

# Carolina Conductor



Volume 5 Number 11

Monthly Newsletter of the Carolina Railroad Heritage Association, Inc.

November 2018

**Preserving the Past.  
Active in the Present.  
Planning for the Future.**

**Web Site:** [hubcityrrmuseum.org](http://hubcityrrmuseum.org)  
**Facebook:** Carolina Railroad Heritage Association

**Meeting Site:**  
**Woodmen of the World Bldg.**  
721 East Poinsett Street  
Greer, SC 29651-6404  
Third Friday of the Month at 7:00 pm

**Hub City Railroad Museum and  
SOU Rwy Caboose #X3115:  
Spartanburg Amtrak Station**  
298 Magnolia Street  
Spartanburg, SC 29301-2330  
Wednesday 10-2 and Saturday 10-2

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Secretary:  
**Marv Havens** - 864-292-3852  
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#### **Editor:**

**Bruce Gathman**  
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Articles can be submitted anytime.

## The Shay Locomotive

In 1873 an enterprising American lumber magnate, Mr. Ephraim Shay, owned and operated an extensive saw-mill at Haring, in the center of the Michigan lumber country. In common with his contemporaries Mr. Shay was puzzled how to keep his mill adequately supplied with logs. Hungry saws are like horses in a stable - financial loss results when they are idle or are not working steadily at their full capacity.

The greatest difficulty was the transportation of the logs from the forests to the mill. Lumbering being essentially a winter calling, it is obvious that advantage must be taken of every minute of time. But the impassibility of the roads owing to snow and ice constituted a serious obstacle. Mr. Shay followed the conventional methods of logging by means of wheels and horses and encountered the general run of aggravating delays and difficulties, while the lumber was proving some-

what costly to bring down.

Under these circumstances he was forced to reflect whether a simpler, more expeditious, and cheaper



**The "M. J. BOND", one of the earliest Shay locomotives built to Ephraim Shay's design by Lima Locomotive for logging in the Michigan woods.**

system of haulage could not be introduced. The railway and the steam locomotive offered an obvious alternative, but he recognized that the conditions were averse to its utilization. Circumstances demanded a permanent way of the cheapest possible construction, comprising virtually the laying of the pair of rails upon the ground surface, ignoring banks and curves. There was another factor which had to be borne in mind. The rails would have to be moved time after time to tap the points where the lumber-jacks were at work.

