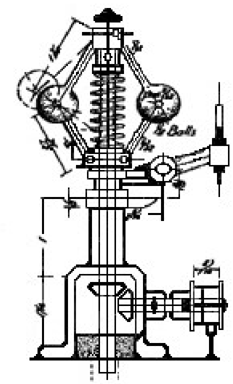

The NEMES Gazette

NEW ENGLAND MODEL ENGINEERING SOCIETY INC.

No 254 August 2017

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August Program

The August NEMES program will be held at 7 PM on Thursday, August 3, 2017, in the Jackson Room of the Charles River Museum of Industry and Innovation.

The meeting agenda will be:

Members exhibiting interesting projects, recent acquisition, questions for the membership, etc.

The Main Program will be a video describing the building of a Challenger V8 engine. The project took two years to complete, and utilizes various CNC techniques. The video will be followed by excerpts from Garry Conleley's shop tour.

Your comments on the various machining techniques used will be encouraged.

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Club Business

Rich Baker

Online Store. The NEMES Online Store is now live, and you can order NEMES apparel and pay your dues from the comfort of your living room. The link is available on the www.neme-s.org.

NEMES Apparel. We have NEMES denim button down shirts, t-shirts, and sweatshirts for sale. The denim shirts $35, sweatshirts $25, and the t-shirts $15. Order online or contact Rich Baker at 978-257-4101 if you would like to order one.

NEMES Membership List. Our mailing and email lists are only as good as the information we are given. Please let us know if you move or change email addresses. If you know anyone who has moved, let us know the new contact information.

President's Corner
Dan Erying

STEAM (Science and Tevhnology Engineering Arts Math)

Just a short note this month, as I am going RV camping tomorrow and would like to get something to Bob Timmerman before my wife and I hit the road.

Today I repped for both NEMES and the Charles River Museum at the Newton Library's "STEAM Expo'. It's an event aimed at inspiring kids to be interested in technology. I took a box full of antique technology which the Museum takes around to grammar school classroom during the school year. Things like a dial telephone, a dial indicator, a big power amp vacuum tube, and a couple of model steam engines powered off a tank of compressed nitrogen. Schools don't do field trip anymore because they can't afford the insurance liability of taking kids off campus. Bummer. Thus, they are eager to have the Museum visit them to show kids things they haven't seen before.

I must confess I was somewhat disappointed as I was setting up. Most of what I saw seemed more arts and crafts or toy like than technology related. Emphasis on the "A" in STEAM I guess. Then I noticed a small group of kids, all wearing robotics team tee shirts setting up a couple booths away. One of them, a boy of age 13 or so, wandered over to see what I was up to. "Is that a dial indicator?" he asked looking at my 12 inch diameter, 30 pound salesman's demonstrator for an Ames DI. I said "So you know what a dial indicator is?" He said "Sure, we've got a few in our shop".

He was referring to a Maker like kid's robotics group at Newton North Highschool called Ligerbots. I decided to go chat with one of the adults chaperoning the group to see if she would be interested in NEMES.

"Sure!" She said. "We've got a lathe, a drill press and a mill. Getting the drill press was good because now we don't have to use the mill to drill holes anymore . But it's not in good shape – the gibs are shot so the tables wobble in X and Y, and the lead screws are pretty worn and rhere's lots of backlash. It's an old Millrite, a Bridgeport knockoff, that somebody donated to us. Do you think somebody in your club could help us tune it up??"

So I'm standing there with my mouth open, looking at this 40ish house wife type, trying to process the fact that words like Bridgeport, backlash, lead screw and gibs are coming out of her mouth in a most natural and intelligent way. Finally I manage to say "Oh yes, I'm sure someone at NEMES would be glad to help you out". We exchanged contact info and hopefully she and some of team and some of their robotics creations will show up at NEMES meeting in the not too distant future.

So it made my day to find out that there ARE smart energetic kids out there interested in what makes the world work

From the

Editor's Desk

Bob

Timmerman

When I took over the Gazette, Norm Jones offered to help with Programs. You can talk to either one of us with program ideas. We are always looking for good program ideas. If you just have an idea of a speaker, or a program, and the contact information for the speaker, let Norm or I know, and we will try to take it from there.

We are also looking for articles for the Gazette, both as main articles, and as small Shop Tips. If you could send me something handwritten and some pictures (I could work with black and white or color prints, or JPG files), I would put the article together, and send you a copy before it goes into the Gazette.

