Boiler Backhead Fittings

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The machining of the various boiler related castings was started and some of the boiler fittings fabricated while waiting for the boiler to arrive. The fittings for the backhead are the water gauge, the firebox door and the throttle lever. A water gauge had already been purchased from Coles so the only water gauge question was the best location for the lower connection. The firebox door castings had been purchased from Kenneth so all that was required there was some minor machining. The challenge was to fabricate a lever that resembled a real shay throttle lever.

The shay throttle lever is similar to other throttles in that a toothed sector plate and paw on the lever are used to hold the throttle position. On some locomotives the sector plate is held stationary similar to the reversing gear lever (see Reversing Gear page). However, on the shay throttle lever, the sector plate is part of the throttle rod head and moves with the throttle rod ---- to the rear and the front as the throttle is opened and closed. The next photo shows this arrangement on Cass No 5.

The throttle lever is the slightly inclined long bar. There are two brake valves, steam on the left and air on the right. The top of the reverse gear lever is between the two brake valves.

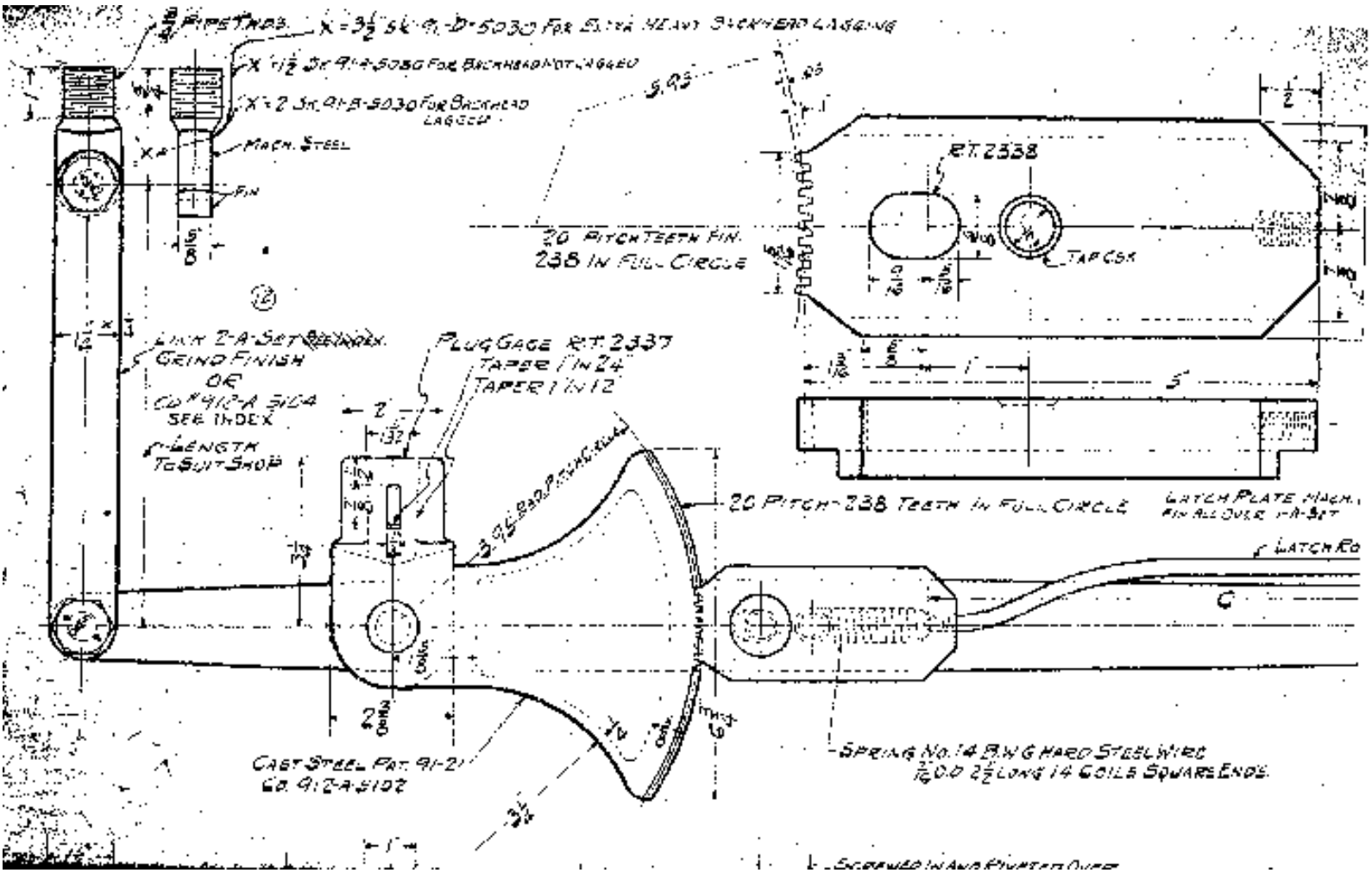
The next photo, also of Cass No 5 shows a close up of the throttle rod head with sector plate and the pivot link to the left of the head. The head and rod have a matched taper fit that is held by a taper pin. The lever rotates around a pivot pin in the head. The link straps pivot at both ends so that they can rotate in the same plane as the lever. Note the tape measure from the end of the throttle lever ~ 44 inches to the pivot point at the rod head.