Thereupon the ingenious saw-

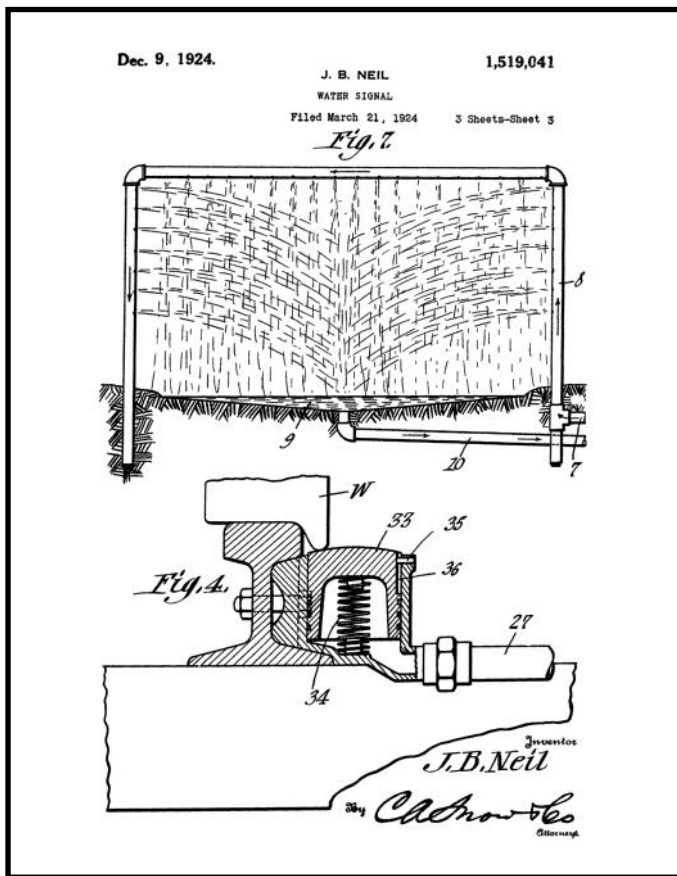
**Continued on Page 4 - Shay**

# Presidential Ramblings

## PRESIDENT'S

### October Meeting

Our October meeting was held at the Woodmen of the World Lodge on Hwy 290 in Greer at 7:00pm. Bruce Gathman presented an interesting program regarding patents that were railroad oriented and were authored by residents of South Carolina. It was intriguing how many patents were written by South Carolina inventors. It also was entertaining to see some patents that were not very practical and probably never were actually put into production.



Water shield crossing gate to keep autos from crossing the tracks as a train was going by.

### November Meeting

The November meeting will be held at the Woodmen of the World Lodge on Hwy 290 in Greer at 7:00pm. The topic for the night is Modeler's Night. Bring a model that you are passionate about and share it

## MESSAGE

with the group. Based on previous years, this will be one of our more interesting meetings of the year.

### Calendar of Events

Mark your calendars for the following events:  
**November 10, 2018** – NMRA Palmetto Division meeting at the Berea Branch of the Greenville Library at 111 North Highway 25 Bypass. The meeting starts at 9:30 am.

**November 16, 2018** – CRHA meeting at the Woodman of the World Lodge, Greer at 7:00 pm. Program is Modeler's Night. Bring a model for presentation.

**December 3, 2018** – Board of Director's meeting at the Taylors Library at 6:30 pm.

**December 8, 2018** – Santa Train on the Greenville and Western Railway. Goto — [www.wcrscorp.com/press.html](http://www.wcrscorp.com/press.html) for complete information.

**December 15, 2018** – Santa at the Hub City Railroad Museum, 11:00 to 1:00.

**December 21, 2018** – CRHA meeting at the Woodman of the World Lodge, Greer at 7:00 pm. This will be our Holiday dinner meeting.

### Caboose Renovation

The caboose renovation has begun. Jim Hopkins, Marv Havens and Terry Brelsford were at the Caboose on October 25 and completed welding of two of the three areas on the roof. Duane Heard has begun removing the sheet rock from the walls and ceiling and we are discovering more dry-rot and mold in the walls and floor. Once the roof is completed, the next step is to replace windows with a design that will prevent water leakage and condensation for causing any damage to the wood. The Caboose is not open to the public during the renovation. We hope to have it back into service as soon as possible. In the interim, please visit the Museum. The HO model train inventory has been relocated to the Museum lobby.

### Coloring Contest

We have received many coloring contest entries. We expect to have the entries judged and notify winners by November 15<sup>th</sup>.

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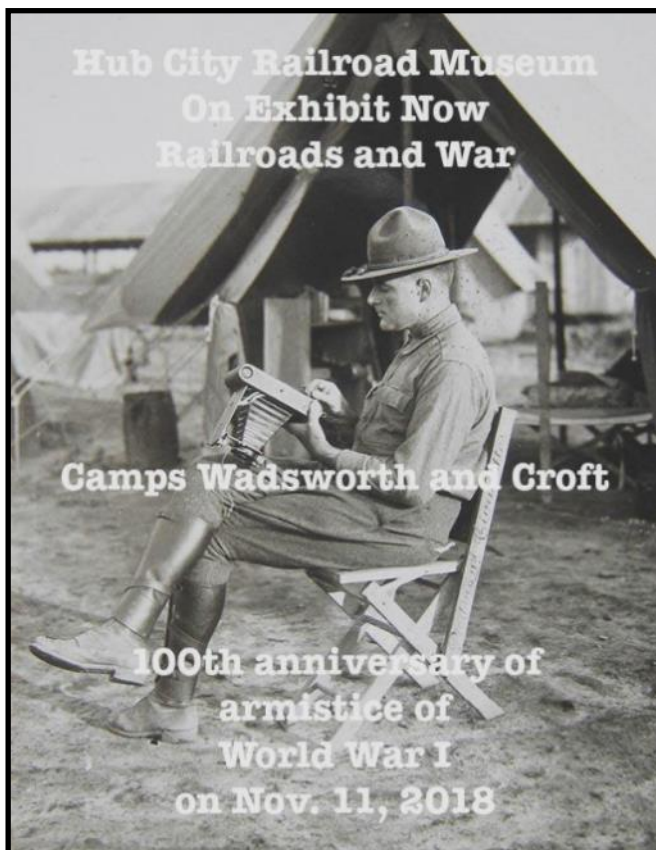
# Presidential Proclivity

