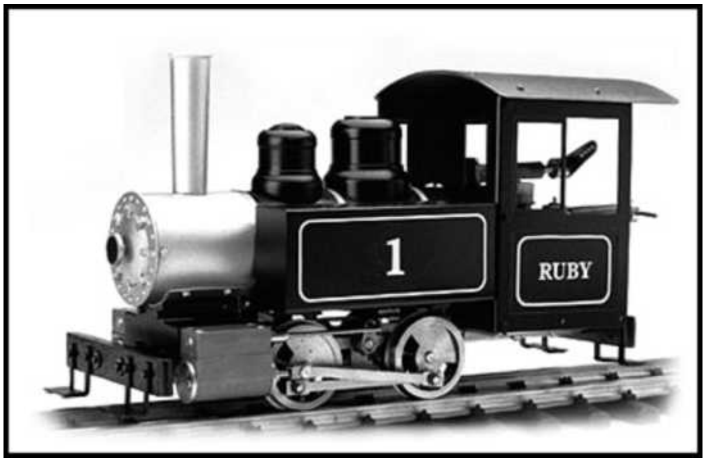


MLS Steam-Class 2004
Build A Live Steam Accucraft Ruby Kit

Chapter 2 - Bashing & Adding Structural Components

By: Tom Farin
Madison, Wisconsin, USA

March 2004

Welcome to Chapter two. Hopefully, you've finished your prototype research, have selected your prototype, and have a project definition. You may also have your Ruby in hand if you own a Ruby or are buying a variant other than the kit. You may have a builders log in the MasterClass forum describing your prototype and how you plan to attack your project. If your answer is "none of the above", consider returning to Chapter 1, doing your research, and defining your project. Then come back to this chapter and move forward.

In this chapter we'll begin working on our Rubys. Because the kit is not yet available, we've shifted the focus of the chapter somewhat from our original plan.. Instead of placing all of our attention on the drive train, we'll instead review some superstructure scratch/bash projects. Some of these projects could be started right away, before that Ruby is in your hot hands. So you have no excuse for procrastination. That means you can get started now with your project so you'll have a running start when the kit arrives. Building some components now will also help you decide whether building in brass is for you, before you start bashing components of the kit. I've found the projects in this chapter to be very satisfying. Finally, these projects are designed to get you thinking and gaining skills - especially those of you that have no significant experience working in brass.

We'll also have an opportunity to review our first prototype article. Two team members played a significant role in developing the content for this chapter. Vance Bass wrote the article that begins on the next page on Baldwin's Narrow Gauge Locomotives. He also contributed the article on working in brass. And he was a great deal of help in the section on building a rear bunker for the *'Olomana.'* Finally, two of his kits are featured in the chapter, his wooden road pilot and his wooden cab.

Landon Solomon has contributed a great design for a front or rear two wheeled truck that can be added to your Ruby. The truck uses wire springs to provide the truck with both lateral and vertical stabilization.

Chapter 2 Outline:

Here is the lineup of material in Chapter 2.

- **Baldwin's Small Narrow Gauge Locomotives:** Vance Bass - This article introduces the Baldwin Locomotive Works. Focus shifts to the Baldwin x-4-x class of locomotives with particular emphasis on the narrow gauge versions. Each class is introduced and discussed. While the title implies the discussion is limited to narrow gauge locomotives, there are links to additional NG and SG photos of engines in each class in the **Steam-Class 2004 Archive**.
- **Project Update**: This section contains an introduction of additional team members and the role they will play in this series. It also includes some new resources. Finally, it contains an announcement of a second poster child engine for the series.
- **Disassembling an Accucraft Ruby:** This article takes you step by step through disassembly of an Accucraft Ida, a Ruby variant. All key parts are labeled and discussed. This is the assembly manual and parts diagram that Accucraft should have shipped with the Ruby kit. This article stops the disassembly process once the chassis is separated from the boiler, leaving the drive train intact. Disassembly of the drive train will be discussed in Chapter 3.
- **The Basics of Working with Brass:** Vance Bass - This article introduces you to tools, materials, and techniques used in fabricating steam engine components in brass. The brass components that are built or bashed in the remainder of this chapter represent my application of techniques discussed in this article.
- **Building Prototypically Working Trucks:** Landon Solomon - This article takes you through the steps of building front or rear two wheeled trucks for your Ruby. These trucks use wire springs to provide both lateral and vertical stabilization. Aside from their esthetic value, these trucks will help your Ruby track better in curves.
- **Adding a Frame Extension and Rear Bunker:** This article takes you through the steps of adding a rear bunker to your Ruby. It begins with an approach to extending your Ruby's rear deck, providing a base for an extended cab and/or bunker. It continues through the construction of the bunker itself including fabricating the shell and adding a fuel tank.
- **Adding a Wooden Cab:** This article will take you through the steps in replacing the Ruby metal cab with a Vance Bass wooden cab.
- **Adding a Road Pilot:** This article will take you through the steps of adding a Vance Bass road pilot to the front end of your Ruby.
- **Olomana Update:** What has been accomplished in the last month, decisions that have been made, and objectives for the next month.

While the latter articles in this chapter focus on specific modifications made to convert the Ida into a more representative model of the Olomana, suggestions will be included on how to adapt these instructions to meet your needs in modeling your prototype. With the possible exception of the stack modifications, all of these projects could be started, and in some cases completed, before you receive your Ruby kit. So get going. Let's get our fingers dirty and start building stuff.

Baldwin's Small Narrow Gauge Locomotives

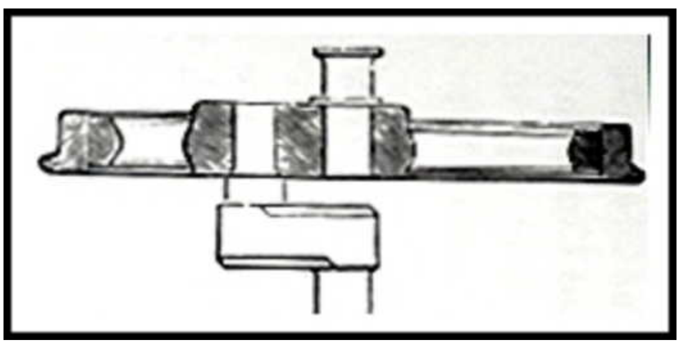
By Vance Bass

Baldwin Locomotives and the Narrow Gauge:

One hundred years ago, the largest company in the world was Baldwin Locomotive Works. They employed over 18,000 workers in a vast complex in Philadelphia and in their peak years produced thousands of locomotives each year. Over the course of more than 120 years (1831-1956), Baldwin made over 76,000 locomotives, the vast majority of them powered by steam. Baldwin's production reached a peak in 1906, after which steam locomotives and then the railroads they served began a slow decline, as paved roads and internal combustion vehicles displaced them. But their dominance of American – indeed, world – industry has never since been equaled.

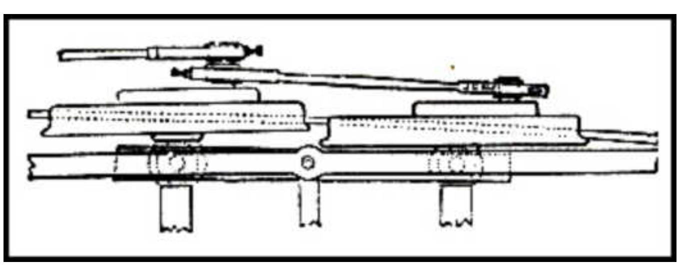
One of the things that drove the company's growth, while other locomotive works rose and fell, was Baldwin's constant technical innovation in locomotive design. In the early years, railroad construction and locomotive building were, by necessity, highly inventive undertakings. The official company biography stated that Mr. Baldwin "regarded innovations with distrust" (no doubt to ease the minds of wary railroad owners). In spite of this statement, the company introduced many new and improved designs to the industry, led by founder Matthias Baldwin and carried on by luminaries such as Samuel Vauclain.

Some of these innovations turned out to be dead ends, but many ended up being standard practice in the industry. Some seem completely obvious in retrospect, such as removing the customary crank arm from the axle ends and fixing the crankpin to the wheels, thus strengthening the running gear.



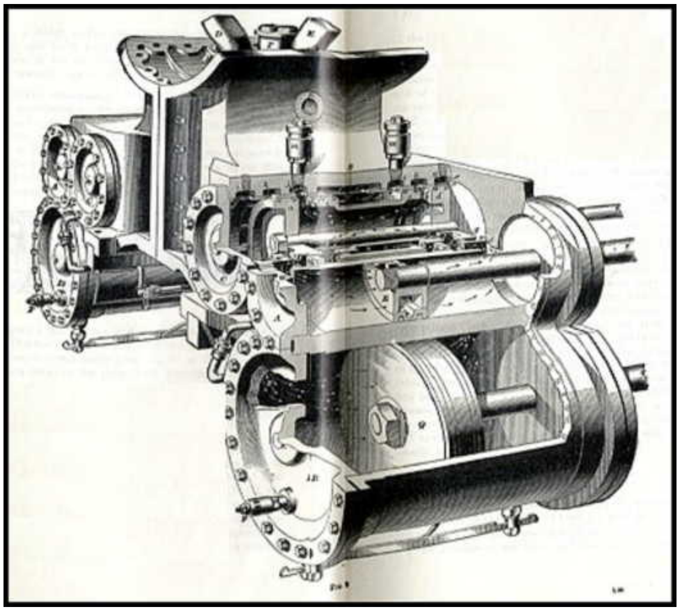
Baldwin Half-Crank
From "The Locomotives Baldwin Built" by Westing.

Baldwin's early six- and eight-coupled locomotives used a system he developed called the "flexible beam" chassis, which put the front two driving axles on a truck, permitting the loco to manage very sharp curves. This was not true articulation, as on a Mallet or Shay. The coupling rods connecting the movable axles to the rear axles were rigid, and the front axles could slide sideways up to three inches to accommodate the track curvature. It was a very successful design: almost all of the Baldwin's built between 1842 and 1866 had flexible beam chassis, according to John White.



Baldwin Flexible Beam Truck – 1842
From "The Locomotives Baldwin Built" by Westing.

Compounding – reusing the exhaust from one cylinder to power another – was common practice on steam ships, but Baldwin obtained a number of patents for applying compounding on the locomotive, starting in 1889, and applied the technique to a quarter of their locomotives by 1900. The result was significant fuel savings, as the locomotives developed more power from the steam produced than single-expansion locos.



Cutaway of Vauclain compound cylinders. High pressure steam is first expanded in the upper outboard cylinders. From there, it is routed to the larger lower low-pressure cylinders where it is expanded a second time.

(Image from the International Correspondence Schools Reference Library – Textbook 60B, copyright 1900.)

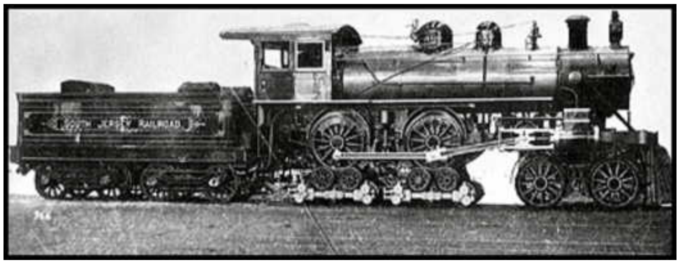
These patents were developed by Samuel Vauclain, later president of the Baldwin Locomotive Works. (Later, the compound expansion principle would be applied by Anatole Mallet to the articulated locomotive design that bears his name.)

Mallet Articulated Compound 2-6-6-2 built for the Great Northern Railroad in 1904.

From Baldwin Record No 65 "Mallet Articulated Compound Locomotives" - 1908

Undoubtedly, Baldwin's most important technical innovation was the use of standardized parts and patterns in their shops. A design draftsman would reuse as many parts from previously designed locos as he could, which in turn permitted the workers in the shop to use existing patterns and jigs to produce consistent, quality products. Matthias Baldwin began working on this in the 1830s, but it only became technically feasible to implement it fully in the 1870s. This standardization is most noticeable to the modeler in that, underneath the skin, one Baldwin is very similar to others of the same class in significant ways. Standardization of designs and parts was a huge contribution not only to the railroad industry, but to manufacturing as a whole. Henry Ford couldn't have killed the locomotive without Baldwin's work on standardization.

At first, no one knew exactly what kind of locomotive would work best. Early designs were quite varied – sometimes even fanciful – and evolved over the years as experience was gained and as railroad traffic grew.

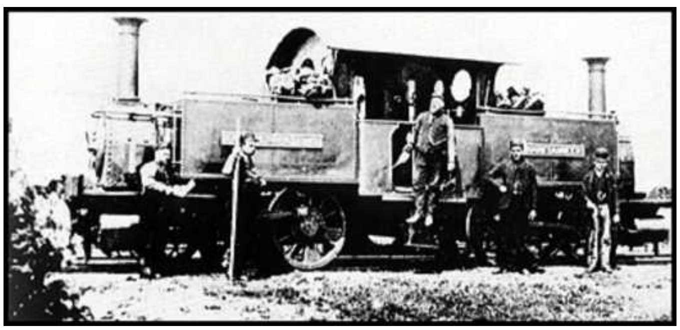


One of Baldwin's more unusual innovations was built for the Holman Locomotive Speeding Company in 1897. The design didn't catch on.

From "The Locomotives Baldwin Built" by Westing.

Eventually, standardization of railway construction methods and of locomotive and rolling stock construction techniques would make national and international exchange of rolling stock commonplace. But at first very little was standardized or even compatible, from couplings to signals to track gauges.

Starting in the mid-1860s, the English engineer and innovator Robert Fairlie – inventor of the Fairlie type articulated locomotive – was an ardent promoter of what he deemed the most rational design for railroads. You have probably heard the story (and it may even be true) that our current railroad track gauge was derived from the width of Roman chariot roads. That kind of apparently arbitrary design choice was typical of the day. In Fairlie's time, track gauges in the UK alone ranged from 1'-11.5" (the Ffestiniog Railway) to 7' (Brunel's Great Western), so clearly some sort of rationalization was needed. Fairlie advocated his ideas as a scientifically based package that would yield the perfect railway, economical to build and run, efficient and profitable.



The Mountaineer, built by the Fairlie Engine & Steam Carriage Co. in 1869.
From "The Fairlie Locomotive" by Abbott

Part of Fairlie's dogma was a track gauge of three feet. Even at that time, though, Robert Stephenson's gauge (4'-8.5", the "Roman chariot gauge") was the one that most railroads adopted, thus becoming the "standard gauge" in the UK, Europe, North America and elsewhere. The narrow gauge question was not really settled until around 1885, though.

Narrow Gauge Fever:

But let us pause now at the year 1870, the year in which the so-called "Narrow Gauge Fever" was born. No doubt you already know the story of how General Palmer, the founder of the Denver & Rio Grande Railway, visited the Ffestiniog on his honeymoon and became a convert to Fairlie's vision. And you may have heard of the Narrow Gauge Conventions in the early 1870s, in which proponents of "scientific" railroads discussed, debated and evangelized the theory and practice of narrow gauge railroading. In the years that followed, there was a frenzy of narrow-gauge building activity. Between 1875 and 1885, over 10,000 miles of narrow-gauge track were laid in the US. In many countries, where railroads were not even started until the 1870s or after, the only railroads were what we would now call "narrow gauge", though of course in that context they were the "standard gauge" for the locality.

Probably the best-known early narrow gauge loco in the US is the D&RGW's first engine, the 3-foot gauge "Montezuma".

A company cannot become the largest in the world based on the economy of only one country, so naturally Baldwin served many markets outside the US. Their first export, to Cuba, was in 1838, only seven years after the company began production. Baldwin's first narrow gauge export, to Brazil, was in 1869, just a couple of years after Fairlie began his research and promotion. During the years 1840 to 1906, 19% of Baldwin's production went to other countries, and exports reached a high of almost 35% of production in the 1890s (when the US economy was severely depressed). Although narrow gauge mileage in the US began a gradual decline after 1885, Baldwin's narrow gauge export business remained significant until the end of locomotive production. Their last narrow-gauge steam locos went to the 36" gauge Ecuadorian national railway in 1951, and one of the very last locos they built was a 34" gauge diesel for a Filipino railroad. So, even though narrow gauge was considered a "dead issue" in the United States after about 1900, it was (and still is!) very much a current technology in much of the rest of the world.

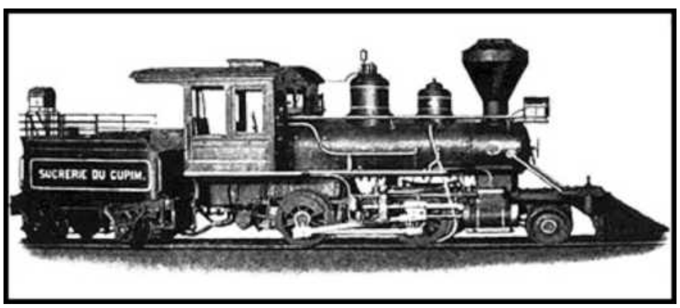
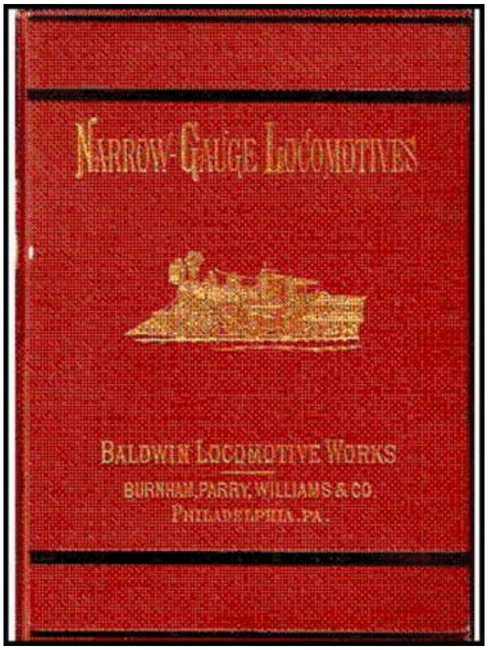


Photo 2: A very similar locomotive to the "Montezuma", this little metre-gauge 2-4-0 was built thirty years later for a plantation railroad.

Selling lots of little locos:

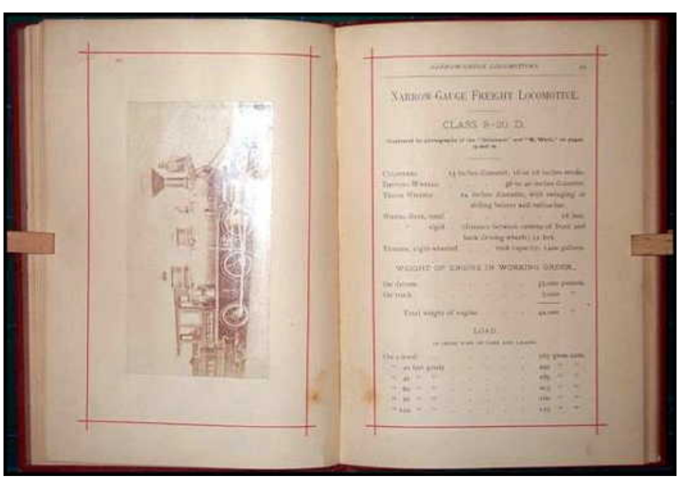
Like any large manufacturer, Baldwin offered a wide range of products, suited to different customers with different jobs to do. The smallest were the four-coupled, or x-4-x designs – those having four driving wheels. Having only two driving axles meant that these engines had a short fixed wheelbase, making them able to negotiate smaller radius curves than larger locos. These little lokies, especially the 0-4-0 or 0-4-2 types, were dominant in industrial locations, such as mines, factories or plantations. The 0-4-4 Forney types were commonly seen hauling short line traffic, or on urban commuter lines in large cities. Reading through the Baldwin construction records, you will find orders for tens or even hundreds of identical mainline locos, interspersed with orders for one or a few smaller narrow-gauge locos. But an order was an order, and each one got the same care from Baldwin. And so, Baldwin's locomotives were spread across the face of the world. A country with no manufacturing economy of its own would still be home to many locomotives, usually US or British, hauling the loads and opening new territories.



The 1877 Baldwin narrow gauge locomotive catalogue.

To aid in this worldwide sales effort, Baldwin had representatives and agents all over the world. Representatives were Baldwin employees who handled marketing and ordering activity for a region. Agents were independent, often buying from several different loco works on behalf of clients in the country. Baldwin's catalogues were printed in English, Spanish or Portuguese, and so were the supplemental brochures called "records of recent construction".

Buying a locomotive was a major capital investment, similar to buying an airplane or a fleet of freight trucks would be today, so the sales effort was not cheap. Catalogues were hard-bound affairs with gold-embossed covers, two-tone printing, detailed descriptions and the builder's "beauty" photos, taken when the loco was newly finished, of representative locos of the class. The earliest catalogues had actual photographs pasted onto the pages, while later catalogues used half-tone reproductions. (Some builders moved to using wood engravings to avoid the expense of hand-pasting photos into catalogues, before half-tone reproduction was perfected.) Between 1872 and 1900, Baldwin issued special catalogues for narrow-gauge locos. The first, in 1872, was 48 pages long; the last, in 1900, was over 450 pages (this included a history of the company, a treatise on the Vauclain Compound system, spare parts diagrams, and so on). After 1900, narrow gauge locos were included in the general catalogues, which were reduced to a more manageable size.



Two pages of the 1877 narrow gauge catalogue. Note the two-color printing and the actual photograph pasted on the left page.

The records of recent construction started out as a way to show current locos to the prospective buyer, rather than reprinting the catalogues every year. There were 100 in the series, beginning in 1898 and going until 1921. After a few years, the general catalogue supplement format gave way to "theme" books, covering areas of interest to narrower customer groups. A sampling of titles of this sort includes "Oil Burning Locomotives" (1902), "Locomotives Recently Built for Passenger Service" (1910) and "Locomotives for Industrial and Contractors' Service" (1911). Some were technical bulletins (e.g. "The Actual Efficiency of a Modern Locomotive (1907)) or topics of interest to the railroad industry ("Are American Railroads Overcapitalized?" (1913)).

boom" collapsed, Baldwin still found plenty of interest in narrow gauge locomotives among industrial users and foreign railroads. So, there were also titles such as "Locomotives for Export" (1915), "Locomotives for Industrial and Contractors' Service" (1914) and "Locomotives for Plantation Service" (1915). These latter, in particular, are a goldmine for the Ruby basher.

A Baldwin "Record of Recent Construction" covering internal combustion locos, translated into Spanish for the sizeable Caribbean and South American markets.

