Accucraft GS-4 Mods Cont.

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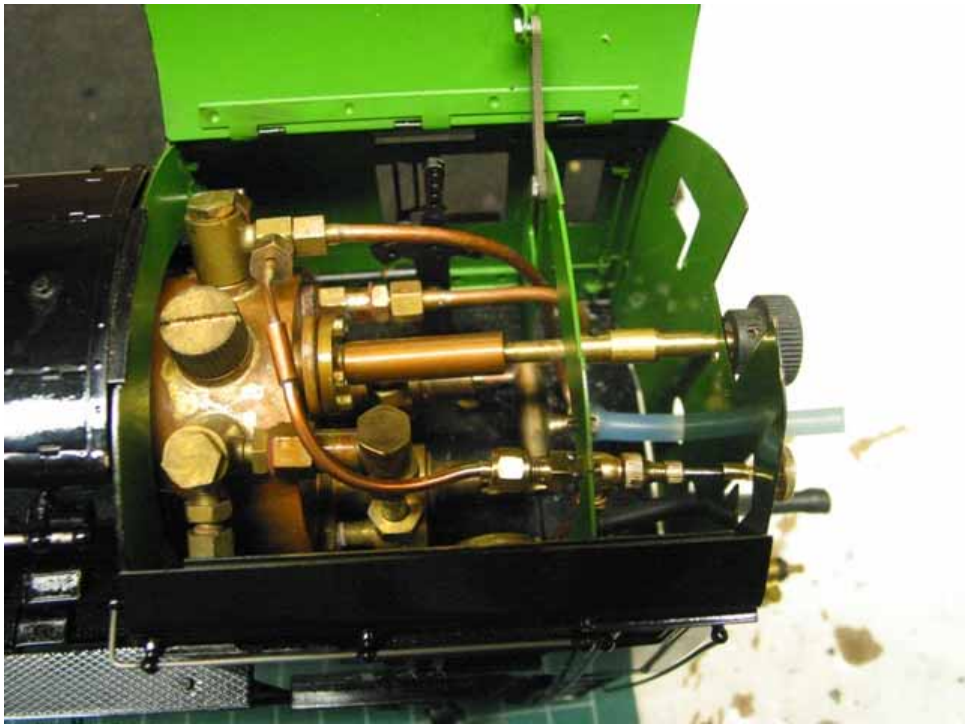
Topic author: rbednarik
Posted on: 04 Jan 2008

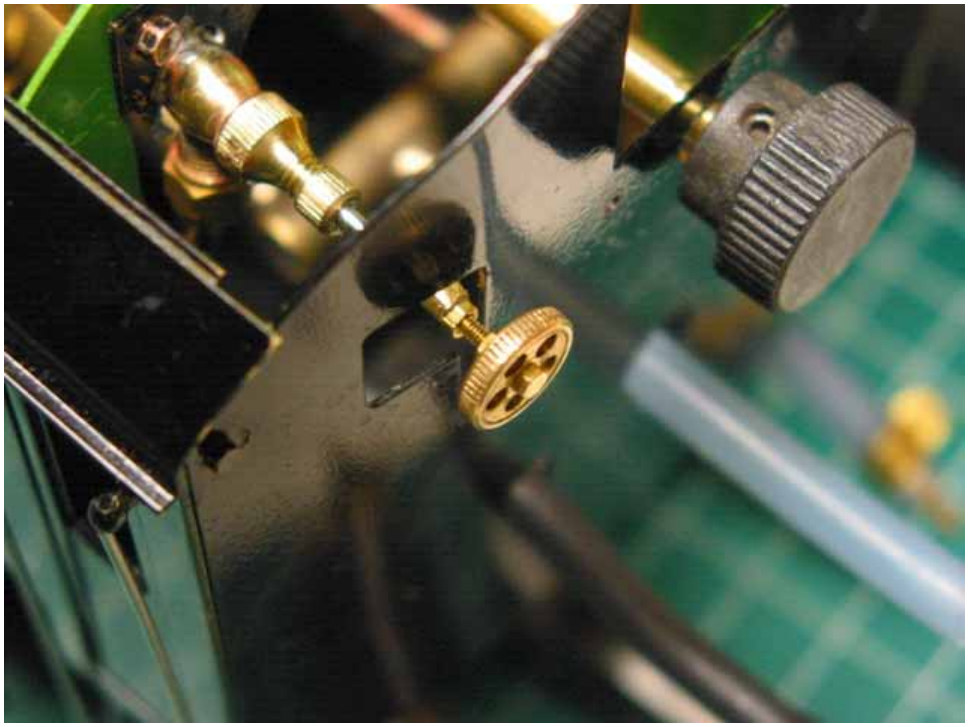
You can teach a new dog old tricks (or is that the other way around??).

Over the past 2 years we have been experimenting with bettering the Accucraft GS-4's. The final culmination of our efforts for either version (gas or alcohol) was the working Combination lever kit, developed and produced by Gordon Watson of Argyle Locomotive Works. In addition to installing the kits, I have been making the smaller bells and whistles, so to speak, that allow convenience in operating this now transformed engine. There are many photos in this post, so dial-up beware!

