Bob: For some reason he decide to come to Rhode Island. The curious thing is his point of arrival was East Greenwich, RI. He came here from upstate New York.

Tim: This must have been a pretty small town back then.

Bob: Oh, not as small as you would think, because it had a good harbor and in those days transportation was mostly marine. The bay hadn’t been corrupted too much so fishery was still active here.

Tim: OK.

Bob: Just by looking at the town hall, which once was the state capitol by the way, it was built way back, just after the revolution. So we have an historic town here.so it’s not unusual that people would come here, because he was busy hitch hiking some days, but he might have come via some other passage. But I’m wandering off the subject.

Tim: So, this Corliss engine is magnificent!

Bob: This particular Corliss engine we were lucky to get because the young fellow who operated it in this box factory up in northern Maine, on a Monday morning, foolishly put the full steam on it before it was warmed up. And water, as this engineer can attest, is almost incompressible – you can’t squash water. And if you have water inside the cylinder and the weight of the flywheel pushing the piston, something has to give, and in this case it blew the head out. So the bolts that were holding the head on were all splayed out like points on a crown and the head was cracked in the middle. The piston was totally destroyed – it was a wreck, literally and I guess the young fellow must have been fired.

Tim: I would think so.

Bob: Any we heard ... our friend in the Smithsonian keeps tabs on things like this and he let me know about this disaster and it didn’t take very long for us to put together a rescue team. I was in the business of providing Marine electronics in those days, mostly commercial accounts, so I had customers, big steam boat customers, fishing boat customers around this area. It was not difficult for me to put the finger on these people and borrow big flatbed trucks and other necessary appurtenances. We had no money – we did this all as amateurs. So we drove all the way down there, it was about a two day trip in those days you know, and went to work.

Tim: So what year was that?

(Looking at a photograph now)

Bob: Well, while I talk about this record *something* the date here. This is the mill.

Tim: this is the ice coming down off the eaves.

Fred: (Chuckle) Yeah, it was cold.

Bob: you know, right on the Canadian border. It’s amazing how we were able to get people to help us. We got a crane operator to truck his big rig up from Augusta and that big rig goes up here and is lifting half of the flywheel. That is me you’re looking at right there. I’m *something* the message center between the wheel and the crane operator. Anyway, picked it up, put it on a flatbed truck and we proceeded. Later, we had already built a new extension on this building. If you look at the ceiling you’ll notice the rafters have a slightly different shade in the middle. The original building is to the South and this is the new part. And the newer part hadn’t been built yet but what we did was take this wall and move it down to here (North wall with windows). And Dick Hanson who is still around, is a very clever engineer, and is retired from the Narragansett Electric Co. now. He put hours and days into designing this building while doing everything around here – making the forms for the concrete. He and I made the forms and we put a brace between the two sides, called the concrete truck and you know, concrete doesn’t wait for any man. The machine goes round-and-round, you’ve got to dump it; you can’t let it harden in the truck.

Tim: Right!

Bob: So, Dick and I worked hard to back-fill and in the central part where the wheel goes which would keep the forms separated and unfortunately, the form on that side was bound to get pushed in by the sand on the rear so Dick and I really shoveled like mad to backfill it. And if you happen to look down in the pit you’ll notice the Southern rim of that wheel almost touches the concrete. This is the correct spacing on the right had side. Anyway, this is not the oldest, but one of the oldest engines here. And, it has the largest flywheel.

Tim: How much does that flywheel weigh?

Bob: How much does it weigh? Can you guess?

Fred: I don’t know. I think the ASME tells us.

Bob: Wasn’t there a pushpin in there? Like this one.

Fred: Yes there is. It’s right there. I’ll get it. So Bob, tell us about the operation of the Corliss engine, why the Corliss was important.

Bob: this is the form that was made for casting the new head which was done over across the Connecticut by Charlie Smithers (?) company. My son welded this cracked cover and he did a remarkable job as you can hardly see it. This was all busted. We had to make a new *something*. Oh yeah, we have to give credit to Harold Foster because he pushed to get the job done. He and his nephew slaved in here for long time (9.36). Now to take energy out of a Corliss engine you usually do it with a flat belt around the flywheel and I’m standing on the end of the belt. It goes all the way to the Southwest corner of the building. That was all one belt going around here and going to the line shafting. Now, ask more questions –

Fred: You were starting to explain how the engine works and its benefits.

Bob: Well, in a simple slide valve James Watt engine the steam comes in the cylinder and exits by the same valve mechanism so you’re alternately heating and cooling the machinery. The Corliss kept away from that by having a dedicated admission valve and a dedicated exhaust valve. (Pointing in valve mechanism) When this opens it lets steam in. This opens to let the exhaust out. The piston moves this way, and vice-versa, this one back to this one. Fred knows the history of the whole thing. Where’d you go Fred?

Tim: I think he went to get a camera maybe, or check the water in the boiler.