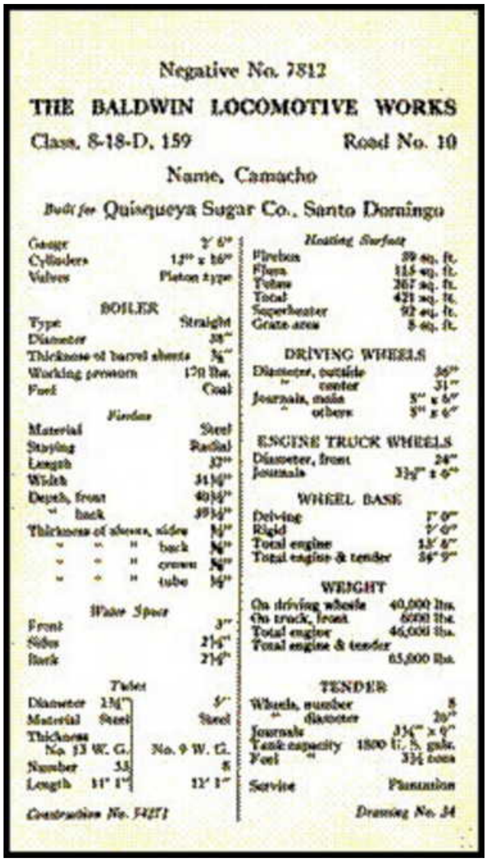
The covers of most Records were a little plainer than this, though all had the company's name in embossed gold lettering.

Reading Baldwin's Class Descriptors:

In looking at Baldwin's literature, you will find that locomotives are grouped under "classes". The BLW classification system was based on the loco's number of wheels (total and number of drivers) and cylinder dimensions. This seemingly arcane system was made up of several codes that gave specifics of the class of locomotive described. For example, class 6-10 1/3-C consists of:

- 6 - Indicates there are a total of six wheels on the engine.
- 10 - Is a designator that can be converted into the cylinder diameter. Divide this number by 2 and add three and you will find the cylinder diameter is 8 inches.
- 1/3 - Indicates there is a two wheel trailing truck. 1/4 would indicate a four-wheel trailing truck.
- C - Indicates there are four driving wheels. D would indicate six, E would indicate eight, etc.

Thus, a loco of Class 6-10 1/3-C has four driving wheels, a two wheel trailing truck, and cylinder diameters of 8 inches. Within this class, locomotives could have different boiler diameters, cylinder stroke, track gauge, etc. So, to completely identify a particular locomotive with a class, you would also need the number of the drawing set used to build it. This number is typically included on the specification card showing a particular locomotive.



Negative No. 7812

THE BALDWIN LOCOMOTIVE WORKS

Class, 8-18-D, 159 Road No. 10

Name, Camacho

Built for Quisqueya Sugar Co., Santo Domingo

Gauge	2' 6"
Cylinders	12" x 16"
Valves	Piston type
BOILER	
Type	Straight
Diameter	38"
Thickness of barrel sheets	[illegible]
Working pressure	170 lbs.
Fuel	Coal
Firebox	
Material	Steel
Staying	Radial
Length	37"
Width	31 [illegible]
Depth, front	40 [illegible]
" back	39 [illegible]
Thickness of sheets, sides	[illegible]
" " " back	[illegible]
" " " crown	[illegible]
" " " tube	[illegible]
Water Space	
Front	3"
Sides	2 [illegible]
Back	2 [illegible]
Tubes	
Diameter 1 [illegible]	5"
Material Steel	Steel
Thickness No. 13 W. G.	No. 9 W. G.
Number 53	8
Length 11' 1"	12' 1"

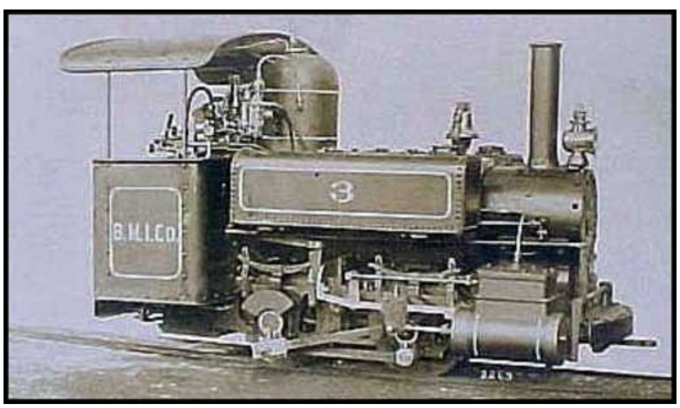
Heating Surface	
Firebox	39 sq. ft.
Flues	115 sq. ft.
Tubes	267 sq. ft.
Total	421 sq. ft.
Superheater	92 sq. ft.
Grate area	8 sq. ft.
DRIVING WHEELS	
Diameter, outside	36"
" center	31"
Journals, main	5" x 6"
" others	5" x 6"
ENGINE TRUCK WHEELS	
Diameter, front	24"
Journals	3 [illegible] x 6"
WHEEL BASE	
Driving	7' 0"
Rigid	7' 0"
Total engine	13' 6"
Total engine & tender	34' 9"
WEIGHT	
On driving wheels	40,000 lbs.
On truck, front	6000 lbs.
Total engine	46,000 lbs.
Total engine & tender	65,000 lbs.
TENDER	
Wheels, number	8
" diameter	20"
Journals	3 [illegible] x 6"
Tank capacity	1800 U. S. gals.
Fuel "	3 [illegible] tons
Service	Plantation

Construction No. 54271 *Drawing No. 34*

Reverse side of a Baldwin specification card.
Note that the class (8-18-D) is specified at the top of the card, and the drawing number (34) appears at the bottom right.

The Steam MasterClass 2004 archive also groups the Baldwin locos by their class designations, just as the catalogues and brochures would. Here is a quick introduction to the Baldwin classes most relevant to a Ruby bash in SteamClass 2004. Links will take you to archive pages containing photos of additional engines in each class.

Baldwin 4-C Saddle or Side Tanks – These engines had four coupled driver wheels. They came with saddle or side tanks. The archive contains photos of both **narrow gauge** and **standard gauge** prototypes. The class designation of 4C indicates there are a total of 4 wheels (4) and all four of the wheels are driving wheels (C).

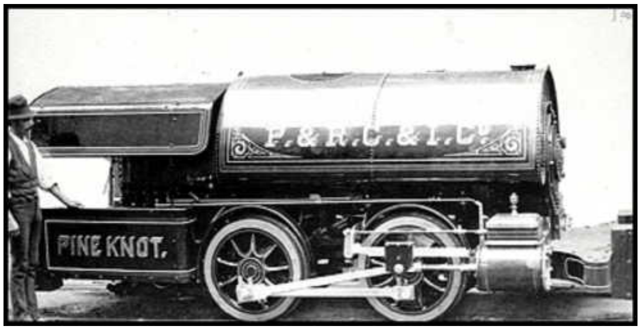


Bridgeport Malleable Iron Company No 3. Note the open plantation style cab and outside frames. This tiny 21.5" gauge engine had 6" by 10" cylinders and 20" drivers.

Baldwin 4-C Tender – These engines had four coupled driver wheels. They were distinguished from the preceding 4-C class by the fact they had an unattached tender. The archive contains photos of both **narrow gauge** and **standard gauge** prototypes.

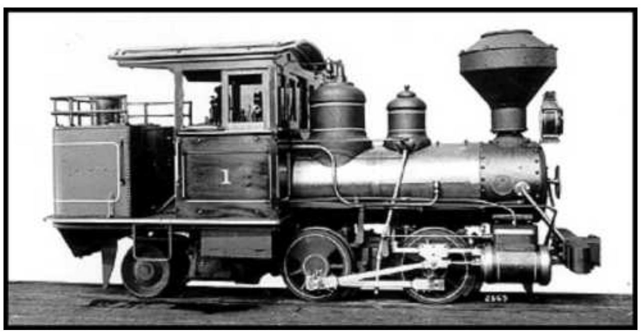
This is Ingenio Valdez #3 "Dolores", Ecuador. She was a 36" narrow gauge engine.

Baldwin 4-C Mining – These engines had four coupled driving wheels. Because they were built for mining use, they had low slung cabs to allow them to fit through tunnels. The archive contains photos of both **narrow gauge** and **standard gauge** prototypes.



This is the class photo from the 1876 Baldwin Narrow Gauge catalog.
The only subclass had 8-inch diameter pistons and 30-inch diameter drivers.

Baldwin 6 1/3-C Rear Tank – These engines had four coupled driving wheels with a two wheel trailing truck. The engine had a rear bunker, which could contain an oil bunker or a place to carry wood or coal. The archive contains photos of both **narrow gauge** and **standard gauge** prototypes. The 6 1/3 C Class designation meant there were a total of 6 wheels (6) of which four were drivers (C) with the remaining two wheels in a rear truck (1/3).



Imperial Forestry Bureau (by Frazer & Co.) #1, Japan. (30" ga.)

Baldwin 6 1/3-C Saddle or Side Tanks - These engines had four coupled driving wheels with a two wheel trailing truck. They had saddle or side tanks. The Archive contains photos of both **narrow gauge** and **standard gauge** engines.

Agustin Ross Coal. Co. #1 "Loreto", Chile (1m ga.)

Baldwin 6 1/3-C Tender - These engines had four coupled driving wheels with a two-wheel trailing truck. They had a separate tender. The Archive contains photos of **standard gauge** engines.

Goldsboro Lumber Co. #7 (Dover & Southbound RR), USA. This is a standard gauge engine.

Baldwin 6-C Rear - These engines had four coupled driving wheels with a two-wheel pilot. The engine had rear bunker containing an oil tank or a place to store coal or wood. The archive contains photos of **narrow gauge** prototypes. The 6 - C Class designation meant there were a total of 6 wheels (6) of which four were drivers (C). The lack of a fraction in the class designation indicates the remaining two wheels were located in a front pilot.

This 42” gauge loco for Nicaragua has unusual wheel arrangement for a saddle-tank engine.

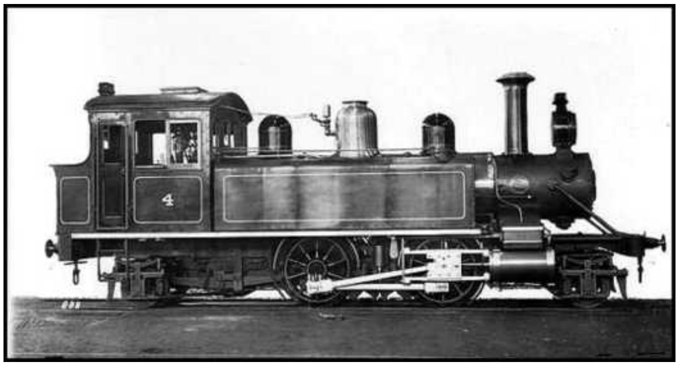
Baldwin 6-C Tender - These engines had four coupled driving wheels with a two-wheel pilot. The engine had a separate tender. The archive contains photos of both **narrow gauge** and **standard gauge** prototypes.

Visconde de Quissaman Plantation #4, Brazil. This is a 1-meter gauge engine.

Baldwin 8 ¼ C Double Ender Tender - These engines had four coupled driving wheels with a two-wheel pilot and a two wheel trailing truck. The engine had a separate tender. The archive contains photos of **narrow gauge** and **standard gauge** prototypes. The 8 1/4 C Class designation meant there were a total of 8 wheels (8) of which four were drivers (C) with the remaining 4 wheels split between a two-wheel pilot and a two wheel rear truck (1/4).

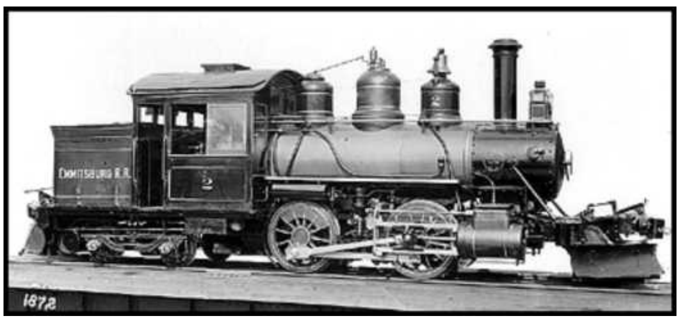
A 3’ gauge 2-4-2 originally built for the Hawaiian Railway Co. in 1925.

Baldwin 8 ¼ C Double Ender Rear – These engines had four coupled driving wheels with a two-wheel pilot and a two wheel trailing truck. The engine had a rear bunker containing an oil tank or a place to store coal or wood. The archive contains photos of **narrow gauge** prototypes.



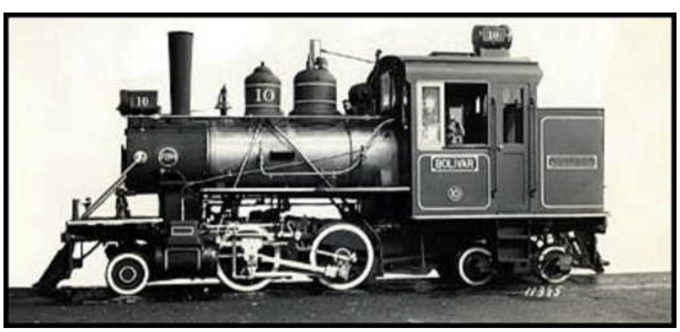
This 42" gauge loco, built for the Bantan Rly. In Japan, was a 2-4-2 Baldwin with side tanks and a rear bunker.

Baldwin 8 1/3 C Forney - These engines had four coupled driving wheels with a four wheel trailing truck that supported a rear bunker containing an oil tank or a place to carry wood or coal. The archive contains photos of both **narrow gauge** and **standard gauge** prototypes. The 8 1/3 C Class designation meant there were a total of 8 wheels (8) of which four were drivers (C). The 1/3 fraction in the class designation indicates the remaining four wheels were located in a trailing truck.



Emmitsburg Railroad #2, USA, a standard gauge engine.

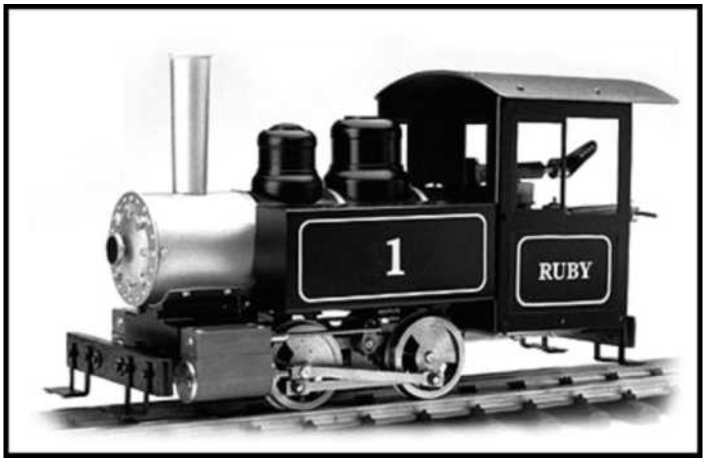
Baldwin SG 10 1/4-C Forney - These engines had four coupled driving wheels with a two wheel lead truck and a four wheel trailing truck that supported a rear bunker containing an oil tank or a place to carry wood or coal. The archive contains photos of **narrow gauge** and **standard gauge** prototypes. The 10 1/4 C Class designation meant there were a total of 10 wheels (10) of which four were drivers (C). The 1/4 fraction in the class designation indicates the remaining six wheels were located in a two wheel pilot and a four wheel trailing truck.



This is the "Bolivar", a metre-gauge 2-4-4 Forney that went to Venezuela.

Accucraft Ruby:

Now, we turn to the "Ruby". Accucraft's little 0-4-0T was patterned after a generic Baldwin narrow gauge locomotive, the kind seen in every Baldwin catalogue from 1870 on. It was designed as a low-cost entry-level engine with good performance. Among the design points was that it should be easy to disassemble for kit bashing, making it perfect for our projects. The Ruby has the basic characteristics of what is known as a "budget" model: accurate scale proportions, but with reduced detail. So, the outline, proportions and overall appearance of the Ruby are consistent with Baldwin's typical narrow gauge designs, though the detail is minimal. That also leaves us with broad possibilities for customization.



Due to Baldwin's standardization of designs, we may take a Ruby, discard the tanks, the cab, or the smokestack and replace them with units of a different design and still have a recognizably Baldwin locomotive. Likewise, we can add wheels in front or behind, to create different loco types such as 2-4-0s or 0-4-4s. And that's exactly what we'll be doing in this class, as we each customize Ruby for ourselves. Just like the full-size prototypes, each will be built just for us, but using standardized designs, parts and techniques.

The common characteristic of all the Baldwin's in the previous section of this article is that they have four coupled drivers. Thus they are realistic target prototype engines for a Ruby bash by almost anyone participating in the class, even those with no live steam experience. No major changes need to be made to boiler, cylinder, drive wheels and controls to model these Baldwin's. This is important in that the Ruby is a live steam engine, so these parts play a functional role as well as a cosmetic role.

Within each class, Baldwin offered a broad range of cylinder diameters, driver diameters, wheelbases, weights, etc. On each class page of the archive is a link to an image containing specifications for that class.

Baldwin also delivered a variety of cab types, stacks, tanks, tenders, pilots, etc. Should you elect to choose a Baldwin prototype for SteamClass 2004, you can model a specific engine if you wish. That's what Tom Farin has elected to do in doing in modeling the *'Olomana."* He is modeling in 1:17 because the particular locomotive he chose to model is smaller than the Baldwin Prototype used to develop the Ruby. If you pick a specific engine for your bash, you may be faced with similar issues to those Tom faced with the Olomana. These issues were discussed in Chapter 1.

If you want to freelance a Baldwin prototype, yet have a prototypically realistic engine, you can choose from an almost endless variety of possibilities. Choose the Baldwin class you wish to model. Check the specifications on the appropriate class page in the Archive to see whether Baldwin produced an engine in the class with dimensions fairly close to the Ruby. Review the other engines in the class. Do you want —

an open or closed cab, side tanks or a saddle tank, a straight stack or a diamond stack, a four-wheel or eight-wheel tender … the choices are up to you. You are the owner of a railroad. Pick an engine that has the characteristics that fit into your layout and the detail parts that fit in with your road and era and that you find to be visually appealing.

Once you have settled on your specific prototype and its detail options, advance through the rest of this chapter. It will help you start moving your Ruby in the direction of your prototype - even before you have your Ruby. Add a pilot or a pony truck if your model is other than a 0-4-0. Extend its rear deck to accommodate a bunker. Add a road pilot or a wooden cab. Learn how to disassemble and reassemble a Ruby.

Then follow along with us in the remaining four chapters as we show you how to tune its drive train, further bash its superstructure, add electronics, and detail its exterior. When you are finished you will have a model to take pride in. Then take it to its first steamup and bring it to life, celebrating the glory of live steam.

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

Chapter 2 - Bashing & Adding Structural Components

By: Tom Farin
Madison, Wisconsin, USA

March 2004

Project Update:

Our best laid plans were interfered with somewhat by the timing of delivery of the Ruby kit. For that reason, we've swapped some materials between Chapter 2 and Chapter 3 of this series. The projects brought forward are structural projects that you can start without a Ruby kit. Drive train related issues have been moved back to Chapter 3 along with some structural modifications that require the kit to implement.

Chapter 2's operation section begins with an article on Ruby disassembly. An Accucraft Ida is used as the subject for this article. Disassembly instructions are provided along with photos. In addition, parts of the Ruby are labeled for reference purposes.

The disassembly article is followed with a Vance Bass article on working with brass. This chapter is crucial in that it covers materials and techniques that will be used in the superstructure articles that follow. The article is also helpful in that it gives the required and optional tools you might consider in putting together your brass 'machine shop'. I love articles like these as they can be placed in front of the significant other in our lives accompanied by the statement, "Honey, I need all of these." One of the keys to winning the contest, 'He who dies with the most tools wins', is to support the 'need' to accumulate tools. Thanks for sharing your expertise and helping us with our tool quest, Vance.

Chapter 2 Projects:

Following the working with brass article is a series of articles on scratch/bash projects aimed at modifying the Ruby superstructure.

Our favorite TrotFox, Landon Solomon shares his expertise in building a front or rear two-wheel truck. The trucks are inexpensive to build as they use stock K&S brass for the most part. If you've worked with brass in the past, you may have many of the required parts in your brass materials box. The article includes a number of photos that take you through step by step. I found building these fully equalized trucks to be a very satisfying project. The majority of the work can be done without having a Ruby in your hands. The only thing you can't do is mount the trucks to the frame.

I wrote the article on adding a rear bunker. But Vance was very helpful in responding to e-mail requests relating to materials and techniques. The two major components of this project are a cab floor extension and the bunker itself. While the modifications are specific to the Olomana, anyone possessing takeoff dimensions on their prototype should be able to complete the bulk of this project without a Ruby. This entire project is done in brass.

The Ruby and Ida ship with yard pilots. The Olomana had a road pilot (cow catcher). Vance's laser cut pilot kit made this bash much easier than had I decided to scratch build this component. Aside from the diamond stack bash, which will be covered in Chapter 3, this was my first small Olomana project. Once again, you can work the majority of the way through this project without a Ruby.

For those of you bashing an early Baldwin x-4-x, one of the more formidable challenges may be to scratch build a wooden cab. Once again, Vance offers a much simpler alternative, building a cab from his laser cut kit. This cab adds a very important period feel to my Olomana project. The vast majority of the work in this project can be completed without a Ruby.

As you'll see, my bash of an Ida into an Olomana has seen significant progress between Chapter 1 and 2. While the individual articles show how the components were build, the Ruby/Olomana was reassembled to show her state at the end of the chapter.

Before we move on to the articles, let's get a quick update on some key elements of the project.

Steam-Class 2004 Archive:

With the focus of the prototype article on Baldwin, the **Steam-Class 2004 Archive** has been updated with a significant number of additional Baldwin photos. But we are also in the process of adding to other areas of the archive. The Vulcan section, in particular has grown substantially in the last month.

New Team Members:

- **John Page:** John will be machining and offering upgraded brass cylinders for the Accucraft Ruby in 1/2" and 9/16" bores. His cylinders will be available for approximately 1/3 the price of a similar product from a firm in the United Kingdom. He's going to try to keep the cost under $60 a pair. This pricing is only available to class members and only through August 1. John's cylinders are based on a process developed by Dave Hottman that will be published in Chapter 3. If you are interested in more information, contact John at **jrpg@charter.net**.
- **Royce Brademan:** Royce (**Royce@Quisenberrystation.com**) is the owner of **Quisenberry Station**. He is supplying the Ruby Kits to class members. Royce is also offering a 10% discount on orders of detail parts from Trackside Miniatures and Ozark Miniatures to class members through August 1. Finally, Royce is offering the Accucraft Test Stand to use in testing your Ruby for $12.

Resources:

Sulphur Springs Steam Models: It's hard to slot this company's products into a particular category. That's because the products hit almost every category on our list. To give you an example, for Chapter 2 and 3, I ordered the following parts:

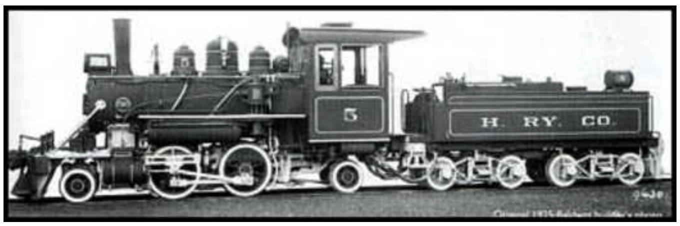
- Brass half round beading for the edges of the bunker on the *'Olomana.'*
- Stainless steel spring wire for Landon's fully equalized trucks.
- A 40-psi steam pressure release valve for the Ruby.

