CHAPTER 18

Engines & Shop Log

- Granger Family Collection

Accurately tracking the Mt. Washington Railway's rolling stock from birth to retirement is difficult because the patient's long history *(both locomotives & coaches)* through many surgeries and repairs performed by different mechanics over the years while trying to keep the trains moving during a short operating season. Glen Kidder's 1969 book, *Railway to the Moon* attempts to nail down the development & pedigree of the Cog engines seen in photos and discussed in news accounts. This chapter begins with a visual recap of Kidder's list of early locomotives, then adds more detail to the Kidder account by transcribing and collating the written notes found of those performing the work on each of the individual machines. That section begins with a one-page typewritten pedigree summary from February 1974 when the new manager, Edward Clark was taking over from Paul Dunn. It continues with individual engine and coach charts taken from three main sources. Notes in the usual Baskerville typeface indicates the information came from a hand-written ledger in Bencosky-Desjardins files. Notes in the Avenir typeface indicates information from single typed locomotive pages for # 1 and # 3 found in MWCR files by Jitney Jr on February 4, 2019. The last main source for the information contained herein are photocopies of shop logs found in New Hampshire Transportation Department files in February 2020. It concludes with a roster of BC&M and B&M locomotives used on the spur line from 1876-1931.

While the notes here will help the next researcher tackling individual engines' development over time, the regular reader should finish with a better understanding of the mechanical toll taken on the 19th Century equipment bringing tourists up and down Mount Washington.

Mt. Washington Railway Locomotive Roster

1866-1878

Glen Kidder List

Locomotive No. 1 - *Hero (aka Peppersass)*

Builder: Campbell & Whittier, Cambridgeport (Roxbury), MA

1866

Otto Gruninger 1869 description: "On the first engine the sizes of the forward and rear driver wheels are different; likewise the forward axle is set more deeply in the frame; the two have the purpose of bringing the locomotive into a more nearly horizontal position, so that the angle a is the average gradient angle of the line. The frame consists of part wood and part iron. The lengthwise walls, each consisting of two½" strong sheets of iron riveted together... The boiler itself is vertical and is suspended somewhat forward of the center of the frame, measured lengthwise, installed on a support made of bent angle irons. The original arrangement allowed for it to remain consistently vertical at all gradients by revolving in its support. Subsequently, however, the small energetic vibrations to which this mighty pendulum was subjected as a result of the irregularities of the line as well as the movements occasioned by the masses being carried, proved so deleterious to the seal [of the steam duct] that the position had to be fixed. Steam pressure is proportionately enough to provide, on average, 75 to 80 hundredweight overpressure. The chimney rises from the cab to a height of 14 to 15 feet. There is no cladding of the boiler worth mentioning. Wood is used for burning; if coal were used, the same dimensions would give the boiler a significantly higher hauling capability, an especially promising detail for the *(Rigi)* project... A small steam-pump device handles the feeding of the boiler... (I)n spite of the complete lack of springs the journey was a relatively smooth one and in addition no shocks, or, better, vibrations, could be felt in the ordinary passenger coaches, that is probably on account of the elastic super- and substructure... Coupling mechanisms are likewise lacking. Passenger coaches are continually pushed upwards by the engine with no further connection to it... The tender, which is built to extend somewhat beyond the rear [bumper], is nothing more than a wooden barrel with [inch-thick?] walls; it serves only to take on fuel; water is carried in a special metal reservoir. This is rather small; it lies under the floor in front of the rear axle. Its dimensions.are: length (measured between the two frames) 4 feet; height 2 feet; width 1 foot 9 inches. The locomotive weighs 6 tonnes and is... in a position to carry a load of 6 tonnes on the upward-bound journey, This first engine is run at 3600 feet per 2 hours. That is the way the engine functions under normal circumstances. Mr. Marsh designates 3 English miles... per hour of time. This has been established as a rule for the prevailing grades. I was not able to obtain any exact data on the consumption of water. What the leading engineer was able to tell me would be based only on approximate information. According to that, one trip *(by Locomotive No. 1)* would require fifteen (15) 32-gallon barrels or 480 gallons. Between the start and the end, three water stations were laid on at approximately equal distances apart *(Cold Spring, Jacobs & Gulf?)*. Originally a number of barrels were placed on a structure from 6 to 7 feet high, which were (supplied) by means of long lead pipes (1200 feet) coming from springs high up. 3/4 of a cord of wood are calculated for each trip. This comes to a value of two dollars."

Locomotive No. 2 - *Not Named*

Builder: Walter Aiken, Franklin, NH

1868

Otto Gruninger: "Three engines are part of the railway's rolling stock. Two were already used in the past year *(Hero & this loco)*, while the third is presently under construction. Of these engines only the first was accessible to me, since the second was out for repair. Common to all three engines is the number of drive axles; they have two with a wheelbase of 10 English feet... The wheels sit loose on the axles in order to produce gliding friction that would arise through the difference between (them) and... the cogwheels sitting on the axles. The second and third engines climb the peak in one and a quarter hours, including stops for water. The second and third engines carried more water aboard; they needed only two water stations placed at equal distances between the two end points *(Skyline & Waumbek)*. Instead of the barrels, wooden water [troughs] were used. 12 feet long; 6 feet wide; 5 feet high."

2nd Locomotive No. 2 - *Geo Stephenson*

Builder: Walter Aiken, Franklin, NH

1869

Otto Gruninger: "The third and most complete of the engines departs from the other two where power and weight are concerned, as well as in actual method of construction. Alterations of the third engine: The front and rear wheels are of equal size and placed at the same position of... the frame. Their diameter is equal to the... the cogwheel. The cab is placed in the middle. Everything is made of iron. The cogwheel that engages the rack for propulsion is on the rear axle "A," for reasons of safety, since the greater part of the engine's weight rests on the rear axle. Heavier loads can thus be conveyed. The drive-wheel on "A" is now larger, and instead of 11 cogs it has 20. Boiler. This is to be larger... Diameter 4½ feet; height 12 feet; It is fastened at its foot at a medium slope... directly to the frame by means of a wrought-iron frame, and no longer rests on an angle-iron platform. The funnel is built in the spark-catching style generally used by American railways. The tender is entirely of iron and is horseshoe-shaped, in the style of locomotive-tender with water reservoirs.

Locomotive No. 3 - *Not Named*

Builder: Walter Aiken, Franklin, NH

1869

Have not seen an image of this engine

Locomotive No. 4 - *Atlas*

Builder: Walter Aiken, Franklin, NH

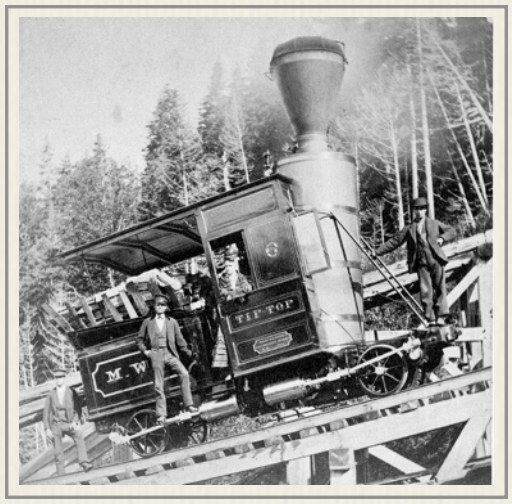
1870

Locomotive No. 5 - *Cloud*

Builder: Walter Aiken, Franklin, NH

1870

Both the *Atlas (right)* and *Cloud (left)* featured cabs that were aligned with the frame unlike the Geo Stephenson with its inclined cab.



Locomotive No. 6 - *Tip Top*

Builder: Manchester Locomotive Works, Manchester, NH

1874

First dual-drive engine with four cylinders - extended cab roof to protect wood supply

Locomotive No. 3 - *Hercules*

Builder: Manchester Locomotive Works, Manchester, NH

1874

First horizontal boiler engine with trailing tender

Boston & Maine Locomotive Roster

1935

Chas E. Fisher List

"In our last bulletin we listed the engines from the Fitchburg Railroad. This list did not include all of the locomotives owned by the subsidiary railroads which went to make up the Fitchburg R. R. The same system will be carried out in the matter of numbers - engines are arranged in their order on the subsidiary road and the 1895, 1899 re-numberings of the Fitchburg and Boston & Maine number will be indicated, provided the locomotive was not scrapped in the meantime.

MOUNT WASHINGTON RAILWAY

The Mount Washington Railway has the distinction of being first rack railroad built in the world. The road was chartered on June 25, 1858, in the State of New Hampshire, to build a railroad from the base station to the summit, a distance of 3.17 miles. Work was not commenced, however, until May, 1866 and a satisfactory trial was made over the 14 mile stretch in August of that year. The road was not completed to the summit until 1872 *(Ed note: July 3, 1869)*. The road was promoted by Sylvester Marsh and is termed the "Marsh System". The track was originally laid with 2x½" strap iron fastened on 6x7" longitudinal timbers, laid flat on the cross ties. It was 4'-7½ gauge and "T" rails are now used. The rack rail consists of 2-3x3x3/8" angles placed back to back between the rails, 4" apart, with 1-½" pins, 4" center to center for the rack teeth. The line commences 2668 feet above sea level and ascends 3625 feet, making an average of 1290 feet per mile. The maximum grade is 1980 feet or 37.5%. There are nine curves varying from 497 feet to 945 feet.

The first engine was named the *Hero*, nicknamed *Peppersass* on account of its high stack. It was built by Campbell & Whittier of Cambridgeport, Mass., in 1866. The boiler was hung on trunnions in order that it might remain in a vertical position on any grade. Steam connections and feed pipes were made through these trunnions. The cylinders were carried outside the frames, carried on four wheels and drove a crank shaft geared to the driving shaft. The gear on the shaft engaged the rack rail. The Boston & Maine assumed operation on June 29, 1895, through control of the Concord & Montreal R. R. Mr. Yeaton gives the following engines on the Mt. Washington Ry. **U** = Upright boiler, **H** = Horizontal boiler

1	*Hero*	Campbell & Whittier 1866 8x12" 2 cyl. 4 wheels **U**	
1	*Falcon*	Manchester 1883 8x12" 4 cyl. 4 wheels **H**	*Formerly #7*
2	*George Stephenson*	Walter Aiken 1869 10x16" 2 cyl. 4 wheels **U**	
2	*Eagle*	Manchester 1878 8x12" 4 cyl. 4 wheels **H**	*See Note.*
2	*Atlas*	Manchester 1875 8x12" 4 cyl. 4 wheels **H**	*Formerly #4*
3	*Hercules*	Walter Aiken 1869 10x16" 2 cyl. 4 wheels **U**	*Rebuilt.*
	Hercules	Manchester 1874 8x12" 4 cyl. 4 wheels **H**	
4	*Atlas*	Walter Aiken 1870 10x16" 2 cyl. 4 wheels **U**	*Rebuilt.*
	Atlas	Manchester 1875 8x12" 4 cyl. 4 wheels **H**	*See Note.*
4	*Not Named*	Manchester 1883 8x12" 4 cyl. 4 wheels **H**	*See Note.*
5	*Cloud*	Walter Aiken 1870 10x16" 2 cyl. 4 wheels **U**	*Rebuilt.*
	Cloud	Manchester 1876 8x12" 4 cyl. 4 wheels **H**	*See Note.*
5	*Not Named*	Manchester 1883 8x12" 4 cyl. 4 wheels **H**	
6	*Tip Top*	Manchester 1874 8x12" 4 cyl. 4 wheels **U**	*Rebuilt.*
		Manchester 1878 8x12" 4 cyl. 4 wheels **H**	
7	*Falcon*	Manchester 1883 8x12" 4 cyl. 4 wheels **H**	
7	*Not Named*	Manchester 1895 8x12" 4 cyl. 4 wheels **H**	
8	*Pilgrim*	Manchester 1892 8x12" 4 cyl. 4 wheels **H**	
9	*Not Named*	Manchester 1908 8x12" 4 cyl. 4 wheels **H**	

Note: The *Eagle*, Manchester, 1878, the rebuilt *Atlas*, Manchester, 1875, rebuilt *Cloud*, Manchester, 1876 and the *Falcon*, Manchester, 1883 were burned in a fire at the Lyndonville, Vermont, shops, where these engines

were repaired *(Ed note: NO! The fire occurred at the Base in May 1895)*, in 1895. The *Eagle* and the *Cloud* were scrapped, the other two engines were repaired renumbered as shown on Mr. Yeaton's list.

"Locomotives of the Boston & Maine Railroad" - The Railway and Locomotive Historical Society Bulletin , October, 1935, No. 38 (October, 1935), pp. 40-49

Mt. Washington Cog Railway Locomotive Roster

As of February 1974

Loco No.	Loco Name	Date Built	Builder	Remarks
1	*Mt. Washington*	1883	(1)	Re-constructed. See (1) and Loco #8 *(1892)* below.
2	*Ammonoosuc*	1883	(2)	Named *Atlas* when built *(1876)*.
3	*Base Station*	1883	(2)	Ex-#5 which originally was ex-#2 of the Green Mountain Railway
4	*Summit*	1883	(2)	Partially dismantled at present. Ex-#1 *Mt. Desert* of the Green Mountain Railway, Maine
5	(Not Named)	1883	(2)	Currently, there is no #5 as #5 was re-numbered to #3 to replace an earlier #3 *(Hercules)* scrapped in the early 1930's.
6	*Great Gulf*	1878	(2)	Named *Tip Top* when first built
7	*Falcon*	1895	(2)	Currently, there is no #7 as this locomotive was destroyed in an unusual accident in July 1897. See *Appendix* - 1897 *Falcon Takes Flight*
8	*Tip Top*	1892	(1)	Originally *Pilgrim (?)* - Currently, there is no #8. The chassis of #8 and the boiler of #1 were used to construct the present #1 in 1972
8	*Tip Top*	1983	(3)	#8 construction began 1978
9	*Waumbek*	1908	(2)	Only locomotive with cab on same plane as boiler
10	*Col. Teague*	1972	(4)	Named after the late Col. Arthur S. Teague of the Railway. First official trip on Sept. 24, 1972

(1) The chassis of one locomotive (#8) and the boiler of the other (#1) were used to construct the present #1 in 1972

(2) All locomotives were built by the Manchester Locomotive Works, Manchester, N.H. except #10. When #9 was built company known as Alco-Manchester Locomotive Works

(3) Built at Mt. Washington Cog Railway & was finished Thompson Manufacturing space in Lancaster, NH in 1983 by Maintenance foreman Michael Kenly of Jefferson, Andre Desjardins of Twin Mountain, and Frank "Chub" Kenison also of Jefferson

(4) Built by Mt. Washington Cog Railway under the direction of Niles LaCoss, at its shops

Shop Log: Loco No. 1

Engine No. 1 gets its tender filled with water at the Base (1930s)
- Robert J. Girouard Collection

Locomotive No. 1 - *Mt. Washington*

Date	Repairs	Category
1/1/1883	Built by Manchester Locomotive Works	*General*
1/1/1906	New Boiler - Water Glass 20⅝th inch	*Boiler*
1929	Retubed (from single typed page #1 Locomotive found in MWCR files)	
1941	7 staybolts put in top of flue sheet pitted a little backend	
1950	New tubes	
1951	Boiler inspected - had 3 broken staybolts - rest all ok	
1952	Three new staybolts	
1953	Tightened two boiler braces - Two broken staybolts	
9/15/1953	New Main Shaft rear with new boxes	*Main Shaft (boxes)*
6/10/1955	9 tubes bottom row replaced	*Boiler*
5/30/1956	New crankshaft rear	*Crankshaft (boxes)*
	Valve seats planed - new D-valves rear	*Cylinder*
	New piston rings rear	*Cylinder*
8/10/1956	New piston valves with new covers front	*Cylinder*
9/24/1956	Right front cylinder no counter bore / Di. 8.521 - inspected	*Cylinder*
9/27/1956	New Main Shaft front with new boxes	*Main Shaft (boxes)*
	New crankshaft front	*Crankshaft (boxes)*
	All crank boxes new	*Crankshaft (boxes)*
1957	Hydroed boiler - 1 broken staybolt - Interior above flues ok - King - Inspector	
9/2/1957	New piston valve front	*Cylinder*
1958	Hydroed boiler - 19 bottom flues - Interior above flues ok - King - inspector	
6/1/1958	2 bottom rows flues new	*Boiler*
6/15/1958	New stack	*General*
8/14/1958	Both front valves new	*Cylinder*
8/29/1958	Left front cylinder rebored new piston and ring	*Cylinder*
	Left rear cylinder new piston & ring	*Cylinder*

1959 Removed 6 staybolts for sheet inspection - 3 broken bolts - Repaired two loose braces - Ok above flues - caulked patch bolts back head - King - Inspector

6/30/1959	Boiler Re-tubed	*Boiler*

1960 Hydroed boiler - 3 broken staybolts back door sheet - One busted tube right side - Caulked front flue sheet seam - One front flue sheet brace loose - Flynn - Inspector

8/8/1960	New crankshaft front	*Crankshaft (boxes)*
	Rear crankshaft ground	*Crankshaft (boxes)*
	Both front cylinders news	*Cylinder*
	Both rear cylinders rebored	*Cylinder*
	Both rear valves new	*Cylinder*
7/10/1961	Boiler re-tubed	*Boiler*
8/8/1961	New Main Shaft rear with new boxes	*Main Shaft (boxes)*
	Rear crankshaft new	*Crankshaft (boxes)*
8/9/1961	New Box right rear	*Crankshaft (boxes)*

June 12, 1962 - Hydroed Boiler: 170 lbs following repairs made. Removed 7 broken stay bolts / entered boiler for internal inspection – found interior ok / renewed 1 broken stud at angle bar left side of fire box / removed all wash out plugs – washed out boiler – applied plugs

8/11/1962 New Main Shaft Front with new boxes - New 4340 main shaft front, bought *(11/27/1961)* from Brad Foote gear works. Order no. C9609 - shipping order no. 1318411, blue print #112-A-9 (modified) Cog bore 4.744 (key-way on cog ¼") 115 ton shaft 4.750 Main gear base 4.620, tool marks inside of this new gear from Grant 5.9.1962, gear scored somewhat while being pressed on shaft and required 95-100 tons to be pressed. Holes found in teeth. Shaft 4 ⅝ (4.625) Ratchet bore 4.372 20 ton Shaft 4 ⅜ (4.375)
The above shaft was installed front *Main Shaft (boxes)*

7/2/1963	Front & rear shafts re-ground & new boxes	*Crankshaft (boxes)*
	Left & right front valve sleeves ground, new spools & new valve rings	*Cylinder*

Left rear cylinder bored & valve seat planed. New piston & new rings. D-valve was re-faced after inspection that yoke fit properly *Cylinder*

Right rear piston & D-valve re-newed, valve seat in cylinder planed *Cylinder*

6/1/1964	New boxes rear	*Crankshaft (boxes)*

Left rear cylinder bored to 8.603, right rear check at 8.389 small, 8.396 large / Right front piston valve ground & fitted with new spool & rings *Cylinder*

Left front piston valve ground & fitted with new spool & rings *Cylinder*

8/4/1964 Right front piston valve & sleeve replaced with another which was slightly small on outside surface so was built up with nickel weld. New spool & new rings in re-ground sleeve *Cylinder*

8/7/1964 New crank shaft with one new box on D.E. & used box re-bored G.E., both boxes approx. 3/32" oversize in jaw, G.E. box built up on one side with electric braize & bored in center front *Crankshaft (boxes)*

10/3/1964	New boxes front	*Crankshaft (boxes)*

5/1/1965 Left rear cyl. Valve seat built up & planed, new D-valve, new stem, bored out & new piston & rings. Crack under valve chest chipped out & brazed *Cylinder*

Left front piston valve sleeve ground & fitted with new spool & rings *Cylinder*

Right rear cylinder planed, new D-valve with new stem, new piston & piston rings, new piston stem *Cylinder*

Right front piston valve sleeve ground & fitted with new spool & rings. New piston in cylinder with new piston rings & stem *Cylinder*

8/1/1965	Right & Left Front valve sleeves replaced	*Cylinder*

Shop Log: Loco No. 1

6/1/1966	Right & Left Front valve sleeves replaced	*Cylinder*
7/22/1966	New Main Shaft rear	*Main Shaft (boxes)*
8/1/1966	Right & Left Front valve sleeves replaced	*Cylinder*
9/1/1966	New crank shaft rear	*Crankshaft (boxes)*
	Above crankshaft broke & was replaced by another new shaft	*Crankshaft (boxes)*
10/1/1966	Front & rear shafts re-ground & new boxes	*Crankshaft (boxes)*
5/1/1967	Right & Left Front valve sleeves replaced	*Cylinder*
7/1/1967	Front shaft re-ground, new boxes applied	*Crankshaft (boxes)*
8/1/1967	Right & Left Front valve sleeves replaced	*Cylinder*
10/1/1967	Boiler re-tubed, new flue sheet front and new smokebox	*Boiler*
11/1/1967	New Main Shaft front	*Main Shaft (boxes)*
	Left rear cylinder bored & planed - applied 4/68	*Cylinder*
6/1/1968	Left rear cylinder - new piston & rings applied	*Cylinder*
	Left Back/Left front - valve rod brackets re-brushed & new pins applied to eccentric rod connectors.	*Cylinder*
	Steam lines to cylinder reworked. New mud plug applied in barrel of boiler. Angle iron applied over back head for cab fastening.	*Boiler*
	Both back valves inspected - gaskets annealed & shim plates adjusted	*Cylinder*
8/1/1968	Front shaft re-ground, new boxes applied	*Crankshaft (boxes)*
	New cab ordered - old cab removed	*General*
	2 new engine wheels applied front end	*General*
9/1/1968	New ash pan applied	*General*
	Water cocks relocated - Teflon flexible lube lines applied	*Boiler*
10/1/1968	Teflon oil lines	*General*
	New ash pan	*General*
6/1/1969	New cab applied	*General*
	Rear shaft turned & reground - new boxes applied	*Crankshaft (boxes)*
	R.F. valve sleeve new	*Cylinder*
	Cylinder rings - R. Rear - R.F. & L.F. inspected R & L.F. valve rings - new L.F. - R.F.	*Cylinder*
6/1/1970	New rear crankshaft and boxes applied	*Crankshaft (boxes)*
	Right rear crank jaw in frame out of alignment. Built up with electric weld and ground out to correct this	*Crankshaft (boxes)*
7/1/1970	New tire - left rear	*Main Shaft (boxes)*
8/31/1970	Front crankshaft re-ground, new boxes applied - Center bearing the same	*Crankshaft (boxes)*
6/1/1971	Arc Welded frame front of right rear cylinder	*General*
7/1/1971	Arc Welded frame adjacent to previous weld right rear cylinder	*General*
8/1/1971	Arc Welded main frame between ratchet cross member & front main shaft right side	*General*
5/3/1976	Hydrostatic test @ 221 lbs. - one leaking stay rivet in flue sheet; Badly cracked dome cover - replaced 5/4/1976 with same from #3 loco	*Boiler*
	Internal inspection revealed ALL stays in good shape; All points in place & all cotter pins present. Crown rivet tight. Some flues badly corroded	*Boiler*

5/4/1976 Boiler checks ground *Boiler*

5/7/1976 Mud ring scraped out & washed *Boiler*

5/10/1976 Built new tender frame *General*

5/15/1976 Tender completed, assembled engine - Ready for service *General*

5/16/1976 Engine fired up for work train on 5/17/1976 *General*

5/17/1976 Shutoff valve for injector badly fouled up - nut holding valve in body stripped. Valve replaced w/ 2nd hand Lunkenhymer *Boiler*

6/1/1976 Replaced r. side upper threaded stud for cab support in boiler *Boiler*

6/1/1976 Set valve timing on front cylinders - Three (5 degree BTDC, TDC, 5 degree ATDC) drilled marks on eccentrics are NOT accurate for proper timing, nor are they identical. *Cylinder*

6/2/1976 Set rear valves & tightened backing plates on all *Cylinder*

6/2/1976 New bushing shrunk on R.F. counterbalance & new connecting rod with C.P. brass. New crosshead brass on same. NOTE: All valve seats, valve yokes & slide valves in good condition except L.R. - seat was built up at least once w/ braze & is cut in deeply - Braze is now very thing but apparently relatively flat & un-scored. *Cylinder*

6/3/1976 Stud inside cab holding bracket support for L. Auxiliary steam lines replaced *Boiler*

6/3/1976 R.F. connecting rod reshaped to keep C.H. & C.P. brass in alignment *Cylinder*

6/7/1976 Engine dropped R.F. main box binder on passenger run 6/6/76. 1 stud broken off in frame - removed by cutting & tapped. (Box jumped out of jaws causing itself, crank pin & box to heat excessively *General*

6/13/1976 Leaking boiler check repaired *Boiler*

6/26/1976 Replaced leaking economrer gasket & repaired leaking boiler check again Boiler

6/27/1976 Back 3 grates replaced *Boiler*

6/29/1976 Both crankshafts Magnafluxed - front shaft has several cracked teeth (marked with X's) otherwise OK - Rear shaft appears perfect. *Crankshaft (boxes)*

7/13/1976 Swing Checks in injector lines removed & ground *Boiler*

7/30/1976 Stack exhaust linkage re-worked to allow Side Exhaust to open fully *General*

8/1/1976 New exhaust nozzle installed & petticoat raised *Boiler*

8/1/1976 Pad bolt installed R. side *General*

1976 Total Season Trips: 43 *General*

1981	***May***	***June***	***July***	***Aug***	***Sept***	***Oct***	***Nov***
Trips	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Shop Log: Loco No. 2

Locomotive No. 2 - *Ammonoosuc*

Date	Repairs	Category
1/1/1876	Built by Manchester Loco Works	*General*
1/1/1905	New Boiler - water glass length 21 ¼"	*Boiler*
7/1/1938	New barrel	*Boiler*
6/15/1954	Boiler re-tubed	*Boiler*
8/22/1956	Right front piston and rings new	*Cylinder*
10/20/1957	Rear shaft ground new boxes	*Crankshafts*
	Right rear cylinder new piston and rings	*Cylinder*
	Right rear cylinder valve seat planed with new valve and gate	*Cylinder*
	Left front cylinder new piston and rings; valve seat planed with new D-valve and yoke	*Cylinder*
8/20/1958	New main shaft and boxes - rear	*Main Shaft (boxes)*
	New crank shaft with boxes rear	*Crankshafts*
8/8/1960	Rear crank shaft ground	*Crankshafts*
10/12/1960	Left front cylinder rebored new piston	*Cylinder*
	Right front cylinder new piston and rings	*Cylinder*
6/25/1961	New main shaft and boxes - rear	*Main Shaft (boxes)*
10/31/1961	All pistons & piston rings checked & OK	*Cylinder*
11/10/1961	Shaft Magnafluxed and gears turned; New boxes applied / installed rear (Inspected July 1969 - OK)	*Main Shaft (boxes)*
	New crank shaft and new boxes rear	*Crankshafts*
5/15/1962	New crank shaft and new boxes front	*Crankshafts*

June 20, 1962 - Hydroed boiler: 170 lbs following repairs made. Renewed 3 broken stay bolts / entered boiler for internal inspection – applied one new pin to right front flue sheet – renewed left front corner mud plug – removed all washout plugs – washed out boiler applied plugs.

8/31/1962 Front shaft re-ground, old boxes bored to fit *Crankshafts*

9/7/1962 LB cylinder - new rings (cyl. bore - 9.065 - 9.071) Crosshead from #1 & piston rod - with piston from #2; LB crank pin bearing - new; RB wrist pin bearing - new; Cause Piston key sheared pushed out head. *Cylinder*

10/1/1962 Left front piston & piston rings checked OK; new D-valve and yoke *Cylinder*

10/3/1962 Right front cylinder bored, new piston & piston ring & valve seat planed, new D-valve *Cylinder*

10/4/1962 Left rear cylinder bored, new piston & piston ring, valve seat planed, new D-valve & yoke *Cylinder*

10/6/1962 Right rear cylinder, piston and piston ring checked OK, valve seat was planed & new D-valve *Cylinder*

7/17/1963 Rear shaft re-ground, new boxes *Crankshafts*

10/7/1963 New main shaft front, shipment #603-1704, shipping date 6.15.62 from letter of *(10-30-61)* and 4-11-62; 4140 steel, rough turned, finished here to 4.840 on Cog surface, 4.732 Main and 4.447 ratchet surface. Code on gear end of shaft is BSCD 6 62 836 E 646E189. Installed with new boxes *(10-7-63)* *Main Shaft (boxes)*

6/10/1964 Rear shaft re-ground, new boxes *Crankshafts*

7/18/1964 Front shaft re-ground, new boxes *Crankshafts*

10/12/1964 Left rear cylinder checked OK *Cylinder*

Right front cylinder D-valve checked OK, piston ring shows some lateral play, pins tightened in ring *Cylinder*

Right rear piston ring & piston new, cylinder checked 8.379 small and 8.390 large, D-valve checked & OK *Cylinder*

10/12/1964 Left rear Cylinder checked OK, D-valve OK also *Cylinder*

5/1/1965 Left front cylinder bored out, new piston, ring. Valve seat planed & new D-valve installed *Cylinder*

7/19/1965 New main shaft rear, BSCO 5-64-521, E, 650H012; Cog surface 6", Main gear 6", Ratchet 5 ⅝". Bearings 4". Wheels 3 ½" OAL 66 ⅛". Cog required 55 yon, Main 50. Manal spec. bronze used in new bearings, Installed *(7-19-65)* / Main gear on above shaft is drawing #1620 Long & short addendum system from order (BFGW) #E3888, new (checked and OK - July 1969) *Main Shaft (boxes)*

Rear shaft replaced with long & short addendum system drawing #1620, B.F.G.W. order #E-3887 No fillet between Crank & Cam surface or between cam & crank boxes on either side, leeway on gear end was cut 90 degree wrong and this is stamped in root of Keresy *Crankshafts*

10/1/1966 Boiler re-tubed *Boiler*

7/1/1967 New front shaft installed with new boxes *Crankshafts*

10/1/1967 Rear shaft ground, new boxes *Crankshafts*

Left rear cylinder planed & counterbored *Cylinder*

Left front cylinder D-valve seat built up & planed. Cylinder was bored, new piston & ring *Cylinder*

Crank pin bearings rear renewed *Crankshafts*

7/1/1969 Rear shaft removed account broken frame jaw RB; Jaw welded - new bozes applied - shaft re-ground *Crankshafts*

Front crank pin bearings *Crankshafts*

Rear crank bearings *Crankshafts*

Shop Log: Loco No. 2

8/1/1969	New Teflon lubricator lines applied	*General*
	Left rear cylinder saddle broken - frame also broke back of cylinder - cylinder saddle brazed and planed - frame welded - engine needs new frame	*Cylinder*
1/1/1970	New frame applied - Rear brake: change of fulcrum on brake lever; thus, single adjustment; New 3" flexible exhaust lines applied.	*General*
	Two 9-inch cylinders - top valve; Two rebuilt cylinders applied - bottom valve; On forward steam - each cylinder has new 2" Barcos; Cylinder cocks on engineer's side - vent horizontal	*Cylinder*
5/17/1971	Steam gauge checked; gauge line annealed; Boiler hydroed 180 lbs/sq in	*Boiler*
9/1/1971	New firebox liner for door	*Boiler*
9/25/1971	Checked & applied new steam gauge	*Boiler*
9/1/1972	Saddle studs R.S.	*Boiler*
9/16/1972	Stack repaired	*General*
5/11/1976	Hydrostatic test @ 221 lbs. - 4 leaking plugs in cab, 2 on each side of boiler just in back of the water cocks. Right side front cab mount (upper stud) leaked	*Boiler*
	Repaired R.R. corner iron in cab. Ran 2 vertical rods (R&L Rear) from roof to center hole of rear corner irons; ran one horizontal rod from side to side just above door. Replaced or tightened loose bolts.	*General*
	Boiler checks ground	*Boiler*
5/15/1976	Internal inspection revealed somewhat rugged crown sheet but rivets & crown bolts all tight. 1 missing cotter pin in L.F. sling stay - was replaced most stays fair to poor.	*Boiler*
	Warning bell repaired	*General*
5/21/1976	Mud ring cleaned	*Boiler*
6/1/1976	Main box badly worn RR; RR crank box badly cracked & burned due to excessive hearing in Fall '75. Both boxes pulled Main Shaft (boxes);	*Crank Shafts*
6/3/1976	New main box installed - crank box cleaned up inside & new grease grooves cut (both RR) C.B. reinstalled Main Shaft (boxes);	*Crank Shafts*
6/6/1976	LR main box replaced	*Main Shaft (boxes)*
6/7/1976	LR eccentric & eccentric strap replaced a new	*Cylinder*
6/10/1976	New main binder RR	*Main Shaft (boxes)*
6/10/1976	New Crank pin brass LR	*Crankshafts*
6/12/1976	"New roof, 3 new rafters - new crosspiece atop door"	*General*
6/13/1976	New piston rings L.R.	*Cylinder*
6/14/1976	New piston rings L.F.	*Cylinder*
6/15/1976	Broken steam line to generator repaired	*General*
6/16/1976	New piston rings R.F.	*Cylinder*
6/16/1976	New valve sleeve L.F.	*Cylinder*
6/16/1976	New valve spool & rings L.F.	*Cylinder*
6/20/1976	"All valves set, timed & marked"	*Cylinder*
6/22/1976	Engine fired up for test run - rough as hell - possibly out of time or valve setting incorrect on one cylinder	*General*
6/24/1976	R.R. valve timing defective - sleeve was pressed incorrectly - valve was put to right & engine timed (was found to be way out) NOTE: L.F. & R.R. eccentrics badly worn.	*Cylinder*
6/25/1976	Engine fired up for passenger run on 6/26/76	*General*
6/26/1976	L.R. crankpin brass heated excessively, seized, replaced	*Crankshafts*