Bob: Anyway, a simple slide valve engine, the exhaust goes out the same port as the steam went in, so you’ll heat and cool, heat and cool, heat and cool… very wasteful. Corliss got around that with his method and he very promptly became very successful. (11:41). A little interesting by note is that Nathaniel Herreshoff, another brilliant engineer, was 22 years old working for George Corliss and Nathaniel Herreshoff was given the job of taking his own 60 flat cars of cast iron down to Philadelphia for the Centennial Exhibit. And this 22 year old, Herreshoff, was in charge of the whole project and he’s the guy that erected the giant Centennial engine of which there is a picture in the other building. Because Herreshoff went on to design many important from an efficiency point of view steam engines, one of which is that triple expansion down there on the left hand side. We’ll get closer to that but first let’s walk around here.

Bob: I’m working trying to bolt this flat back on. These holes go all the way through. The engine obviously had a tough life because there’s a patch in here, a patch on the connecting rod. The original mechanics were brutal, things didn’t look in the right place they just slammed it with a hammer.

Tim: I see what you mean.

Bob: I mean, primitive is all I can say. I would at least have put a piece of slash or something and then smashed, you know – apparently they had broken the first crank up here and this looks like a repair job to me. This sleeve is keyed here and here, I don’t know why that’s printed? Anyway, this is all suggestive of an engine that’s had a hard life.

Tim: Looking at the crank disk which has been repaired by a sleeve.

Bob: This is the end of an HRT boiler. Which has a sign that has disappeared. (Creaking and banging noises). I guess it doesn’t want to come off. (15.03) This is an eccentric rod from one of the early engines. Fly ball type governor.

Tim: We’re now at the Northwest corner of the building.

Bob: We’re now heading South still following the line of the belt. Now, many of our engines were designed to be electric generators and these are two typical switch panels. Field rheostat and so forth. These little cups had mercury in them, and when it was working the connection was made there, and if it was overloaded they tripped like that. I guess the sensitivity for the circuit breaker was adjustable by one of these dials(?). This is just a typical boiler face. Bigelow-Cofax boiler (sp?). Bigelow was down in Connecticut.

Tim: So this is before the day of OSHA. All of these high voltages connections are exposed.

Bob: Yeah, it was rather a good thing Fred… Did I hear Fred’s voice? (17.08) It was part of teaching people to keep their hooks out of there. They learned. If they survived they learned.

Tim: Yes

Bob: Sometimes they didn’t survive.

Tim: Here are some impressive wrenches. (Looking at the West wall now)

Bpb: This is a little engine.

Tim: The Delameter Iron Works.

Bob: They made air engines, hot air engines, among many things. Now Harris worked for Corliss but then he decided there was money in making engines so he split off and made the Harris-Corliss engine. You can see the obvious similarity between the two engines, they both these.

Tim: Dashpots?

Bob: Absolutely, they’re like a big tension spring. When the valve is pushed open and tripped finally, this sucks it down promptly so you have a very quick cutoff. That means the steam is admitted at the beginning of the stroke and when the piston goes to the distance required for the particular power needed the valve would snap closed. And the steam would expand, pushing the piston the rest of the way. Exactly the same thing happens on the other end of a double acting engine. Now moving ahead in time, this engine whose throttle valve I hold is actually the engine which drove the generator which made the juice, 600 Volt DC, for the Sea View Railroad. Here’s a picture of the Sea View Railroad; there’s the station in Narragansett. This is the actual engine near the tracks at the old Sea View Railroad and it fed juice both ways up and down. (20:05). We’re proud of that trolley line.

Bob: Henry Ford, when he was building the Ford museum in the 20’s, he searched all over. He personally went out looking stuff, now much the way that we did though we had no money in our pockets like he otherwise did. Anyway, he succeeded in buying this engine and had it sent to Dearborn, Michigan for his museum and, because he had a particular fondness for Armington-Sims engines. This engine flanged-coupled to a Fort Wayne DC generator which made 600 volts, which coupled to the tracks and drove the trolleys back and forth. The Ford museum had enough of these engines, so they very kindly gave this to us, but they had unfortunately misplaced the Fort Wayne generator so we don’t have that. However we have this and it shows…

Tim: Nice piece of local history.

Fred: Tell Tim about the Armington-Sims factory.

Bob: Oh yes, which still stands by the way in Providence, in Olneyville. It’s a four story brick building, Fred is familiar with it. What about it?

Fred: Well, Henry Ford had xxx village made an exact duplicate of the Armington-Sims factory with all the machinery in it.

Bob: Right, I had forgotten that point. A volunteer working in the Henry Ford museum was working on a horizontal steam engine and somehow he got his head between the connecting rod and the frame and when the wheel rolled around, he head was squished and that was the end of him. Then, I think the Ford Museum at that point took some special efforts to be a little safer about the way they ran things. And that is a lesson to us Fred!

Fred: I know. Bob has always insisted that when someone is running the engine there two, two people who know what they’re doing besides keeping an eye on the public, besides having it roped off.

