pump Description
- Background
- Example of the damage observed
- Hypothesis of the root cause of the damage
- Incorporating a “profiled” key to eliminate the damage
- Conclusions

Pump Description

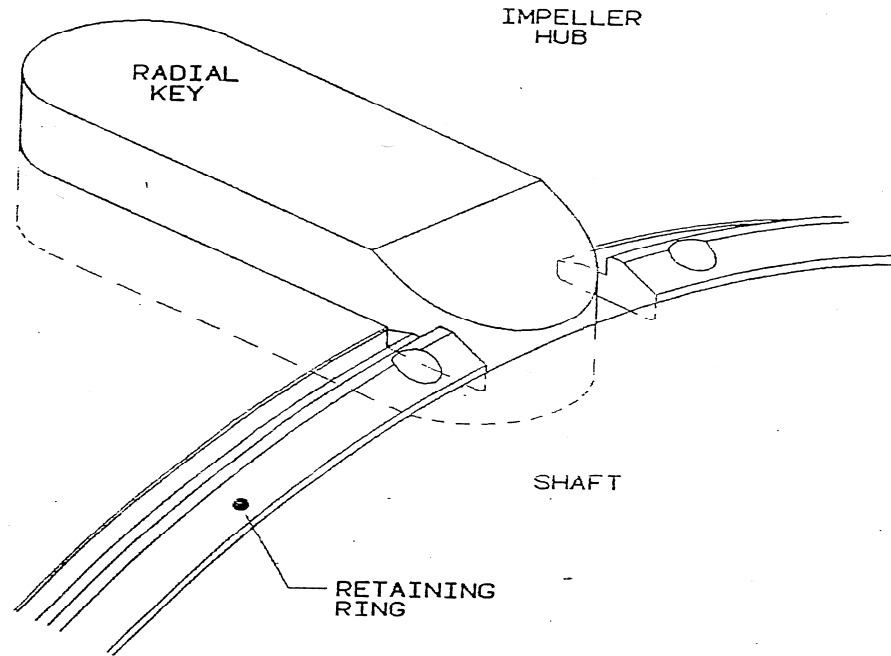
- Speed: 5850 RPM
- Capacity: 5300 GPM
- Total Developed Head: 11,685 FT.
- Temperature: 374 degrees F
- Suction Pressure: 320 PSIA
- Discharge Pressure: 4760 PSIA

