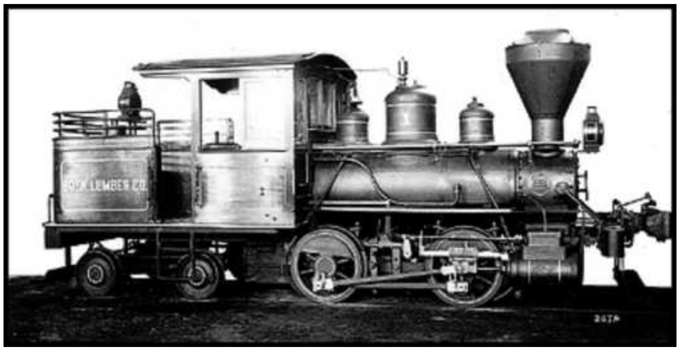


MLS Steam-Class 2004
Build A Live Steam Accucraft Ruby Kit

Chapter 3 - Bunkers, Tenders, & Forneys, Oh My!

By: Tom Farin
Madison, Wisconsin, USA

Yes, another change in plans. With the kits still in a slow boat from China, we've changed the focus of Chapter 3 to deal with projects you can work on without having a Ruby in hand. Many of you may build a Baldwin 0-4-0 tank engine or one with the same wheel arrangement from another manufacturer. But if you really want to set your Ruby apart, you'll build a 0-4-2, a 2-4-0, or a 2-4-2. Or maybe you plan on wandering into Forney territory, bashing your Ruby into a 0-4-4 or a 2-4-4.

Aside from wheel arrangement differences, some members of this class of engines came with a separate tender, while others shipped with a rear bunker. The basic engines carried a small amount of fuel inside the cab.

If you wander too far from a base Ruby, you'll be looking at one of the modifications covered in this chapter. All of these projects can be started now. I'll supply any needed dimensions from my Ruby. Build the part. If you follow the instructions, you should be able to bolt the modification in place once your Ruby arrives. Here's the outline for Chapter 3.

- **Prototype Article** - The prototype article "Introduction to Tasmania's Industrial Railways" was written by David Fletcher on his beloved Tasmania Industrial Railways. It is a great story of how the railroads helped industrializing this island off the coast of Australia and is accompanied with wonderful set of photos.
- **Project Update** - This section will further outline projects for the chapter and supply additional resources to assist you in your live steam Ruby bash.
- **Fabricating a Rivet Punch & Die** - If you'll be punching rivets into brass shim stock, you can learn the hard way as I did. Or you can follow Vance Bass's instructions in Chapter 2 or my instructions in this section and build yourself a rivet punch and die with a fence to keep your shim stock in alignment.

- **Superstructure Upgrades** - This chapter's superstructure modifications focus on tenders and bunkers.
    - **Rear Deck Extension & Bunker** - This project began in Chapter 2 with the construction of a frame extension and rear bunker for the Olomana. We'll finish the structural portion of this project in this chapter.
    - **Selecting a Four Wheel Truck** - Whether you build a tender or a Forney, you will need one or two four-wheel trucks. Here are some options you might consider.
    - **Forney's** - We'll look at two alternatives here.
        - **Fabricating a Forney Conversion** - Pick a four wheel truck, build a frame extension, and fabricate a rear bunker and you have a Forney. Other modifications, of course, may also be required depending on your prototype selection.
        - **Bass Forney Conversion** - Incorporate the Vance Bass Forney conversion kit into your Ruby.
    - **Tenders** - If you need a separate tender, we'll start you on your way with construction the superstructure portion of Hawaii No 5's tender.
    - **Some Thoughts on Soldering** - Written in hopes your learning curve will be somewhat shorter than mine.
- **Progress Report** - Olomana and Hawaii No 5.

Scotty, beam me off to Tasmania ...

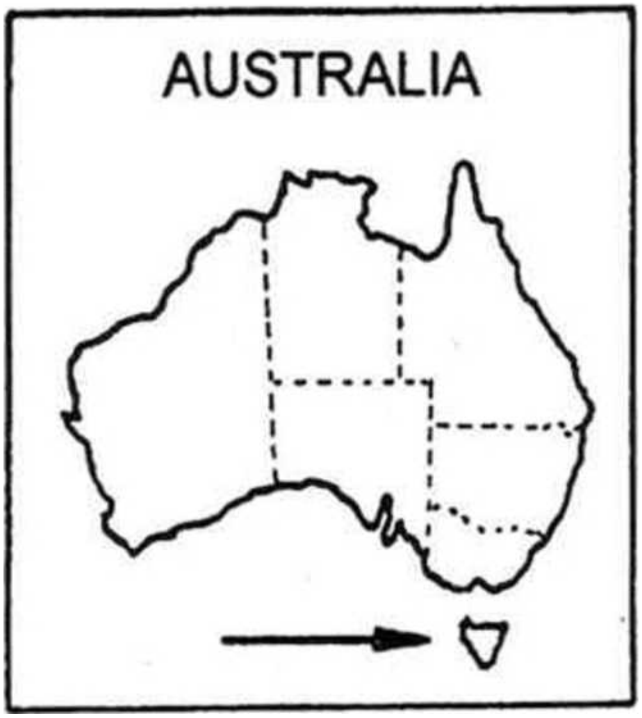
MLS Steam-Class 2004

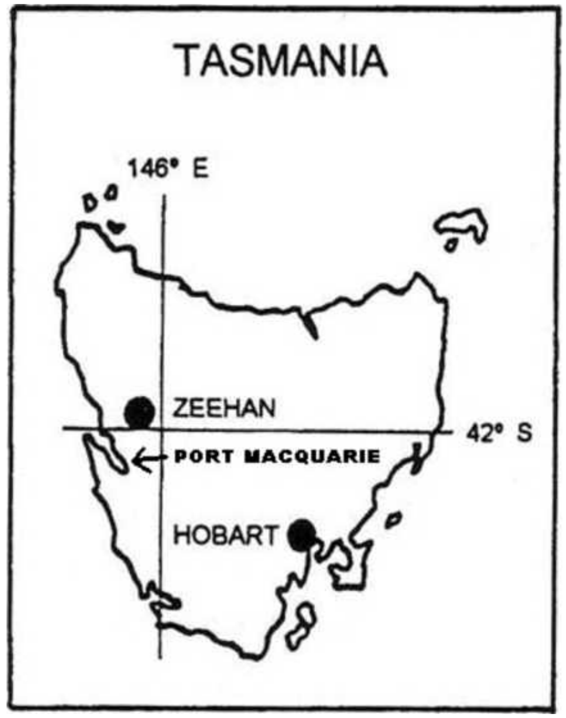
Introduction to Tasmania's Industrial Railways

By David Fletcher
Melbourne, Australia
Colour Photos by the Author

Through the Steam-Class you're learning the story of some of the United State's most endearing small industrial locomotive companies. The diminutive proportions, 'cute' lines and general styling of these smaller machines is only a part of what makes industrial railroading so attractive to modelers. The other attraction is the context in which these small machines were used. Often it is the unusual railway, situated in the beautiful places in the world that we find most appealing; the logging railways of California, Oregon & Washington, the mineral lines of Colorado, Alaska and the Yukon, the coal roads of the south east and so on. As a modeler, I too enjoy the rosters and roads of the United State's beautiful places, but today I'm going to talk about my favorite locations in all of Australia, their industrial railways and unbelievable rosters - The industrial lines of Tasmania's wild and mountainous west coast.

Tasmania is an island forming the southern most tip of Eastern Australia. There is nothing to the south of Tasmania but the Antarctic Ocean, and Antarctica itself. Indeed the southern most road to the bottom tip of Tasmania leads to a sparsely populated, and down right spooky place ... and naturally we built a railway there ... but that is only one of many great little lines in Tasmania.





In the Beginning:

Tasmania, formerly known as 'Van Dieman's Land', was named by the original Dutch explorers during their explorations in the 1600s. Indeed Van Dieman's Land was the first part of Australia's East Coast to be charted. The Dutch explorer was Able Tasman, and his island would later be named 'The Isle of Tasman' or Tasmania. He never did chart Australia to the north, rather continuing eastward to the coast of New Zealand and then home. Those few unfinished lines on the map of Van Dieman's Land and New Zealand drawn by Tasman lead to the belief of the existence of the 'Great South Continent' a vast land, as large as all of Europe, occupying much of the south Pacific. To this end the Royal Society and the Royal Navy dispatched Lt James Cook in 1768 to chart the great south land and claim it in the name of King George III. Cooke only found a vast ocean pot marked by many tiny islands and a multitude of Polynesian races. He charted the rest of New Zealand proving that Tasman's line was not the coast of a vast land, but only a part of yet another Island. Cooke's ship, the *'Endeavour'* was in poor shape after so many months in the uncharted oceans and Cooke believed his ship not strong enough to head eastward again in search of the great south land, had he somehow missed it coming across from Cape Horn. Instead he decided to head west to Terra Australis and chart the as yet unknown east coast. 1770 saw him land at Botany Bay, which is today nestled next to Sydney.

With the War of Independence coming to a conclusion in 1776, King George needed new lands to send England's budging prison population. 12 ships, loaded with Convicts and free settlers were dispatched to Botany Bay. The 'First Fleet' arrived in 1788 and established the first Colony at Sydney Town.

Within a few years, Sydney Town was suffering from crop failure and drought. The ships loaded with convicts continued to arrive. The Governor decided to set up a 2nd Colony to the south, at Van Dieman's Land. Tasmania's west cost had some unusual features, namely a vast inland natural harbour; Macquarie Harbour, now known to be the 2nd largest natural harbour in all of Australia, and surrounding that harbour a vast wooded wonderland, perfect for the construction of a new Colony. In 1822 a new convict settlement was constructed on Sarah Island within Macquarie Harbour. The remoteness of the harbour and the location of the Sarah Island made the settlement practically escape proof. What followed was a time of great brutality and genius in Australia's history.

Sarah Island today, as seen from the air.

The Sarah Island settlement was initially the most brutal of all the British camps, where only the worst prisoners, 2nd time offenders or notorious escapees, were sent. The entry to Macquarie Harbour was treacherous, only the narrowest of a gate lead out to the open sea, and ships coming and going had to steer precisely, while the tides were high. Many a ship was lost at the entrance to Macquarie Habour. The entrance was named by the Convicts as 'Hell's Gates', aptly describing the treacherous entry and the evil world of Sarah Island that lay beyond.

The location of the convict camp at Sarah Island was chosen in part because of it's proximity to some of Tasmania's unusual timber varieties, in particular a light timber known as Huon Pine. The timber had a high resistance to rot and insects, and trees that had fallen into rivers could be found completely intact, rot free, even after 100 years. This timber, among several others, made the camp a rich resource for the colonies. The early years of Sarah Island were a time of harsh treatment - a labour camp supporting a new timber industry. Stocks were shipped directly from Sarah Island out to the Australian settlements.

The View Entering Hell's Gates to Macquarie Harbour beyond.

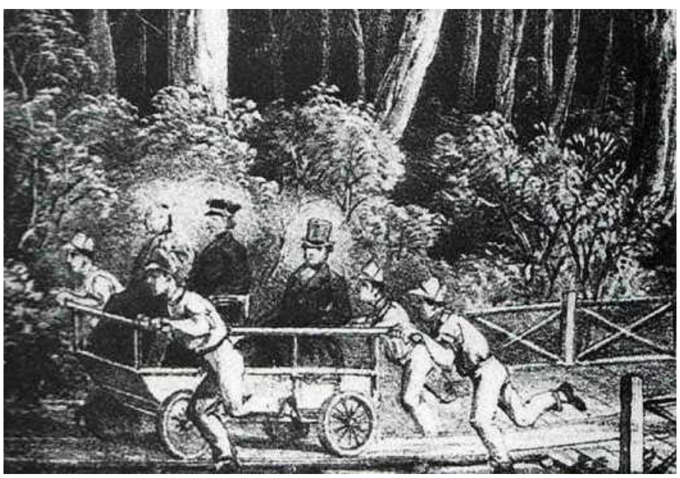
The Ruined Penitentiary on Sarah Island Today.

The island settlement entered its 2nd era in 1825 with the introduction of a new camp commandant, Capt James Butler. Reforms were introduced, and with his rule, the whole atmosphere on Sarah Island changed, from one of hardship to one of education. The camp focus became one of rehabilitation and training. Convicts sent here would leave within only a few short years fully trained as useful tradesmen. About this time the government was concerned about the increased cost of shipping the Sarah Island timbers out, and looked at ways to have the timbers used on the island in convict made products. This also happened to coincide with the arrival of some new convicts skilled in the art of ship design and construction. One convict in particular, convicted for highway robbery, had been trained in the Americas as a shipwright, having designed and built whalers and fast merchantmen. The Sarah Island shipyard was opened up, with convicts training convicts in the art of shipbuilding. The ships that were launched from Sarah Island during those twighlight years were among the finest in the nation, built of the finest timbers, to designs that were state of the art.

Everything from 20ft long boats to large 120 Ton Brigs were built. In one year alone, more tonnage in new ships were launched from the Sarah Island slip than any competing commercial shipyards on the mainland.

The Ruins of the Port Arthur Convict Settlement.

By 1832, the main Colony in Hobart Town, Tasmania, decided that continued operation of the remote Sarah Island was not cost effective, and that the convicts would be moved to the new penitentiary at Port Arthur, on Tasmania's southeast coast. Sarah Island was to be closed down. A select group of 10 convicts and a skeleton crew of guards were left on Sarah island a couple of months longer in order to clean up affairs and package the lumber that had been stored for the construction of the next ship. Through an error in reporting, the last ship was not actually a pile of lumber but a near complete two-masted Brig, named *'Frederick'*. The ship was impressive at 121 Tons. The plan was for the ship to be completed and sailed around Tasmania's southern coastline to Hobart Town. As the ship neared completion, the convicts hatched a plan. Only days before their scheduled departure, the convicts took flight in the ship and sailed out of Macquarie Harbour to freedom. The guards never saw a thing. The 10-man convict crew sailed all the way to Chile. Sadly their escape was foiled when the Chilean government rounded up the men and handed them back to the Australian colony in 1836. There they were tried for Mutiny and the theft of a ship belonging to the Royal Navy. This was a hanging offence. A particularly clever lawyer for the defense managed to have the charges dropped on the basis that the stolen ship was so new, that it had not been officially commissioned as a ship of the Royal Navy, indeed Hobart records still had her listed as nothing more than a pile of lumber at Sarah Island, and as such these men had stolen nothing from the empire other than a pile of logs in the shape of a ship.



Etching of the Port Arthur Convict powered Railway
Australia's first railway.

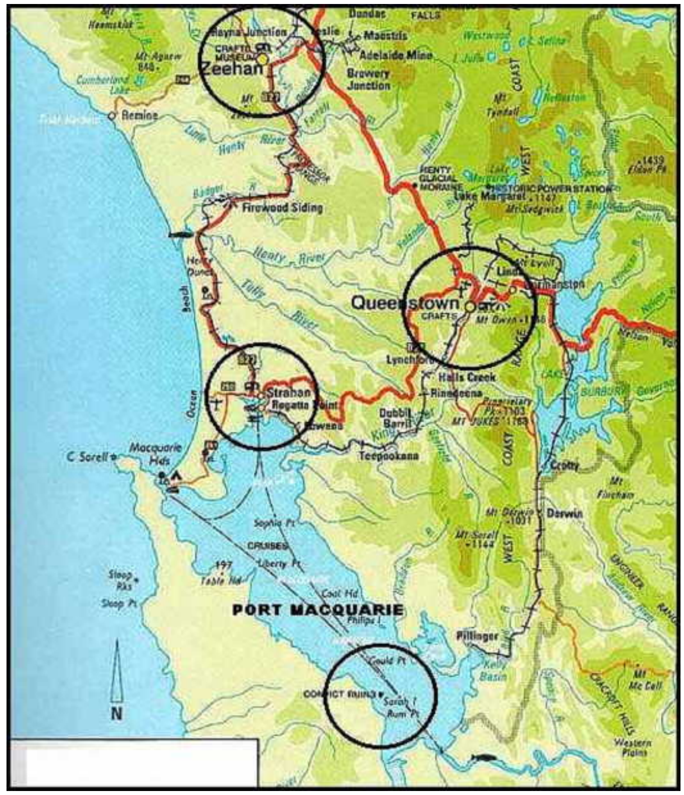
The Port Arthur convict settlement was a large affair and continued the ship building schools along with other trades. The area is also famous in Australian railway history for being the location for Australia's first railway. In 1836, a convict railway was built, comprising wooden rails and 4 wheel wagons, running a mere 7km. The cars were propelled by convicts over a moderate grade. The railway is long gone, but you can stay at the Terminus near Port Arthur today, where the depot is now a B&B. A visit to the Port Arthur Historic site is also an excellent experience and will greatly expand your understanding of the convict era of Van Dieman's land.

In 1833 Sarah Island and port Macquarie fell quiet to human footfall ... but not for long, as prospectors looking for mineral wealth and timber products continued to arrive and the west coast's third industrial life began. The new timber and mining industries in the region saw the growth of the railways and the use of some of the most innovative locomotive designs in all of Australia. Within only a handful of miles, the industrial lines were using gravity incline systems, Abt cog railways, the Hagans articulated locomotive, the world's first Garrett locomotives, Orstein Koppel Mallet locos and a host of smaller industrial locos from the best builders around the world, including Orstein & Koppel, Krause, Fowler, Hudsell Clarke, Sharp Stewart, Dubs and Baldwin. We shall examine some of these railways and their locomotives.

The following map indicates the west coast mining region around Macquarie Harbour, with the locations circled discussed in this article.

The Mt. Lyell Mining & Railway Company:

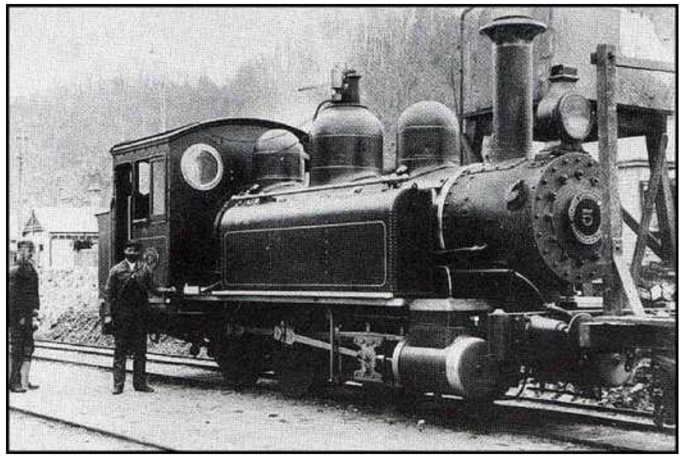
Prospectors exploring the region around Macquarie Harbour had noted the existence of gold traces, and in particular the mountains directly to the east of the Harbour were said to be rich in gold and other minerals. During the 1880s a short-lived gold boom opened up the mining town of Queenstown 25km inland from the Harbour. All too soon the area proved to be disappointing for gold but with the chance discovery of copper mineralisation at the 'Iron Blow' site at Queenstown, everything changed. In the 1890s a newly formed mining Co, The Mt Lyell Mining & Railway Company, began construction of a copper smelter at the site, and company directors looked for ways to transport the refined mineral back to civilisation by means of a railway. The problem was Queenstown was nestled in a rugged mountainous area, a mere 25km from Macquarie Harbour and the ships that could take the mineral to the world. So near, yet so far.... The terrain between Mt Lyell and Macquarie Harbour comprised of steep, rain forest covered ridges and fast flowing rivers. The Mt Lyell railway would become one of the most remarkable railways in Australia.



The 'Iron Blow' where Queenstown's Copper Mining Bonanza began.
Macquarie Harbour is beyond the mountain range in the distance.

Rail surveyors regarded many routes, but the shortest and most economical route required a line of only 34km. The down side was that the line would need some 50 trestle bridges, one of which would be a quarter mile long. Additionally severe grades were encountered where the line left the Queen River canyon, traveled over the ridge and down into the King Rover canyon that led out to Macquarie Harbour at the port town of Straghan. Two stretches of rail leading up to the ridge and down the other side encountered grades of 6.25% and 5%. (1:16 and 1:20). At least twice the max grade of conventional railways. Considering the tonnage of copper that the line would be expected to carry, such grades were considered unacceptable for a steam railway. To ease the cost of construction, a narrow gauge of 42" was used and additionally the Swiss Abt, rack & pinion Cog railway system was adopted for the two steep sections of the line. The Abt system, invented by Swiss born Roman Abt was first used in the Harz Mountains of Germany as early as 1885.

During the construction and initial operation of the line, a team of small export Baldwin 0-6-0Ts worked the line, and even managed to haul tonnage up the mountain. But the real motive power was yet to be delivered. Four very special locomotives had been ordered and were under construction at Dubs & Co of Scotland, each fitted with the Abt rack & pinion system. The first of the locomotives entered service in 1896 and the railway officially opened in early 1897.



The original Baldwin 0-6-0T's, that worked the Mt. Lyell Line.

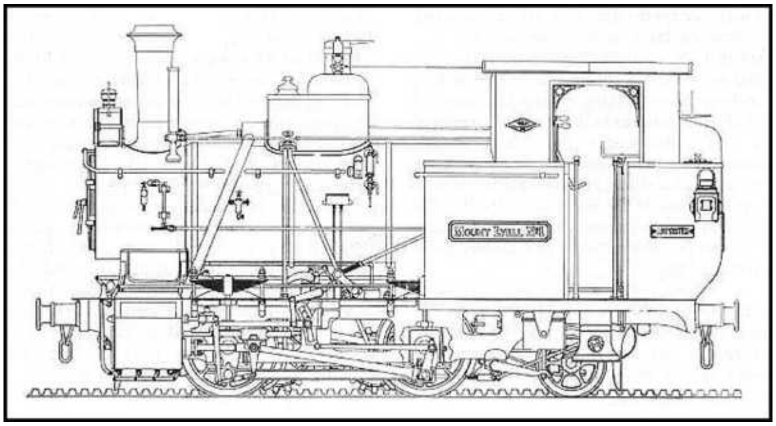
The typically Crooked Abt Mountain locos, this is one of the beautiful steam locos built by Baldwin, for the Pike's

Most who know or have seen Abt cog locomotives, will know they tend to be very crooked in design, where the boiler is level, and the frames are all angled - examples are the locos of the Pikes Peak Cog RR in Colorado, the Mt Washington Cog in New Hampshire, or indeed the Snowdon railway in Wales or any of the Swiss or Austrian Cog railways.

The Dubs Abt locomotives of Mt Lyell were unusual because they were conventional looking but literally a two-in-one locomotive. The locomotives had 4 cylinders. Externally they looked like conventional British 0-4-2T tank locos, but fitted between the frames was a 2nd steam engine, designed to drive the cog system independently. The locomotives were fitted with independently controlled Walschaert's valve gear to both the conventional external engine, and the inside frame cog system. The cab fitout and backhead featured two sets of controls for both steam engine units. The Dubs machines were run as conventional two cylinder locomotives on the plains, while on the steep grades the crew would open the throttle to the cog engine. Through careful co-ordination the crew would run both steam systems together maximizing the potential tractive effort of the loco.

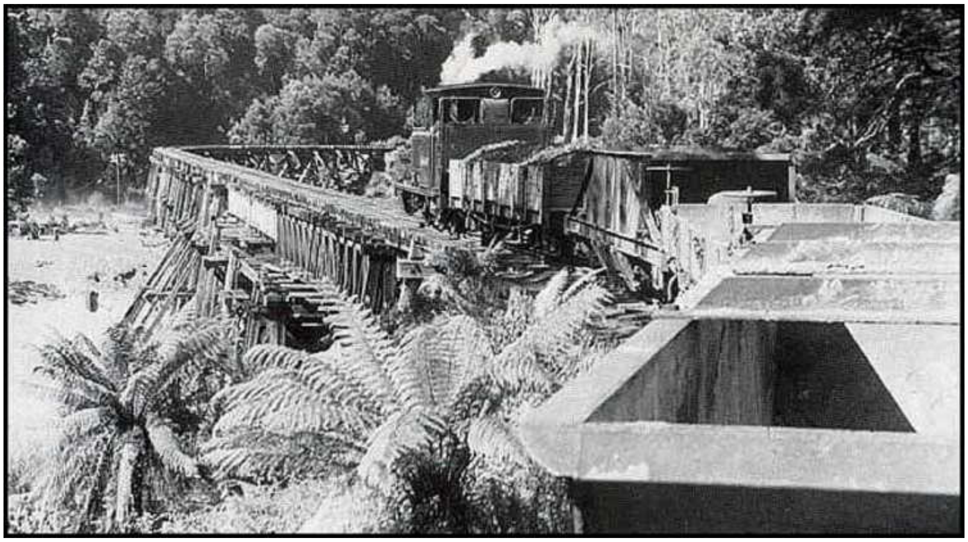
On the steep down grades, the cog engine was used for supplemental braking, where a system of air intake and injected water, fed into the cylinders created a form of compression braking. The compression braking on the Abt system was based on an older British principle, whereby on the steep decent, the crew would throw the valve gear into the direction opposite from travel and open air intakes to the valve chests. The air drawn into the cylinders would compress, retarding the piston travel. In the compressed state the air temp would rise radically, making the cylinders very hot. Cold water was injected into the steam chests with the air, providing coolant as well as a crude form of lubrication. Upon release from the cylinders the compressed air/water mix would blast up to the boiler top and out two brass 'columns' mounted either side of the stack. Heated by the compressed air in the cylinders and released to atmospheric pressure, the water would vaporize creating a wet geyser-like blowout from the columns. The compression brake system on the Mt. Lyell engines is something to be seen!

The crew had to ensure the boiler was topped high with water, to keep the firebox crown sheet covered on the down grades. The braking system used for the train was the British vacuum system. The 4 locomotives met all expectations and a 5th loco was ordered in 1938 from Dubs' successor, North British Locomotive Co. The locomotives were initially coal fired, but during the 1940s-50s the locos were upgraded with electric lighting, increased water capacity and oil firing.