That's just a sampling. They sell steam locomotives, locomotive parts and accessories, machine tools, shop tools, rolling stock, fasteners, materials and supplies, rolling stock, road and stationary engines, books ... the list goes on and on. This is an extremely useful site for large-scale modelers run by a couple of very nice people.

An Additional Steam-Class 2004 Poster Child Engine:

As Chapter 1 indicated, I will be building a second engine from a Ruby kit as part of this project. I have now selected the engine. While I really would like to build a Forney from a Vance Bass kit, I instead elected to build a Columbia type 2-4-2 with tender. Why? Because I'm really enjoying working with brass and wanted more of a challenge than that offered by the Olomana. I also wanted to select an engine that would add more depth to this series. The Columbian tender project will rely heavily on David Fletcher's tender chapter in MasterClass 2001. But the tender will not be a clone of a MC 2001 tender. It will be executed in brass and have a significantly different form factor. In addition, I'll need to fabricate a front truck and a second rear truck.

Which engine should I choose? I dug through the archive and settled on another Hawaiian engine, Hawaiian Railway Co. #5, a Baldwin 2-4-2. This engine was built in 1925 and like the Olomana survives today.



Hawaiian Railway Co. #5, Hawaii (36" ga.). This is her builder's photo.

A nearly identical shot of her later in life serving the Tahoe, Trout Creek & Pacific RR.

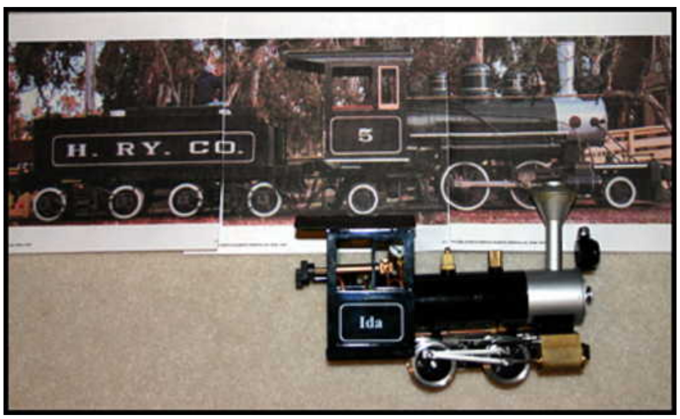
A photo of her following restoration by Richard May.

I love her lines. She certainly won't look much like the original Ruby when finished. When I picked her as the second poster child for this series, I had no idea how famous she was -- one of the few surviving Columbia Type 2-4-2s. Vance Bass supplied the original photo in the archive, the middle photo of the three-photo set. David Fletcher unearthed the rest from his magazine collection. To see a stunning set of photos and drawings of this engine, visit the Hawaii #5 page in the archive. It has been said she was the prototype for the original Bachmann 2-4-2. Bachmann's implementation certainly didn't live up to the potential of this little beauty.

Aside from the scratch built tender, No 5 offers a number of other challenges:

- Bashing the Ruby cab to more closely model the prototype. So in addition to the wooden cab on the Olomana, a metal cab bash will be covered in this series.
- Fabrication of the front and rear 2 wheel trucks. Fabrication of a rear truck is included in this chapter. I'll show photos of the front truck bash in Chapter 3.
- Dome city - 3 domes, sitting on top of the boiler. In addition to the domes modifications already planned for the Olomana, the dome needs of Hawaii No 5 will need to be covered in this series.
- Some interesting piping, detail components, and the running boards. The list includes an original Westinghouse compressor for the air brake system. In fact, No 5 is a more modern engine. As a result, she has more modern appliances.
- Extending the front deck.
- A possible boiler extension. Am I up to this challenge? Can I find a suitable pipe for a boiler extension? We'll see.
- Driver size. Can I find a compatible set of drivers that are larger diameter? Another little research project.

This shot of the Ruby/Ida against a 1:20.3 picture of Hawaii No 5 clearly points out the boiler and driver discrepancy.



The drivers are off by quite a bit, 28" at scale versus No 5's 36". Wheelbase of the two engines is the same but the boiler of No 5 is longer and the drivers further forward relative to the cab.

A boiler extension just behind the stack could solve the problem without breaching the boiler. Time to start scouting for properly sized tube in brass or copper.

Projects on Hawaii No. 5 will begin to appear in Chapter 3. Enough update stuff, let's get down to business.

How to tear down an Accucraft Ruby

In this section, we'll go through the tear down of an Accucraft Ruby step by step. The model being torn down is the Accucraft Ida I picked up as a base model for the Olomana bash. The differences between the Ida and the Ruby kit are mostly superficial in nature. After the superstructure has been removed, we'll be down to a base Ruby drive train which is the same across all the Ruby variations.

Required tools:

For all the steps beyond the first few, hex head screws must be removed as part of disassembly. All of these screws are metric. In addition to the hex screws, there are a few Phillips screws. Tools for fasteners this small are not a very common hardware store item. But with a little digging and a bit of innovation, my tool kit was assembled.

This set of Sears Metric Combination Wrenches was around $25 and has sizes from 4 to 11 millimeters.

They deal with the bigger bolts but lack a 2 mm and 3 mm wrench, two common bolt sizes on the Ruby.

This set of **Wiha** metric hex socket drivers is made from Chrome Vandium steel. They feel great in your hand but leave a $30 dent in your wallet.

Sizes are from 1.5mm through 4.0 mm.

This cheap set of Chinese precision tools came from **Harbor Freight**. A variety of slotted and Phillips screwdrivers are included, as well as a needed 5.0mm hex socket. They don't feel as good as the Wihas but only cost around $15.

As an alternative to the expensive Wiha sockets, you might consider this suggestion passed along by Vance Bass.

> *"On advice from Clark Lord, I made a 3mm nut driver from a metric socket- head screw. The hex socket on the screw fits down on the hex head nut exactly. I screwed the threads into a dowel and -- voila! -- a nut driver."*

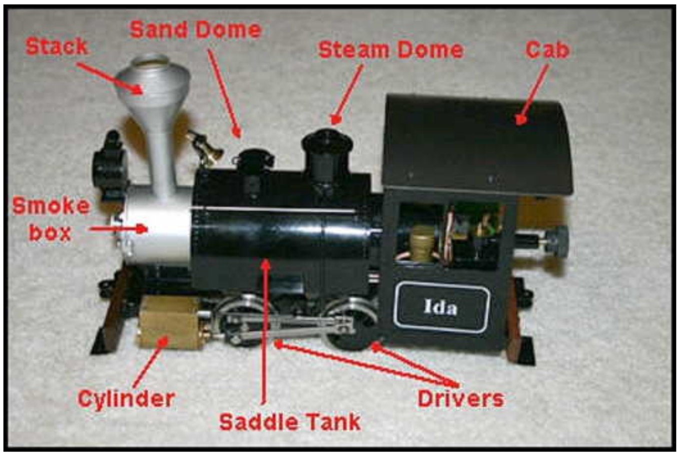
To get at those 3mm screws on the boiler you need a combination wrench or a small socket wrench. I could find neither. Then TrotFox came to my rescue. "Did you know that the hex holes in metric hex socket screws and set screws are exactly the same size as the hex heads on the machine screws"? No, I didn't until both Trot and Vance pointed it out. So here's the cheapest tool of all. Go down to the hardware store and pick up an assortment of metric setscrews and socket head screws. Then buy a nut that fits each set screw. Yes, a set of metric socket wrenches in small sizes. Thanks for the tip Landon.

This little 3 mm socket wrench was made from a metric set screw, an appropriately sized metric nut, and a scrap piece of brass rod.

A hole was drilled through the nut to the set screw. Then the brass rod was glued in place with epoxy. Total cost? Under $1.

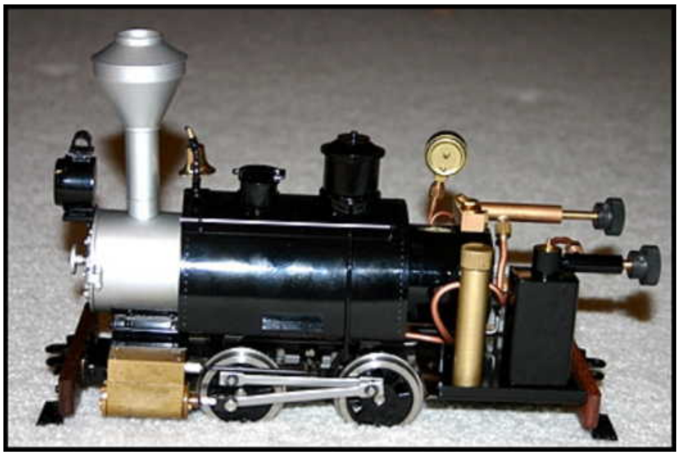
Removing Superstructure Elements:

The Ruby was designed to allow for interchange of parts and easy access to key components. As a result a number of superstructure elements come off very easily.



This is a photo of an Accucraft Ida just before commencement of disassembly. Major differences between the Ida and Ruby are the headlight, stack, domes, saddle tank, and bell.

(note: Accucraft's Ida has sand dome lines coming from the appropriate location of the steam dome. So It is labeled on this drawing as a steam dome, even though it has sand dome lines. Go figure!)



Cab removal is as simple as lifting straight up on the cab. The cab is designed to be readily removed as key components that need to be serviced are located inside the cab.

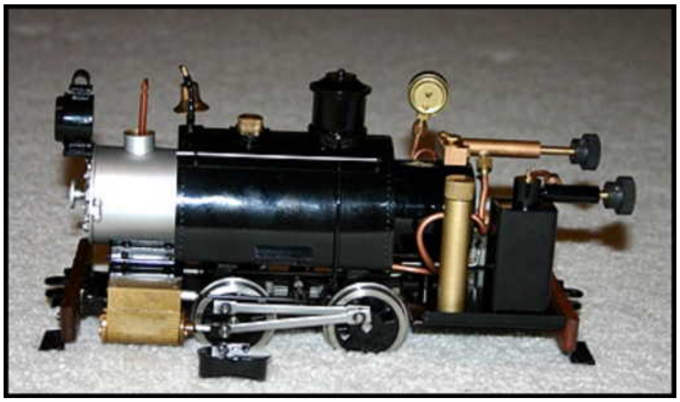
The smokestack can be removed by unscrewing it in a counter-clockwise direction.

That copper tube coming up is the steam exhaust. Unscrew it and set it in a safe place.

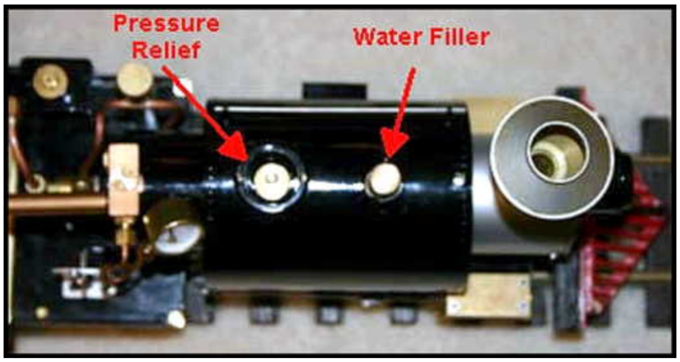
This is what may happen if you ignore my advice to remove the steam exhaust tube. It's fragile.

My excuse is that I didn't know any better! Yours ??

Fortunately the remaining threads screw into the fitting.

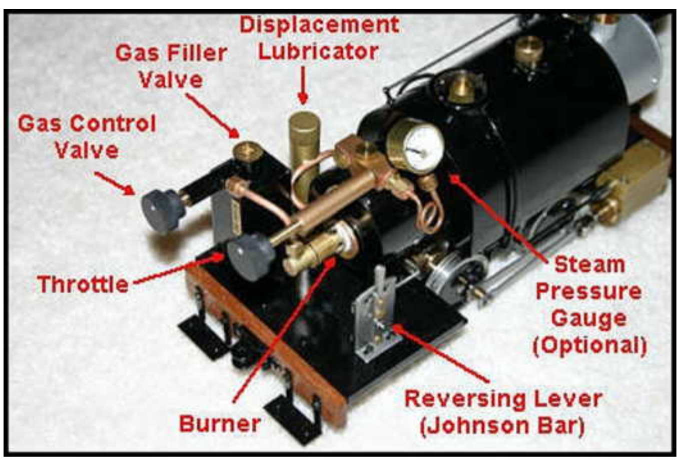


The steam dome rests on top of the engine. It can be removed easily by lifting it off the saddle tank.

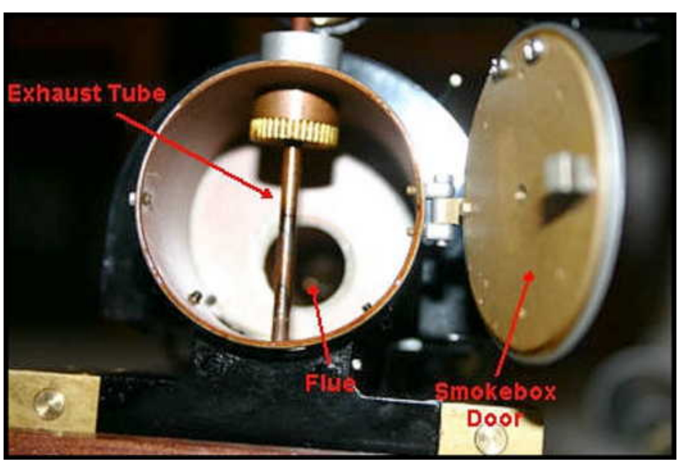


The sand dome can be removed by unscrewing it in a counterclockwise direction.

Once the sand and steam dome have been removed the steam pressure relief valve and the water filler plug are accessible.



The area under the cab contains the major operating controls providing lubrication, fuel, speed control, fuel combustion, direction control, and (optionally) steam pressure monitoring.



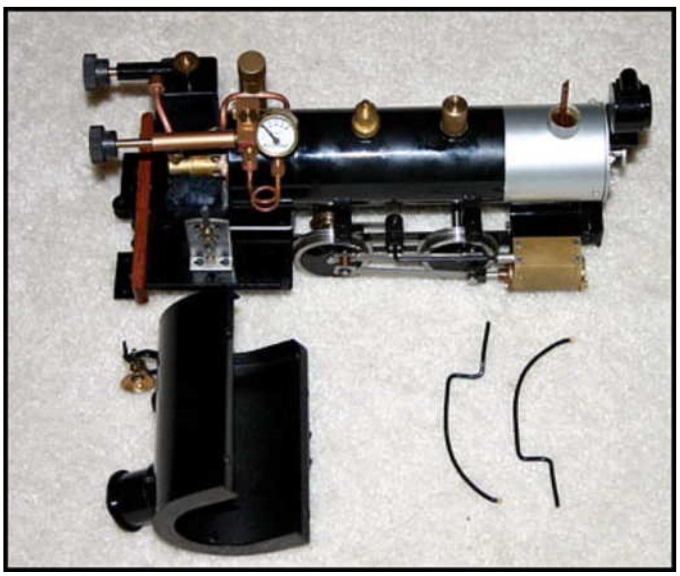
The smoke box door opens, rotating on a hinge on the right side of the smoke box as you face it. Opening the door reveals the exhaust tube and flue. Note that the exhaust tube won't be there if you removed it in an earlier step as instructed.

Removing the Saddle Tank:

In the Ida, water is carried in a saddle tank. On the Ruby, it is carried in side tanks. The disassembly procedure is the same for both engines.

There are four 3 mm hex head screws that secure the tank to the tank brackets coming up from behind the drivers. Remove these four screws, two on each side.

The sand lines pull straight out from the rear dome. They are held in place by two small brackets attached to the tank brackets. They can be popped out of the brackets.

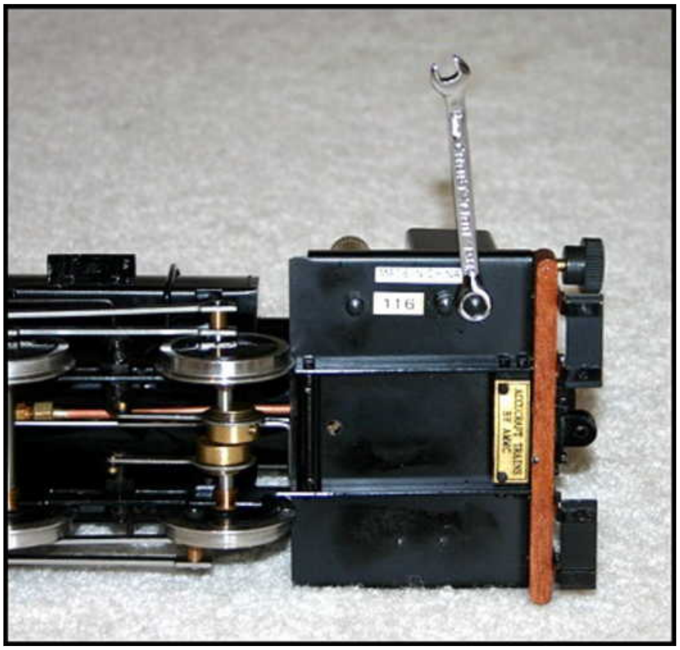


The saddle tank has been removed from the Ida. The two sand lines are shown on the right side of the photo.

Boiler fittings at the top of the boiler are identical between the Ruby and the Ida.

Removing the Fuel System:

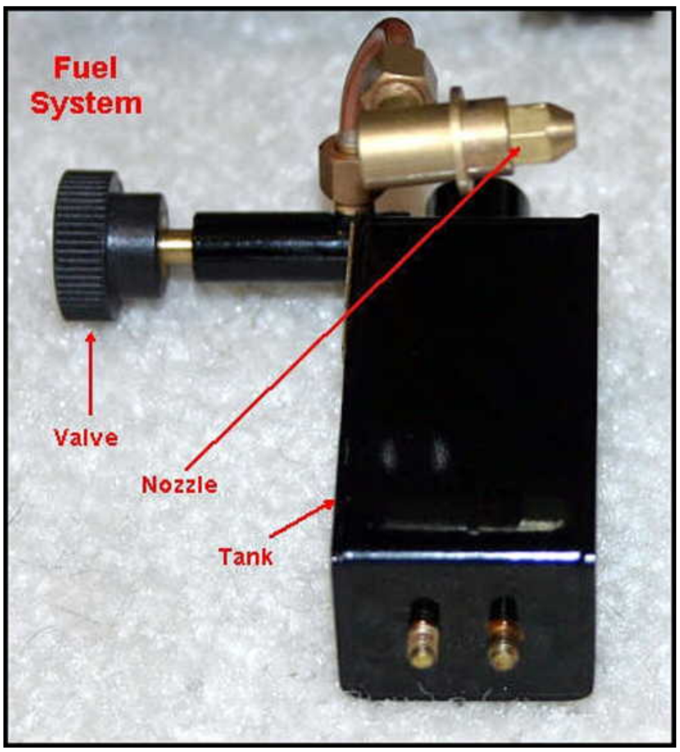
The fuel system can be removed from your Ruby by following these steps.



Removing two acorn nuts at the bottom of the cab allows the fuel system to be removed. A 5mm wrench is currently placed on the right acorn nut, the left is immediately to its left.

Once both acorn nuts have been removed you can set the chassis on its wheels.

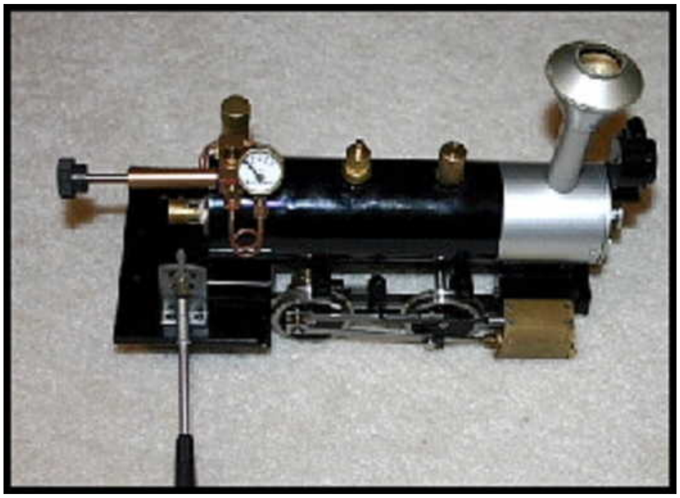
As you lift up the fuel tank, you can slide the nozzle out of the burner.



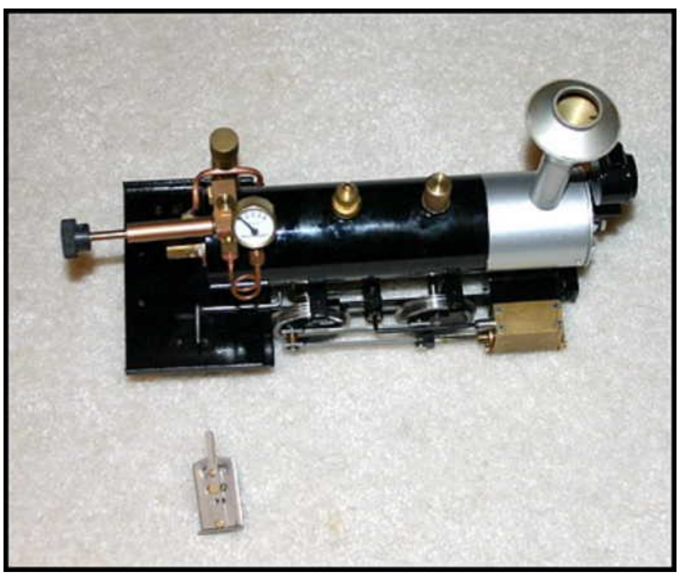
A complete Ruby fuel unit is shown to the left. A 7 mm wrench can be used on the two brass fittings on either end of the fuel line to disconnect the fuel line from the nozzle and the valve.

Removing the Johnson Bar:

The Johnson bar which controls direction on the Ruby and prototype is held to the cab floor by two 3 mm hex screws. In addition, you must remove the locking nut on the threaded portion of the steel shaft that runs to the front of the engine between the cylinders. Note that the threaded portion of this rod is screwed into the Johnson bar. Once the nut and two hex screws have been removed, the Johnson Bar assembly must be screwed off the rod by rotating it on a vertical plane.



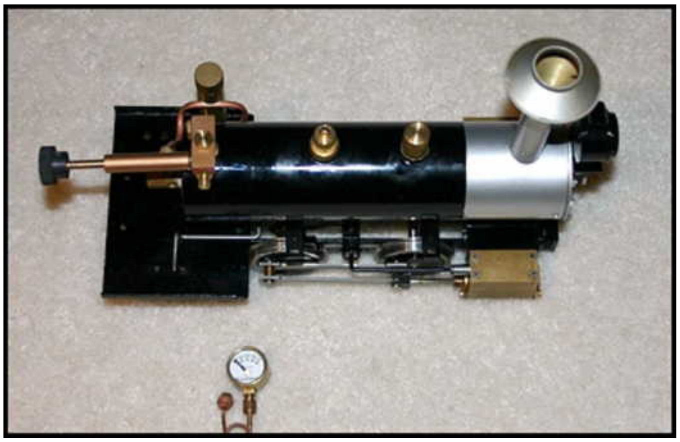
The hex wrench is being used to remove the retaining screw from the rod. The Johnson bar must be unscrewed from the rod to remove.



Johnson bar next to engine after being removed.

