Plumbing Part VI - Blowdown Valve

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When I started to think about the blowdown I realized that I'd never seen the actual valves on a Shay --- and none of my photos showed the valve. On a subsequent trip to Cass I found and photographed the valve on several different shays.

As I understand normal operation, the valve is occasionally opened when the boiler is under pressure to expel debris that has collected in the mud ring. The valve can also be used to drain the boiler. Some of the local folks attach a hose and use the hot water under pressure to hose down their locomotives after use. Maybe the most important use is to initially fill the boiler ---- just connect a garden hose to the discharge pipe.

Blowdown Valves of Cass Shays: The photo on right is of the blowdown valve on Cass No 5. It's under the cab floor in the center rear of the boiler directly above the mud ring.

This photo shows the blowdown valve operating handle beside the broom. The handle is lifted to open the valve. This is also Cass No 5.

This is the blowdown valve on Cass No 11. Note the pipe that takes the discharge to the side.

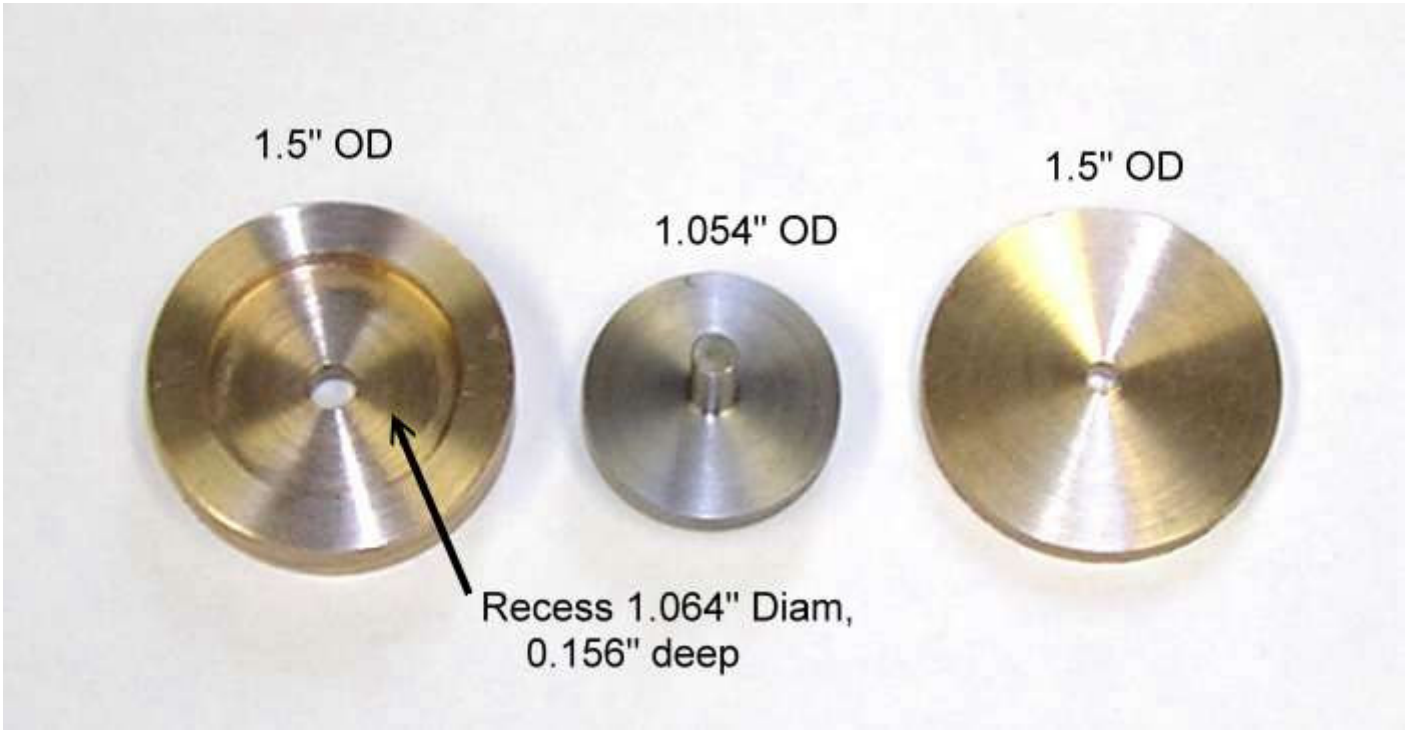
The discharge pipe on Cass No 11. This is the discharge arrangement I plan to use --- handy to connect a hose to fill the boiler.