On another note: volunteers at the Charles River Museum are having difficulty in attaching chucks to the Wade lathe. There seems to be some difficulty in getting the chuck to seat properly on the spindle taper, so that the draw nut can be fully drawn up. Any help from NEMES members with experience in this type of taper shank would be appreciated.

Dan mentioned the Newton North High School robotics club, and the condition of some of the tools in their shop. Would anybody at NEMES have the time and willingness to help them out by tuning up their milling machine, especially making new gibs? I think it is great that High School students are working on robotics, and it would be better yet if NEMES members could give them some help, at least with their tools.

Notes on the July program

The July program was a tour of the Spencer Organ Company, in Waltham. Spencer repairs and restores pipe organs, primarily those made by Skinner and Kimball. Their work of complex and painstaking. The tour was conducted by Mr. Joseph K. Rotella, the President of Spencer Organ, along with two of his assistants.

The following oversimplified explanation of how a pipe organ works will establish the background of how Spencer Organ restores pipe organs.

A pipe organ generates sound by blowing air either over a reed similar to an oboe or across an opening, similar to a whistle. The length of the pipe determines the pitch of the sound. A typical pipe organ contains thousands of pipes, all of which must be in tune, and must be adjusted to make the proper kind of sound. Adjusting the tune is called "tuning", and adjusting the mixture of primary sounds and overtones is called "voicing". The pipes are grouped into "ranks", which are pipes with similar sound, but different lengths, and thus different pitches.

The flow of air must be controlled so that when the organist presses a key, a particular pipe corresponding that note sounds. This is done by the windchests. The pipes sit on top of the windchest,, with a leather diaphragm under each pipe that acts as valve to control the flow of air into the pipes. In an electro-pneumatic organ, the type that Spencer specializes in, pressing a key sends an electrical signal to an electromagnet in the windchest corresponding to the desired note. Energizing the electromagnet causes it to pull the leather diaphragm in a direction to allow air to flow into the pipe.

Since there are far more pipes than keys on even the biggest keyboard, a means is necessary to enable pressing one key to enable pipes with the same pitch in several different ranks to sound. This is the job of the "stops". Each stop controls airflow to one rank of pipes, so that when a particular stop is pulled out, pressing keys corresponding to different notes caused pipes with those notes in that rank, and only in that rank, to sound. From this, one can understand where the saying "pulling out all the stops" comes from.

In order to restore a pipe organ, the pipes must be cleaned, repaired or replaced as necessary, then tuned and adjusted to produce the proper type of sound. Mr. Rotella showed us their set up to clean pipes, and do minor repairs. [They have a firm they work with for replacement metal pipes, they do not do this work, although they might make an occasional replacement wood pipe]. Adjusting a whole rank of pipes is a painstaking job. To facilitate this, they have a small organ console with provision for mounting organ pipe into its windchest. The technician can then play the whole rank, and adjust them as necessary. They demonstrated how this works.

Organ consoles are complex devices, with switches under the keys to control the electromagnets, complex switches associated with the stops, and a lot of wiring. The keyboard is prone to electrical problems, as the keys have to interrupt the current in an inductive load, which causes arcing and contact damage. The stop switches can give trouble, but Mr. Rotalla showed us a modern replacement for the old stop switches that they frequently use. As the wiring in the keyboard is old, and frequently undocumented, they usually replace it.

Mr. Rotella showed how the leathers in the windchest are replaced. They usually use sheepskin. Because the skins vary in size, and contain imperfections, the pieces for the air valves are cut from the skin by hand, using arch punches. After cutting, the pieces are glued to the windchest with hide glue, and fastened to the electromagnets. The electromagnets used in old organs are no longer made. Mr. Rotella told us that "an organ repairman is only as good as his junk pile", and that he has a large stash of parts from old organs stored in a warehouse nearby. From this he can find parts to replace worn out magnets in old organs.

He emphasized that the leathers and the glue used to attach them are animal products, and that over the years, the organ community has tried synthetics without success, and retain the use of animal products.

End of July meeting

The Lombard Water Turbine Governor

(Conclusion)

The previous section discussed the differing needs of controlling the speed of steam engines and water turbines. It left off with the statement that the force developed by a flyball governor is too small to actuate the large wicket gates on a water turbine.