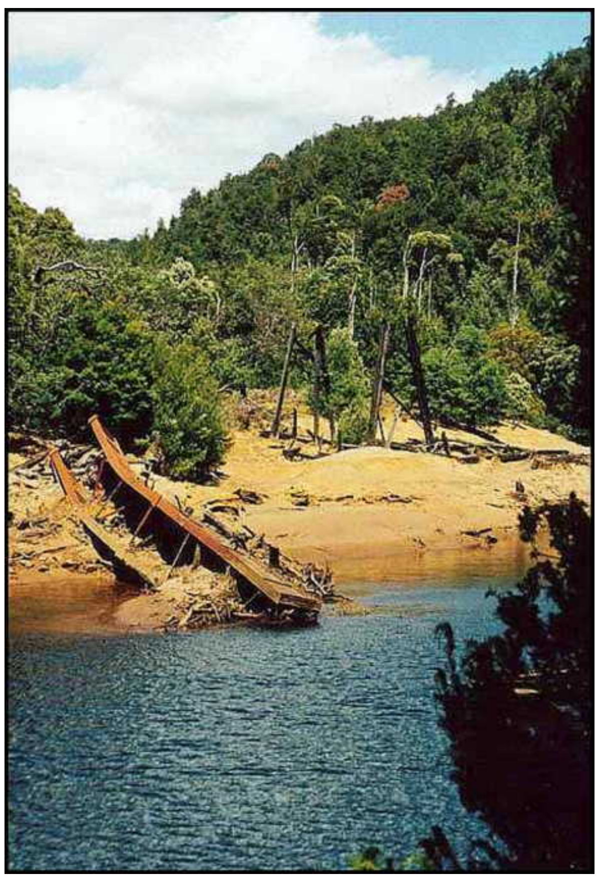


The Abt 0-4-2T locos built by Dubs, UK, for use on the Mt. Lyell railway. This one is the fully Restored Mt. Lyell #3. For 40 years she sat in a park on display only meters from this location.

The railway was a constant financial burden to the mining Co, with yearly flood damage contributing much to the running cost. The quarter mile bridge had been washed away several times. For 60 odd years the railway remained the only access to the Mt Lyell mining area. Progress finally caught up with the high costs of the Mt Lyell railway with the opening of a road to the region and the line was closed in 1963. The copper mines remain open to this day.



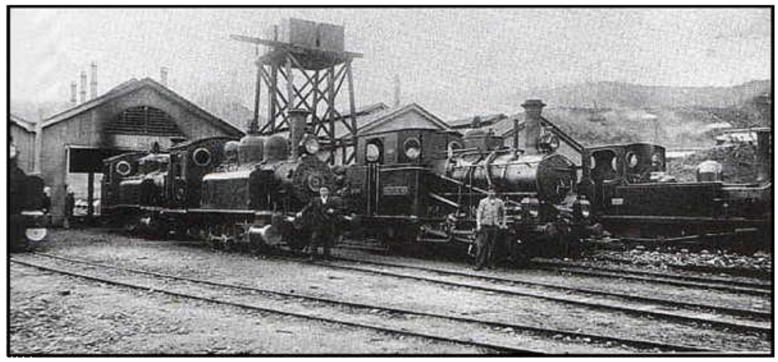
A train approaches to the Quartermile Bridge.

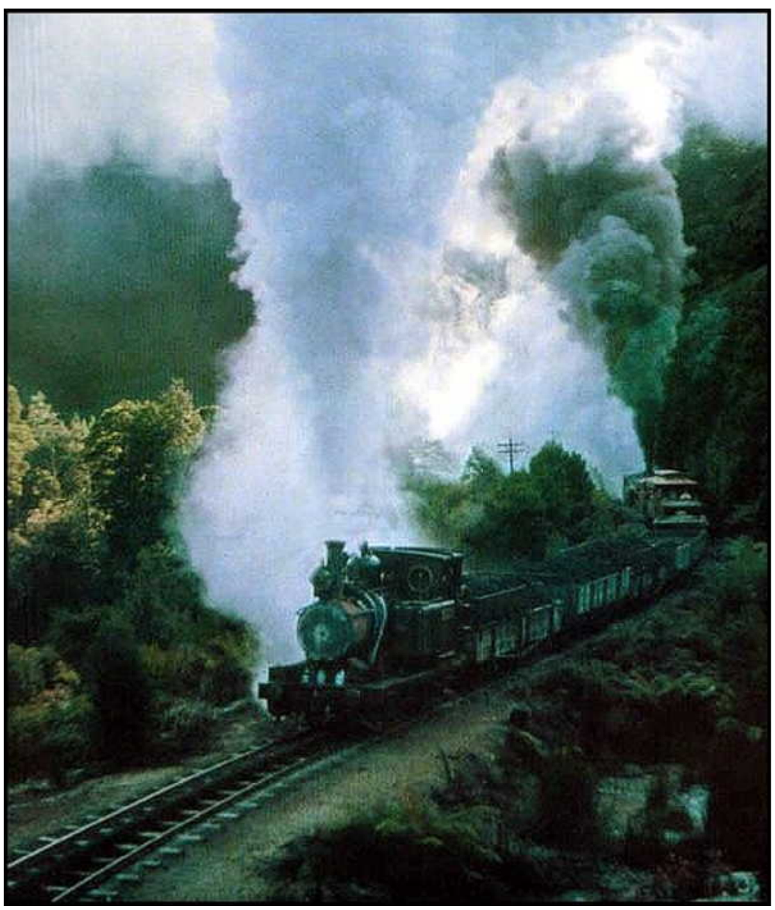


The same location at the Quartermile Bridge, seen one year prior to the line's reconstruction.

View of the Abt grade as it descends into the King River gorge, toward Port Macquarie.

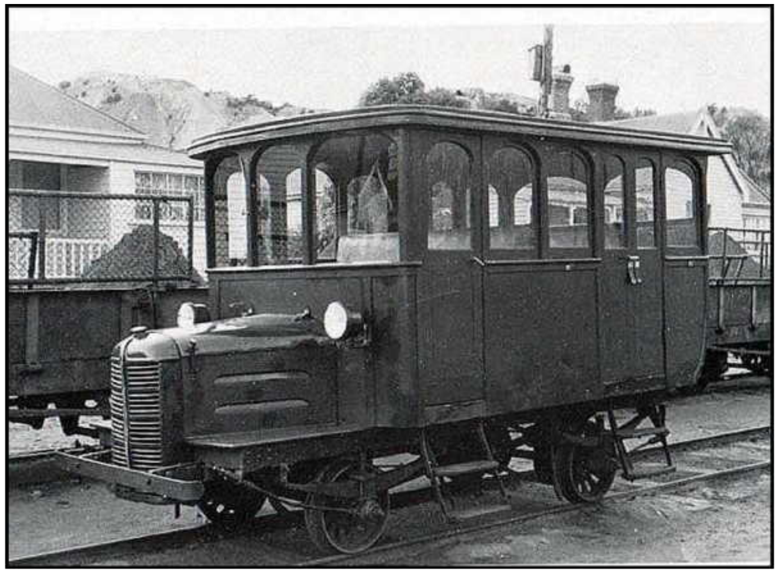
The Queenstown Railway yards around 1900. The new Abt locos stand beside the older Baldwin 0-6-0Ts and an early Hudswell Clarke 0-6-0T.





Nearing the end of an era, two Abt locos blast up the grade in 1963.(photo from the Lou Rae Book).

The Mt. Lyell 1922 Daimler railcar used by the General Director of the Mt. Lyell Mining & Railway Co, seen in service and as preserved today.



In the ten years that followed, much of the right of way had been washed away, and bridges lost. Most who visited the area since the closure never ceased to be amazed at the extraordinary railway feat and the absolute beauty of the sub tropical rainforests that was the railway's home. Rail enthusiasts took to the right of way every year as a form of pilgrimage, and all were heard to say, what a fantastic tourist railway the line could have been had it been retained. Alison and I have visited the area many times and walked along the old roadbed. There is even an iron bridge on our Garden Railway fabricated from the rusting remains of two fish plates hauled out of the forest after an expedition in 1998. The beauty of the scenery, marvelous engineering and unusual roster would have placed the railway as one of world significance. The rainforest area from the railway and to the vast lands to the south fought its own battle with progress in the 1980s and won a place on the World Heritage register, something we're all proud of.

The Original *'Iron Bridge'* on the approach to Macquarie Harbour, seen just prior to the line's restoration.

Upon closure of the line, 4 of the Dubs Abt locos were gifted to well established railway museums, retaining all of their parts and boiler fittings and were never to languish in parks or subject to vandalism. The 5th Dubs loco was dismantled on site along with the last remaining 1890s Baldwin 0-6-0T. While records suggest these two locomotives were 'scrapped', like so many of the locos of the Tasmanian West Coast, 'scrapped' locos were often simply dismantled and left to rust behind a shed, or simply dumped. As for the 5th Dubs 0-4-2T and Baldwin 0-6-0T, it is suggested they were thrown into a local quarry and are still buried there today. In what condition they are in, one can only wonder. I suspect they are nothing more than twisted metal.

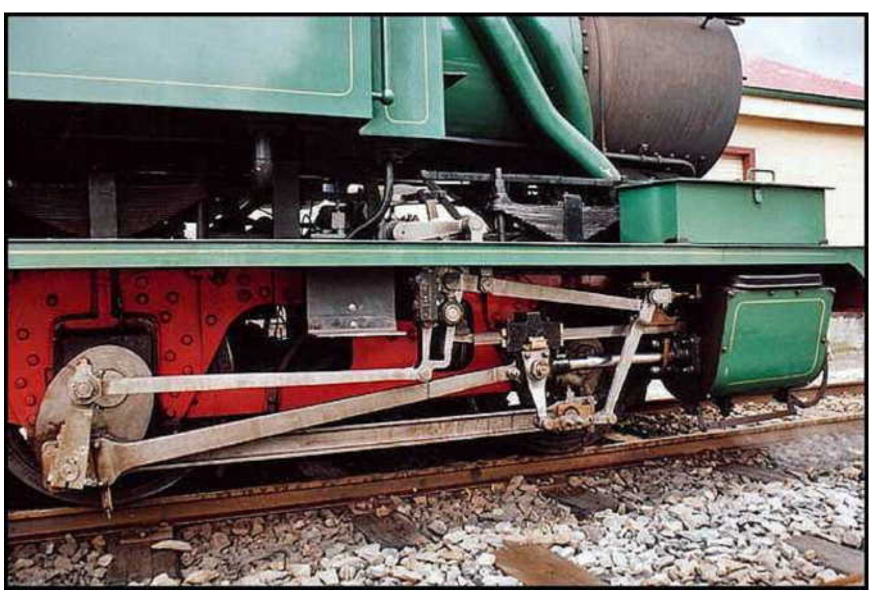
Over the years Queenstown developed a small tourism industry, strangely built on the unusual scenery of the surrounding hills. The many years of mining and smelting at the site all but poisoned the landscape for miles around, creating an eerie barren mars-like landscape of red and orange soil. Sunsets are spectacular!

A typical Queenstown Sunset, where the poisoned landscape really shines!

In the late 1990s, the Mt Lyell Copper mine faced closure as world copper prices fell, efforts by the locals and the Tasmanian Government ensured the survival of the mines and the town for the present, and as part of that effort, increased tourism was regarded as a high priority in ensuring the future survival of the town. To that end funds were provided toward the reconstruction of the Mt Lyell Abt railway as a tourist line. Project managers were brought on board in 1998 and a 4-year effort saw the line completely rebuilt, with two of the four Dubs 0-4-2T rebuilt at a Hobart engineering firm. The line was officially re-opened in early 2003...and what a ride it is! As the train approaches the first of the steep grades, there is a stop a Lynchford, where water is taken on and passengers can take a stroll. At this time the crew test the Abt engine before the big workout. With the locomotive sitting stationary, you can see the cog engine thrusting and the wheels turning between the frames... what a sight! Tasmania remains a place of great personal interest, but with the Mt Lyell Abt, there is something very special there to see. To see the Abt locomotives in action is quite something to behold and I recommend this railway, on a par with the Durango & Silverton, to anyone who has the courage to venture that far. The restoration continues, with Abt 0-4-2T #5 being returned to Tasmania for full restoration and rolling stock gifted to other parts of Australia being back in '63 now being returned. The 4 beautiful original passenger cars however remain the property of the Puffing Billy Railway in Victoria and shall not be returned. Larger passenger cars based on the original styling have been built, each featuring the various unique local timbers. If you visit, do pay attention to the internal timberwork of the cars, lined with Tasmanian Sassafras, Myrtle, Huon Pine or Blackwood.

The following images are as the railway looks today, restored to her original glory, and a great ride. At the time of these photos in Oct 2002, regulations and permits restricted the train from running the full 35km, instead running only half way. By early 2003, the line was fully open.

Inside the Queenstown Depot

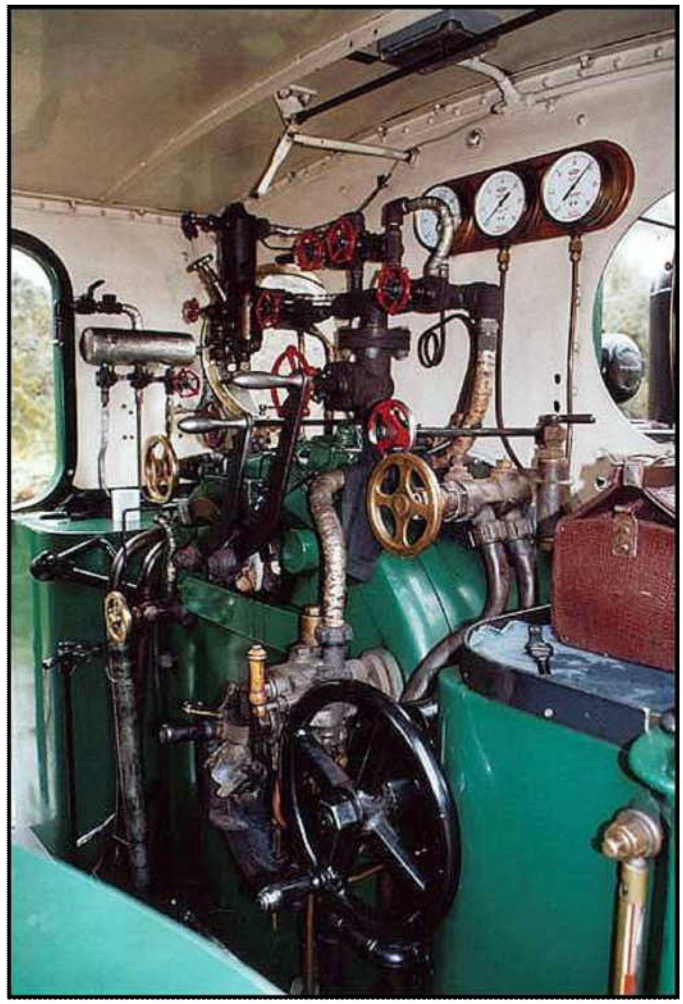


Ready For Departure!

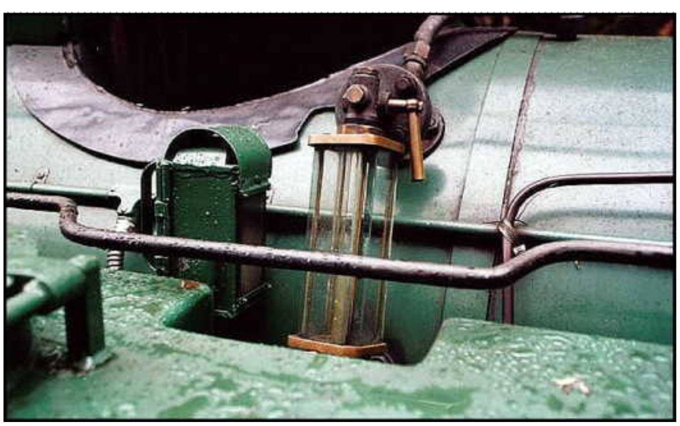
The train halts at Lynchford to take on water. The independant Cog engine fitted between the frames is tested on the stationary loco, prior to the grades to come.

The Cog engine churning over, steam belching and the brass stacks next to the main smoke stack spring to life.

Tourist cars, based on the original Mt. Lyell design, feature Tasmanian Timber interiors.

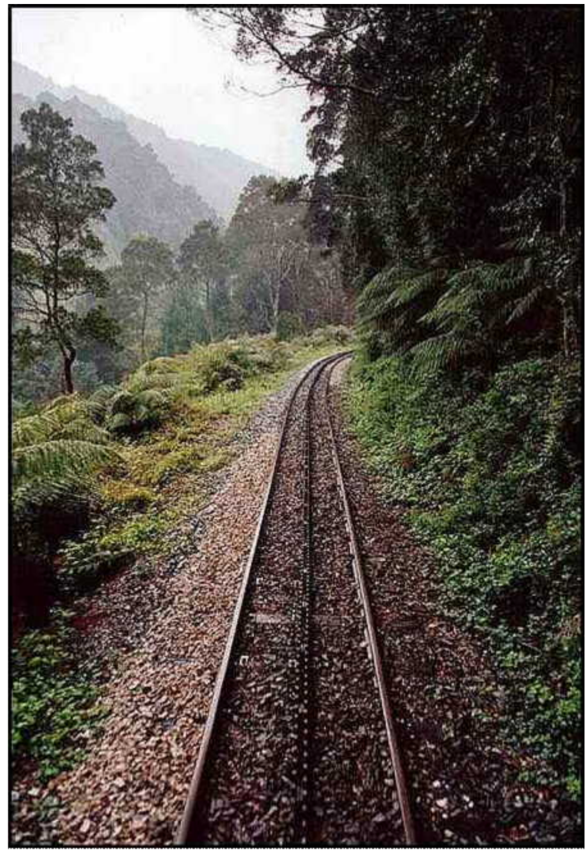


The cab view of an Abt loco. Note the two throttle levers on the backhead. Note also the fuel oil gauge to the lower RHS, but no boiler water gauges on the backhead.

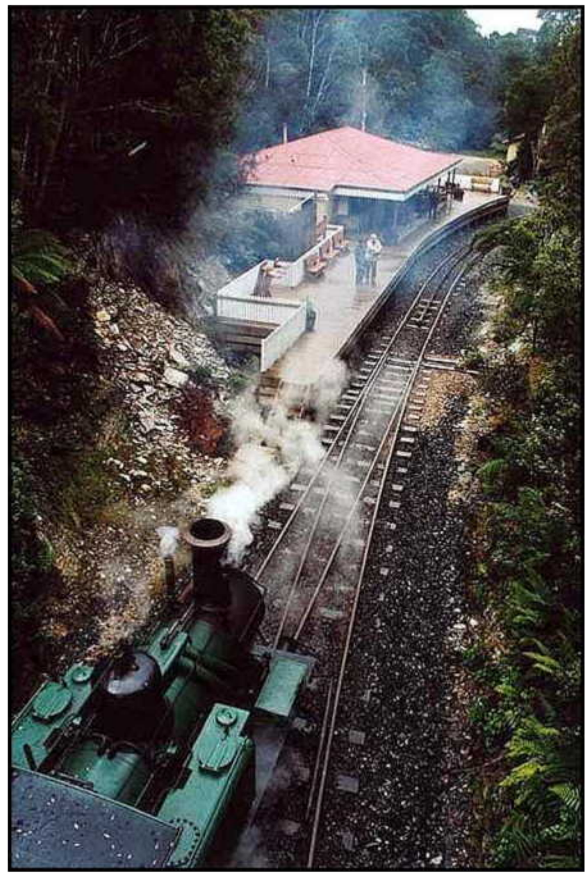


The water glasses are fitted half way along the boiler. The crews are required to read the gauge from the forward cab windows. Amidships, the water glass can more accurate indicate true boiler water level while the loco in on the grades.

Up the grade and into the rainforest.



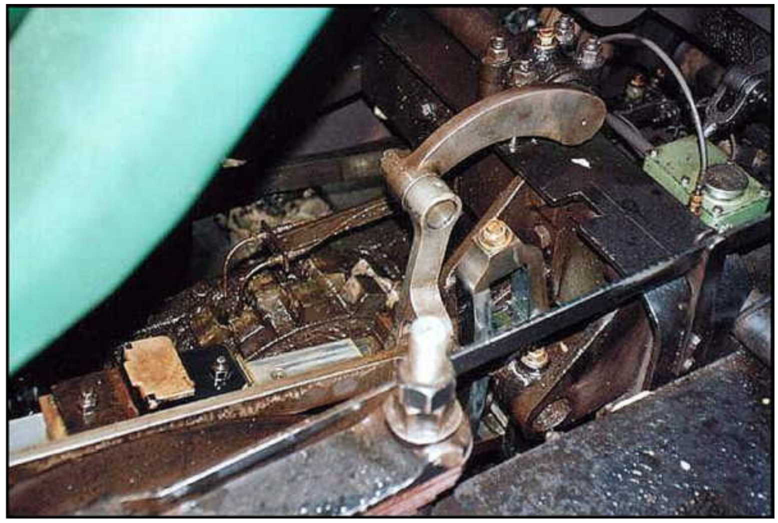
Remains of original Trestles are seen by the new diverted line.

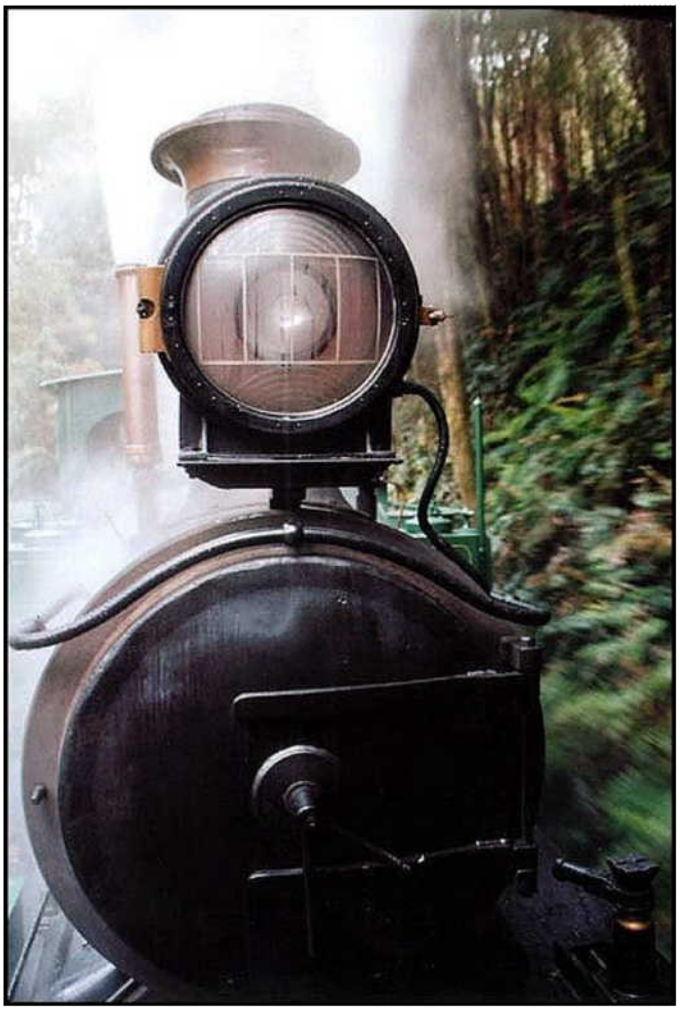


The crest of the mountain is clearly evident at the summit station of Rinadeena, deep inside the rainforest and miles from civilisation.

The train prepares to head down hill, bunker first.

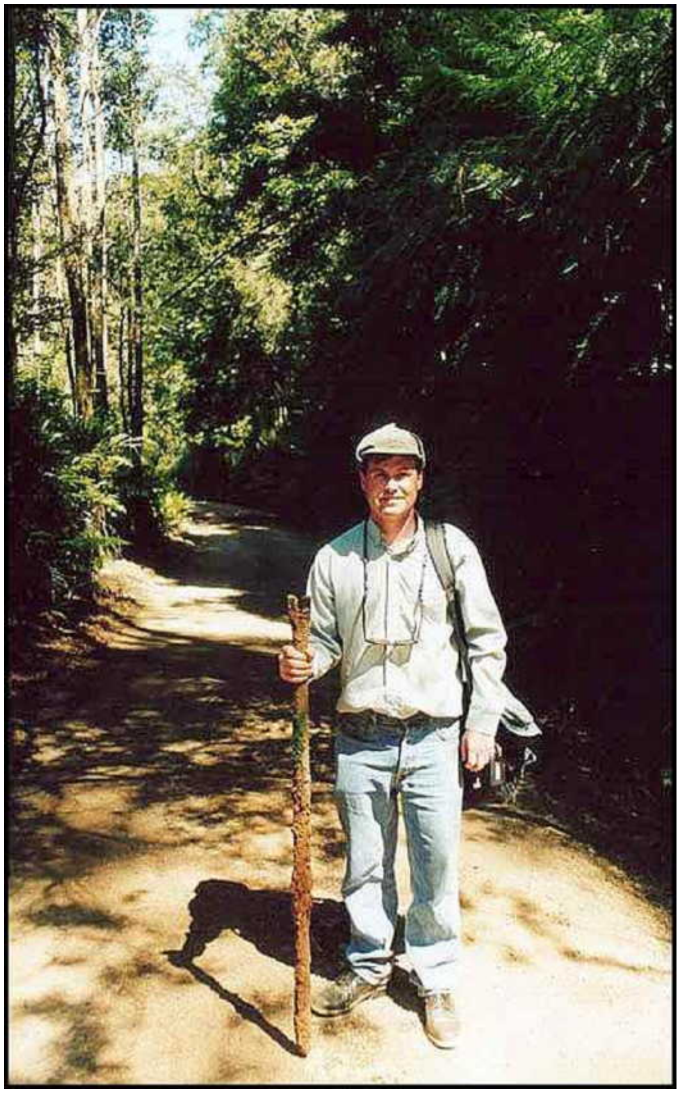
Close-up of the one of the Abt cogs and internal valve gear to the internal engine.





Water in the Abt engine cylinders bursts out the brass tubes by the smoke stack.

Creating a perpetual Geiser as the internal engine works to retard the train's steep decent.



Walking the right-of-way in 1998, prior to the line's restoration. The large (and very heavy!) Gandy Dancer's tool was found among the ruins of a trestle and was handed over to the local historical society.

For further info and much greater detail about this extraordinary railway, please do seriously consider getting the book by Lou Rae about the Mt. Lyell Railway, listed in References below. Also do visit this web site among many on the Mt. Lyell railway:

http://www.users.bigpond.com/Rhol/page2.html

The Small Rails of the Mt. Lyell Mine:

The Mt. Lyell Mining Co didn't just run the Abt railway, this was the primary haulage of the ore out of town, but within the mine district itself was a network of smaller railways. There were conveyor systems, aerial tramways, gravity powered incline railways, electric subterranean railways and a network of 2ft. gauge (610mm) narrow gauge steam railways. The 2ft. lines were powered exclusively by a fleet of 0-4-0T, tank locomotives built by Lokomotivfabrik Krauss & Co of Munich, Germany. These lil 7-10 Ton locomotives were a classic design, typical of the Krauss locomotives of the late 1880s, similar to many found in Europe, Africa and Asia. For those interested, the famous LGB 0-4-0T, *'Stainz'* was a Krauss loco of similar, but smaller design to those used at Mt. Lyell. Mt. Lyell #8 has been preserved on static display at the West Coast Pioneer's Memorial Museum at the nearby town of Zeehan.