Continued from Page 2 —President



Coloring contest entries.

## WWI and WWII and Trains



A new display has been added to the Museum relating to WWI and WWII and how railroads were involved. Camp Wadsworth and Camp Croft are featured as well as historic photos and artifacts from that era. Stop by the Museum and check out the new display.

## eBay Sales

EBay sales have continued to be positive. \$500 was transferred to our checking account on October 21<sup>st</sup>. Thanks to Duane Heard for heading up this effort.

## Santa and Mrs. Claus



Santa and Mrs. Claus are scheduled to visit the Caboose on December 15<sup>th</sup> from 11:00 to 1:00. Mark your calendars so you won't miss this event.

Candy canes will be handed out to all children who talk to Santa. Watch for more details here and on Facebook.

## October Minutes

Approved October Board of Director's Minutes are attached to the email.

Thanks,  
Dave Winans, President CRHA  
864-963-4739  
dwinans4739@charter.net

### Wanted—Articles for the Carolina Conductor

Submit an article of 200 words or more with some photos and captions and see them in print. Every one of us has some unique railroad experience that would make interesting reading for our membership. Your editor always needs more contributions of local railway history and news.

# Arrivals

Continued from Page 1 - *Shay*

mill proprietor resolved to work out his own solution of the issue. He thought of a geared locomotive, where the power developed by the engines might be transmitted through shafting and gear wheels to the roads. The more he reflected the more convinced he became of its practicability.

He set to work to build a locomotive according to the ideas he had evolved. The materials and facilities at



**The hill climber Shay ascending a grade of 5% on the Mount Arisan Logging Railway in Formosa.**

his command in the backwoods were severely limited, but this fact did not deter him. He contrived some rails from maple wood and laid them on rough sleepers fashioned from waste parts of the logs. He used the stand-

ard gauge because he bought some flat deck cars for his experiments, and they were built to this gauge. His locomotive was extremely crude. It comprised a vertical boiler which he placed upon a double truck flat deck car. At one end of the vehicle he placed his water-tank, while at the opposite extremity he rigged up a bunker for carrying wood fuel. The engine, with its cylinders set vertically, was placed upon one side of the boiler, while the piston rods, extending downwards, were connected to a flexible shaft extending longitudinally alongside the truck wheels, and gearing with the latter through bevel and pinion wheels.

Such was the first Shay geared locomotive. Its creator became the butt of ridicule among the camps for his pains. The locomotive certainly was a quaint-looking and primitive machine, giving every impression of having been made from odds and ends rescued from the scrap-heap. But it had cost its builder several hundred pounds, considerable thought, and many hours of tedious labor and disappointment. That it should be received with mirth galled him to the quick, and he accordingly resolved that, come what might, he would make it work successfully.

So, it did, and to such advantage that those who had hailed its appearance with laughter began to regard the experiment with serious interest. Directly the locomotive got out upon the road all sorts of troubles asserted themselves, but as they developed its designer attacked and remedied them. The result was that at last he got it to work smoothly and evinced the greatest pride in the fruits of his labor, because he was able to haul his logs quicker, more continuously, and cheaper by this means than were his rivals with their horses.

As this was the object for which he had striven he became completely satisfied with what he had accomplished. He proved that his locomotive could run and keep the track where an ordinary engine would fail completely. So, he built additional improved engines, and in a short space of Ephraim Shay's gear-driven locomotive became the talk of the American and Canadian lumber camps. Those who formerly had laughed at his efforts now wanted to avail themselves of similar facilities. In a short while Ephraim Shay became inundated with orders for similar machines.

