ROTATING MACHINERY SERVICES, INC.

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THE FINISH LINE

PHONE 484-821-0702 FAX 484-821-0710 WWW.ROTATINGMACHINERY.COM

POWER RECOVERY TRAIN (PRT) ROUND TABLE

Rotating Machinery Services will be hosting a Power Recovery Train Round Table tentatively scheduled for October 29 and October 30, 2013.

The FCC Expander Discussion Group is geared towards expander end users and is headed by a moderator supported by 3 to 4 experts from key Expander manufacturers. Various topics addressing the operation, maintenance and technology of FCC Expanders are discussed. This forum allows the end users to pose questions to the experts and share problems and experiences they have encountered with other end users. A general overview of topics to be discussed are:

- Process and PRT Overview
- Expander Reliability Overview
- Axial Compressor Theory of Operation
- Motor / Generator and Steam Turbine Overview
- Field Service / Technical Advisor Support during outage

More details will be announced soon and will also be listed on our website at www.RotatingMachinery.com.

EXPANDER CONTRACTS

By Don Shafer

RMS has recently seen a dramatic increase in their FCC Expander business and has a shop full of expander components. The work scopes range from emergency breakdown support, requiring expedited support internally and from our suppliers, along with the installation of RMS supplied new upgraded components. The new RMS components to be installed include a replacement Integral Stator Shroud and a set of Low Erosion Rotor Blades. Another unit's Intake Casing Assembly and Rotor, Bearing and Seal Assembly was sent to RMS for complete Phase I inspections and reports. This will be used in the development of the repair work scopes. The Phase I inspection contract was repeat business for a unit that RMS had previously overhauled and was removed from service last fall. The unit had just completed a successful six year operating campaign. RMS has also recently been awarded contracts to supply replacement Ex38 and Ex48 Rotor Discs to replace existing retired components.

The increase in the FCC Expander Business is due to the "staffing and experience" we have put into place to meet our customers needs. This is a positive trend for RMS and demonstrates our customer's confidence in our FCC Expander expertise and our ability to perform under challenging deadlines.

What's Inside

BACK COVER—
Today In America With Terry Bradshaw Features RMS, Inc.
Airing dates, times and Video posted on our website at www.RotatingMachinery.com

RMS IMPORTANT NUMBERS

MAIN OFFICE:
484-821-0702 (O)
rms@rotatingmachinery.com

HOUSTON SALES OFFICE:
Kurt Diekroeger
281-340-8520 (O)
713-898-1015 (C)

TENNESSEE SALES OFFICE:
Mike Spangler
865-981-9831 (O)
484-896-8438 (C)

LOUISIANA SALES OFFICE:
Remus Creel
225-291-4974 (O)
225-939-4680 (C)

RULES OF THUMB - TURBOMACHINERY

By Neal Wikert

Labyrinth Seals

Clearance is a strong factor in labyrinth seal performance. Most calculation techniques assume leakage is proportional to clearance cubed. That is, if you double your clearance your leakage will go up by a factor of 8!

A good rule of thumb for labyrinth seals is to set the radial seal clearance at .001" per inch of shaft diameter for spring-backed seals. Also set a minimum radial clearance at 1½ times the bearing clearance to avoid rotor dynamic problems.

Labyrinth seals can be subjected to a pressure differential of 4-6 times that of a carbon ring seal with no shaft speed limitation. Carbon ring seals are generally limited to a fifteen (15) pound drop across the seal and to a shaft speed of less than 200 feet per second.

A stepped labyrinth can reduce leakage by up to 30 % over a straight labyrinth.

Labyrinth seals in steam turbines cannot be made from aluminum, as the steam will attack the aluminum. Labyrinth seals in the bearing housings are often made from aluminum.

Labyrinth seals in an ammonia service plant cannot be made from bronze material.

STEAM TURBINES

By Sydney Gross

Turbine supports are the method of anchoring and fastening the turbine to the base-plate or foundation in relative location to the coupled equipment and the external connections. Since most turbines operate at high temperatures, the casing and rotor expand thermally in both the axial and radial directions. Therefore, any method of support must accommodate this growth in a controlled way to prevent high casing stresses, bolting failure, misalignment and internal rubs. Although the arrangements presented here are common, there are many different schemes favored by the various manufacturers that achieve the same purposes.

To accommodate axial growth, the turbine case support is fixed at one end and allowed to float at the other end support. Since a turbine's exhaust piping is larger than its inlet piping, it is easier to accommodate the movement on the inlet end and fix the exhaust end.