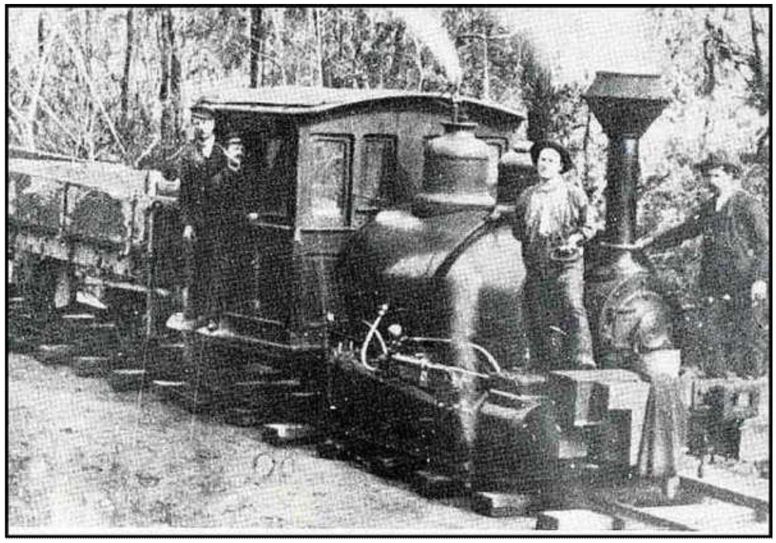
View of the Mt Lyell Incline, where gravity trains rode over the ridge from the Iron Blow beyond to the 2ft. tramway on this side of the hill. A small Krauss loco is seen ready to take the wagons to the Queenstown Smelter.

Views of the Original Mt. Lyell Krauss #8, now preserved at the West Coast Pioneer's Memorial Museum, Zeehan.

The North East Dundas Tramway - Zeehan:

Speaking of Zeehan, this is a small mining township only 25 km north of Queenstown and is famous for it's own railway, the North East Dundas Tramway, which in terms of world significance would eclipse the Mt. Lyell Abt Railway. In fact, calling this 610mm, 2ft. gauge railway a 'tramway' is an understatement! It was here, back in 1910 that the world's very first Garrett locomotives were used... more about that in a moment.

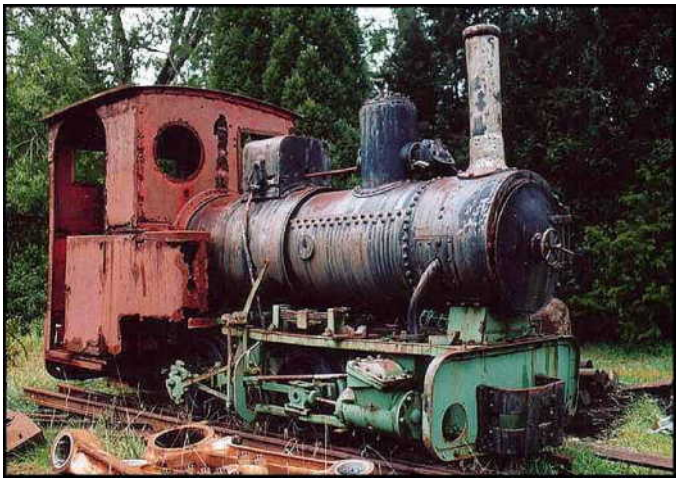
In the early 1890s, the Tasmanian Government built a short 42" gauge rail line to link the Port of Straghan to the growing mining area of Zeehan and the Dundas region. The line also naturally linked in with the terminus of the Mt. Lyell Abt railway. So long as minerals could be brought into Zeehan, there was now a line open to the Port Macquarie shipping routes. Incidentally the Straghan-Zeehan line was built using small Baldwin 0-4-0Ts, not unlike the Hawaiian cane locos, such as *'Olomana.'* Here Baldwin #7108 1884, *'Carbine'* is seen in construction service in 1890.



The Port of Straghan - Macquarie Harbour, as seen today. Once a Busy Port for the Mines.

The North east Dundas Tramway was built in 1896-1898 to transport abundant silver, lead and zinc ore from an almost impenetrable wet and cold rainforest area, near Mt. Dundas, just north of Macquarie Harbour and the portside town of Straghan. The spectacular line consisted of 99ft radius curves (that would be shy of a 5ft curve in 1:20.3), 4% grades, and many wooden trestles, including one that was 150ft long and 50ft high, crossing in front of the huge Montezuma waterfall...what a sight!! Mineral was brought into Zeehan via the tramway and then onward to Port Macquarie via the new Straghan-Zeehan railway.

The Montezuma Waterfalls and the NE Dundas tramway.



From the get-go the NE Dundas Tramway was overburdened by large ore tonnage and lumber loads, and the tiny 1880s Krauss 0-4-0Ts and larger 17 Ton 1897 0-4-2T Sharp Stewart locomotives were overworked. The original Krauss 0-4-0Ts were as close to the LGB Stainz as one could get. Originally delivered to Australia in 1889, 1894 and 1897, the locomotives were acquired second hand for the construction and service to the line. A 4th Krauss of identical design was purchased new in 1889. The 4 locomotives were nominated as the 'H' class on the line. As the larger locos arrived on the line, the fleet of Krauss locos were to be used in shunting operations near the smelters at Zeehan.

Three of the Krauss 0-4-0Ts were eventually sold off to mainland Australia and the 4th (H1) slowly fell to bits in Zeehan. Today a type H Krauss can be seen rotting amongst the large quantity of rusting mining equipment found in the rear yards to the School of Mines Museum in Zeehan. Identical to the type used on the NE Dundas, this one's heritage belongs with the Renison Tin Mines.

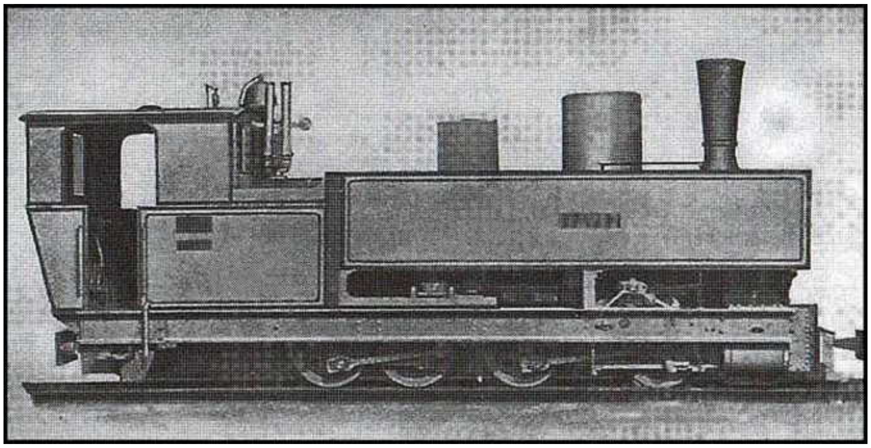
By the turn of the century, as the tramway progressed and mining tonnages increased, the railway looked to alternative motive power to solve their problems. It was the classic narrow gauge problem; sharp curves, steep grades, the narrowest of gauges and too much tonnage to haul on such a line. The Tasmanian Government investigated various articulated designs, of which there were the Fairlies and European Meyer and Mallet locos to choose from, such as the Orstein Koppel 0-4-4-0Ts. Looking a bit further they came across the little known flexible locomotives called the Hagans Patent, from the builders 'Locomotivfabrik Hagans, Erfurt'. Erfurt is a medieval town in the centre of Germany on the border of what was once East Germany. It is also the town in which my father grew up.

Christian Hagans, born 1829, came from a background of blacksmithing. At the age of 28 he formed his own company, 'Hagans Iron Foundry and Machine Works', where he built metal castings for agricultural equipment. Entering the 1870s, Hagans turned his manufacturing business to locomotive design and construction. The limited size of his foundry in Erfurt restricted the size of the locomotives he could assemble and as such, decided to focus on smaller industrial machines, such as 0-4-0s, 0-6-0s etc, in 36 different gauges. In the early 1890s, noting that the requirements for industrial locomotives were pushing for ever larger, more powerful locomotives, Hagans began looking at articulated designs. The quest was to design big power, for narrow lines with sharp curves, with light axle loading...quite a challenge.

The locomotive type he became known for were the 'swivel frame' locomotives of which he built 150 units for all gauges. These were essentially a standard 0-8-0 type loco, with a bending frame, such that the 8 wheels sat in two Bissell trucks, and the side rods could power all 8 wheels from the same cylinder set via a clever arrangement of levers. (This concept is how the LGB 2-8-2 manages to get round 2ft curves!!). The design concept was founded on the need to create a long/large boiler for ample steaming, spread the load over many axles, power all the wheels from the same cylinder set so as to maintain a tractive effort/steam supply balance and flex the chassis so that the long machine could round the tightest of curves.

In 1892 Hagans built his first swivel frame locomotive... outwardly looking like an 0-8-0T, but really an 0-4-4-0, with a single set of cylinders, boiler pressure 175PSI. It was a 28.6 Ton machine for the German Gelnhausen-Bieber open cut mine, 900mm gauge. The locomotive carried the name 'Gluckauf' of 'good fortune'. The locomotive was an outstanding success, hauling trains around curves of 40m radius at 30kph. More were ordered of the same design. The Hagans workshop was now called 'Lokomotivefabrik Hagans'.

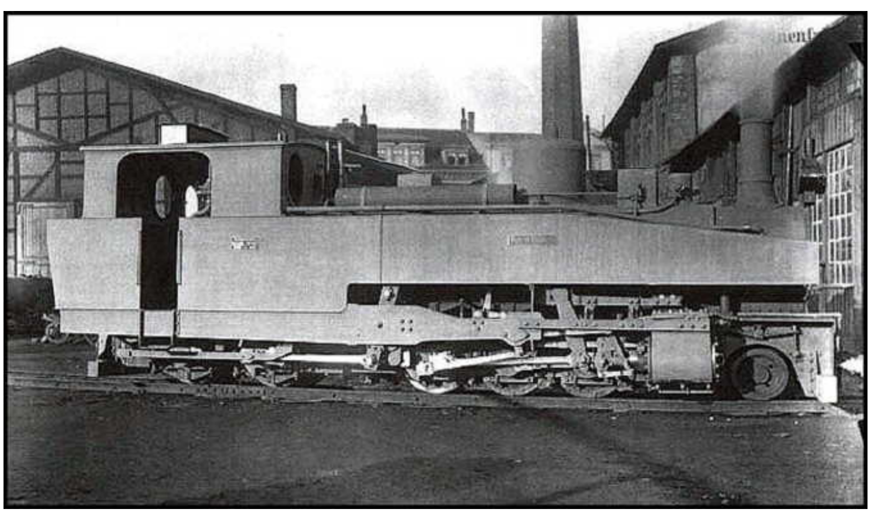
Hagans also actively pursued and pushed for the use of his design by other engineering firms, such as Orstein & Koppel, Maffei, British firms and even Baldwin in the US, but few took the bait.



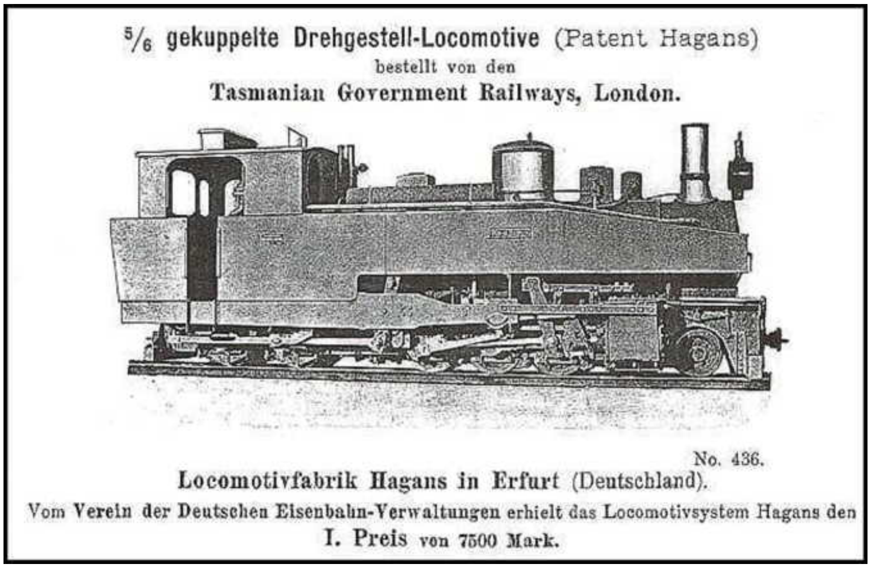
The Hagans 0-8-0T Flexible frame loco built for the German Gelnhausen-Bieber open cut mine in 1892.

In 1900 Hagans was presented with a Gold Medal at the Paris World Fair for his contribution to the development of specialty locomotives for industry. Christian Hagans passed away in 1908, having built up a large and successful locomotive factory. The factory had become a family vocation too, with his three sons, Herman, Otto & Friedrich, also entering into the locomotive business at his side.

In 1899 the agents for the Tasmanian railways in London opened negotiations for a large Hagans articulated locomotive required for service on the NE Dundas Tramway. All data from other users of this locomotive type pointed to a very successful machine of large tractive effort, capable of running on light lines. Tasmania was so confident in the design that a 2nd boiler was ordered along with the locomotive, forecasting their desire to run the machine for a very long time. Herman Hagans took on the design of the Tasmanian locomotive as his brainchild, personally overseeing every aspect of the design and construction. He even had a full-scale wooden model built to test the clearances on the curves. In 1900, Hagans 436th locomotive was ready for steam trials, the largest of the type ever built. She was then part disassembled and shipped to Tasmania.



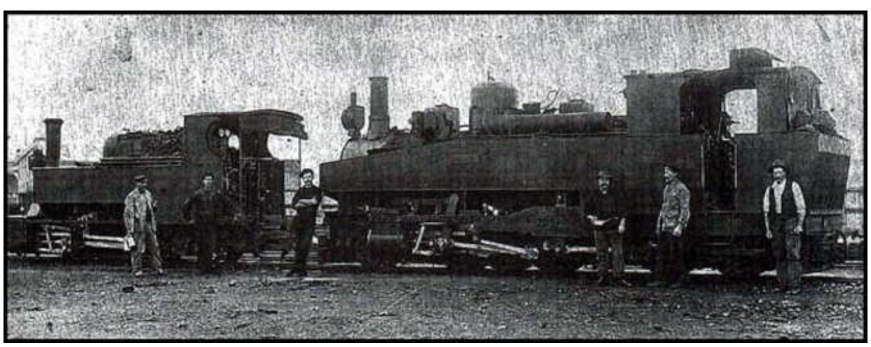
Builder's photo of the Tasmanian J class Hagans, prior to leaving the Hagans factory in Erfurt, Germany.



A Hagans advertisment of the day, illustrating the huge machine built for Tasmania.

Upon entering service on the North East Dundas, she was the world's most powerful 2ft gauge locomotive, she was the only one of its class, custom designed and built by Herman Hagans. She was also unusual for a Hagans locomotive having a pilot truck. She outwardly looked like a 2-10-0T, but was a swivel frame design, 2-6-4-0T. She became the Tasmanian 'J' class.

Initial trials on the railway had mixed success. Her tractive efforts were unsurpassed, but her somewhat limited frame flexibility cause her to spread the light rails, and damaged track work would plague most of her career. She provided excellent service to the tramway until 1928 when her boiler was decommissioned. The line had also been using 0-4-0+0-4-0 Garretts since 1910, but upon the Hagans withdrawal, no locomotives on the line could haul anything like what the Hagans could, and without her power, a lot of strain was put on the line and the remaining locos. Constant requests were placed for the 2nd boiler to be brought to the railway in order to put the Hagans back into service, but the boiler was situated several hundred Kms away, and moving it was too costly. The line temporarily closed in 1928, then reopened to press on with the two *K* class Garretts alone for the next 4 years, closing finally in 1932. Like many a Tasmanian story, the Hagans was never really scrapped, she just fell apart in the rot yard. Today there only remains the front cab wall of once the most powerful 2ft gauge loco in the world.

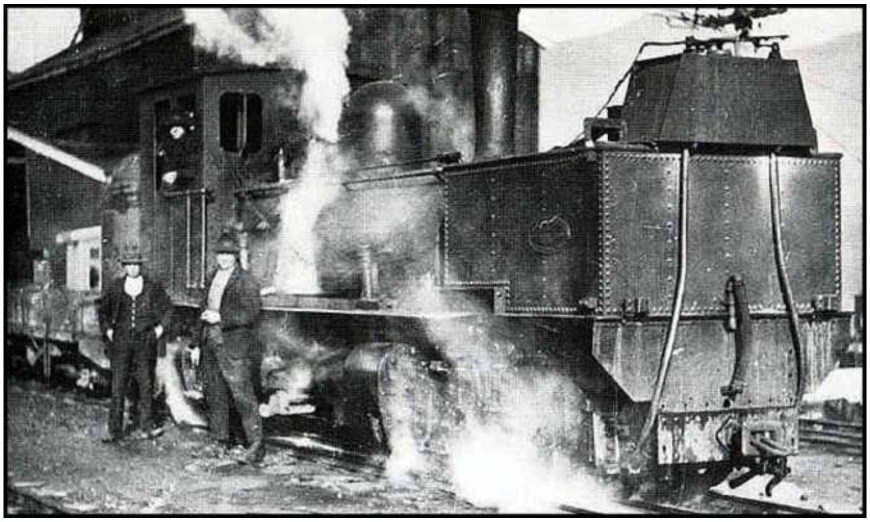

The Hagans seen with one of the earlier Sharp Steward locos - a good indication of side difference!

As an interesting note about specs, the Hagans 2-6-4-0T weighed in at 41.38 tons, whereas the small locos she replaced were the Sharp Stewart 0-4-2T of only 19 ton... Yet the axle loading of the Hagans was approx half a ton lighter than the S. Stewart. It was not her weight so much as her length, which caused the rails to spread. She had an unbelievable 23,885 lb tractive effort... that's almost the tractive effort of the D&RG 3ft. gauge C-25. In contrast the 0-4-0+0-4-0 K class Garretts weighed 33.5 tons and had an axle load 1 ton heavier than the Hagans, but due to there greater flexibility, did not spread the rails.

The Hagans in service on the NE Dundas Tramway.

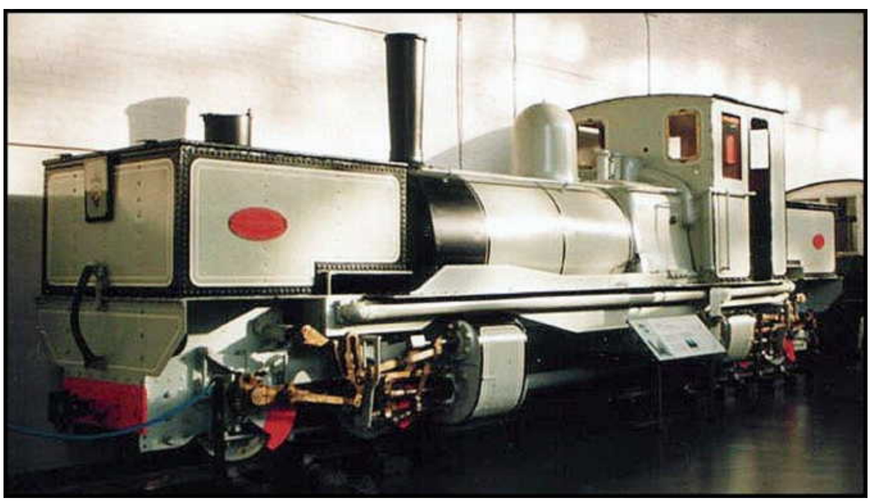
It was this spreading of the rails issue that lead the railway operators to investigate further articulation possibilities for further locos. The lone Hagans locomotive had performed well, but traffic was increasing and more locos of similar tractive effort were required.

Garrett experts may be able to confirm the order of proceedings as to how the Garrett locomotive came to be designed. Whether the design existed, but had not been used prior to the Tasmanian order, or whether the Garretts of the Dundas were purpose designed for the line, and opened up the whole world to the Garrett concept, I don't know. But what we do know is that two 0-4-0+0-4-0 of a completely new articulated design were built by Beyer Peacock of Manchester UK, in late 1909. The concept behind the design was for the ultimate flexible loco, of high tractive effort, and spread axle loading. The Garretts would be named K1 and K2 upon delivery. The two locomotives were assembled in the Zeehan workshops in 1910. The locomotives performed well and have always been regarded as a great design. Being the very first of the type, there were issues with the K class that Beyer Peacock rectified on later designs. Namely the cylinders faced inward on the K, keeping the cylinders close to the boiler and steam lines shorter. Crews complained about the heat coming up through the cab floor from the cylinders directly below. On later Garrett designs the cylinders were outward facing. Additionally the K Garretts were a compound locomotive, with high pressure cylinders on the rear chassis, and low pressure on the forward chassis. This design aimed at steam conservation for the 195PSI boiler. Typical Garrett designs that followed were simple expansion designs. Many references report the Tasmanian K class as being the only Compound Garretts ever built, but others in the UK (thanks Ralph) state that there was at least one other compound Garrett built. The Garretts had a tractive effort of 17,900lb, or about that of a C-18 2-8-0 on the D&RGW. They were an efficient little locomotive, and while not as powerful as the Hagans, the two Garretts and Hagan worked together to move heavy loads over such an impossible railway. It would be doubtful that anything like the loads on this 2ft line were ever encountered on other roads so narrow. As the line was closed in the 1930s, both Garretts were put into storage at Zeehan.



The K1 Garrett in service on the NE Dundas Tramway.

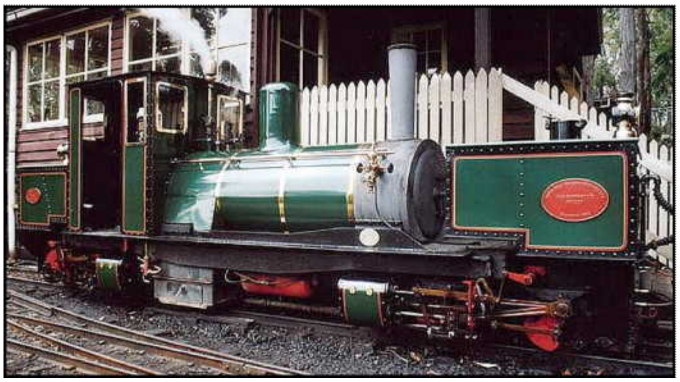
In 1947 Beyer Peacock requested the purchase of the class leader K1 for exhibition at their Gorton works in Manchester. K1 was a well used and worn locomotive by then. Prior to the sale, crews in Zeehan rebuilt the K1 using parts from K2, she was then disassembled and shipped back to the UK forever. In the late 1960s Beyer Peacock closed its doors at the end of the steam era and the K1 was homeless. Transferred to the Ffestiniog Railway in Wales, it was hoped she would be regauged narrower to the 597mm Ffestiniog gauge. However she sat there disused for many years before being sent to the National Railway Museum at York. Being the class leader of the very successful British Garrett design, she was cosmetically restored to original builder's photo two-tone grey. I finally saw the K1 with my own eyes in 1991 and did shed a tear for her. I believe she is now back at Ffestiniog being returned to full steam.



The Rebuilt K1 as seen in the National Railway Museum, York, UK, in 1991.

While most Australian rail enthusiasts would agree that is sad that the K1 will never come home and will be re-gauged to an incompatible gauge, we can take some comfort in seeing a 3/4 scale full steam replica in operation at the 'Bush Mill' just outside the Port Arthur Historic site. This little loco has earned international recognition all its own and is a great little train to see and ride. She runs every day. Also go see the Tasmanian Devil sanctuary over the road from the Bush Mill.

The Bush Mill's 3/4 scale working model of the K1, now in service near the Port Authur Historic Site.



The loco entered service in 1990, and has on one occasion run the narrow gauge rails in Wales, UK.

To learn more about the Hagans and K class Garretts of the NE Dundas, please do refer to the 'references' list below. I cannot overstate how superb the book by Geoff Murdoch is, called *'Tasmania's Hagans.'* He is an authority on the subject of the Hagans, and built the 3 1/2" gauge live steam working model of the Hagans now on display at Zeehan. The book is very inexpensive, soft bound at only 71 pages and is loaded to the teeth with engineering drawings and very fine drawings of the Hagans and the K1 Garretts, better than drawings I've seen elsewhere... buy this book!!

The working model of the J class Hagans, built by the Author of the book 'Tasmania's Hagans', now on display at the West Coast Pioneer's Memorial Museum, Zeehan.

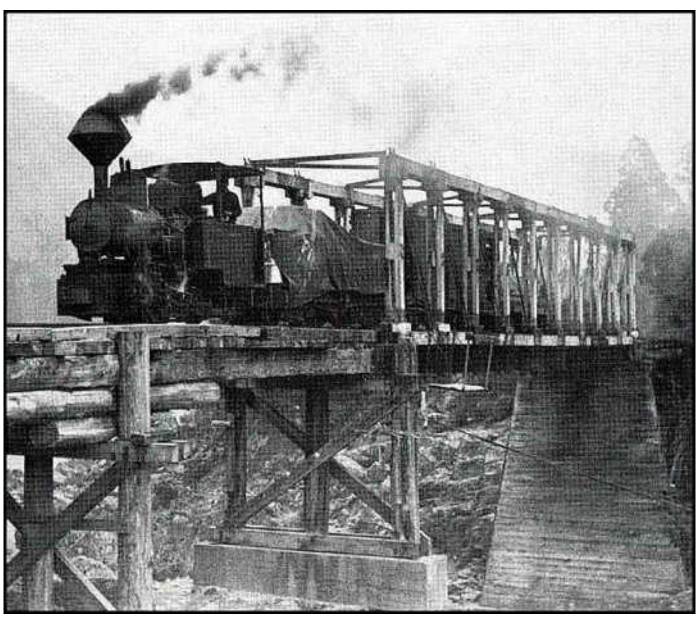
The Emu Bay Railway:

While the Mt Lyell railway and Dundas Tramway were being conceived bringing mining ores to the Port town of Straghan on Macquarie Harbour, a large 42" gauge railway was being built southward from the northern Tasmanian coast seaport at Bernie. Initially a wooden railway, with horse drawn trains opened in 1878, but by 1884 the line was upgraded to 42" gauge full steam railway. The Emu Bay Rwy. Co was formed in 1897 and is still active today as Australia's longest private railway. In 1900 the line reached Zeehan and connected with the mineral lines of the Dundas tramway as well as the Straghan-Zeehan railway. Minerals brought out of both Mt Lyell and the Dundas Tramway could now be shipped directly north via the Emu Bay railway to the large seaport at Bernie on the north coast of Tasmania. The narrow 'Hells Gate' entry to Port Macquarie had always restricted to the tonnage limits of the ships that could enter, such limits were not found at Bernie. The Emu Bay railway grew to be one of the largest mineral hauling lines in the nation, and naturally big steam power was used, including 4-8-0s, and some very large 4-8-2+2-8-4 Garretts. The Emu Bay has an extensive history worthy of a story all her own, but for now, we'll speak more about small industrial lines.

