Scratch Built: Live Steam
Central Pacific Eng. #3 - C.P. Huntington
A 4-2-4T

Built By: Danforth, Cooke & Company of Paterson, New Jersey in 1863

BY

Bill Allen

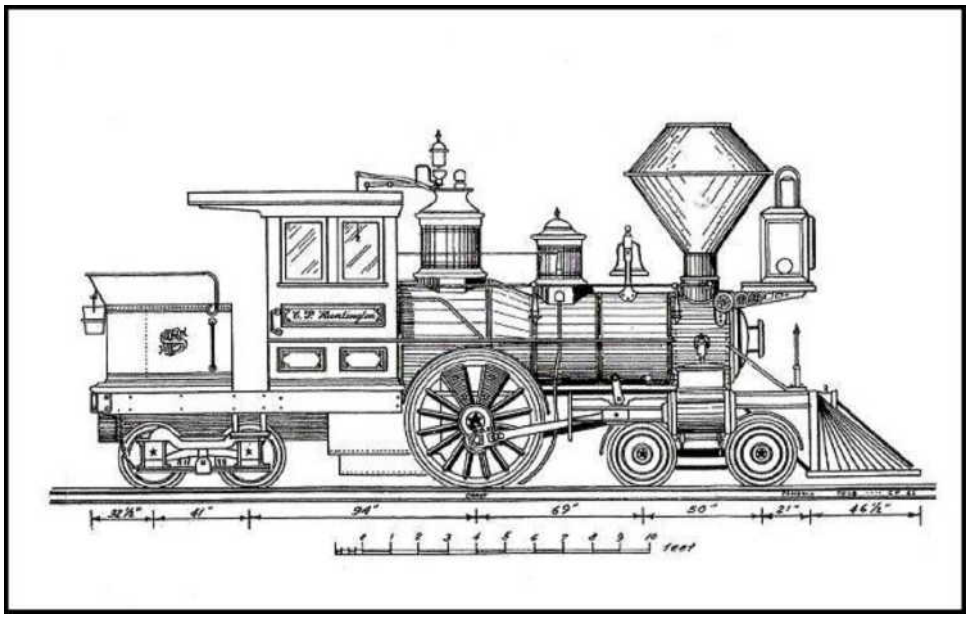
Woodside, CA, USA

(Live Steam Forum/Topic: "T" Box Boiler for C P Huntington)
(Live Steam Forum/Topic: C P Huntington Build Log)

I have thought about building this very small standard gauge engine many times but figured it would be too hard to get a boiler that would hold any water to fit between the wheels. I posted another thread asking for input on a *'T'* type boiler and though there was some doubt, I think the general consensus was that it would work provided it was strong enough. I recently completed a Ruby bash for a friend and it came out so well that I figured I could use some of the replaced Ruby parts on this project.

(05 Mar 2012) Originating Post: "T" Box Boiler for C P Huntington
Ever since I first laid eyes on this beauty in the Sacramento Museum, I had the desire to build one.

I went to the Museum Library and was able to get some measured scale drawings like this.



This is a standard gauge, which would normally be at 1:32, but at that scale, the engine is so small that a live steam version doesn't make sense.

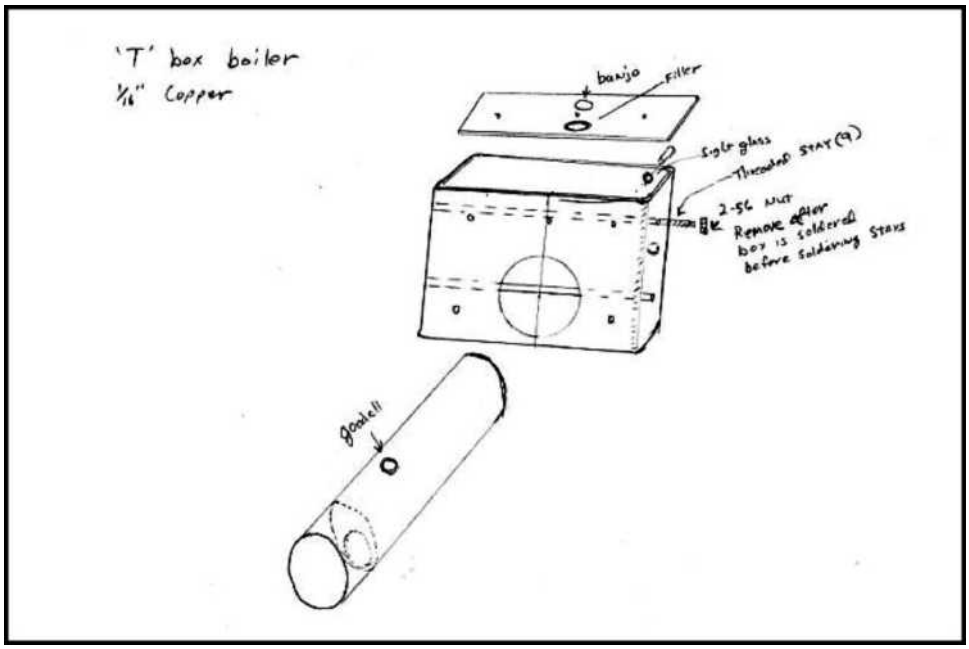
Aster built a standard gauge American in 1:28 and Aristo-Craft does all of theirs in 1:29 so I decided to go with 1:29. This still presents several problems. At first, I thought I could do a Ruby bash but the 3/8" ruby cylinders are actually too big for this engine.

If you look at the drawing, you will see that the top of the drive wheel lines up with the center of the boiler which means a Ruby boiler wouldn't even fit between the wheels (1.5").

I think I can use the Ruby valves by cutting 1/4" or so off and making new cylinders. This will save some time.

Now for the boiler. The largest diameter tube I can fit in will be 1-1/4 inside and 1-3/8 outside. I will need to crush it a little near the wheels in order to make room for the Lagging.

I feel I need a 3/4" outside diameter flue tube for the poker burner, which leaves little room for water. The bunker won't be free and a tender would spoil the look so an axle pump won't work. My idea is to make a T boiler but because the cab is so small, a cylindrical one won't work. So here is my plan.



The box will be just under the cab size. The boiler will be painted black and the windows will be glazed so it should look somewhat natural from that standpoint.

The sight glass and pressure gauge will be between the cab and bunker with the throttle above and center (at the roof peak).

I plan on annealing the copper plate, drill all of the holes and cut out the boiler tube hole slightly undersize. Then bend the pieces as shown so the seam is where the tube goes in.

The stays will have nuts to hold the piece in line while it is soldered. After the seam is soldered, the tube hole will be fitted with the Dremel or spindle sander. The top and bottom will be bolted with the stays and soldered on. Then the nuts will be removed and soldered.
Finally, the tube, flue and front plate will be soldered.
I have never done anything this complicated before and welcome any hints.

Comment David Leech:

Bill, I would think that it would work, BUT maybe not too efficiently. The water circulation during boiling might be somewhat difficult. However, when you have it built, you will be able to show us how it works.

Comment Semper Vaporo:

That square bottom leaves some water space that is not near enough or above the fire to do anything but sap energy from the system. Maybe if the front and rear sheets of that box were shaped like Home plate it would be better (eliminate the lower corners).

Also, that square box is going to 'want to' take on a spherical shape when subjected to pressure. I think I see some stays in the drawing will help eliminate that, but the junction of the round boiler barrel and the flat sheet and the junction of the flue/firebox in the flat backhead sheet may be subjected to some stress, anyway. I'd recommend thick walls for the flat sheets (double that of the cylindrical parts) or an "L" or "T" shaped stiffener across the sheet to help avoid the deformation stress that will occur.

Comment Steve Shyvers:

Bill, I concur with David and Semper Vaporo. There might be some things you could do with internal siphons to get the water to circulate within the "box" section. Also cross tubes at the far end of the flue might help a little bit, but the small boiler diameter probably precludes any huge benefit. Insulation might help too. Think also in terms of the ratio between the boiler's total volume to total surface area. You want that number as large as possible, and volume increases (and decreases) by the cube of it's linear dimensions while area changes by the square. This means a tiny boiler will have a lot more heat loss proportionally though surface radiation than a larger boiler of the same proportions. Another way to view it is that the boiler shape should minimize surface area while retaining as much volume as possible. This was behind Semper Vaporo's "home plate" suggestion. A horseshoe shape would be an alternative.

First thing, though, is you need to figure out proper staying for the flat sections. Just going to thicker copper will only add to the amount of heat the boiler soaks up that doesn't go into the water. I'd be happy to go through the stay calculations with you, but it's too complicated to do here. In the past I tried to design a "boot" or "T" boiler for a logging loco, but the staying got too complicated for the small boiler size. Internal girders are an alternative approach, but still complicated to build.

(06 Mar 2012) - Reply:

You are right about the lower sides being dead space except that if I get to a low-water situation, the extra water will help to get it home before damaging anything. I thought of a U shaped box but it would be harder to solder.

I just sketched the diagram and it is not to scale. The box is quite small only 1.75" x 2.75" x 2.5" outside. The Flue will be 0.750" outside diameter by 5-3/4" long, which should supply the necessary heat. The material will be 1/16" and stays will be no further apart than 3/4". Your concerns about the circulation are probably over my head. Is the concern that it could cause an air bubble in the tube? I wonder what the circulation difference will be vs. a 'T' boiler like on the Accucraft Shay.

Comment Eric Schade:

If you built a true locomotive style boiler with a ceramic butane burner located down low in the firebox you could get the efficiency up while keeping the boiler diameter down. You could keep one large boiler (flue) tube with cross tubes or use several smaller flue tubes.

Have the boiler start down between the drivers as the prototype with a wet sided firebox (with cross tubes possibly).

Comment Richard Jenkins:

You might want to look at the Wuhu Porter as a starting point instead of a Ruby. Same basic technology, but with a smaller boiler diameter and smaller cylinders.

Comment Semper Vaporo:

> *Posted By bille1906 on 06 Mar 2012 08:09 AM*
>
> *You are right about the lower sides being dead space except that if I get to a low-water situation, the extra water will help to get it home before damaging anything. I thought of a 'U' shaped box but it would be harder to solder. I just sketched the diagram and it is not to scale. The box is quite small only 1.75" x 2.75" x 2.5" outside. The Flue will be 0.750" outside diameter by 5-3/4" long, which should supply the necessary heat. The material will be 1/16" and stays will be no further apart than 3/4". Your concerns about the circulation are probably over my head. Is the concern that it could cause an air bubble in the tube?*
>
> *I wonder what the circulation difference will be vs. a 'T' boiler like on the Accucraft Shay*

Extra water "below" the top of the firebox ("Crown sheet") will do nothing to "get you home". The top of the Flue/firebox will glow cherry red and only convection in the metal will heat the water not directly in contact with the directly (flame) heated metal. Thermal stresses could tear the boiler apart. Sloshing of the water onto the overheated metal will flash to steam, which could cause pressure spikes that could damage things too.

Granted, this is a very small boiler and will be well below the size of the "Critical Crack Length" to result in a boiler explosion ("BLEVE") from the thermal stresses and pressure spikes, but why chance the unwanted release of steam from unintended "holes" at inopportune times?

Cross tubes cause circulation to get all the water up to temp so the boiler is more uniform in temperature so the thermal expansion is uniform to reduce stresses. Random cold-water turbulence caused by the motion of the locomotive will cause the steam pressure to fluctuate and cause erratic operation. Cross tubes are also additional heating surface and additional volume of water.

Comment Richard Jenkins:

Another thought, instead of using the cab and/or firebox space for a square extension of the boiler, why not use that space as a water tank and add an axle pump?

Going back to my earlier suggestion of using Wuhu Porter components instead of a Ruby, the Wuhu boiler is 1.5" outside diameter; the cylinders are 5/8" outside diameter (same as the older Ruby cylinders) but only 1" block length. There is enough water capacity in the boiler to run for about 10 minutes, although the fuel runs out after 6 minutes with the stock tank (I have swapped mine out for a Ruby tank). If you use the cab and firebox space for a water tank, I see no reason why that couldn't be increased to the 30 minute run time you're looking for. The big question is how much fuel capacity are you going to have in that bunker space? That deep under frame below the cab and bunker looks like it could also yield some usable space too, possibly for additional water capacity or to stash a battery and R/C receiver and servos

Comment Larry Herget:
This is the boiler I put in my Climax 'A' type. Steams nice even with the offset flue.

Comment Bruce Gathman:
Larry, Where's the throttle. Also not you usual sight glass!

Comment Eric Schade:
Richard-- I am thinking the box under the frame was a water storage tank. I am guessing Larry's throttle was on the other side out of sight in the photo.

(07 Mar 2012) - Reply:
Semper: Got you on the low water issue. I will see of there is any room for cross tubes.

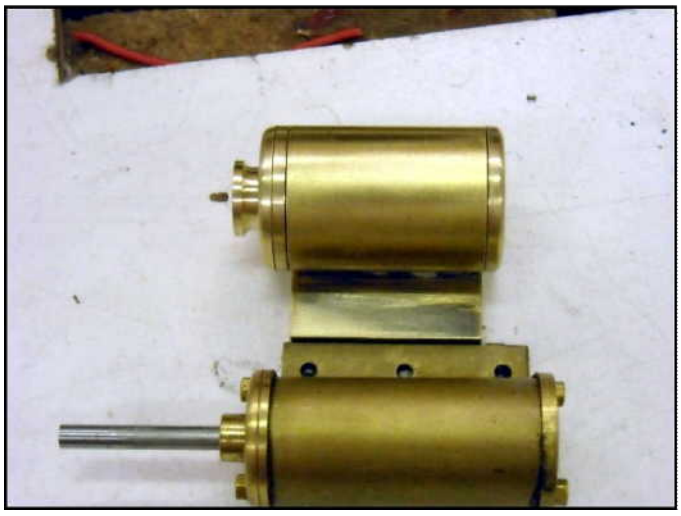
Richard: I just don't want to fool around with adding a pump to the only drive axle, which will already have two eccentrics, a clack valve and a bypass.

The 1.5" boiler won't work because the distance between wheels is 1.5" and I need lagging I already cut up some Ruby valves and made some cylinders yesterday. They are 3/4" outside and 1/2" bore by 0.950" long.

I was planning on using the under frame area for the batteries and using the bunker for receiver, servo, fuel and lubricator. Might be able to fit the receiver in the frame somewhere. Throttle will be manual and reverse by RC.

Larry: That is a nice looking boiler. Similar to what I was thinking except with a cylindrical riser vs. a rectangular one. I don't see why my design would be much different. Do you? Do you have cross tubes? What is your flue diameter?

Comment Semper Vaporo:
The difference between the cylindrical and rectangular riser is that the cylindrical one is already in the shape that pressure will try to force it to, thus less stress on the joint where the horizontal barrel of the boiler joins; and there is less surface area from which to radiate and thus lose heat. In the size you are working with, those differences are slight, but still there.



(07 Mar 2012) - Reply:
Right Semper, thus the need for stays.

By the way, I just finished the cylinders. Here is one next to the longer 3/8" Ruby cylinder. The flange on the cap is for the four-rail crosshead. The need for the shorter cylinder is because of the pilot wheel spacing.

Comment Larry Herget:

Climax T boiler has the throttle out of view on the opposite side. It uses a straight 3/4" OD copper flue with a poker.

Here it is installed.

(07 Mar 2012) - Reply:

Larry: That is an awesome model. Why is the flue offset? It is hard to see from the pictures but is it offset at the 'T' and in the center of the smoke box or offset all of the way?

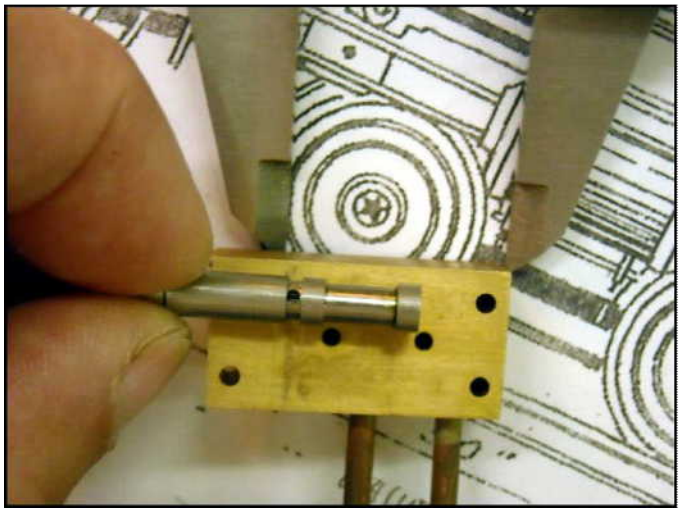
Comment Larry Herget:

The Fire tube is offset to clear the engine, which butts right up against the boiler. If it weren't offset the poker & jet would not be able to be installed.

(16 Mar 2012) - Originating Post: C P Huntington Build Log

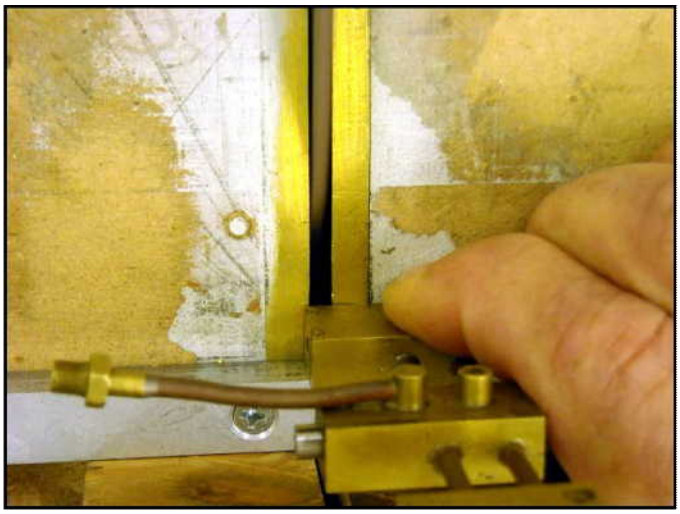
I have thought about building this very small standard gauge engine many times but figured it would be too hard to get a boiler that would hold any water to fit between the wheels. I posted another thread asking for input on a *'T'* type boiler and though there was some doubt, I think the general consensus was that it would work provided it was strong enough. I recently completed a Ruby bash for a friend and it came out so well that I figured I could use some of the replaced Ruby parts on this project.

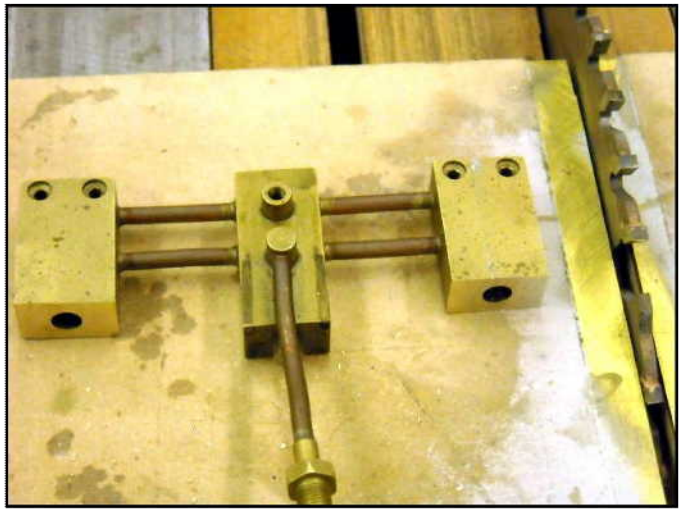
Here is the Prototype:



I start by checking the Ruby valve to see how much I can cut off.