Tim: You never know when little kids will put their fingers in somewhere.

Bob: it’s amazing how stupid people can be. I know that from personal experience. By the way, anything that has a pipe attached to it, particularly a pipe (23:07) with insulation on is in running condition, and this is a very well running engine. Now moving over here we’re going back in time. Edison ??? was around 1880, and in his New Jersey laboratory he used one of these Armington-Sims engines to make his electricity in his laboratory, so he was very fond of these engines. And, as Fred reminded us, he made it proud of us. It’s quite a well-designed engine, although it’s nothing but a slide valve engine, nothing more elegant than that.

Fred: There’s a difference in the way the speed is controlled on this engine, compared to the Corliss.

Bob: And there’s also a way there’s a difference on this engine and on later models. This engine is an earlier engine and the governor is all inside the wheel. You have to stop the engine to change to governor. On later models they realized that this was rather silly so they put the governor out here rather than back in there.

Fred: Tell Tim about the condition of this engine when we got it.

Bob: Ha Ha! Yes! Connecticut Light and Power found this engine in a saw mill up in Massachusetts, Northwest of Massachusetts, and somebody on their board thought it would be decorative to have a steam engine in the corporate offices, so they fetched this engine back to Hartford and put some artists to work who did all this fancy lettering and pin striping and all of that stuff. And they rigged up a little motor underneath. I mean when I say little, it was just like that. But the piston was too much drag for that little motor so they took the piston out and chucked it and they took the piston rod out and chucked it and took a cylindrical piece of brass and put it in place of the rod and connected it here. Of course I’d never heard of a steam engine with a brass piston rod but to those artists it meant nothing. However, Connecticut Light and Power decided, new management or something thank goodness, they decided that this is where that engine belongs, not there so they brought it over on a flatbed truck, all at their cost; they delivered it to us. However, no piston, no piston rod, a lot of nothing there.

Fred: The governor was in backwards?

Bob: Yes, Yes.

Fred: And tell Tim about what they did to these wheels, how they lifted them.

Bob: Oh my God! I’d forgotten those things Fred. They apparently put a strap around the rim of one of the wheels with a crane and just cranked it up with this wheel dangling, and the connecting rod, the crankshaft in the middle. The consequence was they bent the shaft right with the crank in it (27.23). And remarkable, we were able to straighten that with jacks in there and wedges, so we got it running very nicely. They took the piston and junked it, literally through it away.

Bob: Now, one of our longest serving volunteers built a new piston, and one of the valuable things about the drawing cabinet in the other building is that we could go the cabinet and get the original drawing and we could build a new piston exactly to the plans, and that’s what Mel did.

Tim: Great!

Bob: So we have a brand new piston, and of course the brass rod was replaced with a new steel rod. It’s all put together and it runs perfectly.

Fred: When the flywheel was wobbly on the shaft, it had probably been allowed to be loose and then finally wear itself, so Bob rebabbitted the shaft and put a sleeve in the flywheel so this flywheel now runs true and tight.

Tim: Very nice.

Bob: One of the distinct advantages and improvements in the new engines (28.59) is that all of mechanism is on the outside rather than in here where you can’t really adjust it. Anyway, when steam is up it runs fine, and we have this Thompson-Houston Generator – Thompson-Houston is the company that became General Electric. This was a wreck too. The commutator was all hills and dales. I had to rig a lathe tool stand here, drive the wheel around and run the tool across that face. Now it works very nicely, and, if we have that running and we throw this switch, that kills outside power. Then we throw this switch and this is running, it all lights up from this generator. So we can light the whole building with that generator. And it’s *lightening* pretty hard to do, and you can see the load come on as the Armington-Sims digs into the load.

Bob: This is a rather neat circuit breaker. An *Oppola*? Nothing wrong with that but it’s a little complicated. This is the main switch for the generator.

Tim: This is a DC generator?

Bob: Oh, absolutely. Not AC, who ever heard of that?

Tim: Not back then.

Bob: You realize that this is around the very beginning of Edison’s electric lights. ATVH? (what does this mean?)

Bob: While we’re standing here, this is the improved Greene engine. Greene, and there’s an argument – that’s putting it very lightly, was Corliss, and Green built a four valve engine like the Corliss but also very different. (31:34) The admission valves are I these boxes here and there, and they’re grid iron valves. The motion of this back and forth moves the grid open and closed – very efficient, quickly admitting a lot of area without much effort. The exhaust valves are at the bottom and, in order to do all this, you have to have two separate eccentrics. One drives the exhaust valves, and that’s these two guys here, and the other drives this bar back and forth (Bob is now demonstrating the valve motion). You can manually open the valve (grunt) boy, that’s stuck. Can you give me a hand Fred? See this gadget? It opens the valve like this, and that rod

Fred: OK, that’s free. (33:30)

Tim: So, the lattice valve has a big opening, but it doesn’t have to move very far?