The other lil West Coast Tramways

Wee Georgie Wood:

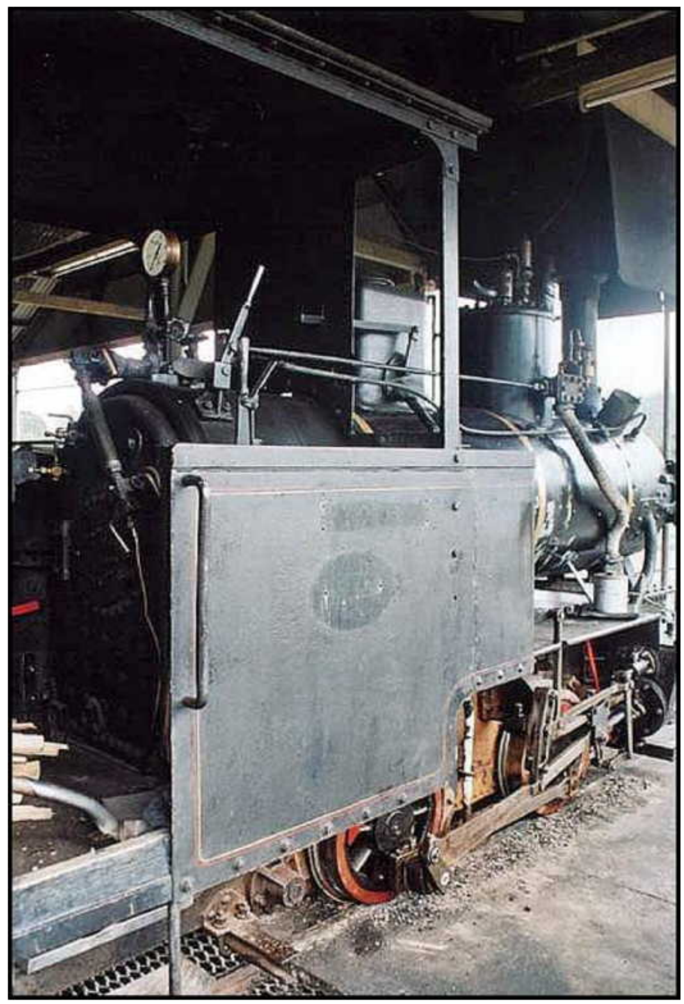
Only a handful of miles north of Zeehan were yet more mining areas. The mining township that grew up at Tullah was isolated from the Emu Bay or Zeehan railway links. A 2ft railway was built in 1924, called the Tullah Tramway, which linked with the Emu Bay Railway at Farrell. The line was the only connection for the town of Tullah to the outside world. The line which carried minerals, lumber and general passenger services became known by the locals as the 'Wee Georgie Wood' in honour of the nickname given to the first UK built Fowler 0-4-0 'Well Tank' locomotive brought into service on the line in 1924. A second locomotive of identical design joined the first Fowler, to be named 'Wee Mary Wood'. Fowler was a noted British builder of industrial locomotives and agricultural equipment, including some of the finest traction engines ever built. The Fowler 0-4-0 locos were a Well Tank design, where the water tank was carried between the loco's frames in a form of 'well'. This benefited the centre of gravity on locos of such narrow gauge, and was a design used often by Orstein & Koppel and Krauss. Indeed the LGB 'Stainz' was a Well Tank loco.



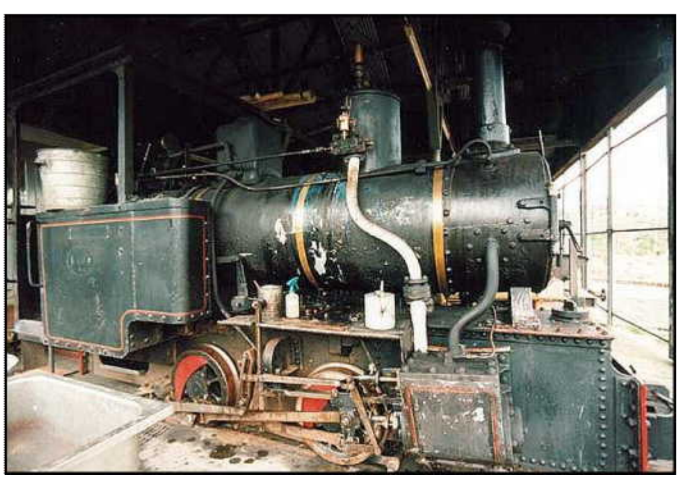
Wee Georgie Wood in service as seen in the 1960s.

The Diminutive 0-4-0s and the Tullah Tramway were so highly regarded by the locals, that when mineral traffic ceased, the town refused to give up the railway. Today much of the equipment is preserved and locals run a small tourist operation on Sundays on a new section of track within the Tullah township. They have plans to extend the line around the lake to a homely restaurant and motel complex. While some texts suggest that 'Wee Mary Wood' fell off a trestle bridge into a gorge where she still remains, other more reliable texts state that Wee Georgie Wood was rebuilt after WWII using parts from the Wee Mary. The lone surviving Fowler seen today and named 'Wee Georgie Wood' is in fact an amalgam of the two locomotives. Duties on the line were also shared with a 10 ton Krauss 0-4-0 locomotive bought 2nd hand from the Mt Lyell Mining and Railway Co (Mt Lyell #9 -similar to the #8 seen above). This loco also survives today at Tullah but is currently in pieces undergoing a very long restoration!

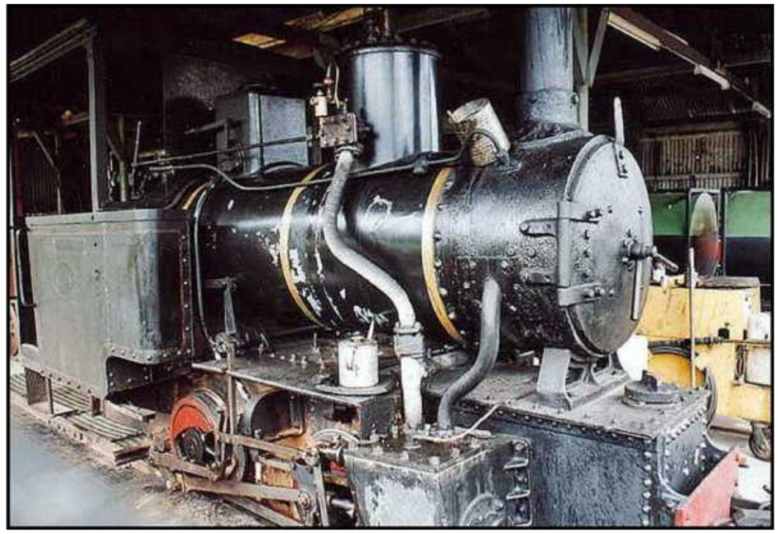
The cute lil bogie coach used on the Wee George Wood line, now preserved at Tullah.



Wee Georgie Wood, Fowler 0-4-0T.



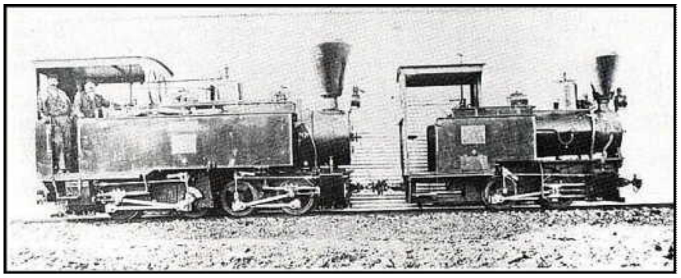
Note the water cap to the well tank, just above the pilot beam.



The delightful remains of many ore wagons, and rail equipment can be seen today in Tullah, here a 2ft gauge truck.

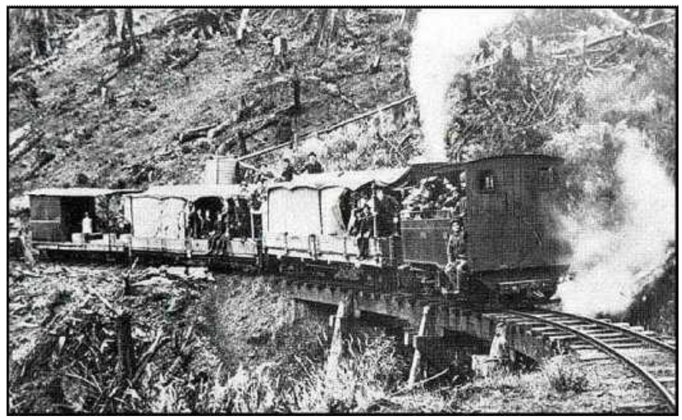
The Magnet Tramway:

Another line of some note in the region was the 16km long 2ft. gauge Magnet Tramway, connecting the Emu Bay near Mt. Magnet. The line only owned 3 locomotives, all supplied by the German firm, Orstein & Koppel. But what locos! Two were classic German Mallets, of the O&K 0-4-4-0T design, and the 3rd loco was an O&K 0-4-0T. The O&K Mallets were typical of that firm's design, with the lead chassis an inside frame design, and the rear chassis an outside frame design, allowing for a larger grate area to the firebox.



The O&K 0-4-4-0T and 0-4-0T on the Mt. Magnet Tramway.

The O&K Mallet rounds a curve on the tramway.



Very similar units were used in Europe and Scandinavia, as well as Mexico and South America to name a few. Today I have seen only two preserved locos of this type, although there are probably quite a few more. One is in active service at Mariefred, a railway town south of Stockholm, near Grippsholm Castle in Sweden and the other is the famous O&K 0-4-4-0 now preserved in working order at Cripple Creek, Colorado. The two Mallets used on Tasmania's Magnet line were of a styling more consistent with the unit preserved in Sweden. As for the disposition of our O&K Mallets, I don't know what happened to them. It is suggested that one was dismantled and abandoned at Magnet Junction in 1936 at the closure of the line. Quite possibly bits of her are in existence as rusting unrecognizable bits of iron in the district.

The restored O&K Mallet at Cripple Creek, Colorado.

The 'Hamra', O&K 0-4-4-0T, now preserved at Mariefred, south of Stockholm, Sweden.

There were several other small lines serving the west coast mining areas with interesting rosters of Krauss, O&K, and UK built Sharp Steward, Dubs, and Hudswell Clarke, along with some very interesting railcars. But their story will have to wait for another day. The Hudswell Clarke Industrial locos were a classic UK design, and while I have not seen any surviving in Tasmania, several similar locos used in other Australian states have been preserved. Their work on the railways included mining, sugar cane, construction, gasworks, cement works and electricity.

The example shown here is a typical 1903 Hudswell Clarke 0-4-2T, very similar to the designs used in Tasmania. This 42" gauge loco was used in the Portland Cement factories of southern Victoria. She is now in operating condition at the Ballarine Peninsula Railway, close to my home, and had always been a childhood favorite. A very similar 2ft gauge version of this loco, also resides at the Puffing Billy Narrow Gauge Museum, originally used on the Queensland Sugar cane tramways.

As for the lil line on the south tip of Tasmania, the Lune River Railway was a 2ft. gauge line a mere 6 miles long connecting a remote limestone mine with a small jetty on the south coast. The area also has neat rainforests and limestone caves. The line was originally steam powered but today has a small tourist industry, noted as being the southern most railway in Australia. The line is served by Malcolm Moore Industrial locomotives with Ford petrol engines, as well as the last surviving steam 0-4-2T from Hunslet. I saw the Hunslet at the Lune River shed in 1998, but in 2002 she had been moved to the north for service at the tourist town of Sheffield while their 0-4-0T Krauss is being rebuilt.

Tourists ride behind the original Malcome Moore Petrol Locomotives.

The Hunslet awaits another run in 1998 at the Lune River Railway.

The Hunslet being readied for service for her new life at Sheffield, Tasmania. Note the environmental oil collection trays fixed under the side rods and cylinders.

There is a great deal to see in the Mt. Lyell and Zeehan area today. The Mt. Lyell Abt railway is world class and not to be missed. For mining interest much survives, both at the Zeehan School of Mines Museum, and in the area leading to town. There remains elements of the aerial tramway in rusting condition, along with much mining plant and equipment... a treasure trove of discovery for people like us!!

Remains of the Aerial Tramway at Zeehan.

I love mines, always have, and should you visit, the tourists numbers in the area are never large and it is possible to take a personalised guided tour into the Mt Lyell Copper Mine ... Oh joy. They might even give you copper mineral samples to add to your garden. But even that is surpassed by a visit to the World Heritage rainforests, take a boat ride up the Majestic Gordon River, visiting the ruins of Sarah Island, and take a Sea Plane ride up into the mountains to land on the narrow upper Gordon River. The approach is spectacular as the plane weaves inside the river canyon to make a landing on the still black waters in the heart of the rainforest.

Aerial View of the Lower Gordon River, as it approached Macquarie Harbour.

Seaplane to the Upper Gordon is a spectacular ride to a narrow river landing.

This is only a snap shot of the exciting industrial railways of Tasmania's West Coast mining region, there is much to see and do there today, and since little has changed in the way of progress, one can really reach out and touch some of Australia's past. Of all of Australia, this area remains high on my list of favorites.

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Murdoch Geoff - **'*Tasmania's Hagans - The North East Dundas Tramway Articulated J class*',** Get a copy at: 'J' Class, PO Box 127, Rebank Plaza, Queensland 4301, Australia. ISBN 0 646 33442 5.

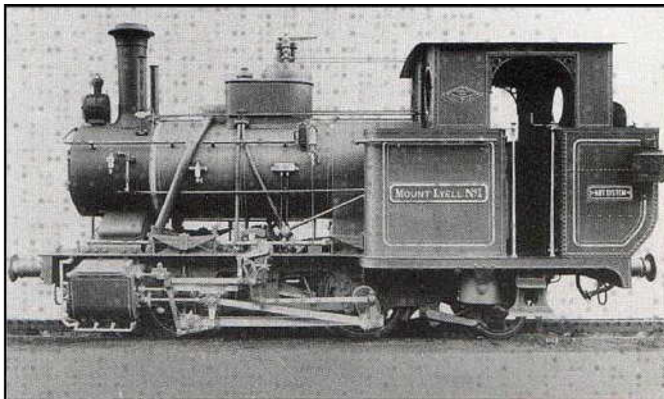
Australian Railway Historical Society - **'*Along the Line in Tasmania Book 2 - Private Lines*'** ARHS NSW div, PO Box E129, St James NSW, 2000 Australia. ISBN 0-909650-19-5.

Australian Railway Historical Society - **'*Along the Line in Tasmania Book 3 - the West Coast*'** ARHS NSW div, PO Box E129, St James NSW, 2000 Australia. ISBN 0-909650-22-5.

Leon Oberg - '***Locomotives of Australia, 1850s-1980s***', Reed Books Pty Ltd, 2 Aquatic Drive French Forrest NSW, 2086. ISBN 0730100057.

Glenorchy Transport Museum Society. **'*Locomotives of the Tasmanian Transport Museum*'** GTMS, GPObox 867j, Hobart, 7001.

Builder's Photos of the Mt Lyell Abt locos:



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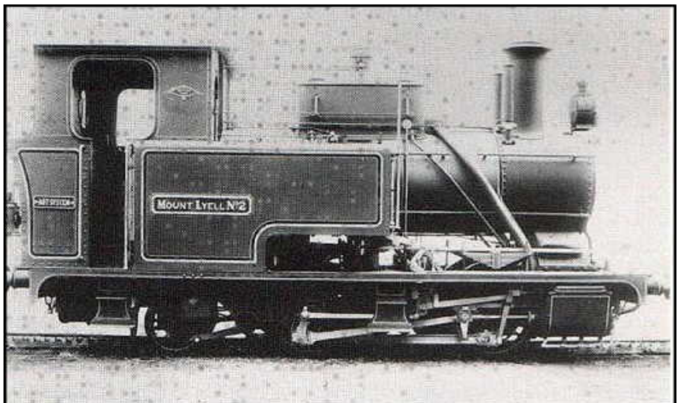

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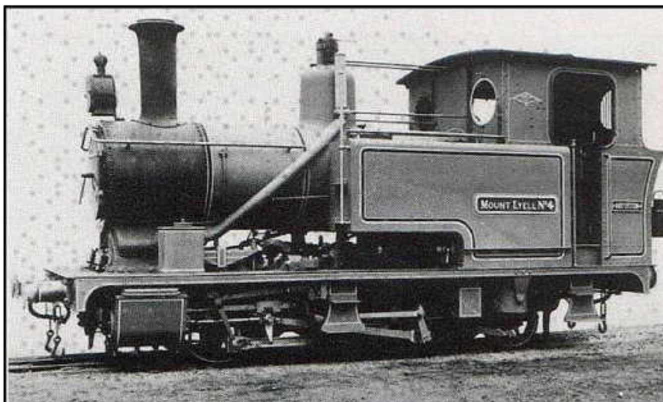

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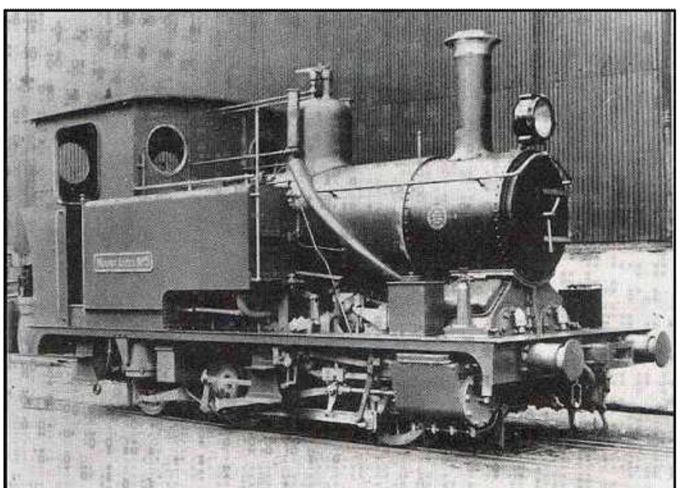

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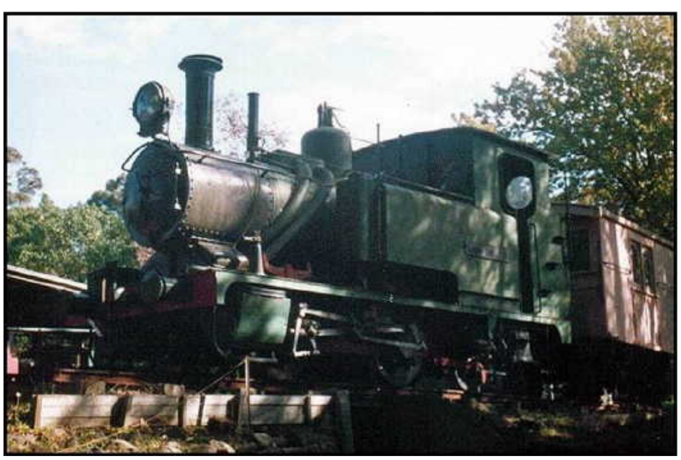
The Mt. Lyell Abt locos, Prior to restoration:

Mt. Lyell #1 - On Display at the West Coast Pioneer's Memorial Museum, Zeehan in 1998. Now fully Restored and Operational since 2002.

Mt. Lyell #2 as seen at the Glenorchy railway Museum, Hobart in 1998, awaiting the day she will steam again.

Mt. Lyell Abt Loco #3, on display at the old Mt Lyell Yards in Queenstown, the first loco to be fully restored. This shot taken in 1996 prior to restoration.



Abt Loco #5 was transferred to the Puffing Billy Narrow Gauge Museum in 1963. She was returned to Tasmania in 2003 and is now undergoing full restoration. This shot of her display was taken on my instamatic camera in 1984, since this railway and museum is literally only 40 min drive from home, I never really bothered to take pictures of her!! She should be back in service later this year. The 4-wheel guards van behind is also from the Mt Lyell railway and has also been returned to Tasmania.

MLS Steam-Class 2004
Build A Live Steam Accucraft Ruby Kit

Chapter 3 - Bunkers, Tenders, & Forneys, Oh My!

Project Update:

The availability of the Ruby kit is still up in the air. So this chapter focuses on structural modifications that can be performed to the rear end of your Ruby. As shipped, she has no visible means to carry fuel. While many Baldwin x-4-x locomotives carried small amounts of fuel in the cab, a railroad desiring to haul over longer distances needed to add either a bunker or a separate tender to carry fuel.

Of the modifications you can make to your Ruby, the set of modifications covered in this chapter are likely to have the largest visual impact on setting your Ruby apart from the crowd.

Chapter 3 Projects:

In Chapter 2, one of the articles focused on a frame extension and bunker. The bunker project had three steps: fabrication of a new rear two wheel truck, fabrication of a frame extension, and the construction of a rear bunker. As the chapter ended, both the frame extension and trailing truck were complete. But I was expressing frustration with my initial attempt to create a riveted shell for the bunker. The problem I was encountering was punching equally spaced rivets that fell along a straight line. That problem was solved with my rivet press. A short article explains how you can build your own **Rivet Press**.

In the next article, the **Bunker Project**, which was left in an incomplete state, is finished, including a paint job in *'Olomana'* green.

The next two projects require one or two four-wheel trucks. A **Selecting a Truck** article examines a few of your options.

For those of you that are Forney fans, we deliver two choices. For those of you that want a greater challenge, our thoughts will be shared on how to adapt other materials already presented in this series in **Scratch Building your own Forney Upgrade**. The 'wimp's way' is to purchase a **Vance Bass Forney Kit** and follow the instructions in upgrading your Ruby to a Forney. We'll give you an overview on performing the Forney upgrade and point you to an Adobe PDF document containing Vance's step-by-step instructions on performing the modification.

Finally, one of the options offered by manufacturers of x-4-x engines was a separate tender. Such is the case with Hawaii No 5, a Baldwin 2-4-2 Columbian that is in operating condition today. An extensive **Tender Construction** article in this chapter will take you through construction of the deck and superstructure for a tender for Hawaii No 5.

I learned a great deal about soldering brass while writing this chapter. I don't have it fully mastered yet. So I'm sharing what I've learned in a short article titled, "**Some Thoughts on Soldering**."

Resources:

Our quest for trucks and other upgrades to our Ruby has brought a number of new players to our list of suppliers.

Online Metals.Com - This supplier has a variety of useful sizes and shapes of brass, copper, and other materials useful in model building. In extending frames in Chapter two, 1/8" x 1/4" brass bar stock was used. Online Metals offers bar stock in a variety of dimensions. They also offer brass pipe and tube in much larger sizes than you will find in the K&S rack at your hobby shop. And this description just begins to scratch the surface of their extensive list of products.

Hartford Products - Bob Hartford supplies G Gauge kits, trucks, parts, jigs, lettering sets, videos and figures. Looking for some prototypically accurate rolling stock to haul behind your Ruby conversion? Bob can help. Need a figure to put in the cab? Bob can put an engineer in the engineer's seat. In this chapter, Bob is a primary source of trucks for our Ruby's tender and Forney conversion.

Bachmann - Probably the least expensive way of acquiring the Bachmann trucks pictured in the section on selecting trucks is to pick up a used Big Hauler on eBay or at a swap meet. In addition to the trucks, the Big Hauler will yield a significant number of parts or even a working locomotive that can be paired with another tender and operated on your pike.

Aristocraft Delton - Aristocraft operates a parts department where you may be able to pick up a set of freight car trucks. On the other hand, Aristocraft Classic or Delton 1:24 freight stock often goes for under $30 on eBay. Pick up a boxcar, steal the trucks and bash the car into a line shack.

Olomana & Hawaii No. 5 Update:

The chapter will finish with an update on the progress made on our two poster child engines, **Hawaii No 5 and the Olomana**.

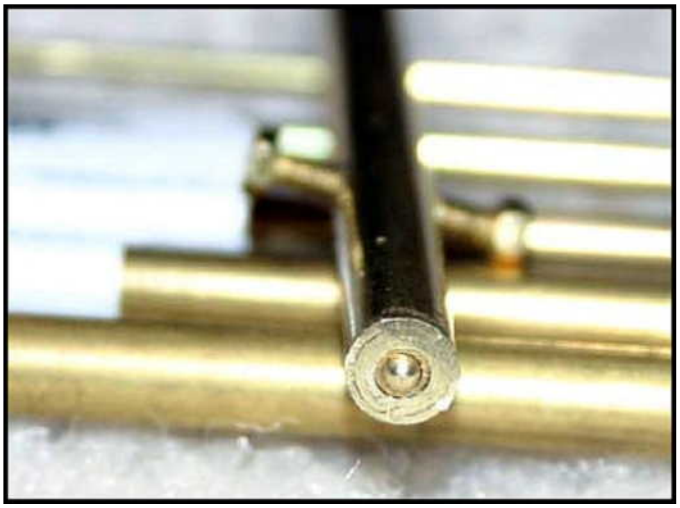
Fabricating a Rivet Punch & Die

The Punch:

After a failed attempt to stamp regularly shaped rivets in brass without a real punch and die, I decided to follow Vance's advice and construct a proper punch/die setup. However, I lacked the lathe needed turn a solid brass rod according to the instructions in his article in Chapter 2. I also tried drilling a 1/16" hole through the centerline of a 1/4" brass rod in my parts box. I wasn't successful with that attempt either. Then a third option popped into mind.

K&S brass tubes are available in sizes and thicknesses that allow them to fit tightly inside each other I built my punch with a 1/16" K&S brass wire and four tubes that telescope inside each other. Tubes are 3/16", 5/32", 1/8", and 3/32" outside diameter. The 1/16" wire fits snugly inside the 3/32" tube. The four tubes and the wire were all cut to a 2-1/2 inch length. All but the wire were tacked together concentrically using super glue to create a hollow brass shaft. Once the glue had dried, a #2-56 hole was drilled completely through the middle of the shaft about 7/8" from one end. It was tapped with a #2-56 tap.

A screw was run all the way through the shaft, holding the individual tubes in alignment. The end of the hollow shaft was then filed perfectly flat. The screw was backed out. I then slid the 1/16" rod into the hollow shaft so only the hemisphere filed onto the end of the wire protruded. Two shorter #2-56 screws, one from each side, hold the wire in place.



In this close up shot of the business end of the rivet punch, you can see the concentric brass K&S tubes used in its construction. The protruding hemisphere is the end of a 1/16" K&S brass rod that was placed in a drill chuck and rounded using a small triangular file.