Here is a general overview of the cab of a gas fired GS-4 with various trinkets attached:



Most notable to the untrained eye is the extension of the throttle valve outside the cab, along with the addition of a globe valve in place of the "whistle lever" that is used to heat the gas tank bath:

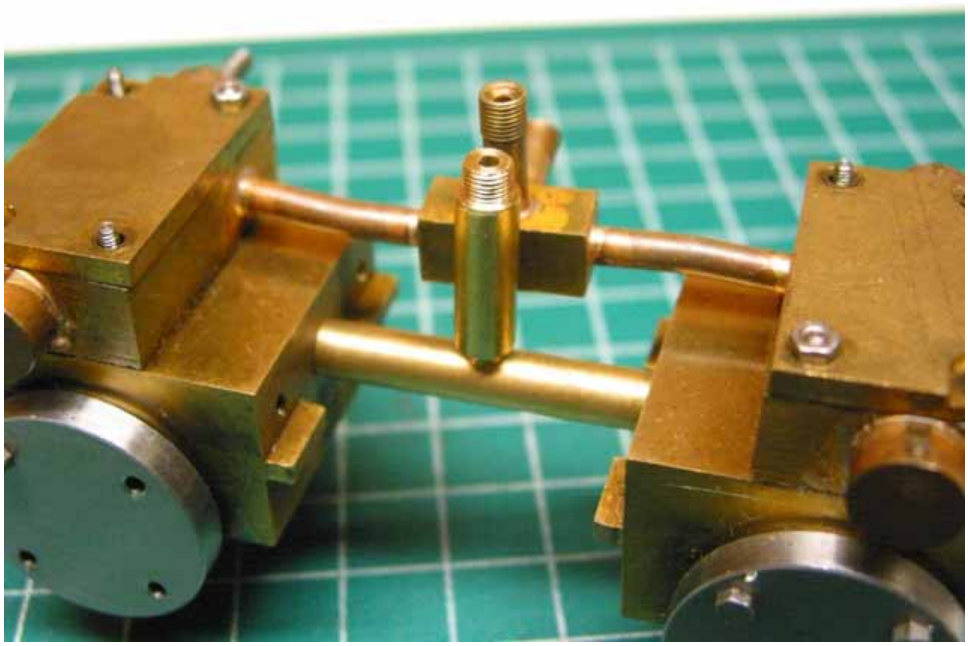


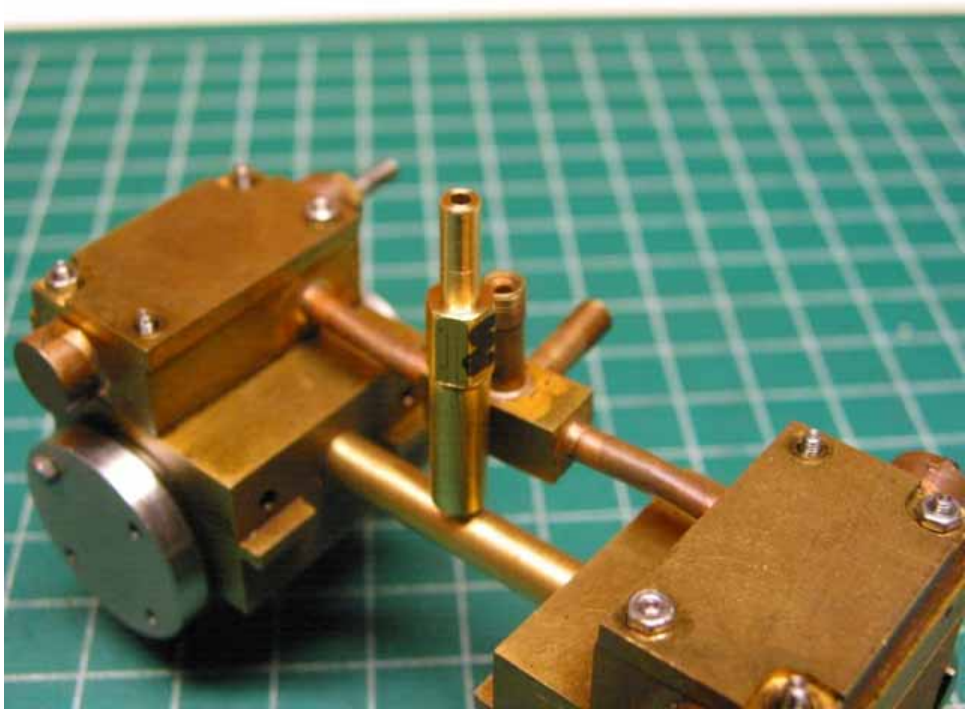
Recently, I have been researching ways to free up some more steam flow to allow a higher speed at lower throttle and high cut-off percentage. In layman's terms, I was opening up the exhaust passages.
Using simple turnings and brass stock, I created a height adaptor (solid round piece with threads on either end) and a exhaust nozzle done to the G1MRA 3:1 stack ratio. All were bored to a 2mm passage (same as the main exhaust line from the cylinders.

Shown here is the stock "chuff pipe" (Right) and the newly designed nozzle and corresponding height/thread adaptor (Left):

****Note, Gas Fired engines only, since the alcohol fired GS-4's get new blower and exhaust nozzles as part of the combination lever kit****