However, when fixing the axial position of the exhaust end, one must take into account the radial growth of the casing. For this reason, guide keys are most commonly used to maintain position and alignment. A typical condensing arrangement is shown in Figure 1. (Shown on Pg. 3) Often the transverse keys may be substituted with flexible supports which allow little resistance to forces in the transverse direction. Back-pressure turbines operate with significantly higher exhaust temperatures and the exhaust casing is normally insulated. For that reason, the support and the bearing housing are usually located away from the casing as shown in Figure 2. (Shown on Pg. 3)

The inlet end support must take into account the same design considerations as the exhaust except that it needs to float axially. Due to the high temperature of the inlet, the bearing standard is located apart from the inlet casing as in the case of a non-condensing exhaust.

STEAM TURBINES *Con't*

By Sydney Gross

The most common design uses flexible supports, often called wobble feet, under the bearing standard for vertical support while allowing axial movement. Key arrangements maintaining radial alignment are similar to the exhaust end. Figure 3 (Shown below) shows a typical arrangement.

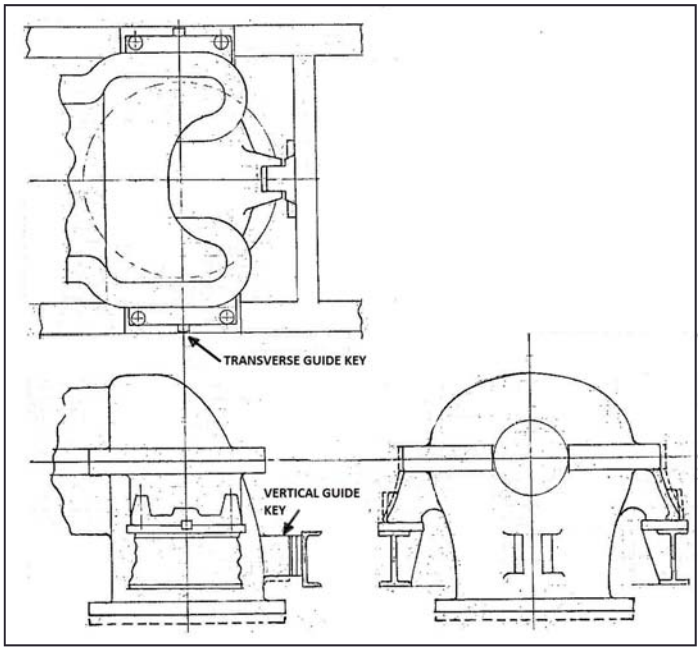


FIGURE 1—Condensing Turbine Exhaust End Support

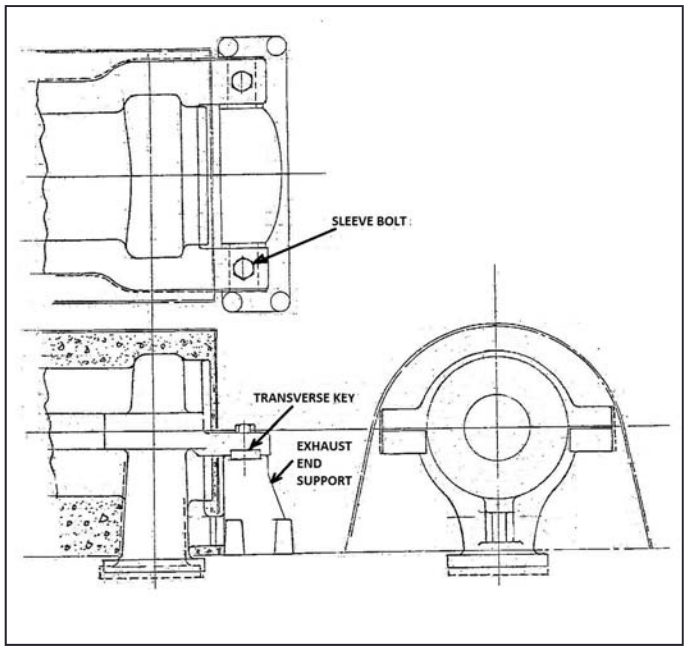


FIGURE 2—Back Pressure Turbine Exhaust End Support

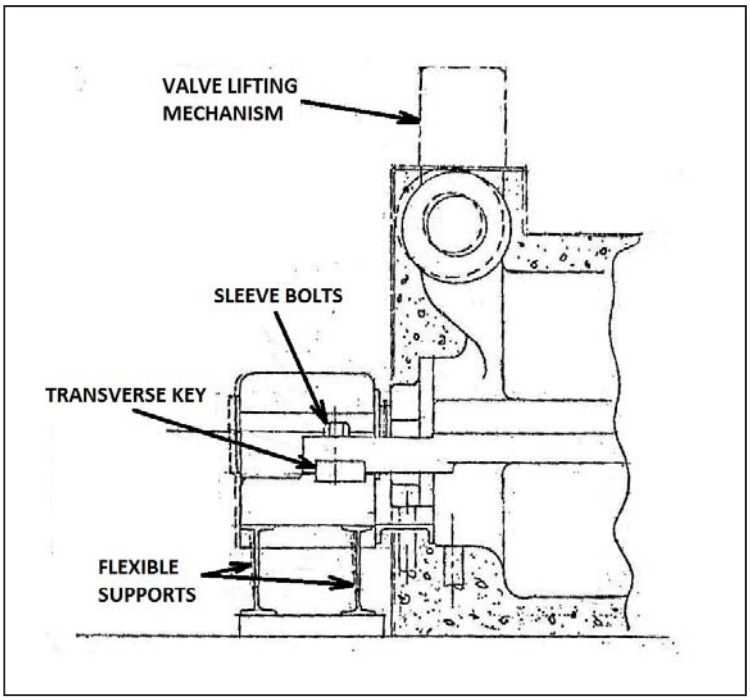


FIGURE 3—Turbine Inlet End Support

RECENT COMPRESSOR ROTOR OVERHAULS

By Marc Rubino

Within the past two years, RMS has been involved in several inspections and overhauls of Ingersoll-Rand MTA-5124 centrifugal compressor rotors. This article serves as a brief description of this notable equipment. These units are multi-stage uncooled, single flow centrifugal air blowers and are usually driven by steam turbines. The typical application of MTA-5124 rotors RMS has overhauled is for blast furnace air blowers at steel mills. These large blowers provide a constant source of air needed for combustion during the smelting process (extracting iron from its ore) within blast furnaces. The MTA-5124 was designed to deliver over 113,000 SCFM of air at 35 PSIG.