A *servomechanism* is necessary to amplify the small force developed by the governor to obtain the large force needed to move the guide vanes. The Lombard Water Wheel Governor is one such device. The one in the Museum's collection is shown in Figure 4.

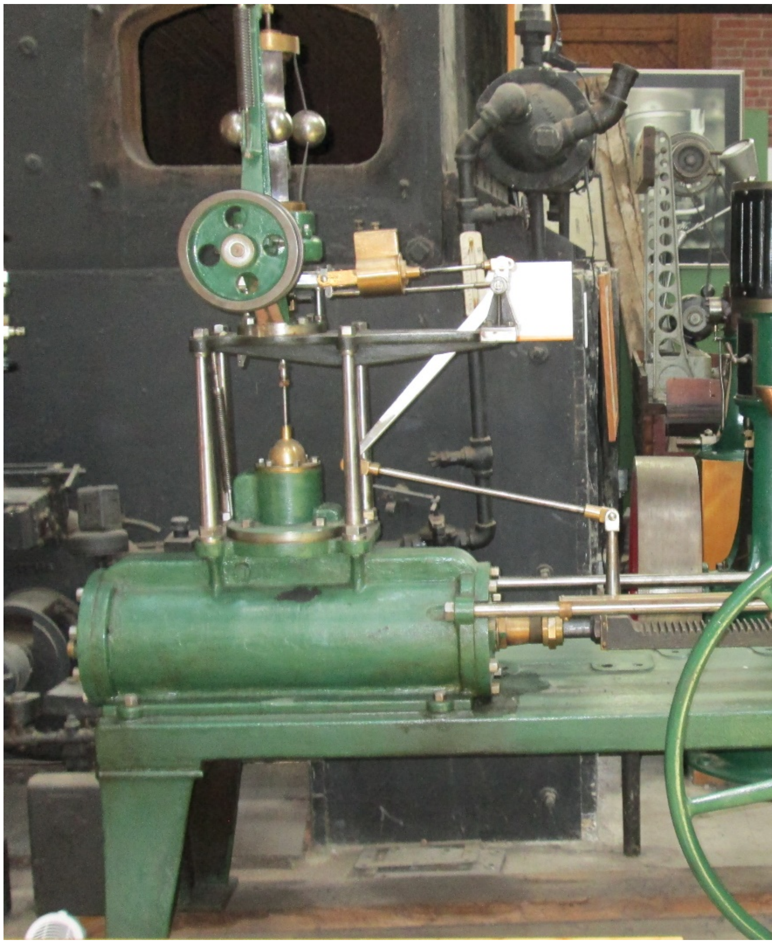

Figure 4: Lombard Water Turbine Governor
The date and model of this unit is unknown. It is missing the hydraulic oil pump, and oil tank. The hydraulic pump would have been mounted on the side of the machine opposite the view. A tank,

containing hydraulic oil under air pressure, would have been mounted under the machine.
The main parts of the governor are:

- The hydraulic oil pump and tank (missing from our version)
- The governor, unit with flyballs at the top of the governor
- The operating cylinder (the large cylinder at the left of the picture)
- The piston rod and attached rack
- The gear which drives the output shaft
- The control valve (small vertical cylinder on top of the main cylinder) which controls the flow of hydraulic fluid to the main cylinder
- The feedback mechanism (the rods on top of the rack), which correct errors in the piston rod position
- The handwheel and gear which permit manual operation of the turbine gates for testing.
- In addition, there are a number of auxiliary parts which provide lesser, but important functions.

<u>The Governor</u>

The governor is a conventional flyball governor, driven from the water turbine by a belt, shown in Figure 5, in the next column.