6/26/1976 Made 1st passenger run - lubricator quit - repaired by installing the tension spring in the oil feed valve, which was neglected when new valve was installed on 6/22/1976 *General*

6/27/1976 NOTE: On the morning of 6/27 a ¾" (approx) crack was noticed in the throat sheet L. side top. Engine was sidelined *Boiler*

7/2/1976 Mr. Malansen was called & approved A(rthur) Minot to weld throat sheet *Boiler*

7/3/1976 Hydrostatic test @ 221 lbs - seam next to weld weeped *Boiler*

7/3/1976 Secondary pop valve found to be defective - replaced with new 2 ½" Crane Air Pop - blow-down ring machined out for ⅔ rds, more clearance for steam - set at 140 lbs - 5 lbs blow back. *Boiler*

7/4/1976 Magnafluxed both shafts (all ok) *Main Shaft (boxes); Crank Shafts*

7/14/1976 Leaking tender seam repaired *General*

7/28/1976 New L.F. eccentric *Cylinder*

7/28/1976 Removed L. side forward steam piping & installed Barco new bushing threaded into cylinder & new pipes installed *Cylinder*

7/28/1976 New roller in block *General*

7/29/1976 Brakes adjusted *Crank Shafts*

7/29/1976 Exhaust & Forward Steam lines all tightened - new Barco gaskets *Cylinder*

8/1/1976 Crack appeared in curve at the top of back head. After grinding, crack was approximately 14" long with many smaller fatigue cracks radiating from main split. Mr. Malansen was called & boiler was condemned - engine sidelined for the duration *Boiler*

8/1/1976 Began stripping engine to remove boiler *General*

1976 Total Season Trips: 87 *General*

1981	***May***	***June***	***July***	***Aug***	***Sept***	***Oct***	***Total***
Trips	*0*	*8*	*7¼*	*61½*	*29¼*	*16½*	*122½*

1992	***May***	***June***	***July***	***Aug***	***Sept***	***Oct***	***Nov***	***Total***
Trips	*12*	*23*	*60*	*35*	*6*			

Shop Log: Loco No. 3

Locomotive No. 3 - *Base Station*

Date	Repairs	Category
1/1/1883	Built as #2 GMRR, Maine - became #5 MWR *(1895)*	*General*
1/1/1909	New Boiler	*Boiler*
1928	Retubed (from single typed page #3 Locomotive found in MWCR files)	
1938	Retubed / New flue sheet - front - and barrel patch	
1941	1 Staybolt - TS RS1 - frontend seam leak	
1951	Inspected 6.51 - one broken boiler brace - 3 staybolts	
1952	3 staybolts - New tubes - Two bottom rows	
1953	Boiler inspected 6/53 and retubed	
6/10/1953	Boiler re-tubed	*Boiler*
7/10/1954	New main shaft front	*Main Shafts & Boxes*
	New crank shaft front	*Crankshafts & Boxes*
	New crank shaft rear	*Crankshafts & Boxes*
	New main shaft rear	*Main Shafts & Boxes*
9/27/54	All cylinders taken off vave seats planed	*Cylinders*
	All cylinders new pistons and rings	*Cylinders*
6/22/1955	Boiler patched right side	*Boiler*
7/9/1956	Right front cylinder changed	*Cylinders*
	New valve and new piston and rings	*Cylinders*
7/15/1956	Front shaft ground - new boxes	*Crankshafts & Boxes*
9/14/1956	Rear shaft ground - new boxes	*Crankshafts & Boxes*
1957	Hydroed boiler - 6 broken bolts - caulked rivets and seam in front flue sheet - Interior inspection ok - James King - Inspector	
9/8/1957	Right rear valve seat planed	*Cylinders*
	Right rear valve with yoke new	*Cylinders*
1958	Hydroed boiler - 4 broken bolts - Internal inspection ok - James King - Inspector	
5/10/1958	Left front cylinder piston and rings	*Cylinders*
	Right front cylinder rebored - new rings - valve seat planed new valve and yoke	*Cylinders*

1959 Removed and applied 20 tubes - Removed and applied 12 rivets bottom of front flue sheet - Hydroed boiler - 2 broken staybolts - Tightened braces - R & L sides of boiler - Internal inspection ok above flues - James King - Inspector

1960 Hydroed boiler - 7 broken staybolts - 5 on door sheet - one R side and one L side - Internal inspection ok above flues. Welded two cracks top of door sheet - Flange Knuckle - W. R. Flynn - Inspector

8/12/1960	Rear shaft ground - new boxes	*Crankshafts & Boxes*
10/10/1960	Front shaft ground - new boxes	*Crankshafts & Boxes*
9/8/1961	New front shaft & crank	*Crankshafts & Boxes*
10/1/1961	Left rear cylinder bored - valve seat planed - new valve and yoke - new piston & rings	*Cylinders*
	Right rear cylinder bored - valve seat planed - new valve & yoke - new piston & rings	*Cylinders*
10/23/1961	Left front & right front piston rings checked - new D-valve on both	*Cylinders*
11/27/1961	New 4340 shaft with new boxes bought from BFG Order #C9609 - Shipping order #B-18411.	*Main Shafts & Boxes*

June 22, 1962 - Hydroed boiler: 170 lbs following repairs made – tapped out front belly plug – have applied new plug / caulked patch on right side of back head – entered boiler for international inspection – tightened one front flue sheet brace on right side – applied new pin to same – removed all washout plugs – washed out boiler – applied same.

7/14/1962	Rear shaft ground - new boxes	*Crankshafts & Boxes*
8/3/1962	Right front main box new	*Main Shafts & Boxes*
5/1/1963	Left front cylinder bored to 8.410, new piston & new piston rings	*Cylinders*
	Right front cylinder checked 8.595, new piston and rings	*Cylinders*
10/11/1963	Front shaft ground, new boxes on drum end, used box re-bored on gear end	*Crankshafts & Boxes*
11/5/1963	Installed in rear	*Main Shafts & Boxes*

5/1/1964 New cranks shaft rear, received 10/22/1962; Flame hardened to 350-380. New box on drum end, used box was built up one side & bored true for rear end, installed" *Crankshafts & Boxes*

5/1/1964	All cylinders & rings checked O.K.	*Cylinders*

8/15/1964 New main shaft front, for shaft specs and shipping date see Loco #8 from of 9/15/1963. This shaft was installed with new boxes 8/15/1964" *Main Shafts & Boxes*

May 1965	Left & right front D-Valve castings built up & milled to fit yoke	*Cylinders*
	Pins tightened in piston rings both fron Cylinders	*Cylinders*
	Both rear pistons, rings & D-valves checked - O.K."	*Cylinders*

6/25/1965 New barrel applied, new front flue sheet, flues installed, ⅔ staybolts put in throat sheet & both side sheets, lower half of inside side sheets renewed & electric welded in place, new blow down valve (Okade) new 3" main steam valve. All boiler braces checked & tight, boiler hydroed to 180 lbs, new safety valve installed in dome." *Boiler*

8/1/1967	New Main shaft rear	*Main Shafts & Boxes*
July 1968	New stack applied - water cocks relocated	*Boiler*
	Waterglass mounts relocated	*Boiler*
	Main shafts & gears cleaned & inspected - indicated for run out - all ok	*Main Shafts & Boxes*

Shop Log: Loco No. 3

L.F. cylinder new piston & rings - X-head pin & bearing new - injectors reworked - new fittings applied - new cab applied - copper oil lines from lubricator to cylinders replaced with Teflon™ flexible lines - Cylinder cocks operating mechanism modified - Lubricator was out. *General, Cylinders, Boiler*

Front crank shaft reground - (center bearing new) - 2 new bronze boxes *Crankshafts & Boxes*

6/1/1970	New bottom to ashpan applied	*General*
7/1/1970	New tire - left rear	*General*
8/22/1970	New front crank shaft and boxes applied	*Crankshafts & Boxes*
9/27/1970	New right rear crank shaft bearing applied	*Crankshafts & Boxes*
10/7/1970	New stack screen applied	*General*
5/17/1971	Gauge checked 180 lbs./sq. in. Hydroed	*Boiler*
August 1971	Complete set of new brake linings	*Main Shafts & Boxes*
	New rings applied LB & LF cylinders	*Cylinders*
	New crosshead brasses applied to LR & LF	*Crankshafts & Boxes*
	New brake arm pivot rear applied	*General*
	Both rear D-valve yoke wear checked	*Cylinders*
	Cam strap pins applied on front end	*Cylinders*
	Two rear cam straps holds built up with arc weld	*Crankshafts & Boxes*
	Left rear pin reamed 1 1/16"	*Crankshafts & Boxes*
	Right rear pin reamed 1 ⅛"	*Crankshafts & Boxes*

Welded main frame (arc) between boiler support and ratchet lifter assembly *General*

Arc welded broken frame LR cylinder *General*

	Welded crack left side frame ⅓ of the way down	*General*
	New center bearing casting applied to rear	*Crankshafts & Boxes*
	Applied 3 long Teflon lines. RF, LF, & LR	*General*

New machined exhaust 3" line nipples front & back of stack exhaust valve. *General*

9/1/1971 Applied ⅛" shims between top of front axle bearing & frame *Main Shafts & Boxes*

9/18/1971 R.F. Cylinder bore 8.635 - new piston & rings; R.B. cylinder bore 8.548 new rings; L.F. cylinder bore 8.465 new rings; L.B. cyinder bore 8.305 new rings; New crank pin bearing L. F.; New crank pin bearing L.B. *Cylinders*

9/23/1971	Adjusted valve plates	*Cylinders*
7/1/1972	Rear crank shaft broke - new applied	*Crankshafts & Boxes*
Sept 1972	New main bearing applied - front main	*Main Shafts & Boxes*
	Front crank turned - applied with new bearings	*Crankshafts & Boxes*
	Center bearing babbitted	*Crankshafts & Boxes*

5/4/1976 Hydrostatic test @ 221 lbs - 2 broken stay bolts - back sheet just above Firebox door - leaking blowdown (extremely stiff-acting valve) Possible leaking pad bolt - r. side. Leaking seam in fire box just above door - needs caulking *Boiler*

5/11/1976	Mud ring scraped & washed	*Boiler*
	Boiler checks ground	*Boiler*

5/15/1976 Internal inspection revealed several poor, badly corroded longitudinal stays & flues in generally poor condition - Dryline has been chafing on crown bolt & appears quite thin at that one point *Boiler*

5/21/1976 Mud ring cleaned *Boiler*

6/25/1976	Replaced 2 staybolts mentioned on note of 5/4	*Boiler*
	New dome cover completed & installed	*Boiler*
6/27/1976	Engine assembled, fired up, made 1st uneventful passenger run	*General*
7/1/1976	Engine sidelined due to 1 broken & 1 Leaking pad bolt - old bolts removed	*Boiler*
7/2/1976	L.R. exhaust flange leading badly - flange & section of pipe removed - 3 stud holes drilled, tapped & helicoils placed	
	R. Side injector removed & disassembled - all seats ground - overflow valve was very poor.	*Boiler*
7/8/1976	4 new pad bolts installed, r. side (welded through both sheets) & new pad made"	*Boiler*
7/10/1976	4 new pad bolts installed L. Side	*Boiler*
7/11/1976	Magnafluxed both cranks	*Crankshafts & Boxes*
	Exhaust nozzle found to be broken as it enters Smoke chest - straightened, welded. Blower nozzle tightened up, straightened & welded.	*Boiler*
7/17/1976	Caulked leaking seams in two places on patch above Firebox door	*Boiler*
7/23/1976	Welded exhaust line - broken @ "Y"	*Boiler*
	Adjusted brakes	*General*
8/1/1976	New side stack valve	*General*
	Front brakes relined	*General*
	Badly leaking flue welded	*Boiler*
8/2/1976	Welded new rim around stack - new bonnet & new rim welded on stack - all the way around.	*Boiler*
8/3/1976	New brass in L.R. valve stem guide	*Crankshafts & Boxes*
9/1/1976	New water glass & gaskets	*Boiler*
	Repaired crack in R.R. eccentric strap	*Crankshafts & Boxes*
	1976 Total Season Trips: 177	*General*

1981	***May***	***June***	***July***	***Aug***	***Sept***	***Oct***	***Total***
Trips	*0*	*0*	*48*	*43*	*39¼*	*15½*	*146*

1992	***May***	***June***	***July***	***Aug***	***Sept***	***Oct***	***Nov***
Trips	*18*	*27*	*53*	*51*	*2*		

Shop Log: Loco No. 4

Locomotive No. 4 - *Summit*

Date	Repairs	Category
1883	Built as *Mt. Desert* GMRR - became MWR No. 4 *(1895)*	*General*
1/1/1908	"New Boiler - water glass length 19 5/8"	*Boiler*
6/1/1948	Boiler re-tubed	*Boiler*
	New flue sheet front	*Boiler*
5/15/1955	New main shaft front	*Main Shaft (Boxes)*
	New Main shaft rear	*Main Shaft (Boxes)*
	New crank shaft front	*Crankshafts and boxes*
	New crank shaft rear	*Crankshafts and boxes*
6/13/1955	Rear cylinders bored out	*Cylinders*
	Valve seats planed	*Cylinders*
	4 new pistons with rods & rings	*Cylinders*
	New Piston valves front	*Cylinders*
7/15/1956	New Piston valve left front	*Cylinders*
8/19/1956	Front shaft ground new boxes	*Crankshafts and boxes*
6/5/1957	New piston valves left and right front	*Cylinders*
8/15/1957	New crank shaft front with new boxes	*Crankshafts and boxes*
8/29/1957	New piston valves left and right front	*Cylinders*
	New piston and rings LF	*Cylinders*
10/10/1957	All piston and rings checked O.K.	*Cylinders*
6/6/1958	Both rear cylinders rebored - valve seats planed - new valves with new piston and rings	*Cylinders*
9/13/1958	Front crank shaft ground - new boxes	*Crankshafts and boxes*
7/23/1959	New main shaft front	*Main Shaft (Boxes)*
	New crank shaft with new boxes rear	*Crankshafts and boxes*
8/12/1960	Rear crank shaft ground new boxes	*Crankshafts and boxes*
6/30/1961	Boiler re-tubed	*Boiler*
9/1/1961	New valves and valve rings 2 front cylinders	*Cylinders*
10/31/1961	All pistons & rings checked & OK	*Cylinders*
5/1/1962	Right front piston valve new	*Cylinders*

June 18, 1962 - Hydroed boiler: 170 lbs following repairs made. Renewed 4 broken stay bolts – caulked left front side of Walker sheet. Welded left top flue sheet flange – entered boiler for international inspection – renewed 2 pins in front flue sheet 13 more on right side – removed all washout plugs – washed out boiler – applied plugs.

7/2/1962	Rear crank shaft new with one new box on B.E. and used box re-bored on B.E.	*Crankshafts and boxes*
8/2/1962	Right front piston valve with cage 50% step seal 2.625 rings	*Cylinders*
8/2/1962	Right rear piston, ring, stem new"	*Cylinders*
5/1/1963	New piston & piston ring right front	*Cylinders*
7/26/1963	Shaft with BB and A stamped on gear end was Magnafluxed and put between center & O.K. This shaft installed front	*Main Shaft (Boxes)*
	Front crank shaft ground - new boxes	*Crankshafts and boxes*

8/14/1963 Shaft with (CC) stamped on main gear end and #10 stamped on ratchet end was Magnafluxed, then heated between centers in an attempt to straighten. After heating and using water on reverse side of bend this shaft was still .035 to .040 out of true. This shaft was installed rear. *Main Shaft (Boxes)*

May 1964	Left front cylinder rebored, new piston & ring, valve cage ground, new piston valve & rings	*Cylinders*
May 1964	Left rear cylinder rebored, new piston & ring, valve seat planed, new D valve	*Cylinders*
	Right front valve cage ground, new rings	*Cylinders*
	Right rear cylinder rebored, new piston & rings, valve seat built up & planed new D Valve	*Cylinders*
	Right & left rear counterbalances new	*Cylinders*
8/4/1964	New rings applied to left & right front valves	*Cylinders*
8/5/1964	Right front piston & stem new	*Cylinders*
6/11/1965	Right & Left front piston valve cages ground, new spools & rings, new gasket under right front cage	*Cylinders*
6/30/1965	Front crank shaft ground - new boxes	*Crankshafts and boxes*
7/2/1965	Rear crank shaft ground, new box on drum end, used box re-bored on gear end	*Crankshafts and boxes*
7/1/1968	Both front valve chest changed out	*Cylinders*
7/6/1968	This engine's boiler not sitting right in frame. New supports applied - engine used very little - no demand	*General*
7/1/1969	Frame broke off right side - broke in cylinder stud hole - welded frame - new type boiler support applied - engine test run - P.N.G. *(Pliney Granger)* says worked Ok	*General*
8/1/1969	New crank shaft applied & New boxes	*Crankshafts and boxes*
Sept 1969	Boiler re-tubed - *(Ray)* Gilman	*Boiler*
	Smoke screen new	*General*
	Flexible oil lines	*General*
5/10/1970	Tested Steam gauge 140#	*Boiler*
7/3/1970	Thirteen new rivets applied to bottom of front flue sheet. Flue sheet built up to full thickness with electric weld	*Boiler*
8/25/1970	Frame jaw slight crack Right rear jaw - frame jaws wearing out of line - New front crank boxes applied and shaft ground	*Crankshafts and boxes*
5/1/1971	Gauge checked & hydroed 180 lbs/sq. in.	*Boiler*

Shop Log: Loco No. 4

Crown sheet of the #4 - *David Huber: "The year I got stuck in the boiler inspecting ferrels on the front flew sheet. Wedged my hips between one of stay rods and top row of flews. Steve Christy had to heat the rod with torch to free me. Ever since this episode, I suffer claustrophobia, which seems to get worse as the years pass."*
- David Huber photo - MCWR: We Worked There (June 6, 2018)

8/24/1971 D valve cylinder from old #2 right front - new piston rings applied - Cam straps shortened 1 1/4" to accommodate D valve setup *Cylinders*

9/1/1972 Saddle studs renewed & saddle holes lined to carry load *General*

9/29/1972 New Main bearings applied - (Front) *Main Shaft (Boxes)*
New crank shaft & bearings applied front - Re-babbitt front center bearing *Crankshafts and boxes*

5/11/1976 Hydrostatic test @ 222 lbs - Leaking Barrel patch L. Side. 4 leaking rivets in a row - top of firebox door. Extremely thin, rusted through sheet - very bad leak next to welded stay-bolt in last row of stays before crownsheet in firebox just above door. This last area has already been Heavily padded w/ weld) several leaking seams including mudring. *Boiler*

5/15/1976 Internal inspection revealed 2 poor longitudinal stays, 3 fair stays. Crown sheet in excellent shape w/ good sling stays. Flues badly corroded especially at Back tube sheet. *Boiler*

5/17/1976 Boiler checks ground *Boiler*

5/22/1976 3 holes drilled in back inside sheet just above Firebox door. Sheet approximately 3/16" thick in all holes *Boiler*
Mud-ring cleaned *Boiler*

6/1/1976 Leak around staybolt inside firebox repaired & area padded *Boiler*

6/2/1976 A new section fo screen placed in bonnet to repair hole eaten out by worn out spark arrester *General*

6/3/1976 New spark arrester installed *General*

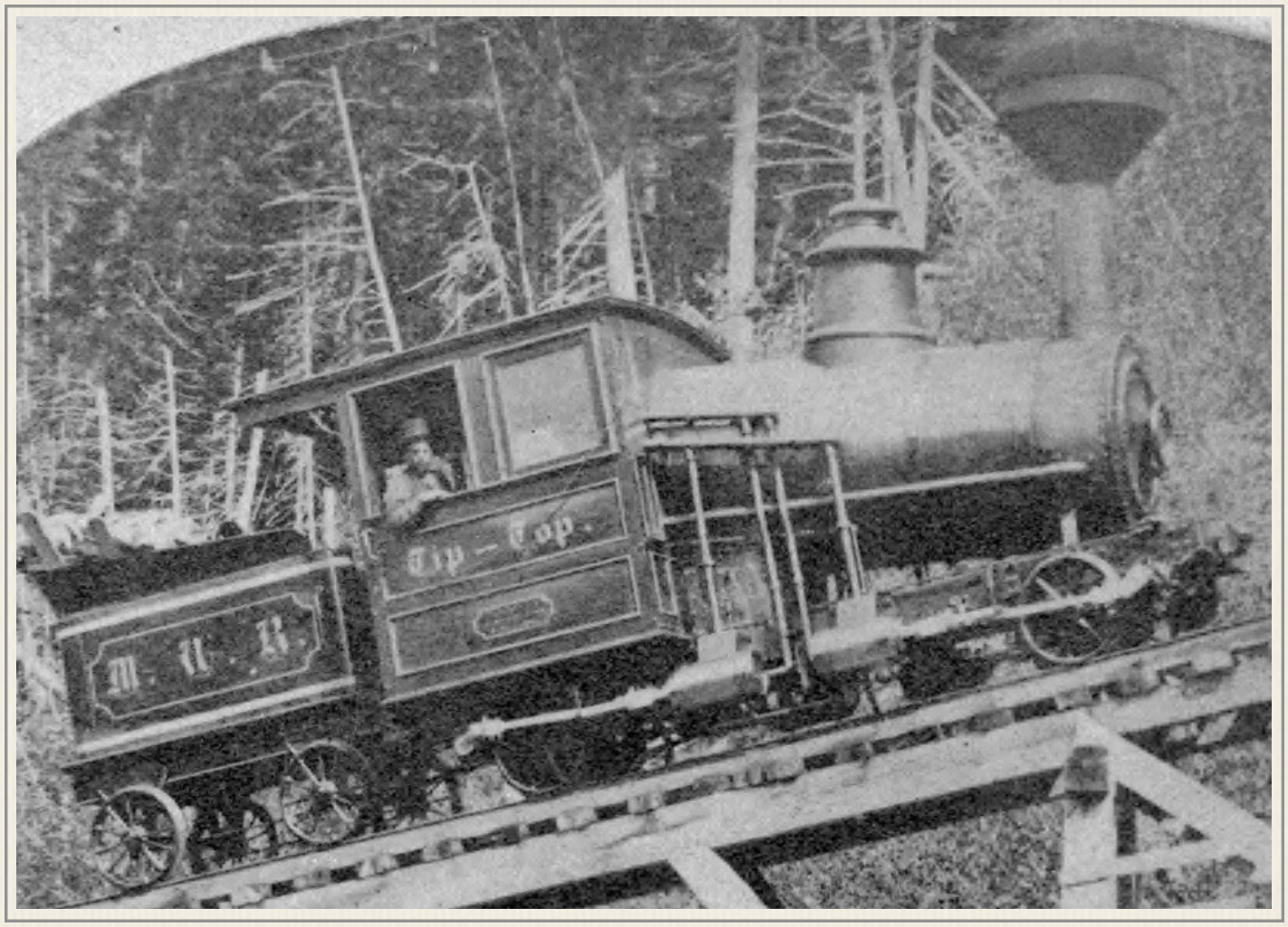
6/6/1976 New piston rings L.F. *Cylinders*

6/7/1976	New valve spool & rings L.R.	*Cylinders*
6/10/1976	Timed & adjusted all valves	*Cylinders*
6/11/1976	Cab mounting stud L. side bottom (in boiler) replaced	*Boiler*
6/12/1976	Engine prepared for service fired up made uneventful first passenger run	*General*
7/14/1976	Tightened up all forward steam lines	*Boiler*
	Repaired crack in boiler in back sheet just above mudring @ R.F. corner	*Boiler*
	Leaking tender seam repaired	*General*
7/15/1976	Magnafluxed both cranks & checked all valves for adjustment, readjusted R.R. & R. F.	*Crankshafts and boxes*
	Center x-member repaired	*General*
8/1/1976	Front brakes relined	*General*
	All exhaust piping tightened	*General*
	Blower pipe broken off & split - welded & reinstalled	*Boiler*
9/1/1976	Tender bearing R.F. fell apart - whole axle & bearings replaced	*General*
	R.F. crosshead replaced; R.F. inside guidebar replaced; R.F. crosshead brass replaced	*Cylinders*
	1976 Total Season Trips: 238	*General*

1981	***May***	***June***	***July***	***Aug***	***Sept***	***Oct***	***Total***
Trips	*0*	*4*	*24*	*33½*	*24¼*	*18*	*103¾*

1992	***May***	***June***	***July***	***Aug***	***Sept***	***Oct***	***Nov***
Trips	*4*	*34*	*49*	*61*	*5*		

Shop Log: Loco No. 6



Locomotive No. 6 - *Great Gulf*

Date	Repairs	Category
1878	Built	*General*
1/1/1905	New boiler - water glass length 20 5/8"	*Boiler*
7/15/1947	New frame and cylinders	*General*
6/23/1952	"Boiler retubed - length of tubes 70"	*Boiler*
5/15/1953	New crank shaft front new boxes	*Crankshafts (boxes)*
9/12/1955	New Main shaft front new boxes	*Main Shafts (boxes)*
5/10/1956	New Main shaft rear used boxes	*Main Shafts (boxes)*
8/1/1956	Used crank shaft rear new boxes	*Crankshafts (boxes)*
8/19/1957	Right and left front piston and rings new	*Cylinders & Valves*
9/20/1957	New crank shaft front new boxes	*Crankshafts (boxes)*
6/2/1958	Left rear cylinder rebored - new piston and rings	*Cylinders & Valves*
9/22/1959	New crank shaft rear new boxes	*Crankshafts (boxes)*
9/30/1960	Right and left front cylinders rebored with new piston and rings	*Cylinders & Valves*
9/30/1960	Right rear cylinder rebored new piston	*Cylinders & Valves*
10/12/1960	New cranks all around	*Crankshafts (boxes)*
9/25/1961	Right front cylinder rebored with new piston and valve	*Cylinders & Valves*
10/30/1961	Left rear piston & piston ring checked - ring shows wear O.K.	*Cylinders & Valves*
5/1/1962	Left rear rocker arm gas welded by P*(aul)* Ph*(ilbrick)*	*Cylinders & Valves*

June 17, 1962 - Hydroed boiler: 170 lbs following repairs made. Renewed 5 broken stay bolts – Renewed 19 bottom tubes – welded flue sheet flange and 7 5 bottom holes – renewed one rivet on left front side of barrel

patch – caulked at seam at same – entered boiler for internal inspection – tightened one front flue sheet on left side applied one new pin on same – removed all washout plugs – washed out boiler – applied plugs.

7/21/1962	New (soft) main shaft front & boxes	*Main Shafts (boxes)*
8/20/1962	New 4340 shaft with new main gear for # 6. The above was installed rear	*Main Shafts (boxes)*
8/27/1962	Used crank shaft front, ground new boxes	*Crankshafts (boxes)*
9/19/1962	Rear crank shaft which was installed in #6 *(9-22-59)* broke one tooth and was replaced by a shaft which was installed in #9 new in *7-8-62*. This shaft was re-ground, new boxes applied and installed #6	*Crankshafts (boxes)*
	Front shaft which was put in #6 on *8-27-62* was also removed and was replaced by front shaft from #9. This shaft was new on *9-14-58* and had been re-ground on *7-9-62*; it was ground again, new boxes applied and installed in front of #6	*Crankshafts (boxes)*
6/25/1963	Left & right front valve sleeves ground, new spools & new rings	*Cylinders & Valves*
	Left & right rear valves sleeves ground, new spools & new rings	*Cylinders & Valves*
7/3/1963	New 4340 shaft with new main gear, boxes were new in *7-21-1962*, were found to be O.K. so were re-installed. This shaft was installed front	*Main Shafts (boxes)*
7/1/1964	# 6 hydroed, 147 staybolts put in throat sheet, side sheets & butt, re-tubed with 229 new flues & flue sheets straightened, new partial side sheets welded in lower half of firebox on both sides. All work done in *10-63* but loco was not returned to service until *7-1-64*	*Boiler*
6/16/1965	All valve sleeves ground, new spools & rings	*Cylinders & Valves*
	Left front piston ring rivets tightened	*Cylinders & Valves*
	Right front piston ring rivets tightened	*Cylinders & Valves*
	Right rear piston & ring checked & O.K.	*Cylinders & Valves*
6/1/1968	#6 hydro - crack at throat sheet left side - patch applied & a Bader blow off valve applied	*Boiler*
	All rings & valves checked - rivets replaced	*Cylinders & Valves*
8/1/1968	Lateral rings applied - all main boxes	*Main Shafts (boxes)*
8/1/1968	New crank shaft applied - old boxes rebored for new shaft - lateral rings applied to end of boxes	*Crankshafts (boxes)*
June 1969	Rear crank shaft removed - bearings turned - new boxes applied & installed in #6 rear	*Crankshafts (boxes)*
	Pull pistons inspect rings - LF rings good for fair service	*Cylinders & Valves*
	Valves pulled - inspected rings - new rings applied all around	*Cylinders & Valves*
8/1/1969	Main boxes rear - removed & liners applied to take up lateral wear	*Main Shafts (boxes)*
5/1/1971	New lining in smoke box	*Boiler*
5/18/1971	Gauge checked and hydroed 180 lbs/sq. in.	*Boiler*
7/1/1971	Arc welded broken diagonal cross member; Arc welded cracked frame top between right side cylinders; Cracked frame welded between left cylinder and guide yoke; New rear linings applied - July and Aug 1971	*General*
	New elbow, new nipple and repaired & ground in seat to main steam dry line	*Boiler*
August 1971	Rear crank shaft ground new boxes	*Crankshafts (boxes)*
	New brake linings	*Crankshafts (boxes)*
6/1/1972	New tubes - 2 bottom rows plugged	*Boiler*
7/1/1973	New crank shaft (rear) & crank bozes old - just rebored	*Crankshafts (boxes)*
	New crank pin brass R.Rear	*Cylinders & Valves*

Shop Log: Loco No. 6

5/15/1976 Hydrostatic test @ 221 lbs. - 1 weeping staybolt in fire box just above door. Small leak in seam between side sheet & knuckle sheet L. side *Boiler*

5/17/1976 Internal inspection - No Problems *(crossed out then)* - sling stays acceptable, crown bolts O.K. Longitudinal stays acceptable, but poor. Front tube sheet & angle iron & anchors for stays badly rusted *Boiler*

Boiler checks ground - secondary safety valve broken internally *Boiler*

5/19/1976 Bad safety valve replaced by lever-type primary *Boiler*

5/24/1976 Rear brake relined & adjusted *Crankshafts (boxes)*

5/26/1976 Cleaned mudring - cut hole in frame to get into Fr. Water leg *Boiler*

Replaced steam gauge - old gauge probably frozen last winter - new gauge tested & reset *Boiler*

5/29/1976 Fired up for spare; replaced water glass *General*

6/3/1976 Old mud plug L. side back below floor boards was removed & mud ring was discovered to contain 6"-8" of rust & scale across back water leg - mud ring cleaned *Boiler*

Repaired rear brake arm fulcrum *Crankshafts (boxes)*

6/4/1976 Weldlet welded where old mudplug was cut out - new bronze plug installed *Boiler*

Pivot stud for grate shaker arm replaced *Boiler*

6/12/1976 Made uneventful 1st passenger run *General*

6/15/1976 Right Rear tender wheel removed - 2 set screws placed between wheel hub & internal bushing *General*

6/20/1976 Engine broke rear main shaft on passenger run of *6/20*. Cog gear was removed by cutting, was brought down with shaft in two pieces against flatcar & #10 loco" *Main Shafts (boxes)*

6/22/1976 Removed remnants of rear main shaft. Pressed #6 spur gear off broken shaft. *Main Shafts (boxes)*

6/23/1976 Put 175 tons pressure to press cog gear off #3's old 4340 main. Pressed off spur gears. Shaft taken to Berlin to have spur gear seat reduced to fit #6 spur gear - dye-checked new (used) shaft. *Main Shafts (boxes)*

6/24/1976 Pressed #6 spur gear on #3's main shaft @ 45 tons *Main Shafts (boxes)*

L. rear tender box in poor condition - packed with grease & reassembled *General*

6/27/1976 Installed rear shaft (Brad Foote gear) *Main Shafts (boxes)*

Dye checked rear crank - witnessed by: F. Kenison & E. Clark *Crankshafts (boxes)*

Old main boxes reinstalled w/ new brass spacers installed. NOTE: main boxes have approximately 1/16" play - crank boxes exc. *Main Shafts (boxes)*

6/28/1976 Crank replaced. Right rear connecting rod badly bent by main shaft failure. Straightened & replaced *Crankshafts (boxes)*