Fred: Right.

Bob: Rolf Richter made these.

Fred: Oh he did. I didn’t know that:

Bob: Yes, very nice job.

Fred: Grid iron bars(?)

Bob: There’s also something?.

Fred: But see these engines with these types of governors, were pretty simple mechanisms, well – elegant rather than simple. Are easier on the governor, so those engines where you have to move the eccentric, it takes a lot of energy to move the eccentric. So these control the speed tightly; the mills liked that, didn’t they Bob?

Bob: Oh sure. This is very sensitive speed control.

Tim: And is this controls the valve admission.

Fred: Yes.

Bob: These fly balls go in and out, and cause this to go back and forth.

Fred: Tell him about the safety feature on this engine, about this governor.

Bob: If the engine starts to run away steam comes in here, and pushes this bar.

Fred: But the other thing, if the belt breaks on the Corliss engine, the engine could run away but on this engine, this would drop down and would shut the engine off. And that plug is only in there for starting.

(Fred pulling something out for Bob).

Bob: Fred, I would study this again, this steam plunger goes up and hits that thing which trips this thing, where the consequence is, it shuts the engine down, automatically.

Tim: If it’s going too fast?

Fred: Yes, if it’s going too fast, or the belt breaks and the governor thinks it’s going too slow. Tell him about the consequence of over speed.

Bob: Well, in Manchester, New Hampshire, I think 1896, they had a big Corliss engine driving a large textile mill up there. The crank shaft was parallel with the river so that the face of the wheel was perpendicular to the edge of the river. Something went wrong with the governor, and the engine ran away in speed and it literally, centrifugally exploded. Pieces of that big flywheel, and the one in Manchester was much bigger than that engine, cut the mill right in two – a four story mill. Workers on the upper floor were, you know, it was awful, and pieces of the wheel went all the way across the Merrimack River to the other shore. Because it’s cast iron.

Fred: You know, cast iron is strong in compression and it’s handy, but it’s very weak in tension. (38:20)

Bob: You know, I should look in the archives and get the newspaper article about that accident and we should reproduce it on the wall here.

Tim: I should probably research that too. One of the managers at the woolen mills was a Straw. I don’t know if he’s a relation or not.

Fred: Tell him how they cast these flywheels and how you put the flywheel on the shaft. The flywheels were meant to be in two but cast as one.

Tim: I see, they’re bolted together.

Fred: What we’re talking about, here you made the whole flywheel, but this point here is made weak.

Bob: Yes, there’s a big gap there, but the skin of the wheel goes around there.

Fred: they put a wedge in there and crack it. They cast it as one and then crack it into two.

Bob: You can see the seam here, and here. It’s clearly a crack, where the break it apart. But before they did that, they put it on a shaft and turned it to make it true. (40:40) I have to brag about this. On a Tuesday when these two halves of wheels sitting out here on timbers waiting to get brought in to the building, we had the shaft in position, we had the form all build and so forth. We had done all that on Saturday, and on Tuesday we were supposed to come together and rig the pieces in here. Paul had put a chain fall up through the ridge pole and through the roof, so there were big timbers above the roof to handle the weight. The chain fall was already up there so I was out here in the morning expecting guys to arrive and nobody arrived so I went ahead and started to jockey the wheel and roll it in on rollers, quite, you know, rollers on planks into here. And finally I got the first section where I could get the chain fall on it, raised it up and lowered it down under the crank shaft. Then chained it around the crank shaft and rolled it down into the pit with it hanging on the chain, on the shaft. Then I went ahead and got the second half, brought it in the same way, and dropped it on the…

Tim: You did this all yourself??

Bob: Yes. By noon I had the wheel all put together. The guys all said ‘We thought you said Wednesday’. Maybe I did. (42.48). Anyway, we’re moving to more modern type of engine, you want to say something about that Fred?

Fred: about which? Oh yeah, if you just come over here and see how they made the… you know, in a modern gasoline engine you have a bearing and a bearing cap, and you put it together, but these are all done by wedges and a key ??. So, you scrape the bearing so that it’s just right with the right clearance, then it’s held in with a wedge. No bolts, nothing to come loose.

Tim: And then there’s one bolt to hold the caps in place.

Fred: Just to hold the wedge in place. It took us forever on that Armington and Sims, remember Bob, to get that crosshead pin working smoothly. First of all, you couldn’t get at it; you had to take it half apart to get at the bolt; that’s one of the bolts there, so trial and error, it took forever.

Bob: I wanted to point out a modification here. You see that pulley right there, the grey one?

Tim: Yes.

Bob: The original belt went around the shaft itself. This wood part is something we built so that the engine goes like this, instead of like this (Bob demonstrating).

Tim: I see, it’s a bigger diameter.

Bob: No way we’re going to let that run full speed in this building here.