Note the drain plugs located in the rounded corner of the boiler. There was one in each corner.

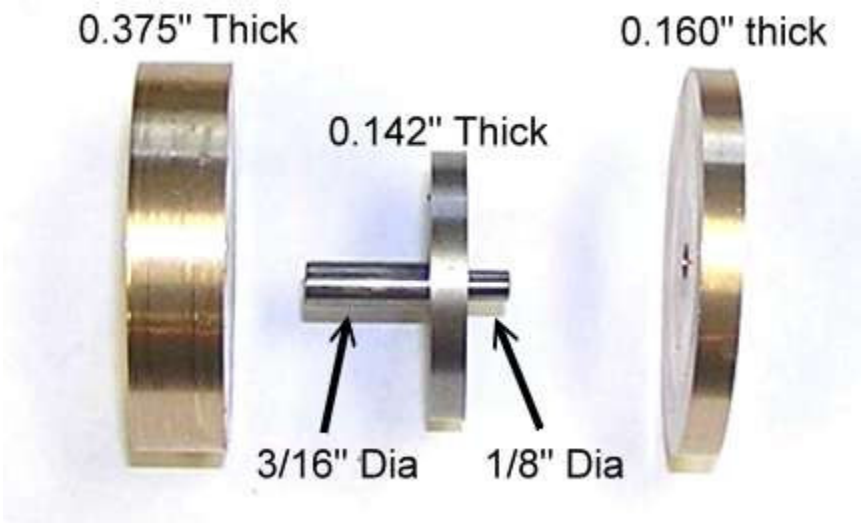
This is a different design of blowdown valve. I didn't record which Cass shay this is; I think it is still undergoing an overhaul. The numbers are the boiler thickness measured during the overhaul.

The blowdown valve I decided to make is like one that Jim Buchanan (Buchanan Machine Works) uses on his Climax. Jim sent me a copy of the design from May/June 1997 Live Steam. ***Jim later told me that he would not use this design again because scale eventually builds in the boiler and the scale then cuts the O Ring necessitating frequent replacement. He suggests a design with bronze body and stainless type wiper.*** Since

I already had the valve constructed I decided to try it and see if I had the same problem.



The photos above and on the right show the three main pieces. The outer disks are turned from bronze --- left over from making crankshaft bearings. Brass or stainless would also work great. The middle disk is stainless steel. The next step was to drill and tap six 4-40 holes on a 1.25" bolt circle to hold the two bronze pieces together. The holes in the thinner piece were threaded.



Next, the three pieces were assembled and a 1/4" hole drilled through all three pieces at a radius of 0.302"

The 1/4" hole in the thicker bronze disk was enlarged with a Letter F drill and then taped 5/16 MTP