The inspection and repair of these rotors is no easy task as they are bulky assemblies. The largest impeller diameter is approximately 65", the overall rotor length is nearly 13 feet, and the estimated weight is 19,000 lbs. Regardless, RMS possesses the shop capability to refurbish these rotors for continued service.

The typical inspection scope includes abrasive cleaning, recording as-assembled dimensions and runouts, de-stacking the entire assembly, non-destructive and visual examination of each rotor component, and an evaluation of shrink fits of impellers, sleeves, and the balance piston. The rotor parts mate to support rings in their bores and the rings themselves rest on the shaft. So the interference of parts to the shaft is achieved by the thickness of the rings. These rings are often replaced due to deformation from the shrink fits and / or shearing via thermal ratcheting—the tendency for parts to move axially on a rotor due to thermal growth.

The bores of the impellers, sleeves, and balance piston are evaluated for roundness and concentricity. If determined unacceptable, the bores are reworked via machining to reestablish concentricity. Another typical repair to these rotors is re-riveting the impeller blades. Rivets that warrant replacement include rivets with eroded, cracked, or voided heads. RMS also has encountered these rotors with riveted impellers replaced with fabricated impellers. Once all repairs are completed, the rotor is reassembled and balanced to RMS and API 687 criteria.

PROJECT MANAGEMENT

By Dirk Paraschos

After a fast pace activity level to finish out the end of 2012, the start of the New Year looks to be just as exciting and challenging. Part of our growing process is the ability to meet the needs of all our projects and at the same time be able to respond to customer's emergency breakdown repairs.

In response to this growth, RMS has staffed up its Project Management group. The project procedures have been reviewed and modified where necessary to meet the variety of equipment we service and our customer needs. The success of any project is communication and commitment to meet established milestones.