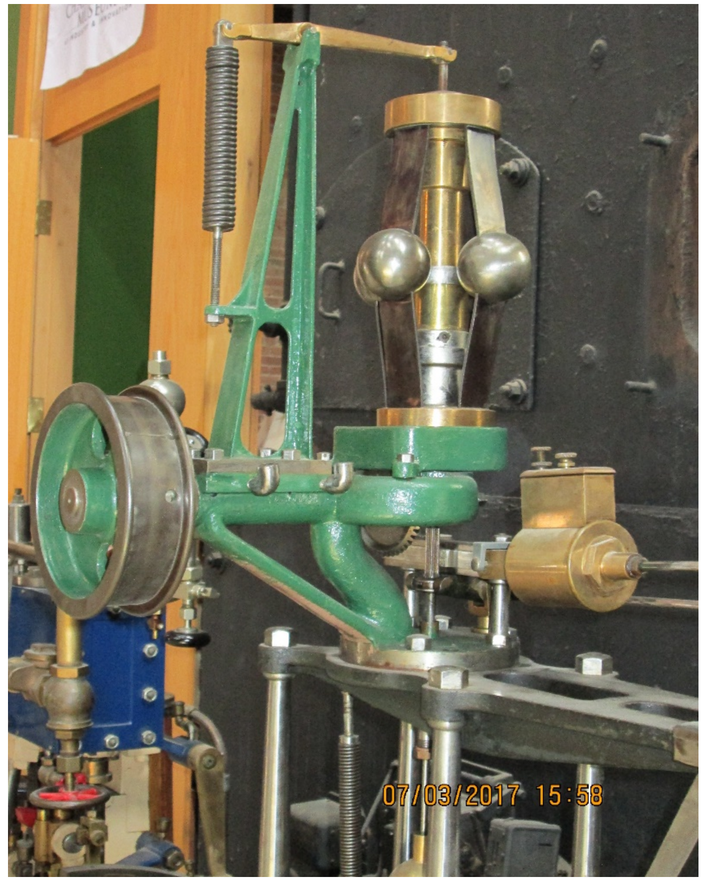

Figure 5, the governor

A belt from the water turbine drives the governor pulley which is flanged to keep the belt from slipping off. The pulley shaft has a bevel gear on the other end, which turns the vertical shaft for the governor. The governor bearings fix the lower end of the governor in place, so movement up and down occurs at the upper end, where the top of the governor presses upon the small rod, causing it to move up as the governor balls move out. The large spring at the left of the governor acts thru the lever to resist the motion caused by the governor. The force from the spring and the force from the governor balance at the set speed. If the speed drops, the governor balls will move in, and the spring will pull the rod up. The reverse happens if the speed increases.
The inside of the governor is hollow, and the rod connected to the top passes all the way thru the governor, down to the top of the valve. The valve and the feedback mechanism are shown in Figure 6:

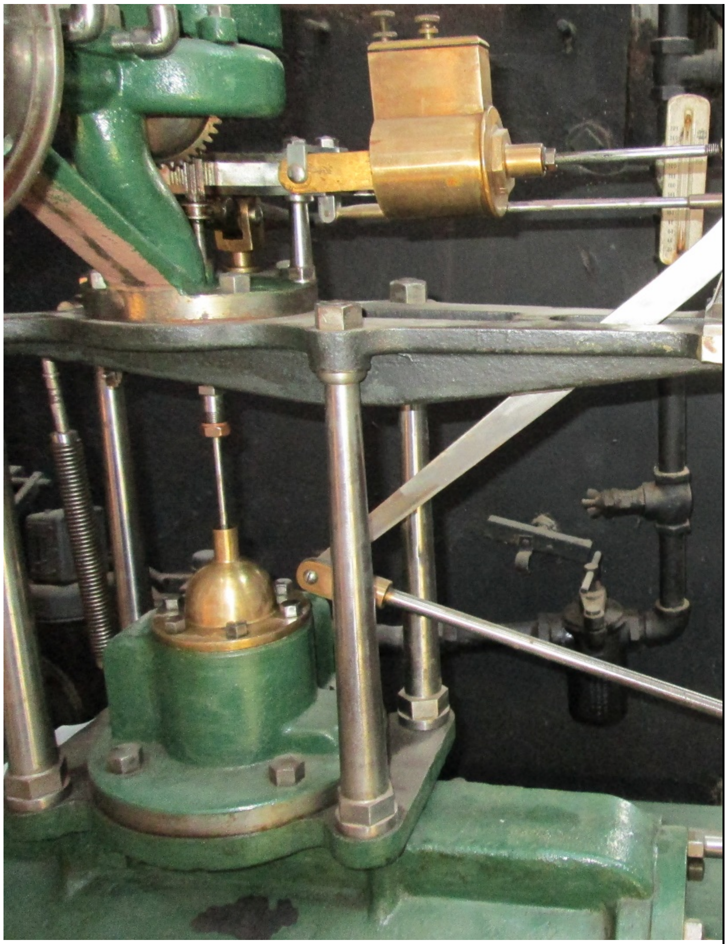

Figure 6: The valve and the feedback mechanism

The rod can be seen just below the bevel gear that drives the governor. The attachment for the feedback mechanism is just below the bevel gear. The rod then enters the top of the valve (the brass dome on top of the valve).
Inside the valve, the motion of the rod directs hydraulic oil to one side of the piston or the other, causing the piston to move in and out. The motion of the piston moves the rack, which then turn the pinion (small gear), which turns the output shaft. The rack and pinion are shown on the previous Figure 4, the overall view.