Note that this shot implies that the tube end is rough. It has been filed until it is actually quite smooth.

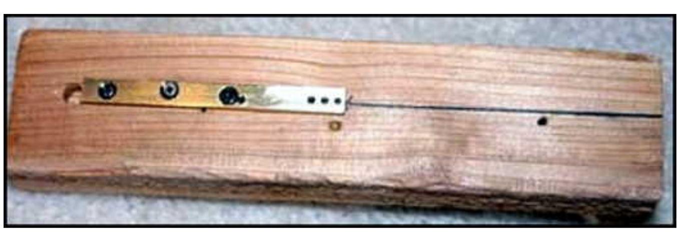
This shot shows the punch with the protruding set screws, the 1/16" wire on the left, and the four concentric tubes on the right. Total cost of materials was under $5, and three-fourths of the tube and wire is left over for another project.

The outside diameter of the punch is 3/16". Insert it in the chuck of a drill press, and it can be used to press the hemispherical end into brass shim stock.

The Die and Fence:

Without a die, the rivet would come out poorly formed. Vance 's article suggested using bar stock with three equally spaced holes drilled with a drill diameter equal to the punch diameter (1/16") plus twice the thickness of the shim stock. My shim stock is .005" thick so the total diameter of the holes will be .0725" or just under 5/64".

The die was constructed from a 1/8" x 1/4" piece of brass bar stock. The three 5/64" holes on the right are spaced 1/8" apart. The three screws on the left hold the die tightly to a piece of scrap wood with a length equal to the width of my drill press table. In my initial attempts to use the tap and die, I ignored Vance's suggestion that a fence be used to keep the shim stock a constant distance from the tap and die. I proceeded to ruin my second bunker wrapper by not listening to the expert.



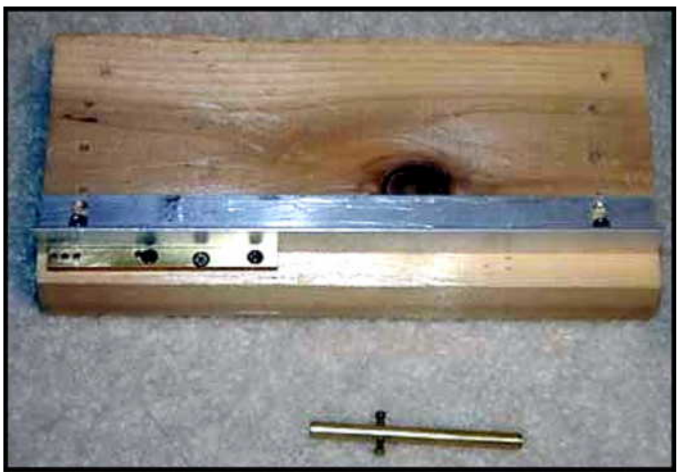
The business part of the die is three equally spaced 5/64" holes spaced 1/8" apart.

This shot shows the die before the fence was fabricated. After ruining some shim stock the die was moved to a larger board and a fence was fabricated.

After the experience of learning the hard way, a fence was fabricated from scrap L shaped aluminum stock. Two slots allow it to be screwed to the table after adjustment for alignment and spacing from the die. Multiple screw holes allow the fence to be adjusted between 0.14" and 3.50" from the center of the die.

Rivets are punched by aligning the shim stock to the fence. The first rivet is punched by pressing the punch into the inside hole using the drill press. Then the piece is slid to the left until the first rivet drops into the middle hole. The second rivet is punched. The piece is slid to the left until the two rivets drop into the left outside and middle holes. Then the third rivet is pressed.

If the operator is careful to make sure the rivets are positioned in the holes and the shim stock is held against the fence, a row of perfectly shaped equally spaced rivets can be punched in a perfectly straight line. This takes a bit of practice so I recommend starting with scrap shim stock until the operator is properly trained.



The die and aluminum L bracket fence are screwed to a cedar board.

Holes in the board allow the distance between the die and the fence to be adjusted.

The cedar board is aligned to the punch so the punch end drops into the innermost hole of the die. The board is held in alignment on the drill press table with a spring clamp.

In this shot, rivets are being punched into the top of Hawaii No 5's tender, using the drill press to punch the rivets.

The approach of screwing the die and fence to cedar was a quick short-range solution. Later, I plan to fabricate the base of the die and fence from brass. But the approach taken in the following photos produces good quality results. This rivet punching tool cost less than $5 to make.

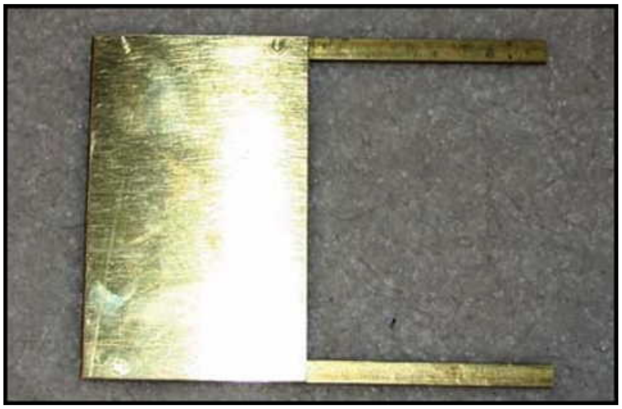
While it is being used in this sequence of photos to punch rivets in brass shim stock, it should work equally well with .005" sheets of styrene.

Fabricating a Bunker

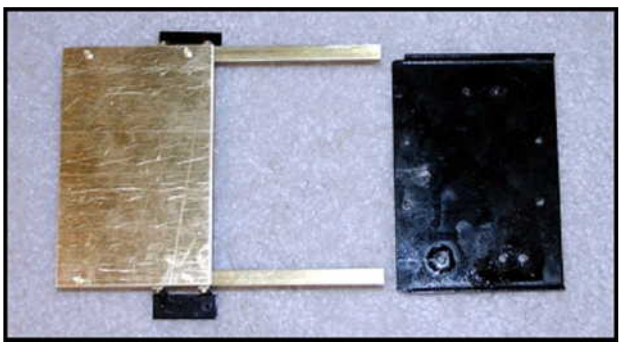
Many x-4-x locomotives had an integral rear bunker that contained, water, fuel, or both. Typical wheel arrangements were 0-4-2, 2-4-2, 0-4-4, and 2-4-4. The two or four wheel rear truck supported the weight of the bunker and rode below an extended frame.

Chapter 2 of SteamClass 2004 went through in the steps in fabricating a frame extension for the 0-4-2 Olomana. The steps are summarized here.

Deck Extension:



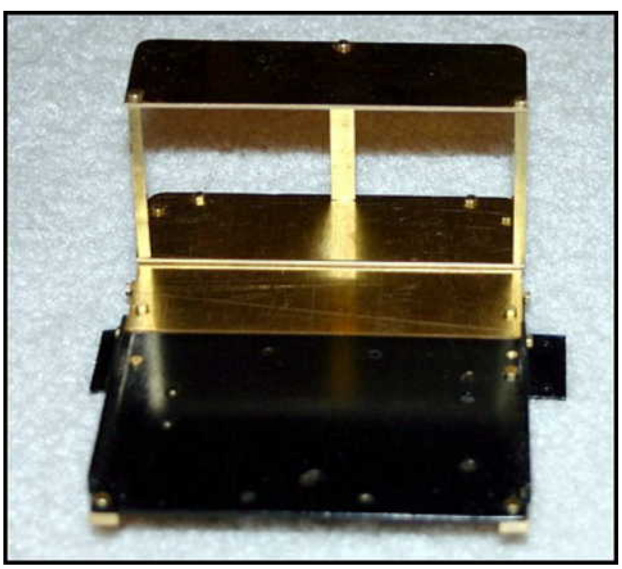
The deck was fabricated from 1/8" x 1/4" bar stock and 0.05" sheet.



The bar stock was tapped to receive screws that attached it to the bottom of the Ruby deck that sits under the cab area.

Side steps were removed from the Ruby front pilot and attached with 2-56 hex head screws.

Fabricating the Bunker Bracing:

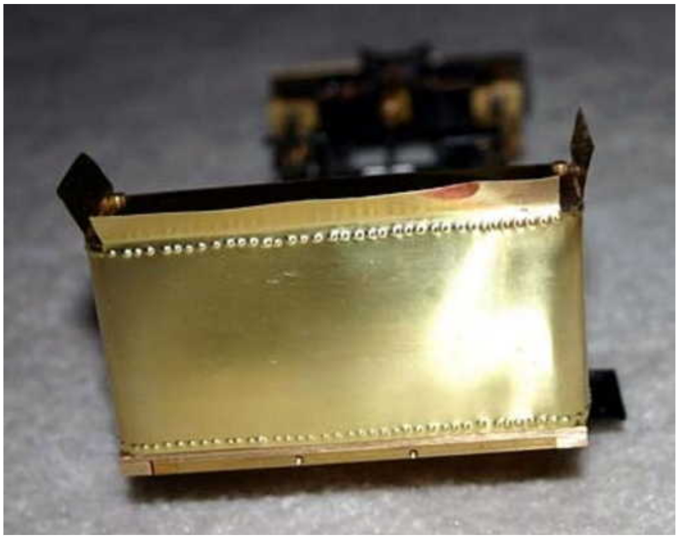


A frame for the rear shell was constructed from 1/8" by 1/4" bar stock and upper and lower plates cut from .05" brass sheet. The frame was held together with 2-56 hex head screws (top) and flat head screws (bottom).

Fabricating the Rear Shell:

A bunker wrapper was cut from .005" shim stock. Rivets were punched.

This was my first attempt, leading to the decision to fabricate a rivet punch and die.



The wrapper was soldered to the bracing.

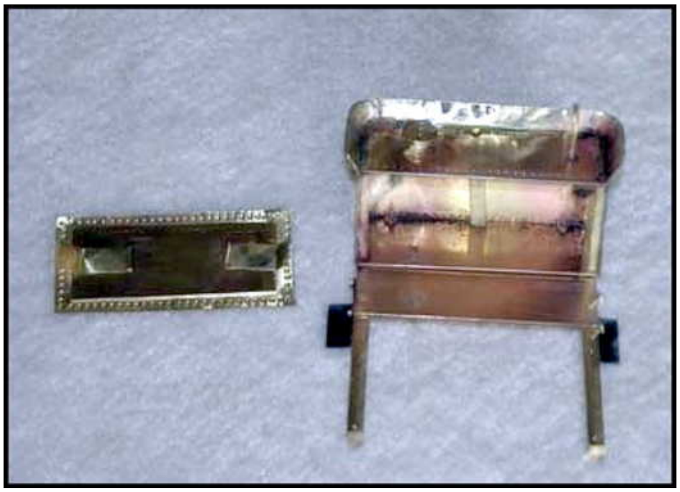
This was my second attempt, leading to the decision to add a fence to the rivet tap and die.

This shot shows my third wrapper with nicely aligned and spaced rivets. Corner pieces were fabricated by cutting and fitting. They were then soldered in place.

1/2 round wire from **Sulphur Spring Steam Models** was used to create the rim around the top and ends of the shell.

The Tank Front:

The tank front was fabricated from .005" shim stock and riveted. Springs fabricated from shim stock allow the tank front to be snapped in place around the support braces on the interior of the shell.



The front of the bunker was fashioned from shim stock tacked to .032" brass sheet. Two 'springs' were fabricated from shim stock.

They fit around the supports inside the bunker to hold the front in place.

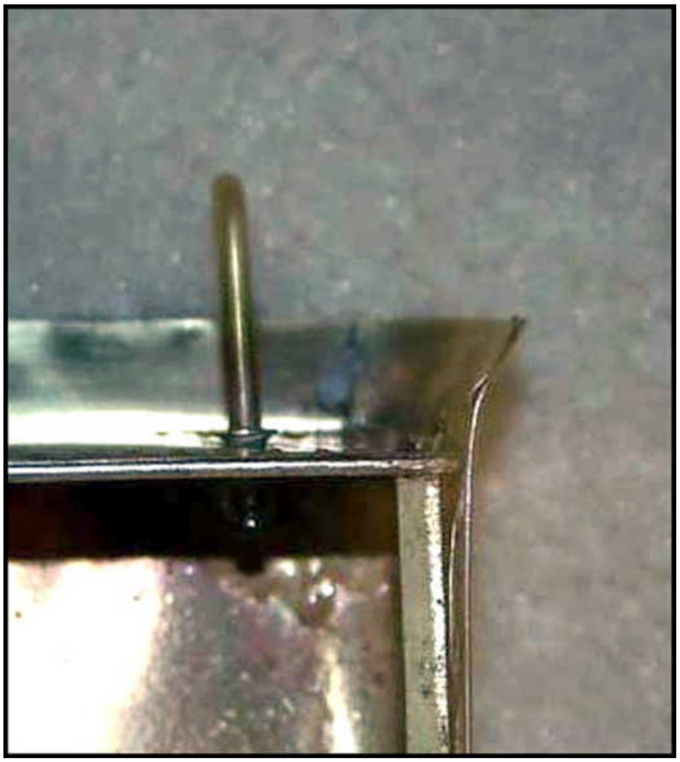
This shot shows the completed bunker with the front clipped to the front of the oil tank.

The front pops right out. That's important, as batteries and electronics will be stored inside the bunker.

The Tank Top and Front:

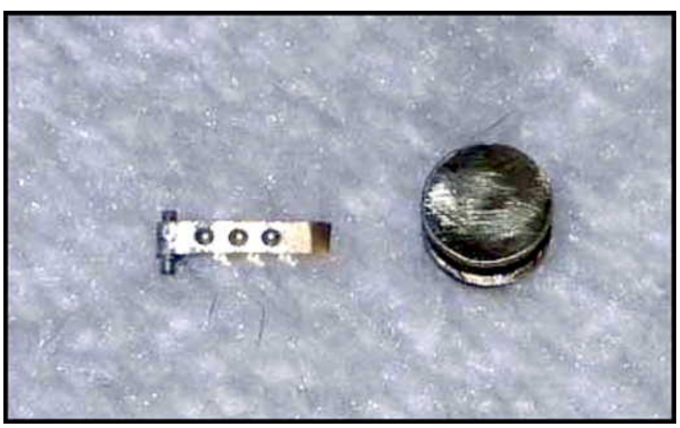
The top needed a vent and filler.

The oil pipe vent is fabricated from 3/32" K&S brass rod. A nut and washer for 2-56 screws served as the top spacer and bottom fastener for the pipe. The nut was drilled to 3/32".



The oil vent has been inserted through a 3/32" hole in the top of the bunker. The nut under the bunker top is soldered to the bottom of the top.

All detail parts are attached in this manner. There is little chance they will be 'knocked off' accidentally.



The hatch body was fabricated from two 0.56" diameter brass washers, a short piece of 0.375" K&S brass tube and a small piece of shim stock to cover the hole in the top washer.

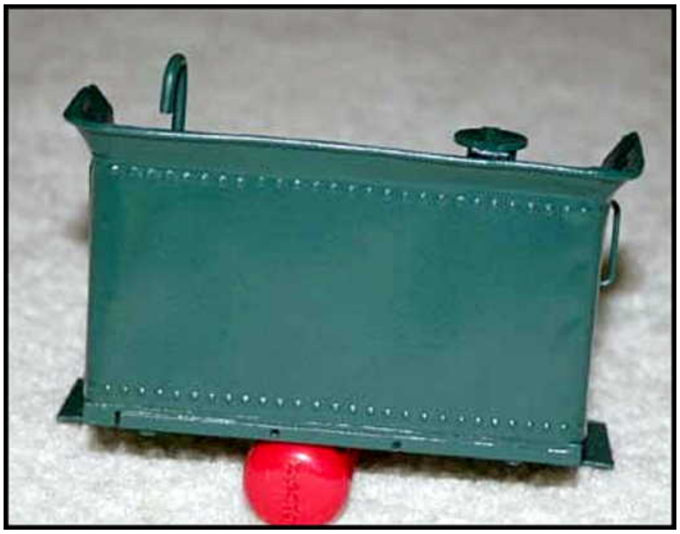
The hinge and hasp was made from shim stock and .06" diameter brass tube.

Finishing the Bunker and Frame Extension:

This was my first brass project. The results are not perfect. My son works at an auto body shop. Less than perfect auto body straightened is covered with Bondo or some other brand of auto body filler. The filler is covered by the paint. Unless you have a magnet, nobody is able to tell.
Brass is not magnetic. Even with a magnet you won't be able to tell.

The primer shows off the oil vent, the oil hatch and handrails while hiding the putty and most of the defects.

The painted front hides the crooked brace at the back of the bunker.



The shot from the rear shows off the rivet detail. The waves and dents in the shim stock are what Vance Bass refers to as an oil can effect.

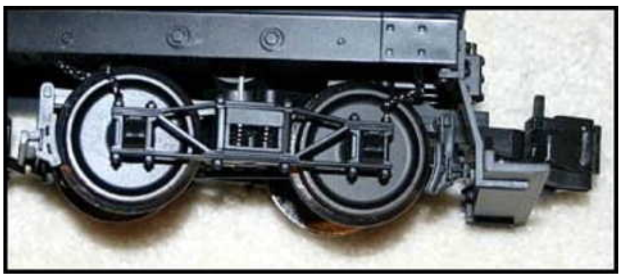
The *'Olomana'*, bunker freshly filled with oil, heads off to duty.

Selecting a Truck:

In Chapter 2, we covered how to fabricate a two wheel trailing truck using an approach developed by Landon Solomon. In the article, he suggested that the same approach might be used to fabricate a four-wheel truck.

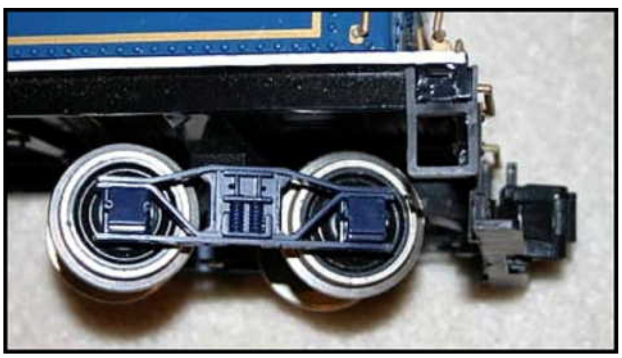
Most of you wishing to install a four wheel truck on your tender or Forney are likely to either pull a truck out of your parts box, or purchase a four wheel truck. Forney builders wishing to go with the Vance Bass Forney kit will find the trucks are included with the purchase of the kit. For those of you needing one or two four-wheel trucks, here are some options to consider.

Bachmann - Many of you have a Bachmann Big Hauler in a semi-retirement state either intact or in pieces. The more adventuresome of you may have bashed a Bachmann Spectrum Mogul or American freeing up the tender. Or maybe you'll see these parts languishing at a swap meet. In these cases, you may already have your truck.



Trucks from the tender of a Bachmann Spectrum Mogul or American have a wheelbase of 2.25" and a wheel diameter of 1.255". The wheelbase scales to 3' 9 1/2" at 1:20.3. The drivers scale to 25.5".

Note that the tender side frame sports separate coil springs in a plastic casting.



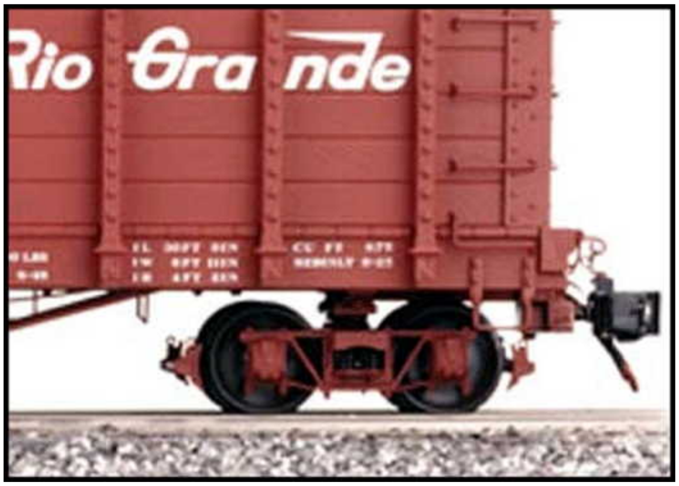
Trucks from a Bachmann Big Hauler are similar in dimensions to those on the Spectrums with a wheelbase of 2.18" and wheel diameters of 1.215". Wheelbase scales to 3' 8 1/4". Drivers scale to 24.6".

The tender side frames are a single plastic casting with coils being a part of the casting.

Aristocraft Classic (Delton) - Aristocraft sells the narrow gauge line it acquired from Delton as its Classic line. Freight cars from this line are often available at closeout for $25 or less. The trucks are fully equalized with coil springs. Wheels are plastic but could easily be upgraded to metal. You could pick up a box car or reefer, steal the trucks for your tender, then bash the box car or reefer into a line shack. Pretty cost effective!

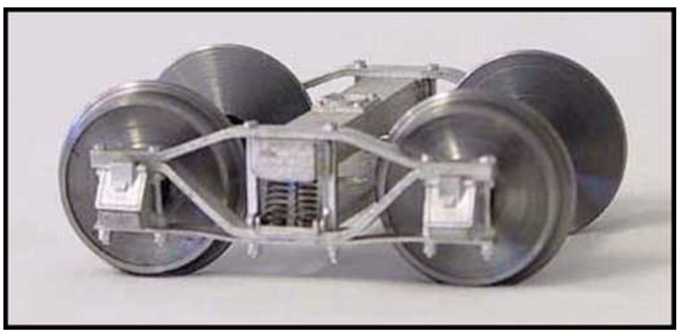
Wheel diameter is 1.189" which scales to 24.13" in 1:20.3. The 2.37" wheelbase trucks scale to 4' at 1:20.3.

Accucraft - Makes a nice looking arch bar truck for its AMS rolling stock division. As these are 1:20.3 models, the wheel diameters are likely to be right on.



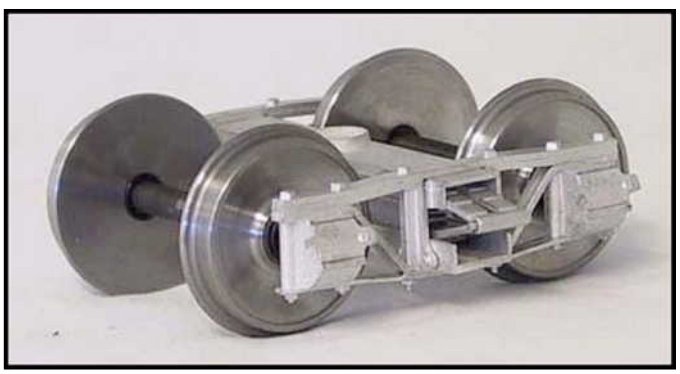
This is a coil spring truck. I can't tell you a whole lot more than that, as I don't own one.

Hartford Products - Sells a line of trucks made from white metal castings and steel wheels.



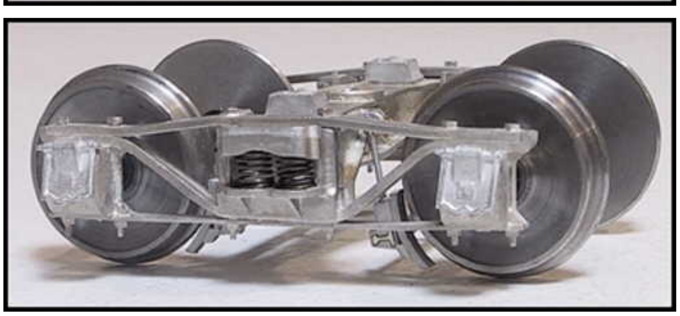
Hartford Products makes an Arch-bar truck kit that sells for $39.95 per pair. Wheelbase is 2.167" (3' 9") and they claim the wheel diameter scales to 24" at 1:20.3".

Castings are white metal except for the wheels.



Hartford also makes a 3'7" D&RGW caboose truck kit with leaf springs for $44.95 a pair. Wheels are indicated to be 26" on the Web site but Bob Hartford tells me you can order any wheel size with a truck.

The springs on Hartford trucks are an active part of the full equalization built into these trucks.

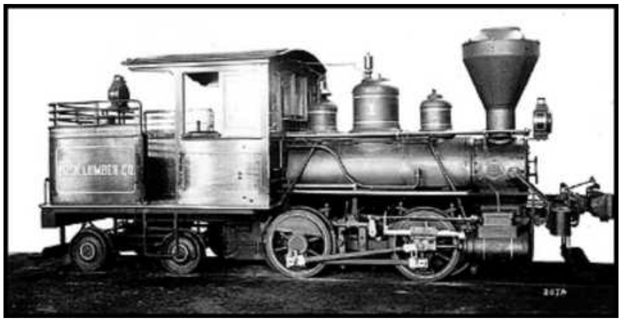


This is Hartford's 4'6" Reefer truck kit with coils for $44.95.

In summary, there are a variety of choices available with variances in quality, performance, style, and dimensions. Cost could range from a parts box cost of zero to around $50 a pair including shipping. There are likely to be a variety of other options available. I'd start out my search for a truck in the basement.

Forney Builders *- Bob Hartford is willing to sell single trucks to those of you building Forneys. Take the above prices, divide by two, and add $5. For example, a single Arch-bar truck would be $24.95 (($39.95 / 2) + $5).*

Fabricating a Forney Conversion:



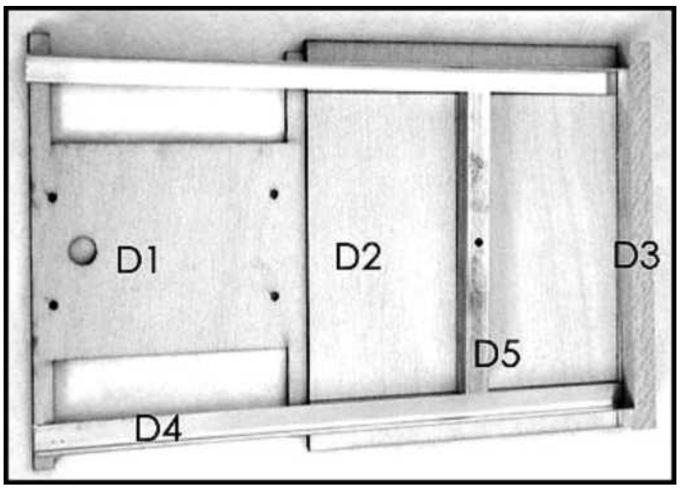
The approach to fabricating a Forney conversion is very similar to the approach taken in adding the frame extension and bunker to the Olomana in the previous section. The process can be broken down to the following steps.