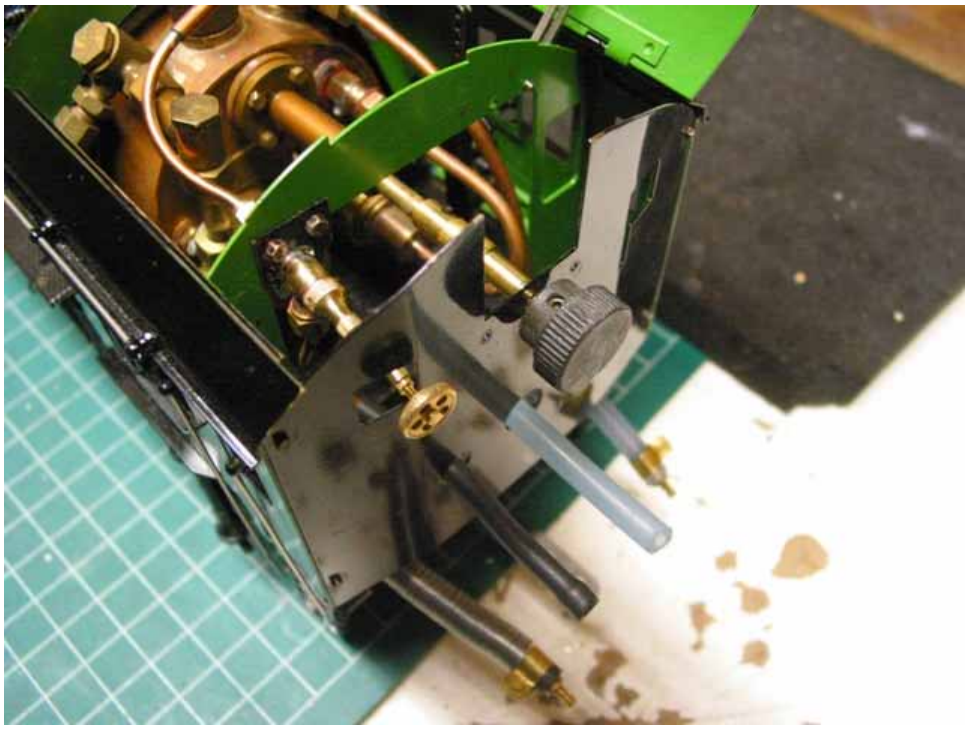
A closer view of the new exhaust parts:





With the Asthma problem half way cured (short of boring all the passages in the locomotive, I was going for ease of install), It was time to move on to being able to control the engine on the fly without hazarding yourself by opening the cab roof and accidentally hitting something, which can ruin your day. Also, after seeing three GS-4's that came through the shop without the backplate on the cab (weakens all the other parts of the cab, eventually needing re-soldering), I needed to design a piece that would allow the owner to retain structural integrity.

Once again , I turned to my lathe and half baked brain. The throttle extension shown here is my own design, but they all work on the same principle. A hole in one end to slip over the OEM throttle, with a set screw to hold it in place, while the other end is finished off with the necessary diameter needed to re-attach the stock plastic knobby thingy:



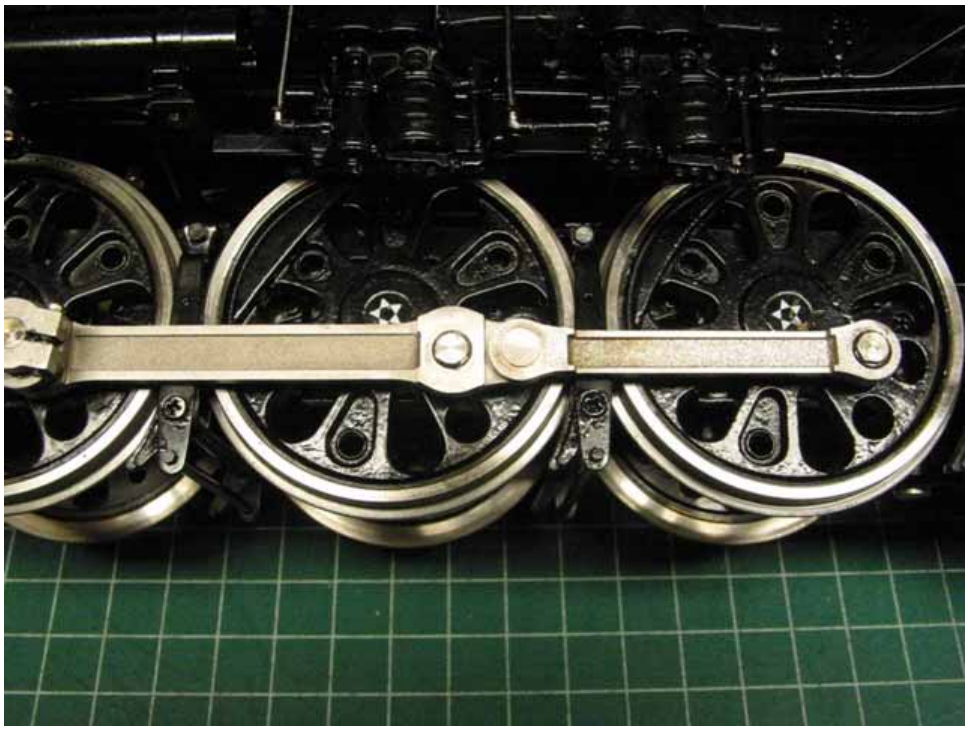
The only thing that needs to be modified for the extension to fit is removing the deckplate on the back of the cab wall.

The next image shows copies I've made of Gordon Watson's extensions, specifically used on the alcohol fired GS's (the LH one is for the blower, RH for the throttle):

A photo of the above extensions on our alcohol fired GS-4:

There were two other items that needed to be addressed before I could give this engine it's road trials. First, the side rods have a extremely poor lap joint (similar to the first run C-16's), creating quite a bit of slop and clanking, creating premature wear on the rod bearings. Following Larry Herget's (highpressure) suggestion, the pins were brazed to the outer rods connecting the 1st and 4th driver to the 2nd and 3rd respectively. See the Informative threads index, **here**

Here is a quick photo:



For those wanting to equip their engine with any of the above mentioned items, please contact me off list. (end plug for my services)

In the next installment, I will cover the rebuilding of the water feed system, along with items that apply only to the Alcohol fired version of the GS-4.