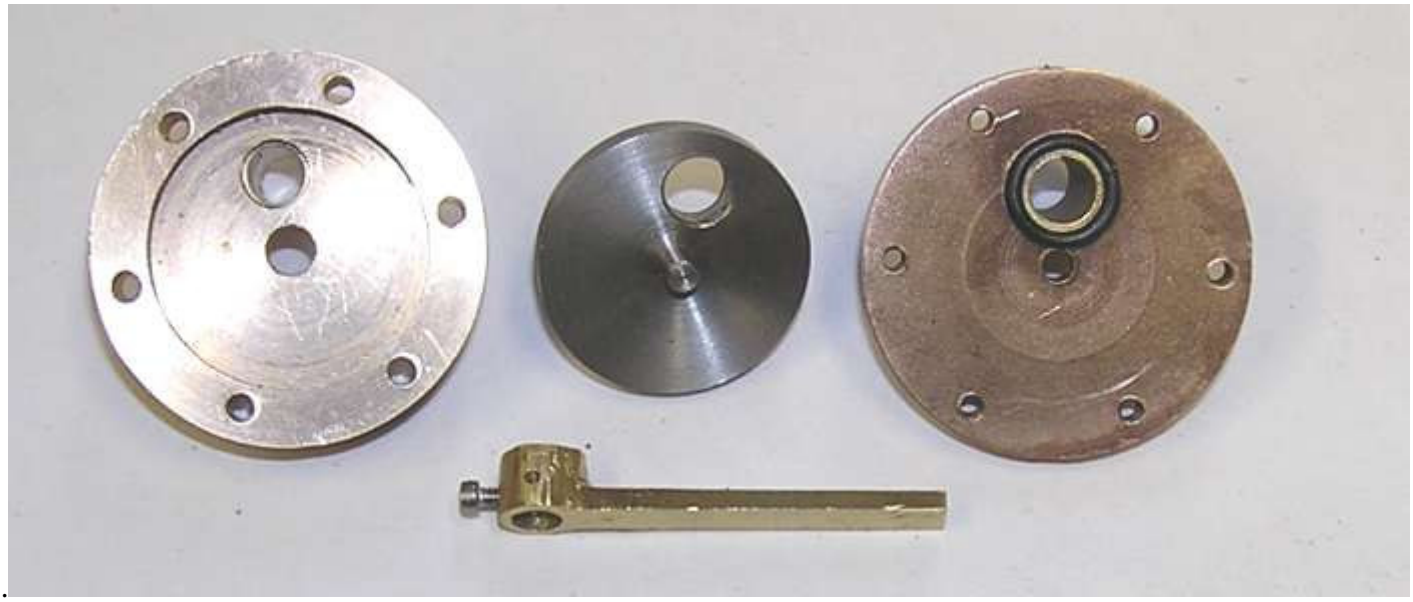
The 1/4" hole in the thinner disk was drilled 7/16" and the input pipe on the right machined from brass stock. The length is not critical. The inside is drilled 1/4" The critical measurements are the 5/16" diameter 0.55" long stub. The sealing O-Ring (7/16" OD - 5/16" ID) rides on the stub.

The pipe was then silver soldered into the thinner bronze disk with the tip of the stub flush with the inside surface

Note that the center disk is 0.142" and the recess it rests in is 0.156" deep so there is a 0.014" end float. The O-Ring recess is 0.055" deep which with the 0.014" end float gives a total height of 0.069" for the O-Ring. The O-Ring nominal diameter is 0.070" with a range of 0.067" to 0.073". The width of the slot is 0.062" so the O ring is squeezed a bit which should push it out a few thousands to give a good seal. I've tested the valve at 125 psi air and no leaks. If it starts to leak I'll turn a few thousands off the thicker disk to reduce the depth of the recess for the rotating disk.

The author of the note in Live Steam (I didn't get the part with the author identified) suggests a Viton O-Ring. Viton has a high temperature rating but is not recommended for steam. I'm going to try the NSF-Approved Ethylene Propylene (EPDM) that is rated up to 300 degrees --- with 100 psi steam I'll be stretching it a few degrees, but I figure it should be OK.

The next photo shows the finished parts. The input pipe was silver soldered to the disk on the right which cause the darker color. The end of the operating handle will be cut to length and drilled after the valve is mounted and the best position of the release handle determined.