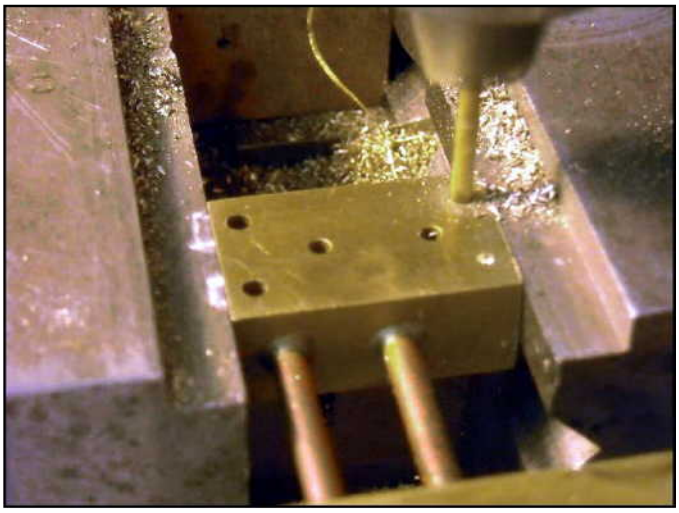
Then a whack on the table saw.

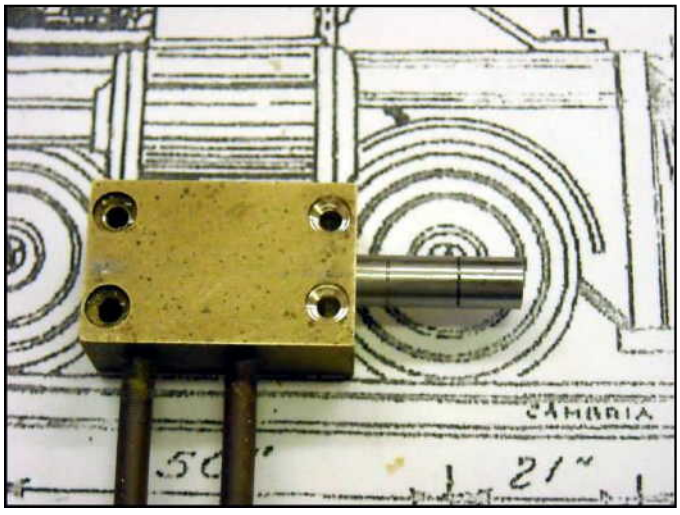




The valves are now cut to length and ready for drilling.

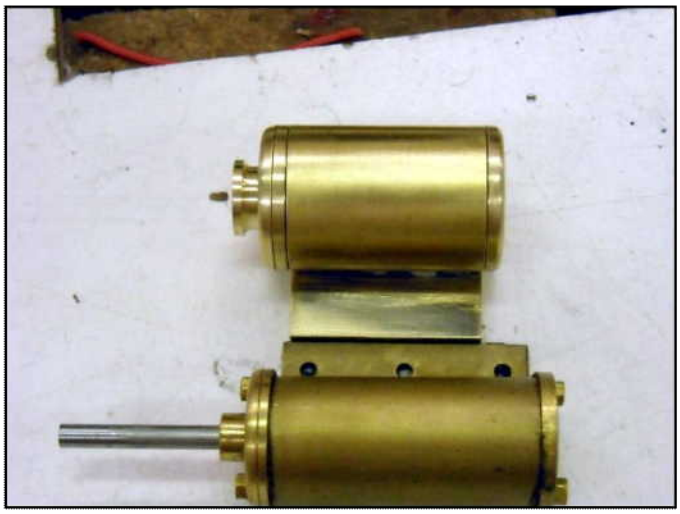
The new holes are drilled on the mill.





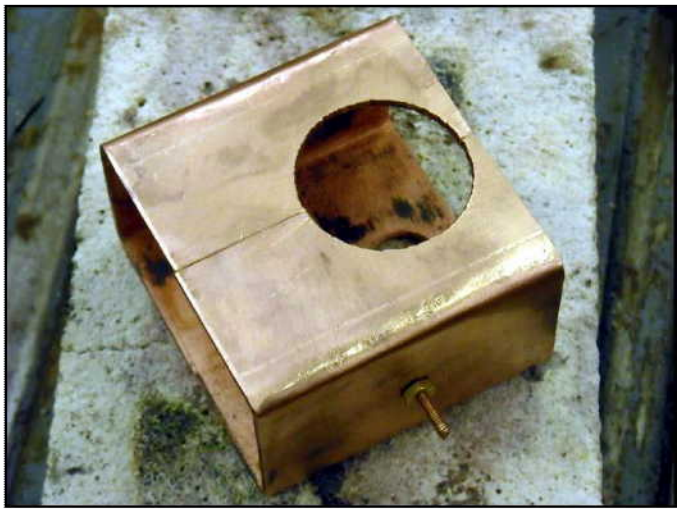
The finished valve it is a little longer than the scale drawing so I will need to increase the pilot wheel wheelbase.

The 1/2" cylinders are turned out of 3/4" stock. The boring bar is ground from an old end mill.



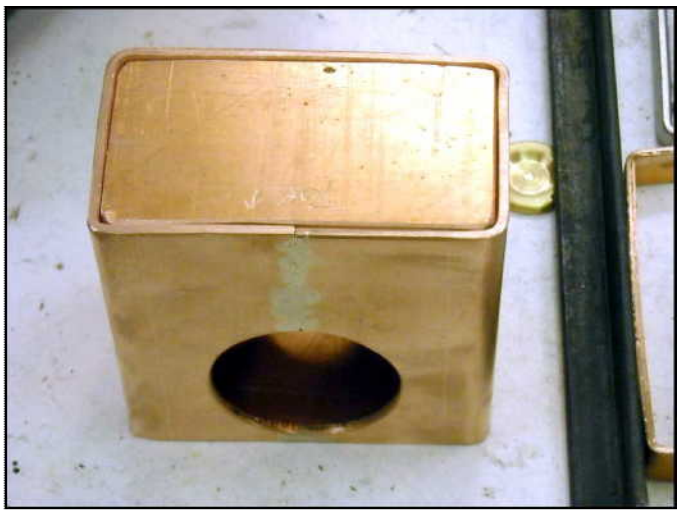
The finished cylinder-1/2" bore x .800" stroke next to a Ruby 3/8" cylinder.

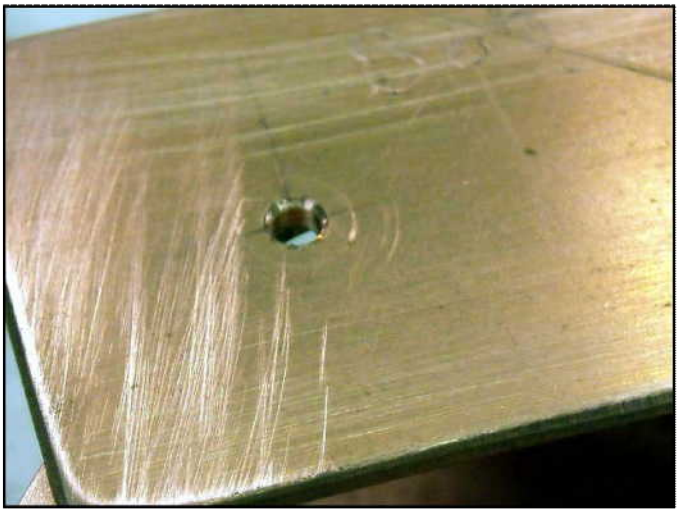
The boiler box is made from 0.080" copper. Two semicircles were cut with the band saw slightly undersize. Luckily they came around and matched up. The stay was threaded and the SS nut held it in place while it was soldered.



After soldering, the hole was finished with a spindle sander. A half round file would have done the trick also.

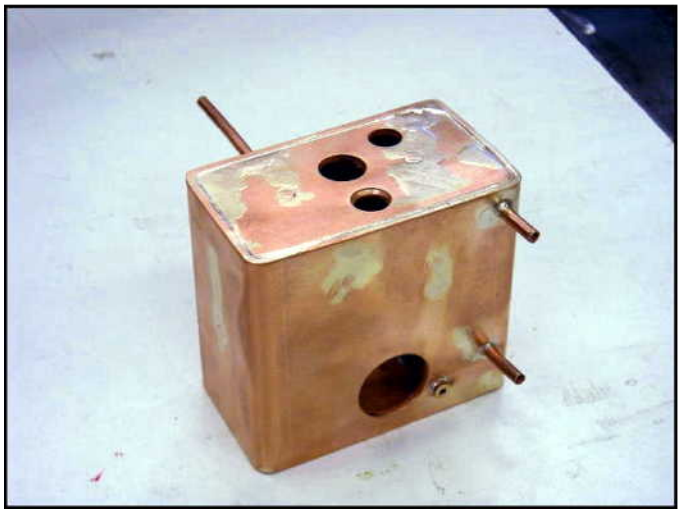
The top and bottom were then cut and fitted.





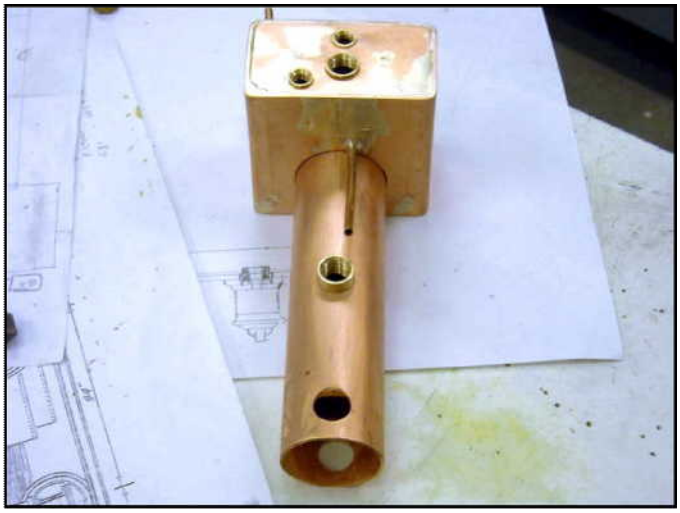
Stay holes were countersunk so that they could be ground flush after soldering.

The stays were double nutted to keep the top from dropping down and from moving up. The SS nuts on the inside will stay there. The cross stays are flattened to keep them from falling out.



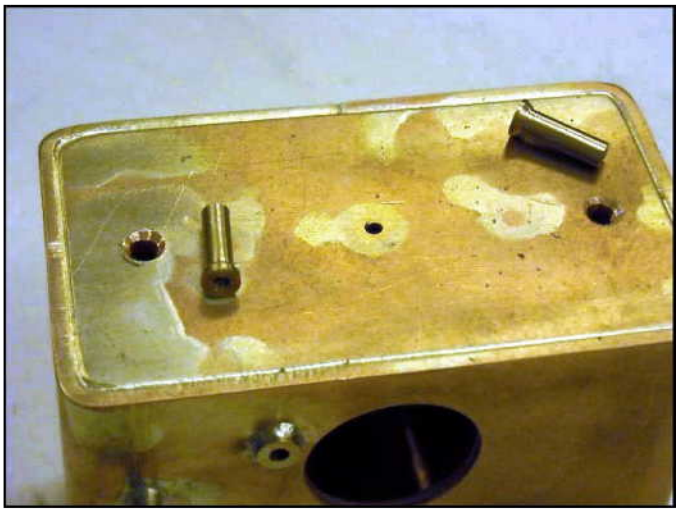
The box is soldered together.

The boiler tube is set in place.



This gives you an idea of the size.

These well nuts were soldered in the bottom for mounting; they are turned from 3/16" stock to 1/8" and tapped to #2-56.



This shows the bushings and the filler, throttle and pressure gauge tube.

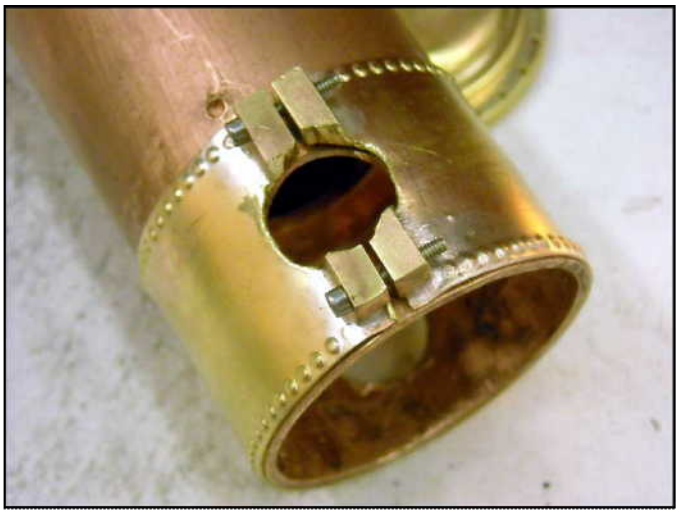
Entire assembly ready for soldering. We used two MAPP torches with the large ends.

Then pressure tested with air in a bucket of water.

Because of the very small scale, I made the sight glass fittings as small as possible using a combination of metric and standard sizes and metric o-rings.

The prototype has rivets around the side of the smokebox so I made a cover for this. Here I am embossing the rivets.

1/8" X 1/8" square stock was silver soldered to the cover and then the relief for the hole was cut out on the band saw before the piece was bent.



The wagon top boiler wrap raises 1/4" so I used a brass rod to keep things in place while I was measuring and cutting the pieces. Unfortunately this is the only shot I have of the process.

Here is the boiler to date. The dings and scratches are filled in with JB Weld. The sides had to be hammered in to allow for the wheel clearance.

The used Ruby eccentrics were replaced because they were worn out. I chucked the worn out part in the collet and turned the larger diameter down to the size I needed.

Then on the mill, I duplicated the setscrew holes on the other side.

I now fit skateboard bearings on the turned portion. I could have made new eccentrics but I now have a set which is factory matched to the valves I have. The ball bearings should ensure a lifetime of maintenance free operation.

Comment Michael Glavin:
Bill: Neat project and your superior craftsmanship too!

Comment Phippsburg Eric:
Bill-- you sure don't mess around!!! You get right to it and it looks great so far.

Comment Steve Shyvers:
Bill: Impressive work, as always. The boring bar in the photo looks like it was ground from an old twist drill? Was it?

(16 Mar 2012) - Reply:
Eric: Thanks.
Steve: It is ground from an end mill. Dennis' invention

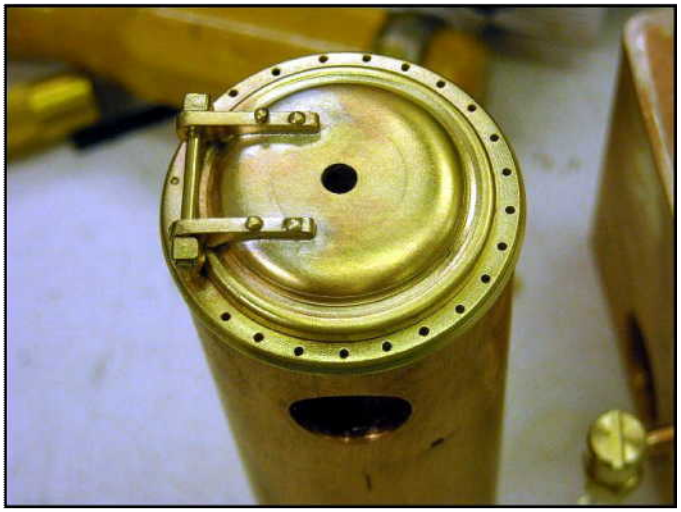
Comment Steve Shyvers:
Bill, Hat's off to Dennis. Tell him I'll pay the same royalty for "borrowing" as I always have. I recently had a notion to use some shanks of old twist drills to make a couple of very small 1/2 round punches, since I couldn't put my hands on any thin-wall steel tubing. The idea came from Colin Binnie's writings, but he used "silver steel". I decided to recycle some old drill bits.

I annealed the drill shank, faced off the end in the lathe, and then bored into the end with a large enough drill bit to leave a hollow tube with a wall thickness of maybe 15 mils or less. Then filed a long tapered flat that removed half of it. I haven't tried to harden it yet. Good project for tomorrow. Not sure whether the shanks of twist drills are the same alloy as is used on the business end. My assumption is "yes", but maybe not typically hardened to the same degree.

Comment Amber:
Ball bearings for the eccentrics, great idea!

(19 Mar 2012) - Update:
Dennis just finished machining the cast iron drivers I got from **Walsall in England** and emailed the photos to me.

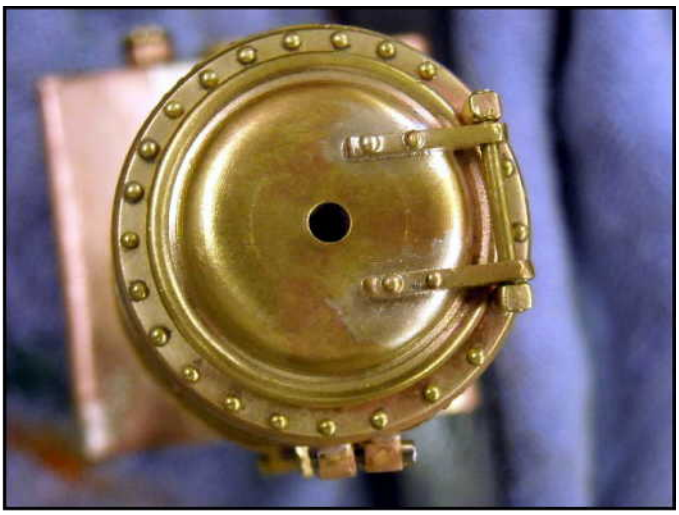
I'll post some higher resolution photos later.

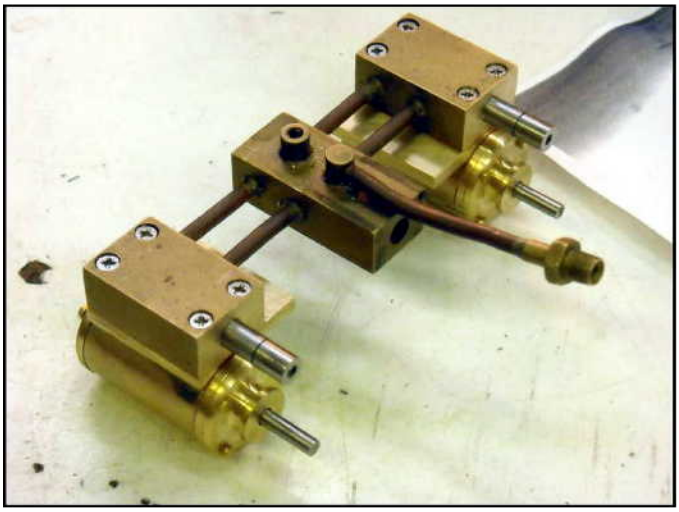


Here is the smoke box front all silver soldered up. The door hinges were super glued in place and then the rivet holes were drilled. It was then taken apart and cleaned in acetone and silver soldered together using the rivets to keep everything aligned.