Replies:

Reply author: RodBlakeman
Replied on: 05 Jan 2008

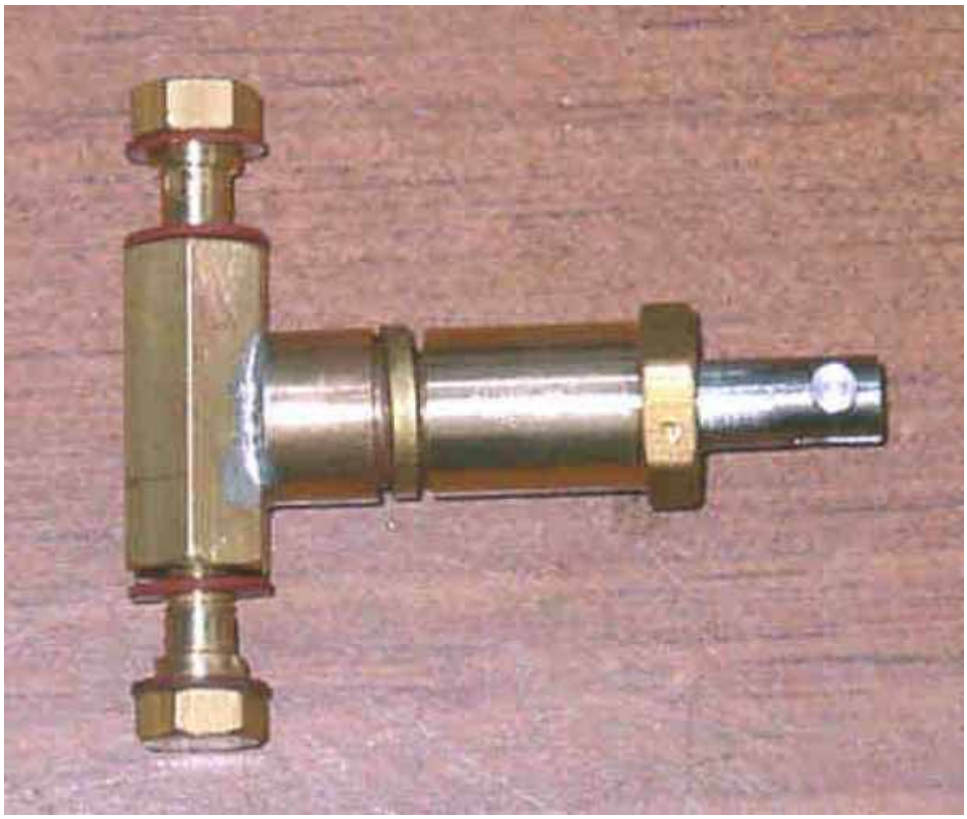
Nice work Ryan, I'm interested in your "water pump" rework as I have some work to do on a friends GS4 that suffers with hand pump difficulties. Do you rework the axle pump or hand pump ? From the pictures you also appear to use a quick disconnect?

Reply author: Charles
Replied on: 05 Jan 2008

Rod
Yes both the axle pump and hand pump have been reworked and replaced (hand pump- also new plumbing). Quick disconnects have been added. Details forth coming.

Reply author: HighPressure
Replied on: 05 Jan 2008

My GS-4 always had a problem keeping the water level up while running requiring a lot of use of the hand pump. Wrote Cliff & he sent a new pump which after being installed did not help the problem. My cure was to put a "BALL" type valve body on it. Remove the piston from the original pump. Heat it and screw the original valve body off of the ram cylinder. Re-create (CLONE) a ball type valve body to the same dimensions of the original valve body. Resolder it to the ram cylinder & reinstall it on the loco. Mine uses 1/8" Nitrile balls with a seat passage drilled #39. I now have to run with the bypass open just a bit.



The hand pump on all Accucraft pumps can be much improved by putting a ball lift limiter on the outlet valve. Simply remove & drill, then tap the top valve cover 2-56 thread. Reinstall the top valve cover & screw in a 2-56 brass or stainless bolt with a like nut on it . Run the nut up to the bolt head. Apply a bit of sealer to the threads and screw the bolt down until you feel it touch the ball in the valve body. Run the nut down until it touches the top valve cover. Unscrew the bolt keeping the nut in its position. Place a .031" feeler gauge on the top cover and screw the bolt & nut down ***(DO NOT LET THE NUT MOVE OFF OF IT'S POSITION ON THE BOLT)*** until the nut touches the feeler gauge. Now keep the bolt from turning, remove the feeler gauge and screw the nut down to the top valve cover and tighten it. You have now limited the lift of the ball to .032" the pump will not chatter as bad & will pump a larger quantity of water with each stroke.

Reply author: RodBlakeman
Replied on: 05 Jan 2008

Larry, Thanks for those tips. I especially like the hand pump limit screw.

Reply author: rbednarik
Replied on: 05 Jan 2008

Rod, Dave, and all who responded, thanks for the comments.

Now on to part deux of the modifications. Some of these modifications are specific to the Gas fired version, while others are more specific to the Alcohol fired version, but for the most part, they are interchangable (throttle extensions, Combination levers, etc). The thrid installment will cover the specific mods to the alcohol fired GS's

Like Larry said, the axle pump on the GS-4 leaves a lot to be desired. It used their version of a steam stop valve (I refuse to call it a check valve), utilizing what I can only describe as a miniature pop rivit and a O-ring in place of a ss ball. To keep the valve seated, there is a spring that compresses the oring

against the flat of the rear of the valve. As has been discovered in past posts, the unit will only lift with 20-40 psi, creating a lot of unnecessary heavy pumping and causing fatigue to the driver/fireman. To remedy this problem, and still use the stock parts, I began with a look at the backhead check valve.