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# Departures

Continued from Page 4 - *Shay*

Luckily, he was a very shrewd man business. The gibes of his competitors did not dissuade him from protecting the salient points of his ideas by means of Patent Acts. Then inquiries began to roll in from other sources. Contractors who appreciated the advantages of mechanical haulage, but who were faced with similar conditions concerning primitiveness of track, banks and curves, having heard of the achievements of the Shay geared engine, wanted them for their works.

The designer not being able to meet these demands by his own efforts, transferred his patents to two concerns, the Carnes Agerter Company and the Lima Locomotive and Machine Company, since amalgamated and now known as the Lima Locomotive Corporation, of Lima, Ohio. The invention, now placed in the hands of experienced and expert engineers, was developed very rapidly along approved locomotive lines.

Colloquially it has become known as “The Hill Climber”, and the nickname is appropriate. Its range of workability is wide both as regards gradients and curvature. It will climb banks ranging from 1 in 33 to 1 in 7 and will negotiate curves of 50 to 100 feet radius, conditions which it is safe to assert could not be fulfilled by many other types of locomotives with ease.



**Shay locomotive rounding a horseshoe curve of 164 foot radius 5% upon Mount Arisan Railway, Formosa.**

Although originally designed for service in lumber camps and upon contractors' works, it has passed to other more useful spheres. Being built in all sizes from 10 to 160 tons weight, it is equally applicable to trunk line working where stiff banks and sharp curves abound. True, its speed capacity is limited, but that is a secondary consideration so long as it moves the loads imposed to and from the points required.

Its salient peculiarity is the enormous power developed at slow speed, and its extreme flexibility in negotiating the sharpest curves. On the Mount Arisan Railway in Formosa the banks run up to a maximum of 1 in 20, while the sharpest curves are only of 164 feet radius. Another interesting application is that upon the Mount Tamalpais Railway in California, where the heavy grades and sharp bends of this sight-seeing line are overcome by means of the geared locomotive.

The modern expression of the Shay geared locomotive differs very radically from its original prototype although the fundamental characteristics are retained. The vertical boiler was discarded in favor of one of the conventional locomotive type, thereby bringing it into line with general practice. The locomotive is built on center bearing trucks, including the tender, which carries both fuel and water. The frame is of the plain girder instead of the special locomotive type, because it must provide a foundation of support and strength. The inverted engines, either two- or three-cylinder according to the size of the machine, are placed on one side of the center line for balancing purposes, strongly supported on the frame, and immediately under the observation of the driver. Although two cylinders are sometimes used, three forms the usual practice, to bring the setting of the cranks to 120 degrees. The vertical engines drive on a crank-shaft, which in turn is connected with the main line shaft, which is built up in sections and rendered flexible by means of universal joints and extension couplings. This shaft drives pinions which mesh with bevel wheels attached to the outer face of the truck wheels. Each wheel, both engine and tender, is geared, so that every wheel, irrespective of number, is converted into a driver. The gear ratio is about 19 to 42. Although three cylinders are employed, each is driven by high-pressure steam,

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# Manifest

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the pressure of the latter being 200 pounds per square inch. When viewed from the driving side the locomotive certainly presents a quaint and lop-sided appearance, but in its present form the locomotive represents the outcome of some 30 years' experience, so that the unworkmanlike design is more apparent than real. The driver has absolute control when ascending and descending the steepest grades. The machine is fitted with all the latest and usual locomotive fittings, and can, if desired, be adapted to the consumption of oil fuel.

system was adopted. In one case where Shay locomotives are at work it was found that whereas the maximum load capable of being hauled by the geared engine was 5,781 tons on the level, it could pull 1,556 tons up a bank of 1 in 100, 852 tons up 1 in 50, 484 tons up 1 in 25, and 235 tons up 1 in 16.66. The latter grade is quite impossible to ordinary adhesion working. The only alternative to the Shay geared locomotive was the rack system or the Fell center rail such as worked the mail traffic over Mont Cenis during the boring of the tunnel. Seeing that the conditions fulfilled in this instance were



**The largest and most powerful Shay geared locomotive in service.**

In running order, it weighs 160 tons, develops a tractive effort of 74,400 pounds, and hauls a load of 200 tons up a bank of 1 in 14.28.