Removing the Optional Steam Pressure Gauge:

The optional steam pressure gauge can be removed from the turret by unscrewing the brass fitting from the steam turret using a 7 mm wrench.

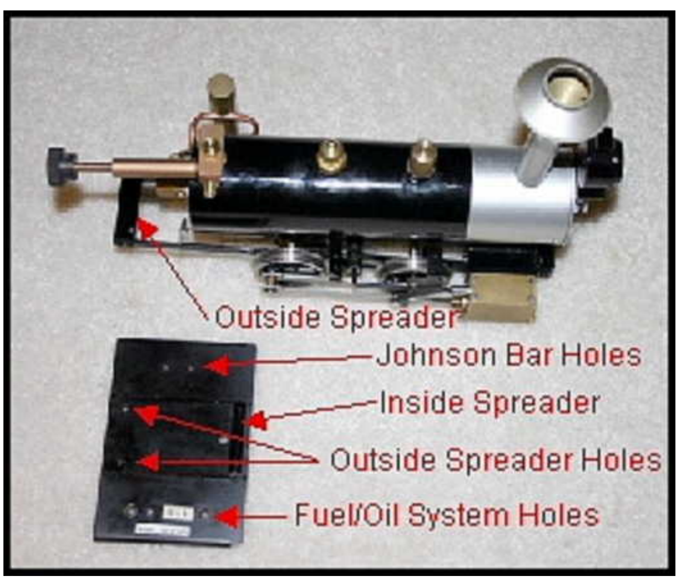


Steam gauge after removal. Note that if you plan to operate the engine after removal of the gauge, the hole in the turret will need to be capped.

Removing the Cab Deck:

Removal of the deck under the tender first requires removal of the Johnson Bar and Fuel System. See earlier instructions for details. The picture of the deck in the following photo shows it after removal and upside down as it would be seen with the engine laying on its back. Remove the deck by following these steps:

- Remove the 3 mm screws holding the inside frame spreader to the deck from the top of the deck.
- Remove the 3 mm screws holding the outside spreader to the deck from the top of the deck.
- Remove the screw holding the boiler to the deck if it is there. Mine was missing.
- Remove the 5 mm acorn nut holding the steam oil container to the deck.
- Gently lift the steam oil container away from the deck until the screw clears. By slightly twisting the deck you should be able to remove it from the frame as shown in the following picture.



Tender deck has been removed and is laying on its back side showing holes as they would appear with the engine turned upside down.

Click photo for a larger image.

Removing the Boiler:

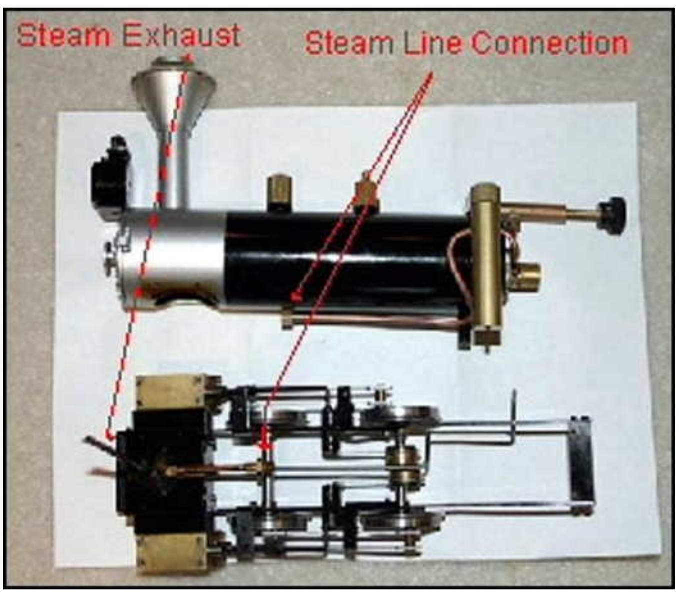
With the deck removed, the boiler is loose on the cab side of the engine. To remove it completely two steps are necessary.

Removing Boiler Support Screws

Remove the four 3 mm screws securing the front boiler support to the boiler.

You'll need the 3 mm hex socket wrench we fabricated earlier as part of the discussion about how of necessary tools.

Click photo for a larger image.

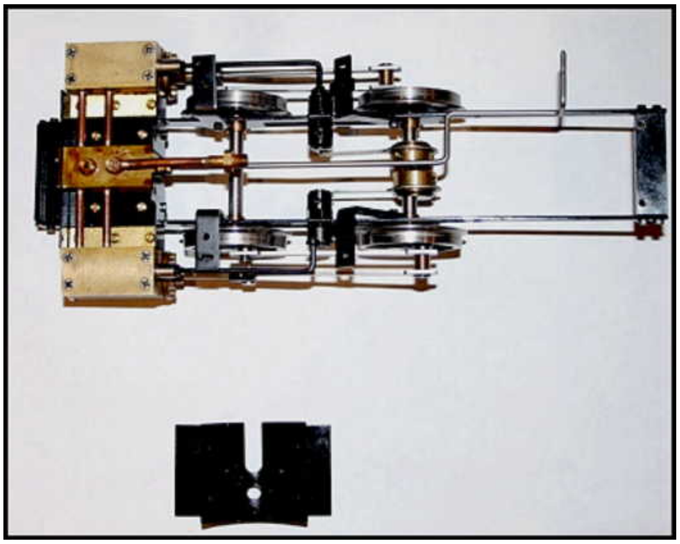


At this point, the boiler is only attached to the frame by the steam line from the cab area to the cylinders. Gently lift the boiler away from the frame so you can reach the steam line connection under the boiler. Use a 7mm wrench to unscrew the connection. The boiler will now come off the frame.

Caution: If you didn't remove the steam exhaust pipe when removing the stack, you are likely to find your exhaust pipe broken off at the base as I did.

Click photo for a larger image.

Removing the Smokebox Saddle:



Remove four 3mm screws (two front and two rear) to take off the smokebox saddle.

That's as far as we're going to take you with disassembly this chapter. As Chapter 3 will deal with modifications to the boiler and drive train, it makes more sense to publish instructions relating to further breakdown of drive train and boiler components in that chapter.

To reassembly your Ruby you can follow these instructions in reverse. In Chapter 3 we hope to incorporate instructions on how to build a Ruby from the kit.

Aside from the major components, there is quite a box of small parts in the parts box awaiting reassembly. Hopefully, I won't end up with any left over when reassembly is finished.

Now that we've disassembled the Ida, let's see what kinds of superstructure changes can be incorporated to begin to move it in the direction of the *'Olomana.'* We'll begin with some Vance Bass instructions on working with brass.

The Basics of Working with Brass

By Vance Bass

This is a primer on basic brass scratch building. It isn't a step-by-step tutorial, but rather a list of tools and techniques I have found essential to building in brass. If you did everything I tell you, you could probably make something useful in brass. If you practice and get to know the material, you could probably make something wonderful in brass. Get to work!

Note from the editor: This excellent piece on working with brass arrived one day from Vance attached to an e-mail. But the article was all text, with no photos. As Vance suggests, I got to work right away applying the instructions in this article in building the cab extension and bunker, and the two-wheel truck discussed later in this chapter.

I've added a number of photos from the two projects, illustrating Vance's techniques. But realize, this is my first real attempt to work in brass. So if some of the photos show less than perfect craftsmanship, it is because I'm a less than perfect craftsman. But they do illustrate how these techniques can be applied by a novice and result in a completed project. And the craftsmanship will get better as I progress through the Olomana bash.

To keep Vance's prose apart from my photos and comments, all of my notes are in italics and inside text boxes -- Tom Farin.

Tools (where I got mine and what they cost, if I remember):

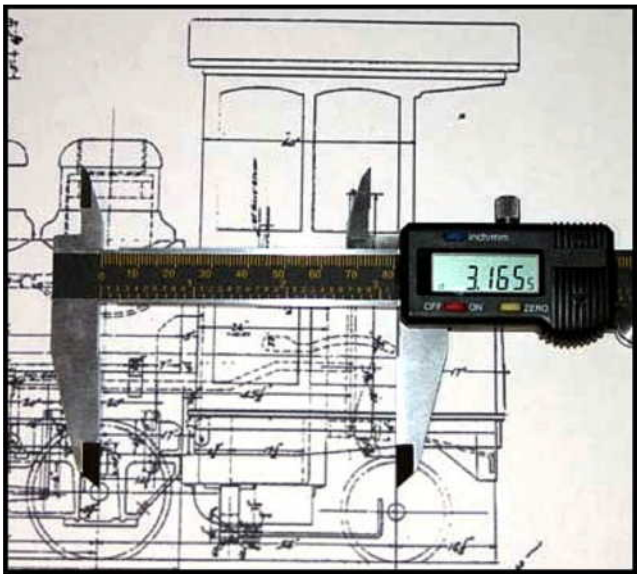
- Aircraft shears (left-, center- and right-cutting). (Sears hardware, < $10 apiece)
- Files (flat and round, 10" and Swiss). These MUST be new and sharp.
- Machinist's square (4" or 6"). Get both if you can.
- Propane torch. (Any hardware or plumbing store, $15 or so)
- Nibbler. (Radio Shack, $10)
- Dial caliper ($30, Harbor Freight) or digital caliper ($30, Harbor Freight). One advantage to the digital is that it will read inches or millimeters.
- Scriber. (Hardware store, <$10)
- Broad-tip marker (or laying-out dye).
- Several grades of sandpaper and a piece of plate glass.
- Bench vise (adding hardwood jaw pads is highly recommended).

Most of these tools are shown in action in the techniques section.

Techniques

Laying out:

Most of the "hard" work should be done on paper. Your measurements for curves, rivet placement, joints, etc. must be calculated correctly before you start cutting metal. I use a CAD program for drawings, so I always print out my parts full-size on paper or thin cardboard and then cut and tape them together to verify my drawings. (With some printers, you can print onto plastic and make mock-ups from Evergreen sheets, too.)



This series of shots shows the steps in building the T brace for a rear two-wheeled truck. This project is discussed in start to finish steps in Landon Solomon's article later in the chapter.

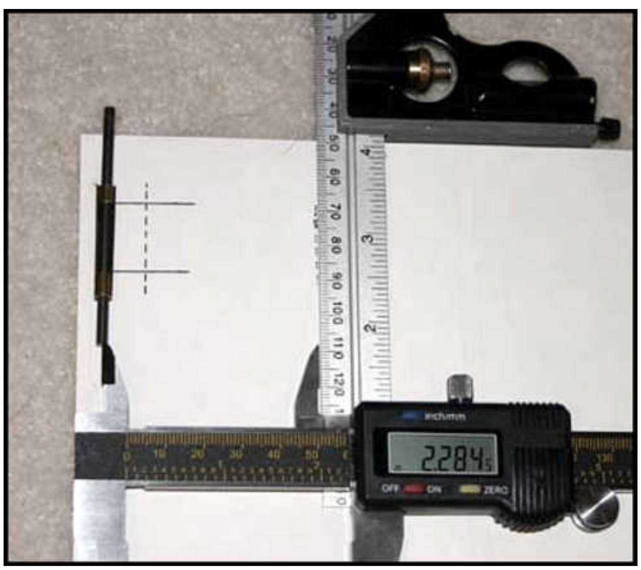
A digital caliper is being used to take off the wheelbase from rear driver to rear truck wheel from the 1:17 drawing of the *'Pokka'* (*'Olomana's'* sister engine).

Wheelbase = 3.165"

The mounting point for the truck will be the holes already drilled in the front frame spreader to accept the Accucraft rear truck. The spreader ships with all Rubys but the truck ships only with the Mimi. We'll be fabricating our own improved truck.

Distance from rear driver axle to rear spreader must be deducted from wheelbase.

3.165"-0.881" =2.284"



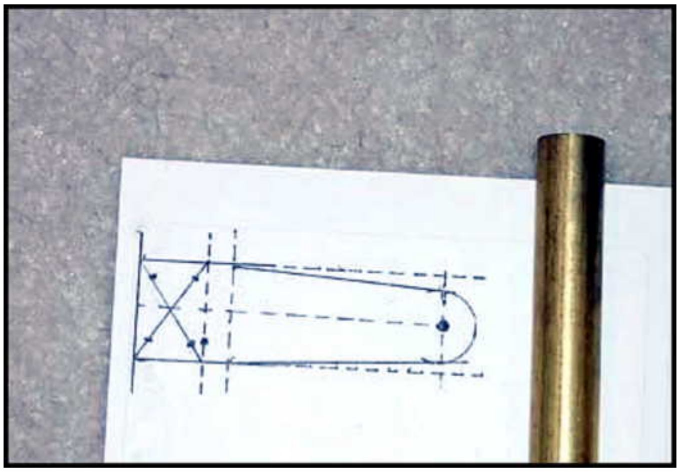
Distance from center point of the axle to mounting hole is measured and marked (right dotted line).

The left dotted line represents the width of the brass strip forming the top of the 'T' of the truck 'T' bracket.

Missing Image

http://mylargescale.com/articles/articles/SteamClass/Ch2_Images/HolePlacement.jpg

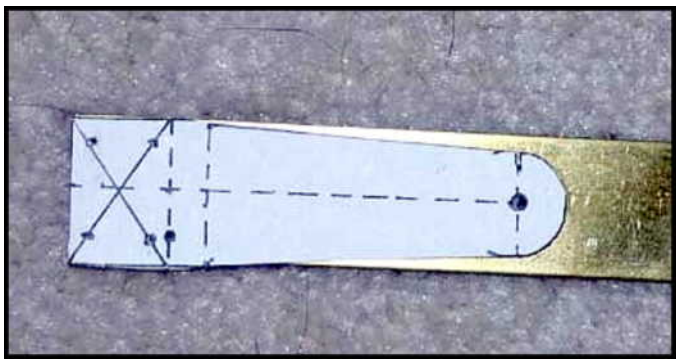
An 'X' has been drawn connecting the opposite corners of the area where the base and top of the 'T' will overlap. A caliper is then used to mark the placement of the four screw holes for the screws that will hold the pieces together.



A 0.5" inside diameter K&S tube is used to mark the circumference of the circle forming the attachment point of the 'T' brace to the spreader.

To mark the taper, lines were drawn tangent to the circle and ending at a line 0.2" from where the top of the T crosses over.

Once you are satisfied with the drawings, lay them out on the metal. I print another copy of the CAD drawing and then lightly glue it to the metal with 3M Super-77 spray adhesive. Then I just cut along the lines, punch the rivets where indicated, etc.



The template has been stuck to the brass strip. Avery label paper was used in this case as I had the labels and didn't have spray adhesive.

A brass spring-loaded punch was used to dent the brass at the five points where holes will be drilled.

If you aren't using CAD or a hand drawn paper template, cover the metal with laying-out fluid, or use the marker to put a line of color down in the area you will be cutting. Then use the caliper and scriber to lightly scratch lines through the dye.

Cutting:

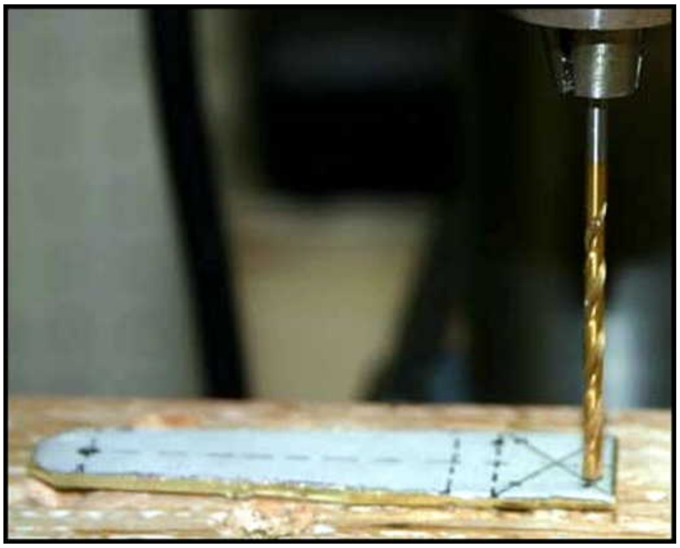
Once you have all the lines laid out, cut out using the shears or a hack saw with a sharp 32 teeth per inch blade. Some shears have finely serrated edges, which leaves a bit of texture on the cut.

The hacksaw has been used to cut the brass piece off the brass strip. It is about to be used to cut along the taper lines.

For inside shapes (cab windows, for example), drill a hole and use the nibbler. The nibbler is also useful for defining the edges of outside curves. Clean up the edges with a file.

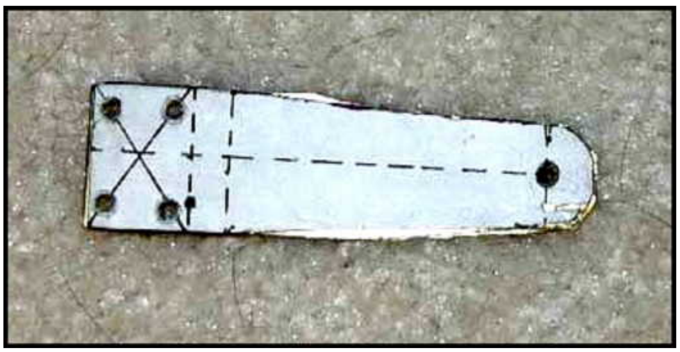
The nibbler was used to bite off small straight pieces along tangent to the radius of the curve, reducing the amount of material that needed to be removed with the file.

When drilling holes in sheet metal, you must use a special type of bit, or the bit will grab the metal and either rip it or spin it at high speed, which is likely to rip you. Always clamp metal down to the bench or drill press table! Since common twist drills will cut a triangular hole, use a brad-point drill bit for thin sheets, or a "Unibit" step drill.



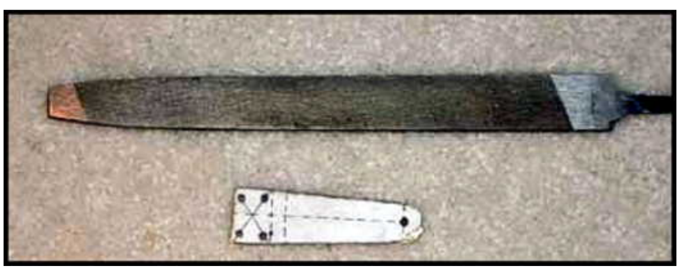
The drill press is about to drill the four holes for mounting the base strip to the top strip of the 'T'. It will also be used to drill an initial hole for the point of attachment to the frame.

Clamp holding down the brass piece not shown for clarity.



All 5 holes are drilled.

Finish the cut smooth with files, or by drawing the metal across fine or extra fine sandpaper on top of the plate glass. (Obviously, this is for straight lines only.) The only way to file brass is with a new file, unlike steel which will respond to duller files. Files are not life-long investments -- they wear out and must be replaced when they dull, like drill bits. If the file doesn't cut through brass quickly and easily, buy a new one and use the old one on steel until it's totally dull, then throw it away.



File has been used to smooth out the edges and convert the tangent nibbler lines into a curve.

The template paper has been removed and the leg of the 'T' polished with fine steel wool.

Forming:

Once your parts are cut out, you must shape them, usually by bending angles in them or forming to a curve. Here are the basic techniques.

Annealing:

Brass can be bent without annealing, but it work-hardens (gets harder and more brittle) as it is bent, rolled or hammered. To soften it some, heat it with a torch until it changes to a dark brown color. To make it dead soft, heat it to red-hot. Dead soft brass may not harden enough during forming, though, so experiment with scrap pieces of the same thickness until you determine how much heat you want for the piece you're making. Only heat the area you need to form (as much as possible) to preserve the strength of the piece.

Angles:

The optimal tool for angles is a brake. You can buy small (12") bench top brakes from places like Harbor Freight, House of Tools or Busy Bee for under $40. If you don't have the room or money for a brake, you'll need a bench vise and some hardwood blocks. I use oak blocks which are 1" x .25" x 6", held together by wrapping rubber bands around the ends. If you have installed hardwood jaw pads in your vise, you may be able to use them instead.

Slide the brass between the blocks so the bend line is just visible at the top of the block. Make sure the blocks are aligned exactly at the marked line. Use the machinist's square to make sure the metal is square to the blocks, and adjust as necessary. Clamp the blocks and metal into your bench vise. Now, take a third, larger block of hardwood (mine is 1" x 2" x 6" oak) and use it as a bending tool. Place it on the clamping block, next to the brass, so the bottom edge is right against the scribed line. Pivot the bending block and the metal at the scribed line until the angle looks right. If the corner isn't sharp enough, you can put the bending block on the bend and lightly hammer it down on the metal (or anneal the piece more before bending). Go slowly -- it's easier to give it more bend than to unbend it.

This U bracket for mounting the rear truck was formed using the techniques discussed by Vance in this section.

Curves:

Again, there's a tool purpose-made for the job: the slip roll. The cheapest slip rolls are still quite expensive new, so if you don't have the room or money, and can't find a used one, there are still hand-forming techniques which work quite well. Approach this, as an art rather than a science and all will come out in the end. Form and check, form and check (see the anecdote below). Enjoy the feel of the metal yielding to your touch. If the bend is too sharp or too loose, or in the wrong place, anneal and adjust it until it fits, or straighten it and go at it again. You don't have to turn out a thousand of these, so take the time to get it right, while putting in the attention and love a handcrafted piece deserves.

To form curves in sheet metal, use a piece of steel pipe or hardwood dowel somewhat smaller than the diameter of the curve you will form. As the brass work-hardens, it will want to spring back to flat, so you must use a form which will compensate for that springiness. There are two techniques I have used for this operation. You can clamp the former and the metal into the vise (good for 90-degree curves), or clamp the pipe in the vise with a foot or so sticking out (works for all curves, and required if the angle is more than 90 degrees). Anneal the area to be formed. Again, use the square to align the metal square to the pipe, then wrap the metal around the pipe using the palms of your hands. You may need to re-anneal a time or two. Check squareness often, as you check the diameter of the curve.

The pipe-former technique works well for small-radius curves. For larger curves (e.g. boiler jackets, cab roofs, etc.) just find a curved former of a suitable diameter. PVC plumbing pipe comes in many diameters and is readily available. Tin cans may also give you the right curvature (they don't have to be empty) and they come in many different sizes (from tomato sauce to beans-for-an-army).

More complex curves are much more difficult, but aren't usually needed. Conical sections for boiler jackets or spark arrestors can be formed by hand over a pipe with some ingenuity. Careful fitting and adjustment will make up for lack of specialized equipment. Hemispheres or domes must be spun on a lathe, hammered onto a form, or stretched using an English wheel. These are jewelry making or custom automobile techniques -- they're learnable, but probably require more equipment and experience than most of us will acquire.

Oops:

Sometimes, you will totally foul up the piece by bending the wrong direction (some pieces are left-handed or right-handed), bending on a line, which is not square, etc. This does not mean the piece is lost. Before junking it, try annealing it really soft, then flattening it by bending, hammering under hardwood, squeezing in the vise, etc. Brass is remarkably forgiving in this way. Once the mistake is flattened, start over and do it right this time.

