Volume 11, Issue 2

THE INSPECTOR

Fall 2004 Issue

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By: Don Mathes:

Old Locomotives, Old Inspectors and Old Friends

The Fall 2004 Seminar will focus on historical boilers and locomotives. We don't have many Inspectors around who can relate directly to riding on a steam locomotive but there are probably a few and we may get the chance to do just that at the Fall meeting since it is being held at the Thresheree.

The upcoming seminar will also focus on changes in the State requirements for ongoing education for Boiler Inspectors with presentations being put on by Mike Verhagen and Rick Merkle. This meeting will be everyone's chance to express their views and have input into these requirements before they go into effect sometime during 2005.

I would like to thank the Fall Committee members and the personnel involved with the Thresheree for putting together the seminar at the Thresheree facility. The presentations being given regarding historical boilers will help us to better understand what our predecessors had to deal with when building these fantastic machines.

While we don't have any Inspectors around that were involved in the origins of these spectacular pieces of engineering we do have a lot of "senior" Inspectors at the meeting willing to tell you stories from "back in the day".

So once again I invite all of you to attend the upcoming WBIA meeting in October to see the old locomotives, talk with the old Inspectors, and chat with old friends

FALL SEMINAR

DATE: OCTOBER 13, 2004

TIME: 0800-1600

LOCATION:

Rock River Thresheree, Inc.
51 East Cox Road
Edgerton, WI 53534

COST: $25.00 Includes lunch.

For more information and directions check out our insert in this newsletter.

The Chief's Words:

By: Mike Verhagen, Chief Boiler Inspector

Wisconsin
Department of Commerce

Greetings to all. I can't believe another WBIA meeting is upon us but have had a busy summer riding the bike, attending Summer-fest, Irish-fest and the NBIC meeting which was held August 16-19 in Milwaukee. I visited family and friends including my sons house warming bash. Didn't get to painting my house or yard work but there's just too much to do and so little time.

Our Commerce website was changed. Navigation is a little different now but the flow is faster and easier to access. The address was shortened from www.commerce.state.wi.us to www.commerce.wi.gov but users can get to the site with either address at this time. If you saved the old address as favorite on your computer, be sure to update.

Talking about website changes, check out the new look for the National Board website @ www.nationalboard.org All previous NB info is on the new site but may take awhile to get familiar with the new arrangement. It has a new INSPECTORS' CORNER … so check it out.

As an educational tool, Safety and Buildings has added a few more program **brochures** to our website. Recall from last time, the new Boiler and Pressure Vessel brochure was made available for distribution. We have since added a Gas Systems & Anhydrous Ammonia and Historical-Hobby Boiler brochure for access from our website. These brochures were designed for our customers to obtain a quick snapshot of rules and requirements and provide all inspectors with a quick one-page document for answering client questions. Each is available under its respective program on our Safety and Buildings website. A Mechanical Refrigeration brochure is presently under development, so watch for it in the months to come.

Comm 5, Credential changes have been completed and effective August 1, 2004. Renewal of your boiler inspector certification in Wisconsin will now cost $ 120.00 for a four- (4) year term. See Comm 5, Table 5.02, item # 28 for Fee and Table 5.06, item # 28 for term. Please make your home office aware of these changes. Is your credential current? Check expiration online or call @ 608-261-8500.

At our the upcoming WBIA meeting, Rick Merkle plans to provide more detail on the topic of boiler inspector "continuing education" and "electronic data interface - EDI" which appears to be going great for both the state and companies involved. State inspectors will get a taste of the EDI pie soon.

With regrets, Steve Cobian recently resigned from his position as Wisconsin's District # 3 inspector but Mark Rudek, Damarc Quality Inspection Services, LLC has entered into a state contract to cover the vacant district. Damarc will be responsible for assignments from Madison which include Marquette, Columbia, Dane and Green county inspections.