<u>Feedback</u>

As the speed of the turbine changes, either due to changes in load, changes in the head of water on the turbine, or due to the action of the governor, the governor will act to keep the speed constant. The action of the governor may not be sensitive or fast enough to keep the governor from overshooting the speed setting. This action is called "hunting" where the speed goes from too fast to too slow, as the governor attempts to get the proper speed.
One cause of hunting is the inertia of the water or steam in the inlet line to the engine or turbine. A change in power output requires a change in flow. To get this change in flow, the water or steam in the inlet pipe must be accelerated or decelerated, as the case may be. Changing the velocity requires a force, which translates into a temporary change in pressure at the engine or turbine. If the load increases, more flow will be needed, which will require force to accelerate the flow. This force will reduce the pressure available at the inlet of the engine or turbine, effectively reducing the power output, just when more power is required. The engine or turbine will slow down more, and the governor will open the throttle, change valve gear position more, or open the wicket gates more. Eventually the machine will be up to speed, but with the throttle or gates open wider than they need to be for the desired output. The governor will then reduce flow, causing the machine to slow down. In some cases, this cause the machine to oscillate.
A simple example will illustrate the effect of fluid inertia.
Consider a 50% change in output to be done in 5 seconds.

100 hp Steam Engine:	
Steam pressure:	150 psi
Line size:	3"
% change in pressure to accelerate flow:	0.07%

100 hp Water Turbine	
Water head	17 feet
Line Size	36"
% change in pressure to accelerate flow	14.6%

Clearly the 0.07% reduction in pressure on increase in flow will not have any effect on the steam engine, but the 14.6% reduction in pressure on increase in flow on the water turbine will reduce the power output, just when an increase in power is required. The net effect will be for the governor to open the gates more than necessary to just meet the increased demand for power, causing the turbine to have difficulty in reaching equilibrium.

The Lombard Governor incorporates an additional feedback loop in addition to the one consisting of the governor and the control cylinder operating the wicket gates. This additional feedback loop feeds back the position of the rack to the control valve, in a direction to oppose the motion of the turbine gates—that is, if the governor calls for an increase in gate opening, the feedback will oppose opening the gates. The feedback is also arranged so that there is more feedback on calls for sudden changes in gate opening than on gradual changes. On a sudden change in load, the wicket gates will called upon for a large movement to keep the turbine speed constant, and to accelerate the water in the inlet line (or canal). This large movement, carried on for too long will cause the turbine to miss the speed setting, and oscillate. Slower movements will require a less severe change in gate opening, and so are less likely to cause hunting.

The feedback is accomplished in an ingenious manner. Figure 4 shows a vertical rod attached to the rack. Figure 6 shows a portion of that rod, and the rest of the mechanism. The vertical rod is attached to two other rods that are pivoted at the level of the governor. The final rod is attached to a brass cylinder, the other end of which is attached to a rack which turns a gear on the rod from the governor. The brass cylinder is a *dashpot*, a cylinder filled with oil with a piston inside. The piston moves inside the cylinder with some clearance, and works similar to an automobile shock absorber. Due to the viscosity of the oil, more force will be transmitted from the linkage to the output end of the cylinder the faster the input rod moves.

The output end of the cylinder is attached to a rack (a rectangular bar with gear teeth cut into it). This rack meshes with a small gear on the governor rod. Inside the governor housing, there is a coupling on the governor rod, with coarse threads. Turning the gear with the rack screws or unscrews the coupling, depending on direction. This changes the length of the governor rod. Since one end of the governor rod is attached to the governor and will not move, changing the length will change the position of the hydraulic valve. The parts are arranged so that movement of this auxiliary linkage opposes the action of the main governor, and causing the governor to return to the neutral position. The action of the dashpot causes more force (and hence more motion) to be transmitted if the linkage is moving fast than if it is moving slowly, causing sharp changes in position of the main cylinder rod to be more attenuated than gradual changes. This reduces the tendency to overshoot on a sudden change in load.