If you're nervous about all this, let me tell you about the time I was building a 1:24 scale tender from an expensive etched brass kit. The shell was formed from two halves, etched with rivet details, etc. on a 1/32" sheet. The first thing I had to do was bend the rear corners to a 1/4" radius. I annealed the halves and carefully bent them to the correct radius over a hardwood dowel. It was scary, but the corners came out exactly alike. Unfortunately, they should have come out as exact mirror images of each other! What was I going to do? I annealed the erroneously bent piece until it was dead soft, then straightened it out as well as I could. I annealed some more, pressed and hammered some more, and repeated this until the sheet was flat and hard again. Then, I started over and did the corner correctly. You can't tell what happened, and even I can't remember now which corner was bent twice. Moral: brass is pretty forgiving and easy to work, so if you make mistakes they're not necessarily cause to junk a piece and start again.

Joining:

The best joint is a mechanical one. Where possible, use screws, tabs and slots, reinforcing plates, etc. Then, solder the joints. If you can remove the mechanical connectors afterwards, fine. If they're soldered in and visible, you may be able to file them down to match the surface of the piece. The mechanical joint is the source of the strength. The solder just sticks it all together.

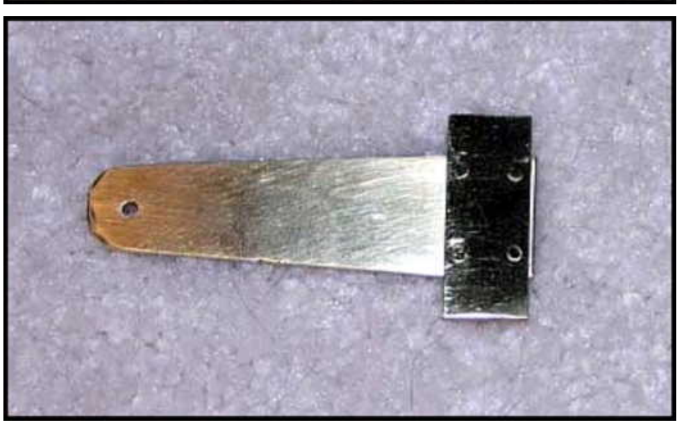
One of the advantages of using thicker brass strip (1/16" in this example) is that it is thick enough to tap for screws. It is also stronger.

The disadvantage of thicker strip is that it is more difficult and time consuming to cut, nibble, and file.

In this photo, a 2-56 thread is being tapped in the top portion of the 'T'. One screw is already in place and is being used to hold the pieces in alignment.

Why 2-56 screws on an engine with metric screws? The screws are cheap in large quantities from **Micro Fasteners**. And if you break a tap, you are more likely to find a 2-56 tap than a metric tap at the hardware store.

Top side of finished 'T'. Four hex head screws hold it securely together.



On the bottom side, the screws were cut nearly flush with a razor saw. Then a file was used to file them flush, leaving a totally flat surface for mounting the U channel and bearings that carry the axle.

Soldering of brass can be done with a propane torch, electric soldering iron, or resistance solderer. If you want to use a soldering iron, go to a plumbing or stained glass supply and get a BIG one -- 1000 watts or so. Copper-based metals radiate heat like you won't believe, so a 25w electronic soldering gun is virtually useless for modeling. The keys to good soldered joints are:

- Clean joints. (file, sandpaper, steel, wool)
- Apply flux to the joint.
- Clean joints.
- Make a strong mechanical connection. (see above)
- Apply heat to both surfaces to be joined.
- Clean, strong mechanical connection.
- Heat the metal only, and let the hot metal melt the solder.
- Clean, strong, fluxed connection.
- Apply the heat where you want to solder to flow to, not where it is puddling up.

Did I mention the importance of clean, strong, well-fluxed joints?

Rivet-punching:

If you're doing something like a tender body or a steel cab, you'll probably want to simulate rivet heads. This can be done a couple of ways. You can drill holes and solder in escutcheon pins with heads the size of your rivets, or you can form the metal to have bumps the size of your rivets. To make a rivet-head former, you'll need a drill press or lathe, a piece of flat steel and some brass or steel rod (1/8-1/4").

First, determine the size of the rivet head. Let's assume you'll want a 1/16" head (.0625"). This is a little oversized for 1:20.3, but it's easy to work with and the results look fairly convincing. Drill a hole of this size in the steel plate to make a female die. The hole can go all the way through the plate. It must be deeper than the distance the rivets will stick up, because if the metal is pressed against the bottom of the hole, it will be formed into the shape of the end of a drill bit, which is not what most rivets look like. If you want to speed up the punching, drill three holes exactly on a line, spaced the same distance as your rivets. (It's important to get these distances exactly the same.)

Measure the thickness of the metal you'll be punching (for example, .015") and subtract twice that number from the rivet head diameter. In our example, .0625" - (2 x .015") = .0325". Now, chuck your brass rod into the lathe and face off the end, leaving a little cylinder in the middle, which is .0325" diameter and .0325" high. With the piece still rotating in the lathe, carefully touch a flat Swiss file to the corner of the protruding cylinder, shaping it as close to hemispherical as you can. This shape will determine the final shape of the rivet head. You can do this on a drill press, but obviously it's going to be easier on a lathe.

To use the punch, chuck the punch into your drill press, lower the punch into the middle hole in the die plate, and then clamp the die plate down on the table. You can also clamp a piece of strip stock or wood to act as a guide fence. Position the marked-out metal so the first rivet is under the punch, then gently lower the punch and squeeze the metal into shape. Lower the punch until the flat surface of the rod presses against the metal, then release. If you push the punch down too strongly, you'll punch a hole in the brass, rather than just forming it. Move the rivet you just formed into one of the adjacent holes, and your next rivet is lined up under the punch at the correct distance.

You could use a 1/32" (.03125") rod as the punch, but the flat surface of the 1/4" rod with a bump in the middle makes a sharper edge, which looks just like a rivet head on flat sheet metal, while the 1/32" rod will make the edges smooth and undefined.

Painting:

As with soldering, surface preparation is the key. Clean and roughen the surface ("give it tooth") with fine steel wool. Then wash with dishwashing liquid or grease-remover. Wear rubber gloves during this operation to keep skin oil from getting on the metal. Some people heat the metal slightly in the kitchen oven (lowest setting, door open) or with a hair dryer or heat gun. You can also soak your spray bomb in hot water for a few minutes to get a finer and more controllable spray. Air-brushes give a very fine finish, of course, though some people find painting a large-scale model with an airbrush too time-consuming. Spray a primer coat and let it harden for a day or so, then repeat with the final color.

Coloring:

For steam locomotive boiler jackets, nothing can compare to blackened brass, which looks very much like *"Russia Iron"*, a specially planished, highly reflective and rust-resistant material that was widely used in the late 19th and early 20th centuries. For our models, the thinnest brass is usually quite suitable, since we're wrapping it around something else, and is easier to work with than thicker material (no annealing necessary, for instance). Here, too, the key to getting a good finish is extra-careful cleaning and handling before coloring. There are a number of different chemicals that will color brass, but the stuff sold by gun shops (Brownell's Brass Black) is easy to find, easy to use and gives good results.

Practice:

Start off building something small, but which gives you a chance to practice most of these techniques. My learning piece was the tender I mentioned, and that's what Stephen Anderson recommends, too, in his Model Railroader series on scratch-building from a few years back. There's a tender plan for the Ruby on my web page -- even if you don't have a Ruby, go get the plan and build one. (Give it to a friend with a Ruby, or get a Ruby to go with your new tender. :-)

The Full Monty:

If you really want to build steam locomotives, you're going to have to invest in some bigger tools than the average home wood shop will have. If you don't have a drill press, get one (even if you're not going to be making cylinders and boilers). You'll need a lathe (Sherline or Taig will work for most applications). You'll need a milling vise for your lathe (pretty limited, but inexpensive) or a milling machine. I've already mentioned a bench vise (which presumes a bench), brake and slip-roll. A resistance solderer makes this kind of building much, much easier. You can buy one for about $150-300, or you can make one for substantially less if you're handy with electricity.

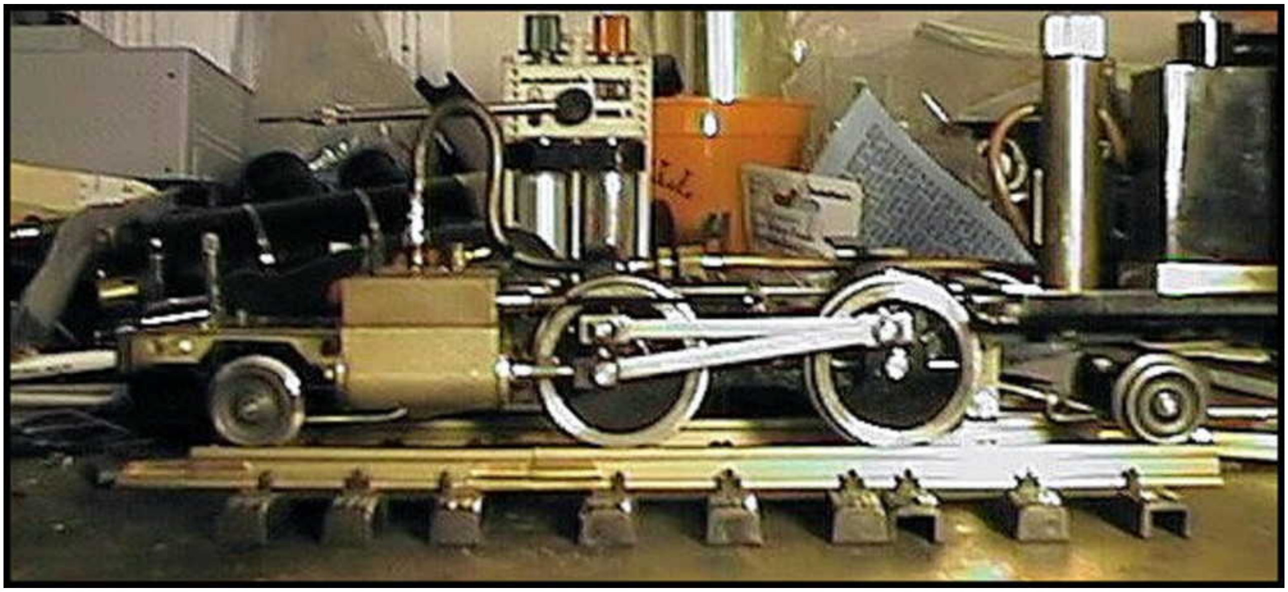
Materials:

I use garden-variety K&S brass strips, rods and angles a lot, or course. For larger projects, though, it gets to be a bit too pricey. When I'm making a tender or saddle tank, for example, I build a framework of wood or brass, and wrap it with thin shim brass. The great thing about this technique is that it's simple and the thin metal acts more like the prototype, which is to say that it doesn't always lay exactly flat. It exhibits a property calls "oil-canning", meaning that it doesn't lie completely flat. Your models will look more realistic using this technique.

This is not only easier to do than forming a hunk of 1/32" slab into a tight "U", but it's cheaper as well. I can buy an 8-foot by 6-inch roll of .005" shim stock for what a couple of 4" x 8" sheets of thick stuff would cost. That makes a lot of models. You can also buy the same stuff up to .020" thickness, which is as thick as you'd ever want to use for bodywork in our scale. I order mine online from **Grainger** and it's here in a couple of days.

Building Prototypically Working Trucks

By Landon Solomon



Editor's note: *When Landon sent me this article; he indicated that some of his photos weren't of high quality. In reviewing the photos, I also noted that there weren't as many intermediate step photos as we needed. A two-wheel rear truck was needed for the Olomana so the truck was fabricated following Landon's instructions. Photos were taken of intermediary steps and added to the article. A number of modifications to Landon's original design were incorporated along the way.*

So as to keep Landon's comments and instructions separate from my photos and descriptions, my comments are all in italics - Tom Farin

Shortly after receiving my Accucraft Ruby I came to a conclusion. She looked too much like all the other Rubys I'd seen... mainly because she was exactly like most all of the other Ruby's I'd seen. This was something that needed to change. After running her for a bit I found that I didn't want a switcher (Gasp! Shock!) The loco was purchased for its price and availability after all, not for its looks. So the decision came to re-work the loco for mainline use and freelance a Columbia 2-4-2 style passenger engine out of her. The mainline idea has gone by the wayside, but the Columbia part is now a reality!

Trucks are important to a Columbia type. It just isn't a Columbia type without them! So my Ruby's truck was made up from 3/4" brass strip that was bolted together to form a *' T '*, and suspended from a *' U '* bracket that bolts to the bottom of the Ruby frame. This is the truck I'm going to describe how to build in this article. The truck could be used as either a front or rear truck on the Ruby. Or, you could adapt it to any locomotive for which you want to add a fully equalized front or rear truck.

In my initial experiments with building this truck, it didn't track very well. On a real locomotive the lead truck is there to do just that. It leads the engine into curves placing steering pressure on the frame (and in some cases, directly on the drivers) of the locomotive. In this way the engine won't be upset by curves at high speeds. Instead, it gets a gentle push in the right direction before the drivers flanges hit the rail which would cause the main body to react violently. Curves can be safely taken at higher speeds without derailing or toppling the engine because the entrance to the curve is gentle and drawn out instead of sudden and hard.

After my first failed attempt I decided that centering springs were the way to go. Out came the stuff-box. Re-working the truck mount made for a workable platform to mount springs while making the whole works easier to assemble and disassemble. Next came a trip to the local hobby store for some music wire. The stuff makes great spring material if you can keep it from rusting. I have found Steam oil to be a great rust inhibitor and it is essentially free when you count how much dribbles out of the smokebox during a run.

> ***Editor's note:*** *In building my truck I substituted stainless steel spring wire available from* ***Sulphur Springs*** *for the music wire. It is inexpensive (about $2.50 for 10 feet) and solves the rust problem.*

Now, a word about springs. There are two basic types of springs used on most locomotives, these are flat springs and coil springs. Cars have a third type but I'm not going to fret with torsion springs here as they would be difficult to implement in our situation. I have decided to use coiled wire springs in my loco. They are easy to fabricate and it is reasonably easy to predict, or design their behavior. The way I use my springs allows them to act in two axes. They control both the amount of swivel the truck can undertake and the amount of down-force on the truck. A small coil is bent into the wire near its mounting point; I've been using three full turns to make the coil. The wire is then allowed to continue straight toward its point on contact on the truck. This length of wire acts as a lever arm reducing the amount of force the coil can place on the truck, making the spring's rate more controllable. It also allows us to make use of the spring in two dimensions by allowing it to act as a tension spring and as something of a torsion spring. Flat springs could do either one or the other of these functions but, as in the prototype, we'd need to use two pairs of flat springs per truck to get all the flexibility of what we have here. Now, back to our regularly scheduled article.

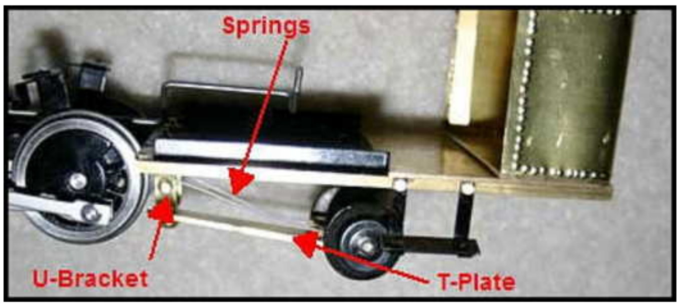
Parts Requirements:

> ***Editor's note:*** *This is a great parts box project. If you've been accumulating brass structural items, you may already have much of the material needed for this project. That was true in Landon's case and also in mine. The only new parts I purchased were the Lionel freight car wheels and the stainless steel spring wire. So feel free to substitute in these specifications. If you don't have a brass parts box, these are the items you should look for. Specifications are for the components I used in building my rear truck.*

- Brass stock
  - K&S brass strip - 3/4" wide, 1/16 " thick cut to an appropriate length given takeoffs from your photo or drawing.
  - K&S brass strip - 1/2" wide, 1/16" thick cut to 1.5" length.
  - K&S brass strip - 1/4" wide, .015" thick cut to 2" length.
  - (2) K&S 1/4" long brass tube in diameter that allows you axle to turn easily without being sloppy.
  - 1.5" of K&S U channel that holds the tube in alignment.
  - (1) - K&S 3/16 brass tube cut to .1"
  - (2) - K&S brass 3/16" x 7/64" rectangular tube cut to 3/8" length.
  - (1) - K&S 1/4" x 1/16" brass bar stock - you'll need about 3".
- Wheels
  - 1 pair Lionel freight car truck wheels, or a suitable alternative. Be careful not to get wheels that are too large in diameter to fit under the rear or front deck. For example, Bachmann Big Hauler pilot wheels are a tad too large to use without cab area frame and deck modifications.
- Axles
  - 1/8" steel axle - cut to 2 1/4" length.

- Music Wire
  - **Sulphur Springs** .031" spring wire - You can substitute K&S music wire but it won't be rust resistant.
- Machine Screws, Washers & Nuts
  - (8) 2-56 1/2" hex head brass machine screws - Purchased from **Micro Fasteners**, Note that you can purchase these screws at the local hobby shop but you save a significant amount ordering in quantities of 50 or 100 from Micro Fasteners. I use this size in many projects, cutting length to what I need for the project.
  - (1) - #2-56 tap - purchased at local hardware store.
  - (2) - #2 brass washers - Purchased from Micro Fasteners.
  - (1) - #6-32 brass machine screw - From local hardware store.
  - (1) - #6-32 tap - From local hardware store.
  - (1) - Bronze lock washer to fit #6-32 screw - From local hardware store.

Rear Truck Construction:

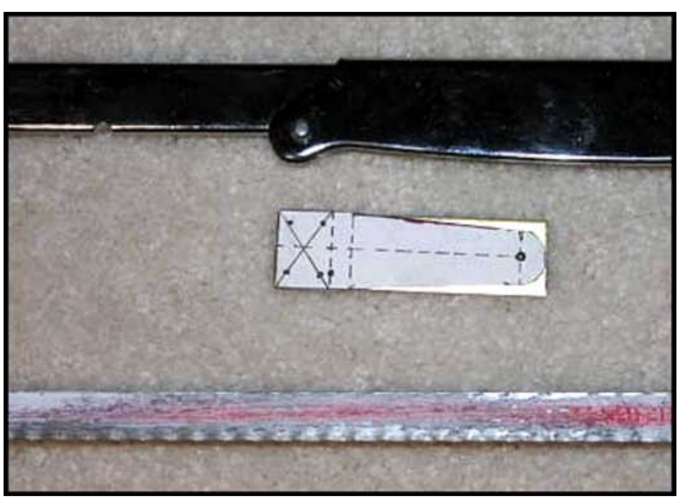


The completed truck is made up of a T plate holding the truck wheels and axel screwed to a U bracket suspended from the inward back frame separator. Springs provide lateral and vertical stabilization.

The following sections will take you through construction of the rear truck.

T-Plate:

You need to first calculate the length of the T plate from takeoffs from your photo or drawing. The **steps to do takeoffs** for this truck were discussed earlier in the Vance Bass article. They will not be repeated here. It is a good idea to use takeoffs to create a paper or cardboard template for the leg of the T-Bracket. The steps of creating the template and applying it to the 3/4" brass are also covered in the Vance Bass article.



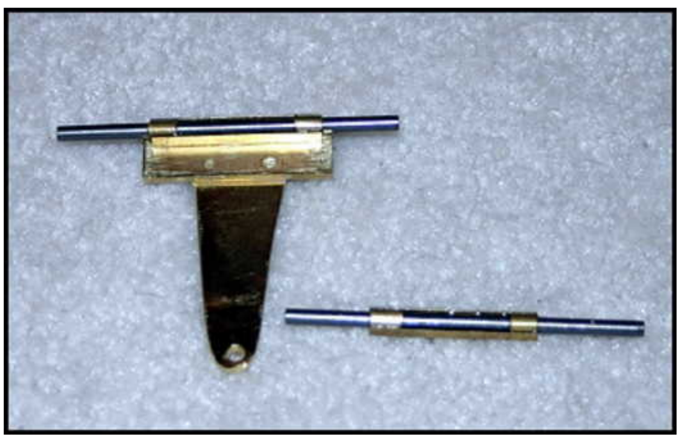
3/4" brass piece cut to length with template laid on top showing further shaping and drilling to be performed. Length of the T leg is based on takeoffs from a drawing of the prototype.

Once the leg of the T is complete, cut the 1/2" wide K&S strip to a length of 1.5".

The shape of the 3/4" T leg was formed with a hacksaw and a file. The 1/2" wide piece forms the top of the T-Plate. The two parts are joined with four 2-56 brass hex head machine screws. Threads were tapped in the 1/2" wide piece. Once screws were tightened, screws were filed flat. This provides a completely flat surface to use in mounting the wheel bearings.

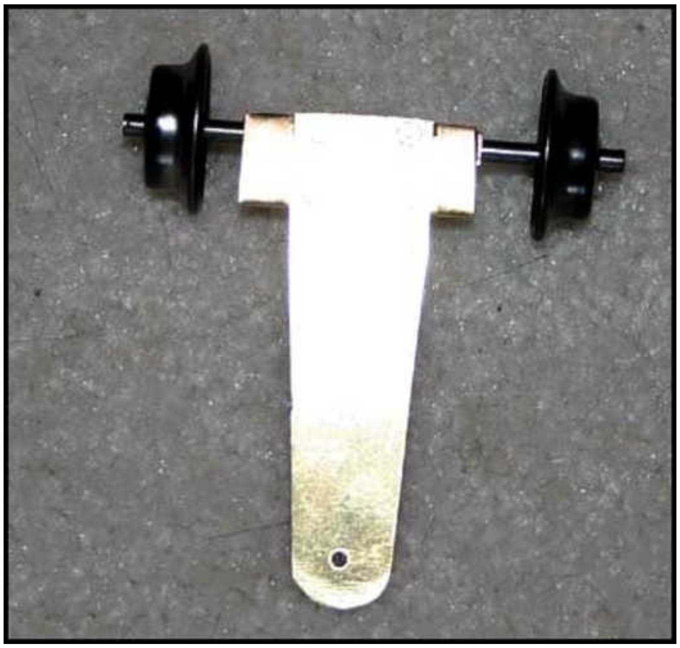
Wheel Bearings:

The wheel bearings will be formed from brass U Channel and a brass tube. The axel, which is 1/8" in diameter, came from a Hartland Value Line Gondola kit. Depending on the diameter of your axel, you'll need to select a K&S tube diameter that allow the axle to turn freely without too much play. The U channel should be chosen so the K&S tube fits snugly in the U channel.



Slices of brass tube are soldered inside the channel at opposite ends, each tangent to the bottom and two sides of the U channel. The wide portion of the U channel is soldered to the top of the T. The axle floats inside the tube. The opening in the channel between the bearings allows space to add machine oil to the axle assembly.

The bearing has been soldered in place on the top of the 'T' using a small hand torch and silver solder.



Holes in the pilot wheels were drilled out to the diameter of the axle.

This shot shows the finished truck with the axel and wheels temporarily in place set to be gauged.