Fred: Because we have no load, and it tricks the governor. The other thing that’s unique, I’ve never seen it in any other engine, is the way this eccentric converts the eccentric motion into a rotating shaft. You see on the Corliss the mechanism goes to a forward and aft ??, whether that was done for efficiency, or whether, do you think that might have been done to get around a patent Bob?

Bob: No, I don’t think so, I think it was part of the valve system that he wanted to have a rectilinear motion. That was a sliding part.

Fred: Yeah –OK. That’s right.

Tim: The eccentric then is driving a rotating shaft. That’s interesting.

Fred: Yes. (45:31)

Bob: While we’re talking Corliss engines, this is the first engine that we acquired. It came from Dorchester, Massachusetts. We had to do all kinds of work on that.

Fred: It’s got a slightly different valve gear Bob, it’s got this Brown gear, whatever that is, but just by looking at it you’d think it’s the same as Corliss, but it isn’t. This was your first engine?

Bob: Yes, well the first big one. The wheel is held together by these iron straps.

Tim: I see, H-shaped straps.

Bob: There’s one of the originals. In order to rig the engine up we had to cut that and unbolt this and, with a crane, pick the pieces up. But then we came to put it back together again, we had to make new straps. We had an old fashioned hand built forge, red hot coals you know, so we would put this in the forge and heat it red hot. Then we would very delicately put it in there and of course when it cooled, it crunched the wheel right together. Everything worked the way it should. So, we had to make four of those things.

Fred: Tell him about the demolition contractor.

Bob: Right. I was working in those days for a living, like every other human being usually and I couldn’t play engine all the time, I had to go back to work. So I went back to work leaving this partially disassembled, and the goons, this was in Dorchester, Mass, and when I say goons, I mean they were really goons. They scarfed all the copper they could get their hands on, it really… well, I won’t say anymore.

Fred: But

Bob: We had to cut this flywheel, but those guys went ahead and cut the flywheel leaving the crankshaft out to about here.

Tim: They cut the crankshaft?

Fred: Yeah.

Bob: So, I was absolutely horrified to come back and find that the engine basically had been wrecked by these jerks. But what we did finally was polish up that stub of a shaft and got a bronze bushing adequately beefy and put the bronze bushing in here so this thing is now resting on a bronze bushing, and technically it has the surface area of the original babbit. It works alright.

Tim: There’s not much load on it.

Fred: Right. (49:16)

Bob: So we stuck a cover there on the end. Formerly the end of the shaft actually appeared right here. Anyway, we had George Corliss day here many, many years ago, and we had a lot of dignitaries to speak out here in a tent.

Fred: I sent him a copy of that. You had one in the office. That was quite a day, huh?

Bob: It really was – we had the Warwick Civic Orchestra playing. They were actually trying to make a centennial of a centennial.

Fred: We need to go back now to the Herreshoff.

Bob: In mills, power was transmitted by countershafts and we just have a little taste of it up here to show people how you didn’t have a wall socket to plug in for power. You took your power off a spinning countershaft. And you had a split pulley like this, and with a lever, when this was running you could guide the belt from the drive pulley to the idle pulley. The idle pulley just spins around, but the driving pull makes it all work by pulling that lever. I can change all of that with a simple switch. Basically, this is the same as that. So there’s a little example of line shafting up there which of course has to be driven by something, and in this case is driven by this engine here. This little engine’s belt drives the line shaft to spin all the other things.

Tim: This is the Clark and Howard engine.

Bob: Made in Mexico, New York. Because of the distance between places, they did things that we would never think of doing today. Locally, they had foundries and machine shops, they were duplicated everywhere you know. When I first got my little schooner and I needed repair parts, I went into almost any old fishing port in Nova Scotia or Quebec and lo and behold there’d be a little foundry and a guy with all makings. He could make you a part from scratch, you know, right there. (52:43)

Bob: Now coming back, Fred has touched base with Babcock and Wilcox; today it is a very large corporation, but they began in Rhode Island, and Mr. Babcock designed this type of engine which was called a bottle engine for obvious reasons. But it was a very successful engine, simple design and so forth. So, he went on to expand Babcock and Wilcox, and how big a corporation is that today, Fred?

Fred: Oh, it’s worldwide, build ?? stations, power plants, nuclear plants.

Bob: You’re talking as big as the Dallas??, right?

Fred: That’s right

Bob: It all began as Hope Valley, Rhode Island, that’s the amazing thing.

Tim: A lot of good things started out in Rhode Island. The New York Safety Steam…

Fred: And tell us why they call it that, Bob, the Safety, why they called it New York.

Bob: I remember being in Nava Scotia years ago, when I brought my little schooner down and the kids up there, when I was in my twenties, when something struck them as being pretty decent, they’d say ‘Hey, just like New York’. You know, it was so good up there in the sticks, just like New York, and curiously, when I went to Iceland, I found the same expression there. The Icelanders would say ‘just like New York’. Anyway, to peddle a product, you weren’t nobody, in the vernacular, if you didn’t come from New York City.