Boiler Feed Pump Showing the Location of the Retaining Rings



Retaining
Ring
Location,
Typical

Retaining Ring and Key Area Which Locates the Impeller Relative to the Shaft



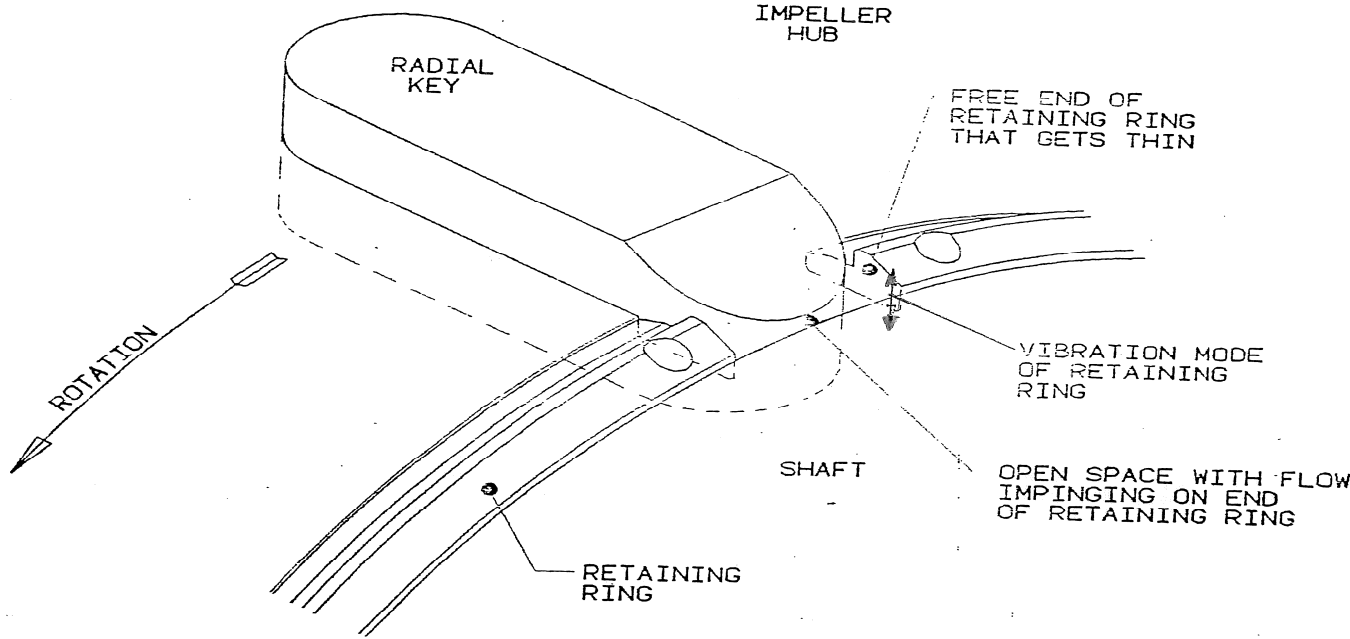
Wear Type Damage to the Retaining Ring



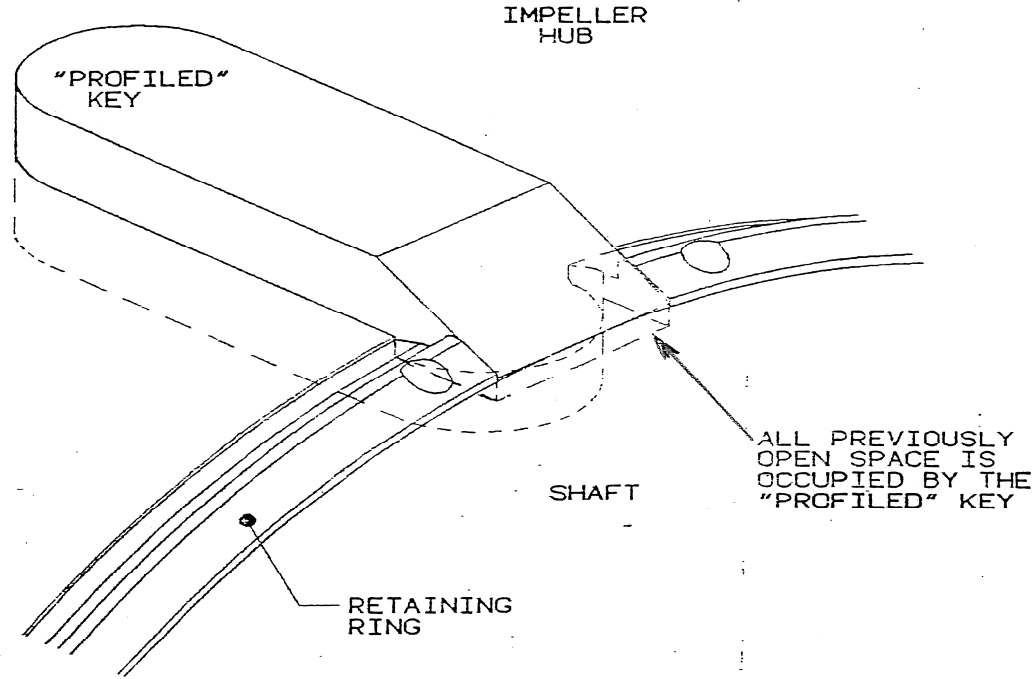
Wear Type Damage to the Impeller due to the Retaining Ring



Retaining Ring and Key Area Showing the Potential For Retaining Ring Vibration



Retaining Ring and Key Area After the Key is Replaced With a "Profiled" Key



The new “profiled” Key and Ring



Conclusions

- Using the “profiled” key eliminated the wear and breakage of the retaining rings.