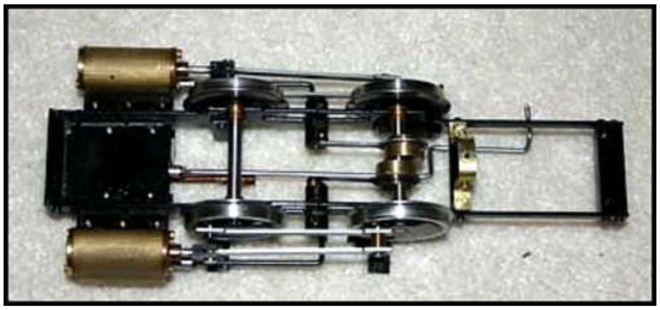
Wheels and Axel:

The wheels are a set of large Lionel 0-scale freight car wheels. The flanges were ground down by a Dremel cutting wheel while spinning the axle in a power drill. This allowed me to keep the wheels concentric while taking off a lot of material in a short time. The treads were shined up by scraping them with a mini bastard file while in the drill. The axle is a piece of 3mm steel axle from the hobby store which gives a clearance fit in the wheel. They are held on with a drop of thin CA, which seems to work quite well but is still adjustable using the old twist and pull/push method.

U-Bracket Mounts:

The rear end required a bit of work to get the way I wanted. In order to decrease pressure on the drivers in the curves I long ago installed a long drawbar connection for my tender. The drawbar attaches approximately 1 inch behind the boiler's cab-floor screw. The draw pin is a 4-40 socket-head bolt which is hard-mounted to the cab floor with a nut. The drawbar hangs a good deal below the frames to clear everything (that mod also required replacement of the rear buffer beam with a thinner one). In this design, a U Bracket is used to lower the swivel point of the T plate so as to clear the drawbar. The U bracket is screwed to the forward frame spreader under the cab. This was drilled and tapped to accept two 2-56 bolts. This tightens down nicely and is easy to removed if need be.

The U Bracket is formed from 1/16" by 1/4" brass bar stock. Holes are tapped in the sides for 2-56 brass screws to hold the springs. Holes are also tapped in the two legs and in the top of the U bracket.

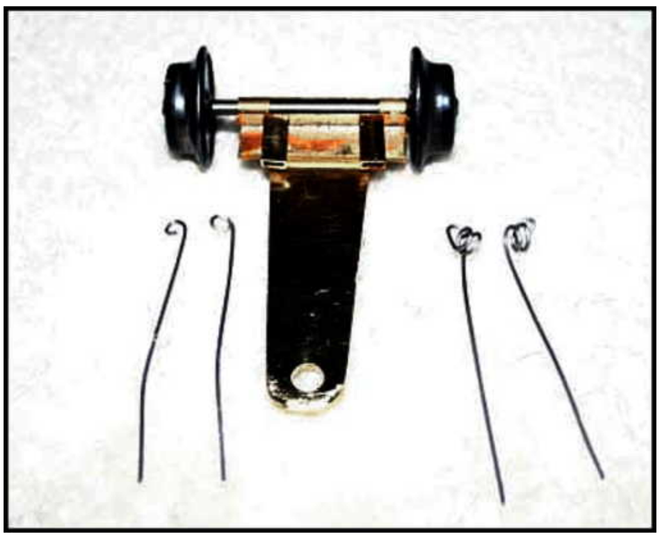


The U bracket has been screwed to the inside frame separator into holes tapped for 2-56 screws.

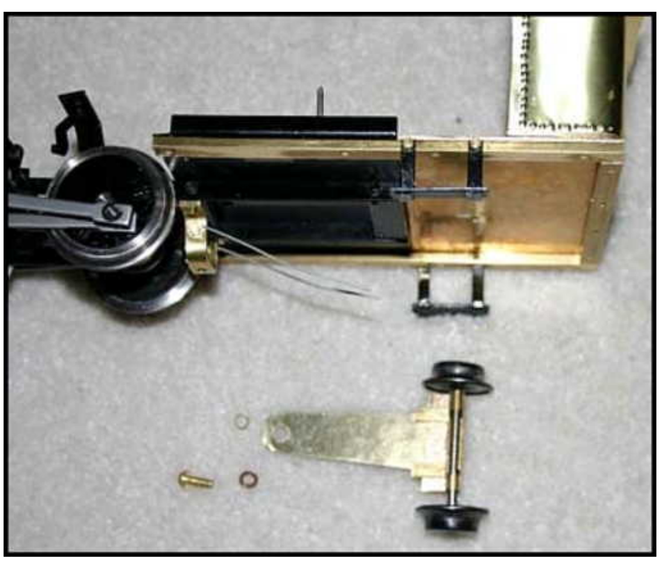
Springs:

The springs themselves were fashioned from a two pieces of music wires. Each wire has coil that increases their flexibility in both the vertical and horizontal axes. The wires push down and lightly out on the truck while it is centered. The springs apply centering pressure when the trucks are not centered in a curve and pushes the loco into the turn just like a real truck would. The spring provides a progressive action causing more down-force the farther above, below, or laterally outside the center the truck goes.

The whole spring mount can be removed by removing just the two 2-56 mounting bolts. The T-Bar can be removed by removing the 6-32 screw used to mount it to the U mounting bracket.

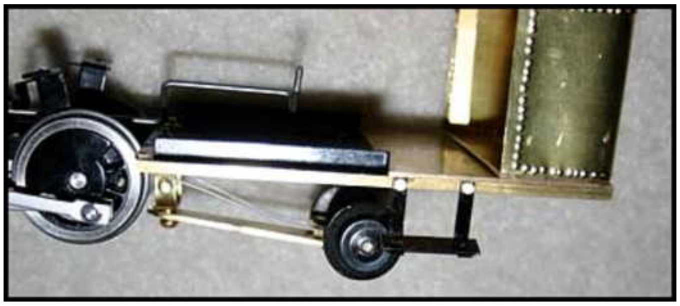


I substituted stainless steel spring material for the music wire. I also formed two separate springs, each mounted to the U bracket using 2-56 screws into tapped holes in the U bracket. Springs were formed with and without loops. The final springs used will be determined after testing. Two rectangular tubes to receive the spring ends are soldered to the top of the truck.



In this photo springs are mounted to the U bracket. A 0.1" piece of brass 3/16" tube acts as the bearing between the U bracket and the truck and prevents the truck from being pinched when the screw is tightened. The hole drilled in the truck is slightly oversized, allowing the truck to tilt vertically to deal with grades. The screw is a 6-32 brass screw with lock washer.

Mounting to Ruby Chassis:



This shot shows the rear truck installed. Ends of spring wire are slid into the rectangular tubes.

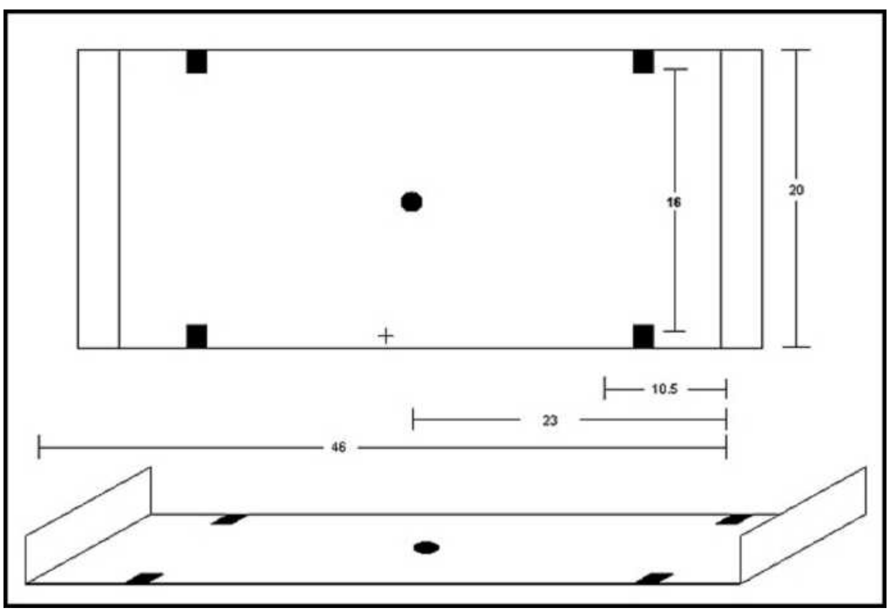
Springs are bent so that they provide downward pressure on the truck.

The springs push down on the truck and provide resistance to side movement providing both vertical and lateral equalization.

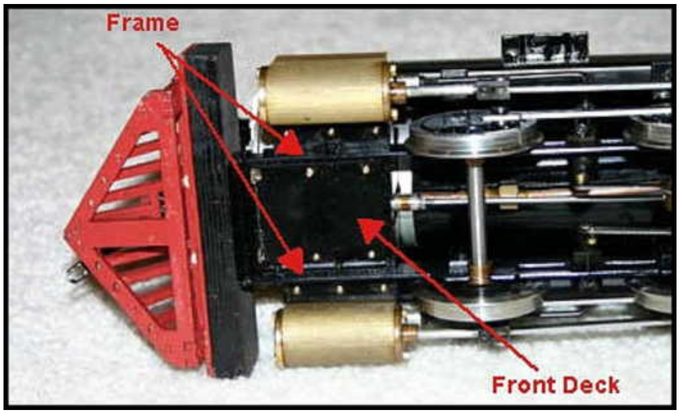
The rectangular tubes allow some un-resisted side movement. In larger side movements (sharper curves), resistance from the springs pulls the drivers into the turn.

Mounting a Front Pilot:

The process for creating a front truck is very similar to that used in creating the rear. Begin by using takeoff techniques to determine the length from the front axle to the mounting point of the U Bracket. A good mounting point would be the front frame stretcher between the cylinders. The following drawing shows a plate that could be fabricated from brass sheet that would surround the bottom and sides of the chassis frame between the front cylinders. While the plate shows a hole in the center of the plate, if a U bracket is used as a front mounting and pivot point for the T-Bar there would be two holes. Once the plate is installed under the cylinders, front truck construction would be the same as rear truck construction.



This drawing shows the design and dimensions for a mounting plate for a a front truck. A single mounting point is marked in the center of the plate. If the U bracket from the rear truck is used. there would be two holes, to the left and right of the center mounting hole in the above drawing.



This photo shows the underside of the engine in the cylinder area. The above plate would cover the bottom and slide over the side rails of the frame. More photos will be supplied as the front pony truck for Hawaii No 5 is built in Chapter 3.

Conclusion:

As a note, keep in mind that this is not a modification that's limited to live steam engines. My next plan for these trucks is a Bachmann Big Hauler bash. With the Ruby, the forward drivers don't even affect tracking anymore. They are against the inside rail on a 10' diameter curve. The loco is capable of taking LGB wide turnouts at full 50PSI throttle without even a bobble, where before she would have ended up on her side. On the Big Hauler, this lead truck should reduce friction in the curves just like it would on the prototype. It should also help out by keeping the loco on the rails as the lead drivers will not be the only thing guiding the loco into curves. Two or three points of contact sharing the load of the curve should have less likelihood of jumping the rail than one concentrated point. Add to this the way that the lead truck can steer itself into the curve, due to its smaller wheelbase, and performance should be greatly improved. We'll see... eventually.

The idea with a four-wheel truck would be to cause a similar effect. This could be done with two of the trucks I have built attached back-to-back. In that event there are two methods I would suggest.

For large radius running a combined pivot/slide on the truck bolster would work wonderfully. Bachmann got close to this with the Big Hauler series but they placed the pivot/slide assembly on the engine. This causes an undue amount of stress on the lead truck when tracking through curves due to the friction of the slide. Because it is placed higher than the truck frame it creates twisting forces which can cause the lead truck to derail if the motion isn't perfect. Moving the assembly down to the truck would eliminate this twisting force, though it would also limit curve radius due to not having as much sideways room on the truck's bolster.

For smaller radius curves there is the method employed by Barry's Big Trains and Hartland Locomotive Works. This involves an arm that pivots at the frame behind the last axle of the lead truck as well at the top of the lead truck. Using this setup will allow great flexibility in running and it can also be sprung in the exact same way as I have done here. Essentially, it turns a 4 wheel lead truck into a more flexible version of the 2 wheeler presented above.

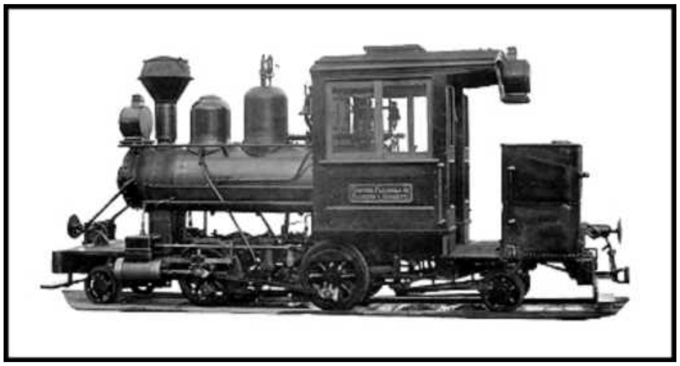
By way of closing, this is only one way to do this modification. The springs aren't truly necessary if you only wish to add trucks. Adding some lead to my trucks would result in them handling just fine.

Building a Frame Extension and Rear Bunker

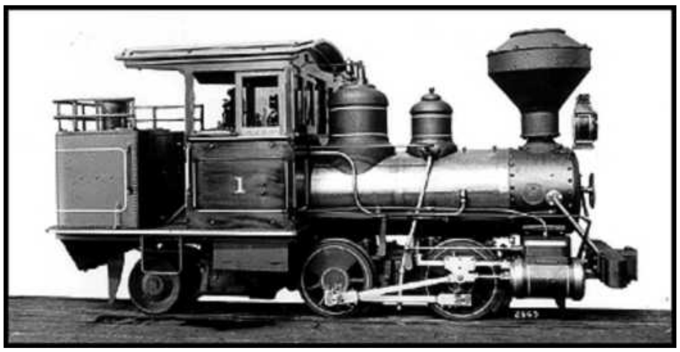
By Tom Farin

Introduction:

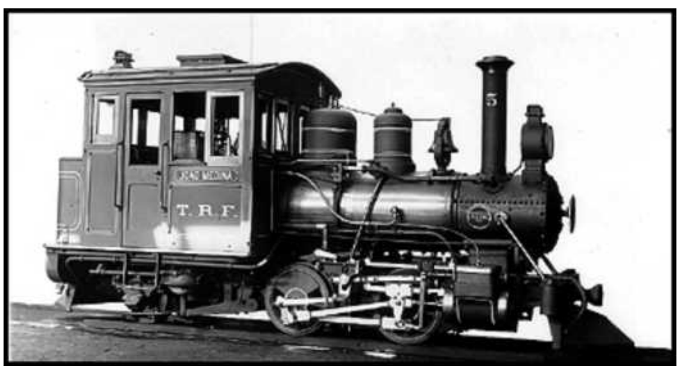
Many x-4-x engines incorporated a rear bunker to carry fuel and in some cases, water. Bunkers ranged in size and style.



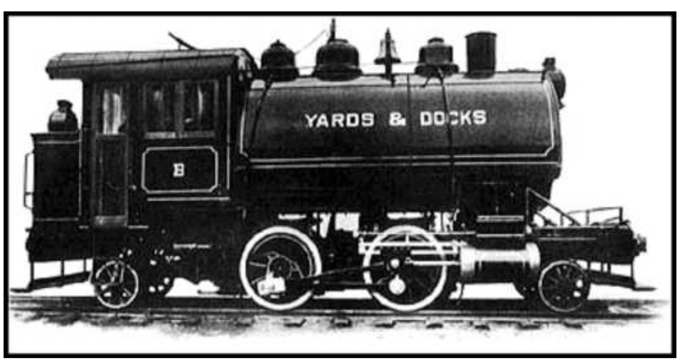
Baldwin - Central Plazuela de Balseiro y Giorgetti, Puerto Rico (1m ga.)



Baldwin - Imperial Forestry Bureau (by Frazer & Co.) #1, Japan.



Baldwin - Tramway Rural Fluminense #5, Brazil (1m ga.)



Vulcan - Class I-S 2-4-2 built for heavy duty from the Vulcan 1913 Catalog

In the remainder of this article, you'll be taken through an approach to extending the frame and building a bunker.

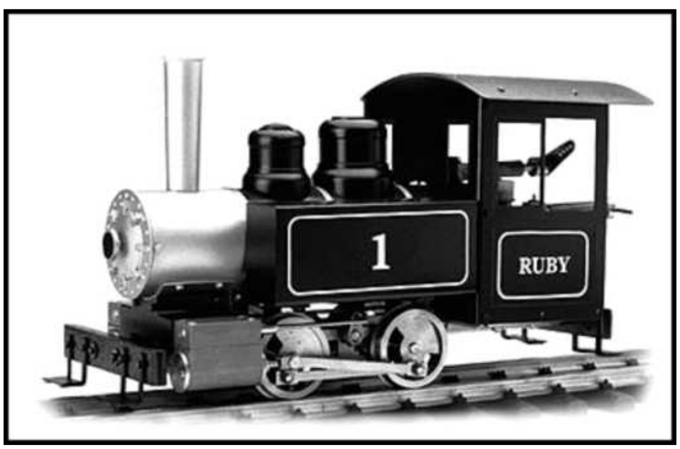
Building the Rear Bunker

Because the rest of the Ruby is done in brass, you may want to use the same material for the bunker as for the rest of the engine. For this reason, these instructions show you how to create a bunker in brass. With only a small amount of adaptation, you could use instructions in this article to create a bunker in styrene. However, many key parts of a Ruby become extremely hot during operation. Consequently, we would recommend a brass bunker over a styrene bunker for the Ruby or any other live steam engine.

The bunker we're going to build in this article models the bunker added to the Olomana by Jerry Best. Our intention is to make the model as prototypically accurate as is reasonably possible. But it is also our intention to build the bunker in such a manner as to allow the radio control receiver, batteries, and circuitry for LED lighting to be contained in the bunker.

In practice, the bunker could contain coal, wood, or an oil tank. In the case of the Olomana, oil was the fuel used in its later years, so the bunker will incorporate an oil tank.

Shot of the Olomana in the Smithsonian. The cab, side entrance, and bunker all sit on a rear deck.



Note that adding a rear bunker will require an extension of the deck so that the side entrance to the cab and the bunker can be added to the rear of the Ruby.

The Ruby Kit ships with no provision for hauling fuel. Yet variants of the Baldwin x-4-x locomotives had a rear bunker. In upgrading the Olomana, Jerry Best added a rear bunker. We'll do the same to the Ruby in this series of steps.

Materials:

- Brass
  - Deck Floor, Bunker Bracing, and Oil Tank Top and side - (1) 1/16" brass sheet - Purchased in an **eBay** auction.
  - Deck Extension Bars and Bunker Bracing - (24") 1/8" x 1/4" brass bar stock - Purchased in an **eBay** auction.
  - Brass Wrapper - .005" brass shim stock - Purchased from the **Grainger Company** - Get a roll. It will last a long time.
  - Trim - (12") 1/16" diameter half round brass wire - **Sulphur Springs**.
- Machine Screws, Washers, Nuts, Taps.
  - (12) - #2-56 Brass Hex Head screws - Purchased from **Micro Fasteners** - You can also get screws, nuts and washers at a hobby shop but you save a significant amount of money ordering these screws and nuts 50-100 at a time.
  - (4) - #2-56 Brass Flat Head Screws - Purchased from hobby shop - distributed by Walters.
  - (2) - #2-56 Nuts - Purchased from **Micro Fasteners** - See above note.
  - (1) - 2-56 Tap - Purchased from local hardware store.

Construction

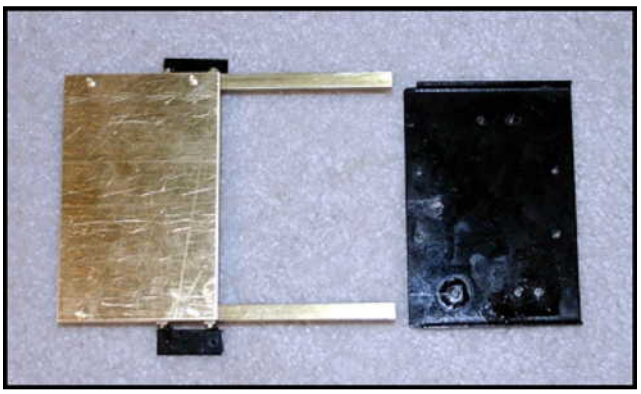
Deck:

The best way to extend the deck without disturbing existing components in the cab is to add a brass deck extension. The most important structural issue in adding the extension is to find a way to add appropriate support to the current deck and extension. A quick look at the Olomana shows a structural steel frame that supports the deck from underneath. The height of the structural steel is approximately 1/8 inch. I cut two pieces of 1/8 inch by 1/4 inch bar stock to replicate the side framing members. The bar stock was cut to a length equal to the combined total of the length of the current cab deck plus the length of the deck extension. Total length may be different for your application as you may need a longer or shorter deck extension. The deck itself was cut from 5/100 inch brass sheet. Dimensions of the deck extension are 2.43 x 3.85 inches. You'll need to adjust the smaller of these dimensions as well as the length of the bar stock to adjust for the length of the extension you will need for your bash. In other words, I can supply the width dimension. The length dimension will need to come from takeoffs from the photo or drawing of your prototype.

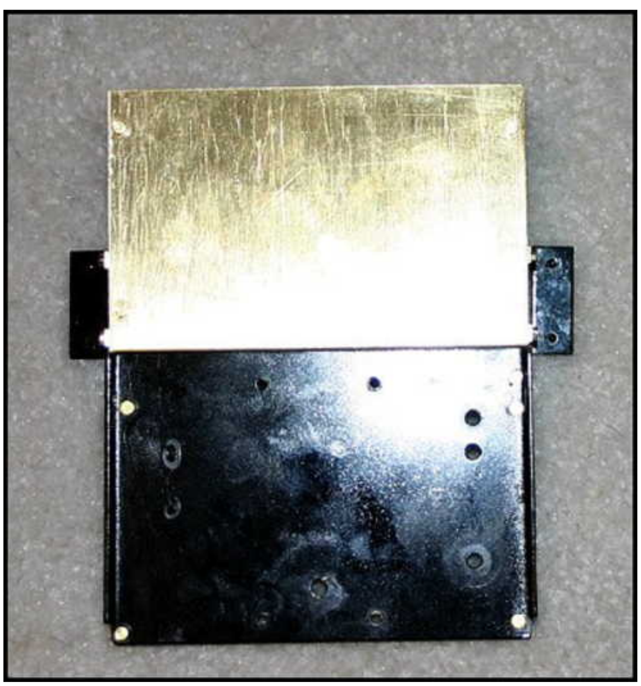
The two pieces of 1/8 x 1/4 inch bar stock are shown on the right. The sheet brass is shown on the left.

Holes were drilled in the bar stock and tapped to accept #2-56 screws. The deck received slightly larger holes. Brass screws were used to bolt the deck to the bar stock. The extensions shown to the right will be tapped and attached to the underside of the existing deck.

Remove the rear cab deck following the instructions given earlier in the chapter. In the following photo the deck is on the right and the deck extension is on the left. Cab steps were added to both sides of the deck extension. They were the steps that came off the yard pilot that shipped with the Ida. They are screwed to the side rails of the deck through tapped holes using #2-56 brass screws.



The Ruby cab deck is on the right and the cab extension is on the left.