Although it was a horizontal valve, I knew from experience that it could be made to work with no spring, only utilizing the pressure from the boiler to keep the ball seated. The problem was that without some sort of lift limiter, the ball would fill the outlet hole, effectively blocking off the water flow to the boiler, which is highly frowned upon. The solution was simple, drill a hole at the furthermost point of the valve body and tap it for a 1.6mm screw, then solder the screw in place to prevent leaks, add a 3mm Stainless Steel ball and seal it back up:

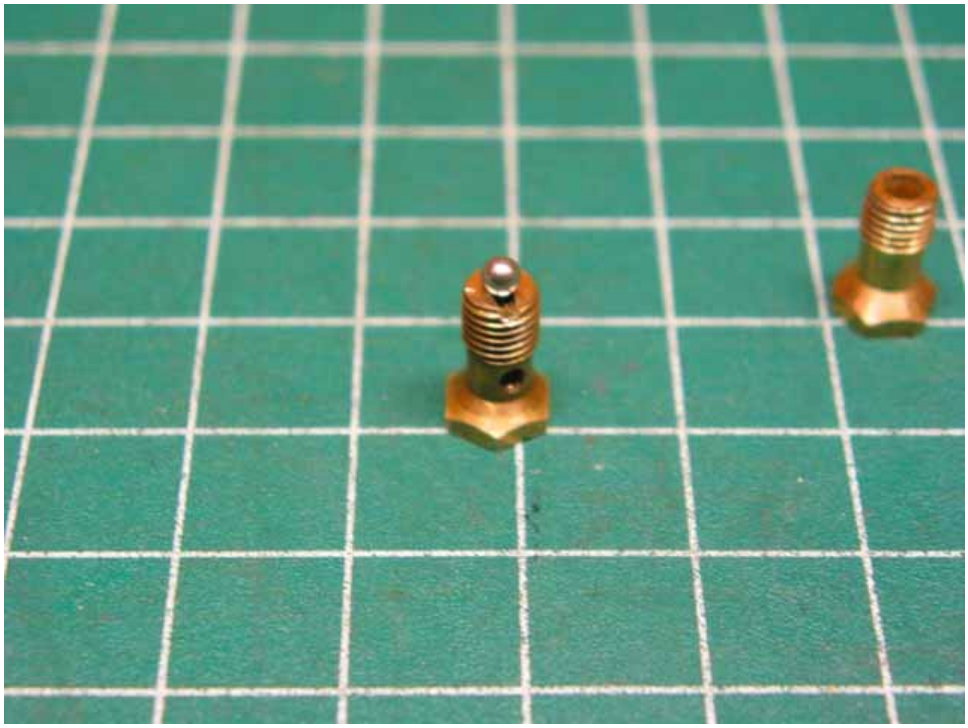
This style of check valve will leak when cold if the water level is over the valve body in the boiler, but once under steam, the pressure seats the ball against, well, the seat .

Now that it took less than 1psi to lift the ball off the seat at the backhead, the next step was to modify the stock pump so it worked. Taking the pump apart, I found that it used the same ridiculous valve and spring setup, which was a problem as you can only have about 15psi on the unloading (suction) side of a 6mm axle pump [thanks to Gordon Watson for this info]:

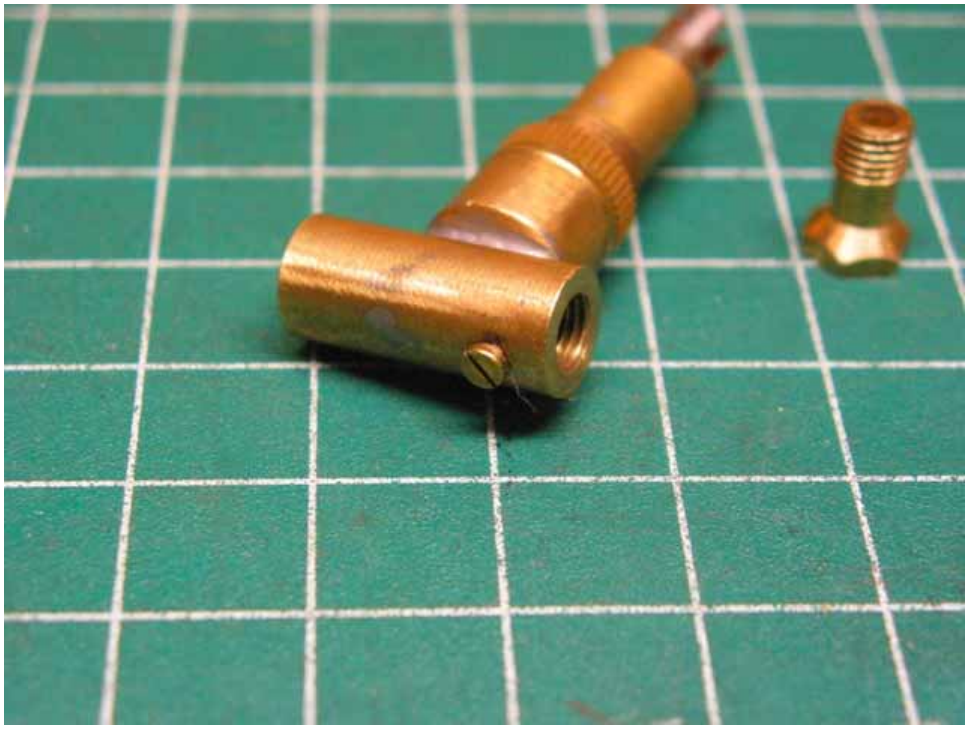
Here's a picture of the to-be top bolt, which also shows the joke that they called a check valve:

Now, the top of the pump is easy, simply slot the top fitting to allow water to flow in and seat the 3mm

ball in the pump housing. Viola! The depth of the slot is not crucial, just so that water can freely flow around the ball when the return stroke occurs.