Engine completed - also installed new crosshead L. R. & New CH Brass *General*

Timed & adjusted rear valves *Crankshafts (boxes)*

7/8/1976 Rolled 2 leaking flues *Boiler*

7/9/1976 Replaced R. F. exhaust nipple *Boiler*

7/10/1976 New R.F. valve rings & sleeve *Cylinders & Valves*

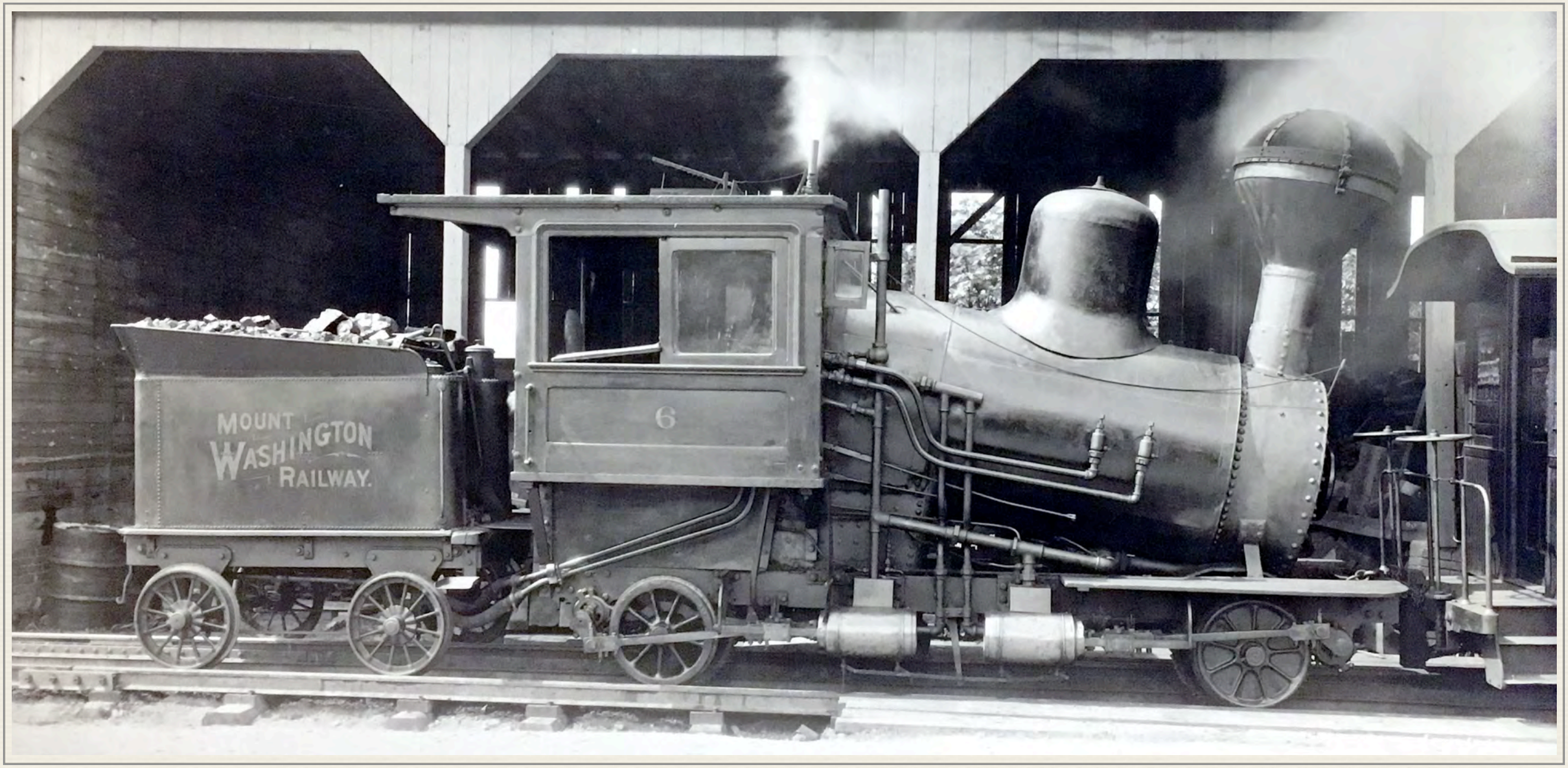
7/12/1976 Right Rear crank box seized on passenger trip of 7/11/76. Box removed & turned - shaft cleaned up w/ emory cloth reassembled & shaft was bound. *Crankshafts (boxes)*

7/13/1976 Crank removed & boxes turned *Crankshafts (boxes)*

7/13/1976	R.F. Exhaust nipple tightened	*Boiler*
7/13/1976	New packing gland R.F.	*Cylinders & Valves*
7/16/1976	Replaced "union" nut and coupling in suction line into R. injector (nut was stripped - injector would not work)	*Boiler*
7/18/1976	"Set screw in Valve sleeve sheared - breaking rocker box to hell - new rocker, valve spool, sleeve & rings installed @ L.R. (broke passenger trip of 7/17/76"	*Cylinders & Valves*
7/20/1976	Welded incessantly leaking flue	*Boiler*
7/25/1976	Rear brake shoes torn apart on passenger trip of 7/24 - ran into fliprail at Waumbek. Shoes removed & straightened - new hard linings & adjusting rod added.	*Crankshafts (boxes)*
7/30/1976	Patch welded on outside of forward steam ell on R. side	*Boiler*
	Welded broken exhaust line	*Boiler*
August 1976	Smoke box caved in where front boiler mount presses - hammered out dent - welded new 3/8" backer inside, made new iron for boiler support (L. Side)	*Boiler*
	New crossheads R.R. & R.F. - New & head brass R.F.	*Cylinders & Valves*
	Petticoat bracket broken & petticoat dropped down - repaired.	*Boiler*
	L.F. tender wheel had new bushing made, pressed in - tender shaft built up with weld & machined @ end of shaft"	*General*
	Front tender boxes leaned and repacked w/ grease	*General*
	Blower pipe repaired (broken off) & Upper petticoat mount welded	*Boiler*
	Auxiliary steam piping (from L. side of main steam) replaced	*Boiler*
	New grates installed	*Boiler*
	Badly leaking flue welded	*Boiler*
	Old open position door latch *r*emoved & hole welded	*Boiler*
	Tender piping removed & tightened	*General*
	Repaired broken long. Stay - main steam valved broke on Passenger trip of *8/30/1976* - valve disassembled & dry line removed	*Boiler*
9/1/1976	New Main steam valved & dry line installed	*Boiler*
	NOS bottom water glass valve installed from #2 Loco	*Boiler*
	1976 Total Season Trips: 188	*General*

1981	***May***	***June***	***July***	***Aug***	***Sept***	***Oct***	***Total***
Trips	*5*	*10*	*57¾*	*57½*	*26½*	*0*	*156¾*

1992	***May***	***June***	***July***	***Aug***	***Sept***	***Oct***	***Nov***
Trips	*4*	*28*	*70*	*82*	*8*		



Reference photo of No. 6 during Peppersass accident investigation in July (1929)
- New Hampshire Transportation Department Archives

Locomotive No. 8 - *Tip Top*

Date	Repairs	Category
1893	Built	*General*
6/15/1937	Patch applied to barrel	*Boiler*
	Mud plugs applied to barrel / water glass length 19 5/8"	*Boiler*
7/1/1952	Boiler re-tubed	*Boiler*
	Top part of flue sheet new	*Boiler*
6/15/1954	New main shaft front with boxes	*Main Shaft (boxes)*
	New main shaft rear with boxes	*Main Shaft (boxes)*
	New crank shaft front	*Crankshaft (boxes)*
	New crank shaft rear	*Crankshaft (boxes)*
1/1/1956	Original boiler in use	*Boiler*
7/10/1956	Rear shaft ground - new boxes	*Crankshaft (boxes)*
8/7/1956	New Piston Valves front	*Cylinders*
6/1/1957	Right rear and left rear valve seats planed	*Cylinders*
	New D valves new pistons and rings rear	*Cylinders*
7/29/1957	New Piston valves front	*Cylinders*
8/14/1958	Both front valves new	*Cylinders*
8/26/1958	All piston rings checked "OK"	*Cylinders*
	Both rear cylinder valve seats planed - new valves with yokes	*Cylinders*
8/18/1960	Rear shaft ground new boxes	*Crankshaft (boxes)*
	Both front valves new	*Cylinders*
	Right gasket blown	*Cylinders*
7/20/1961	2 front cylinders rebored with new pistons and rings, new valve cages and rings	*Cylinders*
11/1/1961	All pistons & piston rings checked & OK	*Cylinders*
11/25/1961	Rear shaft heated and straightened in lathe. Bearing surfaces trued and new boxes applied. Main & Cog gear turned. This shaft installed rear	*Main Shaft (boxes)*

Shop Log: Loco No. 8

12/1/1961 New shaft and boxes in rear *Crankshaft (boxes)*

June 14, 1962 - Hydroed Boiler: 170 lbs following repairs made. Renewed 4 broken stay bolts / caulked 6 rivets top of boiler back of smoke stack / entered boiler for internal inspection – found interior Ok – removed all wash out plugs / washed out boiler – applied plugs.

7/16/1962 Both left & right front piston valve cages ground with new spools & 2.625 50% step seal rings *Cylinders*

8/1/1962 Right front main box new *Main Shaft (boxes)*

8/3/1962 Left front piston valve installed with 50% steo seak 2.625 rings, found gasket partly steam cut & renewed same *Cylinders*

10/13/1962 Left & right front pistons and piston rings checked & found O.K. *Cylinders*

10/16/1962 Left rear cylinder checked O.K., same piston was installed with new ring; valve seat was planed, new D valve applied *Cylinders*

10/17/1962 Right rear cylinder re-bored new piston & piston ring; valve seat planed & new D valve *Cylinders*

9/15/1963 New crank shaft front - ordered *8/13/1962*, received *10/22/1962*, Flame hardened teeth, new 6" brake drum with 6" hub was pressed to 25" face to face between hub and spur gear, and was found to bring the brake band too close to the ratchet gear; with this measurement, there is 3/8" clearance between drum and crank box if the foz is 6" OAL. Old boxes were re-bored for this shaft and it was installed *Crankshaft (boxes)*

9/25/1963 Re-tubed with 230 new tubes, 47 new 15/16" staybolts put in throat sheet, 2 only 1" studs (staybolts) put in the first two belly braces on right side, one new pin installed in boiler brace (front pin on the bottom 2/3 brace from right side to front flue sheet) new cotter on same braced on back end. 9 new 3/4" x 2 1/2" rivets put in smoke box starting with the one off midway behind the stack and running down toward the right side. Bottom of the front flue sheet was padded or built up with electric weld, on the right side of the front flue sheet where this sheet had been welded in 1952 a small crack was found. This was burned out, chipped and re-welded. A crack was found in the back right corner of the inside back sheet in firebox between two rivets of the mud ring, this was burned out, chipped and welded. A hole was sawed out & tapped thru the patch and barrel on the left side of Loco for a new single injector. *Boiler*

9/26/1963 Rear crank shaft ground nw box on drum end & used box re-bored, built up one side 3/32" over 5" fitted to gear end *Crankshaft (boxes)*

6/15/1965 Left front valved cage ground, new spool & rings *Cylinders*
Right front valve cage ground, new spool & rings *Cylinders*
All pistons & piston rings checked & OK *Cylinders*

1/1/1967 New 6" shaft applied old style gear cast *Main Shaft (boxes)*

8/1/1968 Crank shaft boxes renewed front *Crankshaft (boxes)*

9/1/1968 New piston rings applied - valve rod bracket re-bushed - both front valve chest changed out - water cocks removed & cleaned - Teflon flexible lube lines applied - steam piping repaired - new wheels applied front end - Expect would need rebore new pistons next ring change. *Cylinder*
2 new engine wheels *General*

6/1/1969 2 new engine wheels *General*

8/1/1969 Valve rod brackets L.F & L.B. - R.F. Rebushed *Cylinders*

5/1/1971 Checked gauge *Boiler*

8/17/1972 Out of service *General*

9/15/1983 New Main shaft front, shipped rough turned, finished here to approx .100 oversize on all surfaces except wheel. Installed with new boxes *Main Shaft (boxes)*

1981	***May***	***June***	***July***	***Aug***	***Sept***	***Oct***	***Total***
Trips	*0*	*0*	*0*	*0*	*0*	*0*	*0*

New Cog Engine Built

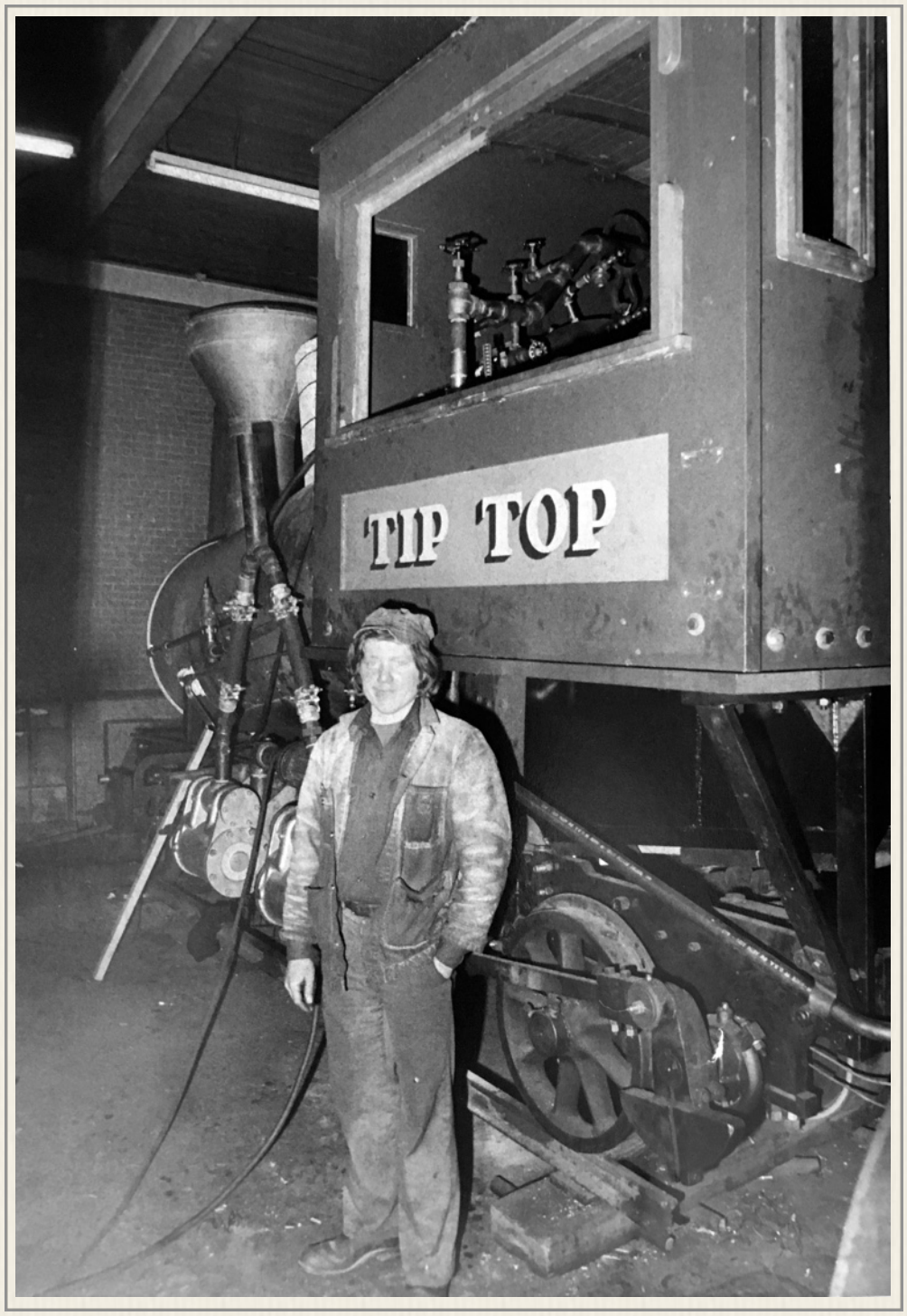
April 10, 1983

Vintage 1870 steam locomotives are rare today. If your business is using them to push *(Ed note: Correspondent Barbara Tetreault incorrectly used the word "pulling")* coaches up the Northeast's highest mountain then keeping six engines in service can be tough. The Mt. Washington Railroad Company has solved the problem of replacement by building its own engine. Maintenance foreman Michael Kenly of Jefferson, Andre Desjardins of Twin Mountain, and Frank Kenison also of Jefferson are finishing work on a new locomotive in the old Thompson Manufacturing building (in Lancaster). Work on the new engine began five years ago when then-manager Charles Teague decided it would be nice to have a spare because the heavy (pushing) requires frequent repairs to the engines. Actually, the Cog Railroad must have seven locomotives because state regulations require ti to keep one locomotive in operating condition at the Base Station in case of emergency. Teague figured building an eighth locomotive would guarantee six engines available for (pushing) coaches up the mountain. Since then, however, engine No. 8 titled *Tip Top* after the old summit building had to be retired. So, the new engine will replace it.

The Cog Railroad locomotives used today are almost exact replicas of the ones used when the railroad first started hauling people to the top of Mt. Washington over 100 years ago. Kenly said there have been a few changes - most notably an increased from two to four cylinders - but the locomotives have remained very close to inventor Sylvester Marsh's original design. Kenly said there are two main reasons the company has kept to the original design instead of adapting to changes in the early part of this century. He pointed out the design has worked. "This design has worked out quire well. Our safety record is very good," Kenly said.

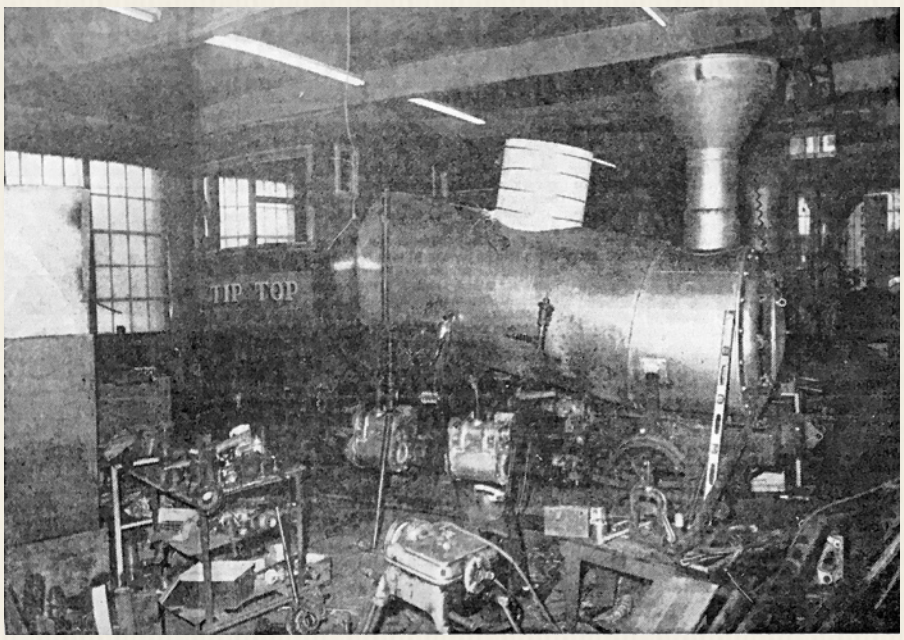
Indeed, the only major accident on the track happened Sept. 17, 1967, when eight people were killed. The mishap was determined to have been the result of human error probably caused when a passing hiker tampered with one of the three switches. *(Ed note: While that was one theory how a rail to guide wheels across the mainline cog rack was in the wrong position, the cause was the crew's failure to notice the rail See Vol. 1 Annus Horribilis and Vol. 4 Skyline Switch).* The other reason is more aesthetic and has to do with the thrill of riding to the summit in a coach (pushed) by an old-fashioned steam engine. In her book on the railroad, present owner Ellen Teague said New Hampshire Profiles polled its readers back in the 1950's on whether the cog railroad should be replaced with a monorail. The response was overwhelming negative.

While Kenly and crew began building



Michael Kenly, the Cog Railroad's maintenance foreman, stands beside Tip Top. Kenly and other members of the railroad's repair crew helped build a new engine to replace the old Tip Tip (1983)
- Barbara Tetreault photo / Coutesy NH Union Leader

Shop Log: Loco No. 8 v2



No. 8 under construction at Thompson Manufacturing in Lancaster, N.H.. What began as "Charlie's Angel" will now be known as "Tip Top" (1983)
- Barbara Tetreault photo / Courtesy NH Union Leader

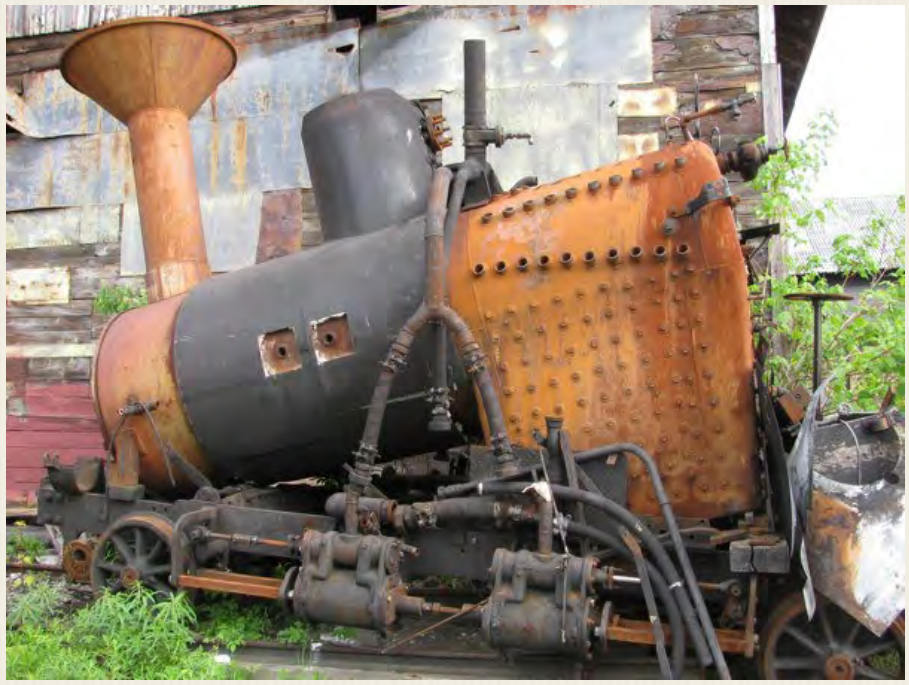
the new locomotive five years ago, they have not been working steadily on it during those five years. Work is done during the off-season when the men are not busy with the day-to-day operations. The first winter the crew put the frame and running gear together. It took two winters to find a company to build the boiler. Monroe Boiler Works of Pittsburg, Penn., built the boiler, which, because of the steepness of the grade, has to be horizontal to maintain operating efficiency. The casting was done in Lewiston, Maine, and most of the machinery was made by Arthur Minot of Bath. The track foreman made the wooden cab. Most of the remaining parts came from Manchester. Kenly said the locomotive should be finished for the railroad's Memorial Day opening. It will have cost approximately $150,000. The 17-ton locomotives climb the mountain at a speed of 4 mph (pushing) a coach that weighs 10 tons when loaded. The track has an average grade of 25 percent with a maximum grade of 37 percent."

- New Hampshire Sunday News - Sun, Apr 10, 1983 pg. 6A

1992	***May***	***June***	***July***	***Aug***	***Sept***	***Oct***	***Nov***
Trips	*19*	*29*	*25*	*56*			

Hikers pose next to the new Tip Top at the summit (1999)
- Rand Peck Collection

Number 8 in Storage
May 31, 2010



The day after Paul Forbes took a photo *(left)* of the Number 8 engine in storage behind the shop, he posted it to the *Mt Washington Cog Railway: We Worked There Facebook* page. It prompted a forth-right discussion thread by Coggers who had worked at the railroad when steam was the prime motive power.

Michael Kenly: "Chub, Arthur Minot and I built this loco from the ground up in 1983. Two years ago we replace all the staybolts; the boiler may be rusty, but it's the best one we have. I could have the 8 in "Tip Top" (haha) running condition in 6 wks no problem if someone wanted to pay for it. Don't be sad, find someone willing to fix this and I will gladly do it!"

Peter Steady: "Sad are the days when that new style engine climbed the hill. So much could be done to draw the crowds. Little cabins to protect the hikers and riders, a REAL Restaurant perhaps. Have the Presbys and Bedors ever been to visit the Clarks. Wow such a waste of what could be. No Place I ever want to be again. A total trashing of Nostalgia. I surely hope that they all die with their greedy profits tight fisted in their hands. What a Shame, and Thank You Charlie for your part of trashing such a beautiful piece of history. I'm sure Daddy Chub would be so proud of you. Enjoy the money, enjoy the mirror, because isn't that what the Cog is all about, to YOU, JOEL and WAYNE... MONEY. You bunch of inconsiderate Oxygen Thieves."

Shawn Foss: "Yeah this is tough.... can't bring it back... damage is done.. actually nothing I want more than to work on those old steam engines but the attitude sucks..... I really hate it!"

Barry Stewart: "The altitude is only 6288. Not high enough to bug most people. Maybe you won't be able to smell the oil from there. Anyone know why they couldn't just change the flange down there? Seems if the robots can cut it, an impact wrench could unbolt a stinkin' flange. Maybe replace with another one with valve? I read on some forum that there's another pipe inside this and they can't risk that popping out, doesn't make much sense to me though. Sorry, not Cog related, I know. The steam can be rebuilt, there's a few of us left that have done it. Just need to convince the owners to keep it alive. They own it, it's a free enterprise system (err, it was), they can do what they want. T he steam costs money. Anyone got the money to buy it? I'd buy it if I had the money or financing with a real chance of success. Powerball is my only chance, the odds are not good. I'm surprised to see the 8 dismantled though. Mike, why did they do this? Are they consolidating parts/ engines? Making room in the shop? T his boiler was made with formed steel sheets like the throat piece between outside water leg and barrel and round corners everywhere. Much more work than the Hodge boilers with all welded construction, square corners butted and welded together. The PA company (Monroe I think?) that built the 8 had a lot of trouble with this and threatened to charge much more to build another. I think parts like this were formed with dies in the old days and these no longer exist. Seem to recall stories of sledge hammers and cracking sheets involved here. Most of what I remember is from what Mike told me. The rust don't mean naathin' but it needs a bit of work. Rob could get right on the cab. Is the 3 still together? Please please - no disassemble! Disassemble 2 instead."

Shawn Foss: "I am so super happy bout the colossal attitude I got from Charlie...."

Michael Kenly: "Barry; #3 is sitting in the shop, under cover, perfectly intact. I don't agree with you about the #2; you, Peter and I built that engine, it's really one of the better ones! I'm so glad to have someone with extensive boiler knowledge explain the #8 boiler, and why it should be saved. You're right; exterior rust don't mean nothin - internal rust means everything. The #8 cab had to be taken off to do the boiler work. The #4 just happened to have a very rotten cab. So, temporarily, we put the #8 cab on the #4. Rob actually had all

the new cab parts made for #8 (he still has them), but then the diesel concept came along. Peter is wrong, though. It's not that the owners are not willing to spend money; each diesel is $750,000 each. The last steamer we built I had figured at $250,000. Perhaps when Sylvester Marsh built the railway there were a bunch of teamsters in Gorham that were totally pissed that he was building a "railway to the moon" when they had the monopoly of the carriage road. Union people are like that."

Paul Forbes: "Mike, is the 3 back under cover? It was sitting outside a couple weeks ago. I'd like to see it saved from further deterioration. I'd really like to run it up the mtn again, but I know that won't happen."

Barry Stewart: "I was joking about the 2, it was an old 3 rival. I'm glad the 3 is still there though."

Locomotive No. 9 - *Waumbek*

Date	Repairs	Category
1908	Built	*General*
1/1/1929	Loco Out of Service *(1929-1935)*	*General*
6/15/1938	Barrel of boiler new	*Boiler*
5/15/1948	Six top rows of flues new	*Boiler*
6/10/1951	Two bottom rows of flues new	*Boiler*
	New Main shaft with new boxes rear	*Main Shafts (boxes)*
6/15/1956	New piston and rings right front	*Cylinders*
9/2/1956	New cylinder with piston and valve rings left front	*Cylinders*
5/15/1957	Right rear piston rings new	*Cylinders*
7/8/1957	Boiler re-tubed	*Boiler*
8/16/1957	Right rear valve sleeve with valve new	*Cylinders*
	Left rear valve sleeve with valve new	*Cylinders*
9/8/1957	Valve sleeve loose right front pinned	*Cylinders*
6/1/1958	Left rear piston rings new	*Cylinders*
9/14/1958	New Main shaft front with boxes	*Main Shafts (boxes)*
	New crank shaft front with boxes	*Crankshafts (Boxes)*
8/20/1959	New Main shaft rear with boxes	*Main Shafts (boxes)*
9/8/1961	Left rear piston checked O.K., cylinder .007 out of round	*Cylinders*
9/15/1961	New Main Shaft front with boxes	*Main Shafts (boxes)*
10/29/1961	Left front valve checked O.K.	*Cylinders*
	Right rear piston & ring checked O.K.	*Cylinders*
5/1/1962	Right front piston & ring new	*Cylinders*
	Left & Right rear valve sleeves with spool & rings new	*Cylinders*
	Right front sleeve ground, new spool & rings	*Cylinders*

Shop Log: Loco No. 9

June 23, 1962 - Hydroed boiler: 170 lbs following repairs made – renewed 22 bottom tubes. Renewed 4 broken stay bolts – Renewed left front corner mud plug / entered boiler for internal inspection – tightened 2 front flue sheet braces – renewed 2 pins on same – removed all washout plugs. Washed out boiler applied plugs.

7/8/1962	New crank shaft rear with new boxes	*Crankshafts (Boxes)*
7/9/1962	Front crank shaft re-ground with new boxes	*Crankshafts (Boxes)*
9/1/1962	Left & right rear valve rings only new	*Cylinders*
9/17/1962	Rear crank shaft installed in # 9 in *7-8-62* was also removed to replace broken shaft in # 6	*Crankshafts (Boxes)*
9/20/1962	Front crank shaft which was installed 9-14-58 was removed from # 9 and installed in # 6	*Crankshafts (Boxes)*
5/1/1963	Left & right front valve rings only new	*Cylinders*
	Left & right front cylinders bored, new pistons, new rings (piston rings)	*Cylinders*

Front & rear shafts with boxes new applied - Both front & rear shafts bought from Brad Foote in *8-20-62* and received here *10-22-62*. Shaft is of 4140 steel with heat treatment. *Crankshafts (Boxes)*

7/10/1963	Left & right front valve sleeves ground, new spools & new rings	*Cylinders*
8/24/1963	Left & right rear valve sleeves ground, new spools & new rings	*Cylinders*
9/17/1963	Right front valve sleeve ground, new spool & new 3.585 rings	*Cylinders*
7/12/1964	Left & right rear valve sleeves ground, new spools & new rings	*Cylinders*
	Right front valve sleeve ground, new spool & new rings"	*Cylinders*

8/30/1964 Rear shaft which was installed in 5-63 broke one tooth on *8-29-64* and was replaced by one which was in rear of # 1 Loco and new in *8-8-61*. This shaft was installed with 2 new boxes in rear *Crankshafts (Boxes)*

8/31/1964 Front main shaft was removed from #8 Loco *9/15/1963* and sent for Magnaflux, was O.K. but .021 beng, bearing surfaces were turned down & new boxes applied. This shaft installed in rear of #9 Loco *Main Shafts (boxes)*

7/12/1965 Rear shaft which was installed in *8-20-64* broke on tooth and was replaced by an old nearly worn out shaft which had been ground & boxes fitted for space. This shaft has no record numbers, was installed in rear *Crankshafts (Boxes)*

8/1/1967	New Main shaft front	*Main Shafts (boxes)*
7/1/1968	Boiler re-tubed	*Boiler*
7/2/1969	Rear (crank) replaced - Rbs turned - new boxes - broken tooth in pinion of old shaft	*Crankshafts (Boxes)*
7/20/1969	Right front valve sleeve & spool & rings new	*Cylinders*
1/1/1971	R back valve new rings & valve	*Cylinders*
	L front valve new rings & valve	*Cylinders*
	L back valves rings removed and O.K.	*Cylinders*
	R front valve sleeve O.D. 4 1/8" Sleeve reground & new rings NOTE: Correct measurement for rear valves (top) sleeve is 1 3/4" from valve head shoulder	*Cylinders*
5/1/1971	Gauge checked & hydroed 180 lbs/sq in	*Boiler*
6/1/1971	New Main shaft rear - make note in journal size	*Main Shafts (boxes)*
6/16/1971	New rear axle long & short addendum gears	*Main Shafts (boxes) note crank page*
	New rear crank shaft & boxes	*Crankshafts (Boxes)*

6/17/1971	Hydro OK - New dry line - water glass length 21 5/8"	*Boiler*
7/12/1971	New main boxes - front	*Main Shafts (boxes)*
	New rear main shaft & boxes	*Main Shafts (boxes)*
	New rear main shaft spur gear	*Main Shafts (boxes)*
	New rear crank shaft & boxes	*Crankshafts (Boxes)*
	New rear engine wheels	*General*
	New dry pipe	*Boiler*
	New crank brass both front	*Crankshafts (Boxes)*
	New crank boxes front	*Crankshafts (Boxes)*
8/1/1971	New stack & spark arrestor applied	*Boiler*
	Crosshead brass LR applied	*Cylinders*
	LF crank pin bushing applied	*Crankshafts (Boxes)*
	Crosshead bushing on LF applied	*Cylinders*
	Both crosshead pins turned	*Cylinders*
	All brake linings replaced	*Crankshafts (Boxes)*
6/1/1972	New crank box L Front	*Crankshafts (Boxes)*
8/1/1972	Front crankshaft broke	*Crankshafts (Boxes)*

5/14/1976 Mansel Lubricator, injectors, Pop valves, steam gauge, whistle, and tender suction lines removed for shipment to Massachusetts *Boiler*

6/17/1976 Engine loaded on Clark's flatbed & sent to Hodge Boiler works by Pete Thompsons KW *General*

7/3/1976 Engine returned and had hydrostatic test @ 221 lbs - several leaking flues most new rivets lead - some weeping welds, 1 broken stay-bolt L side in cab. Mud ring leaks slightly Seat BTW L. outside sheet & throat sheet leaks at bottom *Boiler*

7/3/1976 Leaking flues rolled & Manzel lubricator reinstalled - Chokes removed from lube lines & lines bled *Boiler*

7/4/1976	Hancock inspirator installed	*Boiler*
	Internal inspection - good condition except 1 broken longitudinal stay	*Boiler*
	New exhaust nozzle installed - spark arrestor was previously upside down - corrected	*Boiler*
7/5/1976	Longitudinal stay repaired - Dome cover, jacked, Pops, whistle installed	*Boiler*
	Engineer's seat replaced	*General*

Steam gauge installed (was tested *7/3* & OK) - Tender assembled & attached bonnet installed. Engine fired up for spark - most leaks in new boiler work tightened up *General / Boiler*

7/6/1976	Made uneventful 1st passenger run	*General*
7/17/1976	Removed center crank bearing	*Crankshafts (Boxes)*
	Center cross member (FWD) tightened & 1 bolt (broken) replaced	*General*
7/18/1976	Removed & tightened R.F. Exhaust nipple	*Boiler*
	Removed L.F. main box & turned over - new wheel installed	*Main Shafts (boxes)*

R.F. wheel removed - main box was dismal, but had already been turned over/new wheel installed *Main Shafts (boxes)*

	All cylinder cocks on front cylinders new	*Cylinders*
7/19/1976	New roller installed in block	*General*
	Leaking welded stay bolt, ctr. Above F.B. door inside, ground welded & area re-padded	*Boiler*
	Patch welded in tender shovel plate	*General*

Shop Log: No. 9

7/20/1976 Front crank had been removed because both boxes were bad - new front crank boxes, L.F. Binder replaced, front valves timed & reset *Crankshafts (Boxes)*

Both cranks Magnafluxed - O.K. *Crankshafts (Boxes)*

New pin in brake fulcrum (front) *Crankshafts (Boxes)*

Front brake adjusting rods bent to hold shoes square over drum - brakes adjusted *Crankshafts (Boxes)*

Rear valves timed & adjusted *Cylinders*

7/24/1976 Crank box R.F. seized on passenger trip of *7/23* - box hammered off & old box reinstalled *Crankshafts (Boxes)*

R.F. exhaust nipple tightened *Boiler*

7/31/1976 R.R. exhaust nipple replaced - threaded connections (installed) *Boiler*

8/1/1976 New spark arrester & bonnet *Boiler*

New front crank boxes (old ones destroyed due to excessive heating (broken grease line) *Crankshafts (Boxes)*

New oversize exhaust nipple - R.R. & new side stack piping *Boiler*

2 new bolts installed in L.F. cylinder & x-member R.F. cylinder loose - all bolts tightened *Cylinders*

New copper gaskets made & installed in exhaust line. Broken exhaust welded - expansion joint repacked *Boiler*

Large patch welded in tender shovel plate *General*

Rebuilt air valve *General*

8/3/1976 Frame broken right side just ahead of Fr. Glide yoke on passenger trip of *8/2*. Frame realigned, beveled & welded *General*

1976 Total Season Trips: 120 *General*

1981	***May***	***June***	***July***	***Aug***	***Sept***	***Oct***	***Total***
Trips	*4*	*9*	*46½*	*32½*	*14*	*9*	*115*

1992	***May***	***June***	***July***	***Aug***	***Sept***	***Oct***	***Nov***
Trips	*4*	*6*	*11*	*16*			

Dave Moody & Nigel Day stand with No. 9 outfitted to burn oil during Day's fuel conversion effort
- Nigel Day Collection

End of 2005-2006 Coal to Oil Testing

To: Charles G. Kenison, MWRy General Manager
From: Albert LaPrade, Quality Control Manager and Chief Engineer
Date: 24 July 2006
Subject: Conversion Of Engine 9 From Coal To Oil Firing

Background:

During the last year, Engine 9 (*Waumbek*) was converted from coal to oil firing by Nigel Day, Steam Specialist for the MWRy, employing an oil burner of his own design. On 22 June 2006, Wayne Brigham, Chief Boiler Inspector for the State of New Hampshire, witnessed the operation of the conversion with Nigel Day controlling the oil burner.