<u>Auxiliary Equipment</u>

On a sudden loss of load, or in the event the governor belt breaks, the governor will go to full wide open position, overspeeding the turbine. To prevent this, the Lombard Governor incorporates a device to shut down the turbine in the event of overspeed, shown in Figure 7:

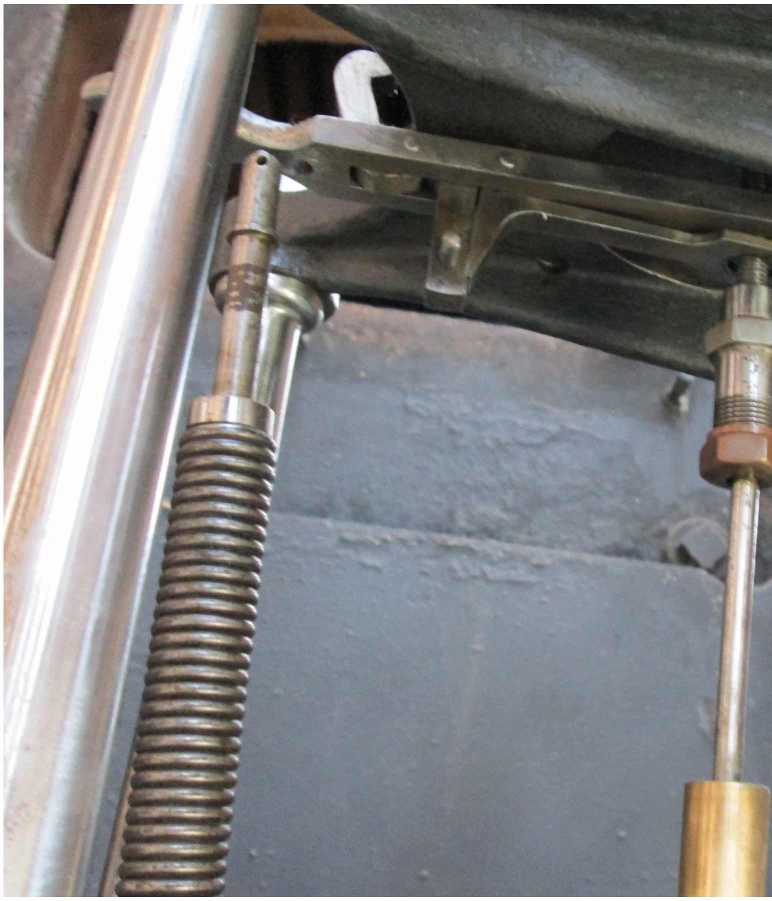

Figure 7: Overspeed Trip

The Overspeed Trip consists of a pivoted lever which fits over the governor rod, and which is pulled down by the spring shown at the left of the picture (our governor seems to be missing some parts that attach the spring to the lever). A hooked lever holds the main lever out of action by hooking against the top of the casting. This latch is held at the lower end by a mechanism that also fits over the governor rod, and which has a trip that is released by a small flat lever fitting over the governor rod. If the governor rod rises to the maximum upward position, corresponding to the hydraulic valve causing the cylinder to move the wicket gates to full open, it will trip the small lever. That will release the latch, causing the spring held main lever to pull the hydraulic valve to the position that causes the wicket gates to close. This trip must be manually reset to put the turbine back in operation.

There is another lever which can cause the governor rod to move up and down. It is theorized that the purpose of this is to test the operation of the governor.