1. Select your prototype. You may want to review the Forney photos in the **Steam-Class 2004 Archive** for ideas.
2. If you do not have an accurate drawing of your prototype, use photo perspective takeoff techniques to take off key dimensions. Not familiar with photo perspective takeoff techniques? You may want to read **Chapter 2** of the modeling series at MyLargeScale.com. You'll want to know at least the following dimensions.
   - Cab side length - compare it to the Ruby cab side length. Some Forney's have fully enclosed cabs and will require a frame extension just to carry the full cab.
   - Total side length from the front of the cab to the rear of the deck supporting the bunker. Subtract the length of the Ruby deck under the tender. The difference is the length of your deck extension.
   - Total side length of the bunker.
   - Height of the bunker sides.
   - Wheelbase of the truck.
   - Truck wheel diameter. Note that you may need to use smaller diameter wheels in order to fit under the Ruby deck.
3. Fabricate your frame extension. The approach will be similar to the frame extension for the Olomana except that you'll need a support beam to which you will mount the truck. Read the section on tender fabrication for suggestions in fabricating truck support beams.
4. Fabricate your bunker. The approach to fabricating the bunker will be similar to that on the Olomana. Depending on whether your Forney has a saddle tank, you may need hatch covers for both wood and water (if an oil burner). Or water and fuel storage areas if a wood or coal burner.
5. Select and install a four-wheel truck.

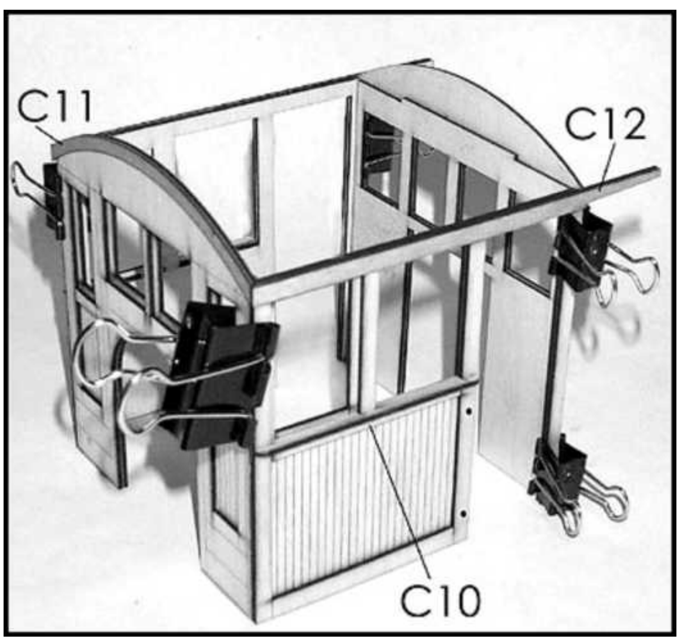
If you are thinking, "This sounds like a lit of work " ... you may want Vance Bass to do the work for you. Read on.

The Vance Bass Forney Conversion:

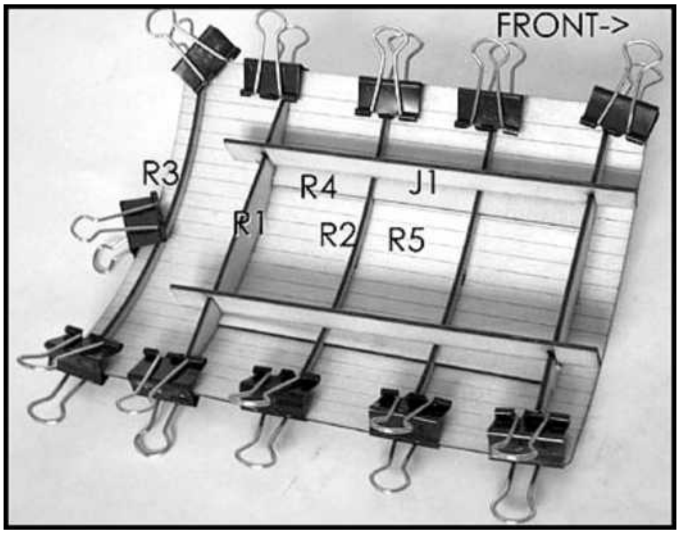
Vance Bass offers a **Forney Conversion Kit** specifically designed for the Accucraft Ruby. The kit, priced at $95, includes cab, frame extension, bunker, and rear truck. You only need to supply some basswood and brass scratch building materials commonly available at hobby shops. Here's a quick summary of the steps involved in construction.



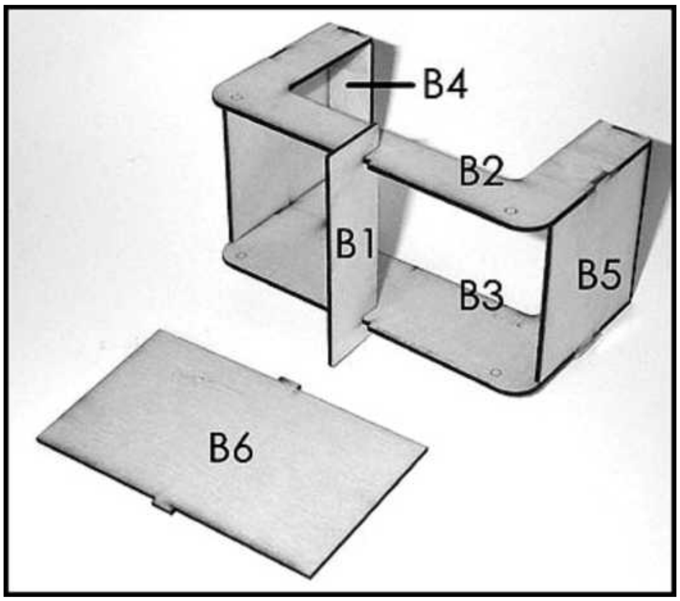
Assemble the frame extension. It is made up of a combination of brass and wood components.



Assemble the cab. It is laser cut from basswood. In Chapter 2, I assembled a Vance Bass cab for the Olomana. The assembly process for the Forney cab is similar.



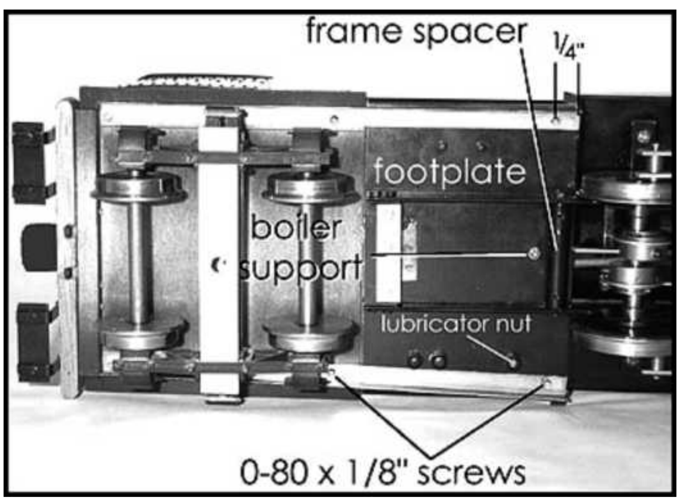
Assemble the cab roof. The parts snap neatly together. Glue makes the bond permanent. The cab and roof underside can be painted or stained. You can use tissue paper or sandpaper to simulate the tarred roof found on the prototype.



Assemble the bunker frame. This is also a laser cut basswood assembly. Part B1 is used to align the parts while drying.

Then wrap the shim stock around the frame and use brass nails to hold the shim stock wrapper to the frame.

You will need to solder the 1/2 round brass wire to the top edge of the bunker.



The rear bumper that came off your Ruby can be reattached. You will need to tap holes for the screws.

The truck is mounted to the bottom of the frame extension.

Then attach the frame to the deck of your Ruby. You will need to drill and tap the holes in the footplate to accept the screws.

This was a quick summary of the steps. Interested in more detail? Vance has the complete **Forney Kit Construction Manual** posted on his Web site.

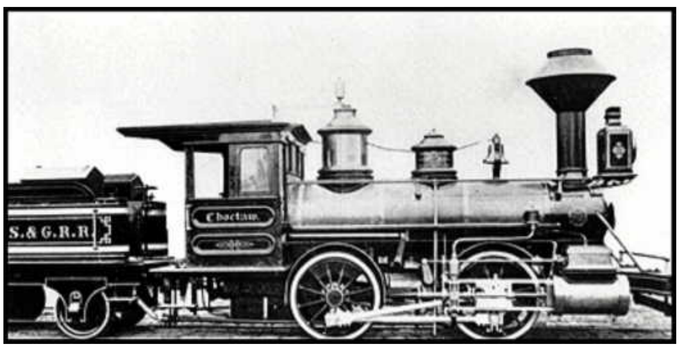
Scratch Building the Hawaii No 5 Tender:

If you are bashing a Ruby into a prototype with a separate tender, you have a number of choices.

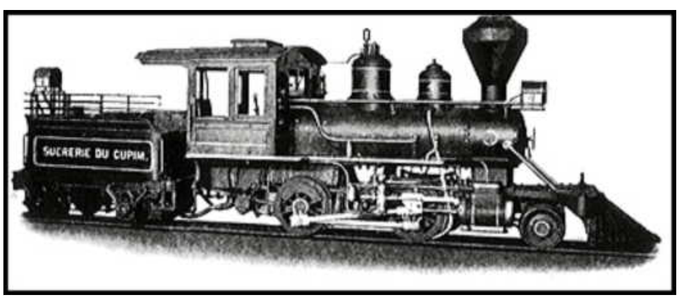
- You can pick up the tender for the Mimi from Accucraft. Aside from its expense, this is a pretty plane Jane tender that will need significant bashing to convert it into a realistic representation of a prototype tender. It has the advantage of being constructed in brass, a material consistent with the rest of the engine.
- You can use or bash an existing Baldwin prototype tender from a Bachmann Big Hauler, a Bachmann Spectrum Mogul or 4-4-0, industrial mogul or some other model. Of course, all these tenders are styrene and your engine is in brass. You may not be able to find a tender consistent with the size of the smaller x-4-x locomotives.
- You can scratch build a tender. The tender can be in either styrene or brass. This is the option we're pursuing for Hawaii No 5 and it will be constructed from brass. This is a great opportunity to build something significant in brass without making a major investment. More on that later.

Bachmann Prototype Tenders for x-4-x Engines:

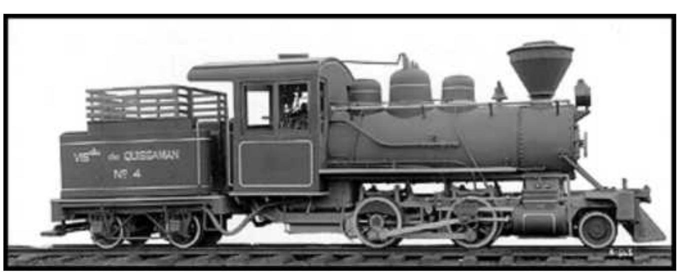
Here's a gallery of tenders we've found for x-4-x engines. As you can see, they ranged from small 4 wheel tenders to larger 8 wheel tenders.



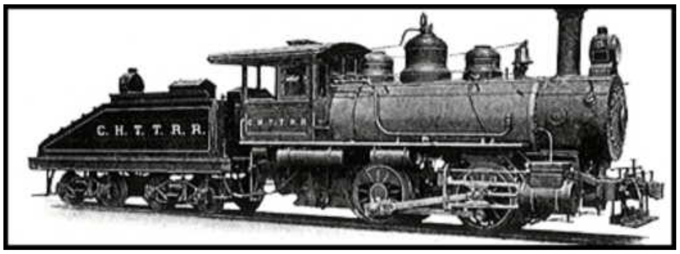
Unfortunately this photo of an 1876 Baldwin engine only shows part of the 4 wheel tender.



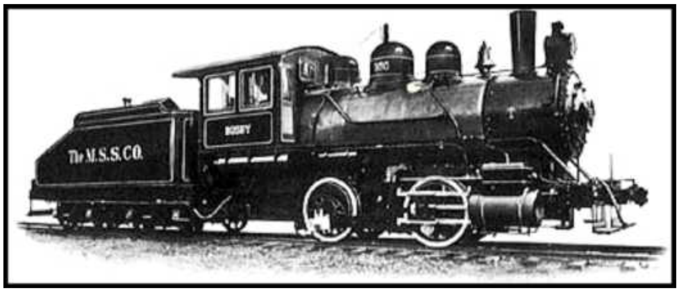
This photo from 1915 shows a complete four wheel tender. It is very similar to the tender in the earlier photo.



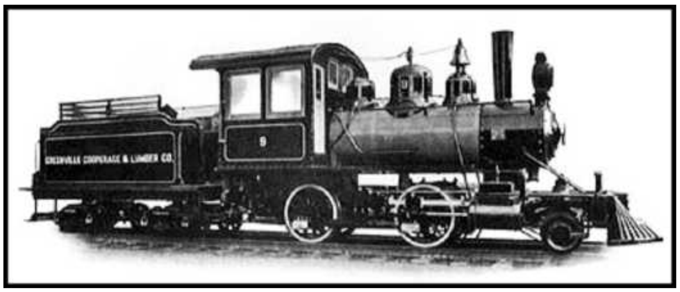
This is an even later 4 wheel tender. Note the change in the trucks.



Here's a Standard Gauge Baldwin from around 1915 with a 8-wheel slope back tender.



Here's a circa 1915 Vulcan 0-4-0 with an 8-wheel slope back tender.



A Vulcan from about the same era with an 8-wheel square back tender.

Finally, the tender I will build, an 8-wheeler being pulled by Hawaii No. 5.

Tender Options:

The main thread of this article will be to take a step-by-step approach to scratch building Hawaii No 7's tender, an eight-wheeled straight back Baldwin tender, in brass. But those of you building a different tender, or building with different materials can lift ideas from this article and apply them to your tender. You are just going to be a bit more on your own. You'll need to do your own takeoffs and adapt what is covered here to your project.

Occasionally, I'll stop and give some general thoughts as to how this material relates to other tender projects. When I do so the material will be inside one of these text boxes and in italics.

Resources:

MasterClass 2001, Chapter 7

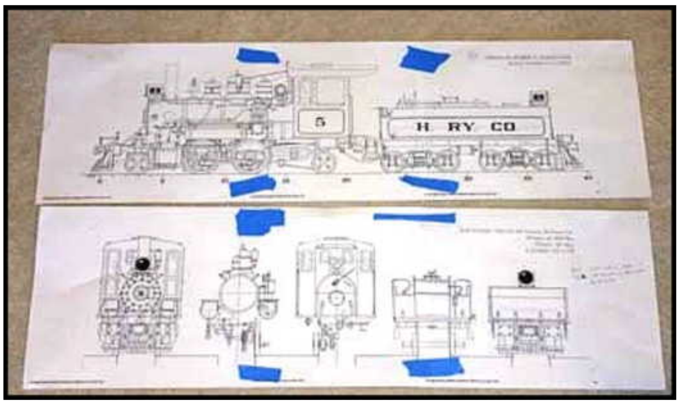
David Fletcher did an outstanding job in writing a tender chapter for MasterClass 2001. Rather than attempting to duplicate all his work, I'm going to suggest you print out Chapter 7 in its entirety. It will serve as a wonderful guide in helping you adapt your tender to different eras and to help you deal with the different fuel types (coal, wood, and oil) used by these engines.

I'll be building an 8 wheel tender specific to the date Hawaii No 5 was out shopped, around 1925. But David's chapter will help you adapt to the tender you wish to build. Of course his chapter focuses on building a tender from styrene. The instructions in this article will focus on how to build it in brass.

There is no reason why your tender must be made in brass. In chapter 2 we added a wood pilot and cab to the Olomana. You could certainly use Fletch's instructions in MC2001 Chapter 7 to scratch build a tender in styrene. After all, other rolling stock is likely to include styrene cars.

Hawaii No 5 Drawings:

I'm fortunate to have a copy a set of Robert Schlechter drawings for Hawaii No. 5. I used the **RailDriver** ScalePrint utility to convert these drawings to 1:20.3 and print them on my laser printer. You'll find the drawings to be very useful in you want to build this tender or if you want to build Hawaii No 5 with tender. Here's a photo of the set of drawings.



Drawings will print out on eight separate pieces of 8 1/2" x 11" paper. Strips of blue masking tape are holding them in alignment.

You can download these eight images individually by clicking on the drawing page numbers (**1**, **2**, **3**, **4**, **5**, **6**, **7**, **8**). Each is about 500K. If you want only tender drawings, you'll need drawings 3, 4, 7, and 8.

Warning - there are errors in these tender drawings. I was forced to use photo takeoff techniques to correct the errors. Pay particular attention to the dimensions in this section for the pieces to be cut from brass. In a number of cases, these dimensions are different than those you would get by taking dimensions off the above drawings.

At this time we have no drawings for the other Baldwin tender styles. If you have one and would like to share, contact me at **tfarin@farin.com**. *I'll post it to the archive and let folks know it is out there.*

Materials:

You can build light or heavy versions of the tender. The material list is for the version built in this section, the heavy version.

Brass Components:

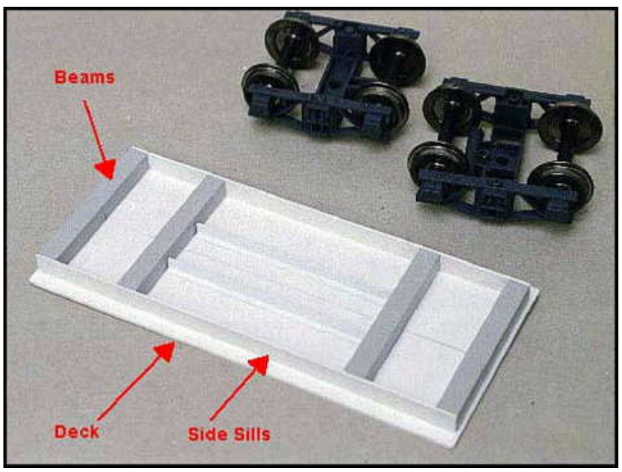
- Sheet Brass - I cut a piece from a .05" thick piece I picked up on eBay. If you use K&S, use the .032" thickness that is commonly available at hobby shops. You'll need two 4"x8" sheets if you build the heavy version of the tender.
- Shim Stock - I purchased a roll of .005" shim stock from Grainger Co. I didn't keep track of how much I used including that wasted on mistakes. If you buy shim stock in 4"x8" sheets, you will need at least two sheets -- more if you make mistakes.

- K&S 5/32" by 5/16" rectangular brass tube. I used these tubes for truck support beams and end beams. 20" should work for this job.
- Brass pipe - 1" OD - Assuming you're building the heavy tender, you'll need about 3". I found a 3/4" x 6" Anderson Barrows brass nipple at Home Depot for $6.25. Outside diameter is 1.006".
- Brass pipe - K&S pipe, .056" outside diameter, You'll use this for the rounded corners at the rear of the tender. You'll need about 3".
- Brass Bar Stock - 0.05" x 0.25". Used as the lifting brackets on the oil tank and the tender hold down brackets. 6" should be more than adequate.
- Brass Bar Stock - 1/16" x 1/4" - Used to fill K&S square brass tube when I wanted to be able to tap a hole in the beam.
- 0.1" diameter brass wire - Used for oil tank vent pipe. 2" is more than enough.
- 0.066" diameter brass wire - Used for oil tank hand bracket. 3" is more than enough.
- 0.2" K&S square pipe - A small piece was used in oil tank fittings.
- Screws and nuts - About 15 #0-80 and 10 #2-56 brass hex head screws, nuts and washers nuts were used in the project.

Trucks - You will need a pair of trucks.

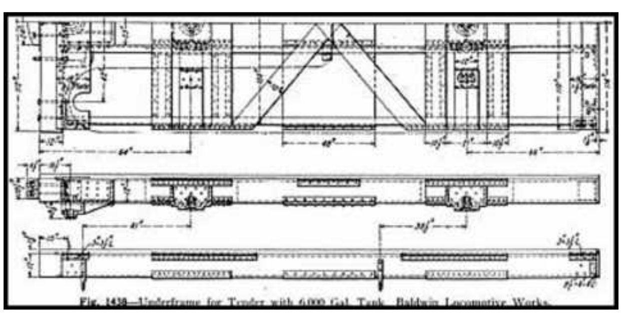
Building the Deck:

Here's a photo of the underside of the deck Fletch showed folks how to build in MC 2001.



This is an early tender with a wood deck, wood side sills, and wood beams. If you are building an early tender you may wish to replicate this design.

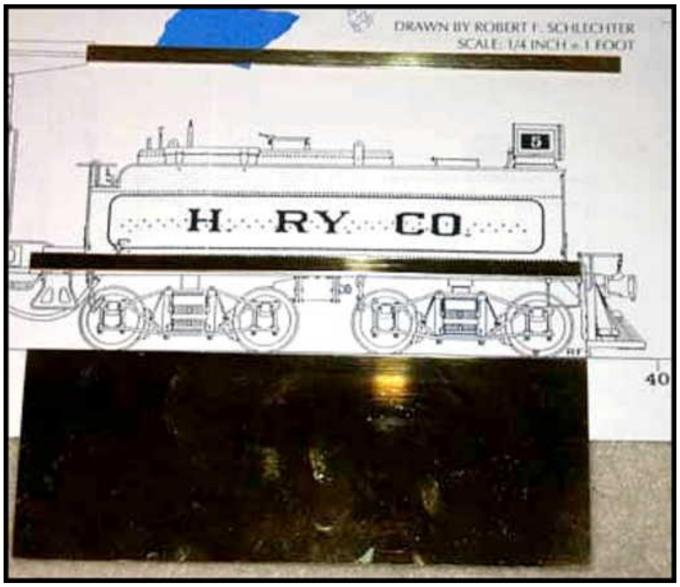
The Baldwin tender on Hawaii No. 5 was out-shopped in 1925, and would have been made almost entirely from steel.



Here's a drawing of a Baldwin tender under-frame from about the time No. 5 was out-shopped. This is for a larger tender. But you can see the understructure has shifted from wood to steel.

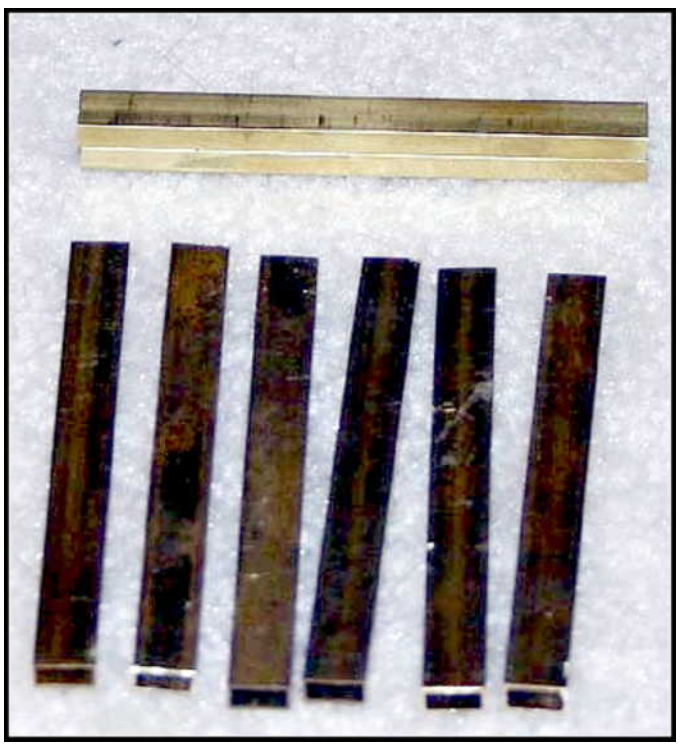
From the **Raildriver Locomotive Cyclopedia**. Used with permission. Click photo for a larger image.

We don't have an under frame drawing for the tender delivered with No 5. But we'll take an approach to its construction that is at least in the spirit of the Baldwin tender in the above drawing.



The deck itself is a 9 5/8" x 3 5/8" brass sheet, from a .05" thick piece I picked up on eBay. If you want to use K&S sheet, the .032" thickness that is commonly available at hobby shops will work fine.

Side sills are made from 9 5/8" x 5/16" sheet brass.



Even had I wanted to go with 5/16" by 5/16" beams in brass, I would have had some difficulty locating that size at the hobby shop. K&S does offer that dimension through its specialty parts division.

But they do widely distribute a 5/32" by 5/16" rectangular tube. Stack two as in the top part of this photo and you have a 5/16" by 5/16" beam.

These beams are all cut to a length of 3 1/16".

While the tubes offer a great deal of strength relative to their length, they are too thin to be threaded.

That problem is solved with the use of K&S 1/4" x 1/16" metal strips. As shown in the top of this photo, two of these strips, when stacked, fit snugly inside the 5/32" by 5/16" rectangular K&S tubes. The filled tube sections can then be tapped to receive screws.

In building the supports for the tender deck, the beams are be doubled to support the trucks. On the ends, a single beam laid on end was used.

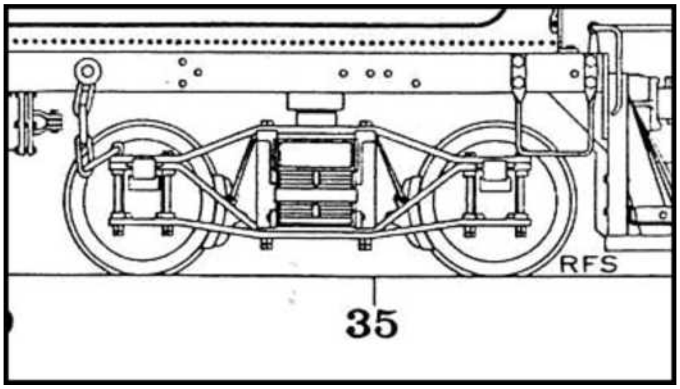
All structural undercarriage parts are shown in this photo of the bottom of the deck after components have been soldered in place. The truck support beams have also been tapped for screws securing the trucks.

This general approach could be applied to four wheel and slope back tenders. All you'll need to do is modify the length to one more consistent with your prototype.

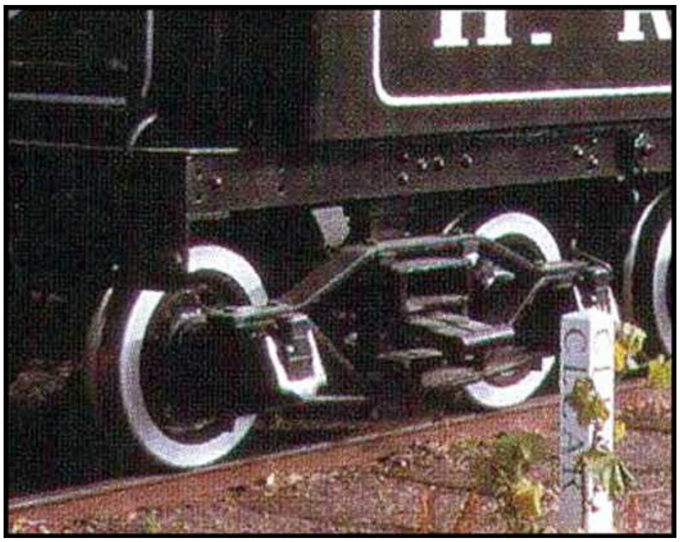
In my case I decided to fill all six rectangular tubes with brass strips. This allowed holes to be tapped in the beams supporting the trucks. Later, couplers can be tapped into the end beams. In addition, the brass strips provided additional surface area for the beams to be soldered to the side sills.