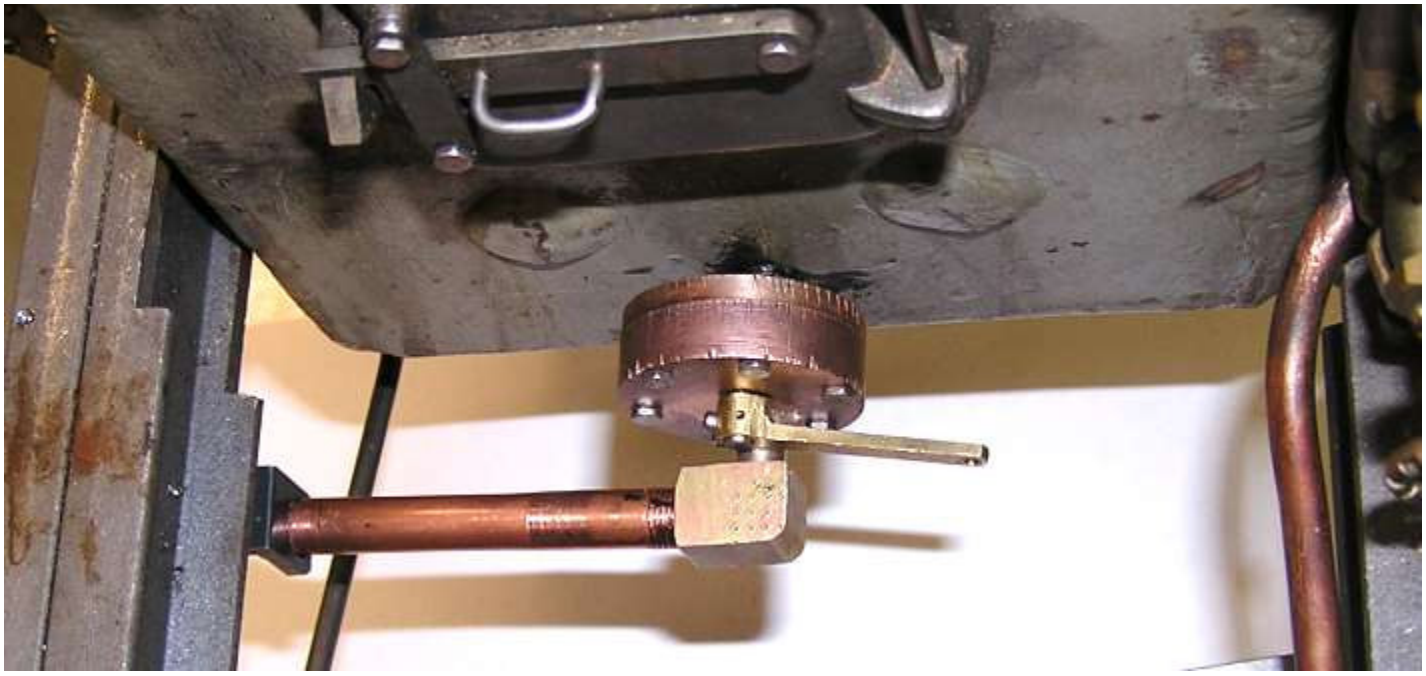
The photo on right shows the back of the assembled valve with 1/8" NPT stub that will screw into the boiler.

The front of the finished valve. The operating lever is retained with a 2-56 screw. Two orthogonal holes were drilled in the shaft so the the handle can be mounted on either side.

The discharge pipe is 5/16 tube. The tube will be replaced by a nipple, elbow and long tube that will pass through a hole in the side of the frame similar to discharge pipe on Cass No 11 shown earlier.

Update (12/07/03): The blowdown valve was installed in the back of the boiler as shown in the next photo. A short piece of 5/16" stainless drilled to 15/64" was silver soldered between the blowdown and the elbow in the discharge path. This was after a 5/16" MTP brass nipple broke. This stainless tube has an ID very close to 1/8" pipe so there will not be much flow restriction. A 3/8" OD soft copper tube threaded 1/8" NPT on each

end is used for the discharge pipe. The soft tube together with a bracket under the frame to support the tube and the use of a stainless tube between the elbow and valve should prevent the 5/16" tube breaking in the future.



While taking apart the valve to do the above modifications I noticed a cut in the O-Ring just like Jim Buchanan predicted. However, that was before it was connected to to the boiler, it had just be tested with compressed air. I removed the O-Ring for closer inspection and found it cut all the way through ----- then I remembered not having the correct size O-Ring and cutting down a larger diameter one. Best order the correct size.