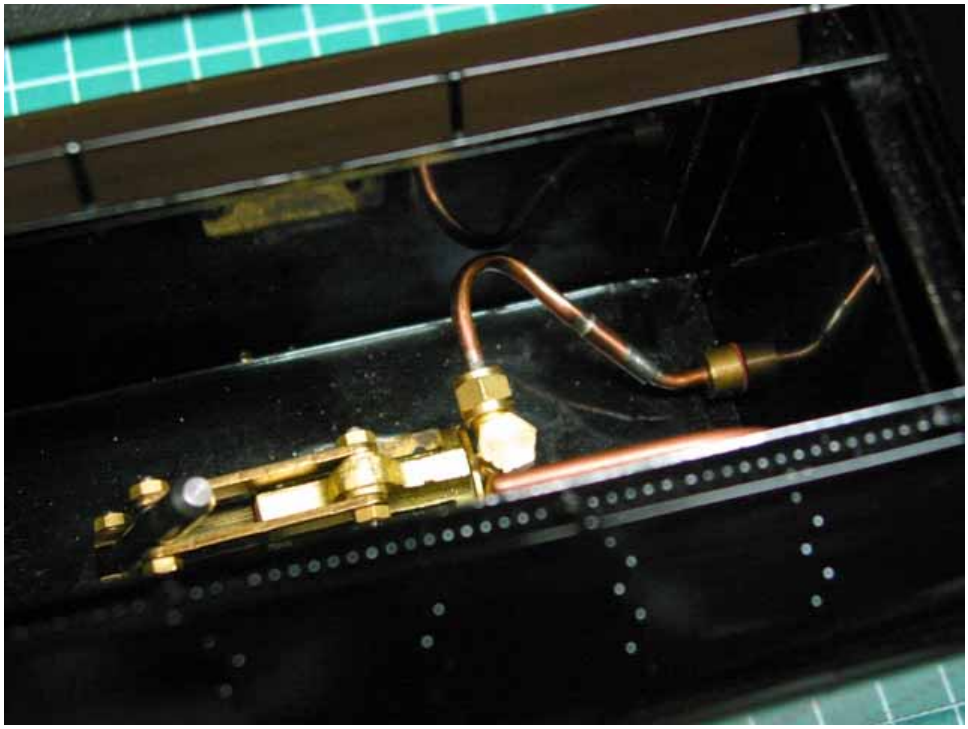


Now that the top of the pump is complete, focus on the bottom. Determine the depth that the ball needs to travel, and drill the pump for a lift limiter, which prevents the ball from being sucked into the ram housing (not good!):



Put the pump back together and you'll find that pumping, even with the un-modified stock handpump has dramatically improved. Now, as far as that handpump is concerned, there are options that can be installed. Larry's example is a perfect way to do it cheap and easy. Here is an example of a customer supplied trackside pump installed in a GS-4 tender, utilizing the existing mounting points for the OEM

pump:



With these mods installed on a frame being air tested, I found the output of the axle pump to be 60ml/min, compared to the 20ml/min of the stock axle pump. Like Larry said, you actually have to use the bypass to stop the engine from flooding the boiler! Success!

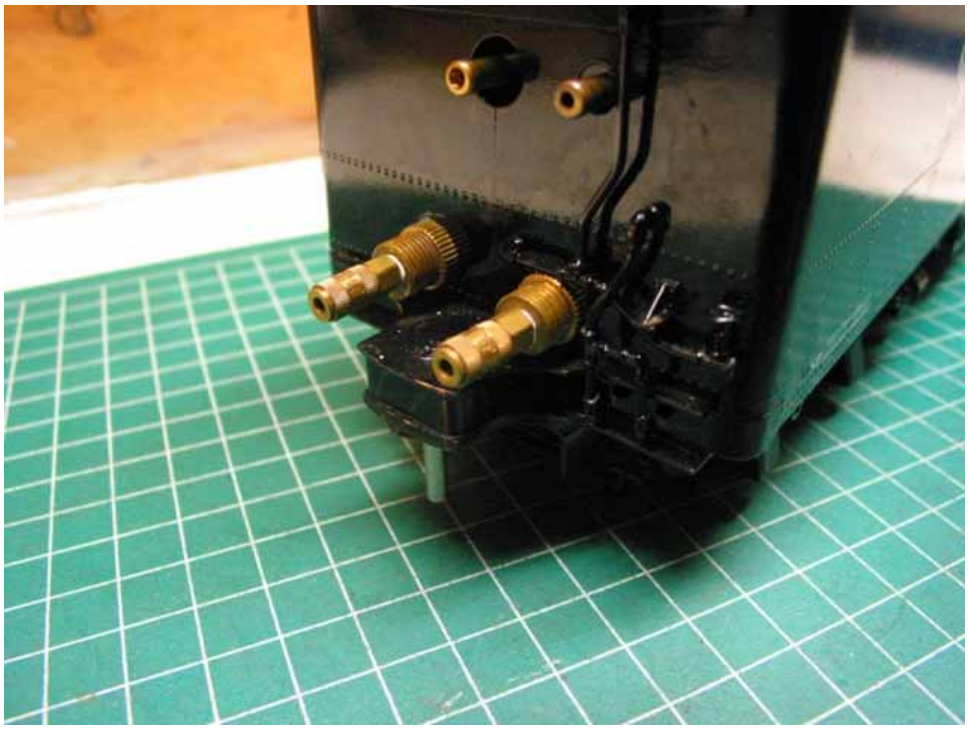
Again, anyone wanting further detail or needing this done to their engine, contact me off list using the fourm email. I have a complete sheet of options that can be applied to either version of the engine.