This is a photo of Cass 10 showing the throttle rod packing gland and the throttle lever links to the left of the gland.

Note the test cock on the right side with the two holes for two more cocks. The very top of the drain pipe funnel is visible below the cock.

Also of interest is the steam turret --- a good view with all the fittings removed.

This next graphic is part of a Lima Throttle Lever Drawing.

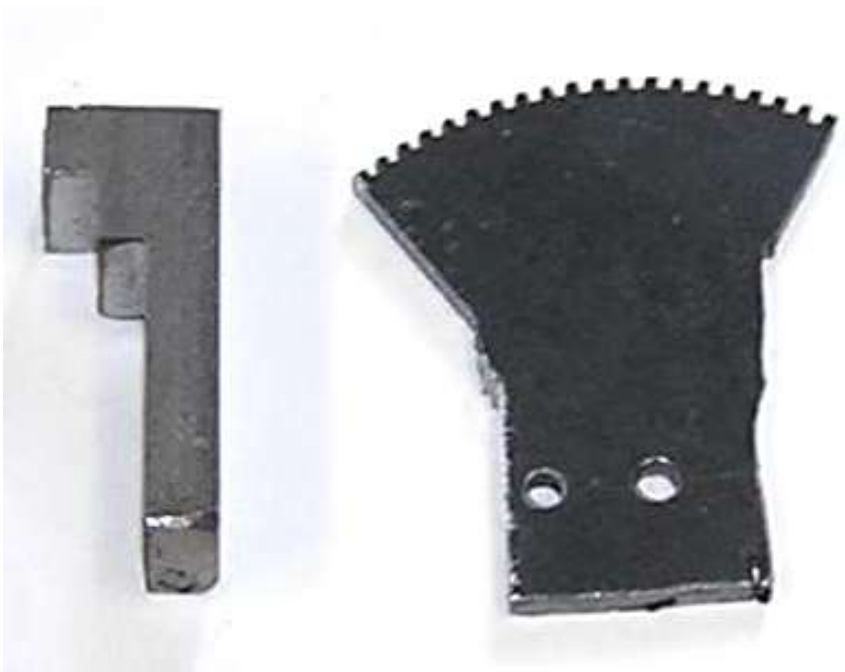


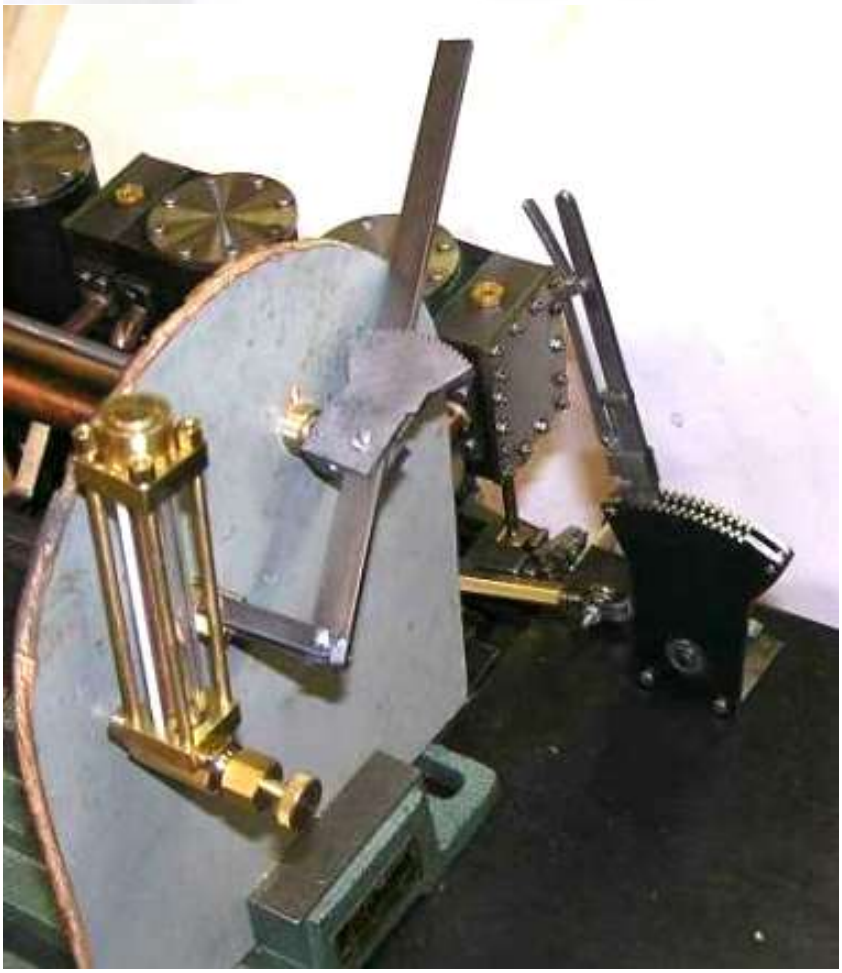
The last piece of data is that the throttle valve specified by Kenneth is a common ball valve that rotates 90 degrees and has a one-inch lever handle that connects to the throttle rod. The rod will move 1.4" to rotate the valve handle 90 degrees. From the drawing above one can see that the lever rotates about 45 degrees from off to full throttle. This leads to the first conclusion --- the distance between the rod head pin and the link pin on the throttle lever must be 2 inches (twice the valve lever length) to make the throttle lever rotate 45 degrees (from off to maximum throttle) as the valve handle rotates 90 degrees.

The next step was to cut a cardboard lever and try various sector radii. The radius on the drawing above is 3.95" that would scale to 1/2". That radius is just too small to have a reasonable number of usable teeth. Based on the teeth from the reversing lever (0.64" wide and 0.070" long) it looked like 0.032" wide teeth 0.040" long were doable and should be usable and a 1.5" radius would not look too out of scale. A bit of calculation yields 3.5 degrees per tooth for cutting teeth using a 0.032" slitting saw on a 1.5" radius disk.