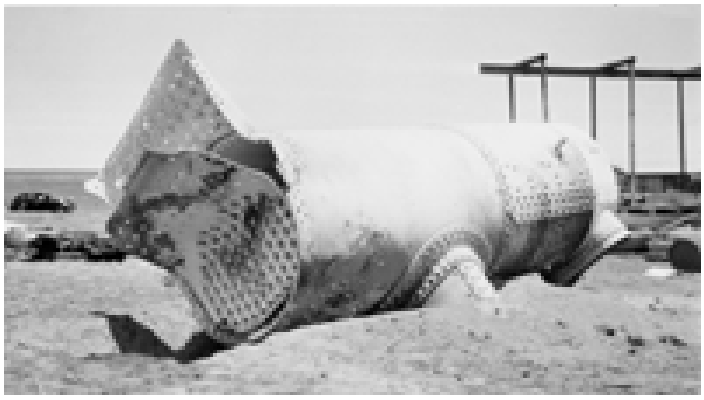
My office hours are Monday –Friday, 7:45 to 4:30 PM and always available to answer questions via telephone, email or regular US mail. When out of the office, you may contact Section Supervisor, Rick Merkle @ 608-266-3037 / umerkle@commerce.state.wi.us or Program Manager, Joe Hertel @ 608-266-5649 / jhertel@commerce.state.wi.us in Madison.

Please plan to attend our fall meeting and Thanks for your cooperation this past year. Looking forward to seeing everyone in a few weeks at the Rock River Thresheree in Edgerton, WI.

Advance Boiler & Tank Co., LLC

6600 W. Washington St.
West Allis, WI 53214
475-3120 Fax:475-3129

SINCE 1919



Boiler Accident Photo

DID YOU KNOW!!!

Did you know that one pound of water at 212 degrees Fahrenheit and at atmospheric pressure occupies 17,000ths of one square foot? When that pound of water is converted to steam under the same condition, it occupies 27 cubic feet. That's almost 1600 times in volume. You can imagine that sudden release of energy.

Did you know that 100 gallons of water at 100 pounds per square inch gauged pressure if released to atmosphere generates seven million horsepower?

Do you know that jet fighters -- jet fighter aircraft on aircraft carriers -- are launched by steam-powered catapults? Did you know that these jets weigh approximately 60,000 pounds when fully fueled and armed? Did you know that when the catapult is released, the same jet travels from zero miles per hour to165 miles per hour in two seconds?

Did you know that a 500-horsepower high-pressure fire-tubed boiler contains about 2300 gallons of water? Did you know that the operating weight of this boiler is around 60,000 pounds?

Retirees

Anyone knowing of inspectors retiring please inform us so we can get their names in this Newsletter.

Advertising in the Inspector

To defray the cost of publishing "The Inspector" we will be accepting your advertisements. "The Inspector" is published twice a year and reaches boiler operators, Commissioned Inspectors, manufacturers, and many more. "The Inspector" is read by people in a 4 State area. These include Wisconsin, Minnesota, Iowa and Illinois.

Please help us reach more people, Advertise in "The Inspector".

Please contact a board member today to get registered or you can reach the WBIA Secretary at keenan@lakeland.ws.

WBIA Helps You Meet Your Training Needs

The Wisconsin Boiler Inspector's Association is offering training classes/seminars.

If you are interested in setting up boiler & pressure vessel training during the year let the WBIA know and we will tailor training to meet your needs. Certificates issued for all training hours. Contact Matt Keenan, Secretary @ 715-648-5506.

Test Your Knowledge

Question:

Where would you find out what standards have been adopted by the State of Wisconsin?

Answers on page 7:

Steam Timeline

Almost two thousand years ago, Hero (actually Heron) of Alexandria invented the first steam turbine, called the aeolipile, a hollow sphere supported on two brackets on the lid of a basin of boiling water. One bracket was hollow and conducted steam. The steam escaped from two bent pipes on the top, therefore creating a force that made it spin around. The movement of the ball was used to make puppets dance. Hero's aeolipile illustrated the scientific principle of Sir Isaac Newton's third law of motion which states that for every action there is an equal and opposite reaction.