Fred: It was either New York or Boston, right?

Bob: Babcock and Wilcox, and the guys down in Hope Valley hired a storefront on Cortland Street and if you recall Cortland Street, which I know intimately well for several reasons. Anyway, the ferry boat from Jersey landed at the foot of Cortland Street. (55:25) and you walked up Cortland street to get the subway, you know, a block up the street. So all the traffic from New York and New Jersey went up Cortland Street. If you wanted to advertise something, no better place in the world than Cortland Street. So they hired a little store front on Cortland Street and they named their engine the New York Safety Steam Power. Marketing is what it’s all about.

Tim: It certainly is, it’s a well-known name.

Fred: Would you like a drink Bob? Want me to get you a soda?

Bob: No, I’m alright, more or less.

Tim: It’s been about an hour, we can take a break.

Bob: Maybe Nancy will make me a Martini. Now, going backwards, there were so many fascinating mechanisms in the world, the Almond drive is one of them. This has a shaft going out that way and one going out this way, if you’re distributing power with belts it’s sometimes necessary to make a right angle turn. Of course you could take the belt and twist it, and drive a shaft this way, but Almond built this thing in South Attleboro, Mass and it’s here mostly because it’s a fascinating thing to work.

Tim: I’ve seen people just watching this when the steam was up.

Bob: The ?? ball action there. And that’s just there to give the science people.

Fred: The Almond Company made drill chucks. They were pretty common, Almond drill chucks.

Bob: Yankees were clever people in those days. One Yankee in particular was Herreshoff and he was, I don’t know the truth of this but, he very likely was the first to drive the valves with a lay shaft separate from the crank shaft. In gas engines in automobile and so forth, usually you drive the valves like this actually, the cam shaft, whereas steam engines had the valves driven from an eccentric on the main crank shaft. It’s just not clear. But Herreshoff had a contract with the Navy these motor torpedo boats and this is the engine he designed for them which was very effective. But Herreshoff had a powerful personality, it might be told, but how to design his stuff – his attitude was ‘I’ll design it, you keep your cotton picking hands off that area’. So the Navy, as it can be, I’m an army man by the way, can be quite smart ass about things and the Navy started to tell Herreshoff what he should do in the design for gun boats.

Bob: Anyway, he made about 8 of these engines and I think about 4 of these gun boats and then, he had enough of the Navy. (59:37) ‘I will do no more work for the Navy’, he said, and he kept his promise. He never would mess with the Navy again, and I feel a little sympathetic for him, but anyway all model air engines have a lay shaft for driving the valves. Just a glorifation of this. This is a triple expansion engine and was very efficient. Steam comes in there, the small diameter cylinder, exhausts to an intermediate diameter cylinder, exhausts to this larger diameter cylinder where it’s low pressure. With the gradual reduction in steam pressure and the increase in area to compensate for it, Herreshoff had designed it so that the force on the crank was the same on all three cylinders. It was a balanced crankshaft in other words. This runs very nicely, and one of Herreshoff’s sons got a job with Phelps-Dodge in Brooklyn, New York. Phelps-Dodge was in the copper and bronze business. Herreshoff had four of these engines left over because he eventually told the Navy to pound sand. He sold these engines to Phelps-Dodge and they hooked them up to generators and they ran them from around the turn of the century up until we got this. Seventy years it says here. We heard that Phelps-Dodge was going to scrap these things, so we had to see if we could go get them.

Bob: Well, it’s a long, horrible story, but we did indeed get down there and saved this one and brought it back up here.

Tim: I’m glad you did – it’s possibly the only like it left.

Fred: I imagine.

Tim: Is this a two valve arrangement for the low pressure cylinder? It looks like there are three cylinders but there are four valve stems.

Bob: These could handle a larger volume, but smaller pressure at the low pressure cylinder. You see, this is high pressure steam (pointing), intermediate pressure steam, low pressure steam so they provided two ports to provide the adequate area.

Tim: That’s a condenser on the end?

Fred: No I think that’s just the ???. Probably went to a condenser – I don’t know.

Bob: Cotton mills, textile mills.

Fred: These must have been terrible things to ride in because it was chock full of machinery, I don’t think there was much crew comfort on that.

Bob: And look at the lack of beam, they must have rolled like crazy. (1:03:29). Yeah, I would never want to be in one of those things.

Bob: This engine here is indicative of the growth of the textile industry in this area. Because here again, if you wanted individual power control on a loom or machine somewhere, you had to have a two cylinder engine twith 90 degrees out of phase so that you could start and stop it by merely turning the steam on and off. Granger built a lot of these for the mills in Rhode Island and around Massachusetts. The cotton mills and the woolen mills. So a woman could run the loom, and when it was time to shut it off or reverse it, just pull a lever and give it no more thought.

Tim: Very good – so this is the Granger engine. Is that the number plate on the Herreshoff engine? 3277B, 1904.