When the Wolgan Valley Railway was carried some 30½ miles inland from Newnes Junction, on the New South Wales Government system, in order to tap the shale oil fields, the fact that some 1,760 feet difference in altitude had to be overcome in this distance offered a somewhat perplexing problem to the surveyors. The location gave banks of 1 in 22, and curves of 330 feet radius, which could not be eased owing to the configuration of the country. The operation of such a railway also occasioned considerable anxiety, as ordinary adhesion working was quite out of the question. The issue was closely investigated and after examining the Mount Tamalpais Railway and its Shay locomotives, which have to run over similar grades, and where the curves range between 70 and 80 feet radius, and also the Canadian Pacific Railway, where the Shay geared locomotives have to overcome curves of 230 feet radius, this

closely allied to those which had to be faced in Australia, twp. 70- and one 90-ton Shay geared locomotives were acquired for the Wolgan Valley line, this decision being influenced by its flexibility in conjunction and the enormous adhesion.

In the country of its origin the Shay geared locomotive has been adopted extensively and many striking machines of this type have been built. The latest and most remarkable is that designed for the Kansas City Southern Railway in connection with the operation of the new terminals of this system which have been completed on the north side of Kansas City, Missouri. This is the largest and most powerful geared locomotive in operation in the world to-day. It is of standard gauge with three cylinders, each of 18 inches diameter by a stroke of 20 inches, and 48-inch drivers. The boiler diameter varies from 67¾ to 79¼ inches, and steam is used at a pressure of 200 pounds. There are 347 two-inch boiler tubes 16 feet 4¾ inches in length between

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# Rare Mileage

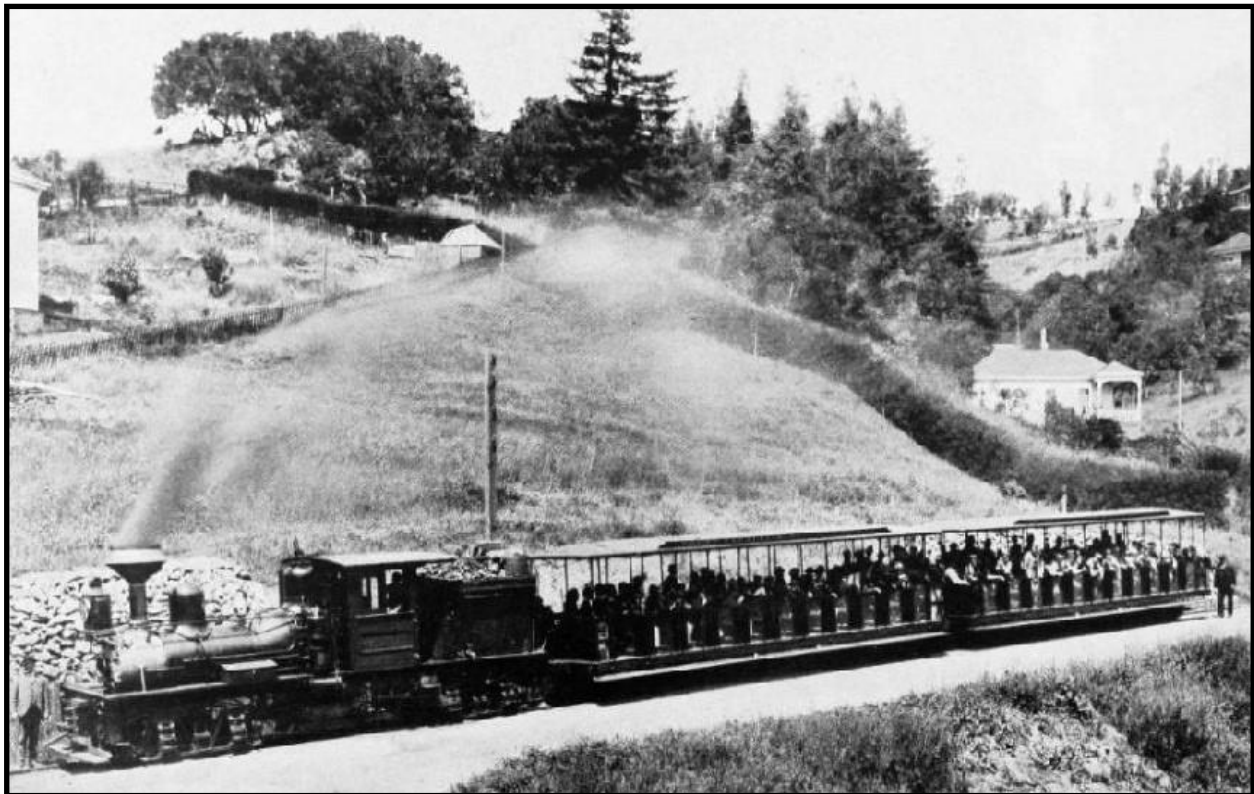
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tube sheets with an aggregate heating surface of 2,910 square feet. The fire-box measures 120 by 68½ inches, and has a heating surface of 185 square feet, so that the total heating surface is 3,095 square feet. The grate area is 57·1 square feet. The rigid wheel base is of 6 feet, and the total wheel base 52 feet 11 inches, while the over-all width is 11 feet 4 inches by 15 feet in height. The tender carries 5,000 gallons of water and 2,200 gallons of oil. In running order, the locomotive weighs 160 tons.