1675: A Jesuit priest living in China reportedly develops a vehicle that is propelled by a form of steam turbine.

1660: Sir Isaac Newton proposes that a jet of steam could be used to power a carriage, an idea now considered to be a precursor to development of the jet engine.

1690: Denis Papin describes an apparatus in which the condensation of steam in a cylinder creates a vacuum. His simple steam engine is called the Papin Cylinder.

1698: Denis Papin develops the first piston that is moved by the pressure of steam rather than atmospheric pressure.

1698: Thomas Savery patents "the Miner's Friend," a machine that pumps water from coal mines. It becomes the first practical machine powered by steam. He later publishes a description of his steam engine in 1702. In 1707, Denis Papin modifies Savery's high-pressure steam pump.

1712: Thomas Newcomen, in collaboration with Thomas Savery, builds the first practical steam engine to use a piston and cylinder, bringing the steam engine out of the lab. It drives a pump in a mine and produces about 5.5 horsepower.

1753: First steam engine arrives in the colonies from England.

1753: In England, an Act of Parliament forbids steam-engine manufacture outside of the home islands.

1755: First steam engine in America is installed to pump water from a mine.

1759: John Smeaton publishes the results of his research on the performance of windmills. He concludes that windmills cannot compete with the powerful steam engines.

1765: Scottish inventor James Watt patents the separate condenser.

1769-70: French Army officer, Captain Nicolas-Joseph Cugnot builds a steam carriage (a steam-powered military gun tractor). This is considered the first true automobile.

Continued on page 6

Becker Boiler Company, Inc.

1785 E. Bolivar Ave.
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482-2840 Fax: 482-0259

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Old Locomotive Boiler

MILWAUKEE BOILER INTERNATIONAL

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Milwaukee, WI 53215

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PBBS
EQUIPMENT CORPORATION

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Menomonee Falls, WI 53051
(262)252-7575 Fax: (262)781-7576

JAY INDUSTRIAL TECHNOLOGIES GROUP Allied Valve Industries

575 Enterprise Drive
Neenah, WI 54956
Phone # 920/727-1172
Fax # 920/727-0857

BOILERS AND PRESSURE VESSELS

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Future Seminars

The Officers and Board of Directors are looking for ideas for seminars. Please contact an officer or board member and voice your suggestions on future training seminars.

The WBIA wants to ensure that good quality educational seminars are presented.

Thought of the Day

Most folks are about as happy as they make up their minds to be.
--Abraham Lincoln

Steam Timeline

Con't form page 4

1801: Englishman Robert Trevithick demonstrates a steam locomotive.

1803: The Louisiana Purchase allows American flatboats, &c. to operate freely on the Mississippi and Missouri Rivers.

1804: Oliver Evans builds his first steam-powered boat, weight: 4,000 lbs.

1804: Englishman Matthew Murray invents a steam locomotive which runs on timber rails. Is this the first railroad locomotive?

1804: Englishman Richard Trevithick builds 40 psi steam locomotive for the Welsh Penydarran Railroad (after he sees Murray's locomotive).

1807: Robert Fulton's steamboat Clermont was launched and made a run from New York to Albany, a distance of 150 miles.

1811: The first steamboat to descend the Mississippi River was the *New Orleans*. By the 1830s, steam ruled the Mississippi.

1812: The first commercially successful steam locomotives, using a rack and pinion drive, commenced operation on the English Middleton Railway. This was the world's first regular revenue-earning use of steam traction.

1804: The worlds first steam-powered rock-boring machine was built by Harvey's of Hayle, Cornwall, England.

1813: Congress authorizes steam boats to carry mail.