The 1/32" rivets are set in place with JB Weld, which is a high temp epoxy.

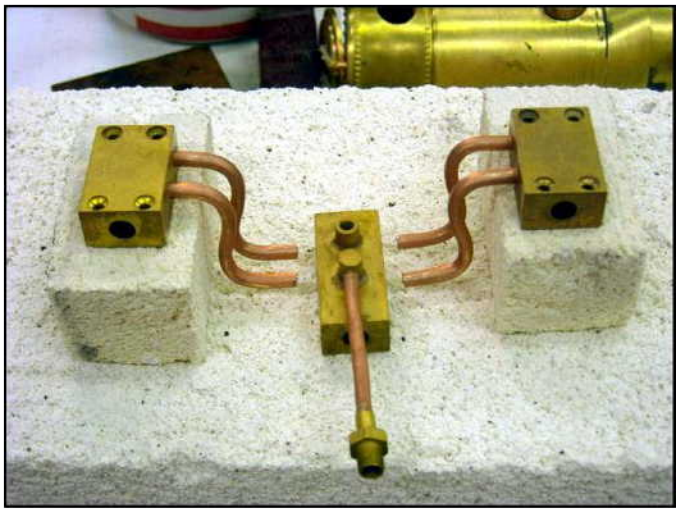
I will add the number plate bracket after I get a chance to see the real thing at the Sacramento RR Museum Tomorrow.

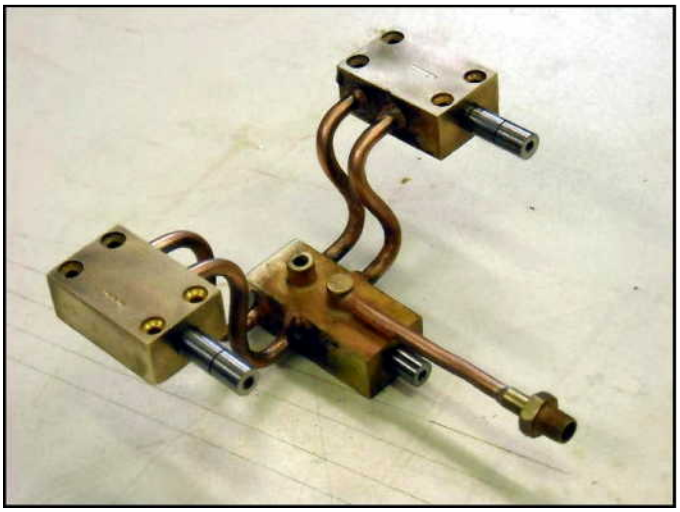




Here is the cylinder and valve setup which looks good except that the smoke box on the Huntington sets much lower than the Ruby smoke box.

I measured the amount of offset I will need and also the horizontal offset to get the exhaust port in the center of the stack. I cut two pieces of foundry brick to that size. I cut off the 3mm ruby tubes and drilled the holes out to 1/8". I then annealed some 1/8" tubing and bent it as shown.





I then soldered everything up with 95/5 solder. I didn't use silver solder as I didn't want the valve bores to get distorted from the high heat.

Comment Dwight Ennis:
Interesting little project you have going here Bill. I haven't commented before now, but I'm following your Build Log. *I like your solution to the small boiler and will be interested to see how it steams and what kind of run times you get.*

(19 Mar 2012) - Reply:
Thanks Dwight: Hopefully it will be more than just once around the track.

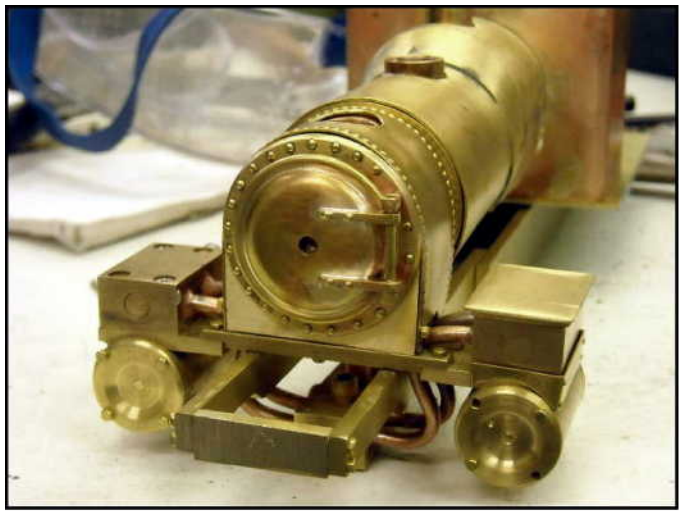
Comment Kenneth Rickman:
I too am following this thread with interest. I did notice one thing, though. Your smokebox seems to be round, but the C.P. Huntington has a "D" smokebox, which the cylinders bolt to, instead of a saddle. Did you make that change intentionally?

Comment Stan Cedarleaf:
Beautiful, Bill.... Just beautiful...

(20 Mar 2012) - Reply:
Stan: Thanks

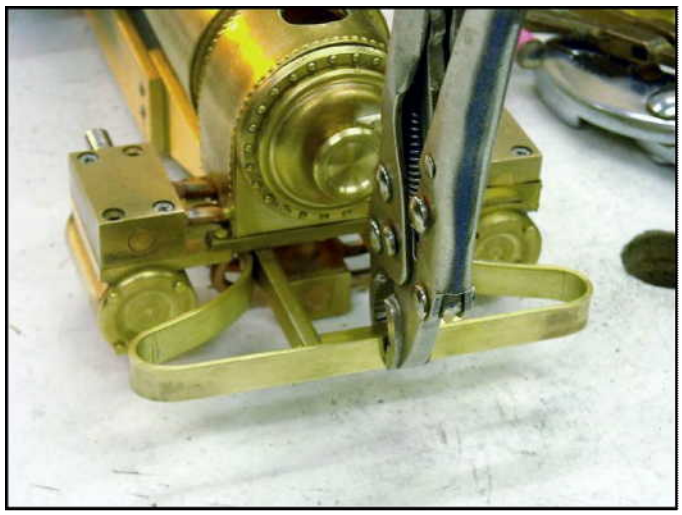
Kenneth: good eye It looked round with a saddle underneath from the photo I had.

I just got back from the museum and indeed it is done that way except there is a D shaped cover, which goes all the way around it. You can see where the two meet only in the rear. Looking at the front, the smokebox does go straight down from the sides. I will probably reconfigure mine to more closely resemble the real thing I took a ton of photos, which I will study tonight



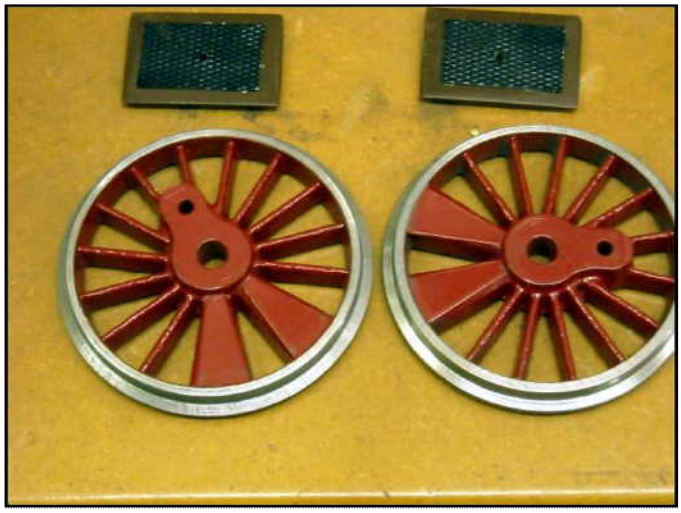
(26 Mar 2012) - Update:
After my visit to Sacramento, I started on some of the things, I couldn't make out from the pictures. The smoke box cover now goes down to form a D shape.

The door is insulated and number plate is attached.

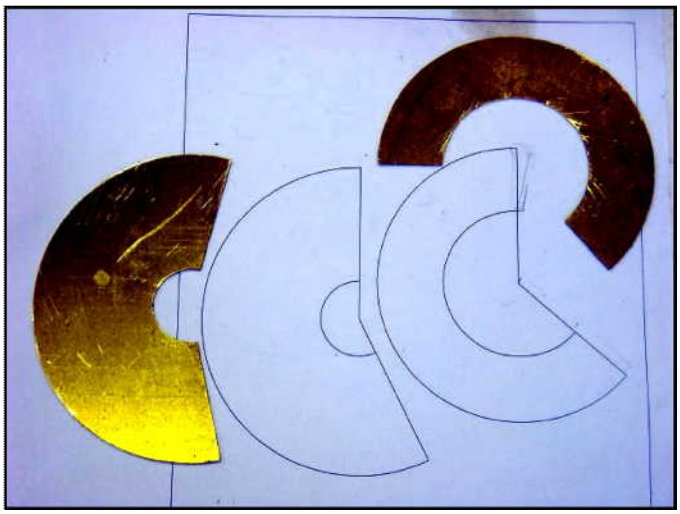


The frame for the pilot is cut, annealed and bent to shape and then held in place for mounting.

Counterweights are cut and set in JB Weld.



Wheels are painted and the tire portion is scraped off and polished on the lathe. The cylinder valve caps get the diamond plate and a paint job.

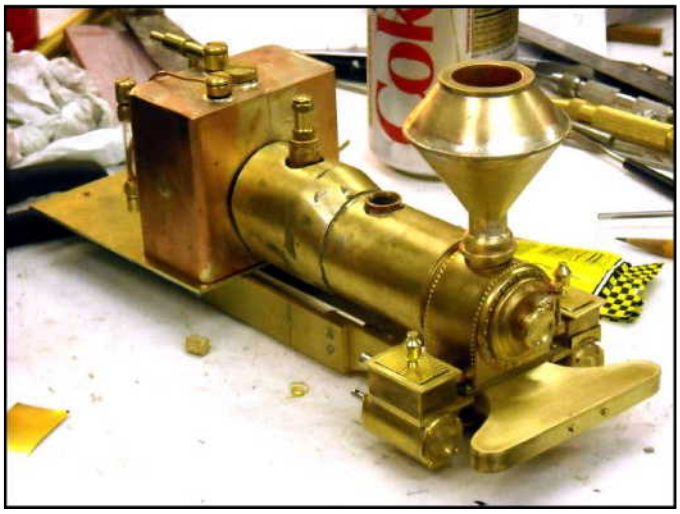


Dennis did a CAD drawing for the stack; I cut the pieces just shy of the line on the band saw and finished the outside with the 1" belt sander and the inside with the spindle sander.

Ready to silver solder.

Here you can see the Ruby base, which was turned down and soldered on the inside. Below are the stock Ruby nut and washer.

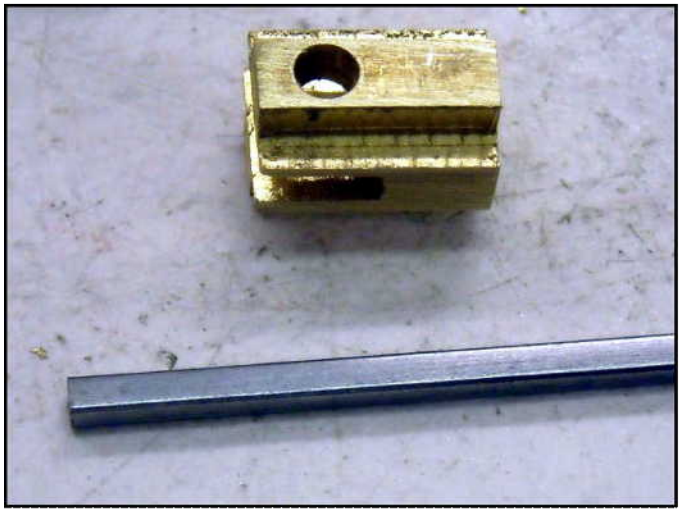
The base looks like this.



Pilot is silver soldered together and mounted.

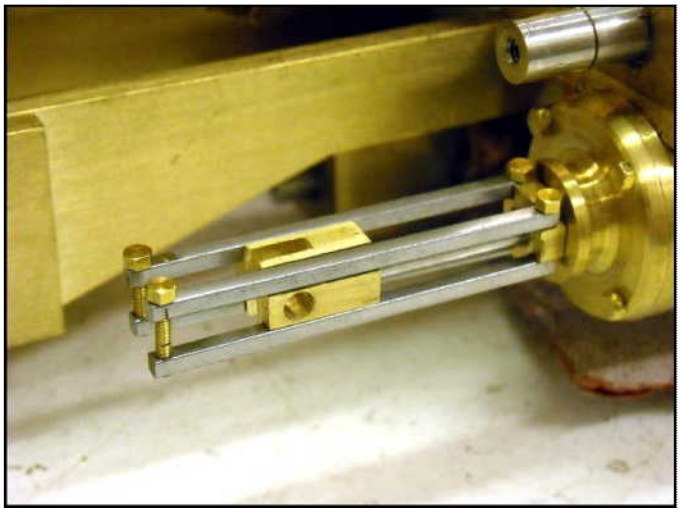
Dennis did the lines on CAD and with a little adjustment; they will be ready to give to Stan for the decal process.

The crosshead took a lot of time to design. The prototype has a four-rail setup with the rails scaling down to 1/16". I start with a piece of 1/4" stock and mill four 1/16" x 1/16" slots.



The pieces I need are then cut from the milled stock and the slot for the drive rod and the hole for the piston rod as well as the setscrew and pivot pin are machined. I couldn't find any 1/16' square stock so I used this high carbon steel. Similar to water hardened drill rod.

The mount at the cylinder is cut from the same stock and bored out to allow the piston rod clearance, the bolts are #00-90.



The brackets on the right will bolt on to the crosshead bracket.

Comment Henner Meinhold:
Bill, your crossheads look beautiful! How did you finally tap them? This loco will definitely join the ranks of "Steam Rolexes."

Comment StevenJ:
Hey Bill, I got some extra Ruby cylinders lying around and a crosshead. You think you could build a second one? LOL Awesome work!

Comment Charles Bednarik:
Bill: Did the engine have a crosshead water pump? I cannot see it in the photo.

(28 Mar 2012) - Reply:
Charles: No it had an injector.

Stephen: Thanks for the compliment. I am glad to see the Ruby cylinders and valves are becoming plentiful. The new 1/2" cylinders come with a complete valve setup so the old valves can be used for different projects. They actually work pretty well if the admission is reversed. I find valve making much more challenging than cylinder making so using the ruby valves saves a lot of time and headaches.

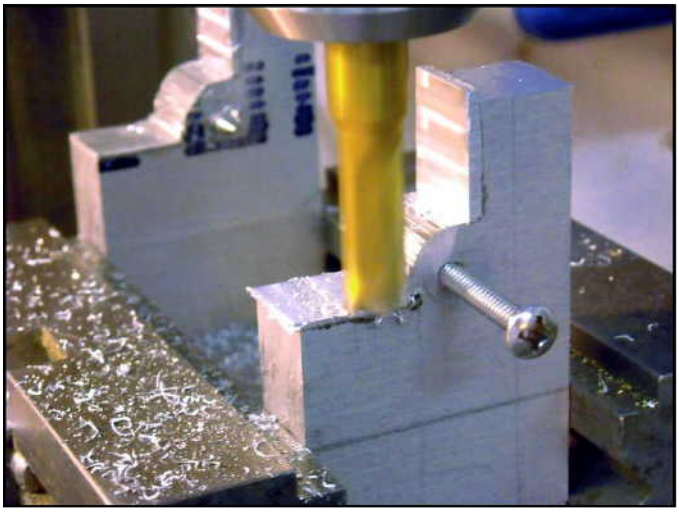
Comment Winn Erdman:
Bill, Beautiful work! I love your solution for a small boiler; I'll be anxious to hear how it works.

(04 Apr 2012) - Update:
Well, I have been busy on the CPH and haven't done much posting so here goes some catch up I didn't get any shots of the cab front roof construction.

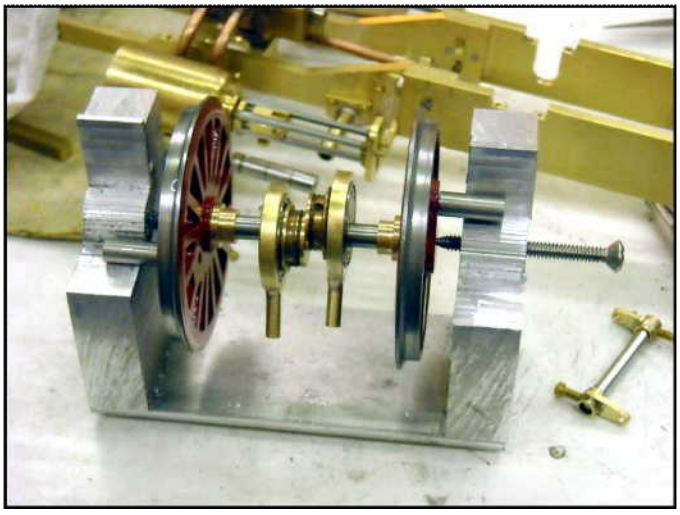
This is the start of the valve linkage bell crank. The tube will have one bushing at each end.

The tubes are set in the brackets for silver soldering.

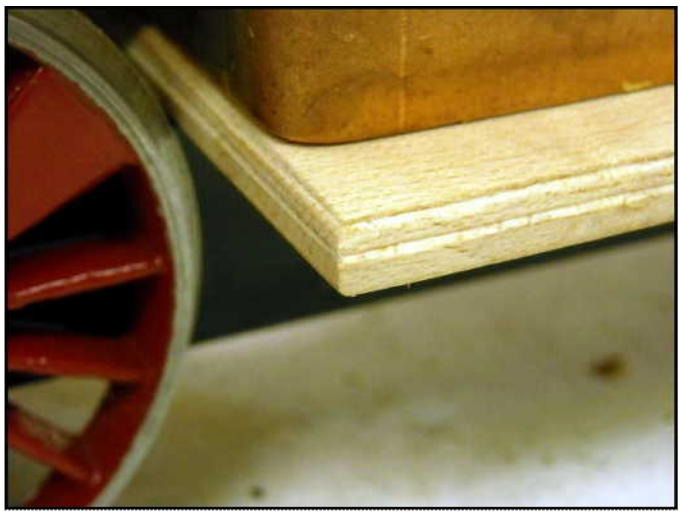
The bushings are then pressed in.