Bob: This was obviously a little pump to pump oil into the steam cylinders, one for each cylinder, driven by this eccentric. When that’s going up and down. Oh, this originally had a steel plate with a cork gasket over on there, so this was oil tight on both sides.

Tim: This is about the crankcase of the Herreshoff engine, so there would be oil slewing around but it wouldn’t get outside of the crankcase.

Fred: And you’ll notice the barring gear then.

Tim: Yes, I was wondering what that is at the end of the crankshaft (clanking and metallic noises). That’s OK. That’s to allow you to turn the crankshaft.

Bob: Boy, it’s seized up Fred. Rust in the cylinders for sure. Can you move it?

Fred: I’ll try but no. We’ll have to get the guys to work on it (more clanking noises). Some of the really big mill engines had a steam barring engine which would trip out when the engine started to speed up. Now as a matter of fact, steamer Liberty ships had a steam powered jacking engine.

Tim: So they maybe have a little donkey boiler.

Fred: Yes.

Bob: That’s a new arrival there, that’s a Liberty ship engine for driving, what was it, a pump or a generator?

Fred: A fan. Jim Pickett donated it and he said it drove a fan.

Tim: This is a White Victory engine.

Bob: Course it never had a wheel like that on it. (1:07) This was made in Hartford, Connecticut and it’s a rather ingenious engine. Everything is to try and save the thermal energy. The guy who made this engine decided to keep the engine inside the boiler.

Tim: OK. This is by the Colt Firearms Company.

Bob: The steam would not lose any heat in the pipe going to the engine.

Tim: So the engine cylinder is right inside the boiler.

Bob: Yes – it’s right in there, in the top of the boiler.

Tim: Makes it fairly compact too.

Bob: This runs very nicely.

Tim: I see you’ve got it plumbed up for steam also.

Bob: This happens to have come from the Colt Firearms Factory. The engine was used to drive machines making guns.

Fred: Did you mention how many of these things they made? (1:09)

Bob: Does it say something here?

Tim: Over 300,000 of these engines. Wow!

Fred: You know it’s the same way with steam cars, but more with steam engines. It’s hard for us now, you know most people have probably never have seen one, to appreciate how many there must have been because, if you didn’t have one of those, and you didn’t live near a river, you couldn’t turn anything.

Tim: So those would be in manufacturing plants and shops.

Fred: Well, or a farm – labor on a farm, pump water

Bob: So it’s said Edison Central electric power put an awful lot of steam engines out of business. Speaking of Edison’s generator, and electric power and steam engines, we’ll move over here. This is another Babcock and Wilcox connection. New York Safety Steam Power horizontal engine, which actually came from the University of Rhode Island, 1895, and the few lights that they had down there were all generated by this engine. In the pictures you can’t see the details very well, but there in the basement of a building that still stands at URI where this was.

Tim: Nice addition to your collection, being a graduate of URI.

Fred: You know, our volunteer Warren Haggist, he rescued this, they were going to throw it out. So he rescued it and got it here.

Bob: We should give him a gold crown.

Fred: And one of his students, who for complicated reasons is the same age as him, but he was still a student, Art Post, went to Harvard and studied Liberal Arts or something, and then decided to be an engineer so he went to URI. Well Art saved his notes when they used this engine for demonstrations, so in that book there are some of Art Posts notes that he took while he was the university with the other fellow, I don’t know how many years ago.

Tim: I remember I met Art at the last Steam Up.

Fred: So he prepared that little description of how an indicator diagram was used.

Tim: So when was he a student there?

Bob: Art Post?

Fred: When would he have graduated? He must have graduated in 1970 or so.

Bob: Yeah – it was in the 50’s.

Tim: Oh – long before I was there.

Fred: Something – do you think you could get your battery going by Wednesday? When the Hasbro people come.

Bob: Well, the only thing is, I have no steam to get this going.

Fred: We’ll have steam Wednesday.

Bob: I’m talking about preparatory, before Wednesday to check it out.

Fred: We were going to do that Wednesday morning.

Bob: Yes, but you never know what you’re going to run into, Fred.

Fred: You want to do that Tuesday morning?

Bob: If you want to put in to run this, we ought to be a day at least ahead because we don’t know what kind of problems we’ll have.

Fred: That wouldn’t hurt because then the boiler would stay warm. I’ll try to get a couple of the guys here Tuesday morning to fire up the boiler. But you have to do something here with your…

Bob: No, that’s all done.

Fred: Explain to Tim what you have to do here.

Bob: That engine drives this generator, and these volts appear here, and these amps appear here coming out of this generator. Now, this is the field circuit and I’ve cheated a little bit here so when we don’t have steam up, like now, I can (sound of a switch clicking) light those lights with this generator by putting this over here. That light is to alarm people that this has 110 volts on it.

Tim: That’s handy to know.

Bob: Yes. Of course it’s got 110 but this side is DC and this side is AC. This is the field circuit and this is the field rheostat to control the amount of current in the field, and you can regulate the voltage with the field rheostat – all of this works.