The Plain Cylinder Boiler

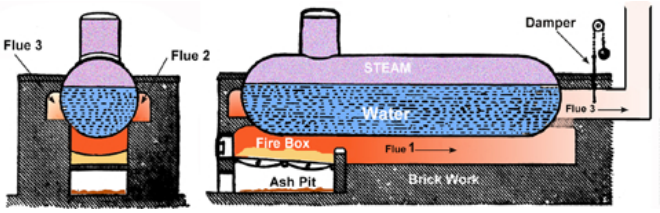
The first real advancement in boiler design came about with the invention of the Plain Cylinder Boiler. It was a simple design and easily constructed.

As its name implies, the Plain Cylinder Boiler is a long metal cylinder with conical (round) ends set horizontally in a brick work. Some of these boilers were 40 feet long. The cylinder was half filled with water and a fire ignited in furnace at one end.

The fire and hot gasses are first channeled from the furnace or **fire box** along the bottom of the cylinder to the opposite end of the boiler. This channel is called a "**flue**" and is made of brick on three sides. The other side of the flue is the metal wall of the boiler. The flames and hot gasses touch the bare metal and heat the water inside the boiler.

When the hot gasses get to the end of the first flue, they are channeled back along one side of the cylinder to the front of the boiler. From there they are again channeled back along the other side of the cylinder to the chimney. This would give a boiler 40 feet long 120 feet of heating surface.

The speed with which the fuel burned was controlled by a **damper** near the chimney. Raising or lowering the damper controlled the draught or amount of air being drawn into the furnace. More air made the fuel burn faster and hotter making more steam. Less air saved fuel and produced less steam.



Although this boiler design was far more efficient than previous boilers, and had been used for more than one-hundred years, it had two major flaws. The first was dirt. Water, especially Mississippi River water, contained dirt and this dirt remained in the boiler after the water evaporated. After a time, this dirt collected in the bottom of the cylinder and acted like an insulator preventing the heat from reaching the water. This means that more fuel had to be burned to get the same amount of steam. It also meant that the boiler had to be cleaned out very often.

The Plain Cylinder Boiler

(con't pg 6)

The second flaw was more dangerous. As the hot gasses traveled along the 120 foot long flue, they cooled somewhat. Not much but enough to cause the metal of the cylinder to be heated to different temperatures on either of the three sides. This uneven heating of the metal caused great stress within the metal which often led to the cylinder exploding

What Is It??

A deadweight safety valves on top of a boiler.

The valve lifting pressure was set by the movement of the weight to the left of the arm. The further the weight from the valve, the higher the pressure in the boiler required to release the excess steam.

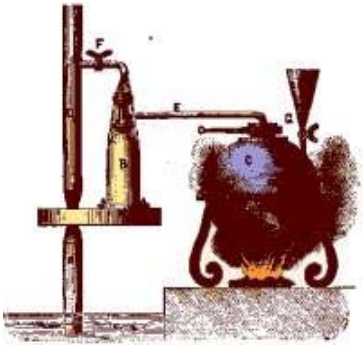
Answer to Question on Page 3:

Comm. 41.10

First Crude Steam Engine

Thomas Savery was an English military engineer and inventor who in 1698, patented the first crude steam engine, based on Denis Papin's Digester or pressure cooker of 1679.

Thomas Savery had been working on solving the problem of pumping water out of coal mines, his machine consisted of a closed vessel filled with water into which steam under pressure was introduced. This forced the water upwards and out of the mine shaft. Then a cold water sprinkler was used to condense the steam. This created a vacuum which sucked more water out of the mine shaft through a bottom valve.



Thomas Savery later worked with Thomas Newcomen on the atmospheric steam engine. Among Savery's other inventions was an odometer for ships, a device that measured distance traveled .

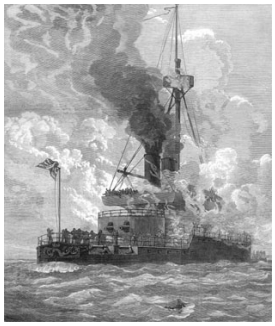
Safety and Buildings Division

Wisconsin's first boiler rules and regulations were implemented around 1914 due to an increase in accidental property damage and fatalities caused by boilers. A public outcry to lawmakers to prevent such incidents caused the birth of rules for safe boiler construction, installation, and operation. Therefore, boiler and pressure vessel inspection today is not a new process. Inspection and subsequent registration began decades ago to protect everyone.