There is still potential to be tapped out of the sunk flagship engine for Accucraft's 1:32 line, as I am finding new items that can be improved upon every one that comes in the shop.

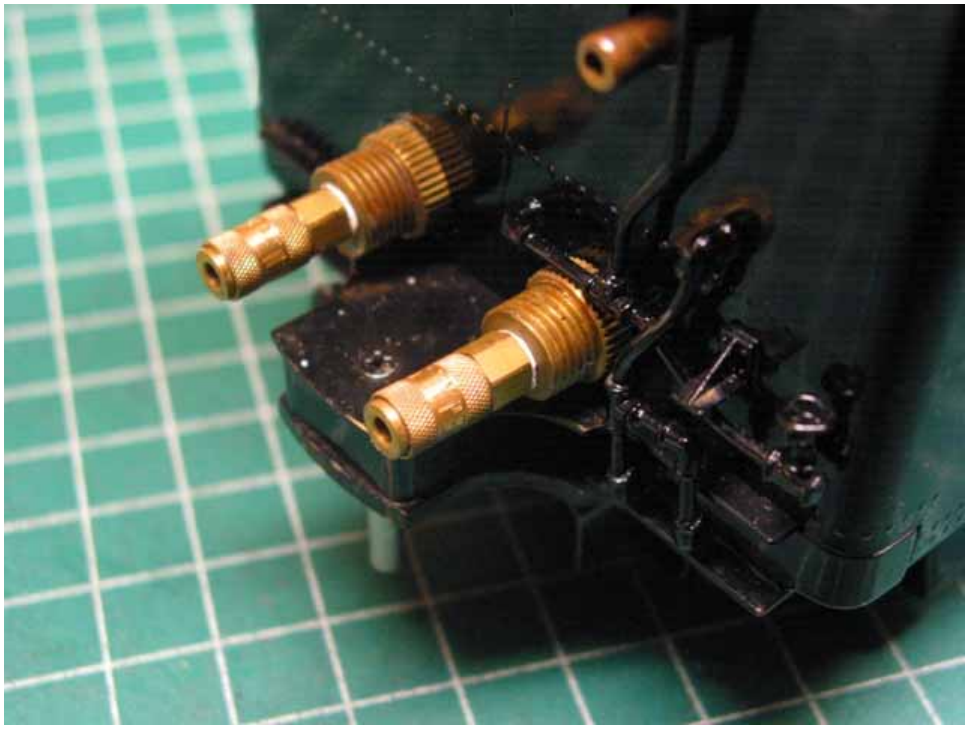
Reply author: rbednarik
Replied on: 06 Jan 2008

Almost forgot, Rod had asked about the Quick disconnects (herein after referred to as QD's).

For the Accucraft engines with bulkhead style fittings, I chose to use the Rectus female fitting, male threaded M3 x 0.5 fittings on the tender and the corresponding 3mm hose barbs for extra water flow (stock lines are only 2mm ID). Simply take your 32tpi hobby saw and cut the barb off of the OEM fitting, then drill and tap for 3mm x .5 QD's. A little Silicon on the threads for good measure and your good to go:



Closer view:



I've gotten my QD's from John Synnestvedt, but others carry them, (Royce, etc). .

Reply author: Jim Overland
Replied on: 07 Jan 2008

As well, Thanks for all the ideas and pictures. After a year and a half of fiddling, I had the Watson overhaul.

I can now routinely run for 45 minutes with 12 cars in 40 degree Seattle weather. My main problem was

getting enough draft. Others was too much draft. Others the pump.

Reply author: Charles
Replied on: 07 Jan 2008

Jim

Prior to working with Gordon Watson, we have 2 years of limited success. Thanks to his expertise we learned a lot (expensive lesson but worth it) and have been sharing the "wealth" of retrofits for others to realize that the Accucraft GS4 can be an outstanding performer.