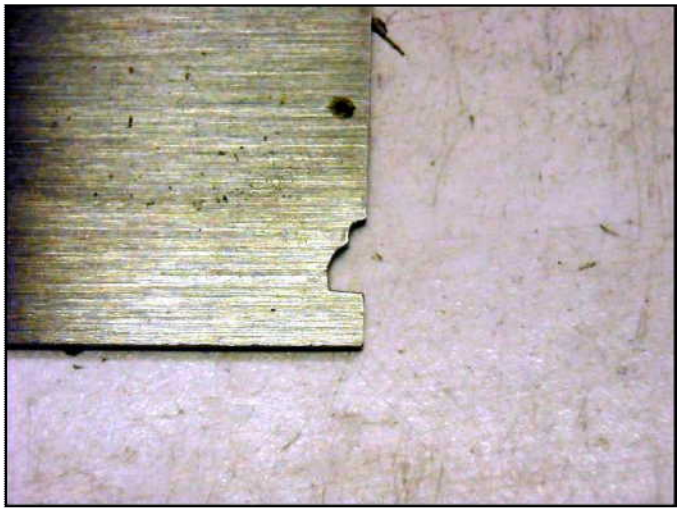
Here I am milling out a homemade quartering jig.



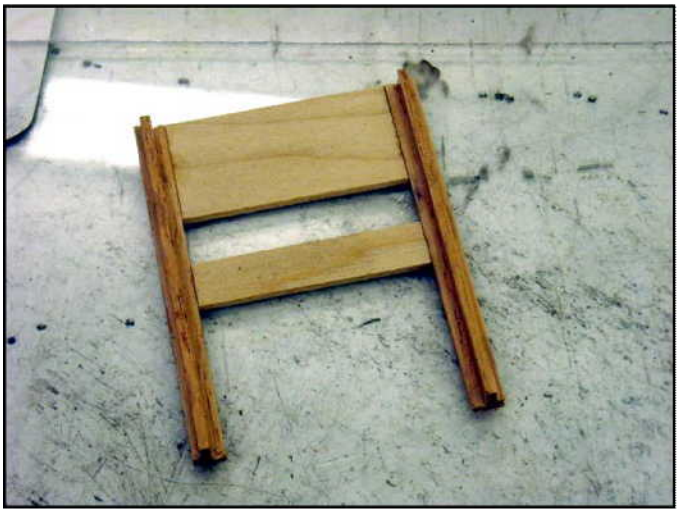
The wheels are then quartered and set with Loctite.



Originally this was to be brass but I found that the original was wood with this detail.

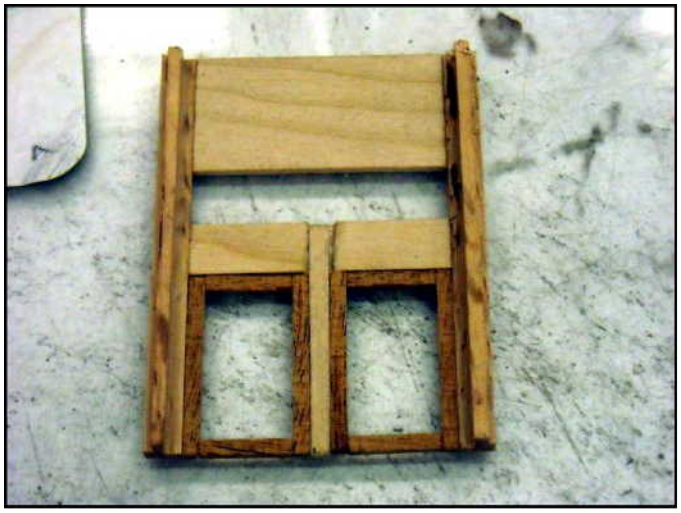


A cabinet scraper was cut to the profile with a Dremel cut off wheel.

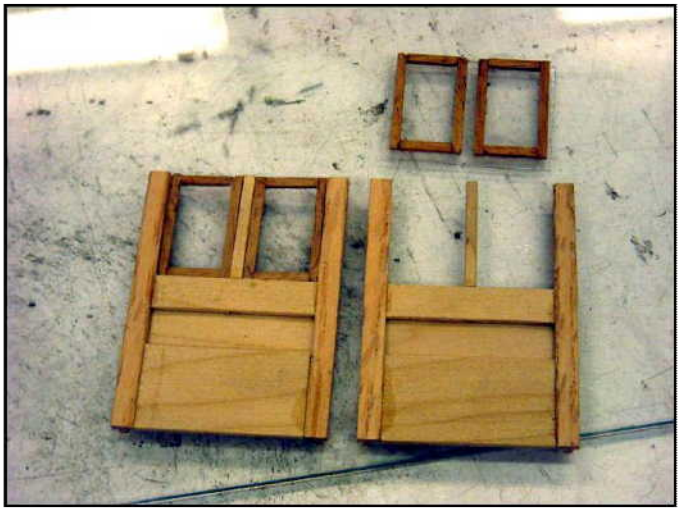


The cab sides are started. The panels are cut from Basswood with oak rails.

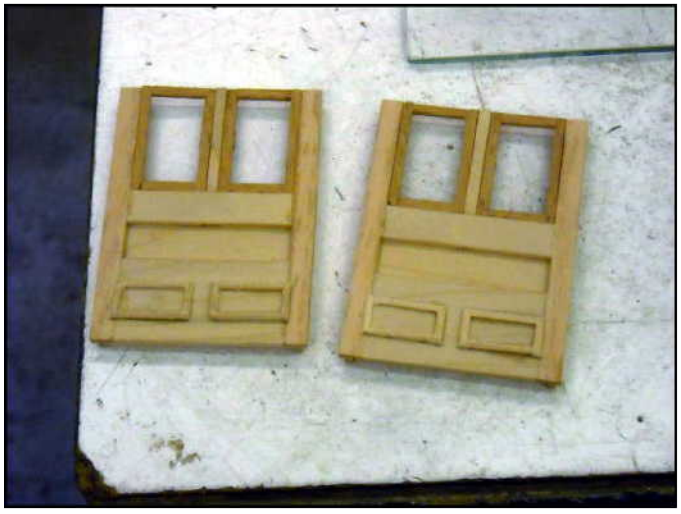
Windows are fitted.



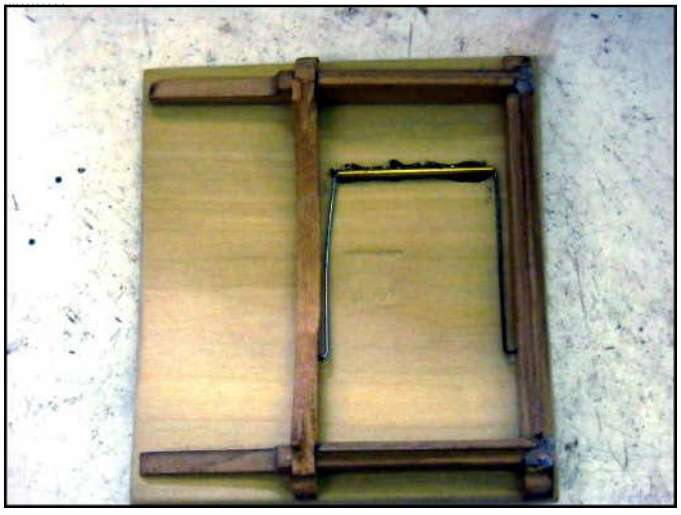
Center rail is set in place and glued.



Mahogany window frames are epoxied to polycarbonate as shown in upper right. They will slide in place and be glued after the cab is painted.

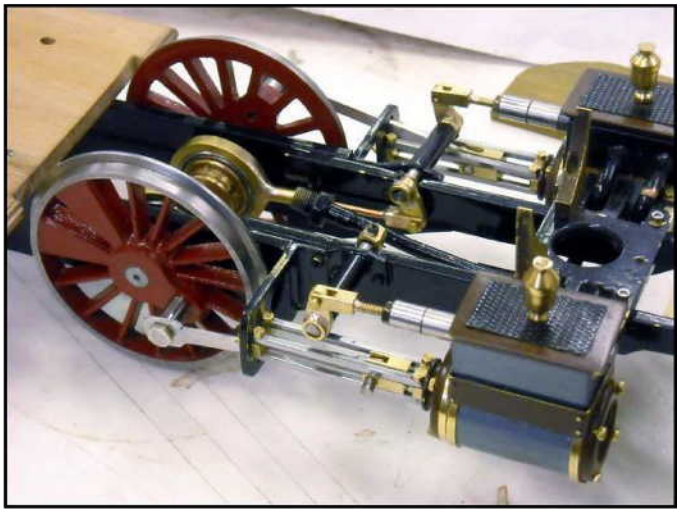


Lower panel detail is added.

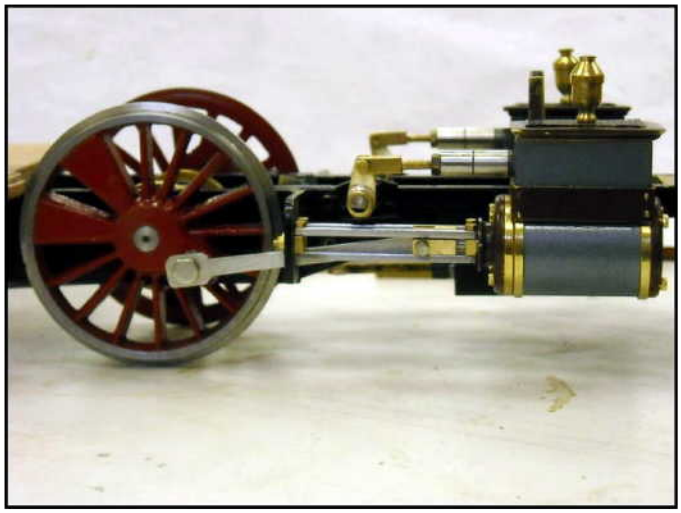


Hinge for roof is attached with JB Weld.

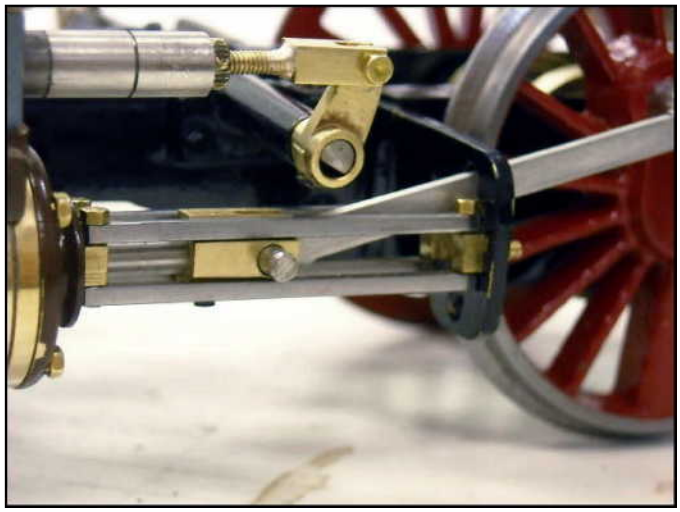
Cab is completed and painted.



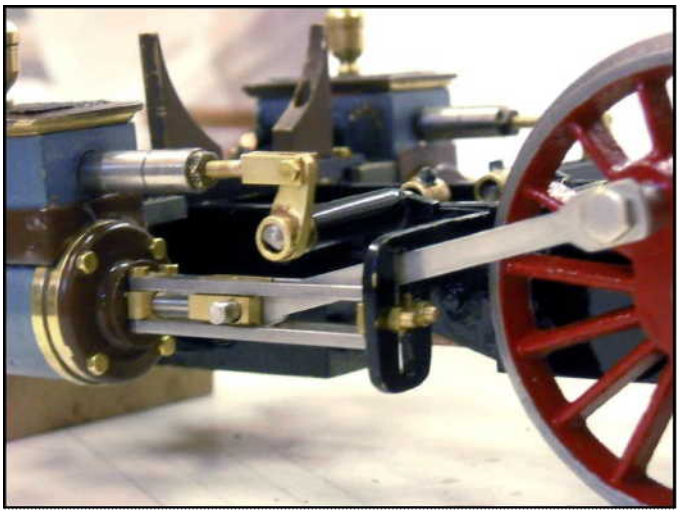
Chassis is assembled and air tested.



Side view.



Crosshead and valve detail. The crank pin is left long for removal and will be cut flush later.



Side rod and nut were machined from brass and then tin-plated.

Boiler wrap is painted silver blue.

Boiler front is brown and the rear is black because of the cab windows need to have a dark interior.

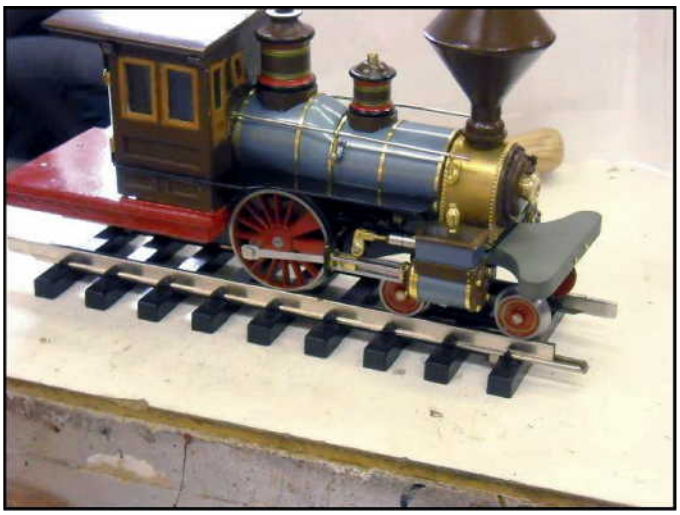
Comment Jason Grimes:

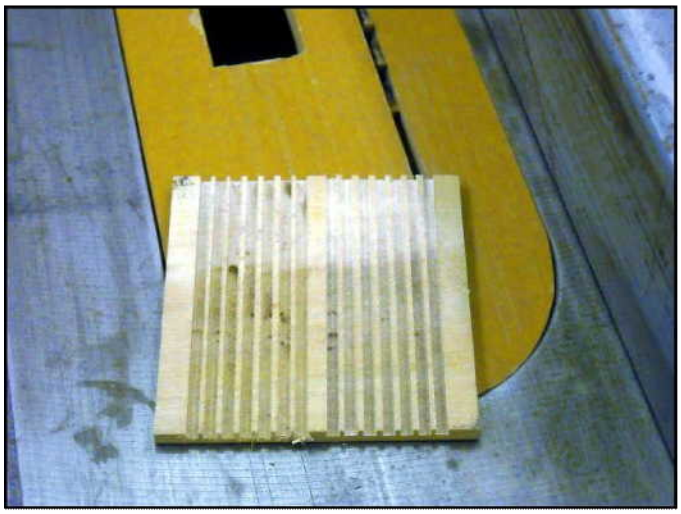
This is so cool; I really like one-armed Billy's. It will be a lot of fun to see it under steam.

(11 Apr 2012) - Update:

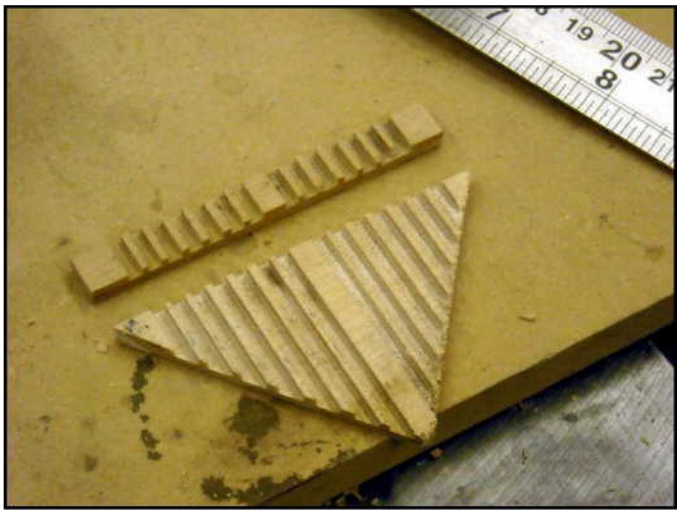
Things are moving along ok I just painted the headlight assembly and I am posting these photos while I am waiting for them to dry.

I turned the domes and Dennis made the octagon bases on his mill with the spindex attachment. I then painted the domes and then, on the lathe, painted the black and red detail with a striping brush and the gold and green with a paint pen with the tip cut down to a chisel point with a razor blade.

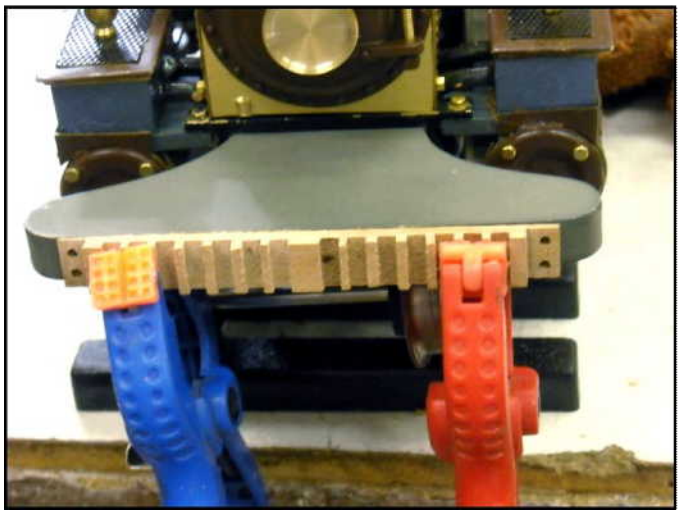




I started the cowcatcher by cutting these groves in a piece of maple with a thin kerf blade on the table saw. The kerf is .100" and the spacing is 5/32". I used the fence and started from the ends cutting both sides before moving the fence. Maple was used for it's strength and painting ability.

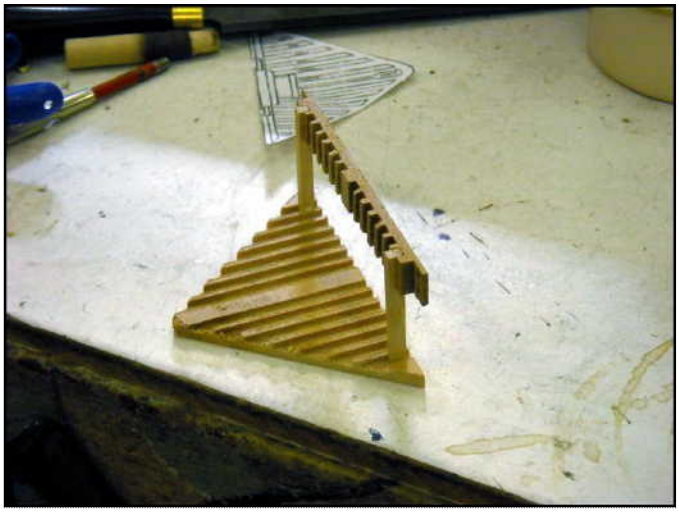


I then cut the upper and lower piece to size and shape.