At that time, Wayne Brigham expressed to me his concern of observed flame instability and flame impingement on the lower portion of the waterlegs immediately above the firebrick. Consequently, he directed the MWRy to increase the height of the firebrick and to conduct tests under full load to determine maximum firebox sheet temperatures through the use of thermocouple instrumentation.

Action:

The MWRy subsequently performed two tests on Engine 9 to determine maximum firebox temperatures using a calibrated twelve channel recorder and type K high temperature thermocouple wire. Two thermocouples were attached to the crown sheet and two thermocouples attached to each of the four side sheets. Both tests were conducted with an empty coach and limited to runs from the base station to Lower Waumbek Switch. Results of the tests are summarized below:

Shop Log: No. 9 - Coal to Oil Testing - 2005-2006

5 July 2006

Engineer: Dave Gooden
Fireman: Nigel Day
Observer: Al LaPrade

All sheet temperatures generally remained below 500 deg F with the exception of the crown sheet temperature which reached in excess of 1600 deg F at the top of Cold Spring Hill.

13 July 2006

Engineer: Dave Gooden
Fireman: Nigel Day
Observers: Al LaPrade, Mike Kenly, Greg Meserve

All sheet temperatures generally remained below 500 deg F with occasional excursions to 700 deg F with the exception of the crown sheet temperature which reached in excess of 1900 deg F and was increasing steadily when the test was terminated.

For comparison, The MWRy conducted a similar test on coal burning Engine 2 whose boiler is identical in design and construction to that of Engine 9. Two thermocouples were attached to the crown sheet and one thermocouple attached to each of the two side sheets. Test results are as follows:

22 July 2006

Engineer:Rob MacClay
Fireman: Unknown
Observers:Mike Kenly, Dave Gooden

All sheet temperatures quickly stabilized between 360-400 deg F with the engineer's side crown sheet stabilizing at 535 deg F on ColdSpringHill.

Conclusions

Based on the test results summarized above,and personal observations of the operation of the Engine 9 oil conversion, I conclude the following:

1.The elevated crown sheet temperatures observed are accurate and are cause for immediate alarm.

2. The suspected instability of the oil flame is resulting in extremely uneven heating of the firebox and extraordinarily high crown sheet temperatures.

3. The sudden and abrupt observed elevation of the crown sheet temperatures at high firing rates is characteristic of the transition from nucleate boiling to film boiling. This condition may result in serious crown sheet overheating and subsequent catastrophic crown sheet failure.

4. The absence of elevated crown sheet temperatures and the overall even distribution of firebox sheet temperatures observed in the test of Engine 2, makes the Engine 9 test results even more alarming and may explain the years of extraordinary boiler life and safe operation experienced by the railway with coal firing.

5. The crown sheet temperatures observed during the Engine 9 tests exceed the maximum mean temperature allowed by the ASME B&PV Code Section II.D by over 600 deg F. at the boilers present 175 psig MAWP.

Recommendation:

In my opinion, the Engine 9 oil conversion in its present form is extremely dangerous and presents a very serious threat to life and property and should not be operated under any circumstances until the issue of uneven firebox heating and elevated crown sheet temperatures is addressed, corrected and brought into compliance with the ASME B&PV Code.

AlbertA LaPrade, Quality Control Manager and Chief Engineer

Shop Log: No. 9 - Coal to Oil Testing - 2005-2006

In April 20223, Al LaPrade & Wayne Presby sat down with Jitney Jr to explain how the Nigel Day Conversion Project came about. LaPrade met Day while in Europe and the U.K. researching a new switch design for the Cog in 2002. "Nigel Day was a self-taught steam guy a hundred percent," LaPrade said. "He loved steam." Day had worked to keep steam locomotives at the Snowdon Mountain Railway, a narrow-gauge rack and pinion mountain railway in Gwynedd, north-west Wales. It is a tourist railway that travels for 4.7 miles from the village of Llanberis to the summit of Snowdon, the highest peak in Wales and still runs "Heritage Steam Express" trains *(below)*.

LaPrade says "They had started introducing diesels, but Nigel wanted to keep the steam there. So he ended up adapting an oil burner that was used in the glass industry… to (a) steam engine. And apparently it worked well… but what had happened is that over there, like here… changing the fuel is an alteration and it has to go through regulatory agencies in order to be approved. Well, he never went through that process. He just cobbled it together, made it work…and it did. I really think that if they allowed him to run it, it'd probably still be there today… he was the kind of guy that knew a lot."

A guy the Mt. Washington Cog Railway ownership group was looking for as a way to reduce fuel costs. "We ended up… hiring him *(Day)* to come over and help us try to oil fire for the Nine," says Wayne Presby. "He was… very meticulous about doing this whole thing… but Nigel was very temperamental." LaPrade says "the big thing he didn't like, 'cuz we had the air stamp and we had the code book… and we had to go by it… it wasn't a choice. There was New Hampshire law. Legally… I was the quality control manager. Up to that time, I'm working with guys, like Mike Kenly, who've been here forever, never once had a problem with him at all, even though I was essentially writing instructions to him *(Kenly)*. And then he *(Kenly)* had the answer to me, but we worked well together." LaPrade tried to explain on Day's first day on the job the steps that had to be taken to meet American code. "And he says, 'No, we're not going by the American code… we're gonna go by the British code.' I said, 'No, no, you don't understand. We have to do it… and I can help you with the documentation, but you've gotta let me know what you're doing.' He didn't like the idea of regulation and he thought we were all out to get him. He took a dislike to just about everybody in the shop… took a very big dislike for me. He just didn't like the idea of what he called 'interference'… and he says, 'You're jealous of me.'" LaPrade says he responded, "I'm not jealous, Nigel, but we gotta do this a certain way."

That certain way included documentation of how the fuel oil burner was affecting the boiler on the engine that became known as *The Victim*. "The state boiler inspector insisted that we put in thermocouple (senors) all over the thing," says LaPrade. "We rented a recorder. They could do 12 channels, and we put a whole bunch of them in… tube sheets… crown sheet… here, there, all over the place." Traversing the relative minimal grade between the Shop and Marshfield "the temperatures were all pretty good," says LaPrade. "Maximum temperature for that material (used to make) these boilers, 700 degrees... and we were around 550 - 600. It was nice. But then as soon as you get on grade, boom," the temperatures would go up says LaPrade. "Nigel claimed...

that we didn't know what we were doing with thermocouples. So Mike Kenley says…what I'd like to do… is to thermocouple the No. 2 *(Ammonoosuc)* that was still all coal, and just see what those temperatures are in that."

LaPrade thought that was a good idea. "Nigel still insisted we didn't know anything about thermocouples," says LaPrade. Charlie Kenison hired a local vocational school teacher Greg Meserve to verify the correct use of the temperature measurement devices. "Greg Meserve had joined the Air Force… went on and got his master's degree in mechanical engineering," says LaPrade. "He was a, a PhD candidate in mechanical engineering at University of Arkansas for the Air Force… then something happened… *(left the Air Force)* never got his PhD, but did all the work. He was an actual rocket scientist. He was designing rockets for the Air Force."

Meserve was in the cab with LaPrade, Day, Kenly and Dave Gooden for a test run on July 13, 2006. "(Meserve) came over and he took a trip with us," says LaPrade. "We got up to the top of Waumbek and he says, 'Let me outta here.'" Meserve had watched the temperatures go from 700 to 1400. "And he says, that's film boiling… a phenomena… discovered in the 1600s. Once you get to a certain point, the flame is heating the (metal) so fast, it forms like a little insulating cushion of steam between the bottom of the the pan and the water… if you have… an intense enough torch, you can actually, even though (it) is full of water, you can poke a hole through (the metal) with the torch, you can burn it." LaPrade had heard the term during his time at the Naval Shipyard helping build nuclear submarines. "Biggest thing that the Navy was always afraid of was film boiling occurring in the reactor. You could have meltdown. Greg Meserve saw that, and he says, 'You're getting into film boiling, I guarantee' he says, 'If I were you, I wouldn't do this again.' So Charlie says, 'I guess you're right.' He said '(We're) shutting it down. That's it. We're done.'"

LaPrade's July 21, 2006 memo to Kenison officially documented the reason for stopping the latest coal to oil conversion effort at the Cog. Despite that Presby and LaPrade say Nigel Day came closest to making it work on Mt. Washington where oil-fired boiler technology had been tried since the late 1930s under Col. Henry Teague's management.

"(Day) was the only one that I know of that ever oil-fired one of the locomotives and got it all the way to the summit," says Presby albeit without pushing a coach. "Nigel did make a couple of trips to the summit," confirmed LaPrade. But Day's fuel conversion idea didn't appear to be as economical as Cog ownership had hoped. "He was going through a 200 gallons of oil (per trip)," says LaPrade roughly ten times needed to power a Cog diesel. And LaPrade says Day's attitude may have also kept him from success. "I think that if he'd been willing to work with everybody here, I think we were gonna come a lot closer to success… I really do. But for some reason, he took a dislike to Mike Kenley… hated Mike Kenley… and he didn't like anybody else except Cookie."

Filling the 10's boiler through the injector on June 14, 1983 in front of the Shop (1983)
- Courtesy Joe McQuaid / NH Union Leeader photo

Locomotive No. 10 - *Col. Teague*

Date	Repairs	Category
9/24/1972	Built by Niles Lacoss at Base - put in service	*General*
7/27/1973	Hi addendum shaft purchase from Bradfoot gear works prior to 1968 installed new 1972. This shaft broke *July 27, 1973* after 129 trips in center bearing area - Replaced with new shaft purchase July 1973 - old boxes re-used	*Crankshafts (boxes)*
5/19/1976	Hydrostatic test @ 221 lbs. - Bottom valve on bottom water glass split - silver soldered 5-20-76	*Boiler*
5/21/1976	Mud-ring cleaned	*Boiler*
5/24/1976	Engine assembled, fired-up for work train on *5/25/76*	*General*
6/7/1976	R. side exhaust lines removed - nipples renewed & new piece fabricated from R.R. Cylinder Exhaust Tee to sidestack	*Cylinder*
6/8/1976	Lost R.F. Main binder on passenger run of *6/6/1976* - 1 stud broken off in jaw - removed by cutting & retapped - binder badly bent - Replaced with # 2's R. R. binder	*Mainshaft (boxes)*
6/13/1976	Firebox door would not stay closed - handle built up w/ weld & ground, latch notch recut	*Boiler*

Shop Log: No. 10

6/21/1976	Removed injector & reground overflow, & forcing tube seats.	*Boiler*
6/29/1976	L.F. eccentric strap and eccentric replaced	*Cylinder*
	L.F. crosshead brass replaced	*Cylinder*
6/30/1976	L.F. valve, rings, sleeve (all new) applied	*Cylinder*
	Rear crank Magnafluxed	*Crankshafts (boxes)*
	Bad crack in tender tank welded	*General*
	1 set grates installed	*Boiler*
7/4/1976	Relined rear brakes & adjusted both	*Crankshafts (boxes)*
7/24/1976	L. injector taken apart & seats ground	*Boiler*
	New piston rings L.F.	*Cylinder*
8/1/1976	Injector removed & completely reworked	*Boiler*
	Valves adjusted & timed	*Cylinder*
	New front brake linings & broken brake band welded	*Crankshafts (boxes)*
	All suction lines to injector tightened	*Boiler*
	Large crack in tender on L. side repaired	*General*
9/1/1976	New screen on bonnet	*Boiler*
	End broke off steam stem on R. injector - final overflow disc fell off on same, both repaired	*Boiler*
	New roller block installed	*General*
	Ground seat on forcer steam valve on r. side inspirator & replaced final overflow disc on same. Repaired overflow hose	*Boiler*

1976 Total Season Trips: 197 *General*

1981	*May*	*June*	*July*	*Aug*	*Sept*	*Oct*	*Total*
Trips	*4*	*0*	*54½*	*52*	*18¼*	*10¾*	*139½*

1992	*May*	*June*	*July*	*Aug*	*Sept*	*Oct*	*Nov*
Trips			*31*	*67*	*8*		

No. 10 became a test bed for the effort to use fuel oil to fire the boiler. Seen here on a test run on Jacob's Ladder (1989)
- Rob Bermudes Jr. photo

Mount Washington Cog Railway

Colonel Teague

Engine No. 10 - Coal to Oil Conversion

Controls DownEast

February 10, 1989

Scope

The locomotives of the Mount Washington Cog Railway are of a special design, developed to perform a special task. They are classified as a rack type locomotive utilizing two cog wheels driving by crankshafts to provide the movement on an incline rack railway with an average grade of 26%. Steam power is transmitted from the oiler to four cylinders (two each side), fore and aft in tandem to drive the cogs.

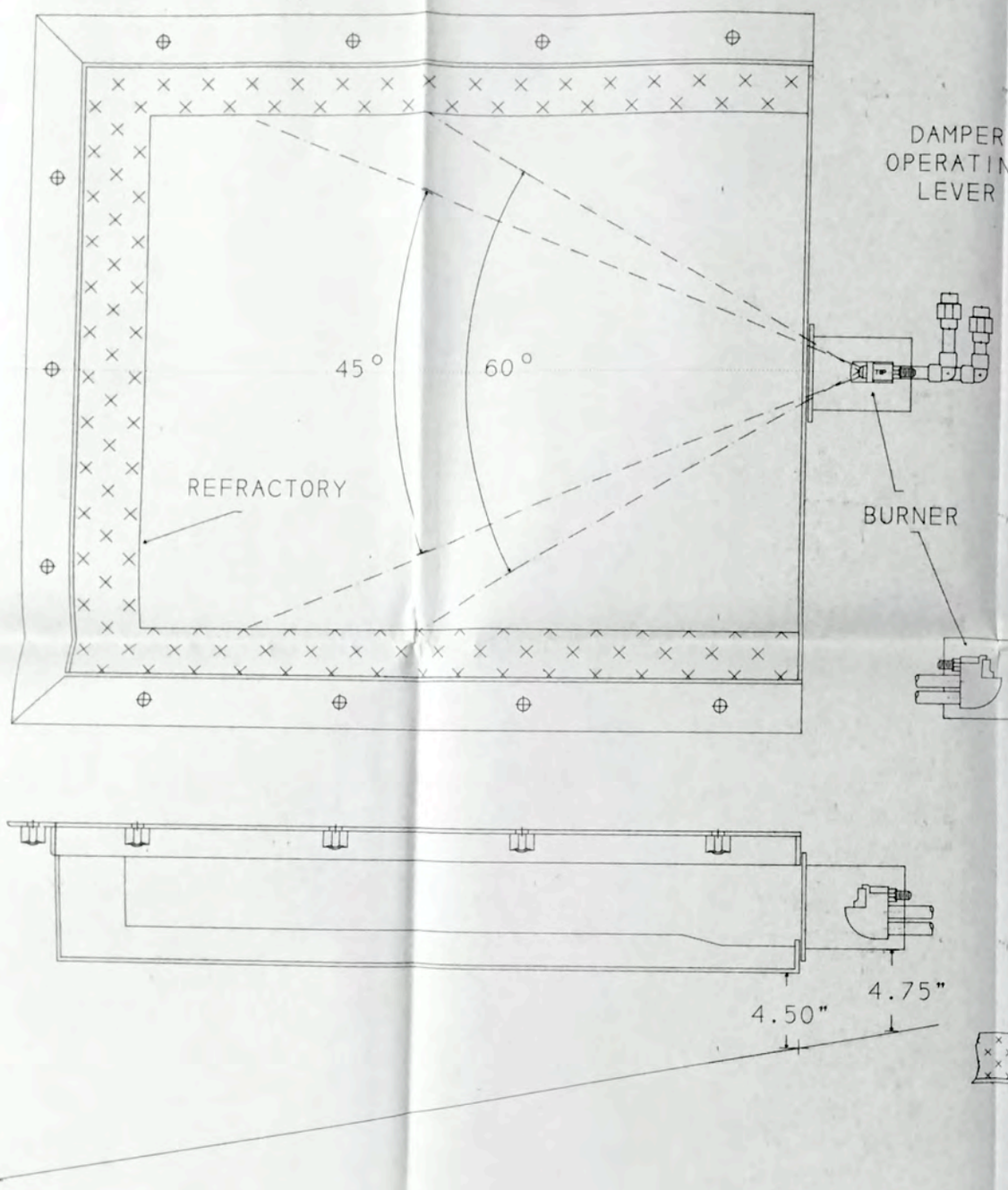
he boilers are single pass horizontal tube types with a working pressure of 180 psig. Steeply inclined to remain somewhat level on the steep grades, they are relatively small in size with heating surfaces ranging from 450 to 550 square feet. However, their maximum output is estimated to be in the neighborhood of 7000-800 pounds of steam per hour, indicating operation in excess of 200% of original rating.

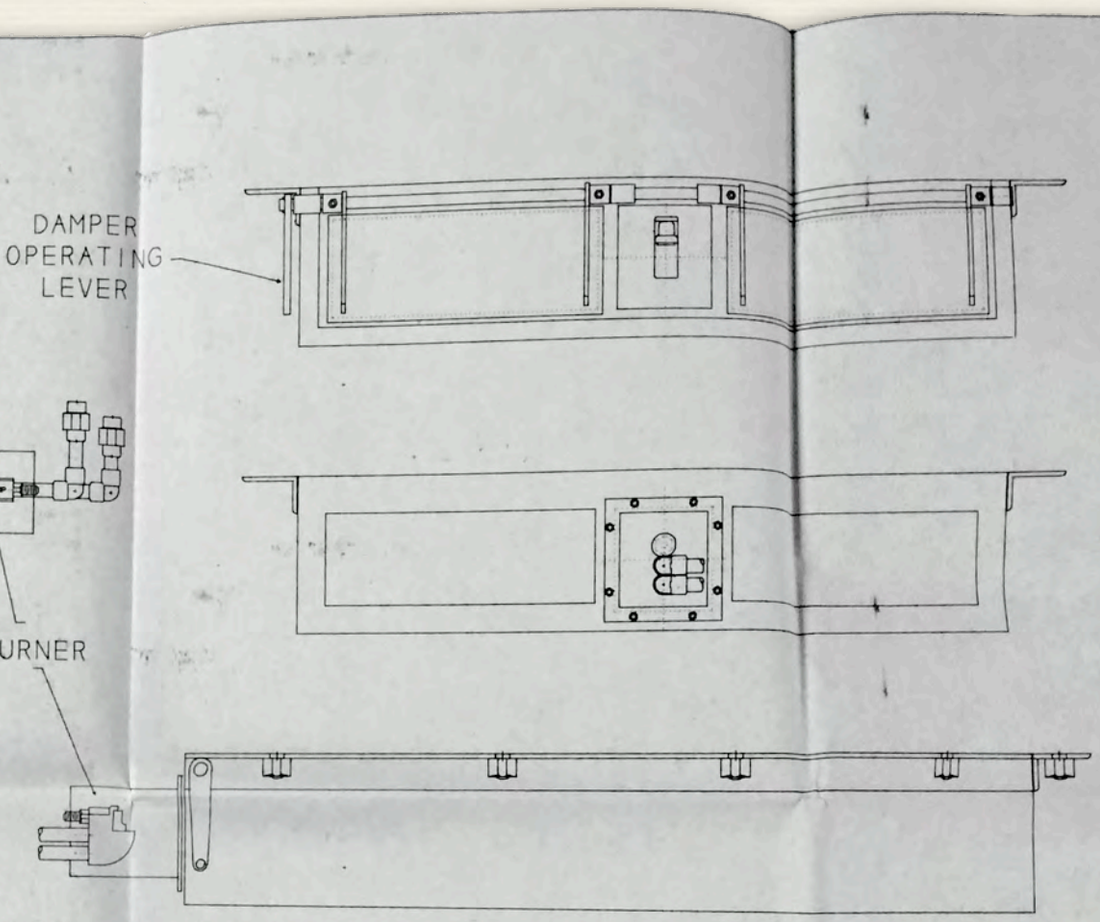
The present method of firing is semi-bituminous coal by hand with a consumption of approximately one ton per trip. At 400 ten-pound shovel fulls per trip, that is one shovel full every 18 seconds. Extensive exercise to say the least.

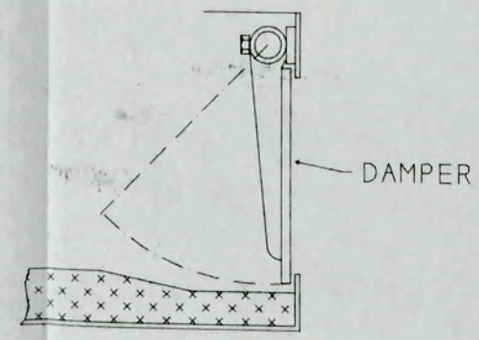
The justifications for the conversion to oil are many with main reason being the price of coal at $110.00 per ton. At $4.08/Mbtu (million btu) as compared to $3.08/Mbtu for oil, the reduction in fuel cost alone would more than justify the cost of conversion. However, there are many hidden benefits associated with the conversion and this report shall address each of these and their relative importance.

Colonel Teague

Engine No. 10 is somewhat typical in design to all the locomotives on the roster. It does vary however, in specific areas of firebox and tube size. The Boiler was manufactured by Dillon Boiler Works of Fitchburg, Massachusetts in 1959. It has a heating surface of 458 square feet and carries 146 two-inch heavy-duty tubes and ef-







PRELIMINARY

FOR DISCUSSION ONLY

REV	DATE	DESCRIPTION	INITIAL	AP'D

CDE

Controls Down East

207 563-1280

UPPER ROUND POND ROAD BRISTOL, ME 04539

CLIENT: COG RAILWAY
MOUNT WASHINGTON, NEW HAMPSHIRE

TITLE: LOCOMOTIVE NO. 10 CONVERSION
ASH PAN / BURNER ARRANGEMENT
GENERAL LAYOUT

DRAWN RPG	DATE 2-10-89	ISSUE FOR BID ☐ PRELM ☒ INFO ☐ CNST ☐ OTHER ☐	DATE
CHK'D	DATE		
APP'D	DATE	DWG. NO. 10-M-01	REV
SCALE NOT TO SCALE			

fective grate area of 3.5 square feet.

In determining the feasibility of oil firing, the initial problem was to establish a criteria for sizing the burner. This has proved to be the most formidable of the tasks. For many years, manufacturers and operating engineers used a formula based upon heating surface to determine boiler horsepower (bohp) output. Using this methodology, No. 10 was rated at approximately 46 bohp. However, it was common practice to operate boilers at 200 to 300 % of rating, as indeed has been the case with all locomotives on the mountain. This would boost the output to over 100 bohp, based upon the old rating. Based upon the amount of fuel and feed-water being consumed and after discussions with operating and maintenance personnel at the mountain, these performance calculations would not prove out.

The answer finally came in discussion with Mike Kenly. Using approximately 1000 gallons of water per trip, we finally have a direct correlation between input and output. One gallon of water weights 8.3 pounds. Therefore, if all the water is converted to steam, we would have 8300 pounds of steam producer per trip. Using the modern formula for determining boiler performance, where one bohp is equal to approximately 33 pounds of steam, we arrive at 250 bohp. Given losses and errors, it is safe to say that No. 10 is capable of producing 700 pounds per hour steam giving it a horsepower rating of 200-210. From this we can now determine the maximum fuel consumption and establish the appropriate size and pattern for the burner.

This realization of output capability reflects quite adversely upon the present performance while firing coal. Based upon the above, calculating the btus required to fire at 200 bohp or 7000 pph steam indicates that we should consume 520 pounds of coal per trip. At the present rate of 2000 pounds of coal, we arrive at an efficiency of 26%. Part of the reason for this low efficiency is the fact that the boiler is being continually overfired.

W.N. Best

In 1938 W.N. Best Company was approached to provide an oil burner to fire the Cog Railway locomotives. Their initial approach was to provide a burner based upon the given bohp vs. heating area mentioned above. The burner provided was grossly undersized and the result was that the boiler could not be fired to its maximum potential.

It was only after personnel from Best were able to view the application first-hand, that they were able to make proper recommendations for oil firing. It appears, however, that their final strategy was not implemented and the project was shelved.

The approach that Best used in 1938 is still viable. The utilization of a modified ash pan with a burner mounted in the bottom is the most expedient and cost-effective method of conversion and requires the least number of changes to the locomotive.

Air

The major departure from the Best approach is in the handling of the air requirements to the firebox. At the time of the W.N. Best recommendations, the considerations for the amount of air supplied for combustion were just beginning to be explored. The feeling at that time was, “the more air the better”. This is still the case in many applications today, although wrongly so.

For proper and complete combustion of fuel, whether it be coal or oil, the excess air (that amount of air above the quantity actually required for combustion” should be kept to a minimum. In the case of “Colonel Teague”, the excess air is above 350%. Excess air does many things to a boiler. It reduces steaming rate by cooling the heating surface and increases stack temperature, both due to the increased velocity created.

Two areas that need to be address with respect to the air requirements are the firebox dampers and the stack. The proposed new ash pan will be supplied with an adjustable damper to provide the fireman/engineer with a method of controlling the amount of air that enters the firebox. In addition, every attempt must be made to eliminate tramp air from entering the firebox. Specifically, the firebox door should be gasketed and the existing air ports plugged. The present grates will be removed, but, the reverse arch will remain intact.

At the present time, much of the exhaust from the cylinders is vented to the stack area to provide draft for the firebox via the petticoat. When the conversion to oil is implemented, the required draft will be significantly reduced to the point where provisions will have to be made for the excess exhaust generated. In addition, the

wire screens and the spark arrestor will not be required, although the screens may be left installed to maintain aesthetics.

Fuel

The locomotive fuel, although yet to be specifically selected, will fall into the category of light fuel oil. A slip-in tender fuel storage tank with a capacity of approximately 225 gallons is proposed for this initial project. In addition, a 50-gallon day tank would be mounted on the left side of the locomotive, extending total capacity to 275 gallons. This should be adequate for three trips and it is hoped that when final testing is complete four trips will be possible.

The initial conversion on No. 10 will utilize a pump to provide fuel at a constant pressure to the burner. It is hoped that this pump will be eliminated if it is determined that the gravity feed is sufficient to provide the burner with an adequate fuel supply at various loads. Fuel and steam flow (for atomization) to the burner will be regulated in the cab by individual flow control valves with precision dials for setting the proper flow based upon actual operating conditions.

Performance

The conversion to oil does not necessarily mean an increase in performance for No. 10. It is evident through calculations and discussions with personnel that the performance could be significantly improved with changes in operating procedures and minor modifications. A major increase in performance can be achieved through the control of air to the boiler as mentioned above. Secondly, but as important, is the reduction of exhaust backpressure on the cylinders. On No. 10, the backpressure is primarily due to the piping arrangement of the exhaust system. Design improvements and relocation of the exhaust piping will be made to… improve the overall performance. Overall locomotive reliability will be increased through the firing of oil. Oil will produce more even combustion and therefore a more constant steaming rate. Through the elimination of coal and the associated dust and ash, a cleaner overall locomotive environment will result. This will mean less wear to moving parts, less buildup of grime and less overall maintenance.

Schedule

The time frame for the implementation of the project is estimated at 8-10 weeks from project start date. Although details will be addressed in the work plan, it is safe to say that the conversion and testing can be completed by mid-May and making contingencies for any unforeseen events, No. 10 will be ready for the mountain by June 1st.

Cost Estimates

The cost estimates provided are based upon the purchase of all materials and labor. After discussions with Cog Railway personnel, I am most confident that the vast majority of the work, including fabrication, can be accomplished by them, working from detailed drawings and minimal supervision.

Total Projected Cost $16,300

November 7, 1989

Russ,

I left a message on your machine re: the #10 work. We put the holes in the firebox but they don't want to draw.

We hope to keep the 10 out for as long as possible this fall to continue the necessary tests. Once winter really sets in we will have to make a decision as to the status of the project. Be assured that I am anxious to see this project succeed.

We will continue to test daily now that our passenger season has ended. I am at a loss as to how to modify things at this point.

Signed: R. M. Clement

This picture of the No. 10 Col Teague at Marshfield platform taking on water after descending in the late after spawned a Facebook discussion thread starting January 15, 2021 on Railway to the Moon – The Mt Washington Cog RY & Alumni page:

No. 10 Col. Teague Remembered

Kevin Day: "Was this the meanest bronco in the stable?" ***Robert Cal Callahan:*** "I liked the 8." ***Mark Brown:*** "#9 Waumbek" ***Bill Fothergill:*** "The guys at the cog told me this did not fire well." ***Paul Forbes:*** "Bill - it fired fine. It just wasn't as easy to fire as the others. The 8 was similar. Boilers for those two were from a different manufacturer. The 10 could flicker." ***Kevin McKinney:*** "I fired the #9 in the early 60's. Loved that engine! Of course, I was partial." ***Morris Root:*** "Had the rare opportunity to run the fleet in '67. #9 ran the best. #8, late summer, was using water in a big way." ***Roger Clemons:*** "Morris - Lucky you. I ran #3 (nice), #4 (pig), #9 (good, but slippery on the way down), and #6 (touchy, but with a good fireman, perhaps the best to make steam). I ran the #6 on the top of a double in 1971, with Paul Case, a track man, as my fireman. First time firing and Charlie Kenison in the Deuce below me. I explained to him how I was firing it and he followed my instructions and we came into Waumbeck with 125 psi. Left Waumbek and Charlie didn't give us much of a lead, but Paul had 130 psi at Jacob's and we took the siding at Skyline after Charlie suggested it, to wait for the down trains. After that it was hard to keep ahead of the Deuce, which was re-boilered in '69." ***Alan Warner:*** "I got to run the 10 its first full year of service in 1973. It was an absolute dream. Easy to fire once you adjusted to the larger firebox, and fast! Even with the crap coal we were using back then." ***Robert Cal Callahan:*** "Alan - in '74 I told Ed (Clarke) it was asbestos coal. Me and *(Mike)* Kenly had the #1 and it was a bitch to keep moving. We broke a rear crank on the flats out of the base." ***Roger Clemons: "***Alan - We had powerhouse coal, i.e. dust in '70-'71. Nasty stuff that would blow out of the stack before it ignited. The #9 would eat it, but only with the sidestack wide open. All other engines would burp and puke the stuff out, and several engines applied the patented "Acme Tender Extender" on the tender behind (pun intended!)" ***Dave Moody:*** "There were only two "real" engines, the #6 and the #2." ***Mark Brown:*** "Dave - ok... why?" ***Dave Moody:*** "Mark - The #6 was smooth and quiet, #2 was a powerhouse and easy to fire." ***Morris Root:*** "According to G(ordon) C(hase), 1 was #1!" ***Robert Cal Callahan:*** "Dave they were great engines, I liked the 8 because I often got that when I was a weekend guy in late 80's. Always had to do repairs on the engine before a run. But it had power on the steep grades." ***Mark Brown:*** "Dave Moody - is there a list of the locos and where they're now at? Did they actually sell one on eBay??" ***Dave Moody:*** "Mark, One is a static display in Twin Mt, another in Bretton Woods, The rest are all still at the Cog base station. Two are still inspected and operational, no engine

was ever sold on Ebay." ***Thomas Lane:*** "Dave - One did pop up on eBay in 2007? 2008? They were asking for 1.2 Million. Don't know if that was actually the owners or just some prankster."