Update (12/10/03): Yep, here's another update. Shortly after I did the update above Dan Staron suggested that it would have been better to use a tee rather than an elbow in the discharge. The straight end of the tee could be closed with a plug but opened if the blowdown became plugged and a rod run though to unplug it. Good ideal!. I'd also decided to hook up the operating link. I had been postponing the link figuring that I could reach underneath and open the valve with my hand. However, then realized that there are no seals in the output side of the valve and it will likely leak ---- don't want boiling water over my hand. Also, had obtained the correct O-Ring so went back at it.

The photo on right above shows the tee ----- or more accurately, a 1/4" MTP cleanout plug in the elbow.

The operating link is 1/8" stainless with a cotter pin in the bottom. The top of the link is threaded 5-40 and

doesn't quite reach the underside of the cab floor when the lever is pushed all the way down (valve closed).

The handle shown on the right is a loop of 3/32" stainless rod silver soldered to a length of 3/16" brass rod. The bottom of the rod is tapped 5-40 and screws over the link. The handle can be unscrewed when it is necessary to remove the floor.

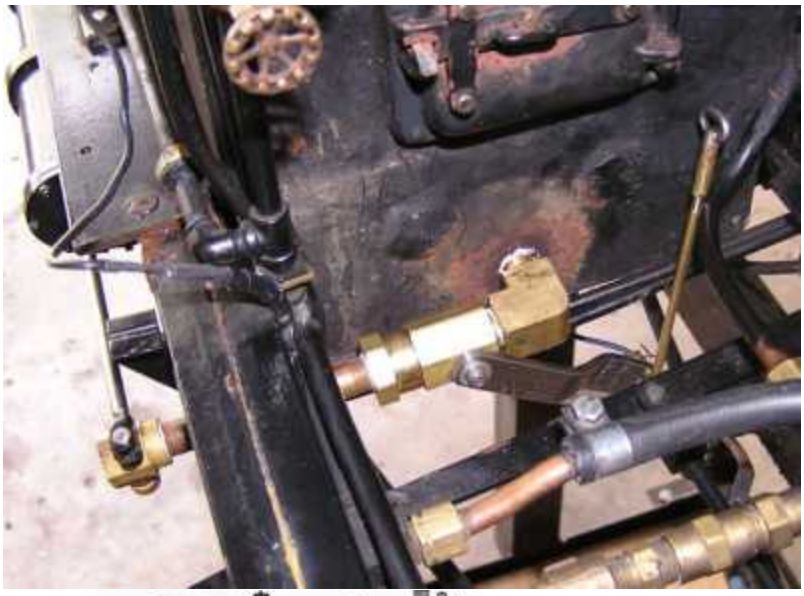
I'll update this again after some experience with scale ----- not long now. LocoParts has reduced the price of their blowdown valve --- probably a good alternative to changing O-Rings.

Update 6/6/04: The valve had been in use for a number of steaming hours and no problem yet with the O-Ring. I also noted that Bob Reedy used this type of blowdown on his Three Truck Climax (Live Steam May/June 2004). The drawing is such that I'm pretty sure he's the author of the original design I got from Jim Buchanan

Update 2/10/06: The shay is in the workshop for annual maintenance and a few improvements. I had the cab floor off so thought it was a good idea to open the blowdown valve and check the condition of the O-Ring. The photo on right shows the inside of the valve. Everything has a rusty discoloration but the surfaces are smooth and there is no scale. (Maybe the LSB-8000 is keeping the scale away.) The O-ring was removed and found to be undamaged after two years service. However, I have some Viton O-Rings of the correct size (#011) so will replace the O-Ring. Unlike EPDM, Viton is compatible with oil so I'll lubricate the valve with steam oil before reassembling it.

Update 4/24/06: While doing a final test before

the operating season the shaft in the blowdown valve broke. Maybe the new Viton O-Ring was too hard for the clearance (one shouldn't try to fix it if it ain't broke.) The blowdown is hidden so function is more important than appearance. McMaster-Carr Miniature Ball Valve # 4112T13 fit perfectly in the tight space as shown in photo on right. I had to make new handle for the valve with the on and off positions 45 degrees from the horizontal. (Why didn't I think of this before?) The valve has PTFE seats and Viton seals and is rated for 300 degrees F. The WOG pressure rating is 1000 psi at 70 degrees but is not rated for steam.



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