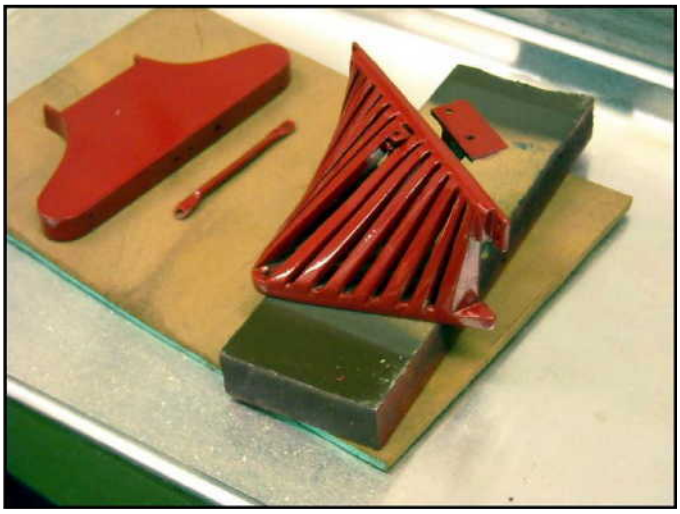
The upper piece is clamped in place and the mounting holes are drilled.

The unit is squared up and the outer vertical rails are glued in place.



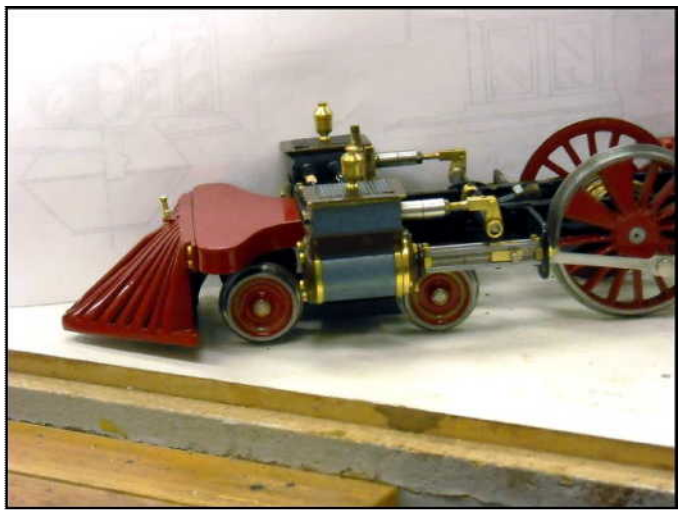
The angle cuts are cut on the rails and they are about 1/4" long to allow for the sanding, which is done after the glue dries.

The flat item you see behind the cowcatcher is a brass reinforcement member which is epoxied to one of the groves on the bottom of the cow catcher and bolted to the frame cross member.



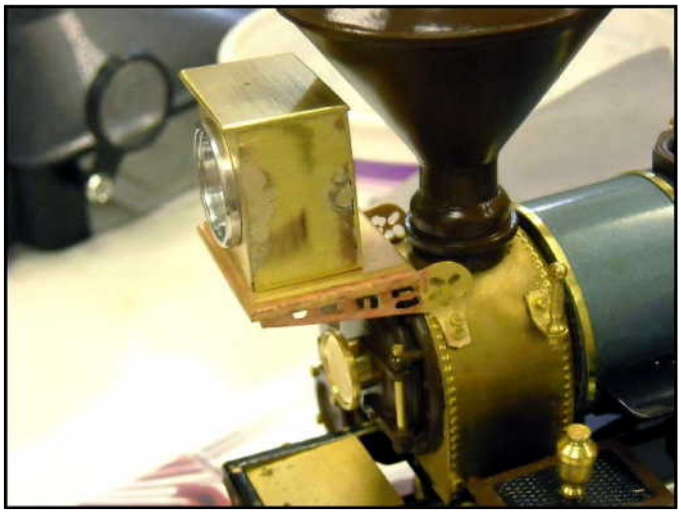
Completed pilot.

The wheels were turned out of steel stock to match the prototype on Dennis' lathe. My 7" x 14" was straining too much for the job. The striping was done on the lathe.



The headlight is formed by silver soldering some 0.025" stock up. The bezel and reflector are turned on the lathe.

The mounting bracket is cut from 0.025" stock and the detail is done with a 1/16" end mill. Screws are #00-90.



A 6v light bulb from Radio Shack is JB'ed to the reflector. One insulated and one stripped 28ga. wire are fed through the 1/16" OD tube (two won't fit).

Comment Richard Jenkins:
Can anybody recommend a good method for getting drool out of a computer keyboard? What a beautiful little gem of a locomotive she is shaping up to be. Great work, Bill!

(11 Apr 2012) - Reply:
Thanks Richard. I was sitting here doing my taxes and feeling low when I saw your response and it cheered me up. Oh well, back to work.

Comment StevenJ:
Only thing I'd done different is build a brass cowcatcher. I have bad luck with wooden ones! Awesome!

Comment Semper Vaporo:
I must chime in on admiring your workmanship. VERY NICE
Like diamond jewelry.
Each piece is exquisite...
However, due to my own personal aesthetic vision, I see only diamond jewelry hanging on an ugly ol' sea cow. When the C.P. Huntington was designed somebody forgot the 2nd set of drivers and ruined the whole thing! I realize that there are those that like the design, and if I hide the lower rear quadrant it is a nice engine, but when the 2nd set of drivers are replaced by the small 4-wheel truck the whole balance is lost.

(11 Apr 2012) - Reply:
Steven: I want to use the same materials as the prototype as much as possible. I have built two other wooden cowcatchers, both out of Mahogany, which is very strong and stains up nicely but does not paint well. The maple is even stronger and you can see how it holds paint.

The cowcatcher I made for my C-16 withstood a 3' nose first dive off my track. It bent the SS frame horns but the cowcatcher remained intact. The secret is the interlocking joints formed by the groves.

It is hard to see but I also have a substantial brass reinforcement on the underside. I will post a shot of that. Also, I would never use any wood other than Maple or Mahogany for one of these.

Semper: The single drive axle is what lured me to making this. Beauty, is in the eye of the beholder

Comment Semper Vaporo:
Yeah, I know. I spent the afternoon one time talking to a nice biologist in Florida that thought Sea-Cows were beautiful! There is just no accounting for taste! 😎 *Beautiful jewelry anyway!*

Comment StevenJ:
Ah ok Billie. I love Bronson Tate's cabs but his cowcatchers are very fragile. I'll never forget that one wood cowcatcher kit I built for my Ruby that got crushed with one foul acorn! Sounds awesome!

Comment Eric Schade:

Bill: The engine is coming along beautifully! She looks kinda like an express Forney!

I have a walnut wood pilot on my number nine. I have dug some cinders with her front end several times. The pilot is fine but I just now looked up (she resides above my monitor) and the brass step next to the pilot was bent. No worries, I bent it back without a problem.

Comment Dwight Ennis:

Outstanding work Bill. She's gonna be a real little gem!

Comment Steve Stockham:

I am enthralled!! You are definitely putting together one gem of a locomotive!

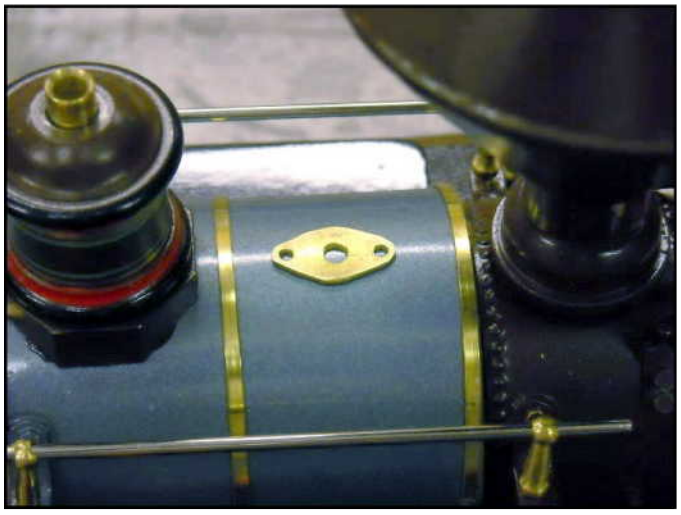
Comment Randy Lehrian:

Outstanding! The attention to detail is incredible. I can't wait to see how it steams.

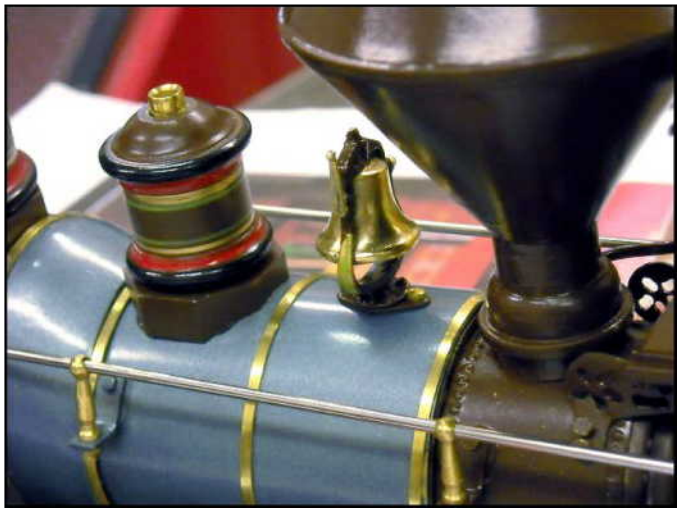
(16 Apr 2012) - Update:

Thank you all for your compliments. I just finished the underside of the chassis and a few other things.

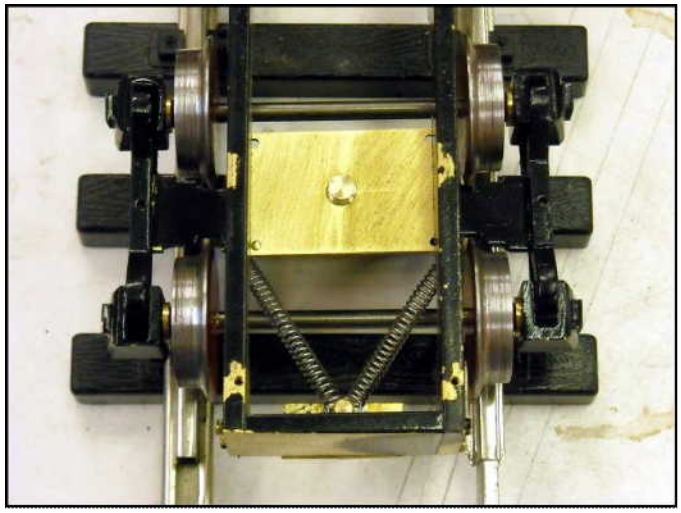
I got a bell casting from a friend. It had to be finished though. I filed off the flashings with a diamond needle file then sanded the bell with 180, 220, 320 and 600 and then polished it on my buffing wheel. Here I am applying a clear coat. The picture is blurry because of the shiny bell reflecting the light.



I made this mounting bracket. The hole in the middle will center the mounting bracket, which will be soldered on.

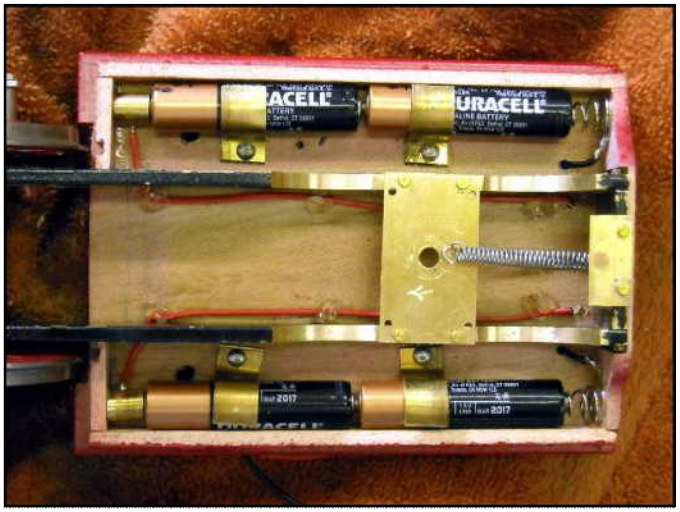


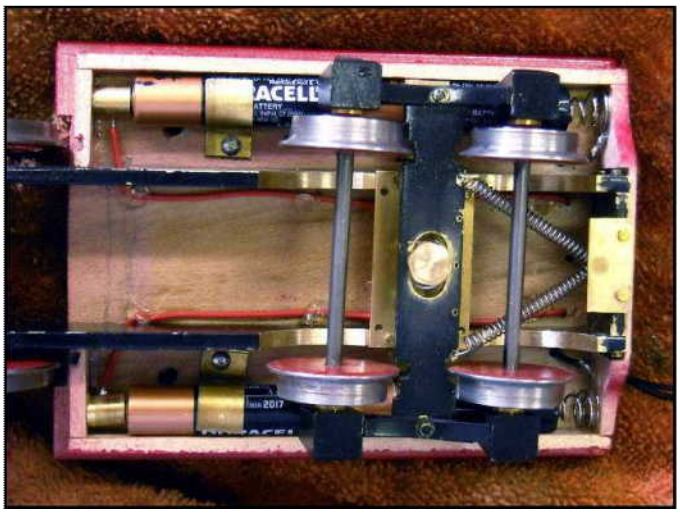
Finished bell. Screws are #00-90.



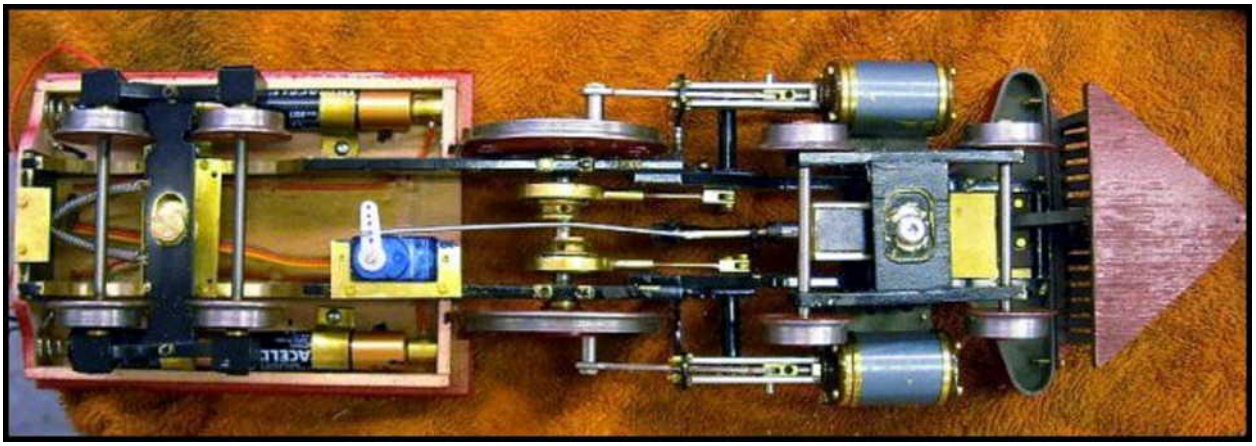
Here is the rear tender truck. Again, Dennis made the wheels. There is a little pivot in the center on each side but other than that there is no lateral movement in the truck it's self. The brass spacers on the outside of the wheels were turned to allow only a few thousands of clearance. On the prototype, these axles are fixed to the frame to keep it on the straight and narrow as there is only one drive axle. Because I will be running on our smaller G scale radii I need some movement thus the springs, which will keep, it centered and brings it back after the turns.

Because everything is so small, this is the only place, which accommodates the batteries. These are AAA's and will be removable by removing the two screws on the left. The batteries on the right slide through their mounting brackets. The springs and brass terminals are epoxied the wood frame. Nothing touches the brass frame.

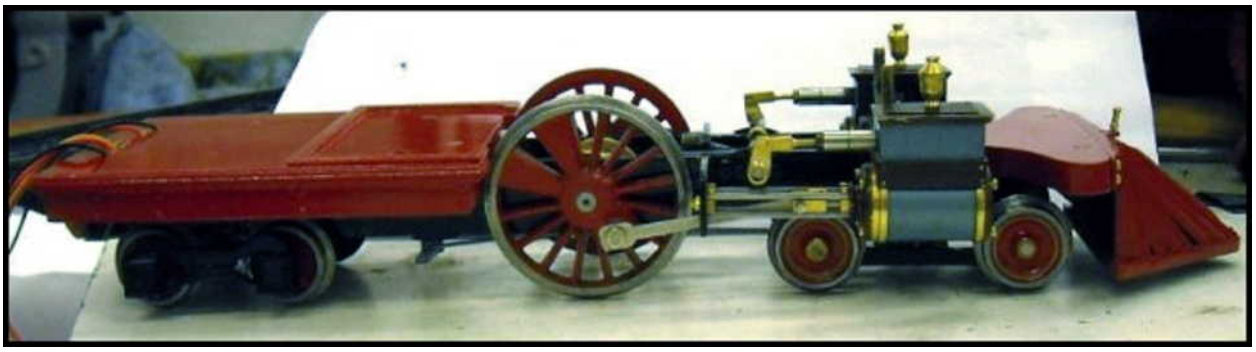




The truck is mounted in place and clearances are checked. You can see the 1/8" lateral movement built in to the assembly.



The reverse servo is mounted and the wire routed. This is a good shot of the cowcatcher brace shown just ahead of the front axle with the two brass screws.



Side view of the chassis with the pony truck in place. Next up, the bunker, fuel tank, lubricator and RC.

> ***Comment Semper Vaporo:***
> *FYI: A "pony truck" has only two wheels. A leading truck with 4 wheels has no specific name other than a "4-wheel leading truck."*

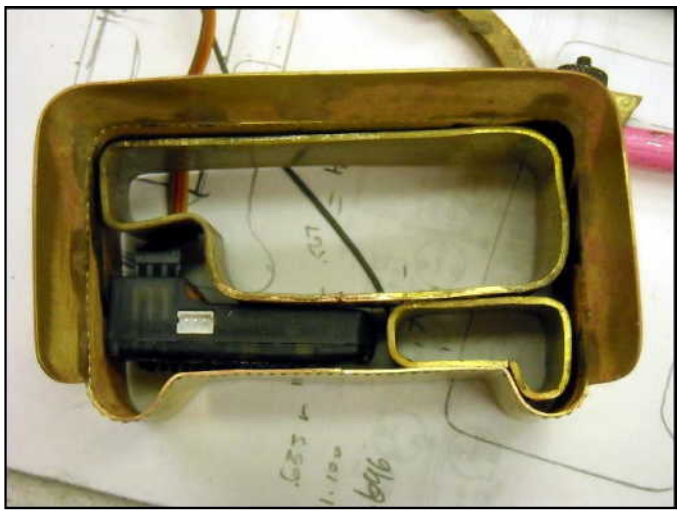
> ***Comment Dwight Ennis:***
> *Generally speaking, the bell rope is on the fireman's side and the whistle cord on the engineer's side - just an FYI.*

(16 Apr 2012) - Reply:
It is amazing how little I know. Thanks for the corrections. Luckily the bell bracket is symmetrical so i can turn it around.