The thread attached to another picture of the No. 10 *Col. Teague* as the current Base Road billboard continued the discussion.

Michael Thompson: "I'm glad no one has to fire that miserable thing *(No. 10)* anymore" ***Shawn Foss:*** "Michael - why miserable? That engine has a lot of history on that mountain. Spent many days braking on the coach in front of that engine." ***Michael Thompson: "***Shawn - did you ever fire it?" ***Shawn Foss: "***Michael - no I didn't - you?" ***Thompson:*** "yes"

Brett Hall: " Michael - beat the hell out of firing the #1. Used a ton and a half of coal on a good day and you prayed there was a little rain water in the skyline tank if you couldn't make it to the summit." ***Shawn Foss:*** "Oh wow. Back a bit to have Skyline tank *(aka Gulf Tank to some)."* ***Brett Hall:*** "Shawn - '81 thru '84. Me and Dan Moulin had to hide under that tank when a sudden storm blew in while we were working on the water line from the bar the the summit. The damn thing got stuck by lighting and we couldn't hear for an hour." ***Shawn Foss:*** "Brett - nice ok - I will say I miss the old Marshfield- was awesome feeling building shake and running out to see train as a kid." ***Brett Hall:*** "Shawn - #10 went into service for the first time when I was there. First new engine since the #9 in 1909." ***Shawn Foss:*** "Oh wow ok. I always thought the whistle on the 8 had a really awesome sound echoed off the hills with such a neat sound- not like the diesels Hooooooonk! Haha." ***Brett Hall:*** "Shawn - the whistle on the stream pump house down below the shops was the best ever. It was a five or six chime and could be heard at the summit. It took about 150 hp of (steam) to sound it and was fed with a 2" pipe. If I remember right, Peter Oeschle came up with the 8's whistle somewhere of campus. I'll have to look at some of pics." ***Shawn Foss:*** "Brett - they did a great job with the biodiesel. Just a different experience for sure!!!" ***Brett Hall:*** "Shawn - they could have packaged the diesels in more stylish boxes. I missed the 125th reunion three years ago due to a hospitalization and haven't seen them in person yet. After I left MWRy I went on to Pike's Peak for the years while I was a professor in the winters. Their Swiss diesels were a different experience altogether. Came home clean every night!" ***Shawn Foss:*** "They *(the Cog diesels)* are great, and clean, and quick. They were done well and the IQAN system apparently makes running them near foolproof but definitely lacks the charm."

BUILDERS CARD	LOCOMOTIVES	LINE	DATE	
	1, 2, 3, 4, 5, 6, 8	1	11/9/15	
753-5-9000	9	2		

~~Arthur~~ - Outlined in orange is the way the Charlestown Welding Co has their stacks made up and I am of the opinion that we put band on that I have noted on this plan but I am not sure just how it is made up but I believe it is something like the section noted.

#20 STEEL WIRE NETTING, 10 X 10 MESH.

2½ x ½" W.I. RINGS

SPARK ARRESTER CAST IRON. ALLEN PATN. NO. M-4850.

(B) FOR DETAILS OF SPARK ARRESTER SEE DWG:- 753-B-6 B. & M. PATN. Nº 75-44.

#12 STEEL PLATE

#10 STEEL PLATE

5/16" STEEL PLATE

SMOKEBOX

4 HOLES

38 1/4"

12" DIA.

36 1/8"

16"

12"

7 1/2"

5"

12"

26"

38"

5'-2 1/2"

10"

3"

4"

2 1/2"

7/8" DIA. W.I.

15" I.D.

15" DIA.

24"

(C) ADD

? Did the netting overlap this way?

Also 7½" Band on the stack.

5/32 x ½

½" PIN

SPLIT KEY

9/16" HOLES

3/16" x ½" SLOT

HINGE
WROT. IRON 1 PC.

LATCH
WROT. IRON 1 PC.

9/16" HOLE

LATCH CATCH
WROT IRON 1 PC.

22"

19"

15 5/16"

10"

20"

DRILL

(C) COLLAR ADDED.

(C) REISSUED AND COLLAR ADDED.

BOSTON AND MAINE RAILROAD

MECHANICAL DEP'T.
BOSTON

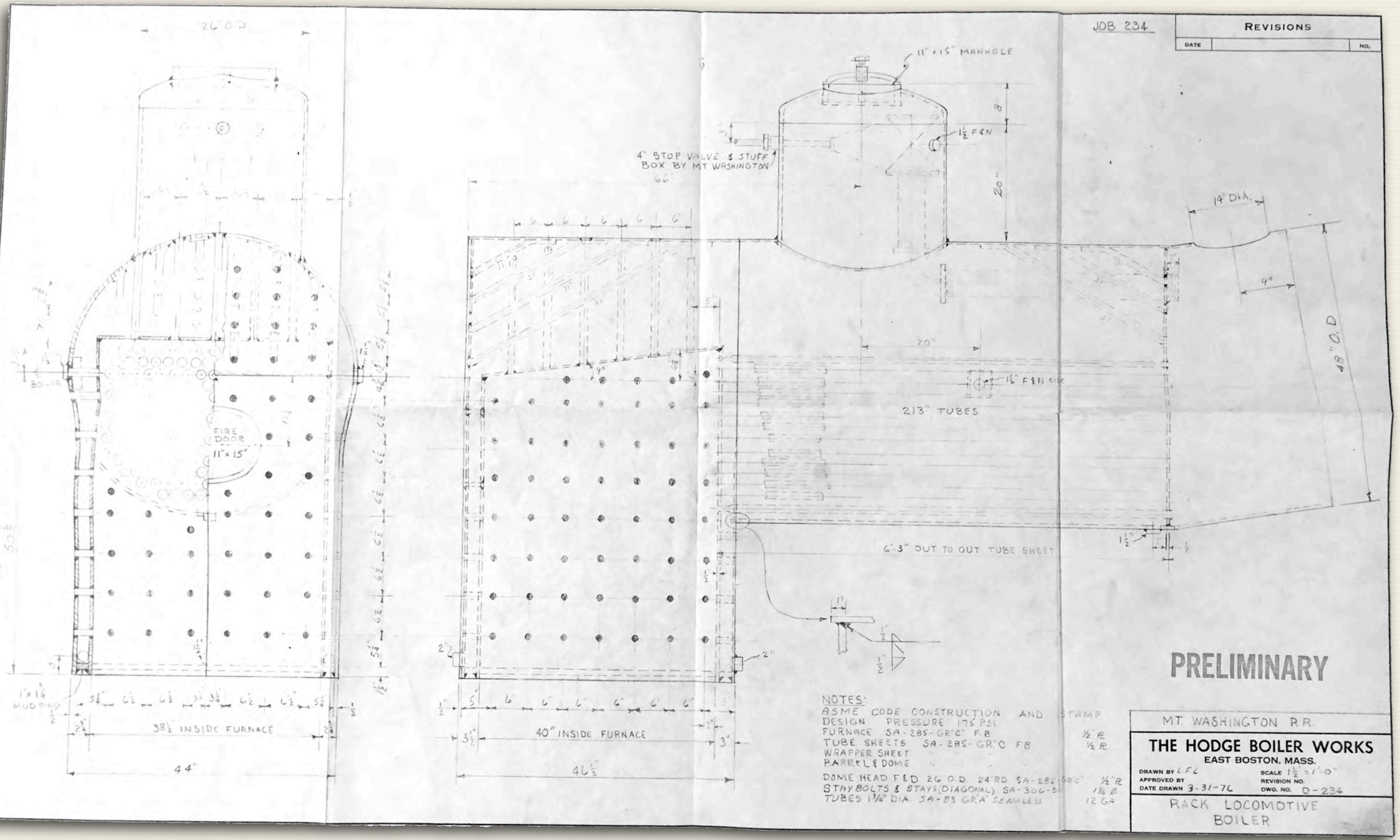
SMOKE STACK
RACK LOCO. Mt WASHINGTON RY.

BACK AHEAD	ISSUED	30589
REFER	11-20-13-A 7-14-39-B 2-20-48-C	BC
M-30 BR	M-30 TR	

75

JOB 234

REVISIONS		
DATE		NO.



NOTES:

ASME CODE CONSTRUCTION AND STAMP

DESIGN PRESSURE 175 PSI	
FURNACE SA-285-GR"C" F.B	½" R
TUBE SHEETS SA-285-GR"C" F.B	½" R
WRAPPER SHEET " " "	
BARREL & DOME " " "	
DOME HEAD F&D 26" O.D. 24"RD SA-285 GR"C"	½" R
STAYBOLTS & STAYS (DIAGONAL) SA-306-5	1¼ Ø
TUBES 1¾" DIA SA-83 GR"A" SEAMLESS	12 GA

PRELIMINARY

MT. WASHINGTON R.R.

THE HODGE BOILER WORKS
EAST BOSTON, MASS.

DRAWN BY L.F.L
APPROVED BY
DATE DRAWN 3-31-76
SCALE 1½"=1'-0"
REVISION NO.
DWG. NO. O-234

RACK LOCOMOTIVE BOILER

Hydrostatic Drive System

Ed Clark's mid-70's effort to build a cog diesel locomotive was frustrated by the interconnected front and rear cog wheels that had the engine climbing out of the rack, and by the inability of the transmission to handle the demands of the grade. Clark's Spirit of '76 hydraulic fluid would boil out of the transmission. (See Appendix - Speedy & Patriotic). Thirty years later, Al La-Prade tackled the problem and designed a diesel with independent cog gears and a hydraulic system that would not only provide power to the cogs to drive the train up the mountain, but would also safely provide braking on the way down as the diesels would not have any cylinders air compression like the traditional steam engines. A Northborough, Massachusetts company, The Hope Group (now a SunSource Company) explained their role in the diesel's development and IQAN system in the following blog post that was first captured by the Internet Archives' *Wayback Machine* on February 23, 2020:

https://www.thehopegroup.com/engineered-systems/hydraulic-engineered-systems/hydrostatic-drive-system/

Parker Hydraulics and IQAN Control Drive Cog Railway Bio-Diesel Engines

The owners and engineers at the Mount Washington Cog Railway made a decision several years ago to introduce their first major redesign of the railway engines. IQAN electrical controls were integrated with the hydrostatic drive transmission, which enabled trains to use less fuel when pulling (pushing) its passenger cars to the summit of the 6,288 foot mountain in the White Mountains of New Hampshire. Since 1869 the historical steam engines of the railway have burned through over one ton of soft-grade bituminous coal per round trip to the summit. At the prevailing rate of about $225 per ton (and rising annually) there was a lot of appeal in the concept of a bio-diesel alternative that would reduce the cost to about $60 per trip, a fuel savings of 74 percent.

Beyond the fuel costs, just the annual $100,000 expense for "boiler inspections" had become an economic burden without any obvious solution. Only the elimination of the boiler could stop that expense. Further, with a diesel engine, instead of a boiler, the train could operate with one person in the cab, instead of two, which cut personnel costs in half. And, economics aside, the proposed change reduced the emissions issue, reduced the chance of fires starting along the tracks, and would encourage more riders that otherwise objected to the smoke and dust from the existing engines.

Shop Talk: M-Class Diesels

Innovative Hydraulic Solutions

With the switch from a boiler making steam, to a diesel engine driving a Power Take Off pump, a new age was born. The engineers at the Cog Railway designed a new system from the engine, to the braking, to the overall system control. Working closely with the Cog Railway engineers, The Hope Group team introduced several Parker system solutions, including a hydraulic power train drive and hydraulic controls for the braking system.

Two Parker Denison hydrostatic pumps provide electronically controlled variable pressure and flow to two Parker fixed displacement, axial piston hydraulic drive motors. They are coupled to two planetary gear boxes that drive the locomotive's two Cog gears. The decision to go hydraulic was based on the fundamental advantages of hydraulics when it comes to power density.

Even in descent, there is an important requirement for power, ensuring the train comes down the mountain at a slow, safe speed, and under complete control. (No coasting down!). A Parker Denison fixed vane hydraulic pump runs unloaded during the trip up the mountain, but is used as a brake during the descent. A Parker proportional relief valve controls the pressure of the pump, which induces a load on the power train and applies brakes for the locomotive and the passenger coach during the descent.

IQAN System Control

A Parker IQAN-MDL electronic control system provides integrated system management for the locomotive's diesel engine, hydrostatic drive system, braking system, and cooling systems. The control system functions as a master controller, providing a display for the operating engineer, and providing a data gateway. Through the careful selection of an electronically governed diesel engine, the engineering team was able to integrate the Parker IQAN control system with the engine and other power train components. The control system gathers vital engine data from the engine's CANbus protocol and monitors parameters such as engine speed, oil pressure and cooling water jacket temperature. All of the data is transferred directly via a simple connection through two wires where it can be monitored, analyzed and displayed. The multiple screens display vehicle speed, angle of inclination, train location, vibration, and hydraulic filter status.

Monitoring Hydraulic Fluids

A clean engine is a happy engine. To ensure the safe operation of the engine, it's vital to measure and monitor the hydraulic fluids in the system. The IQAN-MDL constantly reads pressure transducers that monitor pressure levels of hydraulic functions. The system can detect possible leaks and can take appropriate action. To ensure clean hydraulic fluid, the engineers installed a Parker Icount particle counter system to measure dirt particles in the fluid from the drain of the two hydrostatic transmissions. If the particle count becomes too high, the MDL alerts the locomotive operator and slows the train before critical damage to the transmission occurs.

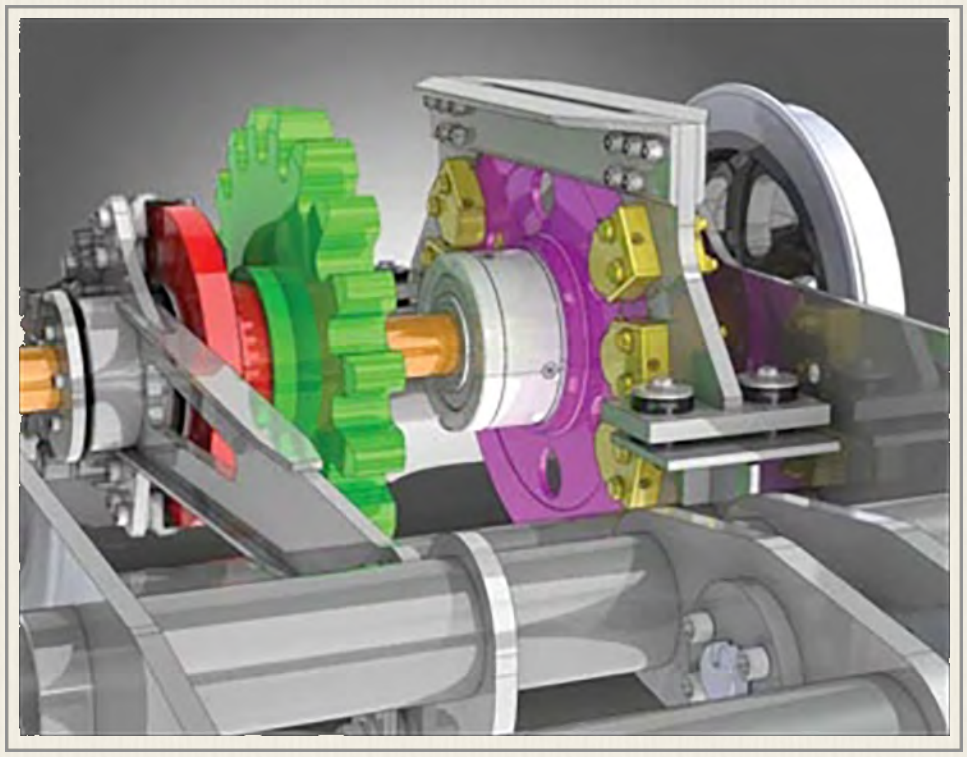
Visitors to Mount Washington now have a choice of a traditional steam powered ascent or the revolutionary bio-diesel powered locomotive's now coming on line. Several of the new engines are operating successfully now and more are on the way. The Cog Railway was a true innovation in 1869 and it continues that reputation as an innovator today.

- The Hope Group – a SunSource Company - 70 Bearfoot Road Northborough, MA

21st Century Ratchet Lifter

The famous Mount Washington Cog Railway in New Hampshire has been transporting visitors to the highest peak in the Northeastern US since 1869. At the summit, 6,288 ft. above sea level, the mountain experiences some of the most extreme weather conditions in the world with wind chill temperatures down to -102°F. A directly measured surface wind speed of 231 mph is a Northern and Western Hemisphere record. The 6-mile, 3-hour round trip features an average grade of 25% (some sections approach nearly 38%). The railway fleet currently consists of a pair of steam locomotives, seven biodiesel locomotives and seven passenger coaches. The railway's first diesel-powered locomotive was designed primarily by Al Laprade, now retired and serving as a consulting mechanical engineer. The locomotive was built entirely on-site by the Cog's shop crew. In 2001, LaPrade also designed the unique sprag

clutch system installed on the passenger coaches that replaced the original ratchet-pawl system in use since the late 1800's. The bothersome "dinging" noise created by the older ratchet system during the entire trip up the mountain was a major passenger complaint. In addition, the ratchet could not be trusted as an emergency stop mechanism because if it were suddenly applied with any speed, it would either bend the pawl, break a crossmember, a bearing, or worse, an axle shaft.



There are 12 hydraulic caliper brakes that hold the clutch rotor stationary when applied. To engage the clutch, the brakeman flips a valve which applies hydraulic pressure to the brake calipers, preventing the sprag rotor from rotating (2021)
- Altramotion image

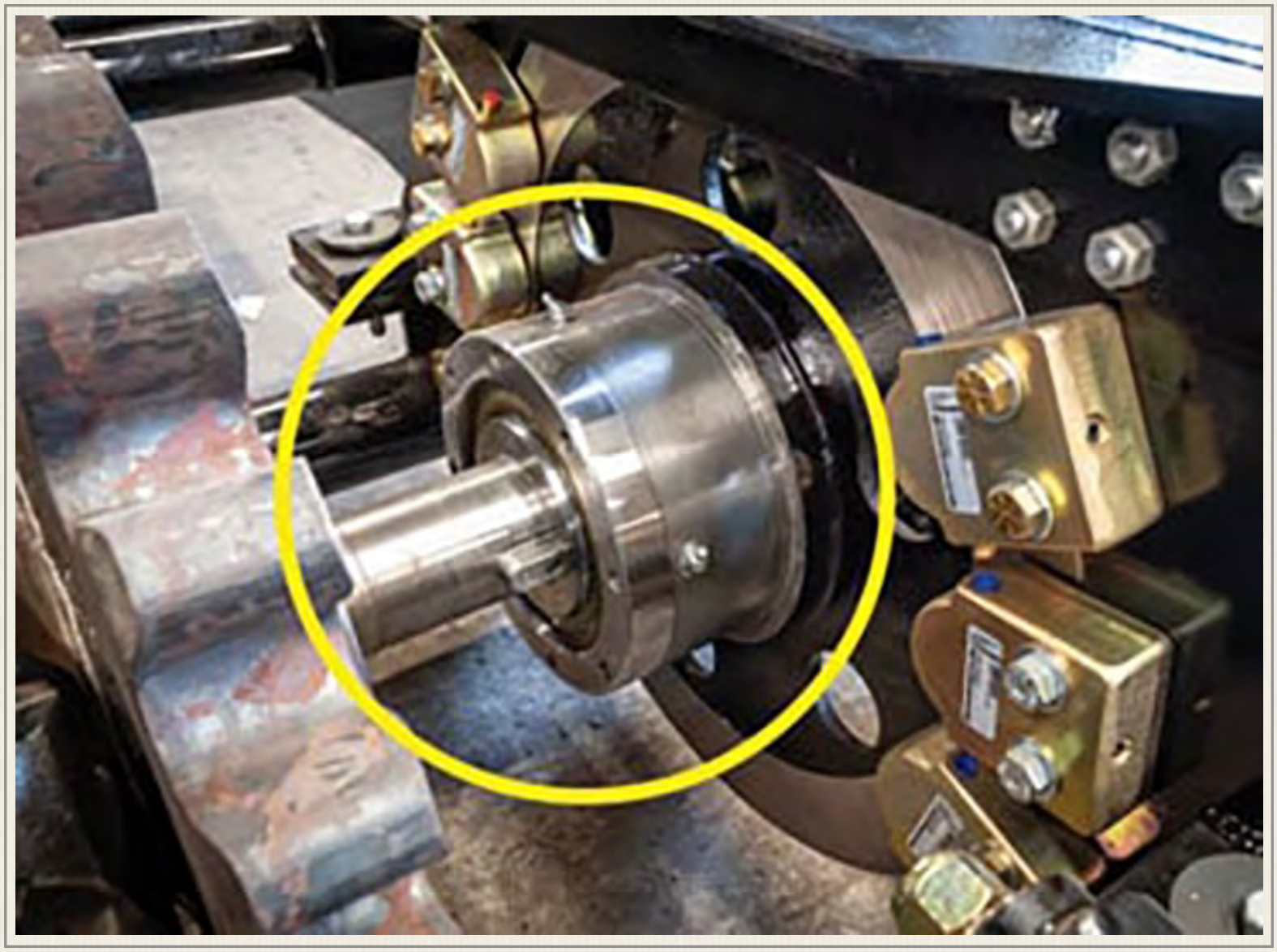
Formsprag FSO clutches were selected to meet the challenging backstopping application requirements and are currently installed on every coach in the fleet. According to Caleb Gross, Mechanical Engineer at the railway, the Formsprag clutches were chosen for several reasons. "Formsprag had the most engineering information available for our reference. Compared to competitors, the clutches also appeared to be thoroughly tested and engineered to give us confidence in using them in our application. Product documentation and honesty was key in our decision." During the early phases of the sprag clutch system development, LaPrade visited Bretton Woods (a ski area located nearby and formerly owned by the owners of the Cog Railway) to view a Formsprag clutch that was installed on a chairlift carousel. Based on the successful ski lift application, no further clutch manufacturers were considered. The ski lift clutch turned out to be a similar model to the FSO unit specified for the railway coach retrofits. The specific Formsprag Model FSO 800 clutches, featuring PCE sprags with Formchrome®and Formsprag "Free-action" retainers, were chosen based on superior 13,000 lb.ft. (17,680 Nm). torque capacity and the general ruggedness of their construction. The compact 10 in. diameter FSO units also fit within the existing hardware and the small space available on the older coaches.

The supplied FSO units are grease-lubricated with lip seals. Grease lubrication was specified because of the concern of lubricating oil leaking onto the adjacent caliper brake rotor which could allow the brake calipers to slip. Also, grease will seep out slower and presumably more visibly than oil allowing more time to identify a leak. "The specified FSO clutch has a lip seal mainly for the slow application shaft speeds (~50 RPM). Our maximum design forward/reverse speed is just shy of 5 MPH and this is a direct-acting clutch," said Gross. "The simplicity of the lip seal allows for easy, inexpensive service if replacement is ever needed." A critically important FSO backstopping sprag clutch is installed on the down-mountain axle of each coach. The sprag clutch is engaged by the brakeman for the up-mountain portion of the trip, preventing any roll-back of the passenger coach. There are 12 hydraulic calipers that hold the clutch rotor stationary when applied. To engage the clutch, the brakeman flips a valve which applies hydraulic pressure to the brake calipers, preventing the sprag rotor from rotating. The settings are left in this configuration (only forward motion allowed) until right before the train leaves the summit. For the down-mountain leg of the trip, the clutch is disengaged to allow downward movement. When the engineer is in the cab and ready to go, he gives the brakeman a signal to flip the valve back and release hydraulic pressure on the clutch rotor brake calipers. The brakeman stands ready at the brake wheel on the down-mountain end of the coach for the entire trip from the summit

The locomotive stays behind (down mountain of) the coach at all times and the two are not coupled (connected). There is an individual manual brake for each (up mountain and down mountain) axle for redundancy. Each shaft also has at least one brake drum or rotor, depending on the design. Newer air ride coaches have 3 modern air brakes which are all simultaneously applied through a parking brake valve. In both designs, the sprag clutch is also an added redundancy that can be quickly applied if needed to stop the coach from rolling downhill. The coach clutches are field-tested often. Every time a train comes to a switch, the locomotive must stop until the brakeman signals an 'all clear' to proceed. Every time this happens, the coach remains in position

and does not follow the locomotive backwards downhill. The railway is very pleased with the long-lasting performance of the Formsprag clutches. "The first clutch was installed on one of our coaches for the 2001 summer season. That coach has been in service since and the clutch has yet to give us a reason to consider replacement," said Gross

- *https://www.altramotion.com/en/newsroom/2021/06/mt-washington-cog-railway-relies-on-backstopping-clutch - Jun 14,2021 press release*



The compact 10 in. diameter FSO units fit within the existing hardware and the small space available. The sprag clutch is engaged for the up-mountain portion of the trip, preventing any roll-back of the passenger coach. For the down-mountain leg of the trip, the clutch is disengaged to allow downward movement. (2021)

- Altramotion image

Manager Rolli Remembers
1983 - 1985

From a Letter to Donald Bray from former Cog-owner John Rolli following dedication of the new Marshfield Station in 1994. In it he recalls the various mechanical, operational, and Base Station improvements made during his time managing the railroad.

Reliability: "What did I accomplish during my three years? I like to think that I greatly improved reliability of daily train operations. The first thing I did when I got to the Cog was to review all the breakdown reports for the past five years. I found that the cause of the most serious and time-consuming breakdowns was cracked forward steam lines. When this happened, the loco would lose all downhill braking ability, so that it was necessary to send a welder from the shop up the mountain to make repairs, tying up trains for hours. The frame of the loco was subject to great flex, due to no suspension and deteriorating track alignment and surfacing. The stress was transmitted to the forward steam lines, causing their fracture. They had been fitted with Barco ball joint fittings, all mounted upside down, large side facing up! This trapped cinder dust between the surfaces, locking up the fitting, and causing the pipe to break. George Burdick had placed short lengths of flexible rubber hose on the newly-constructed #8, and even before this went into service, I requested that similar but longer pieces be placed on the forward steam lines of all locomotives, and the Barcos removed. Result: no more forward steam line breakage. We followed this by looking at the exhaust side, where many locos had cylinders exhausting into each other by opposing flows, causing high back pressure, and constant failure of the expensive Johnson Flexible Metal hose used to absorb the twist on the exhaust pipes. I had the piping rerouted to resemble auto manifolds, with "Y" style piping, and eliminated the costly Johnson Metal Hoses by replacing them with special oil field rubber hose made only once a year by Gates Rubber Company. I also experimented with the #4, slowest of the fleet, by installing dual exhaust pipes, side stacks, and twin nozzles in the smoke box of varying sizes. (None of these helped much.) *(Ed note: No. 4 Summit had dual side stacks in 1950 - apparently didn't work then either.)*

Crankshafts & Boxes: "I had found much down time caused by "crankbox" and other bearing failure, due to the high rotational speed of the crankshaft, and irregular lubrication due to constant plugging of the hydrostatic lubricators. The engineers favored the mechanical lubricator on engine #9, taken from a liberty ship by Ed Clark, and I had similar ones installed in the rest of the fleet, replacing the troublesome hydrostatic lubricators to everyone's delight. The Hydrostatic lubricators used to flash back steam and oil onto the engine crew during refilling, causing burns and a mess in the cab. It took some time for Mike Kenly to find the best way to hook up the mechanical lubricators, as the rods first used were too heavy, and would bend or break. Finally, he perfected a cable and spring system that was reliable." For other lubrication with the grease guns, Rolli bought "grease in tubes rather than in bulk from barrel, higher quality, less mess."

"I called in an expert from Bearings, Inc. to look at the crank boxes, as I wanted to convert them to ball or roller bearings. He recommended a very heavy-duty roller bearing designed for stone crushers. It took the genius of Earl Temple to make a jig to hold a die rotating in the plain bearing to make the frame and strap cut on the same axis for the roller bearing. We began to convert slowly and found that the conversion worked well. The #9 had a thinner frame in the forward bearing area, and would have to wait for a new frame for its conversion.

"Crankshaft wear was a problem. They were very expensive, and subject to tooth wear if misaligned as the crankboxes wore out. Changing to the roller bearings helped alignment, and I also had Earl Temple work with the manufacturer, Brad Foote Gear Co. on a new design, flame-hardened on the surface, which had not been done previously. This helped considerably. I also had some new rack made up which had flame-hardened spools to combat wear. This was to replace worn rack taken from the mountain to use in the new shuttle track.

Guidebar & Crossheads: "Another item taking much machinist time was the guide bar, a square stock piece with threaded ends, which would break off in the flange or in the yoke. Trainmen were forever tapping guidebars with hammers to detect the off-key sound of a cracked end. We solved this by cutting the threaded ends off, drilling and tapping them, and holding them with schedule #8 bolts. This allowed the guide bars to twist slightly with the flex of the engine, and the cracking problem ended. Riding on the guidebar was the crosshead, which rested on "gibs," shoe-like devices then made of cast iron, which caused serious guidebar wear.

Rolli Recalls 1983 - 1985

I learned that years ago, the gibs had been made of brass, and no one knew why we had changed. I ordered them cast in brass once again, to the improvement of the wear factor.

"Our most serious delay during 1983 was caused by a seizure of the eccentric and the strap which wrapped around it, both made of steel, a recipe for failure! I had the machinists cut down the eccentrics and shrink fit brass wear rings around them, again improving reliability. At the time he left the Cog, ace machinist Earl Temple was experimenting with round guidebars which would let the crosshead ride in brass sleeve bearings or linear roller bearings, eliminating gibs. He was also experimenting with new design piston rings to replace the multi-segmented ones then used, and ball bearings for rod ends and eccentrics. I don't know if anyone following him continued this research, except on the piston rings, which have now been successfully changed.

Arch Brick: "Engines had been run for several years without arch brick in the fireboxes, due to fragility of the compound used to make them. We contacted the manufacturer, and got a newer, more rugged and more expensive formula mixed, and began again to use arch brick. We had not found the best solution by the time I left the Cog *(1985)*, and were still trying different formulas to cope with the crumbling problem.

Vibration: "Vibration was a problem due to the non-suspension chassis. I had a set of rubber isolated wheels made up for installation on a locomotive, and was working on a vibration-damped crankshaft with the same company, Penn Wheel, when I left the Cog. I don't know how the rubberized wheels worked out, or if development continued on the crankshaft.

Whistles: "The final item concerning the engines was strictly for fun. I had a five-chime whistle from a main line loco installed on the #8, the big whistle from the roof of the pump house installed on the #4, and another big main line whistle installed on the #1 shuttle train. On a good day, these whistles could be heard on the front porch of the Mt. Washington Hotel. Some show!

No. 4's Big Whistle *next to new coaling station (1985 - Henry Vaughn photos*

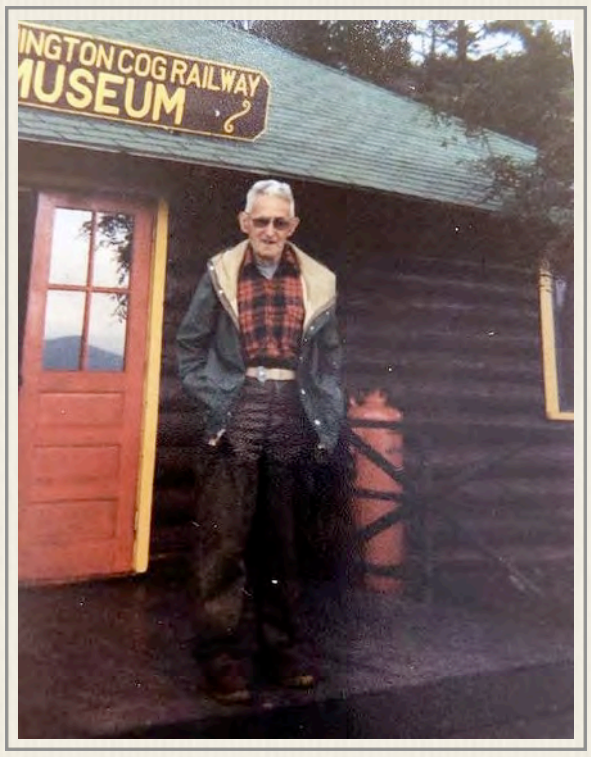
"Did these modifications help? I believe so. During my first year at the Cog, a fireman could not advance to engineer until he had been involved in a breakdown which involved tying down a cylinder and valve assembly, blocking them off with scrap wood found along the tracks, and bringing the train down the mountain safely on three cylinders' braking effort. By my third year, such breakdowns were so rare that many firemen had not seen such a serious mechanical failure. Of course, frames and yokes still crack, heads punch out, and many other gremlins lurk to make life interesting on the mountain.