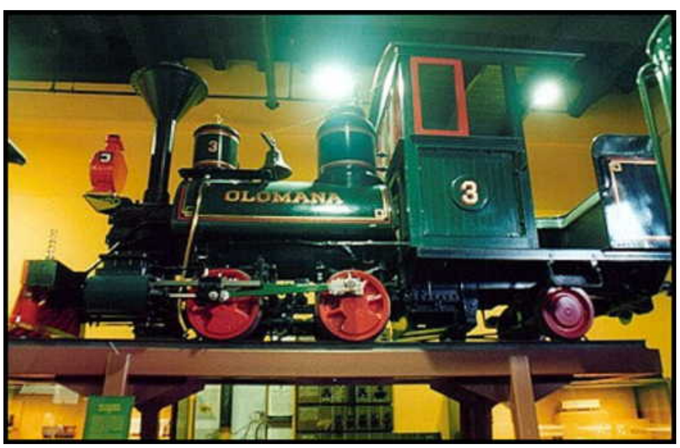
The cab deck is screwed to the rails of the cab extension using four 2-56 brass screws into tapped holes in the extensions.

You are looking at the top of the extended cab deck.

As you can see from the bottom of the deck. screws are filed flush with the rails. While the photos suggest that one surface is higher than the other, the deck is actually level.

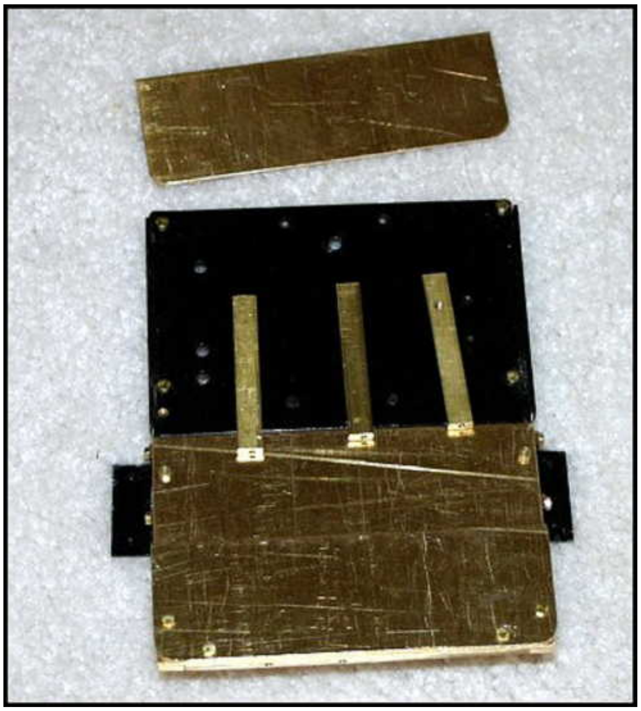
Bracing:

The bunker will match the Olomana bunker as closely as possible except that it will contain an oil tank. The oil tank will be the container for the engine's electronics. Brass shim stock will be used to fabricate the sheet metal of the bunker. A top and bottom brass base will form the curves. The top brace will do double duty as the top of the oil tank. The surface of the oil tank facing the cab will be removable to allow access to the electronics.



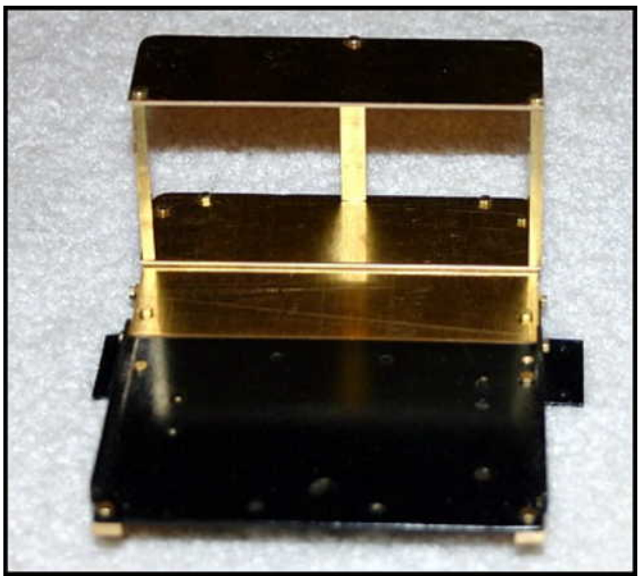
This shot shows the Olomana's bunker, an open design. Note the beveled edge at the top of the bunker.

The bracing for the bunker is made from the same brass sheet material as the deck. A top and bottom former were cut and shaped from the material. The bottom piece is screwed to the deck frame using the same holes as those securing the deck extension to the frame. A frame element was added to the back of the extension to provide a place to screw the rear bumper. The frame element is held to the bottom of the deck with #2-56 screws.

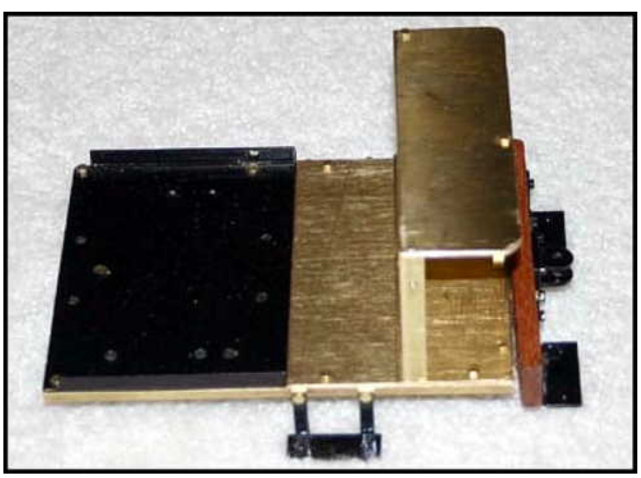


One of the two bunker formers is screwed to the top of the deck extension. You can see it at the bottom of the photo. The other which will also function as the top of the oil tank is above. These two pieces are identical.

The three 1/8" by 1/4" brass pieces are the vertical elements that will hold the top and bottom plate steady and in alignment.

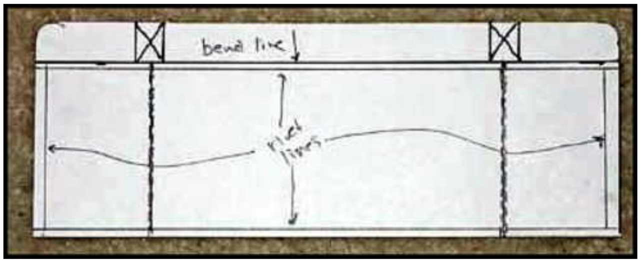


In this shot, the bunker former set is in place on top of the extended deck. 2-56 brass hex head screws are used on the top. 2-56 flat head screws will be used on the bottom.

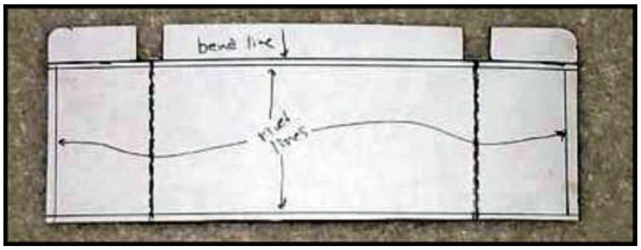


Flat head screws now hold the former to the bottom former plate. The rear bumper holes have also been drilled and tapped into the extension frame using 2-56 hex head screws and washer.

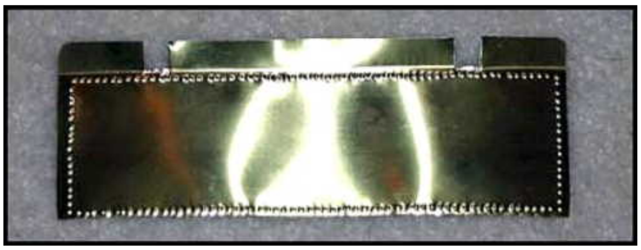
The wrapper is fashioned from .005" brass shim stock.



Using dimensions taken off the photo, a full sized pattern was drawn on paper for the bunker wrapper. The paper is Avery label paper.

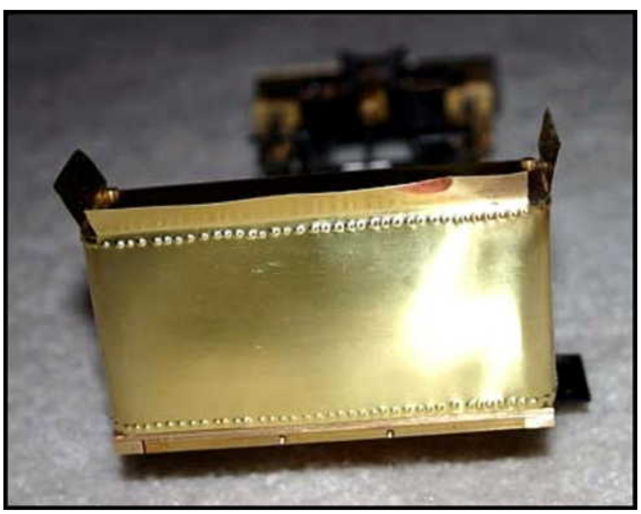


The template was stuck to the shim stock. A scissors was used to cut the brass to the size of the template. The lines on the template were used to place rivet impressions.



This is the completed wrapper. The Avery label paper was loosened under water and removed. Remaining glue was removed with paint thinner.

The wrapper was then soldered to the frame.



The bunker shell from the rear. The top portion of the wrapper has already been bent to create the bevel found on the prototype.

Side view of the bunker showing its relation to the cab.

I'm not totally happy with this wrapper, both the rivet lines and the soldering job. I'm going to redo it. You'll see the end results in Chapter 3. For that reason, the corner bevels and the strip that will give the beveled edge a rolled effect were left off. Also, the front cover which serves as the front of the fuel tank was left off. I'll finish the bunker in Chapter 3.

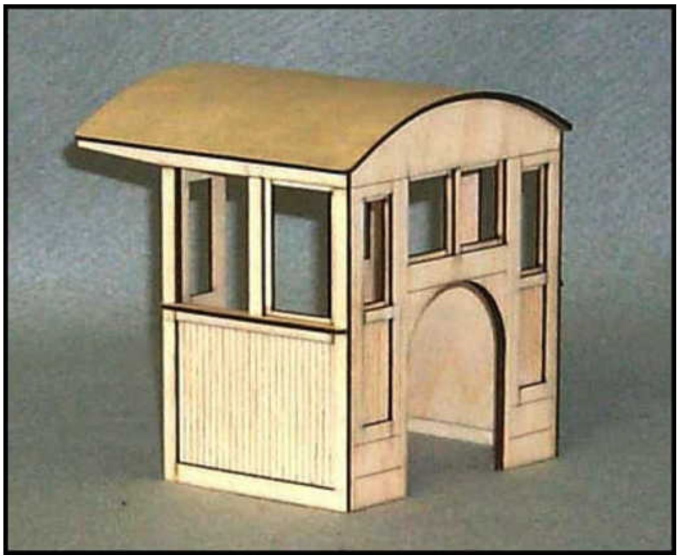
Building/Bashing a Vance Bass Cab:

The *'Olomana'* cab is constructed from wood, while the cab that came with the Ida is brass. While I could have chosen to scratch build the cab, I instead took the wimps way out and ordered a cab from **FH&PB Railroad Supply Company**, owned and operated by Vance Bass.

These two photos compare the FH&PB cab to the cab on the Olomana.

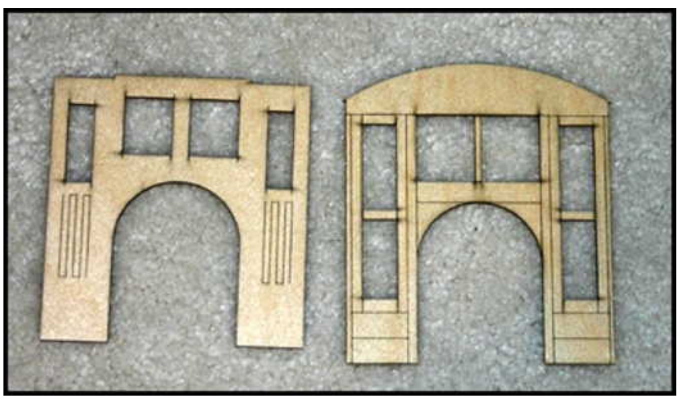
This side shot of the Olomana cab shows a very traditional Baldwin wooden cab.

Note, however, that the windows are the same height on the front and sides of the cab. This cab has an open rear, a feature that will make it easy to get to the controls of a live steam engine.



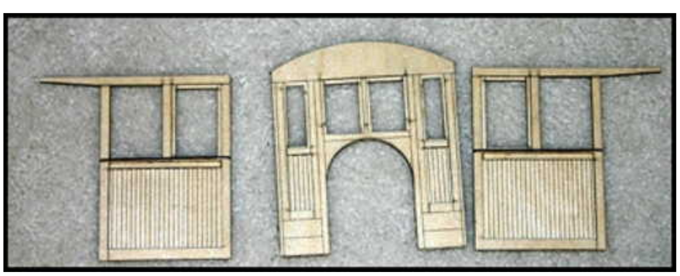
The FP&PB cab is similar in many ways with a rounded roof and vertical boards inside its panels. However, window height is lower on the front side windows. Window widths on the front are also different. This shot shows a closed windowed back but the kit also ships with an open back.

There isn't much that could be done about the window width on the front without scratch building that portion of the cab. I didn't want to scratch build the front. But it is possible to raise the window top of the front outside windows and lower the window bottom of the front middle windows.

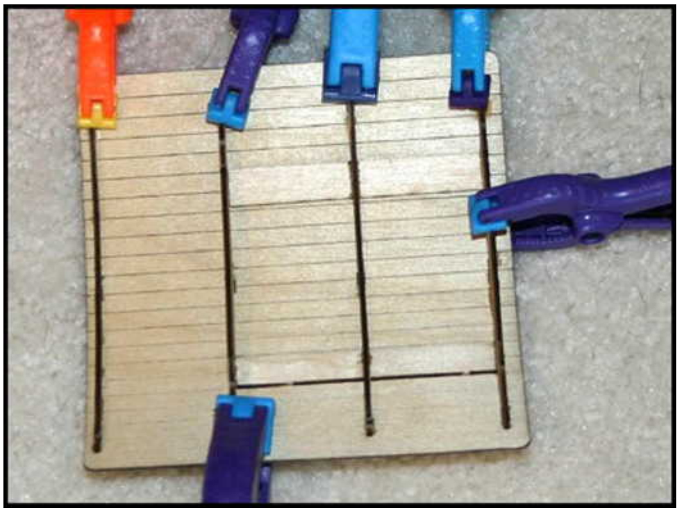


These are the inside (left) and outside (right) panels for the front of the cab. Just after this shot, they were bashed by cutting away a slice of wood at the top of the outside windows and at the bottom of the inside windows.

An X-acto knife and a small file was used to bash the front of the cab. Tops of the window openings on the outside front cab wall were raised on the two outside windows to make their tops even with the inside windows by cutting away material with the X-acto knife. Bottoms of the window openings on the two inside windows were lowered by cutting away material at the bottoms of the windows. Similar cuts were made to the inside front cab walls, to maintain the window frames around the middle. Once the openings were cut they were smoothed with sandpaper and a small file.

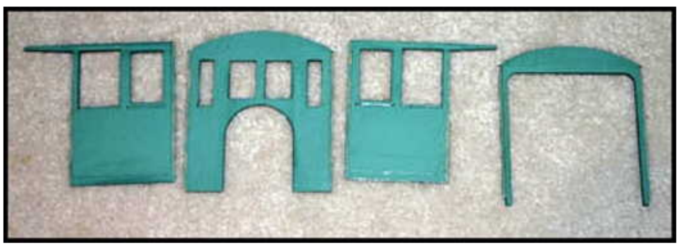


This shows the completed front side along the two side panels after the front panel was bashed. While the front middle windows aren't as tall as the outside windows, they will be mostly hidden by the boiler and steam dome.

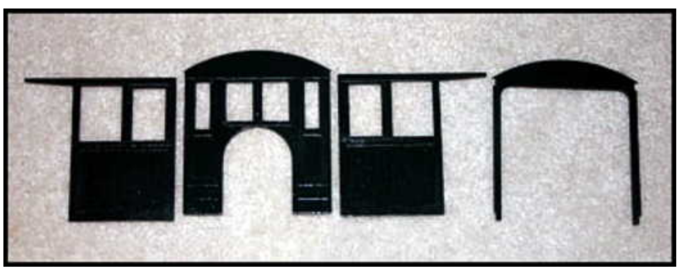


This is the inside of the roof. The dark vertical lines are the roof braces. Boards are scribed into the inside of the roof horizontally.

While the painting of brass parts is being saved for later chapters, I couldn't wait to see how the cab would look when painted. The cab was painted using Krylon spray paints from the local hardware store,

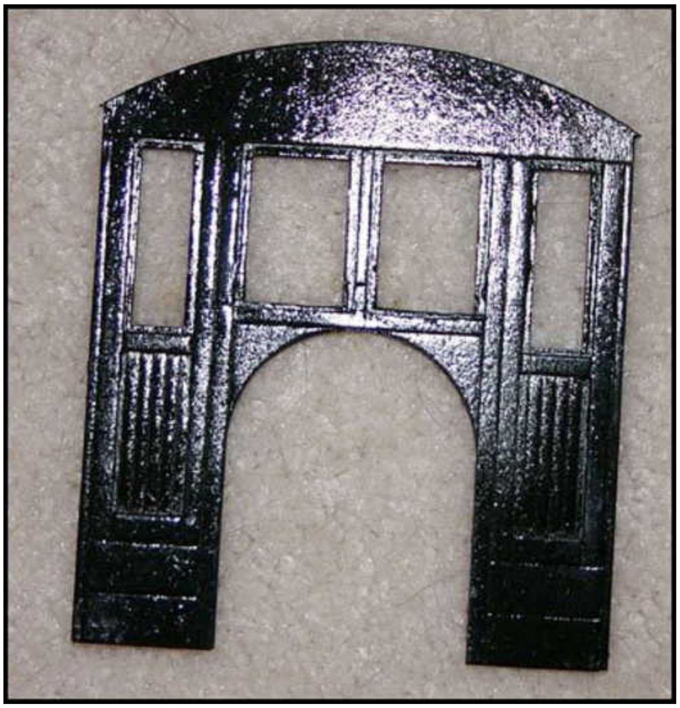


The inside of the cab was painted a Krylon light green. This is consistent with the inside colors of most cabs of the period.



The outside of the cab is painted a Krylon dark green, close to the color of the exterior of the Jerry Best modified Olomana.

The inside of the cab roof was also painted a light green. The opposite side will be covered with 'tar paper' and painted black.



Here's a shot of the front of the cab showing the bashed windows awaiting trim paint and window glazing.

Windows were painted in the next step to a bright red on the exterior and windows placed and framed on the interior.

The outside window frames on the front wall windows and front-most side windows were painted a bright red to match colors on the rear truck wheels and front pilot.

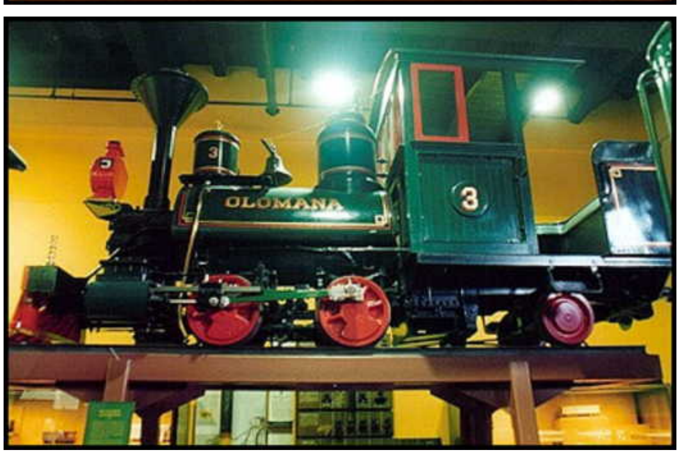
All painted windows received glass panes (evergreen clear) on the inside and were framed with strip wood pieces.

Assembly required glue and clamps. Given the fact the Olomana will see outside use, Borden's Titebond Glue was used to glue together the four sides of the cab.

This photo shows the four walls of the cab in the process of being glued together. Clamps were left in place overnight.

Gluing of the cab walls is complete. Glue bonding the cab roof to the sides is setting in this photo which shows the cab on top of the cab deck with the extensions implemented earlier in the chapter.

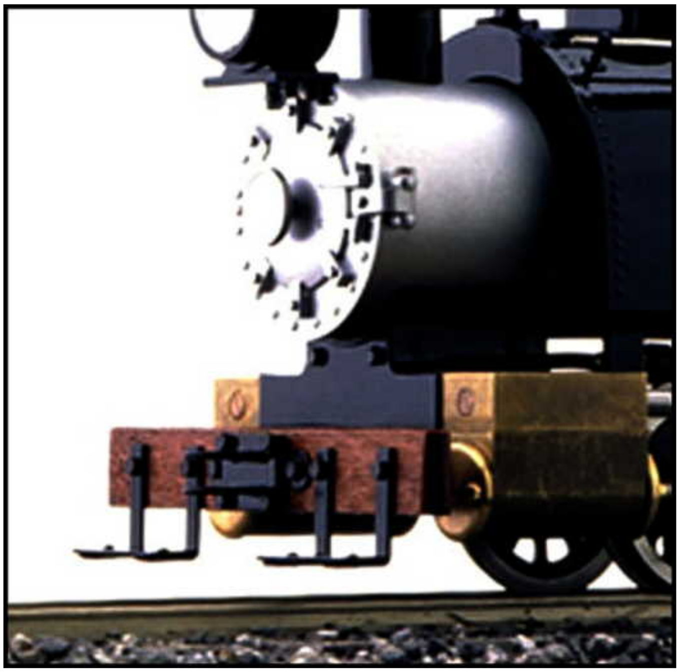
The cab will be 'roofed' as part painting and detailing in a later chapter.



While not identical to the Olomana cab, the Vance bass cab certainly gives the illusion of being prototypically accurate. The only way to come closer would be a total scratch build combined with finding a way to lower the Ruby boiler which rides higher than the boiler on the prototype.

Building/Bashing a Vance Bass Pilot:

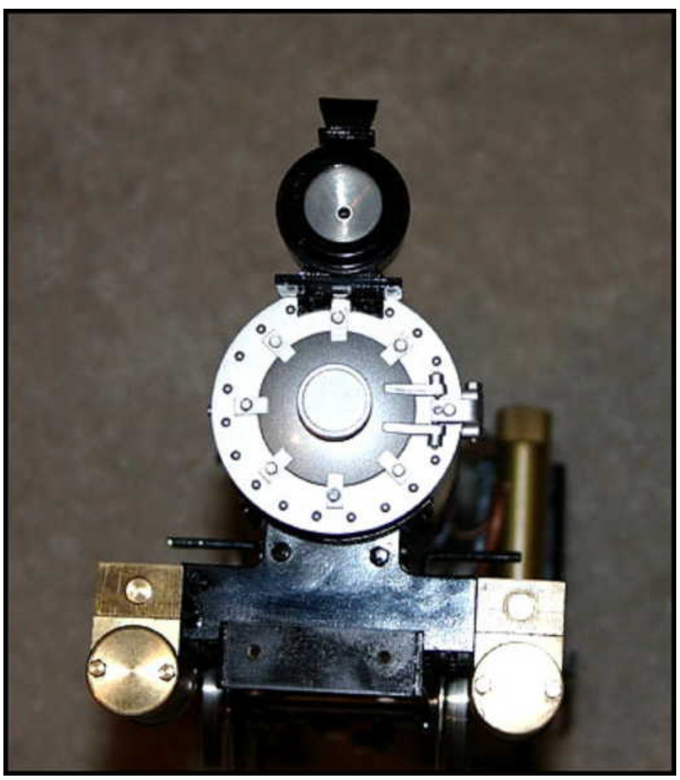
Vance's pilot is very close to that on the Olomana. The primary difference is in the link and pin coupler pocket, which causes some of the pilot staves to be shortened on the Bass pilot. I decided these inconsistencies could be tolerated in exchange for the ease of assembly and strength of Vance's laser cut components. Vance claims a 30-minute assembly time. The pilot went together so fast I forgot to take a photograph until after it had left the paint shop.