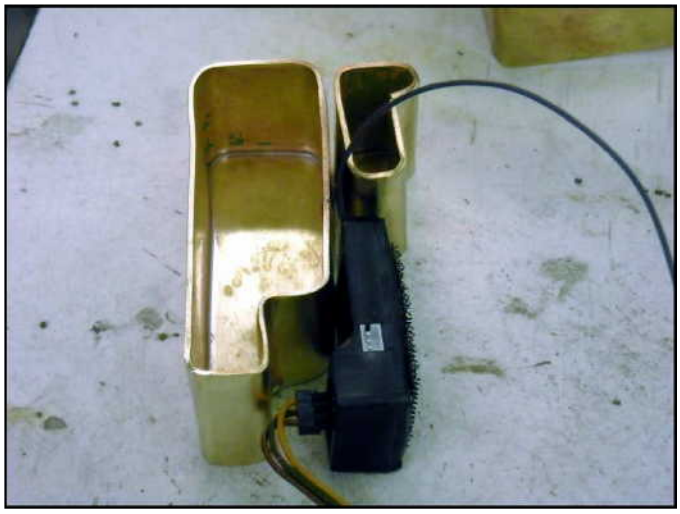
> ***Comment Semper Vaporo:***
> *We're only nit-picking because we are insanely jealous of what you have going!*

(22 Apr 2012) - Update:
I have been putting this off for a while and all of the time trying to figure out how to put all of the working parts in a bunker, which is only 3" wide and has a working height of 1". When you look at a Ruby, you think the fuel tank and lubricator are small but they are 3" high vs. my 1" so I needed to do some shoe-horning.

The lube and fuel tank shells are bent to shape from 1/16" brass and fitted with the RC receiver.



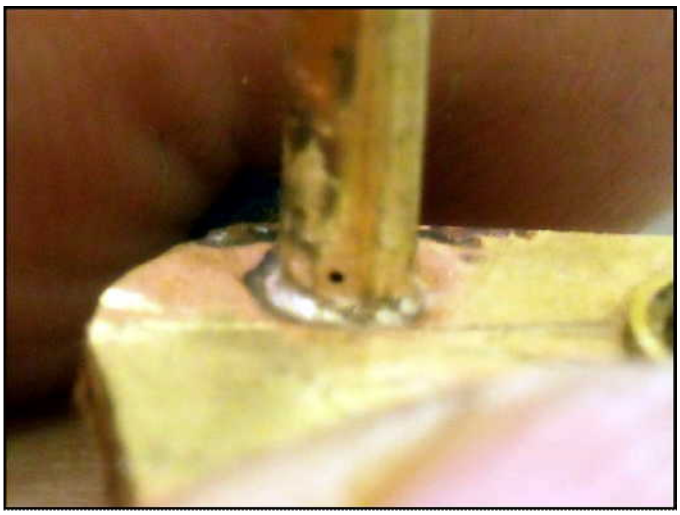
The bunker is rivet embossed, bent, and soldered 0.025" brass sheet is used.



The three components.

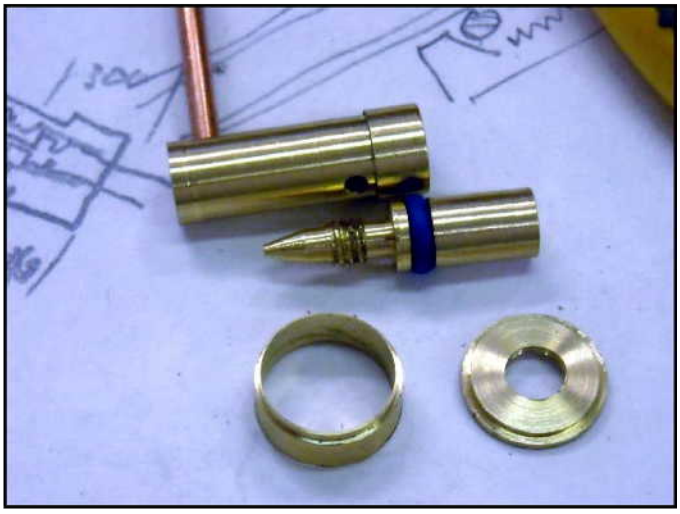
Ready for the tops now.

The lubricator is a pass-through design. The .0135" hole is drilled with a #80 bit after the tube is silver soldered on and before the top is attached.



The completed lubricator has the inlet and filler plug at the top and an offset outlet manifold at the bottom which is set in the bunker floor. Tube at the bottom goes directly to the cylinder valve.

The fuel valve is at the top and the filler riser on the bottom. The 5mm x .5 Accucraft filler valve will be used.

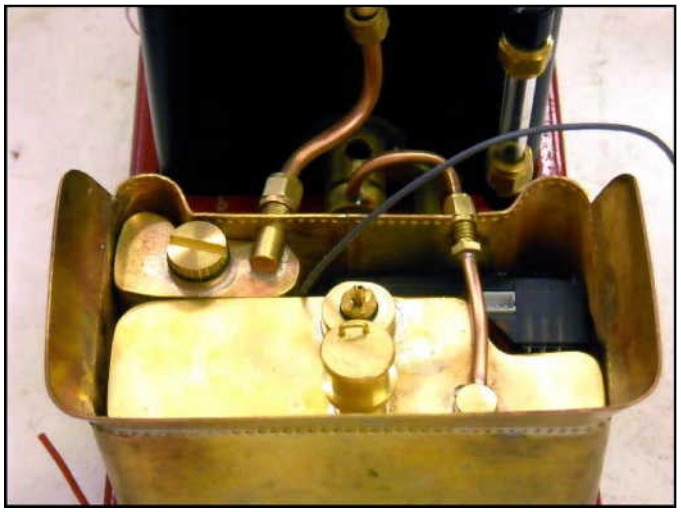


Here is the underside of the fuel tank top. The valve is on the left. The hole at the base is where the gas is picked up and the tube at the top goes to a solder fitting and then to the jet. The filler riser is on the right.

The completed tank shows the filler at the bottom, the valve at the top and the outlet on the left. There is a hole in the outlet, which does not show in the picture.

The tank is gassed up and checked in warm water for leaks.

The bunker is so close to the boiler that I had to cut down the burner tube, the jet and the jet holder. Here you see a complete assembly, which is the same size as the original burner alone. This setup will allow for removing the jet without removing the bunker.



Finished setup with tubing installed.

Comment Eric Schade:

Wowee!!! That is slick! Great work Bill! Where did you get the filler valve for the gas tank?

(23 Apr 2012) - Reply:

Eric: From Cliff at Accucraft $7.00 each. The Accucraft valve has a nice big vent hole where generic valves vent through the space between the filler tube and the valve body You just need to make sure your mount is no thicker than 1/16" or you will block the vent hole. If you need a riser like the one I did, it should be wide enough to allow the fluid to pass by the venting gas

(27 Apr 2012) - Update:

Well I am getting near the end. I have a few more detail parts to make and then disassemble and install the decals, which I will be getting from Stan Cederleaf. I took some shots prior to the disassembly.

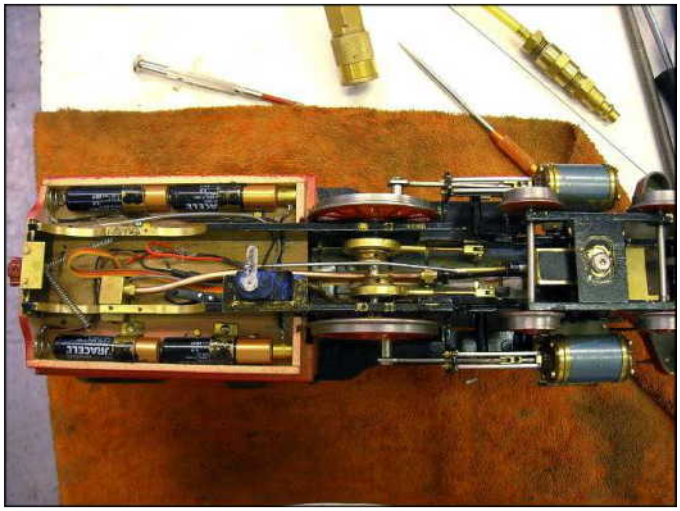
I used 14 ga. copper wire to make the bunker beading with the scroll detail per the original. The prototype has a horseshoe shaped bunker but I needed more room so I made the rivet detail on the cover in that shape, as I understand that an oil tank was added on later so the center section represents the added tank.

The flagpoles are chrome plated so I used SS to duplicate them. These pieces were done on the lathe and then sanded and polished while still on the lathe.

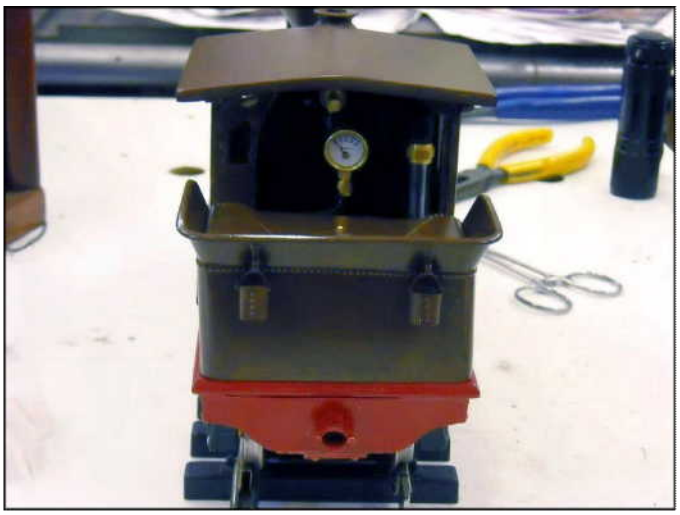
The number was cut on the band saw and cleaned up with a needle file. I learned this trick on this Forum - I think from Eric.

The number is soldered on.

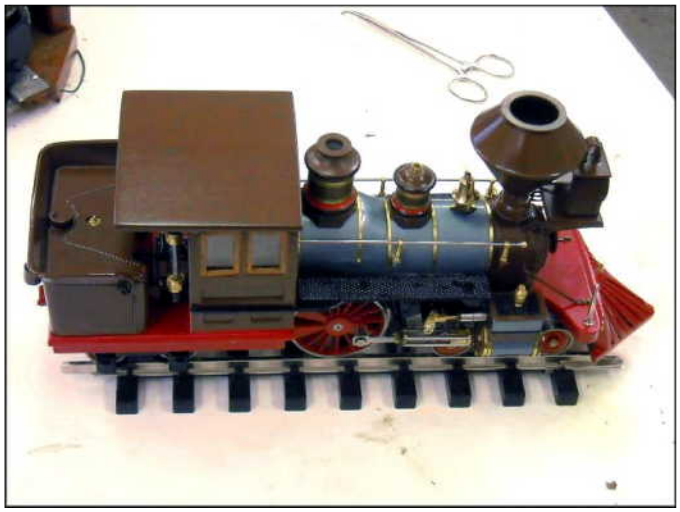
Here is a bottom shot with the rear truck removed you can see how the steam line hooks up to the lubricator. The micro connectors with the white dots are for the battery switch and the lights. The servo for reverse will also control the speed. Below are shots from different angles Big brother is in the background.



The buckets were made from 0.010" brass sheet. The coupler was turned from round brass stock, annealed and then flattened out in the vise. The rest of the detail was done in the mill. You can just barely see the toggle switch for the battery under the roof on the left side. The throttle valve is under the center of the roof. I haven't decided on the handle I will use.



You can see the servo and rod between the drivers and rear truck. This will be covered with a replica of the extra water tank used on the original.



I'm not sure I like the running board diamond plate. I used a mesh and the epoxy came through in a few places causing the shiny areas. Dennis says it just looks like oil or grease spots but I am not sure. I painted some flat black on it last night and if it doesn't work, I may try something else.

Comment Charles Bednarik:
Bill, Very anxious to see that outstanding craftsmanship on the track!

Comment Richard Jenkins:
We'll be expecting a full report on her first steam-up, I'm sure we're all interested to see how the box-T-boiler performs. She looks spectacular!

Comment Ray Cadd:
Very nice. Q- when cutting your stack material on the band saw, what gauge metal, speed, and what size (tpi) blade did you use?

Comment Pete Thornton:
Awesome! A beautiful model. I want one - can't you ask Accucraft to make a run of them for us?

(27 Apr 2012) - Reply:
Thanks for the compliments.

On the boiler, I checked the capacity this morning and it is 180 ML and a Ruby is 120 ML so I should be able to go 20 - 30 minutes before refilling through the goodall valve. It's ready to run but I don't want to get any oil on it before the decals go on.

On the stack, it is cut from 0.025" brass sheet. There is a company near me that sells new and recycled metals and there seems to be a lot of remnants in this size. I usually anneal it by heating it with a butane or MAPP torch till it is red. This makes it easier to bend and keeps it from springing back. It softens and weakens the material somewhat but with the 0.025" thickness it is still plenty strong. The thickness also allows drilling and tapping holes to mount things when you use it for a boiler wrap.

I have a 1/4" metal cutting blade and an 8-tooth wood cutting blade on a 16" Jet band saw. It has only one speed as it is designed for wood. Either blade works well with the 0.025" stock but if I need real fine work (like on the number "1") or am using thin material, I use the metal blade.

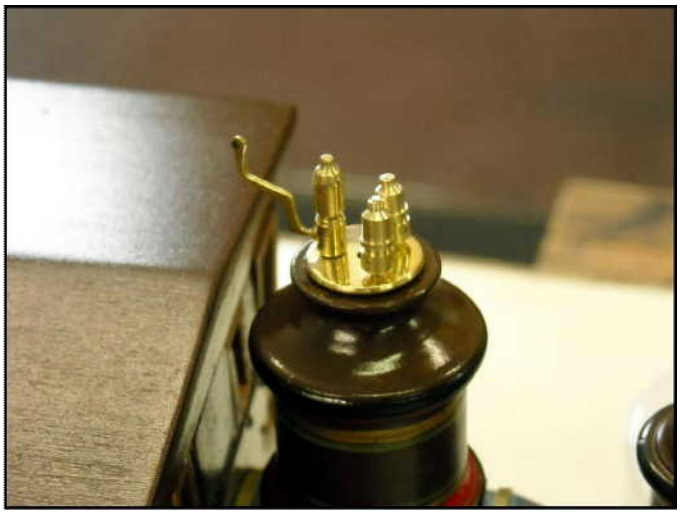
When I cut the material, I only go to the line with the band saw and then use the 1" belt sander and the oscillating spindle sander or sometimes files to take out the line. This gives a perfect fit and takes out the band saw blade marks. You really only need a slow speed for cutting steel.

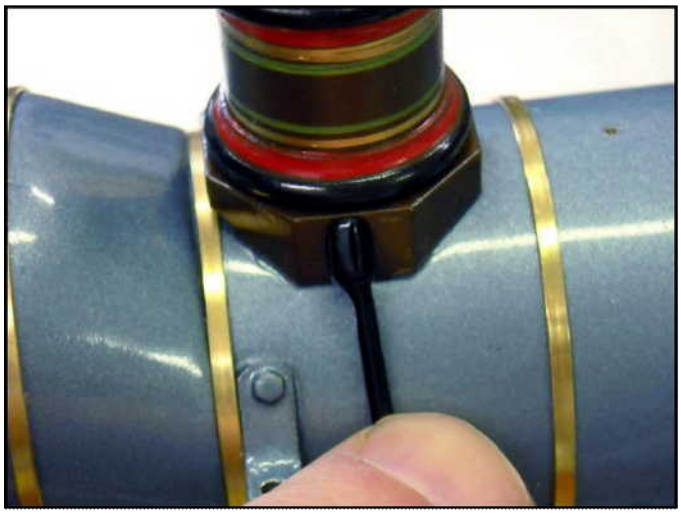
Comment StevenJ:
You run it all on air? Is the throttle going to be r/c or just the reverse? I have a Pearse switcher setup with no r/c on the throttle but the reverse is r/c. It does work for piston reversers but it is not the smoothest way to drive a train. If you ever want to sell it let me know! j/k Great job!

(27 Apr 2012) - Reply:
Steven: Yes I will only have the reverse on a servo. I will probably set the running speed with the manual throttle and tweak it with the reverser. I have actually had good luck controlling the piston reversed trains that way but you are right it becomes very sensitive. I ran it and tuned it up on air so it should be good to go.

(05 May 2012) - Update:
Well I am nearing completion; I decaled the parts last night and clear coated them today so everything should be ready for assembly tomorrow. Finished up a few detail parts last week while waiting for the decals to come in.

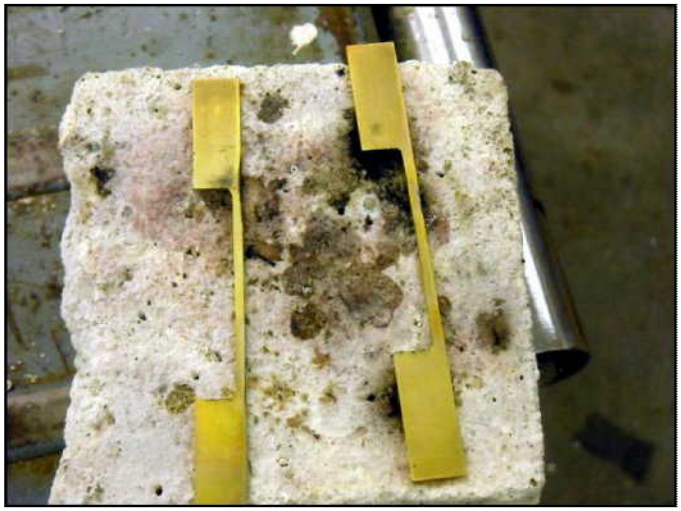
Detail parts are turned and added to the steam dome.





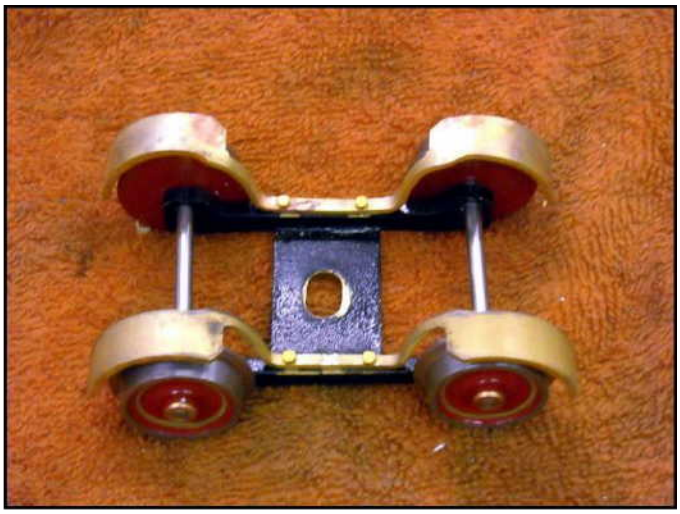
Sand pipe and angle fitting are added to the sand dome base. This will be JB'ed after the base decal is installed.