Tim: So, it’s a General Electric DC generator. (1:15)

Bob: This unfortunately is not the URI generator; they junked that long ago and that (pointing at the engine) would have been junked if it weren’t for Warren. I laughed, I went to the Harvard engineering school as Fred has pointed out, and a trivial course in statics and dynamics – elementary course, I lacked for a degree. The degree required that you have this course. So, I had completed everything else at Harvard but I lacked this one course, and I had a job crewing on a yacht. So I crewed on the yacht and came into URI I think a week and half late after the summer course started. I was going to take this course in statics and dynamics. I drove to the ???- I lived in Edgewater in those day. Every day I rode the casement??, took the course, and the incredible thing to me is that’s the only course in college that I ever took that I didn’t get one single grade less than 100%. Everything was 100%. And it was a snap course. That was my experience with URI. I’ve never told Warren this fact.

Fred: You’ll have to tell Warren!

Tim: I took statics and dynamics at URI even though I was in electrical engineering – all of the engineers had to take basic mechanical courses. I got A’s – I don’t think it was all 100%.

Fred: We’ve got one more engine and that will be it.

Bob: Do you work in engineering now?

Tim: Just on little model engines, as a hobby. In engineering, I’m a sonar engineer working for the Navy, in Newport at the Underwater Warfare Center.

Bob: Sonar is why I’m deaf. I used to test these transducers by holding them up to my ear. 50 kHz.

Tim: Oops. Well, you can’t hear it.

Bob: One Kilowatt.

Tim: Wow- you could probably feel it.

Bob: This is a Fitchburg engine which is kind of an interesting, amusing engine. It was a fairly popular engine.

Tim: So it has two eccentrics and four valves.

Fred: Again, the exhaust valves are on a fixed timing, and the governor, we can look at it afterwards, it changes the angle of approach if you will, which affects the cutoff time. Bob will show you – there’s the inlet valve.

Bob: Look what condensation does, let me get the steel wool out here. It’s early in the season, no steam up. That will be shiny very shortly. This disengages – this drops into a notch and you can manually put the steam in either end to warm up the engine, and then when you’re ready to go, you hook ?? and that locks it. This box hear (cranking noises).

Fred: Fitchburg didn’t make this, the oiler.

Bob: They would have done a much nice job. Now, this is a contrivance to drive this lubricator to drive oil into the steam line.

Tim: Yeah – it doesn’t look like original equipment (winding noises).

Fred: These Mandell? Lubricators, they’re still made.

Bob: Yes, but it’s empty, we’ve got to fill it back up. They’re still made Fred?

Fred: Yup. (1:21)

Bob: My cousin big Dave?? Came from Peterborough, New Hampshire and that’s his wife, and this is in the mill. The date of the engine is not 1831 but that’s the date of the mill. And there is the mill (Bob showing me a photograph or print).

Tim: I know Peterborough pretty well, I grew up in Southern New Hampshire. In Mont Vernon – it’s a small town outside of Milford, just to the West of Nashua, NH. So I know Manchester too.

Bob: You born up there?

Tim: I was born in Hanover, NH – further North.

Bob: Ah-huh, and you didn’t go to Dartmouth?

Tim: No – I went to URI, I wanted to be near the ocean.

Fred: Bob, here’s an example – there’s absolutely no excuse for that, is there?

Bob: Yet, look at the George Corliss, it’s got some scars.

Fred: They must have used a hammer or a chisel.

Bob: I mean they really had some crummy people, which is why I say, something? ten years is not guilty... what’s this?

Tim: That looks like a repair or something, that collar.

Fred: I don’t know, it could be.

Tim: I have to say my brother is not very nice to machines – they have some big machines, and he figures one size fits all, one size pipe wrench, look what it does to these nuts and bolts.

Fred: You can get bronze-faced, flat faced pipe wrenches which I used for … This is the spring-loaded governor mechanism in here that just rotates one of these eccentrics.

Tim: How easy is that to adjust?

Fred: Well you can imagine – I think we had this one apart one time.

Bob: It’s all working, it’s filthy but it’s working. You see that – it’s the pivot point and it swings this way against those springs.

Tim: Just by inertia.

Fred: But that’s a lot more effort than the way the Corliss and the Greene changed their timing.

Tim: There is more mass that is moving.

Bob: This is the Bullet generator. The rods in it were a natural wreck. It may still look like a wreck, but we’ve done a lot of work on it. One of the nice things about DC machines is that you can make motors out of them by sending the current in and generators by taking it out. It’s identically the same machine, so one of the thoughts we had was to bury a little line around here so we can throw a switch over there to let this spin as a motor from that generator. Steam – generator – motor. Maybe we’ll get that done this year. Ken Adams really slaved – this was such an awful mess.

Tim: Looks pretty nice now.

Fred: I think we’re done. Thank you Bob.

Tim: Yes, thank you very much – we have an amazing amount of information.