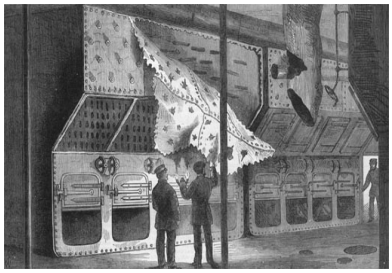
State statute Section 101.17 gives authority to the Department of Commerce, Safety & Buildings Division, to promulgate rules to protect the health, safety and welfare of the public.

HMS THUNDERER
Boiler Explosion

The most disastrous accidental boiler explosion in the annals of the Royal Navy occurred in the battleship Thunderer on 14 July 1876, and it led to the death of more than 40 persons. The Thunderer, the sister of the turret ship Devastation, had been supplied with eight rectangular box boilers, arranged in two stokeholds, constructed by Humphrys, Tennant and Company for a working pressure of 30 lb. per square inch. On the day of the accident, the ship proceeded out of Portsmouth Harbour to Stokes Bay to carry out a full-power trial. Many officials were on board to watch the trials, and the ship was just being put on her course, when without any warning, the upper part of the front of the starboard forward boiler was blown out and the stokeholds and engine rooms were immediately filled with the release of steam. The explosion killed fifteen men instantly, including her commanding officer, who was in the engine room at the time, and seriously wounded seventy others, thirty of whom subsequently died of their injuries. Owing to the extraordinary nature of the explosion, the inquiry that followed was very thorough, and many eminent engineers gave evidence. The reasons for the explosion, however, were not far to seek, and they had nothing to do with construction or condition of the boilers. It was show conclusively that no one had opened the stop valves, and that the pressure gauge, having been found out of order, had been shut off, while examination and experiments with the safety valves in the shop left no doubt that they had become inoperative having seized in their seats through corrosion. The safety valves were of the dead-weight type, and while the valves and seatings were of brass, the safety-valve box was a large iron casting. Had the stop valves been open, or the safety valves been in working order, the accident could not have occurred, while if the pressure gauge had been in use, attention doubtless would have been called to the undue rise in pressure. As it was, no one could say at what pressure the boiler gave way.



The Thunderer, which was launched in 1872 and completed in 1876, was the last capital ship in the Navy to have rectangular boilers. Whilst such boilers had proved satisfactory for steam pressures up to 30 lb. per square inch cylindrical boilers were required for higher pressures required for higher powers. There had been some reluctance to adopt higher steam pressures for fears of the consequences of an accident but, since this explosion showed that even low pressure steam could be lethal, it seems to have been argued that high pressure steam would be no worse. The accident also brought about the introduction of the spring-loaded safety valve, with an alarm whistle fitted which blew when the pressure reached a few lb. per square inch above the set pressure of the main valve; it was also arranged that safety valve easing gear could be worked from the deck above the boilers.



"The inquest held by the local Coroner, at Haslar hospital upon the death of the forty-five men killed by the explosion of a steam-boiler on board HMS. 'Thunderer', at Portsmouth, on July 14th, 1876, has been proceeding many days. One of the most valuable witnesses was Mr. F. J. Bramwell, the engineer appointed by the Lords of the Admiralty to examine the engines and boilers of the ship. His examination occupied three entire days of last week He ascribed the explosion simply to an excessive pressure of steam caused by the accidental sticking-fast of a safety valve, and he felt convinced that the valve had not been tampered with. The starboard forward boiler had exploded, blowing away nearly the whole of the top front plate. This plate was about 15ft. long and 4ft. 3 in. deep. It was broken into two pieces. The top plate of the boiler was bent upwards in front. There had been three wrought-iron columns, or stanchions, each eight inches in diameter, supporting beams over the stoke-hole and in the deck above. The after stanchion was broken through at the level of the stoke-hole plates, and again ten or eleven feet above them. The second was much bent, and the third was considerably indented."