Pilot fender blanks are roughed out on the band saw and annealed.



Pieces are bent to shape and final markings are made in place. Then the 1" belt sander is used to finish to the line.

Final adjustments are made for proper clearance. The cut out part in the middle is to clear the cylinders.



Painted and ready for mounting.

Comment Randy Lehrian:

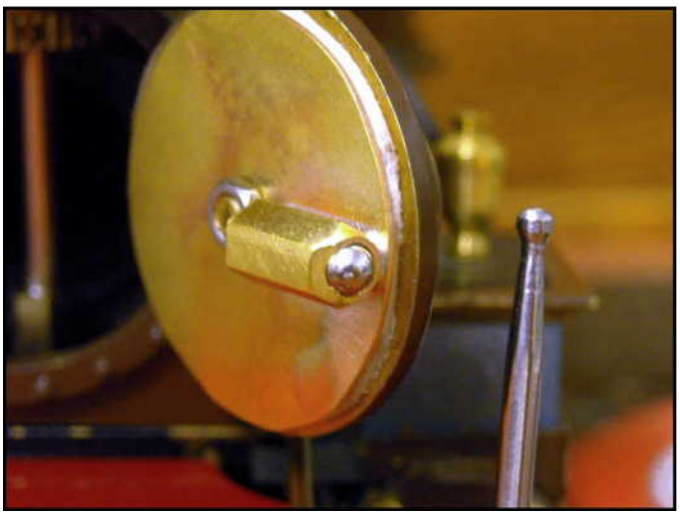
Wow, just wow. Even the pilot truck is a fiddley work of art! Please don't leave us hang long, we need to see this thing steam. Did you come to a decision on you diamond plate running boards?

(06 May 2012) - Reply/Update:

Hi Randy: The flat black on the running boards works out ok. I should be giving it a steam run next week.

Here are some shots of it decaled.

Here you can see the rosewood throttle handle above the pressure gauge and the hand made buckets.



Spring loaded ball catch for the smoke box door.

Comment Henner Meinhold:
Bill, did the Solvaset work?

Comment Steve Stockham:
Oh man!! That turned out fantastic!!!

Comment Gerd:
Awesome work !!!!

Comment Chuck *(MLS - chuckger)**:***
Hi Bill, Super build, great work and thanks for the explanation on how you built the cowcatcher.

(07 May 2012) - Reply:
Hi Henner: On the stack decal... I forgot your directions and couldn't find the Train Shop in the navigator and got lost. I was late in getting back home so I never picked it up. After I got home, I looked it over and decided it wasn't that bad so I clear coated it and it actually came out pretty good. My main concern was that any bubbles might cause a problem in the high heat areas but I used clear engine enamel (500 F) so I will give it a try. If it lifts, I will just redo it

Comment Eric Schade:
Bill: She looks great! The decals and painting really give it the final glory. Can't wait to see how she performs.

Comment StevenJ:
It does look really good. Great job!

(09 May 2012) - Update:
Well, I have the answer to the question many of you were asking.

Will this contraption run?

I gave her a couple of runs today and it was great. She came up to 40psi in about five minutes or so. I had the gas on low, as I am not familiar with it yet. It had a little condensation, which cleared out with a couple of forward and reverse shifts on the R/C and took off pulling three small cars.

The speed is adjustable from a slow prototypical speed to about 150 mph. Even though it is a sunny day, the plume was nice and the chuff is noticeable because the diamond stack is actually a chuff box (Dennis' design). It ran about 20 minutes and then ran out of gas with some water still on the sight glass.

On the second run, I added two cars but it didn't seem to make any difference. The lubricator worked as planned with the #80 hole but it actually could have been smaller. It uses about 1/4 the amount of oil as the Ruby does and I should be able to get 6 or 8 runs out of a tank full The plan was to have the lubricator heat the gas tank and the gas tank cool the lubricator. I think it is working as the lubricator was at 120F and the gas tank at 85F at the end of both runs. It's about 80F outside.

In the future, I'll probably top off the gas after reaching pressure. I am having some friends over Saturday to run trains and hope to post some videos of it next week.

Comment Charles Bednarik:
Bill: Great accomplishment, hope the next run will allow us to enjoy your steam re-creation of a historic locomotive.

Comment Henner Meinhold:
Bill, congratulation to the successful run! I know this was a fiddly project. Do we need to christen it with a Champagne bottle on Saturday?

(09 May 2012) - Reply:
Henner: I actually have a 1/32 Champagne bottle Dennis gave me. I will try to find it for Saturday

Comment Stan Cedarleaf:
Bill, it turned out fantastic. The stack decals look great... 👍👍👍👍👍 *Glad you have it done.*

Comment Steve Stockham:
"It is ALIVE!!!" Seriously, a fantastic job! Bravo!!

Comment Winn Erdman:
Bill, That is a fabulous work of art! I can't believe how fast you got it done. My live steam Bogie using Fletcher's drawings took about 2 1/2 years! Thanks for sharing; you have some great ideas on how to do things.

(11 May 2012) - Reply:
Stan, Steve & Winn: Thanks for the compliments.

Winn: That was pretty fast. I had to go back to check my first posting on March 16 which was a day or two after I started work. But, I have been thinking about the project for a couple of years so even though I didn't have plans drawn up, I kind of knew how I was going to go about it.

I actually went up to the Sacramento museum library and got photos and drawings a couple of years before I started the project and decided it would be too hard to do so I decided a Garratt would be easier.

Surprisingly, I find that I am able to keep things going by making most of the stuff my self rather than waiting for something to be shipped and then to find out it isn't the right thing My friend Dennis Mead helps me a lot on some of the more difficult machining jobs and puts my drawings into CAD which is helpful in the build and is good for future reference. He made the octagon dome bases and the pilot and trailing wheels

Comment Norman:
Hi Bill Allen: Have you thought of having a local US firm mfg a qty of these? What would be the required retail price?

(13 May 2012) - Update:
Here is a video of the Huntington at my house yesterday. Please excuse the rolling stock, it was the only thing I had around that was close to scale. I will be making some cars for it. If anyone has some info or photos of 1860 - 1910 cars, I would appreciate it. Actually, post 1911 would work too as that was the date the original was restored.

To answer the question about having a company make these, I would think that it would be too expensive to produce and sell at a reasonable price. I believe Delron made a brass electric model a few years ago but the scale, colors and some of the material was off. I think it sold somewhere in the $2k range

Comment Steve Shyvers:
Just looked at the video. Fantastic. Bravo!

(13 May 2012) - Reply:
Steve: Thanks.

I forgot to post this photo of my little guy next to Joel Taylor's Coal fired K-28

Comment Jason Grimes:
So cool, looks great! Doesn't appear like it has any problem keeping the steam pressure up too. :)

Comment Stan Cedarleaf:
Wonderful video, Bill. Runs like a champ... Love the "Specially Designed, Hi Tech" coupler.... 👍👍👍👍👍

(13 May 2012) - Reply:
Jason: No problem on the steam at all. Runs as planned.

Stan: Yes, the coupler took a lot of tome on the CAD and 3-D printer. The decals are nice also

Comment Henner Meinhold:

Bill: Thanks again for a wonderful day! Both your locos ran flawlessly. I was surprised, how well the Huntington kept up steam, even with the heavy train and full speed. The photo above is quite interesting: The Russian iron looks gray in the shade and turns to blue in full sunshine with the blue sky reflecting. Exactly what the experts say all along.

Comment Norman:

Hi Bill: This is super neat. What is the run time on the model?

The T boiler filling the inside of the cab is not a negative at all. Rather it is a plus as this makes the throttle lever and steam gauge more accessible.

Can you post a summary of model line drawing plans and step-by-step construction similar to what Dave Fletcher did for his MasterClass Series? I believe several folks would like to build this loco.

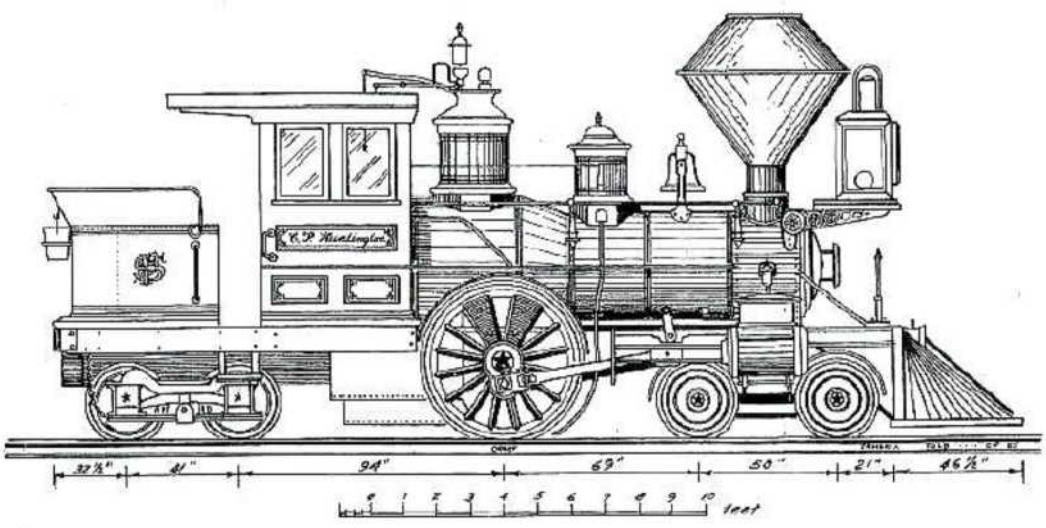
(14 May 2012) - Reply:

Norman: I haven't timed it yet but I think it is about 20 minutes before it runs out of gas. There is still a little water left at that time. I could probably lengthen the time bu cutting the gas down so that the pop off doesn't go off and run it at a more prototypical speed but it is more fun doing Indy 500 version for now.

I haven't seen David Fletcher's series. From what I understand it has been lost in the archives so I don't know how he did it.

I tried to document most of what I did in this build log. I thought I had posted the drawing but I just looked and it is not here. I'll send what I have in a few minutes.

Here is the drawing of the CP Huntington I used to get my dimensions. I saved the file and printed it out to the scale I needed using the percentage tool in the printer. From that I was able to measure every part with my calipers. I have the original files from the museum but they are in bitmap and I can't get them in here. On this one, I printed it and then scanned it into my computer in jpeg. I can email the files I have which include the top and front/back view if you send me a private message with your email address



My scale is 1/29 so I just divided the scale by 29 and reduced till I got the right number on the print out.

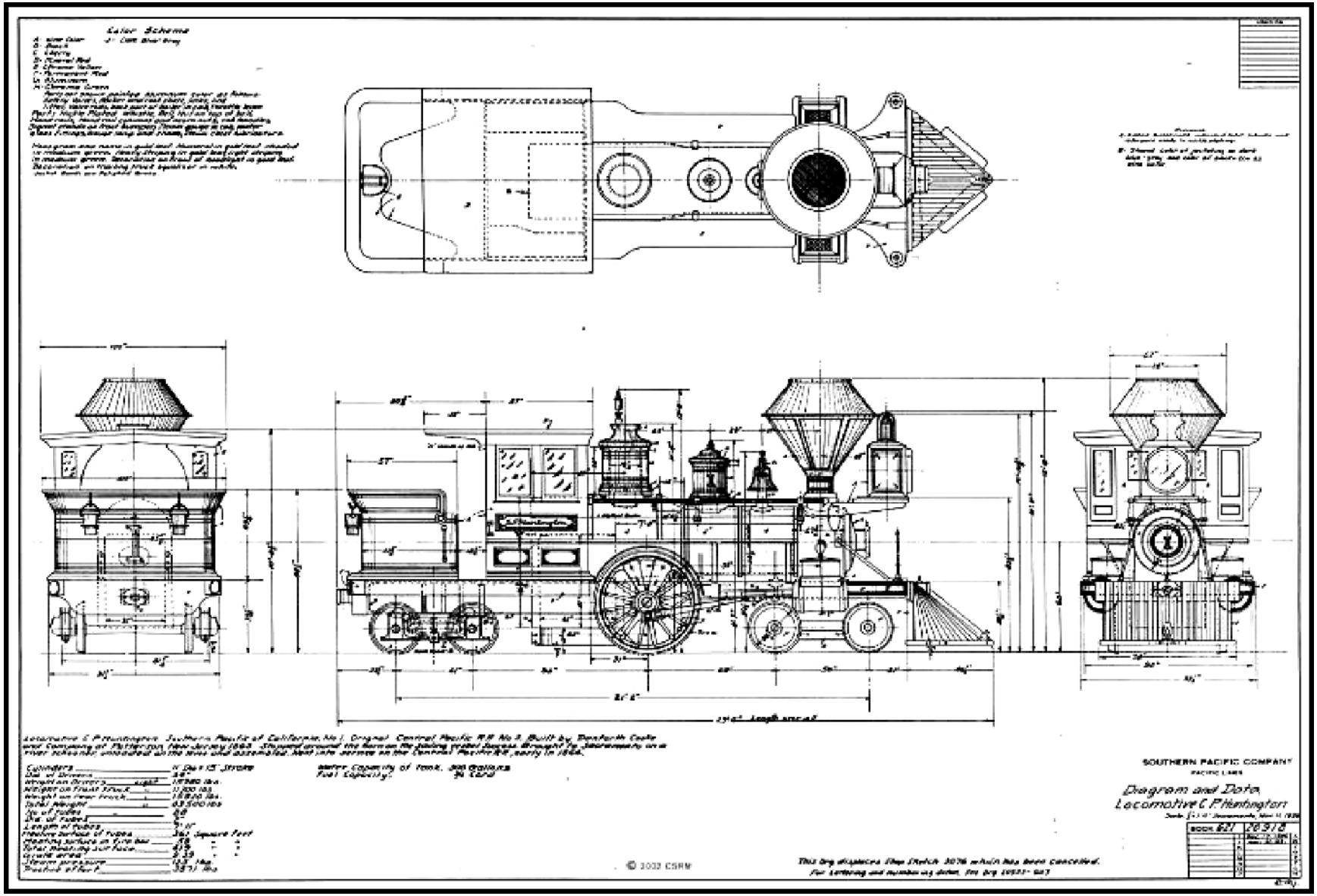
(14 May 2012) - Update:
Henner was able to convert all on the drawings I have to Jpeg. Also in his previous posting he mentioned about the changes in color when the engine is in the sunlight under a clear blue sky how it reflected the blue color. I tried several different paints before I decided on this color, which most closely matches the restored original (see end of this file for larger drawings).

> ***Comment Norman:***
> *Hi Bill: Which drivers did you order from England. Company and specific cast driver?*
> *Running the loco with the pop valve lifting is actually fun to watch. Do you have a bark box in the stack?*
> *I like the wagon top boiler, cab, stack, oil headlamp and cowcatcher of the CP Huntington. The single driver is a love / hate opinion for me. However, watching your model run under steam makes it all look great.*
> *The Disneyland Ward Kimball loco (but then altered) with fluted domes, diamond stack, flat panel roof cab and cowcatcher as per the CP Huntington is the most attractive combination for my tastes. Similar to the HLW "Princess" loco freelance design.*
> *Has Cliff at Accucraft seen the finished model in person? This would be a nice follow up to the Mason Bogie project if it could retail under the 1,500.00 mark.*

(15 May 2012) - Reply:
Norman: I think this link will get you there G1909 wheels with 5/16" cranks

Walsall Model Industries - ID: G1909 5"3 Driving Wheel

The stack is a bark box I doubt that any company would undertake one if these as a project in standard gauge. I believe Aster did an American with an alcohol potboiler in 1:28 but it wasn't under $1500.



Locomotive C.P. Huntington, Southern Pacific #1 (California No.) Original Central Pacific RR No 3. Built by Danforth Cooke and Company of Patterson, New Jersey 1863. Shipped around the horn on the sailing packet Augusta. Brought to Sacramento on a river schooner unloaded on the levee and assembled. Went into service on the Central Pacific RR, early in 1864.

Cylinders	4 Dia x 15" Stroke
Dia. of Drivers	54"
Weight on Drivers	18980 lbs.
Weight on Front Truck	11,100 lbs.
Weight on Rear Truck	13,820 lbs.
Total Weight	43,900 lbs.
No. of Tubes	48
Dia. of Tubes	2"
Length of Tubes	9'-6"
Heating Surface of Tubes	361 Square Feet
Heating Surface in Fire Box	58 " "
Total Heating Surface	419 " "
Grate Area	6.39
Steam pressure	130 lbs.
Tractive effort	3971 lbs.