Coaches: "I had little work done on the coaches beyond routine maintenance during my tenure, especially embarrassing compared to the beautiful work now being done in the car shop by today's crew. We were slowly working on a new coach, and had the other wooden coaches painted a uniform bright yellow upon your recommendation, Donald. To my despair, Ellen Teague requested that the new wooden coach be painted "a rich, royal, blue," and we reluctantly respected her wishes. I later found that you *(Donald Bray)* had put her up to this!

New Shuttle Track *images as seen in September 1985 - Henry Vaughn photos*

Grounds: "The biggest changes to the grounds during my time at the Cog were the construction of the lower parking lots and drainage ditches by Loxley Ness, the shuttle track *(left & next page)* extending down to the transfer table built by Con-Trak, a Vermont company owned by William Drunsik, the conversion of the girls dorm to the Ammonoosuc Station shuttle terminal, planting of flower gardens, and construction of additional restrooms, both inside Marshfield, and in the Middleton annex. Besides allowing the operation of the shuttle train the new track provided a way to get a train out of the se-

quence in which it came down the mountain and was parked at night, by running around the queue and descending to the shop. It no longer became necessary to put each train away in the engine and car house each night, as the starting sequence could now be altered by use of the shuttle track. We also found the buildings to be painted any number of colors, including a garish off-yellow in the shop area. We had every building on the property painted a uniform log cabin brown, greatly improving the appearance of the place.



Crawford at the Cog Museum (1981) - Margaret Machell Corey collection

Museum, Coaling & Gift Shop: "Through the efforts of Brett Hall, we created the museum where the new Marshfield now stands, staffed by 80+ year old Crawford Hassen, who regaled countless tourists with his "blood on the tracks" stories. We converted the former motel office to the administrative office and eliminated the small adjoining cabin. We eliminated the terribly loud groaning water pump in the shop which supplied water to the summit, and installed a quiet new pump in the woods driven by a separate water wheel. We also relocated the coaling area to the opposite side of the tracks under Loxley's direction, and built a new coal bunker there. This greatly eliminated the mess at the base and provided a quicker turnaround for coaling the trains. The old wooden coaling tower was fragile, supported by rusty cables, and reached by driving the "scoop" up a rickety wooden ramp. Picturesque but dangerous. We began to charge admission to the base (and shuttle train ride) at a gate house, and increased gift sales to the delight of gift shop manager Nurnet Bader by placing a barrier pipe to direct all passengers exiting the train into the gift shop.

Track Maintenance: "Little change on the mountain. My track foremen over the three years were Andre Desjardin, Ken Chadwick, John Bolton, and George Walton, with work scrutinized by Walter King of the Public Utilities Commission. In my first year, upon suggestion of George Burdick, we ordered treated timber for the first time in Cog History. *(Ed note: See Arthur Teague opening season letter, Winslow Melvin inspection of 1963 & Jim Gordon description of handling treated track timbers in Roster entry)* This seems to have worked well on everything except side pieces, which continue to crack and split regardless of treatment. In our first two years, the quality of timber was exceptional, with tight, dense, growth rings. Availability of such good wood declined in my third year and has not improved today. We abandoned the military field telephone system with two wires leading up the tracks, in favor of a VHF radio system, first on the Marine band, then on the railroad frequency. A great leap forward in train control and safety! Loxley Ness bought an hydraulic arm for the #2 work train, which was most useful in placing timbers on Jacobs Ladder, and even more so at recovering discarded trestle timber from along the right-of-way. Previously, this wood had to be cut up on the mountain into two-foot lengths, and lifted by hand up to a work train, an arduous and time-consuming job, such that wood had accumulated for a number of years. Using the hydraulic arm, we were able to completely clean everything from halfway house to the base, one autumn with a crew of myself, Steve Giordani, Brad Wecker, Steve Comeau, and Timmy Nelson. The other work train was repainted by resident artist Sheelah Christie to resemble a passenger coach with Crawford Hassen riding on board and caused much comment from the public whenever it went by.

Waumbek Station: "One on-mountain change came very close to happening, only to be cancelled by me at the last minute. This was the construction of Waumbec Station, at a site above the end of the present switch track, which was to be extended. We had a design, a contractor, and we were ready to break ground. This station was to accommodate primarily tour groups, and late afternoon tourists, who wouldn't have time for a three-hour round trip to the summit. I cancelled it because it just wouldn't work around our schedule of summit trains. The Waumbec train would have to leave from the shuttle track immediately after the second half of the

double dropped below the ticket booth for coal, in order to be first on the switch at Waumbec. It could only stay there for either a few minutes or an hour, as it would either need to follow the next double down or wait until the next pair came through an hour later. This would have been too long to stay at Waumbec, even with a food service, which we had planned. In addition, we found that most tourists would rather pay a greater fare and go to the summit, rather than a reduced amount and go part way up. I wonder if a copy of these plans still exists. Perhaps we should have planned it for Skyline, and done a two hour trip. (On busy late afternoons, we would sell such tickets, temporarily renaming Skyline to "Summit Switch," and found that we could squeeze in one extra train, which would follow the two from the previous hour's summit trip down the mountain as darkness fell. We would let the tourists out at Skyline to watch sunset, and get nearly the same price as a full summit run.)

"With the scrapping of the Waumbec Station idea also went our plan to relocate the Waumbec tank further up-mountain between the switch track and the main line. When running doubles, much time was lost at Waumbec due to the need to service the lower half of the double. If the downcomers were already there upon its arrival, it took the switch immediately, and did not water up until they had descended and the top half had left the switch. If the downcomers arrived first, the top train could have watered up, saving time on the turnaround below. (Today's crews are more efficient. We used to lose 12-15 minutes per trip after noon time when running three doubles, and could carry as many people on a busy day using five trains as with six, since with five, we could hold schedule. Crews can now hold schedule with six trains on the mountain, which Bobby Trask relates to their greater experience level today.)

Ticketing: "A change put in by Bob Schafer was little used at the time, but he correctly predicted that it would be the basis for much greater utilization in the future; the origination of the reservation system. Bob felt that the only way to sell out those cloudy days was to have a firm non-cancelable reservation system in place. To do this, we had to begin accepting credit cards, which had not been allowed in the past. We also solved the ticket mix-up which habitually occurred due to having both 48 and 56 passenger coaches in operation, by having ticket books made with the exact number of tickets in them for each run, coded, lettered, and numbered. Worked great, but not as good as today's computerized system. Bob also orchestrated the advertising campaigns, hiring the agency which created the logos, artwork, photos, and television commercials still used ten years later. Wherever those kids who modeled for the brochure are today, they remain there frozen in time pointing out the coach window on their summit ride.

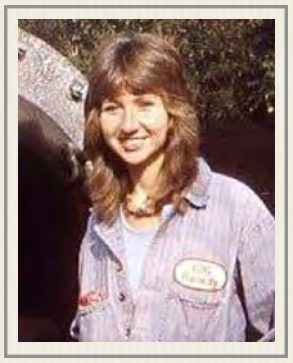
Coal Supply: "I had to learn all about coal as part of my job. I soon learned that there were four major components of the soft coal that we burned: volatiles, carbon, ash, and screening. We had ordered double screened coal, in order to eliminate excess fines, which would blow right up the stack, but we felt that the movement of shipping and handling ground up the coal so that we always had lots of dust. George Burdick had favored coal with high volatile percentage in relation to carbon percentage, which gave more quick heat. I found later in Arthur Teague's records information that lower volatiles and higher carbon percentage worked better. We found by experimentation that neither mattered as much as getting a coal with a low ash percentage. We also discovered that even coal from one mine could vary greatly, depending on where in the seam it came from. My first year saw us getting coal delivered at Fabyans via the Maine Central Railroad. We would then unload and truck it to the Cog with our own equipment. When the old coal pocket collapsed, they helped us rebuild and watched us spend $3000 on the project, only to announce that the Mountain Division was to be immediately abandoned! For the next two years, we had coal which was brought to Portland by rail, then to the Cog by truck. Rail cars were always getting lost or delayed. Our broker was so good to us that one Sunday afternoon when we were low on coal due to a wayward rail shipment, he stole some coal from another customer's pile and delivered to us that night, replacing it with coal from our shipment when it finally arrived.

"One time some hard coal was delivered to us in error. We held it for use in the shop stove, the only source of heat in that building. One day, I discovered the hard coal pile was reduced in size. I asked Dave Hicks, bunker boy, about it, and learned that he had just used the scoop to load it into the #9 loco, about to head up the mountain! At the base, the fire looked normal, and steam was up, so we told the passengers what had happened, and launched the train. We got only up the first hill; the release rate of heat with no volatiles was insufficient to keep up steam, so we backed down, changed coal, and ran 15 minutes late. The passengers took it in good spirits.

Rolli Recalls 1983 - 1985

Let There Be Light: "The Cog grounds had been black at night, with only a bare bulb or two to light up the way for passengers groping their back to their cars after a late train. We installed quartz lights in many critical areas, ideal since they could tolerate a great range of voltage fluctuation, the norm at the Cog due to our diesel & water wheel generator system. The present electrical connection to Public Service Co. one of the greatest technological events at the Cog, was still several years away.

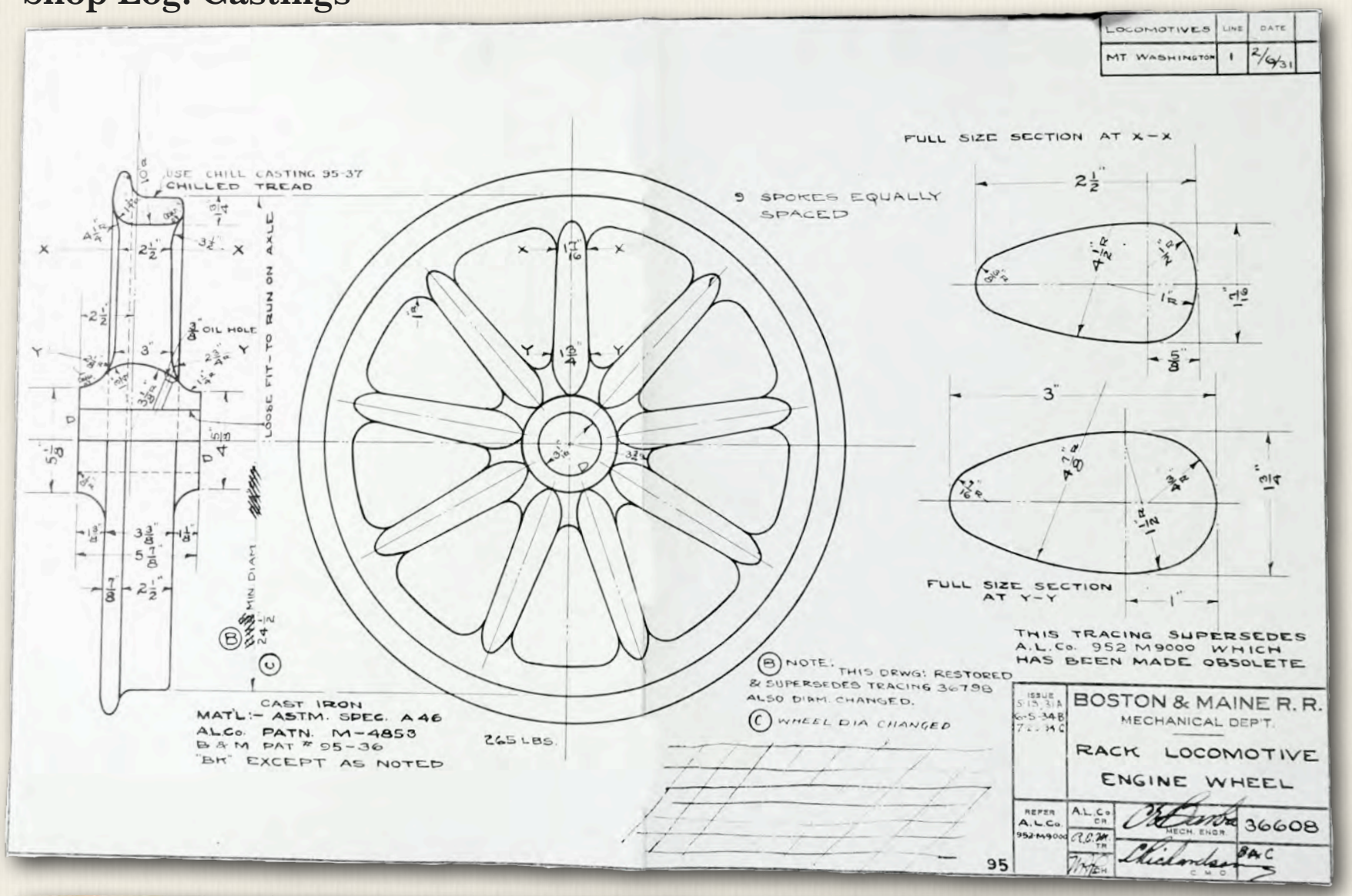
Train Crew: "Those three years marked another milestone, female train crew members. Laurie White *(left)* was the first *(1983)*. Brought to the Cog by her cousin, Dave Moody, trainmaster, she distinguished herself by moving heavy rocks as a member of Liz Mock's grounds crew. Blond-haired, blue-eyed, and dimpled she had the strength of a blacksmith, and a beauty that shone through the layers of grime and soot on her face. She had no trouble breaking into the man's world of Cog trains, and her crew of Nat Putnam and George Walton were very protective of her. She left after only one year, to our great regret. The next year *(1984)* saw Heather Allen *(right)*, our second trainwoman, start as a brakeman, and graduate to fireman by the end of the season. My final year at the Cog *(1985)* was marked by Heather firing nearly full-time and by the arrival of Cathy Carmen *(left)* as brakewoman on a crew with Walton as engineer and Brad Wecker as trainer-brakeman. Cathy was an athlete and well able to handle the job, as she previously worked as a group leader for Outward Bound in the Maine wilderness.

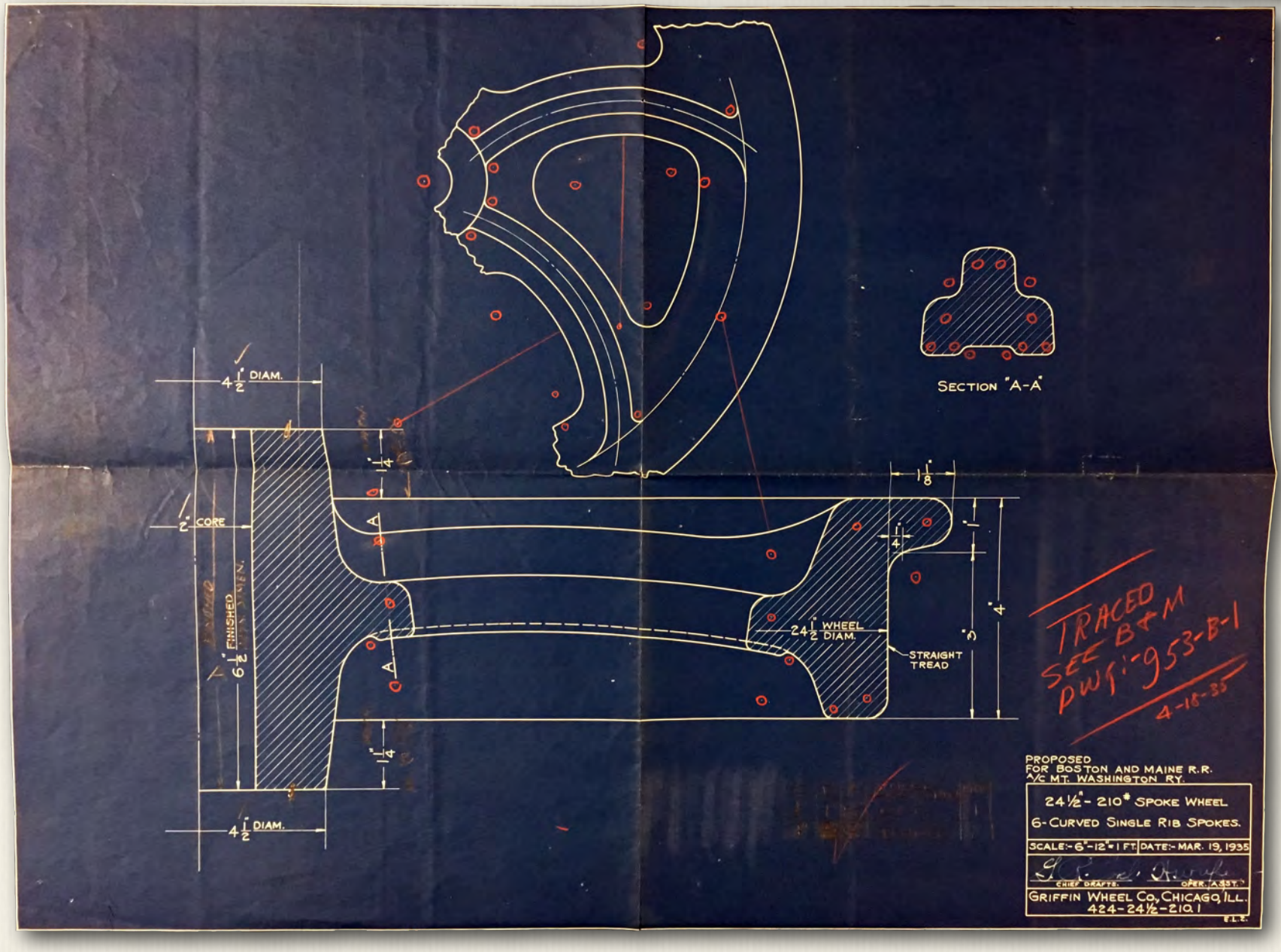


"My three years at the Cog were the most interesting of my life, yet it was time to leave and allow the business to stabilize for a year or two after so much change in so little time, before embarking on it's next growth cycle. It was nice to see you, Ellen, Ed Clark, and so many people that I worked with still at the Cog on its 125th celebration at the dedication of the magnificent new Marshfield Station."

Track Crew *(L-R) Adam Rolli, Bobby Trask, Steve Comeau & Paul Coburn at Waumbek Switch (1983-ish)*
- John Rolli photo

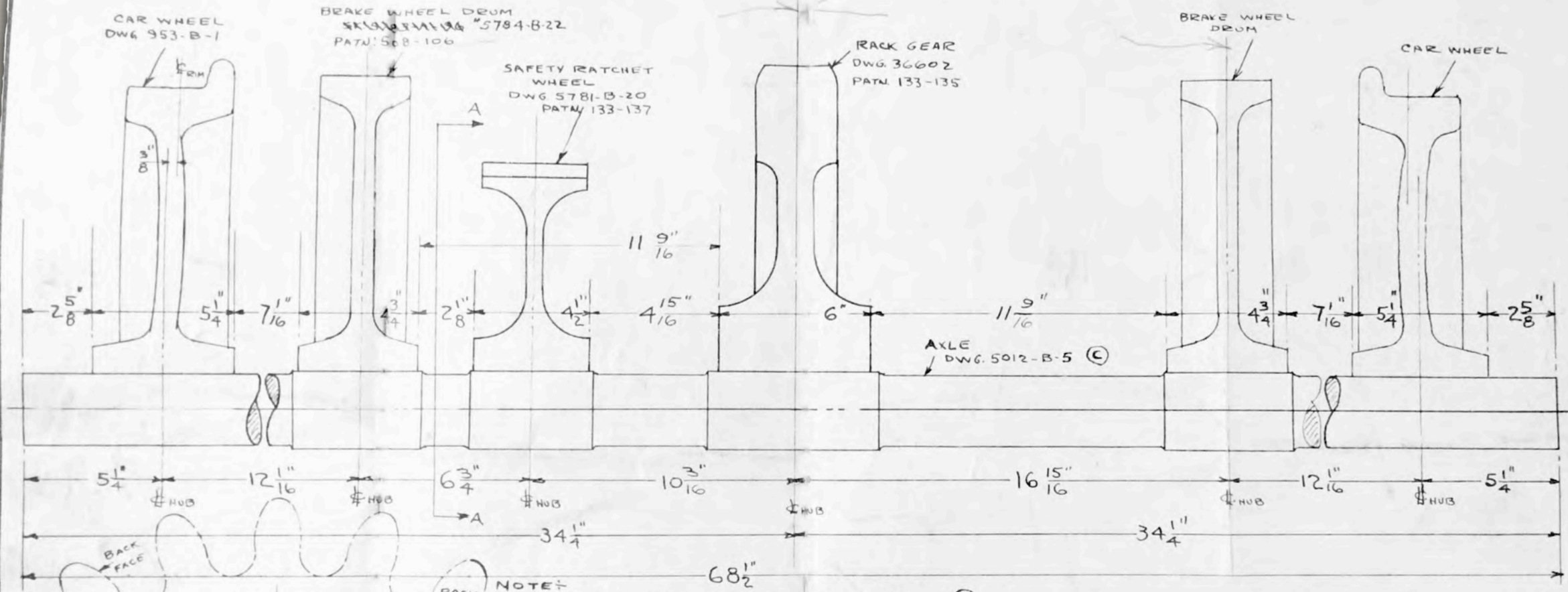
Shop Log: Castings

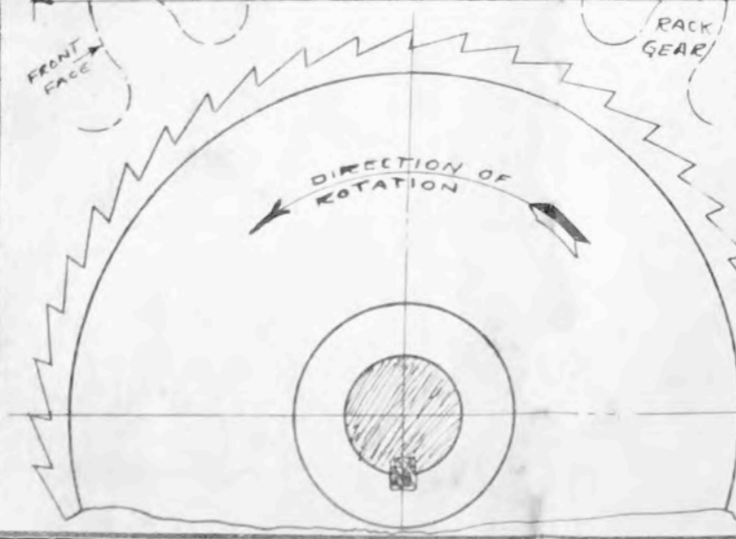




CARS	LINE	DATE	
MT. WASHINGTON RAILWAY	1	7-18-38	

NOTE
CENTER OF RACK GEAR MUST BE ON CENTER OF THE AXLE





SECTION A-A

NOTE:
WHEN FRONT FACE OF TEETH ARE WORN AND BACK FACE OF TEETH ARE NEW, REVERSE THE RACK GEAR SO THAT NEW FACE WILL BE ON LEFT SIDE WHEN FACING SEC. A-A. WHEN BOTH FACES ARE WORN, GEAR SHOULD BE SCRAPPED (B)

ONE AXLE PER CAR ASSEMBLED AS SHOWN.
ONE AXLE PER CAR ASSEMBLED WITHOUT SAFETY RATCHET WHEEL

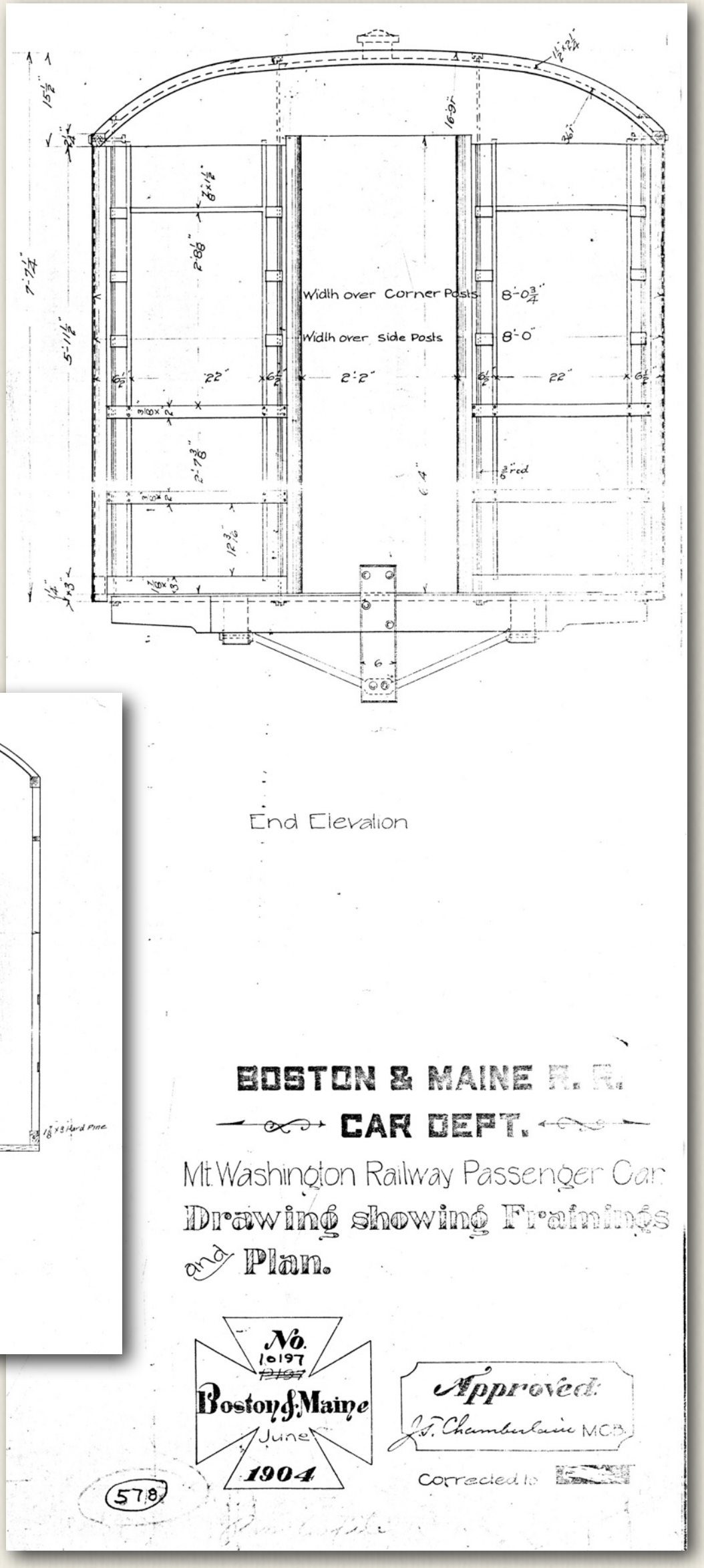
(C) DWG. REF. CHANGED FOR AXLE

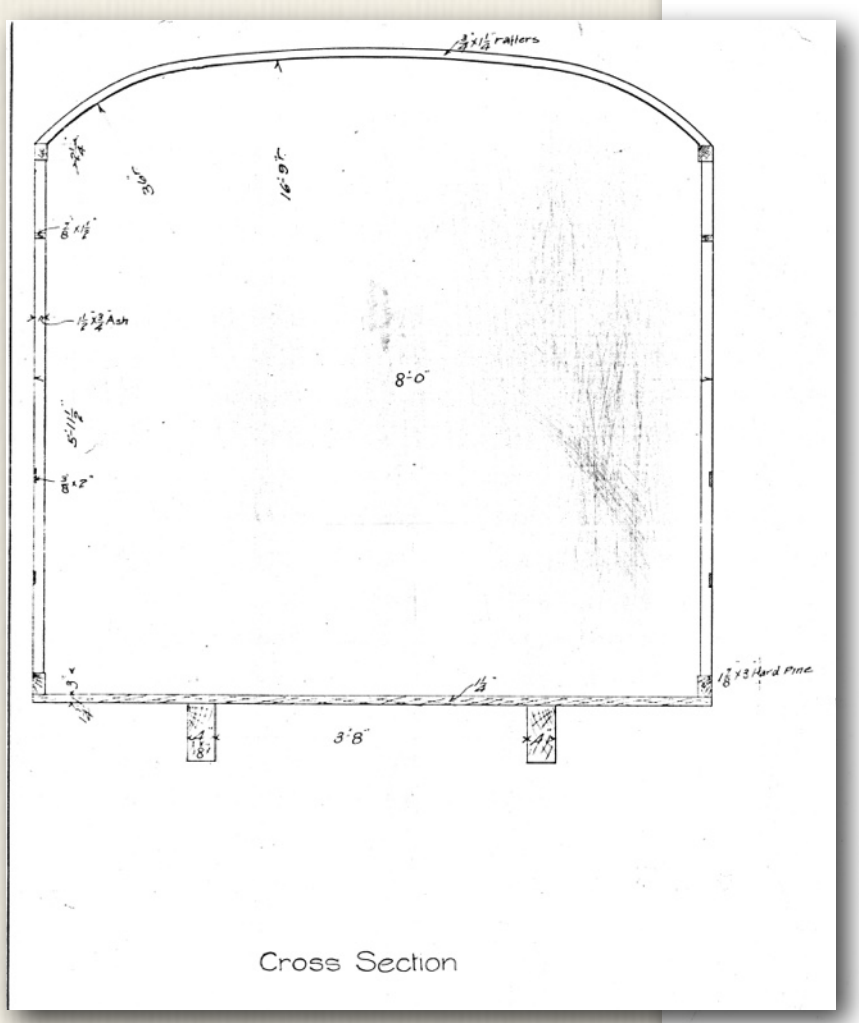
ISSUE	BOSTON & MAINE R. R. MECHANICAL DEP'T.		
7-19-38:A 8-4-39:B 12-8-39:C	AXLE ASSEMBLY		
REFER	DR.	D. McKeown ASST. ENGR.	5782-B-21
	TR.		
	CH.		A, BC

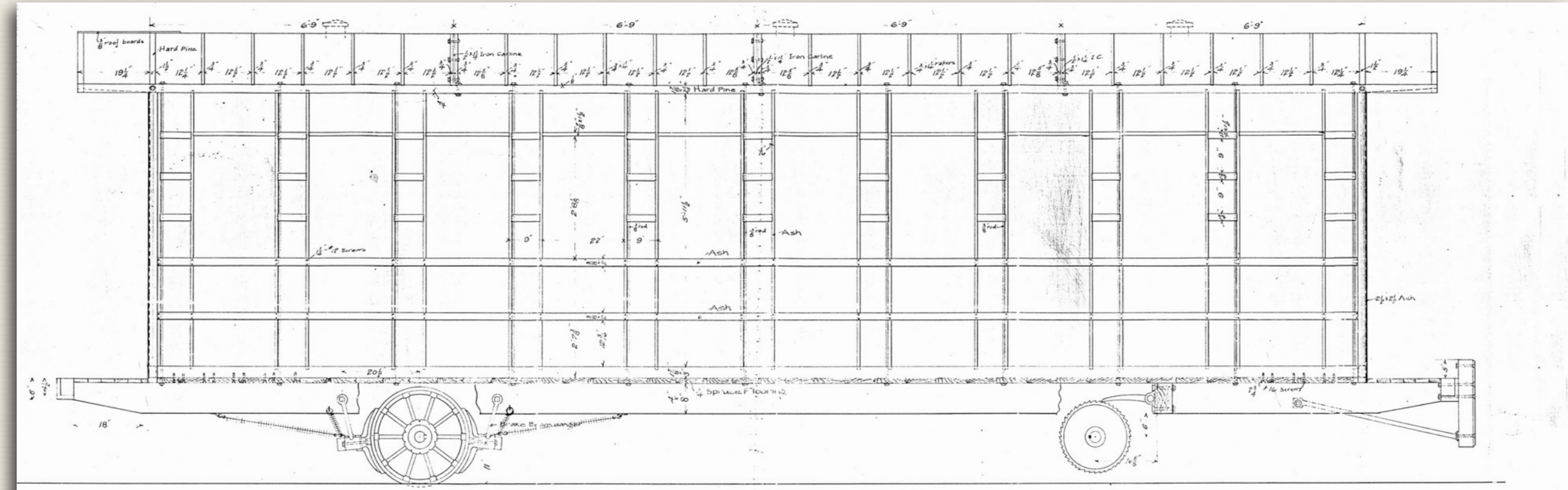
Shop Log: Passenger Coaches

1904 40-passenger Coach Blueprints:
"Car No. 11 of the Mount Washington Railway has been shipped from the builders and will shortly be ready for service. Its most striking feature is the seats, which are the Wheeler pattern, made by Heywood Bros. & Wakefield, of Wakefield, Mass., and are of a type much used on long-run trolley lines. There is no side arm and the back pulls along the seat to reverse; without turning over. There is a convenient hand-hold on the end of the back by the aisle which is useful to turn the seat or to hold on by if one is standing. the roof is arched and much higher than is the old cars. The seats are upholstered in green plush.."