The photo on the right shows the parts of the the rod

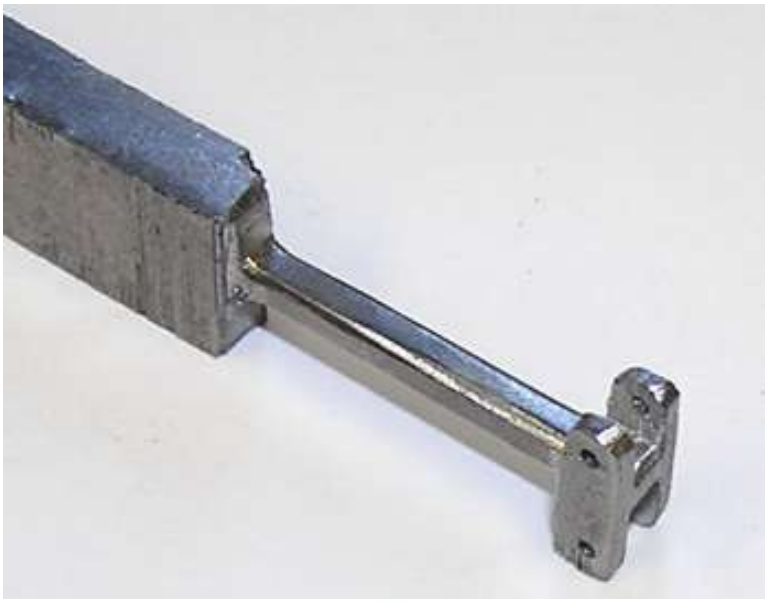
head. The part with the teeth was cut from a 1.5" radius disk. The teeth were cut with a slitting saw. A rotary table was used to do the indexing similar to the tooth cutting on the reverse lever sector plate. The other piece was milled from bar stock and then drilled and taped 10-32 to accept the throttle rod. The two pieces were joined with a 2-56 screw, silver soldered and then the screw head filed off.





This shows a mockup of the backhead. There is no interference between the water gauge and the longer left end of the throttle lever. The lever worked smooth and readily achieved the 1.4" throttle rod motion. The right side of the lever is 5", a bit shorter than Cass No 5 (44 inches scales to 5.5") and pointed up at a greater angle to give enough room to operate the reverse lever under the throttle lever. (The problem is fat fingers --- the engineer's hands are not to 1/8th scale.)