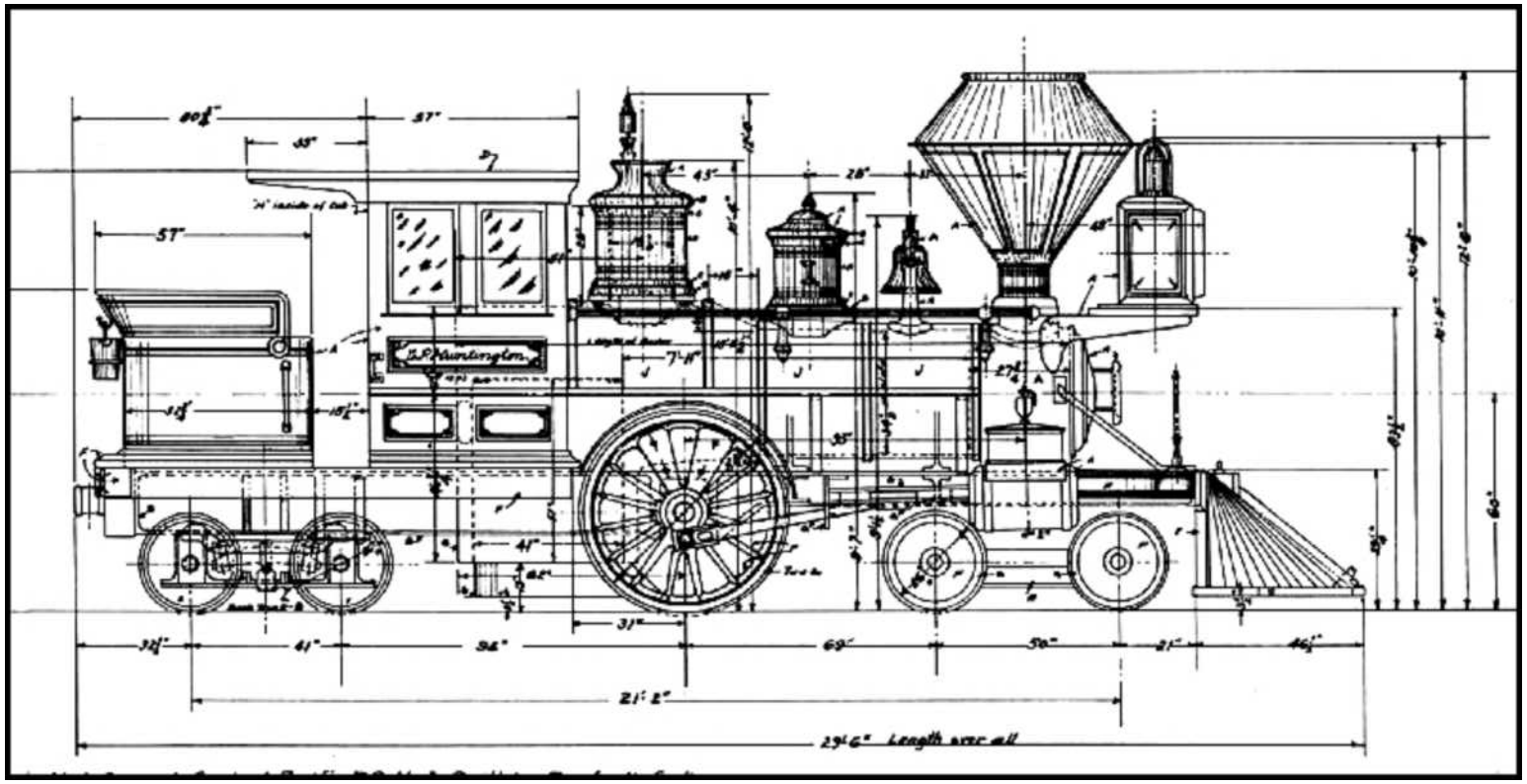
Water Capacity of Tank 300 Gallons
Fuel Capacity 1/4 Cord

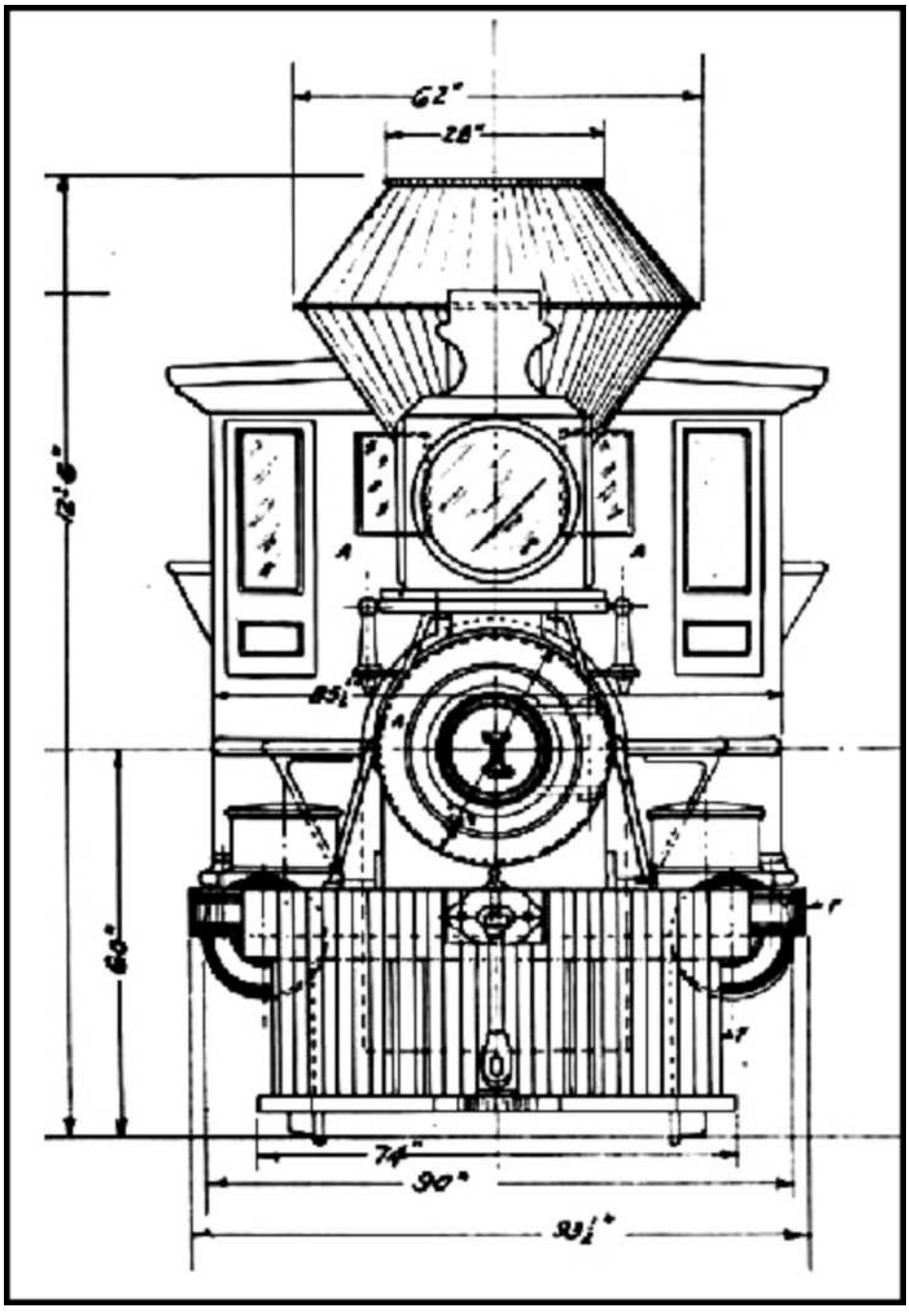
This drg. supersedes Dwg. Dated 3076 which has been cancelled.
For Lettering and numbering data, see Dwg. 10931-067

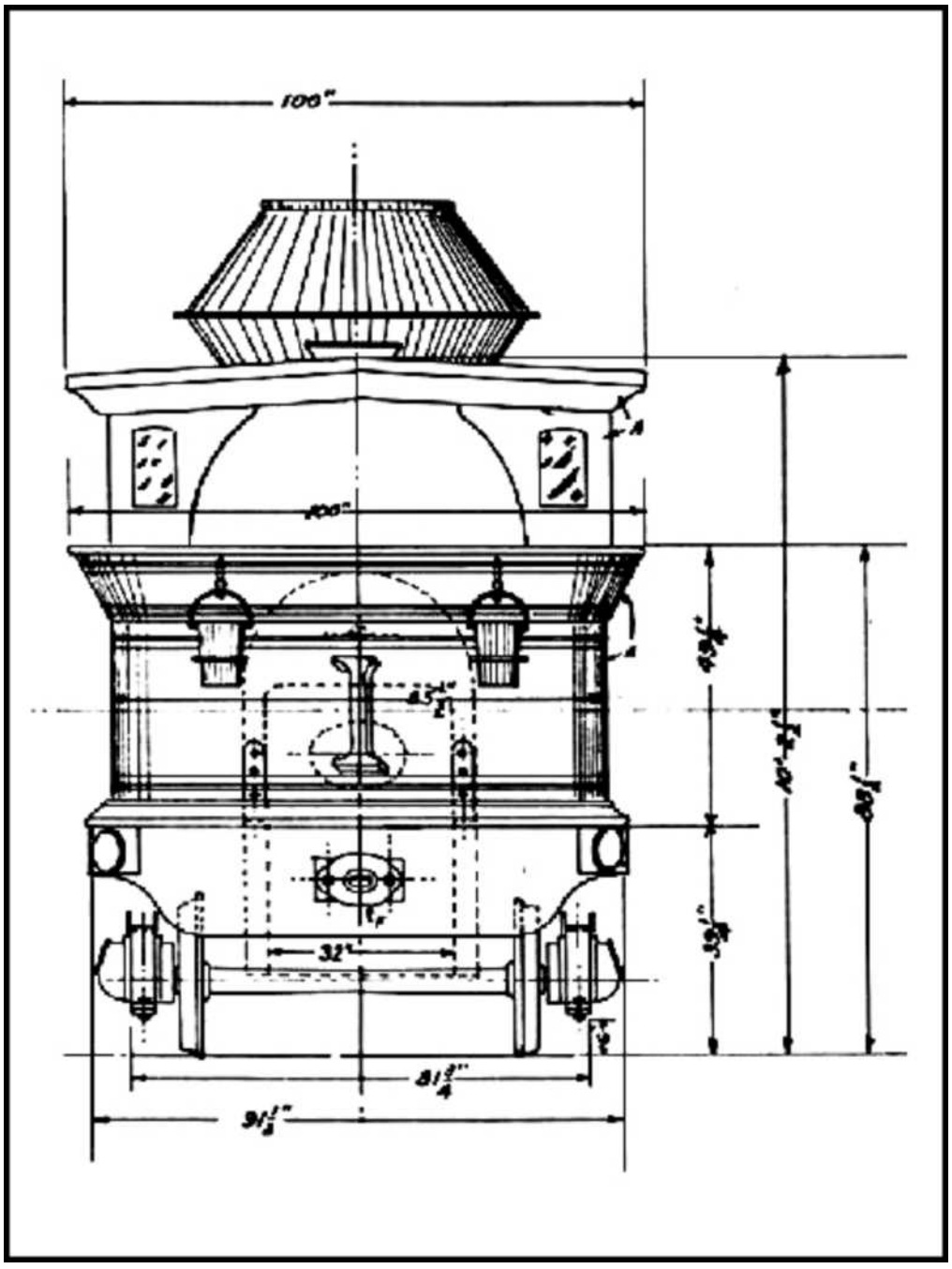
SOUTHERN PACIFIC COMPANY
PACIFIC LINES

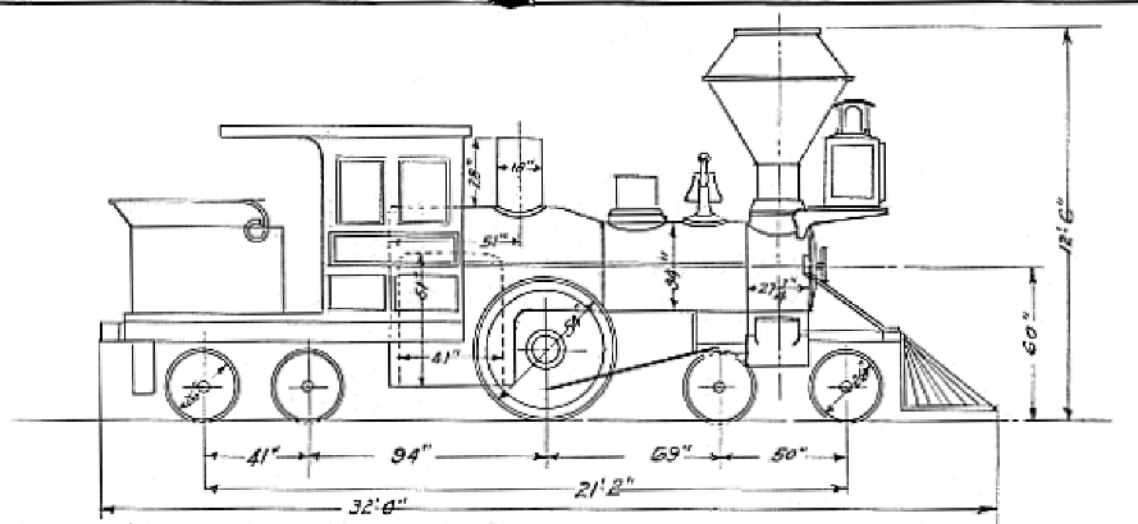
Diagram and Data
Locomotive C.P. Huntington

BOOK 621 10918


C.P. Huntington
29'6" Length over all


62"
28"
12'6"
85½"
60"
74"
90"
93½"


100"
100"
32"



Locomotive "C. P. Huntington", SOUTHERN PACIFIC of California No. 1
Original Central Pacific R.R. No. 3. Built by Danforth Cooke & Co. at
Patterson New Jersey. Shipped around the "Horn" on the sailing vessel
Success. Brought to Sacramento on a river schooner, unloaded on the levee
and assembled. Went into service early in April 1864, on the Central Pacific R.R.

	÷ Dimensions ÷	÷ GS-1 ÷
Cylinders	11" Dia X 15" Stroke	27" Dia x 30" Stroke
Dia. of drivers	54"	73"
Weight on drivers	18500 lbs.	262,000 lbs.
Weight on trucks	20500 lbs.	180,300 lbs.
Total Weight	39000 lbs.	442,300 lbs.
No. of tubes	88	49 , 1 [illegible]
Dia. of tubes	2"	2[illegible] , 3[illegible]
Length of tubes	7'-11"	21'-6"
Heating surface of tubes	361 Square feet	4[illegible] Sq. Ft.
Heating surface of fire box	58 Square feet	356 Sq. Ft.
Total Heating surface	419 Square feet	7423 Sq. Ft.
Grate Area	9. 39 Square feet	90.4 Sq. Ft.
Tractive effort	3571 Pounds	28,710 Pounds
Steam pressure	125 Pounds	200 Pounds
Water Capacity	300 Gallons	16152 Gallons
Fuel Capacity	3/4 Cord	4912 Gallons Oil

Diagram & Data, Loco.
C. P. Huntington.

Sacramento, January 14-1932

Shop Sketch 3076

	L	A
	J	B
	K	C
	L	D
	M	E
	N	F
	O	G
	P	H

BRJ.

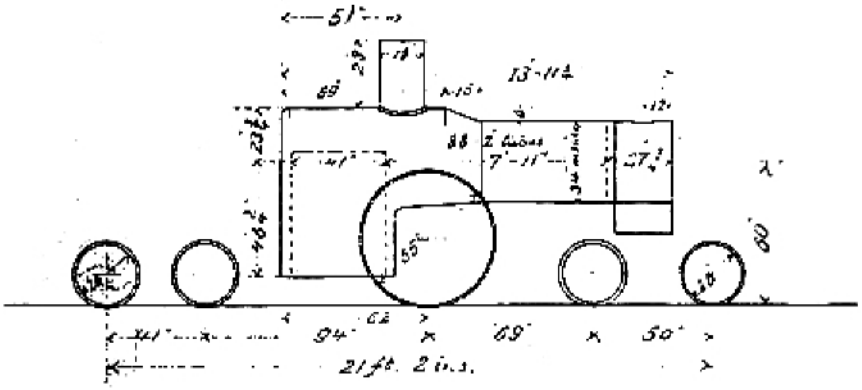
DIAGRAM of 11 × 15 ENG. № 1 S.P. COOKE, BUILD. _____

_____ Office Supt M.P.R.R. SP Co. Aug 1892. _____

C.P. Huntington

ENGINE WENT INTO SERVICE, 1864.

This Engine was originally C.P.R. Sold to S.P.



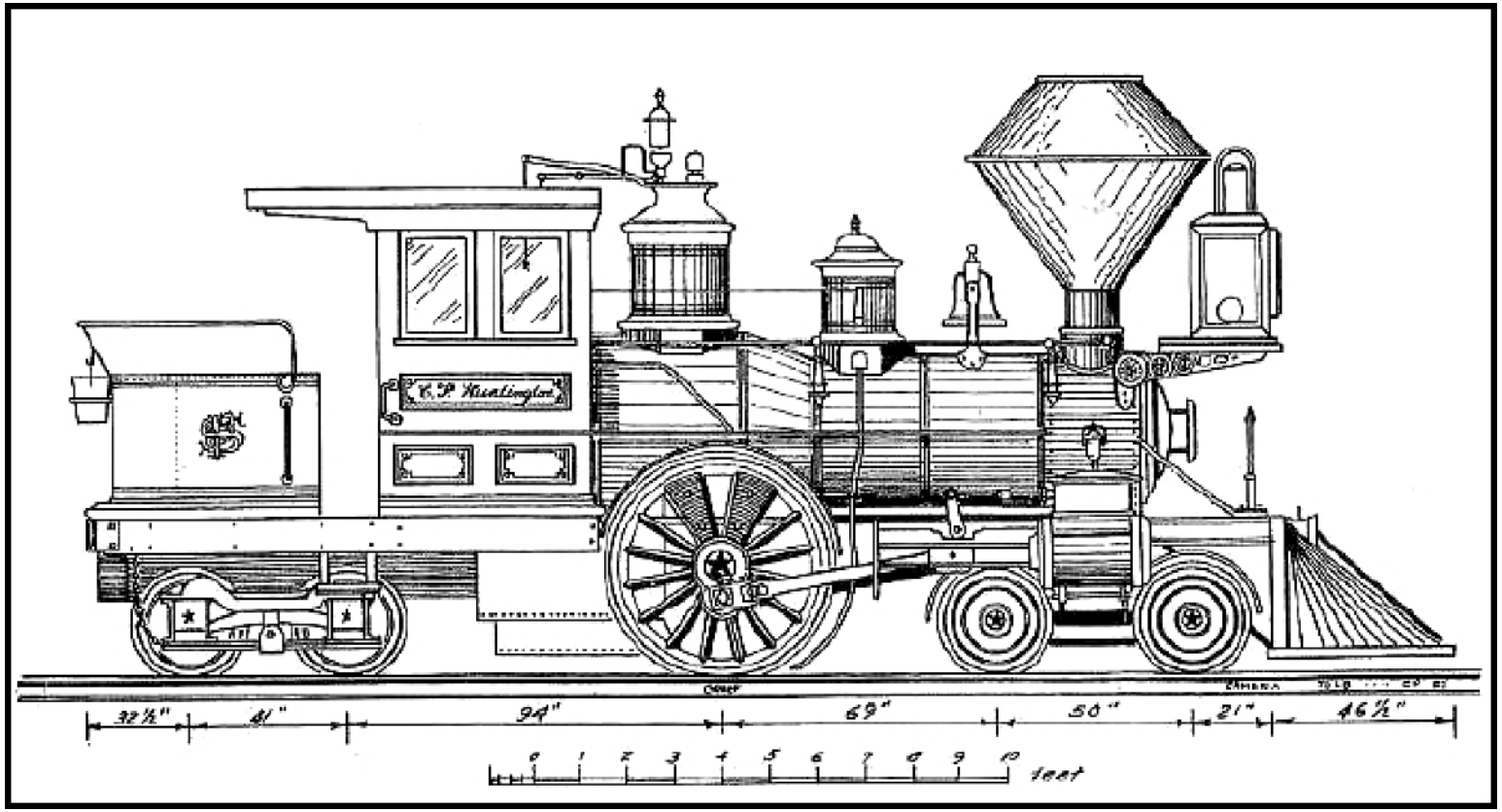
1 ENGINE THIS CLASS IN SERVICE AUG. 1. 1894.

Cylinders 11 diam. × 15" Stroke Drivers 56 diam.		
Weight of Engine loaded	39000	lbs.
" " on Trucks	20500	
" " Drivers	18500	
" " " " per ct.	47.4	%
Grate Surface	9.39	sq. ft.
Heating Surface in Fire Box	55.	" "
" " " " outside of Tubes	361.	" "
" " " " Total	419.	" "
" " " " per sq. ft. of Grate	44.62	" "
" " " " inch Cyl. area	2.2	" "
Cyl. Area per sq. inch Flue Opening	0.89	inches

BOILER PRESSURE ALLOWED. 125. LBS.

Tractive Power 3571 lbs.

C3RML, SP Diagram Book 1890's


C. P. Huntington
32½"
41"
94"
69"
50"
21"
46½"
0 1 2 3 4 5 6 7 8 9 10
feet