- Among the Clouds - Sat, Jul 16, 1904






6'-9"
Hard Pine
Iron Carline
Ash
Spruce Flooring
Brake Beam
Side Framing
15'-0"
Lever Guide
Spruce
Hand Brake Shaft
Car Wheel
Brake Wheel
FOR AXLE MOUNTING
SEE DWG. 5782-B-21
Sprocket Wheel
Ratchet Wheel
Spline
Spruce Flooring
Posts (Ash)
Plan

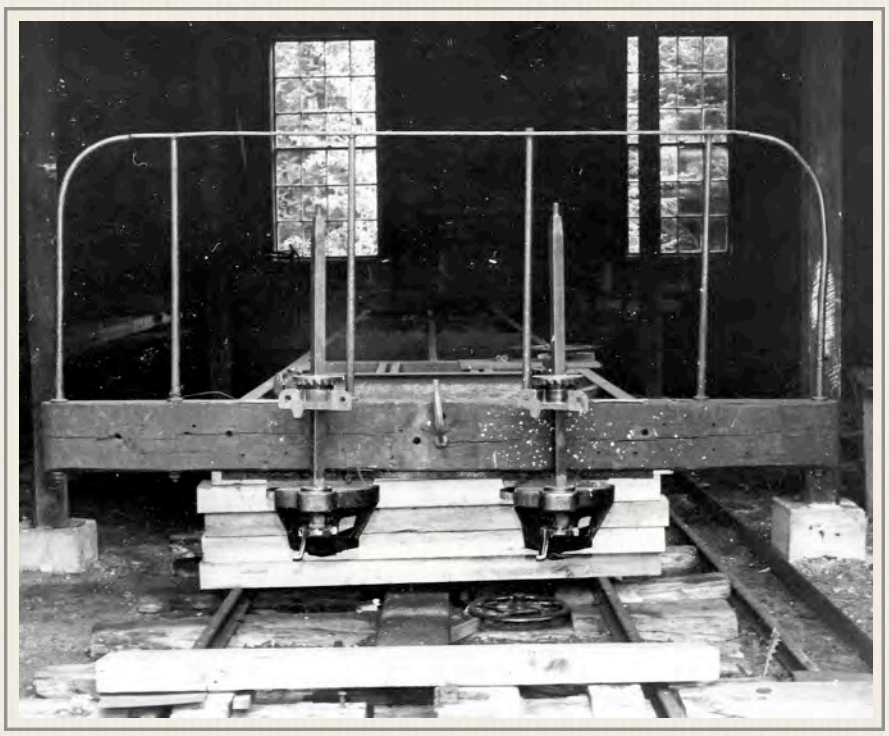
Passenger Coach No. 1

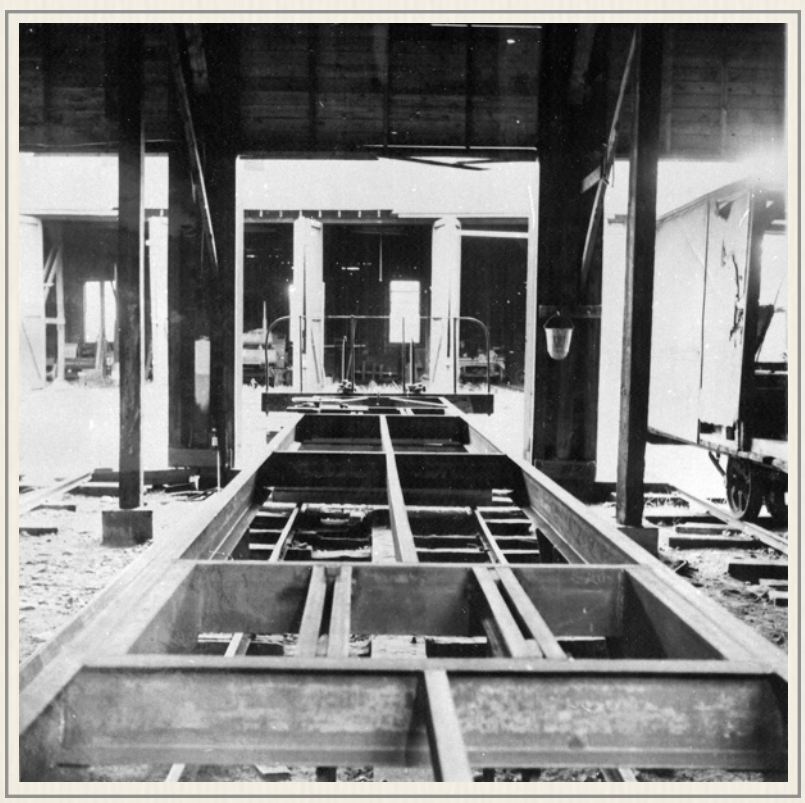
Date	Repairs	Category
1869	Built by Laconia Car Works - 40 passenger	*General*
1936	Extended at Cog RR to 48 passenger	*General*
1939	Lined brakes, new shafts, new wheels (present design) - Bearing & wheel bore 2 7/8"	*Main Shaft*
1966	New rear babbit poured, enclosed beam & steel reinforcement, new plywood end & engineers side added	*General*
1967	Steel brakes on front	*Main Shaft*
1970	New front beam & steel steps added	*General*
1970	Car refinished	*General*
9/6/71	Sign finished, new wheel down mountain fireman side, new bearing down mountain fireman side, rebuilt steel brake, relined steel brake	*Main Shaft*
1966	Refinished yellow & red *(? - trl understood this to occur after 1967)*	*General*

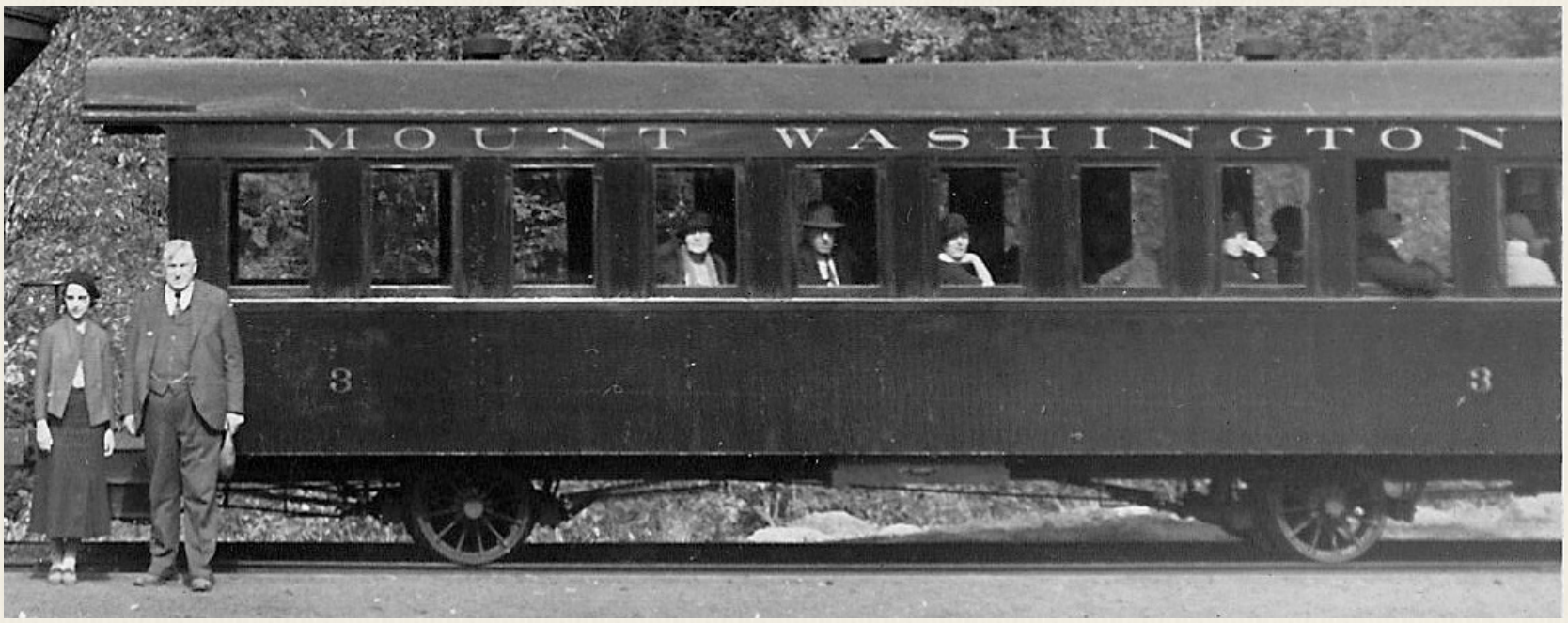
Up at the summit on car #2. No date on photo. Kodachrome Slide (pre-1950)
- Robert J. Girouard Collection

Passenger Coach No. 2

Date	Repairs	Category
1872	Built by Laconia Car Works - originally built as 48 passenger car (?)	*General*
1939	Lined brakes, new wheels & shafts added	*Main Shafts*
1963	Car entered car shop in 1963 for rebuilding - steel frame *(below)* and new 17" brake drums - added roller bearings - rear & engineers side of car replaced in plywood and entire inside paneling replaced, re-finished as the original in 1970, rebuilding completed in Sept 1970	*General*
1970	Front brakes relined	*Main Shafts*
9/6/71	Sign finished	*General*







New railway owner, Col. Henry N. Teague with unidentified woman (left) poses with Car No. 3. Passenger Coach 3 was not noted in the in Shop Log book (1932)
- Anne Teague Koop Collection

Passenger Coach No. 3

Date	Repairs	Category

Editor's note: Any reference to the 40-passenger coach No. 3 seen above in the B&M era paint scheme was not found in the Shop logbook with the other coaches in this section. Coach No. 3 was expanded to 48 seats in the late 30s. It was carrying 24 passengers to the summit in a rain-storm on August 10, 1946. The engine had stopped at Lizzie's to rebuild steam when a runaway flatcar of trash from the summit smashed into the car all the way to third passenger window. *(See Appendix - 1946 Flatcar Collision)* The metal parts of the car were salvaged. The wooden pieces were burned alongside the track.

Official accident photo by Winslow Melvin (1946)
- N.H. Public Utilities Commission

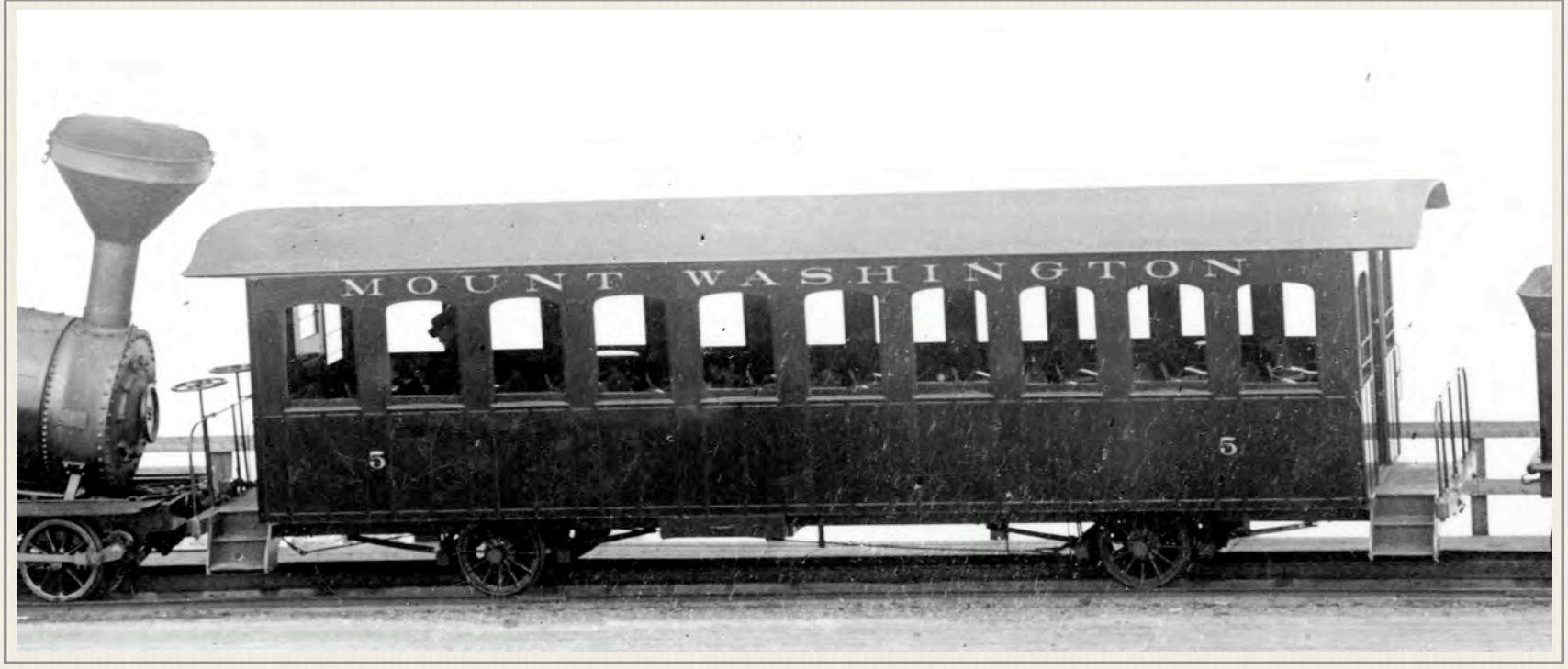
Car No. 4 on Jacob's for June 4, 1946 photo op with mainline headlight atop roof (1946)
- B&M Publicity photo / Alan E. MacMillan Collection

Passenger Coach No. 4

Date	Repairs	Category
1895	Built in 1895 (approx) by B&M RR	*General*
1936	Built as 40 passenger coach - extended to 48 at Cog RR	*General*
1939	New lined type brakes, new shafts, new wheels applied	*Main shafts*
1965	Interior refinished	*General*
1965	Cable operated brakes with improved leverage installed - new linings installed	*Main shafts*
1968	New rear babbit poured (both bearings)	*Main shafts*
9/6/71	New rear babbit poured down mountain fireman side, up mountain bearing repaired - new wheels down mountain axle, patched frame, car withdrawn from service *8/71* - Frame broken and pillar block smashed down mountain engineers side. New frame started. Windows repaired. Both sides repaired	*General*

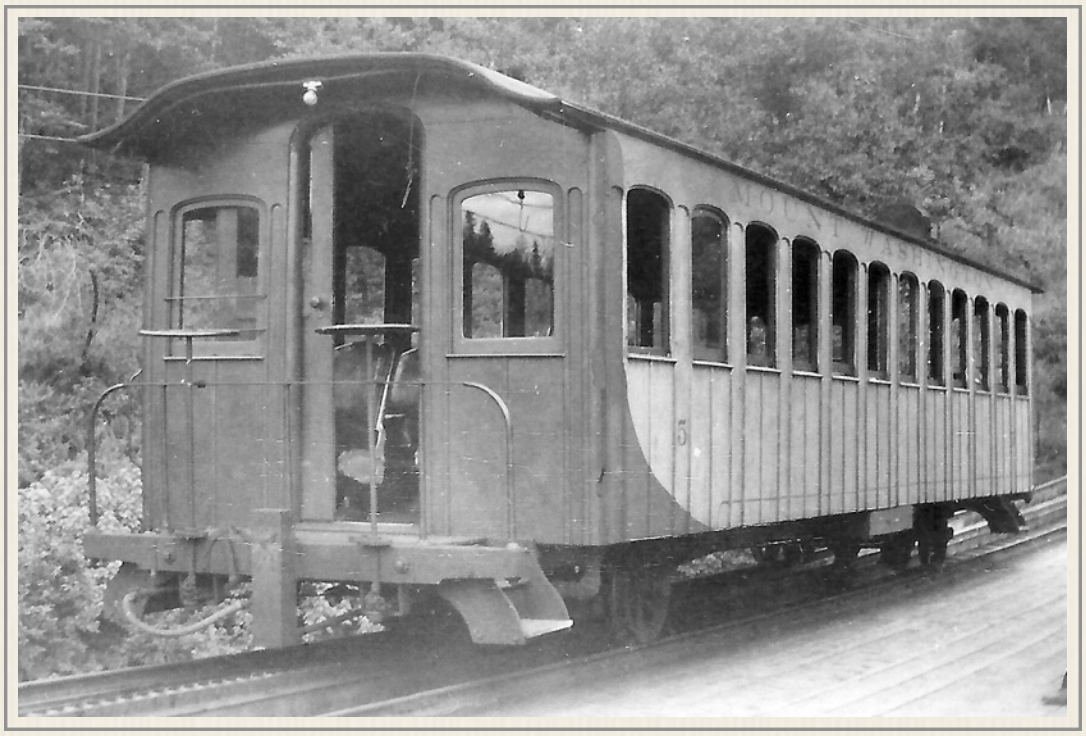
Car No. 4 alongside Base switch (1965)
- Elvira Murdock photo / Anne Teague Koop Collection

Shop Log: Coach No. 5



Passenger Coach No. 5

Date	Repairs	Category
1882	Built by Laconia Car Works	*General*
1939	Built as 40 passenger car extended to 48 at Cog R.R.	*General*
1939	New shafts, lined brakes, new wheels	*Main shafts*
1962	Engineer's side rebuilt with plywood	*General*
1965	Interior refinished	*General*
1968	Steel brakes	*Main shafts*
1970	New rear bearings poured	*Main shafts*
1970	New end beam & wider bumper block and new steel reinforcing added	*General*
1968	Plywood side built on fireman's side	*General*
1969	New front bearings poured	*Main shafts*
9/6/71	Steel brake refined and aligned - new windows, new door down mountain. Repainted and sign finished - new canvas on roof - new window strips.	*General*



Car No. 5 in 48 passenger configuration at Base platform (1939)
- Gary Irish Collection

Car No. 6 leaving Marshfield Station ahead of the No. 8 (1966)
- Elvira Murdock photo/ Ellen Teague Collection

Passenger Coach No. 6

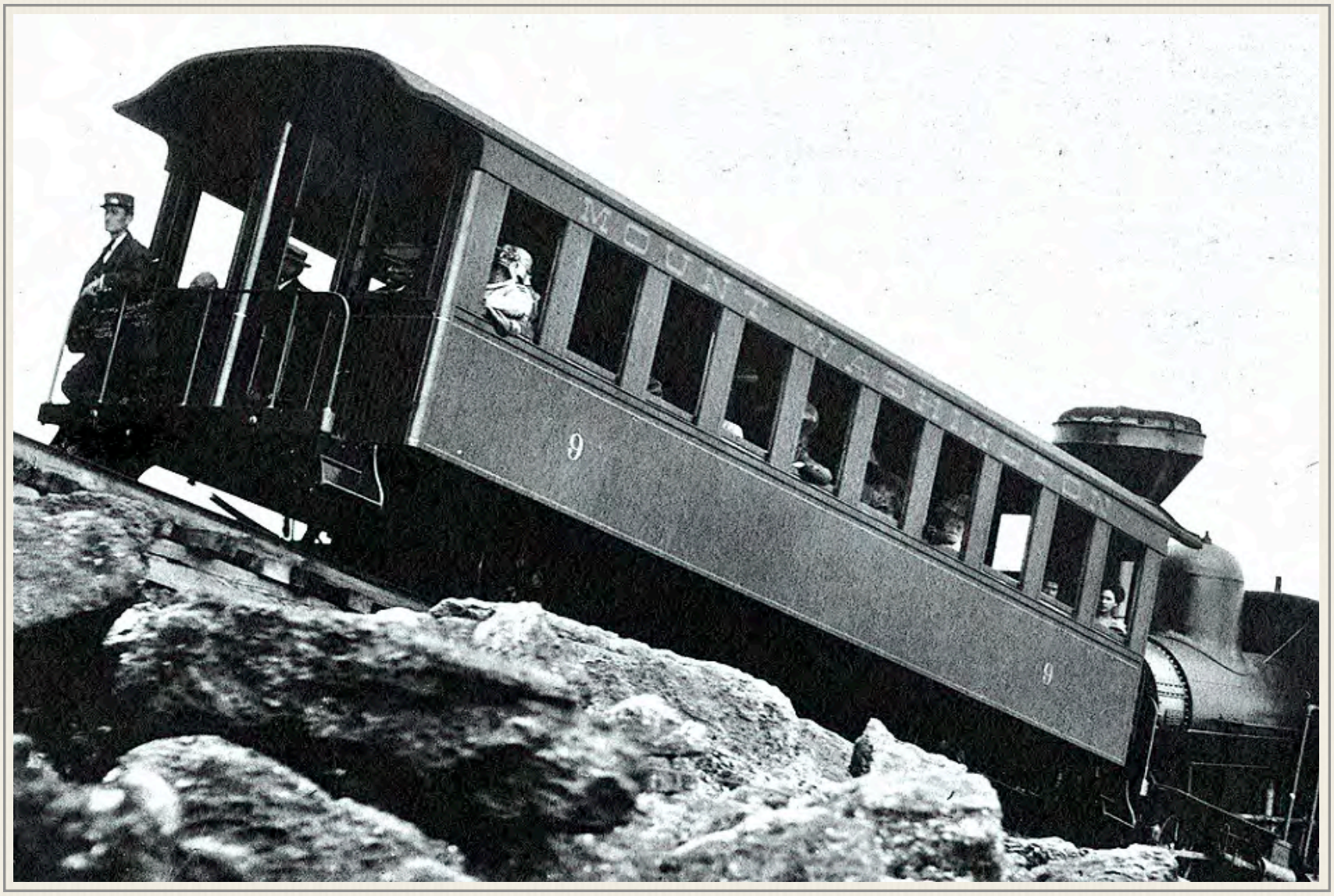
Date	Repairs	Category
1906	Built by B&M RR	*General*
1936	Built as 40 passenger car - extended to 48 at Cog RR	*General*
1939	Lined brakes, new shafts, new wheels	*Main shaft*
1952	Aluminum windows added	*General*
1967	New side constructed of plywood on engineers side and steel brakes (one set)	*General*
1970	New steel reinforcing added to rear end, new front beam & steel steps added	*General*
9/6/71	New wheel down mountain engineers side	*Main shaft*

Shop Log: Coach No. 7

Car No. 7 (needing work on siding) moves past Appalachian Trail crossing near Skyline ahead of the No. 9
- Dick Smith photo/ Ellen Teague Collection

Passenger Coach No. 7

Date	Repairs	Category
1937	Built at Cog RR - built as 48 passenger car - retains original brakes, shafts, wheels - journal size - 2 7/8" for bearings & wheels	*General*
1965	New end beam added (rear)	*General*
1966	Front beam added	*General*
1967	Steel brakes added	*Main shaft*
9/6/71	New uprights engineer's side - rebuilt siding - replaced with plywood, both sides - 12 new windows engineer's side, other windows rebuilt - Car painted maroon for first time, sign finished - new interior panels, New wiring 7 descend Jacobs Cloud lilton	*General*

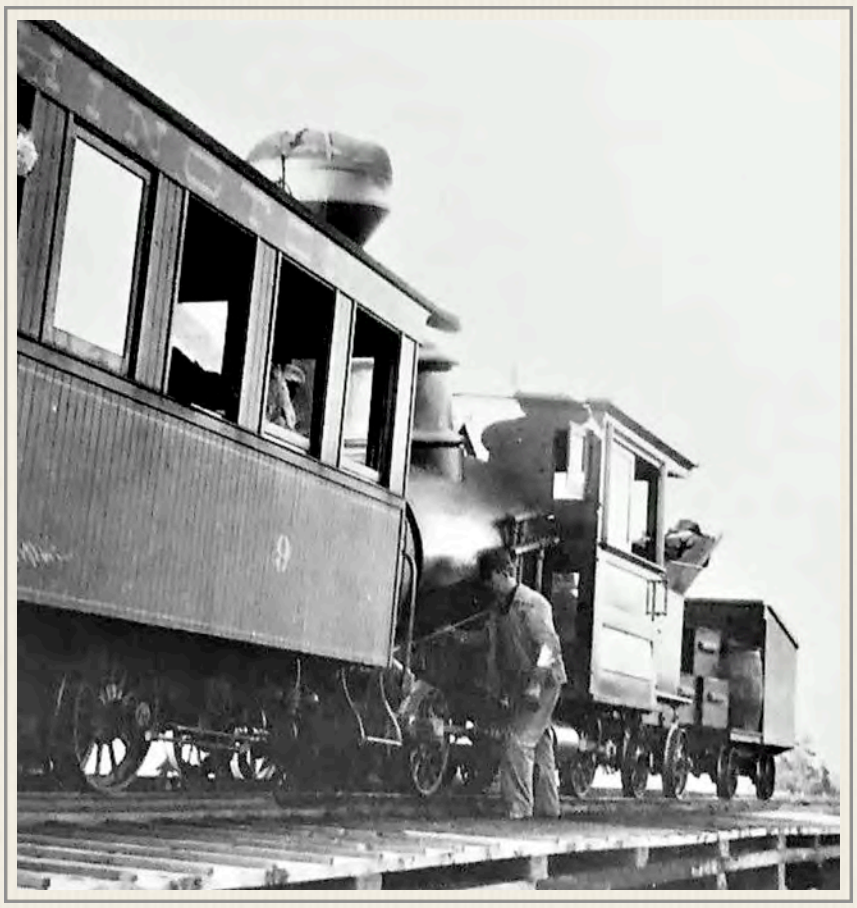


Car No. 9 at list pitch to summit(Aug1910)
- Robert J. Girouard Collection

Passenger Coach No. 9

Date **Repairs** **Category**

Editor's note: Any reference to the 40-passenger coach No. 9 seen above in the B&M era paint scheme was not found in the Shop logbook with the other coaches in this section. It is not known whether it was taken out-of-service or rebuilt and renumbered.



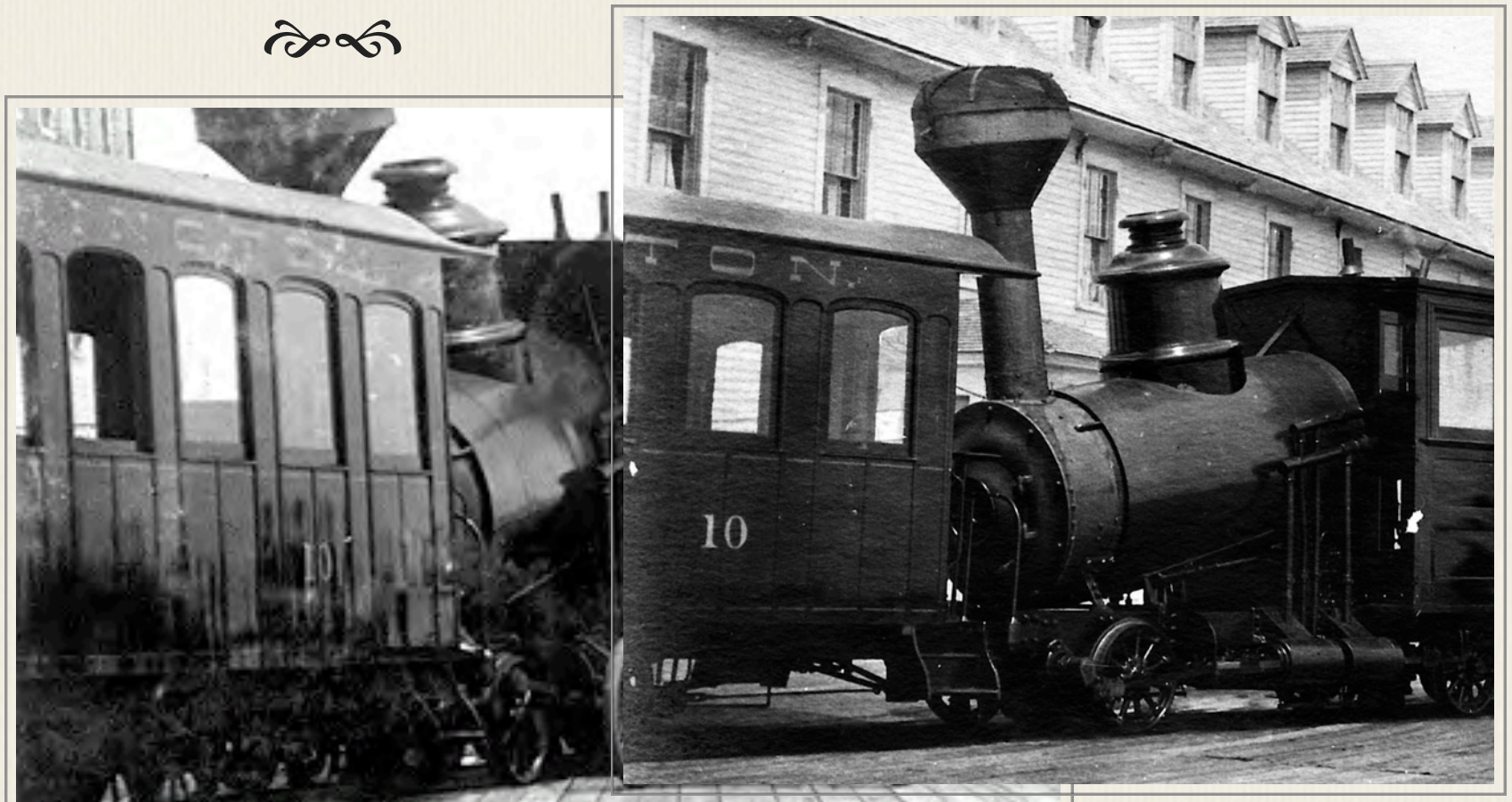
Car No. 9 at Waumbek with wood burning locomotive (pre-1910)
- Girouard Collection

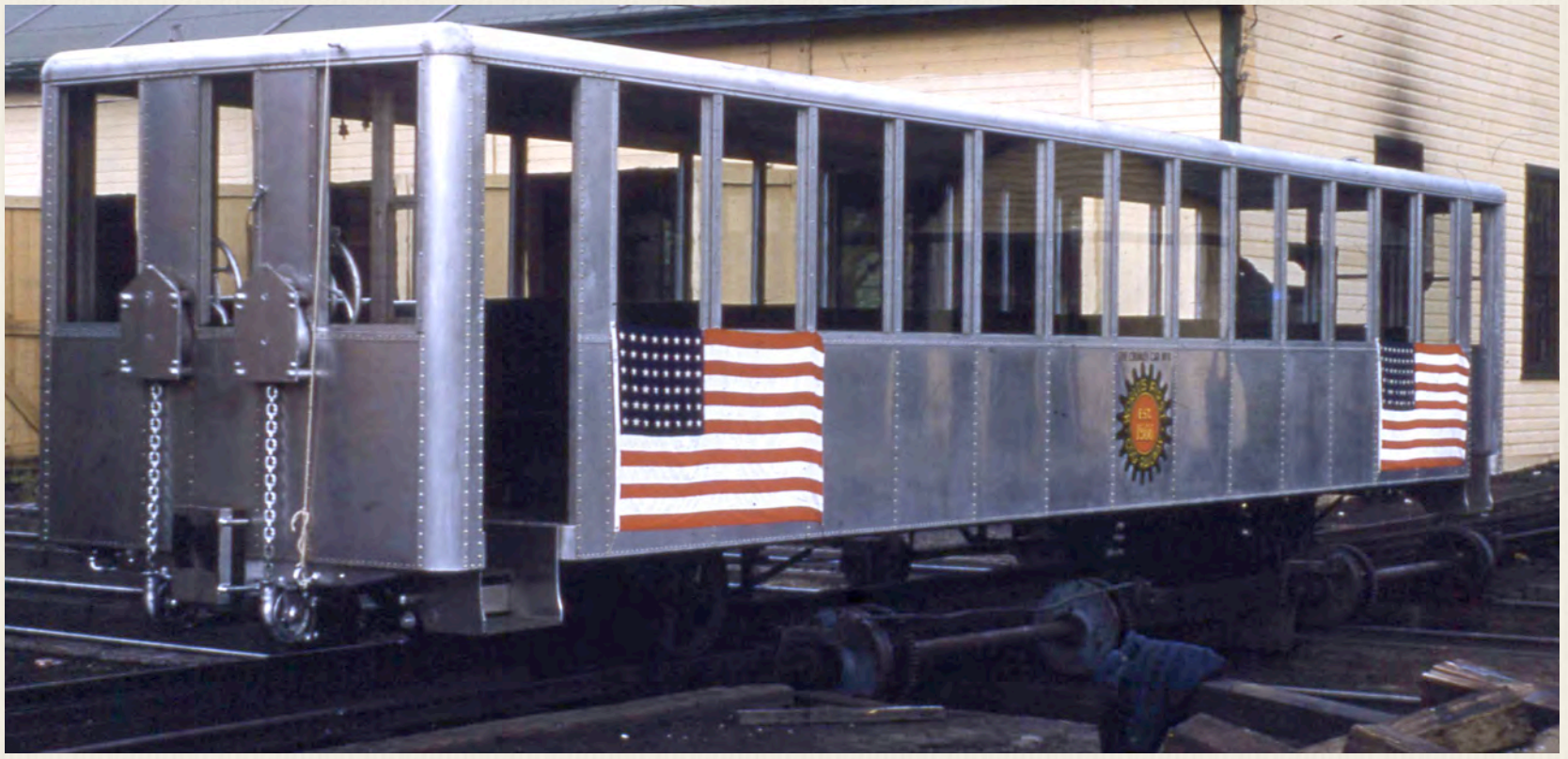
Shop Log: Coach No. 10

Passenger Coach No. 10

Date **Repairs** **Category**

Editor's note: Any reference to the 40-passenger coach No. 10 seen in the B&M era paint scheme starring in publicity photos with a Stanley Steamer auto in 1904 was not found in the Shop logbook with the other coaches in this section. It is not known whether it was taken out-of-service or rebuilt and renumbered or destroyed.