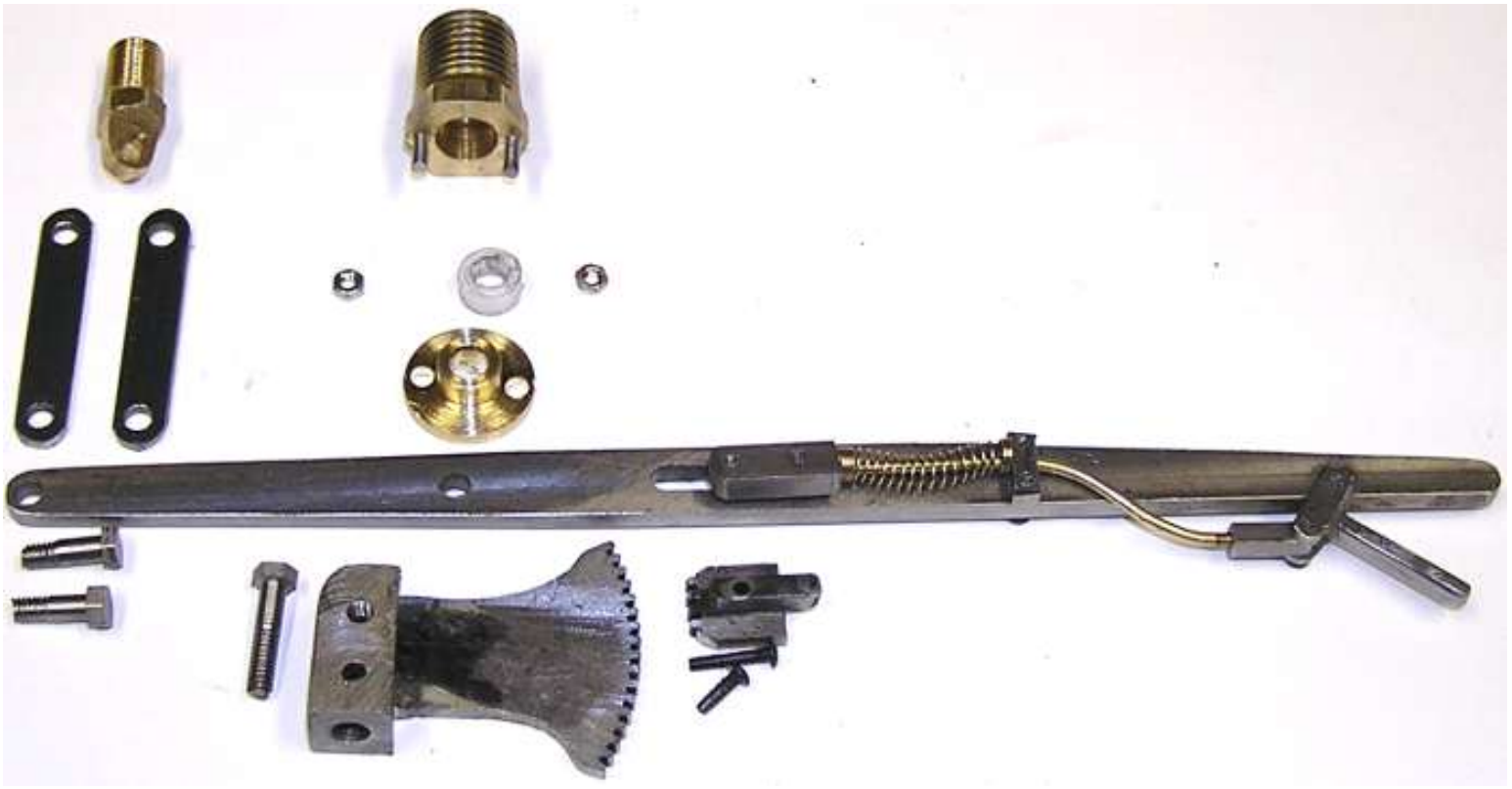
The next step was to make a trigger-paw arrangement and then trim and shape all the parts.



The photo on the right shows the trigger. It was milled out of 1/4" X 1/2" CFS bar. The trigger was left attached to the bar during the milling process to make it easier to hold the part in the milling vise. The next step was to file a radius on the ends beside the holes for the pins. The last step was to separate the trigger from the bar and file the end smooth.

Extra teeth were cut in the 1.5 " disk for use in the paw. The paw as shown on the right is the same width as the lever handle. There is a piece of 1/8" square rod silver soldered to the back.

This next photo shows completed parts of the throttle lever. The pivot point on the upper left is made from 5/16" hex brass and threaded 1/16" NPT (5/16" MTP). The little links are 1/16" thick steel plate. The throttle rod gland is made from a 3/16" compression to 1/4" NPT brass fitting. The compression part was cut off and a solid brass rod was silver solder into the 1/4" NPT side. The inside was then drilled #12 as specified by Kenneth. The packing area was drilled 5/16" with an allowance for 1/8" thick packing. The little white piece is a Teflon packing piece. If that doesn't work, O-Rings will be the next option. The little disk rather than a nut is used to compress the packing, matching the prototype. The studs are 2-56 stainless.



The three partially threaded screws are 5-40 made from 3/16" hex stainless stock. They will be retained with locking nuts. The photo shows the underside of the rod head, lever and paw. The paw is attached to the lifting block by a couple 1-72 button head screws. The lifting rod is 1/16" brass threaded 0-80 on each end. The pivot on the trigger are more of the 1-72 button head screws as are the screws in the spring retaining block. The spring is out of the scrap box and too large diameter. A 1/8" OD spring will be secured on the next McMaster order.

The next photo shows the top view of the assemble lever. It works slick!

Firebox Door: The firebox door castings were machined per Kenneth's drawings. The door will be attached to the backhead with screws in the four corners.

A photo of the assembled backhead is in the Plumbing VIII page.

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