This is the pilot that ships with the Ida. It is a yard pilot. The Olomana had a road pilot (cowcatcher).

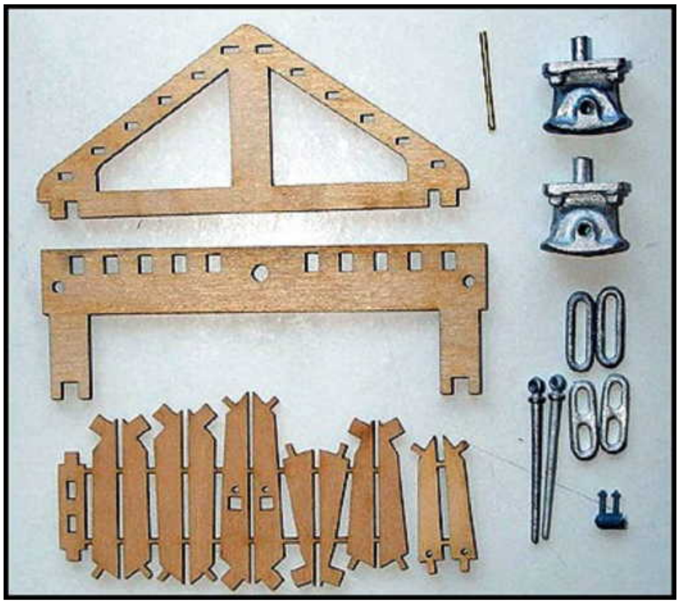
The pilot is held to the frame by two screws with washers in this photo, one on each side of the coupler. You will need a 3 mm wrench to remove these hex head screws.

The remaining screws on the pilot are 2 mm.



This is the front end of the Ida with its front pilot removed.

The Vance Bass kit supplies laser cut components that lock together when glued to form a very solid unit. Assembly takes 1/2 hours or less. Finishing and attaching the pilot added another half hour to the time. But overall the kit built pilot was assembled much faster and in a much more solid manner than had the parts been scratch built from wood or styrene.



This photo shows the kit as delivered. The pilot components lock together using tabs and slots. As a result, this is a very strong wooden pilot.

Here's the Vance Bass pilot assembled and painted in a bright red Krylon paint.

The parts were glued together using Bordon Titebond glue to waterproof the joints.

After painting, the pilot was clear coated.

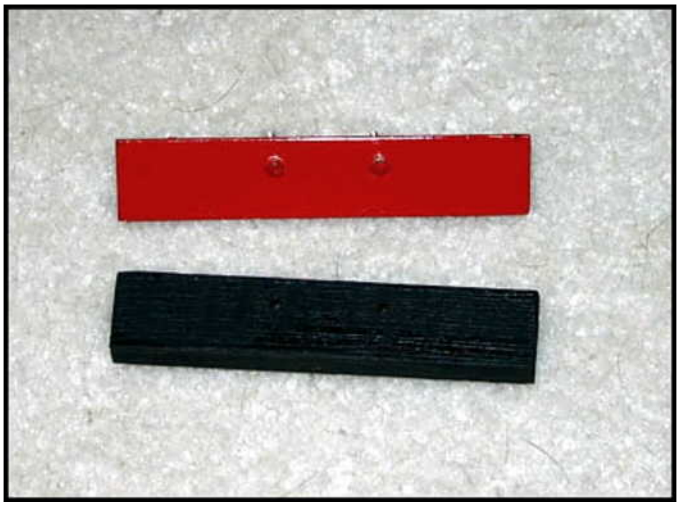
Link and pin coupler components. The two left hand components are white metal castings which are included with the kit.

The coupling rod in the right was fashioned by pinching the ends of a from brass tube closed, A hole was then drilled through the flattened ends. Detailed instructions are in Chapter 1 of MasterClass 2002.

In this photo, the components have been painted with Krylon black.

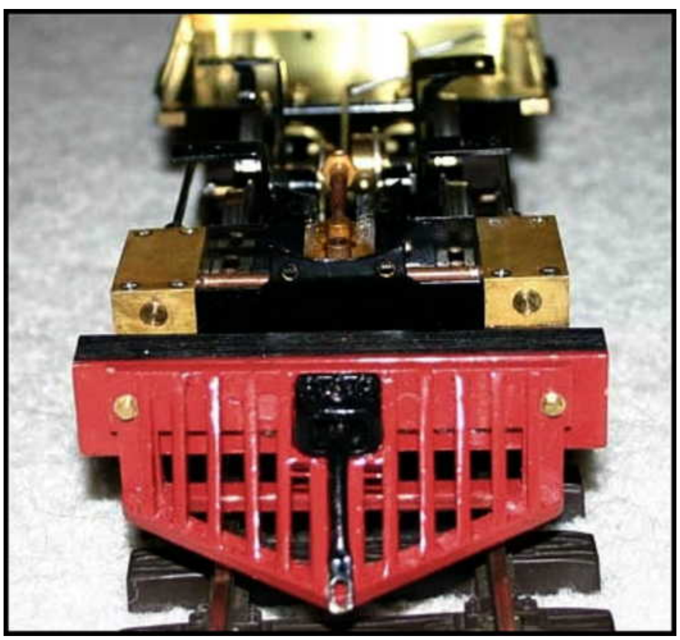
The completed pilot. The pin holding the bar in place was secured with epoxy. Then the coupler assembly was glued to the pilot with epoxy.

The only steps left are mounting the pilot to the beam and a little paint touch up work to the coupling rod.



A beam was fabricated from a piece of oak and a brass piece with the same length and width.

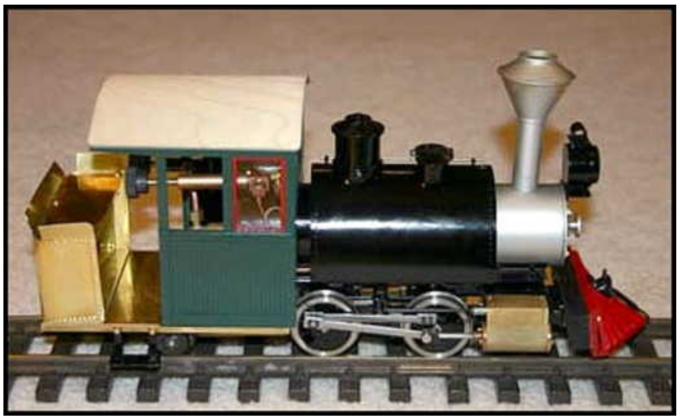
The brass piece was painted red and the wood black as they were on the prototype.



Holes were tapped into the assembled beam to accept the new pilot. Thus photo shows the pilot/beam assembly attached to the front of the engine.

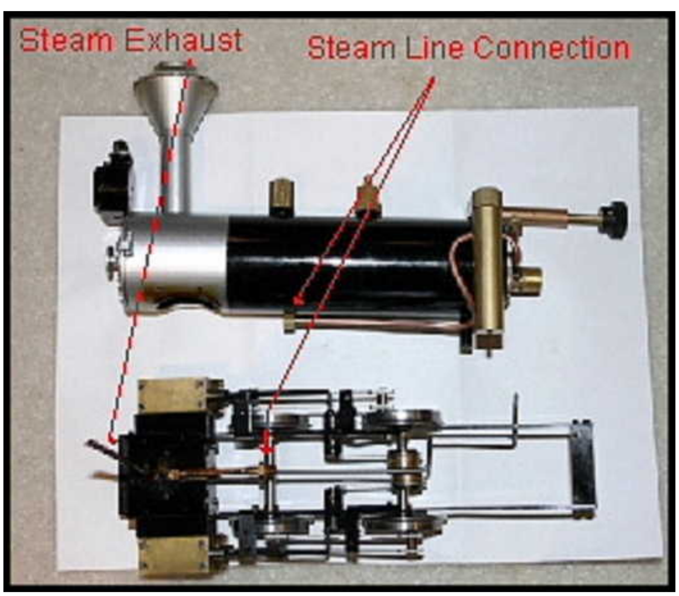
'Olomana' Update:

This chapter began with a stock Accucraft Ida, the base engine for this kit bash project.



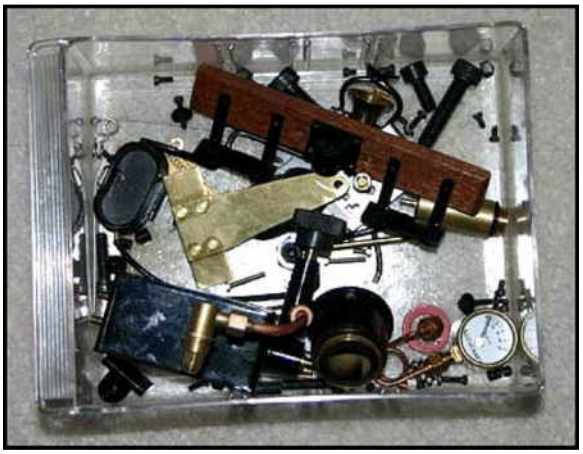
By the end of this chapter, the Ida's appearance had changed in a very material way.

The little Ruby/Ida has come a long way in this chapter, sporting a number of superstructure modifications that are moving her in the direction of the prototype. The process began with disassembly, which served two purposes. First, photos and instructions on disassembly are a major focal point of the chapter. Second, portions of the disassembly were necessary in order to make the superstructure modifications that are part of this chapter. When I finished disassembly she was down to the drive train and boiler with a parts box full of screws and other detail parts.



When disassembly had reached its final stage only two major components remained, the boiler and the drive train.

There are only a few additional parts that could be removed from the boiler. As for the drive train, we'll be discussing drive train modifications in Chapter 3. So we'll leave disassembly of the drive train for that chapter.

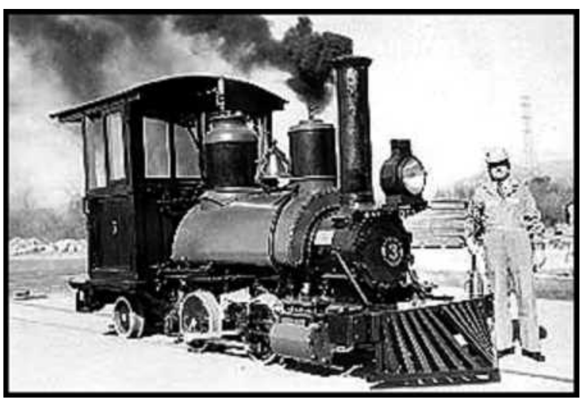


In addition to the two largest components, a variety of parts occupied the parts box, and the cab and water tank were set off to the side.

Could I remember how to put her back together? Fortunately, I had the disassembly photos, which I could walk through in reverse. Would all the new parts fit? Test the fit as you proceed and this question will be more perceived than actual. Will I damage any parts? My only casualty was the brass tube for the steam exhaust, which broke off at the threaded base. Fortunately there were enough threads left to screw the remaining piece back in place.

An Admission:

I might as well own up to it. In the last chapter, my goal was to model the 'as shipped' version of the Olomana, sans the Jerry Best added bunker. I changed my mind for three reasons. First, I needed a place to hide the electronics. The bunker suited that need. Second, I wanted this bash to be more challenging. The frame extension and bunker construction added challenge. Third, it gave me a chance to demonstrate some of the brass fabrication techniques covered in the Vance Bass article. And a number of you will want to add a bunker.



This is the Olomana version I had intended to bash. It would have been easier to model as no frame extension would be required.

A much more difficult bash in that a frame extension had to be scratch built along with the bunker.

What did I do to deal with the fact I was not modeling an 'as operated' engine? As I mentioned in Chapter 1, in addition to the Ida bash, I also planned on building a second engine from the Ruby kit. As announced earlier in this chapter, that engine will be Hawaii No 5. In her restored state she's true to her origins. So subsequent chapters will wrap up with an update on both engines. There, I feel better now.

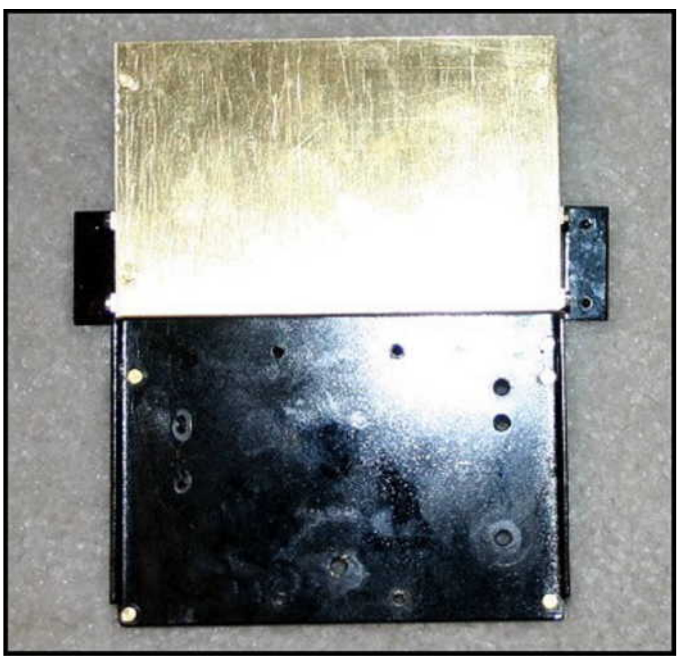
Changes Incorporated in the Model:

The focal point of this chapter changed from drive train to superstructure because we are still waiting for the kit. So the modifications made in this chapter are focused on the superstructure rather than the drive train, although Landon's article on fabricating two wheel trucks was originally planned for Chapter 2. Here's a brief summary of modifications incorporated in this chapter.

Frame Extension and Bunker:

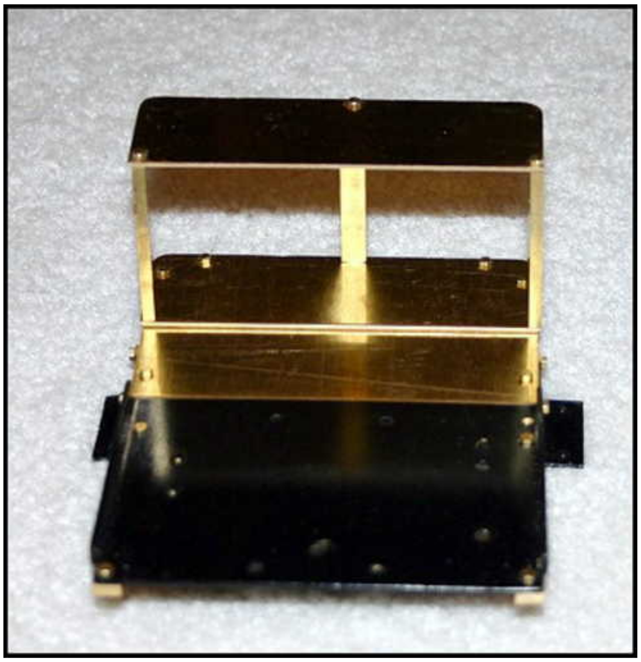
Of the projects completed in this chapter, this was the most time consuming and also the most satisfying. The cab deck extension is very solid and convinced me I can master working in brass. Most of the fabrication techniques described in the Vance Bass article were used in this piece. Basic skills like cutting, drilling, tapping, filing, and soldering came into use.

In addition, the bunker requires application of rivets, which in turn required fabrication of a rivet press. And a few detail parts were needed to complete the job. Because the article supplies width measurements, you don't need to own a Ruby to get started on this project. Take off the length you need from a prototype photo. Then follow my instructions and build your deck extension and bunker. Mine is done, sitting there ready to be painted.



The upper portion of the photo is the deck extension, fabricated from brass. It has been attached to the deck that shipped with the Ruby.

Side steps were taken from the Ruby's front yard pilot, which has been replaced by a wooden pilot.

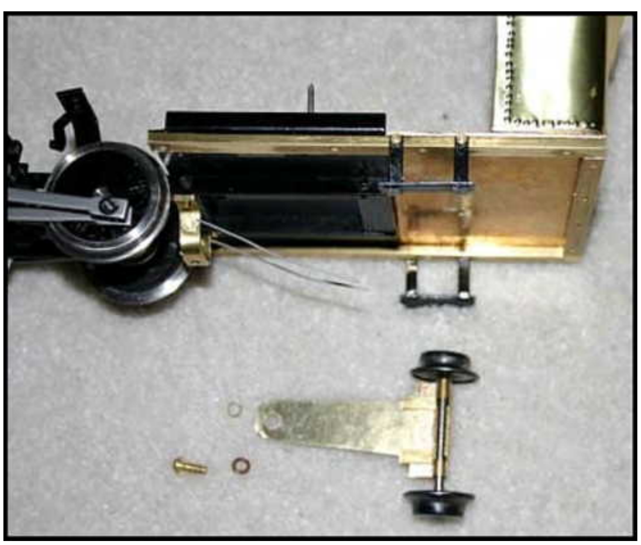


This shot shows the deck extension with the framework for the bunker in place.

In this shot, the bunker is complete, waiting for detailing.

Rear Truck:

The Trotfox's talent for design and fabrication played a big role here. I used his instructions to build the rear truck needed for the Olomana. I also learned what I need to know to build the front truck needed for Hawaii No 5. What I really like about these trucks is that in addition to their esthetic qualities, they are very functional in that they are fully equalized.

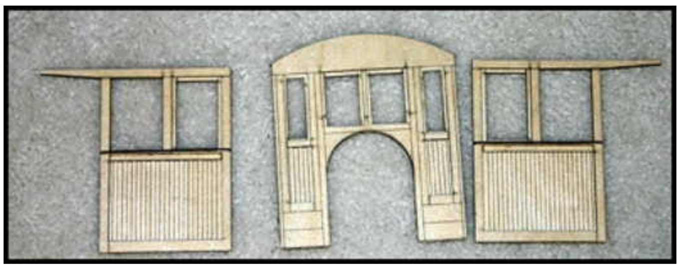


The rear truck ready for final assembly.

The rear truck ready for operation.

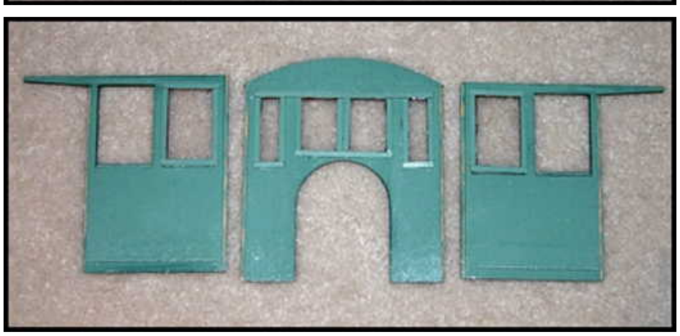
Wooden Cab:

Building this Vance Bass kit was very satisfying from the standpoint of bringing the Ida closer to the Olomana. But it wasn't much of a technical challenge. Vance, your kits are just too easy to build. The most challenging part was the small window bash and glazing and framing the windows that contained glass. Oh yes, another challenge for me was and painting the interior and exterior of the cab - challenging because my old eyes are no longer suited for detail work.

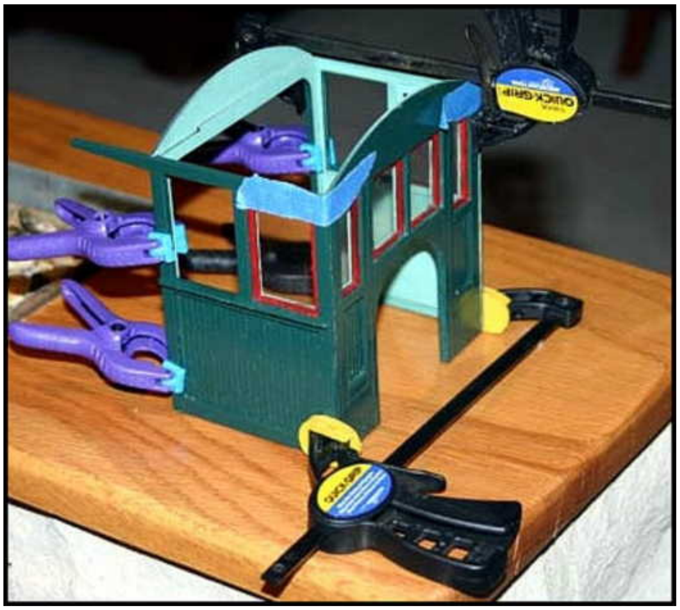


Laser cut cab components after window bash.

Underside of cab roof after painting.



Inside of cab after glazing and framing windows.



The sides have been glued together and and will soon be glued to the top.

In this shot she sits in her ultimate resting place - on top of the cab floor extension and in front of the bunker.

Road Pilot:

This was another 'no brainer'. Scratch building the wooden cowcatcher would be a challenge in styrene or brass. Vance's kit just snaps together making it much more solid and easy to assemble than the scratch alternative. A true 'wimps way' modification if there ever was one.

Pilot after exit from paint shop.

Pilot with link and pin coupler.

This shot shows the pilot mounted to the front beam which in turn is mounted to the engine frame.

What's Next?

Olomana:

In the next chapter, we'll begin talking about drive train modifications. Hopefully, the Ruby kits will be available at that point. The Olomana will also receive the drive train modifications discussed in Chapter 3.

Aside from the drive train, the Olomona focus will be on smoke stack, domes and saddle tank, the last major portion of the superstructure modifications required for this engine.

Hawaii No. 5:

All we have of Hawaii No. 5 at the end of Chapter 2 is photos and drawings. Like you, I haven't seen the kit. There is no guarantee that the kit will be available before Chapter 3 is published. Yet there is plenty to do with no kit available.

- Tender construction can certainly begin. There are trucks to purchase and a superstructure to scratch build. For those of you that need a tender, instructions in Chapter 3 will show the way.
- In addition, the Ruby cab (off the Ida) is available for my use. Instead of waiting for the identical Ruby cab in the kit, I can move forward with a bash of the Ruby cab into a more representative prototype cab.
- In addition, steps necessary to place prototypical domes on her structure will be covered.
- Finally, on at least a conceptual level, the approach to frame extension, boiler extension and overall length will be settled. I also will discuss how I'm going to deal with her undersized drivers.

Hopefully by the end of Chapter 3, Hawaii No 5 will have caught up with the Olomana. For a preview of Chapter 3, press the Continue link at the bottom of this page.