Passenger Coach No. 11 - *Chumley*

Date	Repairs	Category
1956	Built at Cog RR - built as 54 passenger car - 3 1/16" bearing journal size, spherical roller bearings, 17" brake drums, wheel journal size 2 3/4"	*General*
1958	Placed in service	*General*
9/17/1967	Wrecked	*General*
Winter 1974-75	Rebuilt by Ed Clark at shop below the station master's house in Fabyan	

Shop Log: Coach No. 12 - *Thelma* / *Taylor Made*

Car No. 12 on Skyline Switch on August 3, 1963 awaiting a meet on a down-mountain run (1963)
- Woody Thompson Collection

Passenger Coach No. 12 - *Thelma* (Taylor Made)

Date	Repairs	Category
1961	Built at Cog RR in 1961- built as 54 passenger car by Douglas Taylor - wheel journal 3 in.	*General*
9/15/62	Placed in service	*General*
1970	New rear shaft added	*Main shaft*
1970	rear brakes relined	*Main shaft*
9/6/71 rebuilt	Eight (8) sash type windows installed, - new wheel down mountain fireman side, ratchet lifter	*General*

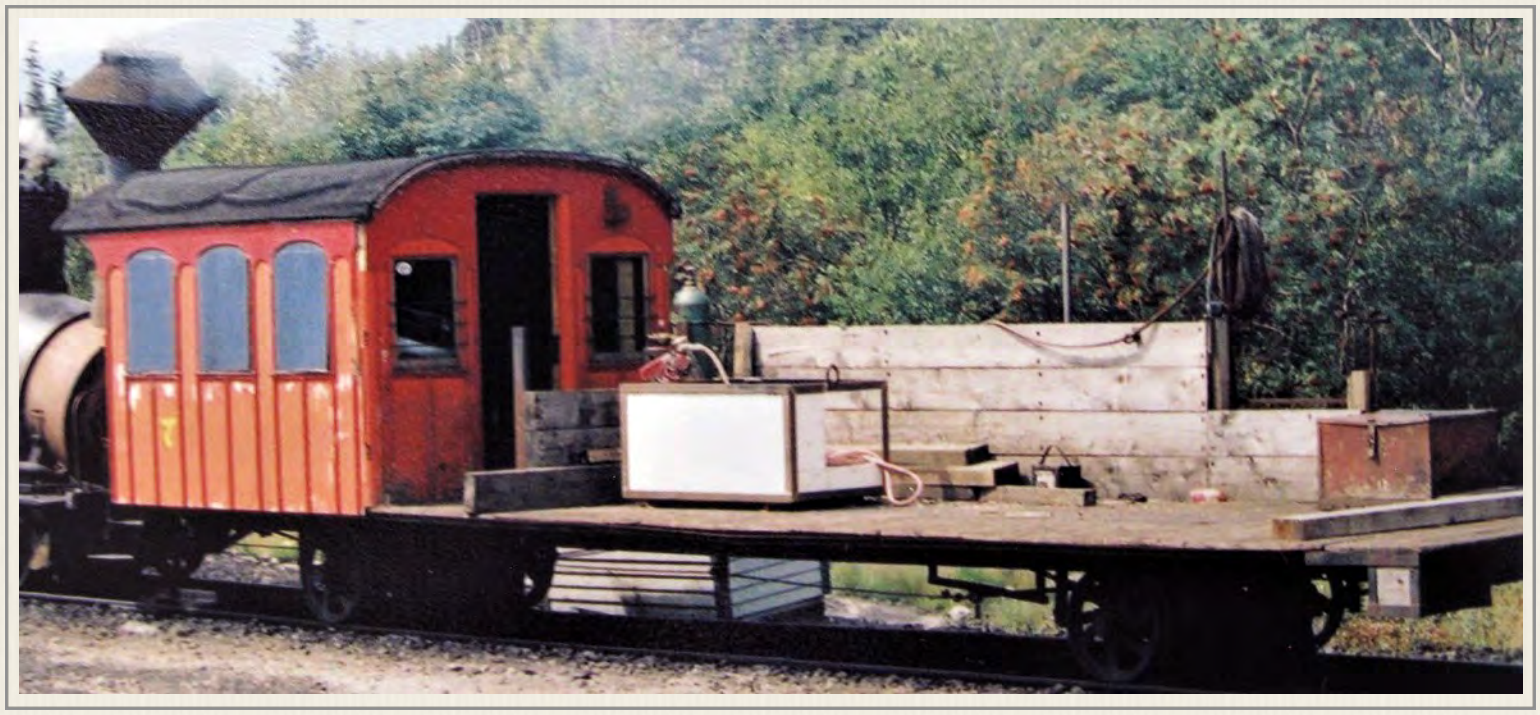
Car No. 12 was the second of the aluminum 54-passenger coaches built at the Railway. Construction began under the direction of Ed Chumley who had built the first aluminum car and was completed by Douglas Taylor's team - thus it was the Thelma for Chumley's wife and Taylor Made to recognize Doug's work. Here Col. Arthur S. Teague is seen with the two sides of the new car (1961)
- Teague Family Collection

70-Passenger Coach Construction Log

Rob Maclay started working mostly in the car shop five years after he started at the Cog Railway. He has posted a hand-written construction log on the car shop's wall. It outlines winter work as the new 70-passenger coaches were built to replace the 48-passenger wooden coaches and the 54-passenger aluminum cars, and who worked with him to build and rebuild the Cog's coach fleet.

Winter	Work Done	Builders
1996-1997	First 70 passenger #6	Gareth Slattery, Sean Slattery
1997-1998	#1 & #3 Built all new	Bruce Houck, Gareth Slattery
1998-1999	#8 & #9 Built from *Thelma* & *Chumley*	Bruce Houck, Sean Slattery, Jon Sykes
1999-2000	#6 Brakes & DM Platform rebuilt	Bruce Houck, Sean Slattery
2000-2001	#2 Rebuild	Al LaPrade, Joe Lovely
2001-2002		
2002-2003		
2003-2004	Dog Bone #2 Green room	John Watkins, Pete Steady
2004-2005	Dog Bone #6, #9, #3 Ski Trains	Bruce Houck, Jon Sykes
2005-2006	Wooden seats, Ski trains, Snow Jet	
2006-2007	Dog Bone #1 & #	
2021-2022	New passenger coach	Rob Maclay

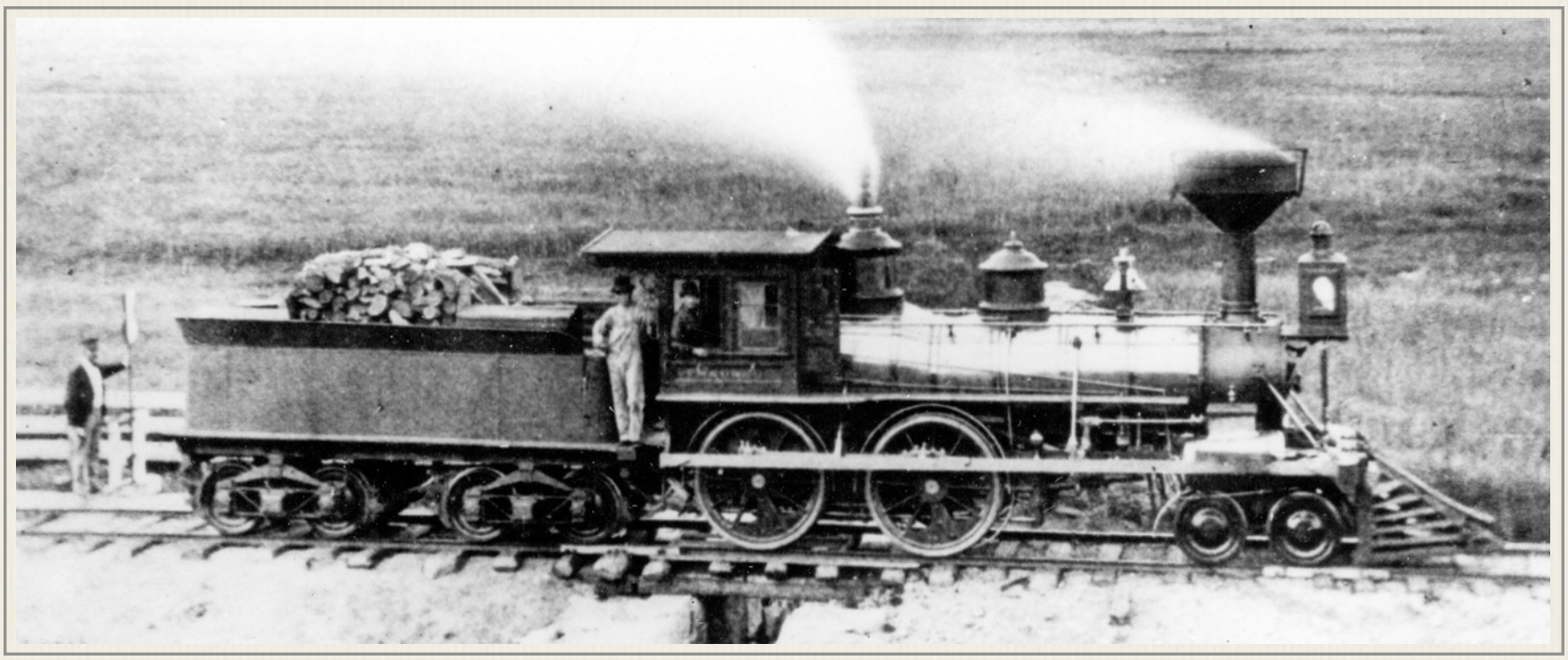
Shop Log: 70 Passenger Coaches



Spur Line Locomotive Roster
1876-1931

BC&M extended its line to the Base, bought a special locomotive, the *Mt. Washington,* No. 29, (which was the first ten-wheel locomotive every in New England) and special observation cars to run from Fabyans to the Base. However other engines worked on the line. In 1919, F. W. Lougee wrote to the *Warren News Press*: "In 1876 they built the road between Fabyan and Base of Mt. Washington. I was firing for John Swain at that time. There were four engines doing the work – the *Belknap*, *Pehaungun*, *Winnipesaukee* and *Paugus*. We had the *Pehaungun* and this was the first engine that run a passenger train over that road. Dr. Ordway's party from Lowell. We had only one car and that was all this locomotive could handle. Mr. John E. Lyon and Mr. J. A. Dodge were riding on the engine at that time. They had a new engine built named *Mt. Washington* to run on this road and when they opened it up in July this engine was put onto the train; Geo. A Ferguson was engineer and John F. Marsh, fireman. They run this engine in the summer months and in the winter, it was taken to Lakeport (then Lake Village) and stored on account of being too heavy to run on the main line.

Boston, Concord & Montreal Railroad

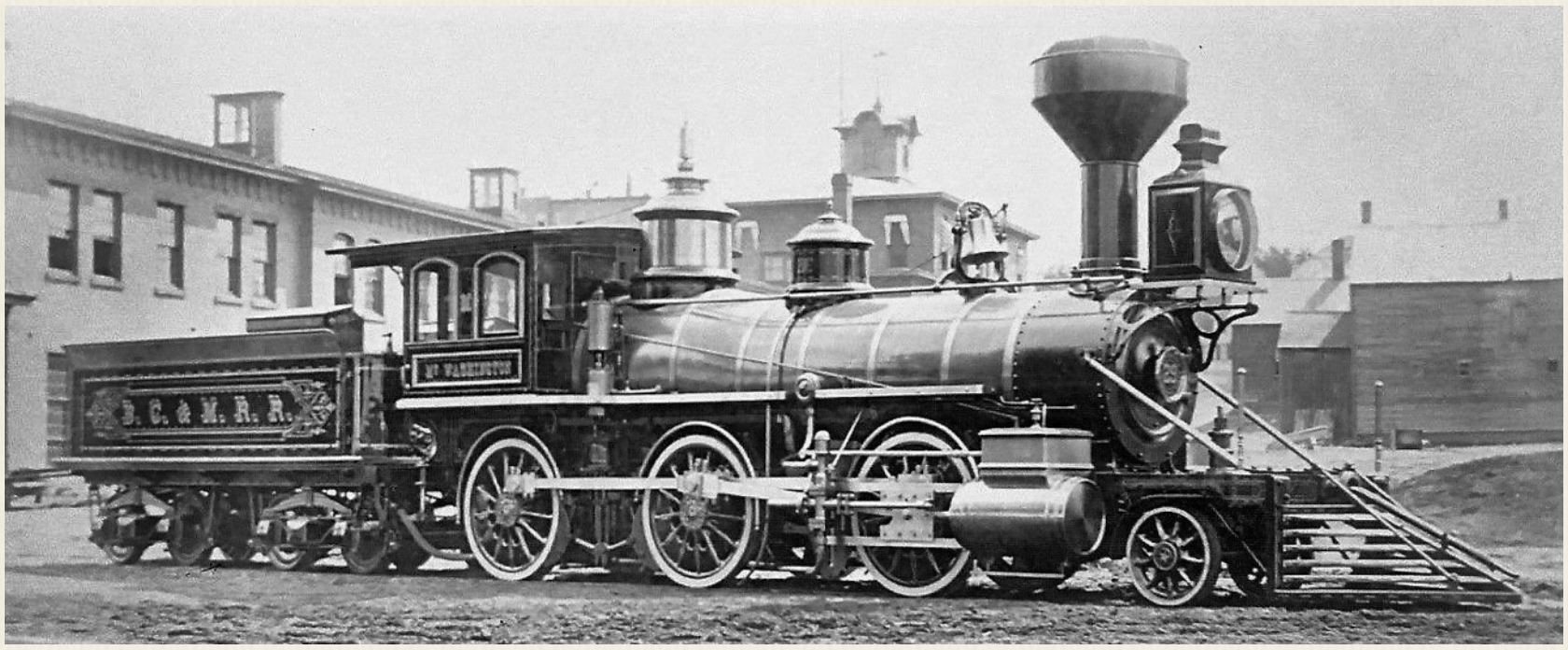


Locomotive - *Pehaungun No. 8*

Boston, Concord & Montreal RR No. 8 *PEHAUNGUN* at Fabyan, N.H. c1878. Built by Boston Locomotive Works 1853. This loco hauled the first passenger train over the Fabyan Branch to the base of Mount Washington in 1876. Digital image made from photograph in Boston & Maine Railroad Historical Society Archives. Gift of and copyright Walker Transportation Collection, Beverly (Mass.) Historical Society. Learn more about the B&MRRHS at www.bmrrhs.org. Photo 3246

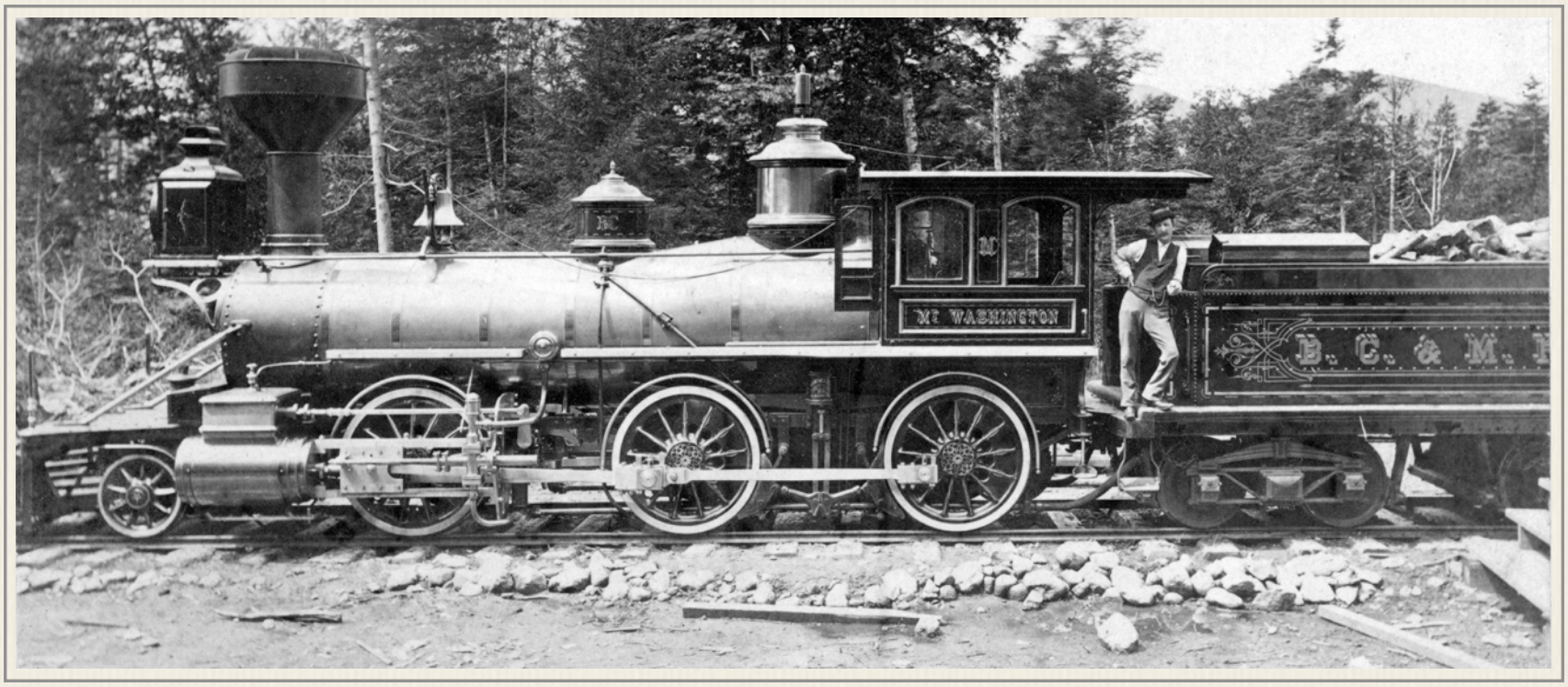
Locomotive - *Belknap*
Locomotive - *Winnipeasaukee*
Locomotive - *Paugus*

Shop Log: Spur Line Locomotives



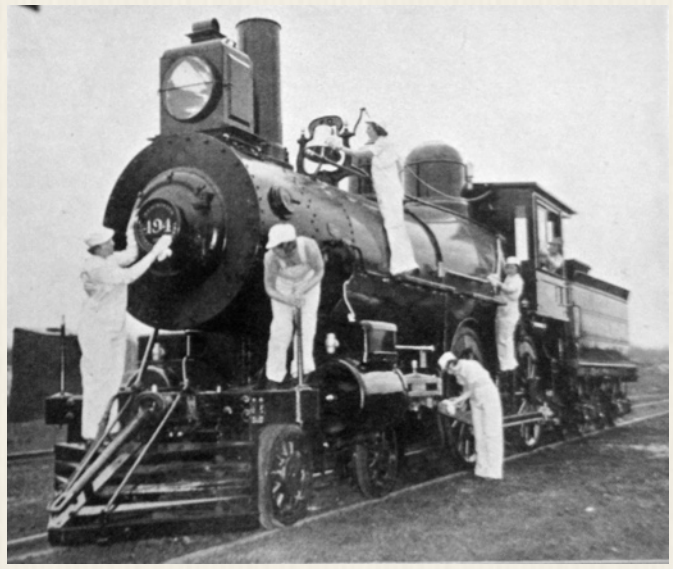
Locomotive - *Mt. Washington No. 29*

No. 29 *Mt. Washington* was built by the Manchester Locomotive works in 1876 *(above)* for the Boston, Concord & Montreal railroad. BC&M records in the Boston & Maine Railroad Historical Society for September 30, 1881 reported the *Mt. Washington* run by engineer J. F. Marsh had run 7,369 miles in the prior six months and had used just 92½ gallons of oil, repair cost 29.01 yielding a cost per mile run of .00'39. Six month later on March 31, 1882 engineer Marsh had run the Mt. Washington another 1,500 miles while using 8½ gallons of oil. The cost of repairs during those six month was $1.83 for a cot per mile of .00'02. Between September 1882 and March 31, 1883, the Mt. Washington had gone 3,675 mile with engineer J. F. Marsh. 27½ gallons of oil had been used for lubrication. $16 had been spent on repairs for a .00'43 cost mile. A year later, six month figures at the end of March 1884 had 2,025 miles run, 13½ gallons of oil with just $1.87 spent on repairs. Cost per mile run was .00'09. Engineer Marsh was still at the throttle



***Mt. Washington** & engineer (J.F. Marsh?) pose at Ammonoosuc Station transfer station after backing up tourists from Fabyans (~1877))*
- Rob Bermudes Jt. Collection

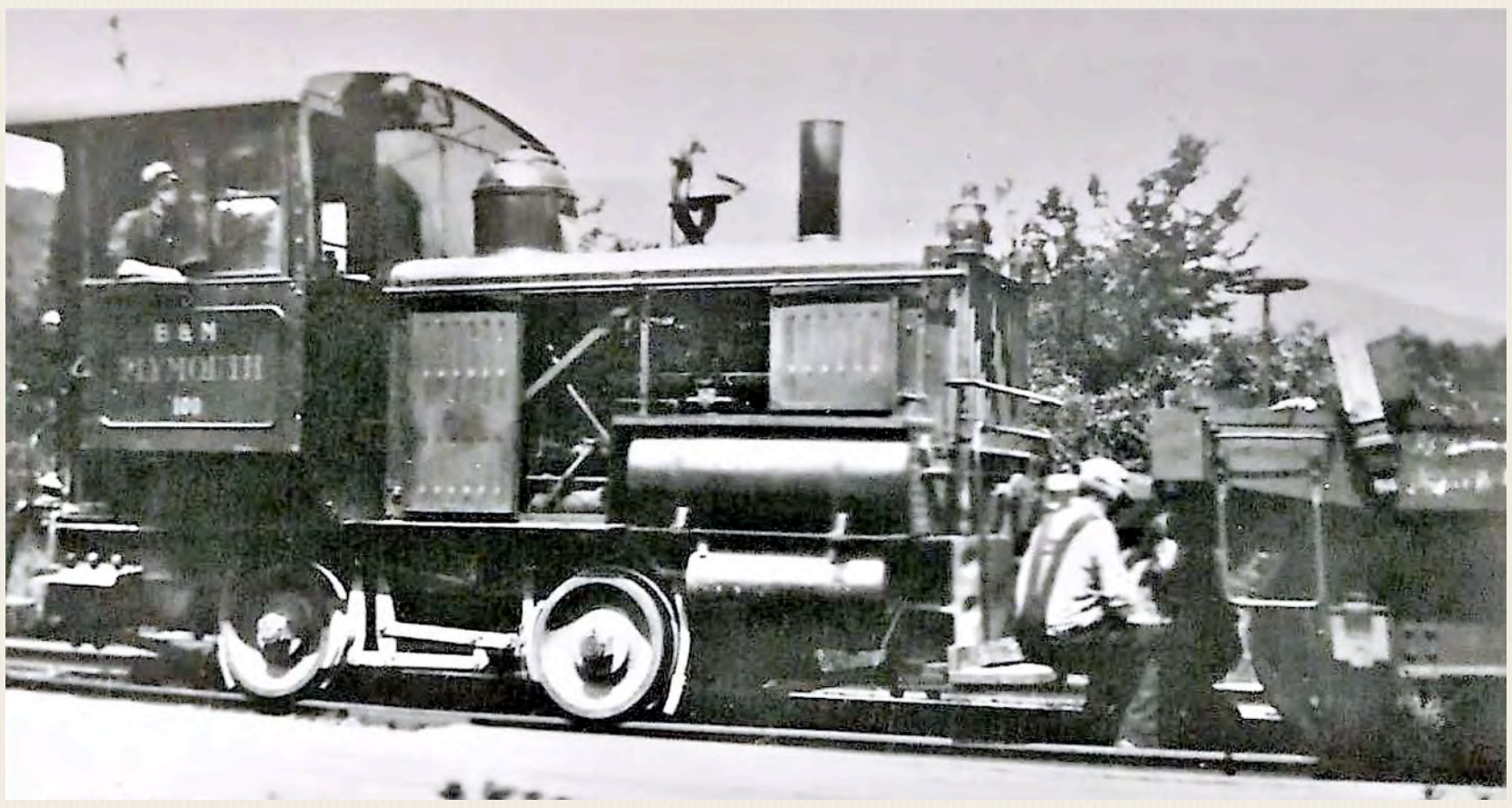
Later she became Concord & Montreal railroad #82 and then Boston & Maine railroad #782 (pre-1911 number). She spent 31 years on this short, steep and famous vacation spur line before being scrapped in 1907. The job was then taken up by Boston & Maine No. 494 that was also built at the Manchester Locomotive Works in July 1892. The engine would be renumbered to No. 905 and end its career hauling cars of coal from Fabyan to the Base Station of the Mount Washington Cog Railway. Following retirement it was stored in Portsmouth, New Hampshire where it rusted awaiting a final trip to the scrap pile. But it was salvaged and reno-



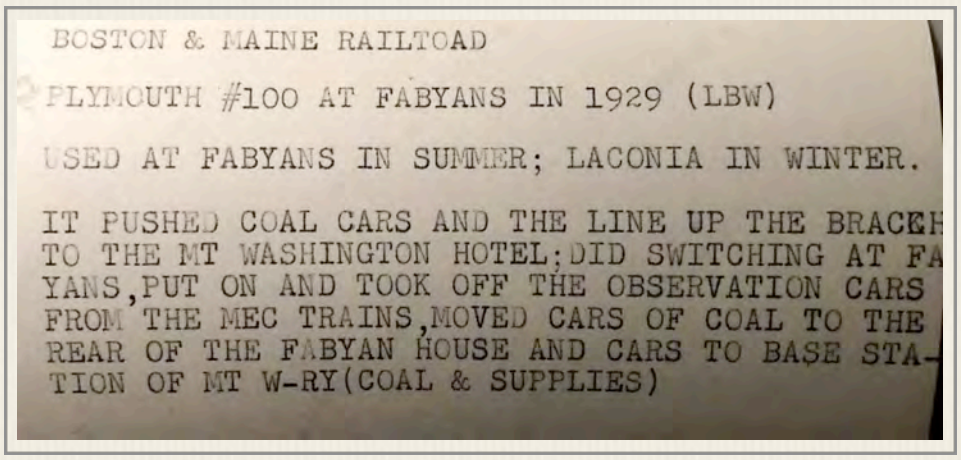
vated *(next page)* by the New England Division Railroad Enthusiasts Inc. for showcasing at the 1939 World's Fair. The volunteers working on the overhaul was B&M machinist and Cogger Earl C. Cone. Following the '39 World's Fair, No. 494 was stored at the Fitchburg and Lowell yards for several years. Again facing the cutting torch in the mid-1950s, a Boston-based group acquired the engine and found a permanent home in the Town of Hartford, Vermont in 1957. The engine remains on display today at this historic hub of railroad activity in the Connecticut River valley. *- See Vol 4 - A Hero's Odyssey*

Boston & Maine Railroad

February 22, 2022 - Conrad Eckstrom posts on his *The Railway to the Moon! Facebook* page: "Look at this *(above)*. The photo back explains it better than I can. Very interesting. Enjoy." ***Tim Lewis:*** "Conrad - this is brand new to me. I haven't run into this "tug" - I knew the coal came up the branch



line in railroad cars but thought that was handled by the larger Mogul engines that brought the tourists up. 1929 means it only had to run two more summers. Thanks for opening up a new line of inquiry with my friends at the Boston & Maine Railroad Historical Society. Where did you find the image?" ***Ekstrom:*** "In the RB Sanborn Collection. Yes, it is new. WOW and new to you also. OK. As you said a new line of inquiry! The back *(right)* says a lot." ***Art Poltrack:*** "Something new for me too!" ***Lewis:*** "Conrad - yes, very helpful. Most Cog testimony about the coal cars coming to the base involved "bitching" about having to hand shovel the cars empty and the various ways to make the right noises of doing the work without actually doing it *(while never saying what was pushing the cars into place.)*" ***Eric Cunningham:*** "Hard to imagine this little guy hauling much all the way up to the Cog, wasn't that a pretty steep grade?" ***Brian Dame:*** "Eric - 5.59%" ***Bruce Davison:*** "Here is a shot *(next page)* at the Cog Ry base, that has been

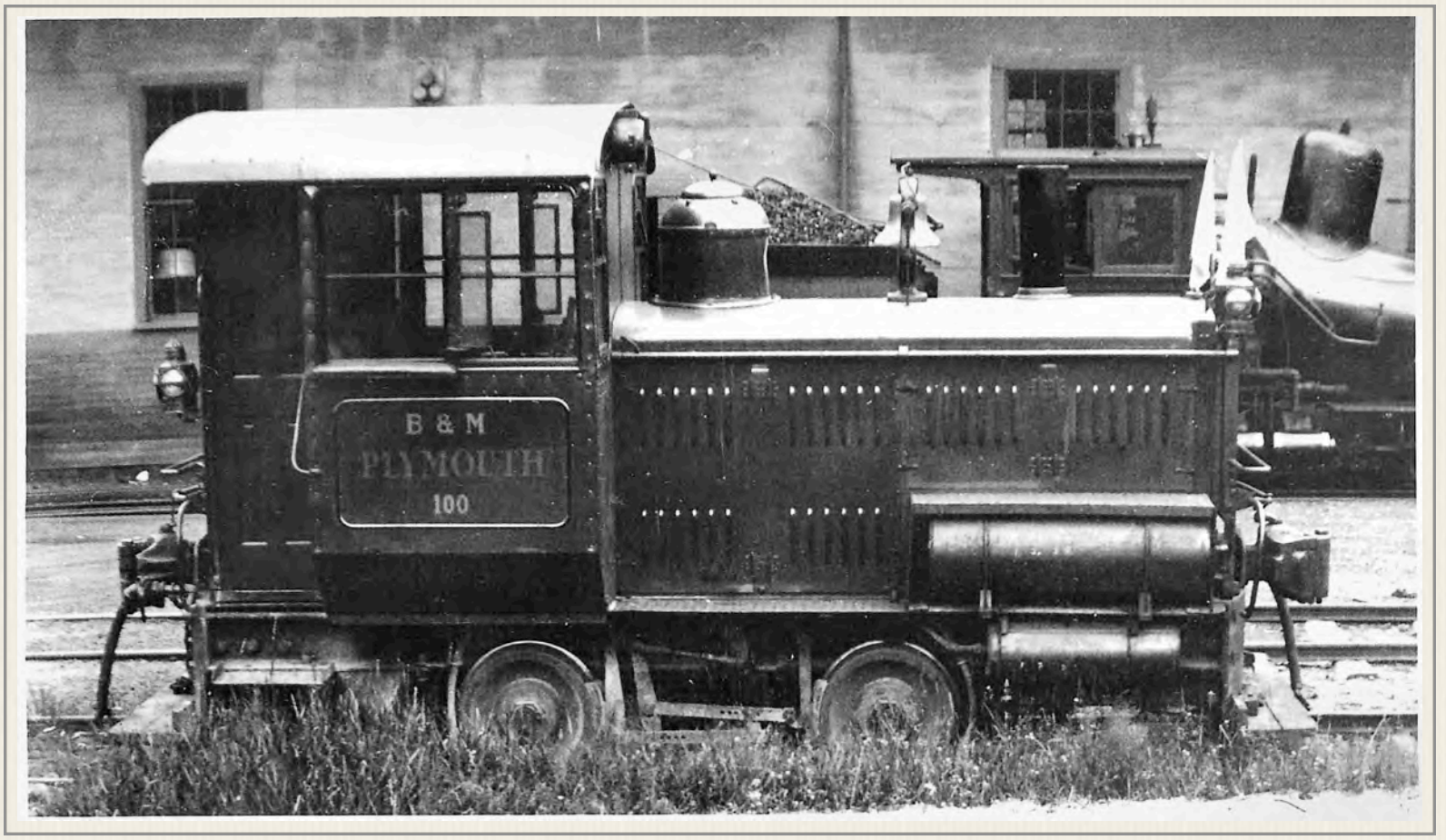

BOSTON & MAINE RAILTOAD

PLYMOUTH #100 AT FABYANS IN 1929 (LBW)

USED AT FABYANS IN SUMMER; LACONIA IN WINTER.

IT PUSHED COAL CARS AND THE LINE UP THE BRACH
TO THE MT WASHINGTON HOTEL; DID SWITCHING AT FA
YANS, PUT ON AND TOOK OFF THE OBSERVATION CARS
FROM THE MEC TRAINS, MOVED CARS OF COAL TO THE
REAR OF THE FABYAN HOUSE AND CARS TO BASE STA-
TION OF MT W-RY(COAL & SUPPLIES)

Shop Log: The Spur Line Tug



around for a while. Shots of this little critter are pretty scarce. I hiked part of the base station line roadbed, from the Mt Clinton Rd towards the base station, and it is indeed a pretty steep grade! I am sure this little guy struggled mightily on that grade." ***Conrad Ekstrom:*** "Bruce - Thank you. Nice post about a chapter just being revealed. WOW! UPDATE - I added Bruce Davison's post of #100 at the Base Station. Wow! two rare photos in two nights! Thanks Bruce Davison."

Boston Maine 16T Plymouth #100 (above) at Concord, NH in December (1936)
- Houghton's Rail Images

Plymouth 100 on display at the Depot Shopping Center in Lincoln, N.H. (left) with shot of engineer's controls in the cab (right) and the view out the engineer's front window. (2012)
- Photos by bumthum / Railroad.Net

Tim Lewis: "Found some links to more info.... https://railroad.net/b-amp-m-plymouth-switchers-t82358.html AND https://www.datazap.net/sites/2088/BM_1.html for the curious. Still need to contact my B&MRR Historical Society folks for details as to deployment to spur line, etc but this was a good couple of days - Bruce - great shot - may have been around for awhile but I had not stumbled over it in my seven years of research