Installing the Trucks:

The Hawaii No. 5 tender has two four-wheel trucks. The truck wheelbase appears to be 4' 6" based on drawing takeoffs, which scales to 2.66" in 1:20.3. The wheel diameter is 24" based on the specifications card in the archive. At 1:20.3, wheels scale to 1.18". Here are a truck drawing and photo.

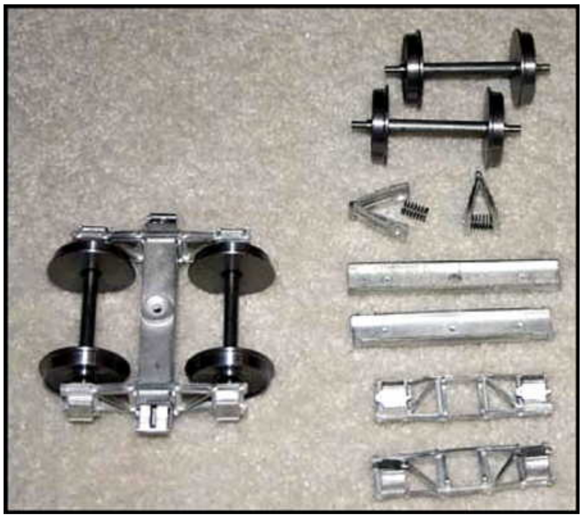


Note that the rear truck mounting center point is 2 1/8" in from the rear end of the side sill. Based on takeoffs, the front truck mounting center point is 2 27/32" in from the front end of the side sill.



Note the leaf springs that serve as the suspension system for this truck. The majority of the commercial trucks on the market sport coil springs.

You should select your trucks before soldering the deck together. Beam placement for the truck support will vary based on the wheelbase of your trucks. The prototype truck wheelbase was 54". I chose the Hartford refrigerator trucks as the frames for the arch bars were fairly close to the prototype. The trucks had prototypically correct leaf springs. I ordered 24" wheels with the kit, which are also prototypically correct. But the Hartford truck wheelbase is only 42". I wanted the truck wheels closest to the end to be in the correct position so it was necessary to move the beams further out from the middle than in the prototype. The hole for the rear truck was drilled 2.0" from the rear end of the deck. The front hole was drilled 2.65" from the front end of the deck.

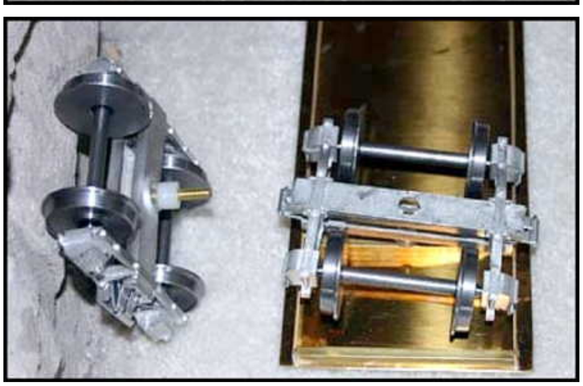


This shot shows the Hartford caboose trucks - complete on the left and disassembled on the right. To disassemble, pinch the leaf springs and remove. The two main rails between the side frames slide out and the truck comes apart.

The Hartford trucks are fully equalized. So all that was necessary in building a truck attachment system was to allow the trucks to swing horizontally. To minimize friction, nylon bushings were used to provide a pivot point. Nylon bushings can be found at any well-stocked hardware store. The left T-bushing has a .205" diameter leg. The hole in the upper frame was drilled out to 7/32" to accept the bushing, which is inserted from the back side of the photo that follows. A second bushing with a .365" outside diameter was drilled out to 7/32" so it would slide over the first bushing. The hole in the lower frame was reamed out to .34" to allow the head of the 8-32 screw to pass through the frame.

These are the parts used to support the trucks. The 8-32 screw began at 1/1/4" but was cut off flush with the nut once the truck was attached to the deck.

You will find an assortment of nylon bushings at the hardware store. As the wall thickness varies, be sure to select a T-bushing bushing that will accept an 8-32 screw.

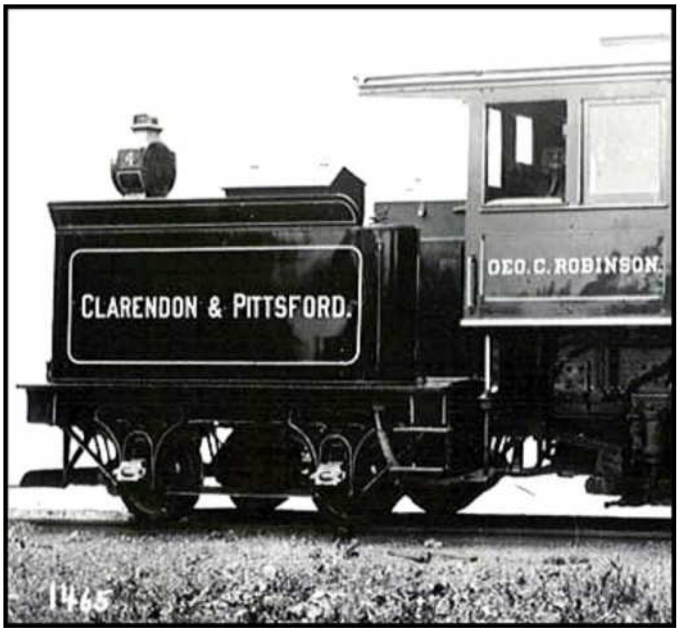


This shot shows two trucks. The right truck is attached to the deck. The left truck shows the bushings and screw in place awaiting being attached to the deck. You can see the larger nylon bushing. The top of the T-bushing is inside the upper frame.

The #8-32 screw is screwed into the beam until the truck rotates smoothly but is not sloppy. A washer and nut are tightened from the top of the deck to fix the position if the screw in place.

Doing a Four Wheel Tender?:

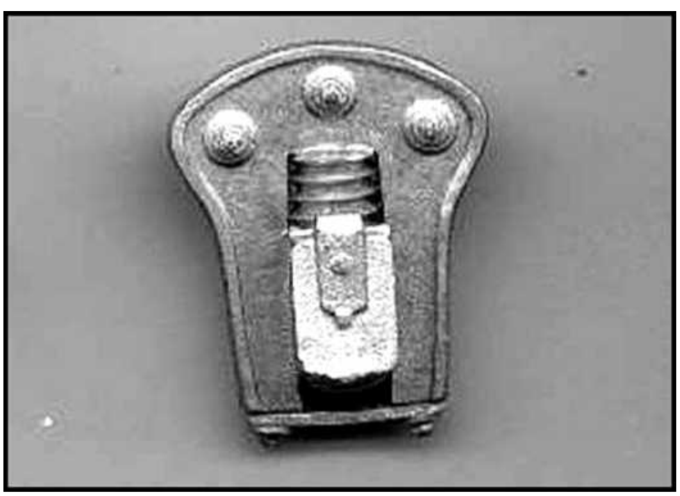
If you are building a four-wheel tender, you might consider a bash of a Hartland Value Line kit. You could build a tender on top of the deck of the Hartland kit and have a dirt cheap tender.



Here's an example of a later era Baldwin 4 wheel tender. The earlier tenders had wooden decks and side beams emulated in the Hartland design. If wheels are 24" in diameter, length of the deck of this tender would be roughly 10'.

Kits like these are available from dealers for under $10. Deck length is 5.51" or 9' 4" scaled up at 1:20.3. Journals are leaf spring while prototype appears to use coil springs. Leafs could be cut off for a closer prototype look.

*Wheels were purchased separately from **San-Val** for $6.95 a pair and are 1.13" in diameter, which scales to 23" in 1:20.3.*

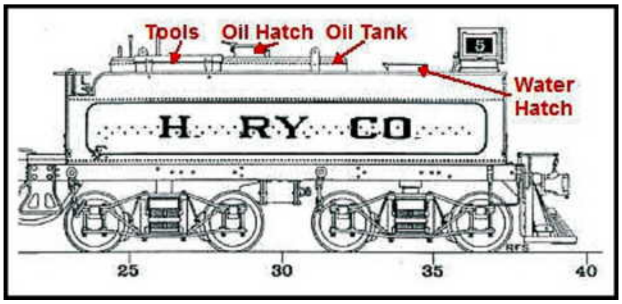


Or if you prefer to scratch build a four-wheel tender, consider Ozark Minitatures' Coil Spring Journal (part OM-05CS) for $4 for a set of four. Then add a pair of wheels and axels, and incorporate these white metal castings in your undercarriage.

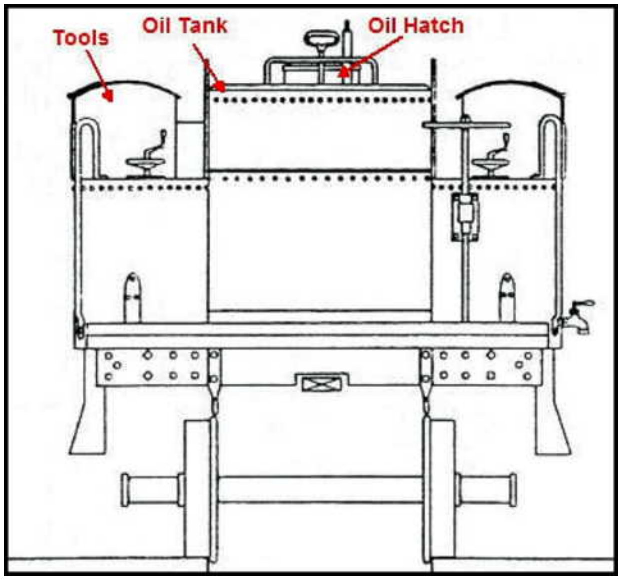
The NBW's could be ground down and replaced with brass hex head screws and washers that would screw right into brass side sills.

Tender Superstructure:

We'll define the tender superstructure as the portion above the tender deck. The drawings give us three views of the tender --- front, side & rear.



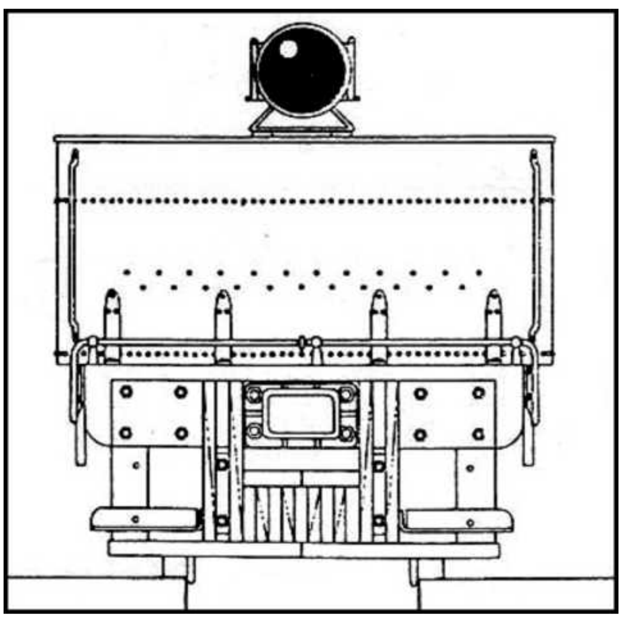
Aside from the sides of the tender, there are a number of key superstructure components identified in the drawing. The oil tank is the dominate structure running from the top of the side curve to just about the axle of the front wheel of the rear truck.



The tank is only as wide as the distance between the water tank extensions at the front of the tender superstructure. The length and placement of the tool boxes is shown in the top photo while their width and profile is shown in the middle photo.

By looking at the first two photos, the location, height, and diameter of the oil hatch can be established.

Finally, the location, height, and diameter of the water hatch can also be determined.



This photo allows the height, width, and style of the back headlamp to be determined. It's depth can be determined from the first photo.

The top and bottom photos show the width, style, and depth of the pilot at the rear of the tender.

A Columbian 2-4-2 was designed to be operated in either direction, thus the presence of a road pilot at both ends.

From the information gleaned from these drawings, the following dimensions and other measurements were taken from the drawings. All dimensions have been converted to 1:20.3.

Component	Width	Length	Height	Comments
Tender Shell	3.58"	8.50"	1.8"	Height is 1.40" on front extensions while diameter is 1.00" per extension.
Oil Tank	1.44"	3.56"	2.32"	Set back 1" from front of shell. Height is from deck.
Oil Hatch	0.50"		0.25"	Height is from top of oil tank to top of lid. Front edge is set back 2.375" from front of oil tank.
Water Hatch	0.75"		0.125"	Height is from top edge of shell. Rear edge is 1.50" from back edge of shell.
Rear Headlamp	0.80"	0.875"	0.80"	Diameter is .625".
Tool boxes	0.80"	1.625"	0.31"	Set back 1.31" from front edge of shell.

A design feature not obvious from the drawings is whether the front portions of the water tank are flat or rounded.

The light shining off the front portion of the tender in this Jon Radder photo makes it obvious the front is curved rather than flat. In addition, you can see the shell curving over the top of the support beam next to the step at the front of the tender.

That the rear corner is curved is also obvious from a second Jon Radder photo. Aside from the play of light, the rear curving over the beam can also be seen.

Fabricating the Tender Superstructure:

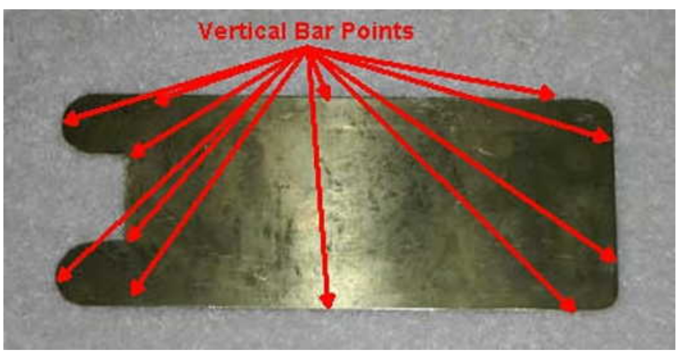
There are at least two alternative ways to approach this portion of the tender. This first will be referred to as the light version. The second will be referred to as the heavy version. The light version would be constructed using the same approach as was taken in building the shell for the bunker in Chapter 2. The tender won't be built using this technique, but the steps are outlined here. A heavy superstructure adapts the techniques outlined by David Fletcher in Chapter 7 of MasterClass 2001 to construct the superstructure.
The tradeoffs between the light and heavy versions are:

1. The light version will cause less weight to be pulled behind your Ruby increasing the ability to pull additional rolling stock.
2. Less soldering and time is required with the light version.
3. With the light version, there will be no support behind the shim stock forming the sides of the superstructure. As a result, it will be more prone to denting and will require care in handling.

Light Tender Superstructure:

Forming a light superstructure requires the formation of an internal framework for the shim stock. It could be formed in brass, wood, or styrene. In the example that follows, brass is used to form the internal frame. There are three major steps to this process.

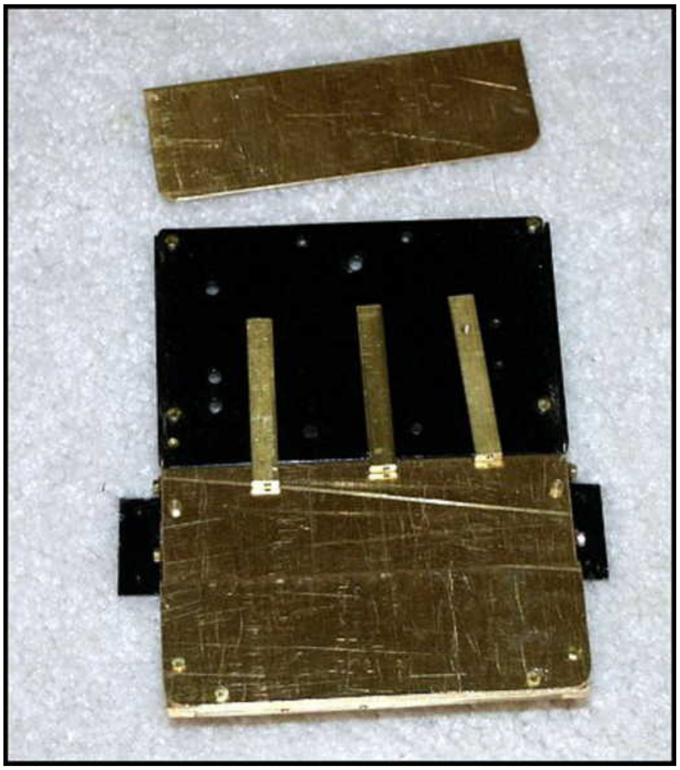
1. Fabricate an upper and lower plate. K&S .032" brass sheet would be a good choice for these plates. You could use brass tube, pipe, coins, or other round objects to trace the shape of the curved portions of the plates.



Here is how your top and bottom plate would look after being cut and filed.

Arrows point to points at which vertical bars would be placed.

2. Cut a number of vertical supports that separate the two plates and keep them in alignment. My supports for the bunker were cut from 1/4" x 1/8" brass bar stock. The above photo shows 12 points at which vertical bars could be placed. You may be able to get by with a smaller number of vertical bars. But you would lose some support behind your shim stock sides.

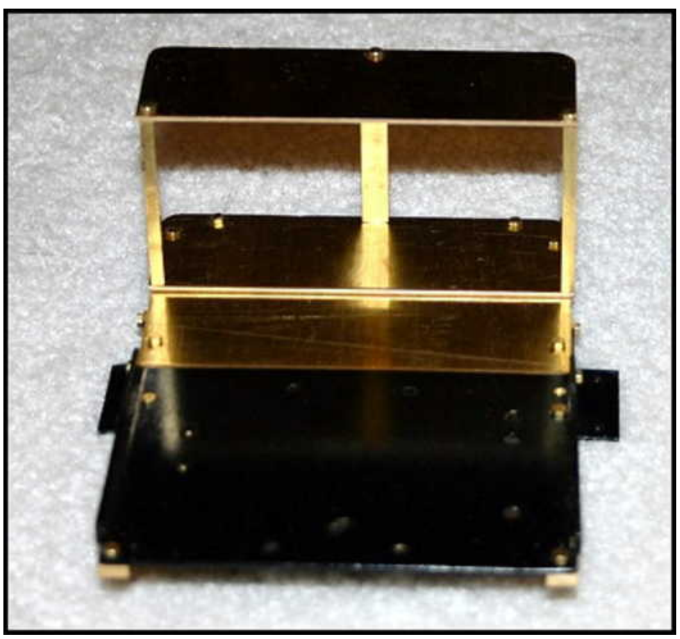


This shot shows three brass bars cut to provide the vertical supports for the top plate of the bunker constructed in Chapter 2. The top and bottom of the bars are drilled and tapped to accept 2-56 screws.

You will do the same for the tender. But because the tender is much larger than the bunker, more vertical supports will be needed.

Length of the bars will be equal to the height of the water tank less the thickness of the two plates.

3. Drill holes in the top and bottom plates for the vertical bars. These screws will need to be countersunk to accept flat head screws. Use flat head screws to attach the top and bottom plated to the vertical bars. Once they are attached, file the flat head screws even with the surface of the top and bottom plates.



This shot shows the bunker including the top and bottom plate as well as the three vertical bars shown in the previous photo.

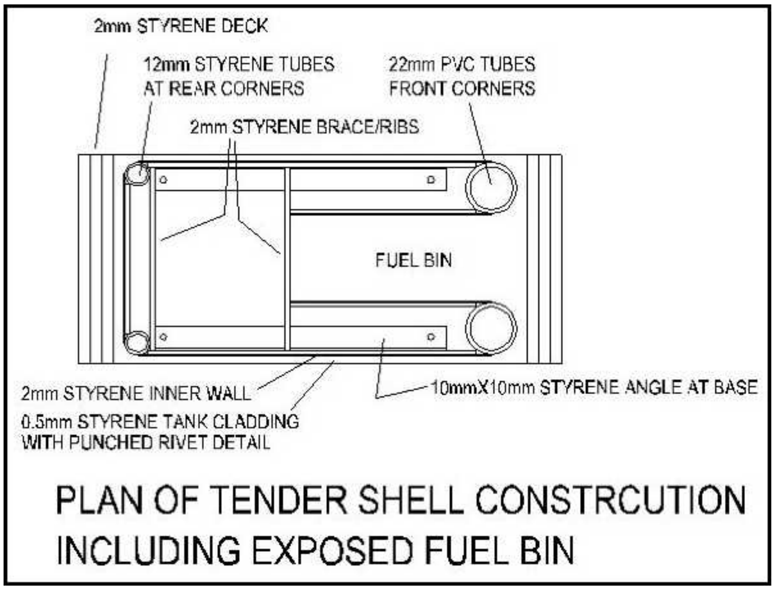
Your tender frame will be similar in construction but much larger.

4. Wrap the framework with a brass shim stock wrapper that has been punched with a rivet pattern. The wrapper will be soldered to the frame in the same manner as discussed for the bunker wrapper earlier in the chapter.

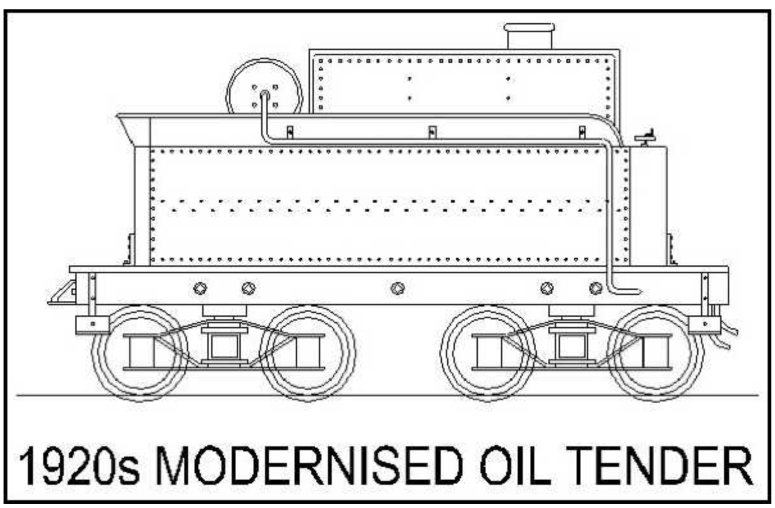
Heavy Tender Superstructure:

I will be installing electronics inside the tender. For that reason, the shell must be removable. Because it will be handled frequently, it must be sturdy. While a rivet punched .005" shim stock will be used as the external surface, it will need to have a solid backing to take handling and to allow detail parts to be attached. So I chose to build the Heavy Tender Superstructure.

As indicated earlier, the approach taken will be very similar to that taken by Fletch in his tender chapter for MC 2001.



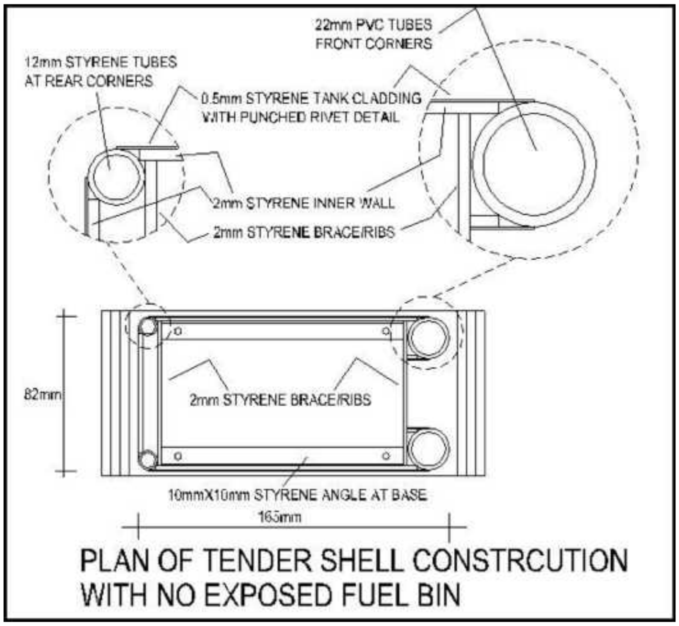
This is a drawing of Fletch's tender designed for an open fuel area. Styrene tubes provide the surface for rounded corners of the water tank portion of the tender. Smaller tubes provide the rounded corners at the back. Thick styrene was used for strength as the inside surface. The outside surface was rivet punched thin styrene sheet. This is not the version I'll build but it was included for those of you who wish to use wood or coal fuel.



This side view of Fletch's 1920s Baldwin tender shows many similarities to the tender on Hawaii No 5. Major differences include placement of the air tank, height of the oil tank, an older style deck, and the beveled upper surface on the shell. But there are many more similarities, enough that he can use his design and our specifications and takeoffs, while switching the material from styrene to brass.

Parts Fabrication:

The superstructure will be constructed of an inner brass framework that provides rigidity and structure. The framework will be wrapped with a finish layer of brass shim stock which will carry the rivets and provide a finished surface.



This well labeled Fletch drawing from MC2001 identifies the basic components that will make up the major portion of the superstructure of the tender. We'll use different materials and dimensions, but the approach we take will be very similar.

In forming the curves in the inner wall at the front and back of the tender, you have two choices:

1. Duplicate the approach taken by David Fletcher in MC 2001 by forming the inner wall with five straight pieces of brass sheet. Then use brass pipes or tubes as the curved surface that forms the corners.
2. Create a single inner wall. Use the annealing techniques discussed in Vance's article on working with brass in Chapter two to bend the single piece to form the inner wall.

With no real experience forming curves in brass, I found the prospect of attempting to form the inner wall from a single piece of brass to be intimidating. So I chose to use separate straight and curved pieces and solder them into a single unit.

Front Corner Tubes:

These tubes are to be 1" in diameter and 1.3" long. My local hobby store didn't have K&S tube in 1" diameter so I stuck my caliper in my pocket and headed to Home Depot. There I found a 3/4" x 6" Anderson Barrows brass nipple in the plumbing department's brass fittings section for $6.25. Outside diameter is 1.006".

Rear Corner Tubes:

These tubes should be available through your hobby shop. I used K&S pipe, 0.56" outside diameter, You'll need two 1.3" pieces.