The duty which this engine must fulfil is of a very exacting character and demonstrates very conclusively the enormous power developed by this geared system. Owing to every wheel being a driver and available for adhesion the locomotive can develop a tractive effort of 74,400 pounds. It was designed to haul a train load of 200 tons up a grade of 1 in 14·28 on which there are some sharp curves, and upon reaching the top of the bank to negotiate curves of 95·5 feet radius to move the cars to and from the various warehouses.

Even though this huge geared locomotive was built 30 years after the inventor, Mr. Ephraim Shay, contrived his first crude engine to facilitate his logging operations, strict adherence has been made to the original Shay idea - the vertical cylinders are placed on the side and are geared with each wheel by a flexible shaft, so that each wheel becomes a driver, and all the weight of the locomotive and tender is disposed over the driving wheels. Since Mr. Shay evolved his unique solution for overcoming an exasperating difficulty in the backwoods of Michigan several different types of geared loco-motives have appeared, but it is interesting to observe that the Shay has more than held its own, over 2,000 locomotives of this type being in daily use throughout the world. Although the Mallet articulated, Fairlie, Garrett and other duplex forms have appeared since, the Shay geared locomotive still is preferred for service under conditions closely analogous to those for which it was first designed.

*This is an early accounting of the Shay and it's unique design features. Ed.*



**The Shay geared locomotive at work on the Mount Tamalpais Railway in California.**

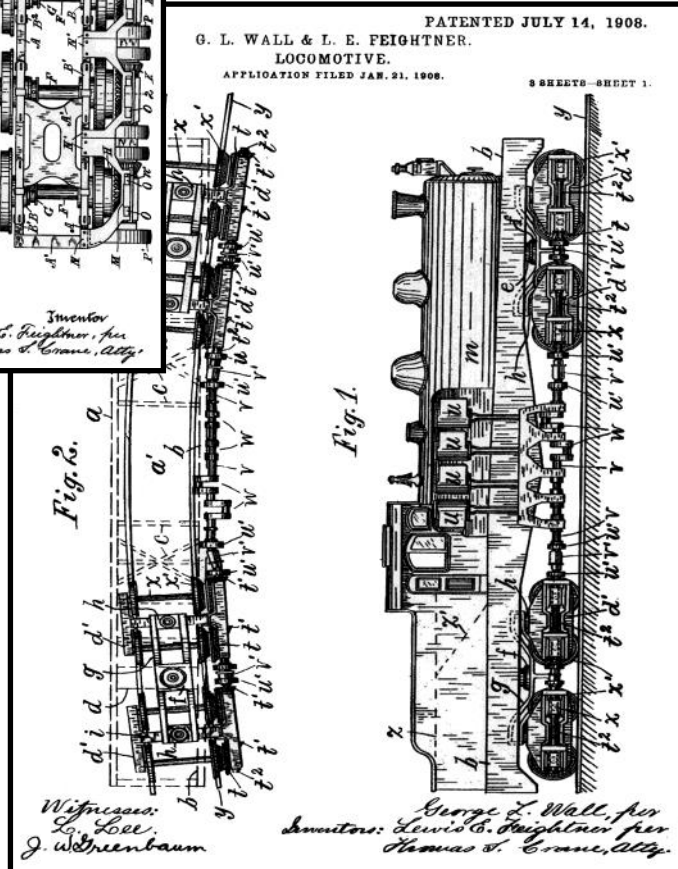
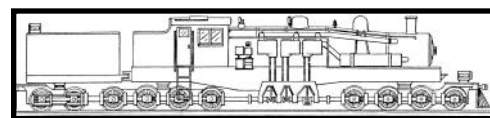
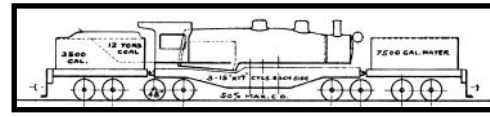
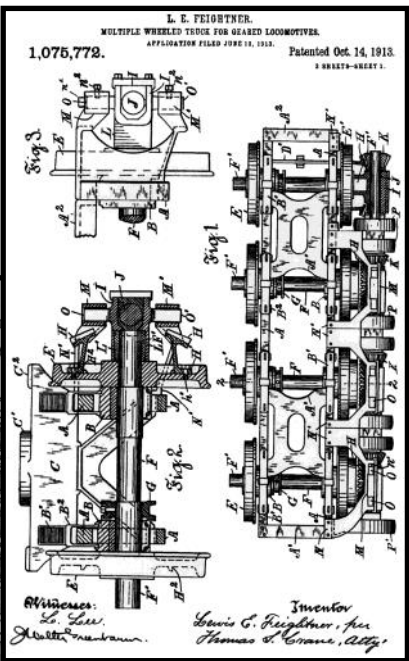
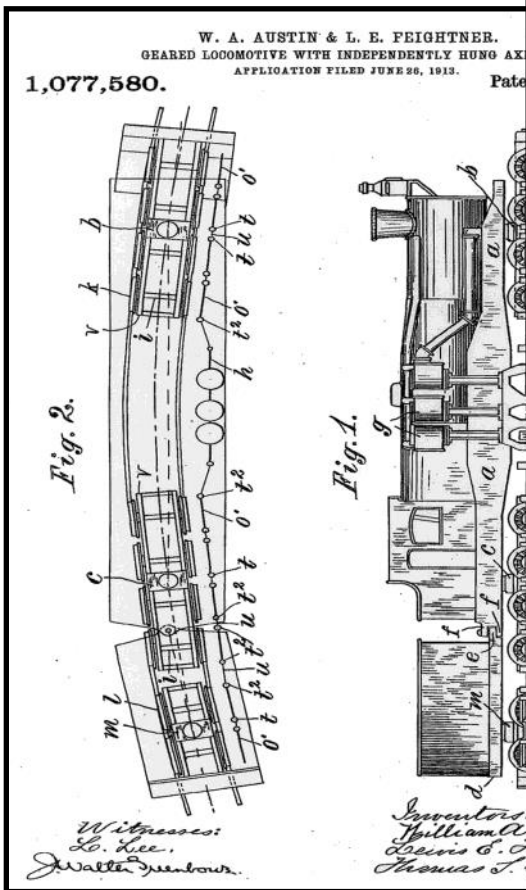
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# Marker Lights



Continued from Page 7 - *Shay*

Ideas for improvements of the Lima Shay locomotive that were patented but never produced.



CHECK OUT THE CRHA:  
[WWW.HUBCITYRRMUSEUM.ORG/CAROLINA-RAILROAD-HERITAGE-ASSOCIATION](http://WWW.HUBCITYRRMUSEUM.ORG/CAROLINA-RAILROAD-HERITAGE-ASSOCIATION)  
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