QUALITY CONTROL

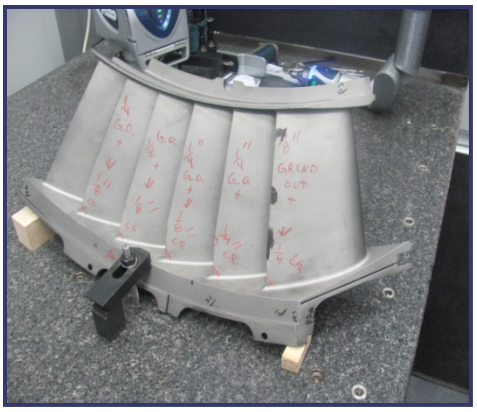
By Robert Dehart ASQ CQT

Spring 2013 arrives at RMS. A change in the weather is sufficient to recreate the world and ourselves.

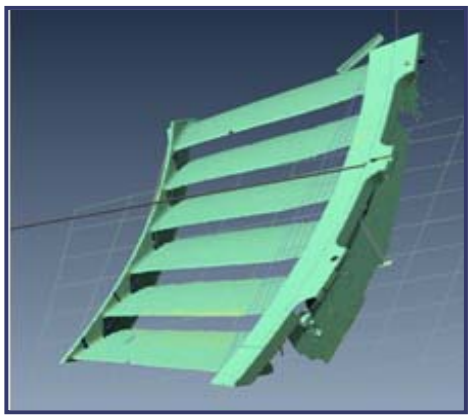
In the spirit of recreation, RMS has added a laser line scanner to its inventory of measuring instruments. The laser attaches neatly onto the wrist of the Faro portable co-ordinate measuring machine. It is capable of collecting data at very high rate, 45,120 points per second with an accuracy of +/- .0014".

The laser can be used to inspect parts by comparing them to a CAD model, or, if no CAD model is available, recreate the parts by reverse engineering. As the laser moves over the part, the modeling software produces an accurate 3D representation of the object. Laser scanning generates thousands of data points that create what is known as a point cloud. The point cloud is essentially a raw 3D image of the part. The digitizing process is simple. You start with the physical model, scan it then automatically generate perfect continuous surfaces and watertight models. Advanced editing tools let you further refine the model.

Conducting engineering analysis such as computational fluid dynamics or finite element analysis on CAD models does not always tell the whole story. By capturing and creating a model of the as built product, we will be able to assess true performance characteristics that we can compare to the theoretical analysis performed on the perfect CAD model. After the entire part has been completely scanned, data can be quickly turned into polygonal meshes useful for part reproduction and rapid prototyping or modeled into full nurbs surfaces for CNC operations and general manufacturing. Bringing our physical parts into the digital world opens a new realm of possibilities.



Physical Part



Laser Point Cloud

RMS IN THE COMMUNITY

By Frank Marrone, Jr.

RMS was invited by the Lehigh Valley Executive forum to participate in the 3rd annual Enduro cart race to benefit the American Red Cross of the greater Lehigh Valley "Heros for the American Red Cross" campaign .

We were able to raise $1300.00 in sponsorship donations ,which was the 3rd highest total in less than two weeks as a result of generous donations by RMS suppliers. Overall the Executive forum had achieved record donations for this year's event.

The race was very exciting and involved 12 teams from local businesses. The format was a 3 hour Enduro, that included 6 drivers form each team with 12 driver changes, as well as one fuel/cart transfer. The Team consisted on Joe Kovacs, Frank Marrone, Bob Klova, Chot Smith, Tony Rubino, and Sydney Gross.

RMS ended up finishing in 10th place but had a blast participating for this important cause.

We would like to extend our appreciation and a thank the following suppliers for their support.

- Donation Made in "Memory of Lois Prettiman"
- Tooling Specialist Inc.
- Ted Prettiman
- Pacesetters Enterprises Inc.
- Beaver Tool and Machine
- HEI precision Machined Parts
- BWC

A LOSS AT ROTATING MACHINERY SERVICES

By Barry Ruch

It is with a deep sadness and regret that I announce the loss of one our employees Richard Pittenger.

Rich passed away suddenly at his home the evening of January 22, 2013 at the early age of forty-seven. Richard was a true 'family member' to everyone here at our organization. As a person, Rich was always there when a favor was needed. He was instrumental in developing our SolidWorks program, along with numerous standard practices which we work to on a daily basis. He was always obliging to put in the extra hours in order to meet the required dates to keep projects on schedule.

I personally have worked with Rich since the early 1980's, and have known Rich for the kind hearted generous person he was. He helped older neighbors by doing yard work whether it be mowing their lawns, raking their leaves, or taking on intensive landscaping.

He took great pride in remodeling his home, which reflected his pride in himself that he always presented and that we all knew. He will be missed and always remain in our hearts.