In order to operate the turbine for testing without the governor, the large handwheel is provided. This wheel turns a small gear, which meshes with the large gear on the output shaft. See Figure 8, below:

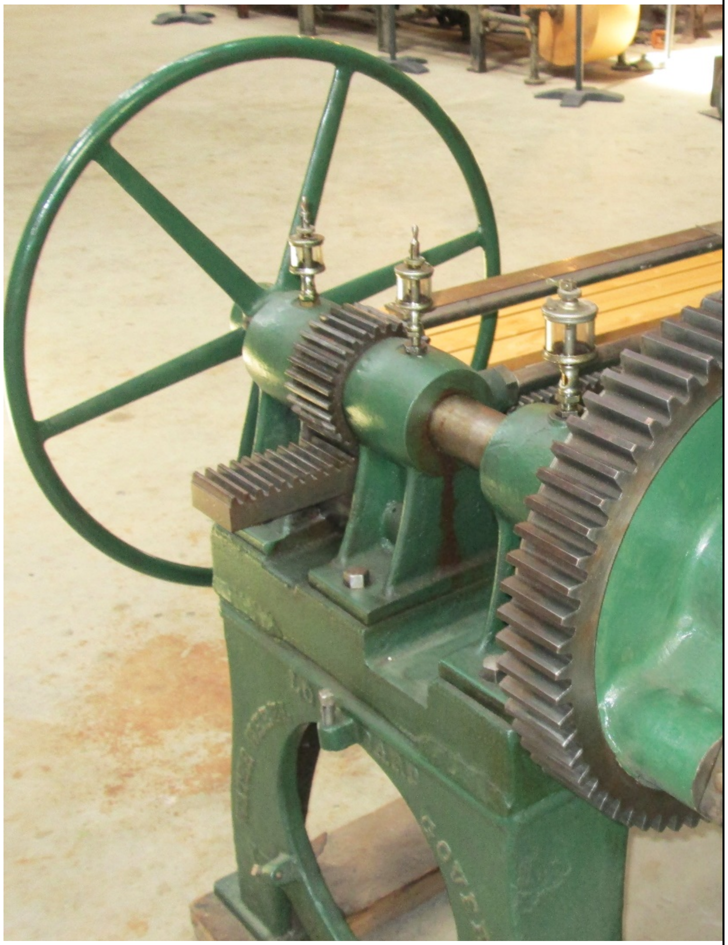

Figure 8: Manual drive shaft

The shaft carrying the handwheel and small gear is free to slide in its bearings, so that the handwheel can be used to drive the large gear on the output shaft. As exhibited, the output flange from the governor (not shown, it is behind the gear) is rigidly connected to the gear. In practice, there is a pin clutch, the handle for which is at the bottom of the gear. It is believed that as installed, this clutch could be used to disconnect the governor from the large gear, but that the large gear would remain connected to the output shaft. This way, when running the turbine manually (after repairs, for example), the governor would be disconnected via the pin clutch, and the handwheel would engage the large gear, to position the wicket gates.

Upcoming Events

August 2017

4, 5, & 6 August The Northeast Rockbusters will be hosting another Antique Equipment Show in Connecticut in 2017!!

@ Mark Gluck's farm in Plainfield CT.   More to follow

August 18th, 19th, 20th Bristol Society of Model and Experimental Engineers Model Engineering Show

Thornbury Leisure Centre in Thornbury, Gloucestershire
England http://www.bristolmodelengineers.co.uk/

12-13 August Straw Hollow Engine Works Show

Pine Ridge Farm, Cross St., off Rt. 70.
Boylston, MA

Contact: Daniel Moore, 125 Linden St., Boylston, MA 01505;   508-869-2722.

19-20 August Antique Marine Engine Expo

75 Greenmanville Ave Mystic CT
1-95 exit 90, south on CT Rt. 27 to Mystic Seaport.
Contact: Scott Noseworthy, PO Box 6000, Mystic, CT 06355   860-572-5343
email: scott.noseworthy@mysticseaport.org
www.mysticseaport.org

September 2017

8-12 September 46th Annual Dublin Engine Show
Dublin NH East of junction 101/137 on Rt. 10t
Feature: Vertical engines.

Contact: Bart Cushing, PO Box 668, Walpole, NH 03608   603-313-9970
ernail: bart@cushingandsons.com
www.dublinnhgasenginemeet.com

13-17 September Tobacco Valley Flywheelers 37th Annual Show
Haddam CT
Haddam Meadows State Park, Rt. 154.
Contact: Russ Bengtson, 646 Bear Hill Rd., Middletown, CT 06457
860-347-5774
www.oldengine.org/members/tvf

22-24 September 33rd Annual Connecticut Antique Machinery Assn. Fall Festival
Kent CT
1 mile north of Kent on Rt. 7.
Contact: John Pawloski, PO Box 425, Kent, CT 06757   860-927-0050
email: j.a.pawloski@att.net
www.ctamachinery.com