This is the AB brass nipple used in constructing the front corner tubes.

Front corner tubes are in the back of this photo. The rear corner tubes cut from K&S brass tubes are in the front.

Inner Walls:

We'll cut and size these from .032" K&S brass sheet. Note that the sides of these inner walls will be 1.3" high, even though the finished sidewalls will be higher. These inner walls will support the top plate of the tender.

> *Building a different tender? As long as you know the superstructure length and width, you can use the following formulas to come up with the length of your inner wall pieces. Height will be the distance between the deck and the top plate. Dimensions given are for the Number 5 tender and also illustrate calculations.*

Calculate your sidewall lengths by taking the overall length of the tender side and subtracting the radius of each of the end tubes.

- Side Inner Wall Length = Superstructure Side Length - Front Tube Radius - Rear Tube Radius.
- Side Inner Wall Length = 8.44" - .50" - .28" = 7.66".
- Dimensions of each of the two side inner panels is 1.3" x 7.66".

Calculate the back end wall length by taking the overall width of the tender superstructure and subtracting the total radius of the two back tubes.

- Back Inner Wall Length = Superstructure Width - (2 * Rear Tube Radius).
- Back Inner Wall Length = 3.63" - .28" - .28" = 3.07".
- Dimensions of the back end inner panel is 1.3" x 3.07".

Calculate the front inside inner wall length by taking the radius of the front tube.

- Front Inside Inner Wall Length = Front Tube Radius.
- Front Inside Inner Wall Length = .50".
- Dimensions of each of the two front inside inner walls is 1.3" x .50".

Calculate the inside brace ribs length by taking superstructure width less the thickness of the two side inner walls.

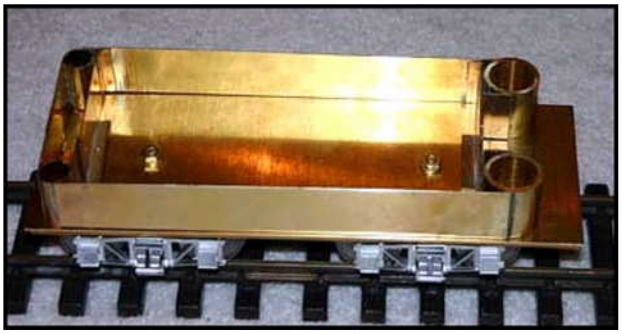
- Brace Rib Length = Superstructure Width - (2 * Side Inner Wall Thickness).
- Brace Rib Length = 3.58 - (2 * .03") = 3.52".
- Dimensions of each of the two brace ribs is 1.3" x 3.52".

Superstructure water tank pieces - Sides (bottom 2), Back (middle left), Brace Ribs (top right 2), and Inside Inners (top left).

1/4" K&S 'L' brackets have been soldered to ends of brace ribs and one end of inside inners. Edges of all pieces butting up to curved objects have been beveled with a file.

Looking for cheap metal clamps to hold your work together while soldering? This set of electrical clamps cost $5 at Harbor Freight. There were 28 in the package.

This shows the inner walls clamped together just prior to being soldered. Pipes being used to form the rounded corners are a 1" OD brass pipe and a .56" OD K&S tube. See the parts list for more information.



The entire assembly has been soldered together and is sitting on top of the deck for a measurement check. This is the same design as Fletch's except executed in brass.

If you look closely at the above photograph you can see that a scrap brass bar has been soldered to the two inner walls. As I plan to make the tender superstructure removable, holes will be tapped in these two bars. Screws from the under side of the deck will be fed into the tapped holes to keep the superstructure in place. You can also see the nuts on the end of the #8-32 screws that hold the trucks in place.

In this shot, the inner walls for the tender superstructure were used as a template to scribe the outline of the top of the superstructure on .032" K&S brass sheet. In this shot, the brass bar hold downs are more obvious.

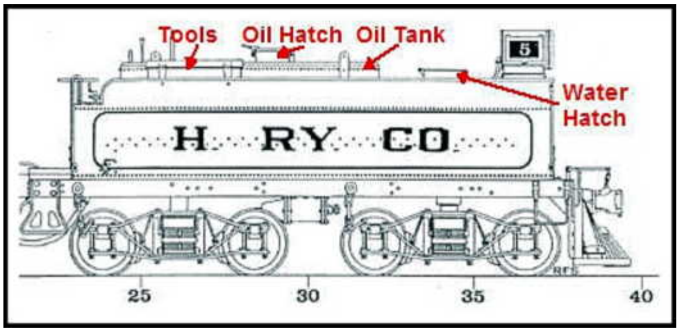
In this shot, the brass sheet has been cut to size and filed to match the superstructure.

In this shot, the superstructure sits on top of the deck after the brass sheet was soldered to the inner walls.

Top left is the two oil tank side panels. Top right is the oil tank top. On the bottom is the tender side outer shell.

Oil Tank Construction:

Construction of the oil tank will be very similar to the lower portion of the superstructure. A box will be made of a front, a rear, and two side inner walls, covered by a top plate. It's bottom will be open. It will ride on top of the tender deck.



Drawing showing the oil tank from the side.

Inner wall heights are calculated by taking total height from the deck, less height of water tank inner walls less thickness of water tank top plate.

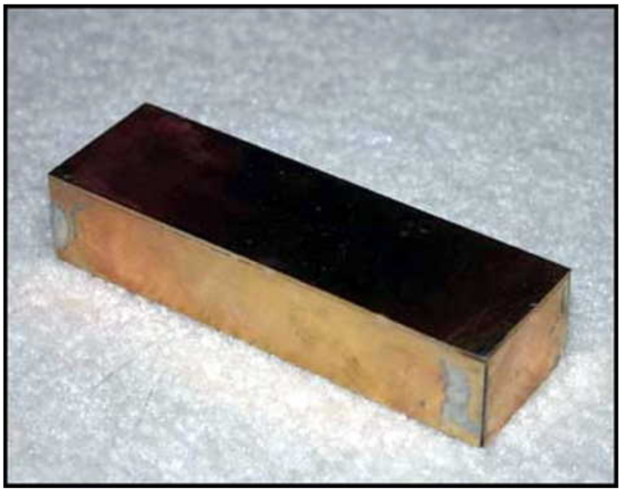
- Inner Wall Height = Height from Deck - Height Water Tank Inner Walls - Thickness of Water Tank Top Plate - Thickness of Oil Tank Top.
- Inner Wall Height = 2.32" - 1.30" - .03" -.03" = 0.96".

Sidewall length is taken from the earlier specifications table, the length of the oil tank --- 4.53". Therefore, dimension of the sidewalls is 0.96" x 3.58".

End wall length is equal to the oil tank width less the combined thickness of the two side walls.

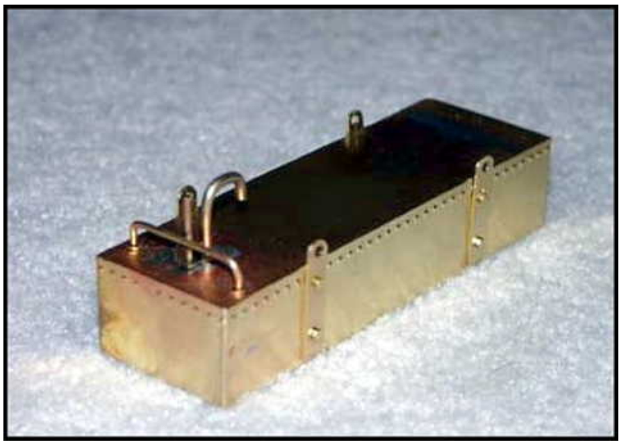
- End Wall Length = Oil Tank Width - (2 * Side Wall Thickness).
- End Wall Length = 1.44" - (2 * .03) = 1.38".
- End Wall Dimensions are 0.96" X 1.38".
- Tank top dimensions are 3.58" x 1.44".

End walls (opposite ends), side walls (top, bottom) and tank top have been cut out and sized in this photo.



The top, side, and end walls have been soldered into a box that is open on the bottom. Brass K&S L channel was used to increase the soldering surface between all brass walls meeting at 90 degree angles.

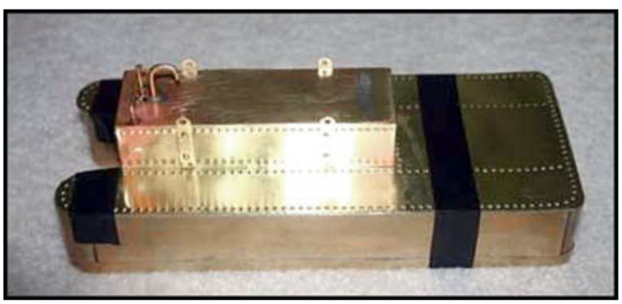
1/8" by 1/4" brass bar was soldered inside to the front and rear ends at the bottom of the box. 2-56 holes were tapped in the bar stock, allowing the oil tank to be attached to the top of the tender from underneath.



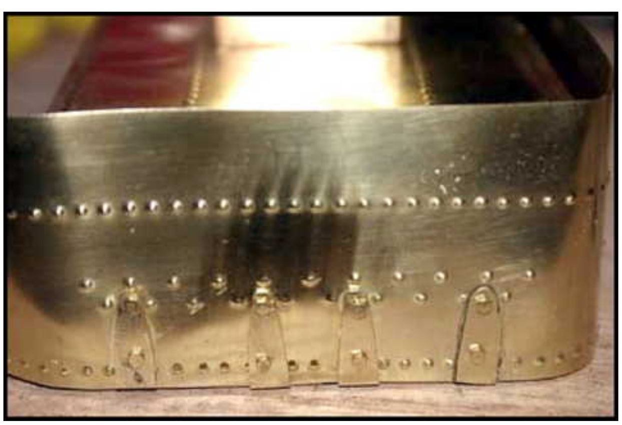
Brass shim stock was riveted then soldered to the inside sides of the oil tank. Hoist lift points were fabricated from brass strip then screwed to the sides of the oil tank with 0-80 brass hex head screws.

The hand rail and vents were fabricated from brass wire, brass washers, and square brass tube. Techniques for their attachment were similar to those described in the earlier section on bunkers.

Detailing the Tender 1:

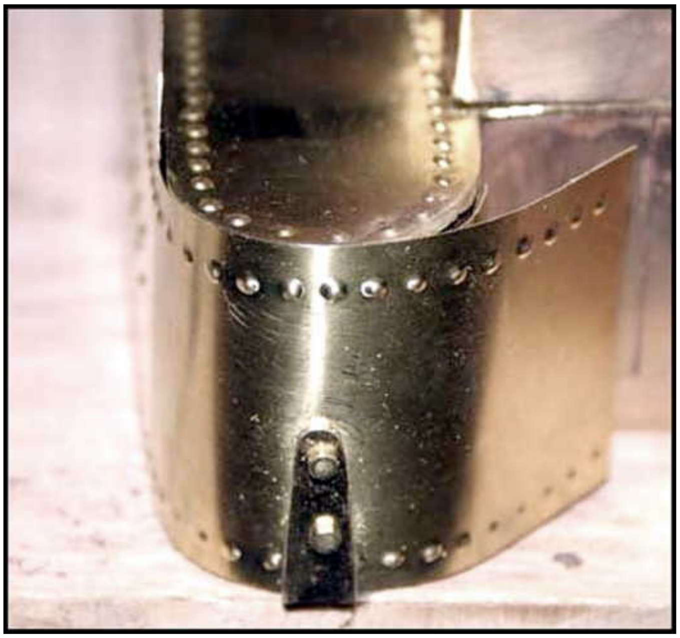


A tender top was cut and riveted using .005" brass shim stock. In this shot, the oil tank has been screwed to the surface with 0-80 brass screws. This provides a good mechanical connection to hold down the shim stock. Tape held the shim stock in alignment while screws were being tightened. The top was then tacked to the inner top surface with solder.



Tender sides were also cut and riveted from .005" brass shim stock. In this shot brass tender hold down brackets have been fabricated from brass bar stock. 0-80 brass hex head screws through the brackets, shim stock, and rear inner wall provide a solid mechanical connection for the sidewalls, also keeping the walls in alignment with the inner shell.

The shim stock was wrapped around the sides, held in place with a piece of 2x4 and clamp and tacked in place with solder.



Hold down brackets, also fabricated from brass strip, provided a mechanical connection at the front of the tender.

On the prototype, the brackets were attached to the tender with rivets. I sacrificed some prototypical accuracy in exchange for the ability to use screws and nuts to make sure solder was supplemented with solid mechanical connections.

Detailing the Tender 2:

This shot shows the fully attached tender sides. In addition 1/2 round brass wire was soldered to the outside top side walls to emulate the rounded edges of the prototype.

Here it is, on the deck, waiting for the next step.

At this point, the tender is complete with the exception of a few detail parts, couplers, and paint. Completion of the rest of the tender for Hawaii No 5 will be addressed in the SteamClass 2004 chapter on painting and detailing.

Some Thoughts on Soldering

As I pointed out in wrapping up my bunker discussion, my biggest frustration to date has been soldering. That's in spite of the fact I have a fair amount of experience soldering electrical connections. I also have sweated quite a few copper pipes in my day in adding to and repairing plumbing systems. So my frustration in soldering brass came as a bit of a surprise.

Let me pass along a few thoughts and tips. I wish I could approach this by giving the steps to do it right. I'm not there yet. So instead, I'll focus on some of the things that don't work, hoping by doing so to reduce your learning curve below mine. Some of these tips mirror Vance Bass's comments in Chapter 2. Others I've learned from experience.

Solder:

As Vance pointed out, the best solder to use is silver solder. You may be able to find it locally. If not, low temperature silver solder is available from **Micro-Mark** and a number of other mail order suppliers. If you need extremely high temperature silver solder (for live steam boilers and such) you can obtain it from **Sulphur Springs Steam Models**. You will have even more difficulty than I encountered with the low temperature variety, so stay away from the high temperature solder unless you really need it. It takes a lot more heat to melt high temperature solder. And as you'll see, too much heat can be as big a problem as not enough heat.

In shopping for silver solder, you want small diameter wire. Big globs of solder coming off a large diameter wire may be OK for electrical wiring. They can be a real problem when attempting to use solder to join brass.

In addition to purchasing solder in wire form, you can purchase solder in ribbons and in a paste mix that can be squeezed from tubes. I've used Radio Shack ribbon solder when I needed to tack shim stock to a thicker brass piece I generally nip the longer ribbons into smaller pieces. I've used the stuff from a tube when I needed to solder very small pieces together like 1/2 round brass wire to shim stock.

Left to right is silver solder with flux from Micro-Mark, ribbon solder from Radio Shack and paste solder in a tube, also from Micro-Mark.

Cleanliness & Flux:

As Vance points out in his article, clean brass is extremely important when attempting to join two pieces. That means if you attempt to solder two pieces together and the joint doesn't hold, you must clean both sides of the joint and start over. That's because debris and oxidation may be there from your previous attempt. If solder is still sticking to one side of the blown joint, you don't need to get it all off. But you may need to use steel wool or a file to clean it up until it is shiny. Don't attempt to solder two pieces of brass together without flux. I can guarantee it won't work properly at least 99% of the time. Some solder includes flux. This is generally true of the paste form and the ribbon form. Some wire solder has a flux core. I've yet to find silver solder with a flux core, so flux must be applied separately.

Applying Heat:

You want to heat up the brass so it is hot enough to melt the solder. If you melt the solder and drip it onto a piece of brass with a temperature below the melting point of the solder, the solder will solidify as soon as it hits the brass piece. You will have a unsightly and hard to remove glob of solder on brass.

You can apply too much or too little heat. With too little heat, the solder will not flow properly and will convert to solid state before it has a chance to flow where you want your joint. Too much heat anneals (softens brass), oxidizes brass, and can melt nearby joints. You'll learn about too much or too little heat the way I did, the hard way. See my comments on soldering tools for hints.

Joining Two Brass Pieces:

First, if you can attach the two pieces with a physical joint (like a screw and nut), your joint will be much stronger. It will also keep extremely thin brass pieces (like shim stock) from moving while you are attempting to solder. You may have noticed that I used the oil tank to hold the top surface shim stock down while attempting to solder it to the tender top interior wall. Tender hold downs were also used to hold the tender side shim stock to the inner wall, keeping it in alignment while soldering. Aside from the advantages of using physical connections to hold the pieces in place, you won't be relying on the solder for all the holding power.

If a permanent physical connection isn't feasible, a temporary connection may be. The tender article shows the use of clamps in holding pieces in place for soldering. Cheap electrical clamps work great. But if overheated, they lose their ability to clamp. If you buy in quantity, they will be cheap and you won't feel bad about throwing them away. Do not use plastic clamps. The melting point of plastic is well below that of brass.

If one of the two brass pieces is thicker than another, apply the heat to the thicker piece. Brass does a wonderful job of transferring heat. The thicker piece will transfer heat to the thinner piece if they are physically joined.

A joint's strength will increase in proportion to the amount of surface area joining the two pieces. When joining brass at 90-degree angles, use of brass L channel to increase the contact area will result in a stronger joint.

Soldering Tools:

I've been told the best tool for soldering brass is a resistance soldering setup. They cost over $200. I have one but it has been hiding from me since my last move (three years ago). If I find it, I'll report on its use. The advantage of resistance systems is that they produce relatively high temperatures exactly where you need them. Torches produce high temperatures too, but the location of the heat is much harder to control.

The 40 to 75 watt soldering iron you may use for electrical soldering is totally useless for soldering all but the smallest pieces of brass. The combination of the mass of the brass and its excellent heat distribution capabilities conspires against being able to heat all but smallest brass pieces to the temperature necessary to melt solder.

Even Sears best soldering iron (400 watts to heat up the tip then 150 watts to maintain the heat) isn't up to soldering larger brass pieces. It cost $65 and I'll use it for electrical work.

My favorite tool is a $10 pencil torch that runs on butane that came from Harbor Freight. It puts out all the heat I need and more. It's flame is small enough to be more controllable than that produced by a larger torch. It rests nicely in one hand and can be turned on or off with a single hand, leaving the other for managing solder. Unless you are attempting to melt silver solder with a high melting point, it is all the torch you should ever need.

My $10 pencil torch from Harbor Freight that runs on butane fuel.

I use an X-acto knife with a metal handle and an old dull blade in two ways. When I need to hold down brass while a joint cools, the handle comes in handy. And when that inevitable glob of solder lands in the wrong place, I use the blade to move and lift the glob while heating with the torch in the other hand.

A set of riffler files in invaluable when too much solder ends up at a location and needs to be filed away.

Finishing the Job:

My soldering jobs to this point are nowhere near perfect. The problem is compounded by the fact that my solder shaping is less than perfect causing small gaps to appear. I've accepted the fact (for now) that my work will be less than perfect. Green Squadron Putty is perfect for filling gaps and achieving the consistency in joints that I can't yet achieve with solder. It's all going to be covered with paint anyway.

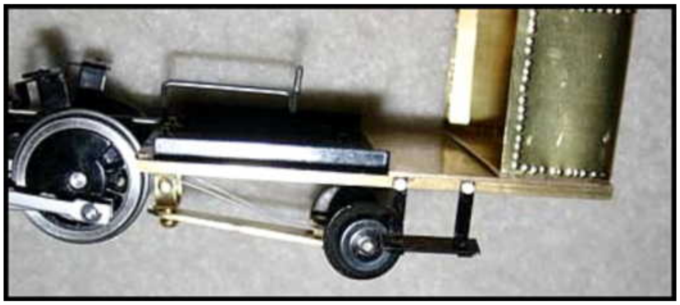
Maybe when I get better, I'll be able to skip this step and display my beautifully covered brass pieces. I'm a fair amount of 'practice' away from being able to pull that off.

Progress Report - Olomana and Hawaii No. 5:

Given that we're still waiting for the release of the Ruby kit, the focus of the chapter shifted to frame extensions, bunkers, four-wheel trucks and tenders. Progress on the Olomana was limited to completion of the rear bunker, a project begun in Chapter 2. Work did begin on Hawaii No 5. But lacking a Ruby kit, the entire focus was on building the Hawaii No. 5 tender.

'Olomana' Update:

The above photo shows the state of the Olomana bunker bash at the end of Chapter 2.



The frame extension and bunker supports had been fabricated. A shell had been punched with rivets and soldered to the frame. But I wasn't happy with the rivet work. So shortly after this shot was taken, the shell was removed.

In Chapter 3, my new rivet press was used to fabricate a new shell for the bunker. This shot summarizes the steps covered earlier in the chapter.

This shot shows the new bunker shell attached to the deck extension. Top and side edges were formed using 1/2 round brass wire soldered to edges of the shell.

Corners were shaped by pressing in place and removing excess material, then soldered in place.

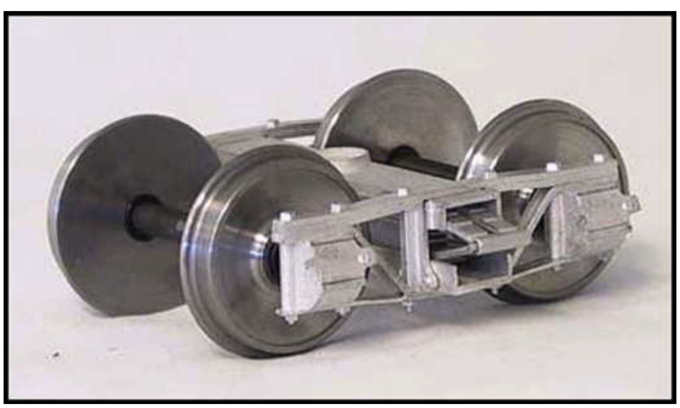
Components for the top of the oil tank and sides were also fabricated from brass. This shot shows the bunker painted in primer.

The bunker was then painted with the same Krylon green used on the cab.

The reassembled Olomana awaits final superstructure modifications to her stack, saddle tank, and domes, scheduled for Chapter 4.

Hawaii No. 5 Update:

Hawaii No. 5 is to be built using an Accucraft Ruby kit. As the kit was not yet available, work focused on the tender. Trucks were selected to closely match those on the prototype.

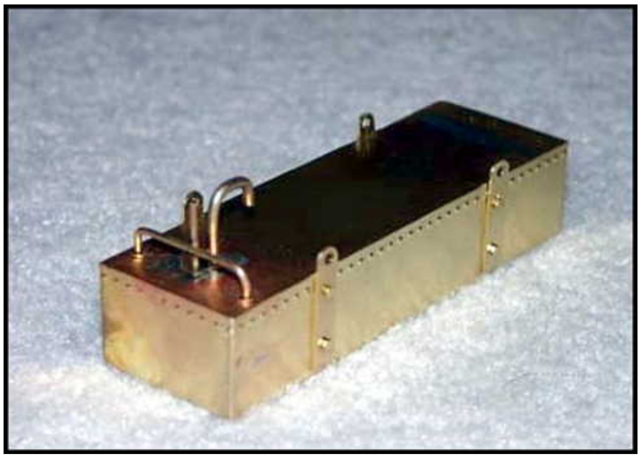


Hartford caboose trucks were chosen because of their detailing and their leaf springs.

The tender itself was constructed in a series of steps from all brass parts.

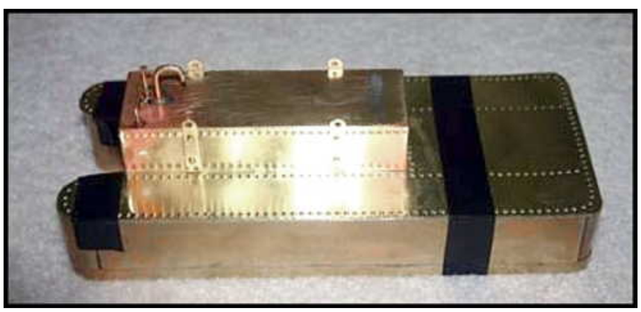
A tender deck was constructed from brass sheet, brass strips, and rectangular brass tubes. The trucks were mounted to beams made from brass tube.

An inner shell was also fabricated for the superstructure.

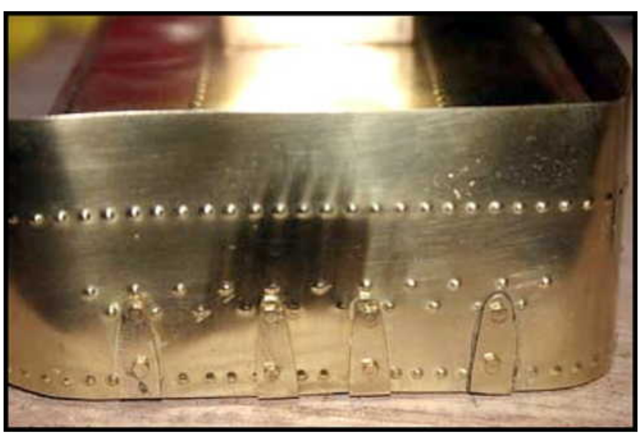


An oil tank was constructed from brass sheet and brass shim stock. Detail parts were fabricated using brass strip, brass wire, and square brass tube. Parts were attached using brass hex head screws, nuts, and washers. Rivet detail was stamped on brass shim stock, which in turn was soldered to inner walls.

The oil hatch is on order from Trackside Details.

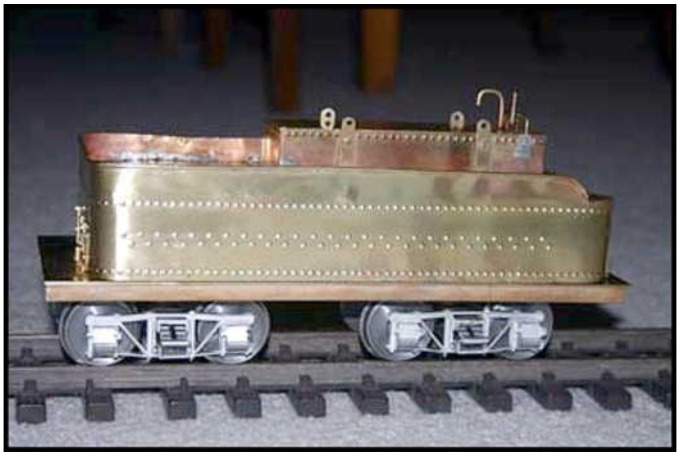


A shim stock top was punched with rivets. The oil tank is holding it to the deck in this photo.



Sidewalls were also fabricated from shim stock and riveted. Tender hold down brackets screwed through the shim stock into the underlying inner structure provided a solid physical attachment of the side walls to the inner structure.

The superstructure was detailed using 1/2 round brass wire and brass wire. A water hatch is on order from Trackside Details as is a headlight.



Here's the tender on her deck waiting for the next step.

This project is now on hold pending arrival of the Ruby kit and the detail parts. This project will be finished in the chapter on detailing.

This is the end of SteamClass Chapter 3. Click the Continue link for a preview of Chapter 4.