Early Steam Powered Cars

Several Italians recorded designs for wind driven vehicles. The first was Guido da Vigevano in 1335. It was a windmill type drive to gears and thus to wheels. Vaturio designed a similar vehicle which was also never built. Later Leonardo da Vinci designed a clockwork driven tricycle with tiller steering and a differential mechanism between the rear wheels.

A Catholic priest named Father Ferdinand Verbiest has been said to have built a steam powered vehicle for the Chinese Emporer Chien Lung in about 1678. There is no information about the vehicle, only the event. Since James Watt didn't invent the steam engine until 1705 we can guess that this was possibly a model vehicle powered by a mechanism like Hero's steam engine, a spining wheel with jets on the periphery.

The first vehicle to move under its own power for which there is a record was designed by Nicholas Joseph Cugnot and constructed by M. Brezin in 1769. A replica of this vehicle is on display at the *Conservatoire des Arts et Metiers*, in Paris. The Smithsonian Museum in Washington D. C. also has a large (half size) scale model. A second unit was built in 1770 which weighed 8000 pounds and had a top speed on 2 miles per hour and on the cobble stone streets of Paris this was probably as fast as anyone wanted to go it. The picture shows the first model on its first drive around Paris where it hit and knocked down a stone wall. It also had a tendency to tip over front wards unless it was counterweighted with a canon in the rear. the purpose of the vehicle was to haul canons around town.

The early steam powered vehicles were so heavy that they were only practical on a perfectly flat surface as strong as iron. A road thus made out of iron rails became the norm for the next hundred and twenty five years. The vehicles got bigger and heavier and more powerful and as such they were eventually capable of pulling a train of many cars filled with freight and passengers.

Many attempts were being made in England by the 1830's to develop a practical vehicle that didn't need rails. A series of accidents and propaganda from the established railroads caused a flurry of restrictive legislation to be passed and the development of the automobile bypassed England. Several commercial vehicles were built but they were more like trains without tracks.

The development of the internal combustion engine had to wait until a fuel was available to combust internally. Gunpowder was tried but didn't work out. Gunpowder carburetors are still hard to find. The first gas really did use gas.

They used coal gas generated by heating coal in a pressure vessel or boiler. A Frenchman named Etienne Lenoir patented the first practical gas engine in Paris in 1860 and drove a car based on the design from Paris to Joinville in 1862. His one-half horse power engine had a bore of 5 inches and a 24 inch stroke. It was big and heavy and turned 100 rpm. Lenoir died broke in 1900.

Lenoir had a separate mechanism to compress the gas before combustion. In 1862, Alphonse Bear de Rochas figured out how to compress the gas in the same cylinder in which it was to burn, which is the way we still do it. This process of bringing the gas into the cylinder, compressing it, combusting the compressed mixture, then exhausting it is know as the Otto cycle, or four cycle engine. Lenoir claimed to have run the car on benzene and his drawings show an electric spark ignition. If so, then his vehicle was the first to run on petroleum based fuel, or petrol, or what we call gas, short for gasoline.

Siegfried Marcus, of Mecklenburg, built a can in 1868 and showed one at the Vienna Exhibition of 1873. His later car was called the *Strassenwagen* had about 3/4 horse power at 500 rpm. It ran on crude wooden wheels with iron rims and stopped by pressing wooden blocks against the iron rims, but it had a clutch, a differential and a magneto ignition. One of the four cars which Marcus built is in the Vienna Technical Museum and can still be driven under its own power.

In 1876, Nokolaus Otto patented the Otto cycle engine, de Rochas had neglected to do so, and this later became the basis for Daimler and Benz breaking the Otto patent by claiming prior art from de Rochas.

Old Engraving depicting the 1771 crash of Nicolas Joseph Cugnot's steam-powered car into a stone wall.