NEW EMPLOYEES AT RMS

By Kathy Ehasz

JOAN BERG - PROJECT MANAGER

Joan Berg joins us with a combined 24 years of experience in Engineering and Business ownership. Joan holds a B.S. in Mechanical Engineering from Penn State University and a MBA from Butler University. She has held previous positions at VBW, Inc. (owner), JB Consultants (owner), Johnson Controls - Building Services Energy Engineer, General Motors - Prototype Project Engineer and General Electric Astro Space Division - Electronics Packaging Design Engineer.

Joan has experience in designing and managing the installation of energy reduction retrofits in the industrial and hospital markets; managing the quality programs for prototype headlamps and bumpers for GM vehicles and the design of electronic housing for satellites.

JIM CAMPANA - SENIOR APPLICATIONS ENGINEER

Jim brings thirty-one years combined applications and sales experience in multiple industries and products. He previously held positions with Ingersoll Rand, Magnetic Bearings, Inc., CONMEC and Ecolaire/SPX Heat Transfer and an owner of two companies in the converting industry.

Jim will be responsible for quotations and marketing in support of sales and product engineering efforts.

SCOTT MACFARLANE - DESIGN ENGINEER

Scott graduated from West Virginia University with a B.S. in Mechanical Engineering and a B.S. in Aerospace Engineering in May 2010. Prior to joining RMS, he held a position at Jerr-Dan Corporation as Design Engineer and Application Engineer for over 2 years. Scott looks forward to continuing his career at RMS within the turbomachinery field as a Design Engineer.

STEVE RISSMILLER - CAD DESIGNER

Steve joins RMS as a CAD Designer. He previously held positions at Effort Foundry in Bath, PA in the sales department and Laird Technologies in Delaware Water Gap, PA for over 15 years where he was a production supervisor/programmer. He continued to further his education in the drafting field in both AutoCAD and SolidWorks. He looks forward in continuing his growth with RMS.

SCOTT DEFIORE - ASSEMBLER

Scott DeFiore joins the RMS team with 21 years turbomachinery experience. He previously held positions as a welder assembler with CONMEC for 18 years and most recently, G.J. Oliver as a console assembler. Scott is no stranger to the business and has worked with many of the RMS personnel in the past and looks forward to working with them again.

GARY SUTTER - ASSEMBLER

Gary Sutter joins the RMS team with over 23 years experience in the turbomachinery industry. He previously held positions at CONMEC performing Steam Turbine blading, compressor and expander assembly for 20 years, BWC Technologies performing rotor assembly and balancing and most recently G.J. Oliver, Inc. assembling consoles and lube oil systems.

Rotating Machinery Services, Inc.

2760 Baglyos Circle
Bethlehem, PA 18020
Phone: 484-821-0702 / Fax: 484-821-0710
www.RotatingMachinery.com

PRODUCT LINES:

AXIAL COMPRESSORS • CENTRIFUGAL COMPRESSORS • EXPANDERS • GAS TURBINES • POWER TURBINES •

News Release from Today in America with Terry Bradshaw - 3/28/2013

March 28, 2013, Coral Springs, FL – The Producers of Today in America with Terry Bradshaw are pleased to announce that Rotating Machinery Services, Inc. will be featured in an upcoming segment on topics, trends, and issues related to "Meeting the Engineering Challenges of Today's Industries" as part of the show's "American Industry" series.

Rotating Machinery Services is an aftermarket engineering and services company located in Bethlehem, Pennsylvania. Experience in axial and centrifugal compressors, expanders, and gas, power, and steam turbines, RMS performs a wide range of services on turbomachinery, including reliability improvements, performance optimization, repair, component replacement, and supply of upgraded or overhauled surplus equipment. The company also has experience with repowering turbomachinery packages, as well as providing custom-designed equipment skids and lube oil systems.

Today in America with Terry Bradshaw combs the nation and the globe to bring viewers fascinating business stories and firsthand insights from entrepreneurs within various industries. The television show is broadcast nationally and regionally on many popular television networks. The show's host, Terry Bradshaw, is considered by many to be one of the greatest quarterbacks of the NFL. Since retiring from the gridiron in 1984, Terry has remained a familiar face to television audiences. After ten years with CBS as a Color Commentator, Bradshaw joined Fox Sports in 1994, where he remains today as one of the co-hosts of and analysts for Fox NFL Sunday.

For more information on Rotating Machinery Services, Inc., please visit www.rotatingmachinery.com.