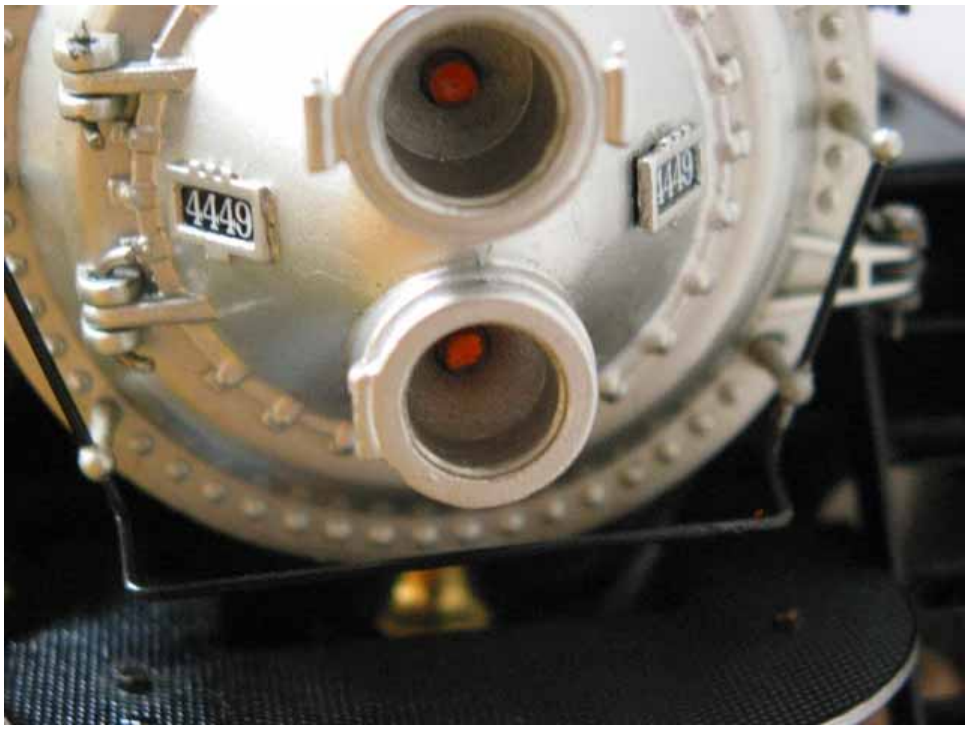
BTW- I am sure Ryan will post his newest upgrade, it will shine the light on the GS4!!

Reply author: rbednarik
Replied on: 08 Jan 2008

Like Charles said, these photos are a compilation of 3.5 years of research and development testing, finally coming around to give results. We sure have gone a long way since the 10 minute alcohol fired runs using a 1/2 gallon of fuel per run! The Version 4 alcohol fired GS-4, the one we had modified by Gordon (thanks again Gordon! It's running as good as ever!) will run for over 1 hour and 20 minutes on one tank of fuel and a tender and a half of water (approx 1 gallon) pulling anything you care to put behind it.

Now, since my Dad is twisting my arm to get these photos up, besides the mechanical aspects of modification to the GS-4, there are many cosmetic items that can be done as well. The past week I have been installing lights in our GS-4. Here's a culmination of the lighting so far:

The lighting on the smokebox door actually has a simulated mars light LED on the top and a Soild beam LED on bottom , like the prototype. If I recall correctly, the light kit is for an H.O. Scale engine (or O scale). Can't remember the name of the manufacturer though, but the Unit (2 lights and a PC board) can be purchased from Paul Lator at Southern Digital . The head/mars light unit is run off of a 9v battery in the tender. Here's a photo of the front not lit up. If you look closely at the lower right corner (the right of the bell), behind the deckplate, under the smokebox, you can just make out the wire running to the circuit board.



The Classification lamps and Train # boards use parts from Miniatronics. For the Class lamps, I used 2 3mm Yelo-glo LED's run off of a 6v closed loop series circuit. The Number Boards use 6v GoW (Grain of Wheat) bulbs and are tied into the 6v power feed to the class lamps. All batteries are in the tender, connected using a mini 4-pin polarized plug.

The jury is still out on the Number board lights as to replacing them with a broad spectrum LED, as the 6v GOW bulbs leave a little left to be desired.

Reply author: Charles
Replied on: 10 Jan 2008

Another aspect of modification that I believe was not posted among the "master list" was the work by Dave Hottman on restricting the air flow in the top flue(along with Brooks, John and Andrew):

http://archive.mylargescale.com/forum/topic.asp?TOPIC_ID=35223&SearchTerms=GS4,restrict

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Reply author: Jim Overland
Replied on: 10 Jan 2008

Hi Ryan,

Can you add a bit more detail on wiring up the lights?

Thanks

Reply author: rbednarik
Replied on: 10 Jan 2008

Jim,

I'll take some more photos and do up a wiring diagram tomorrow. I think I found the manufacturer of the Mars light unit as well.

Reply author: insanerocketkid
Replied on: 10 Jan 2008

Ryan, you might be thinking of Richmond Controls or Accurate Lighting for the main headlights.

Reply author: rbednarik
Replied on: 10 Jan 2008

Mike,

You hit the bulls eye with this one! Richmond made the mars/headlight unit that I have installed. After having tried the ill-begotten Miniatronics unit, the Richmond unit is far superior. Here's the website_**link**

I'll give everyone the exact package numbers I used tomorrow, just closed up the shop for the night.

Reply author: Taperpin
Replied on: 11 Jan 2008

Charles, Ryan and Jim.

Just a short note, to all GS4 owners.. file this away for the future! while working on Jims and Charles locos, I ahd the cylinders out and dismantled.. in both locos the surface finish in the cylinder bores was not good, spiral scratches and quite rough..both where honed and cleaned up..Charles loco as the first had Oring piston rings fitted, and seems to be fine.. Jims I decided to try a different way, as I feel orings are fine on N/G slow speed locos but problematic on large mainline modesl running with big loads and fast..anyway i made up PTFE rings % graphite loaded] in pairs remachined the grooves and fitted 2 rings in each groove . with the splits 180 deg apart..I think these will last for ever.and would definitley be worth doing when the Orings wear out, this note applies to both Gas and Meths firing versions.

Gordon.

Reply author: rbednarik
Replied on: 11 Jan 2008

Gordon,

I have been researching doing this myself after reading Markus Neeser's article in G1MRA. I had noticed that the bore was badly machined when looking at the spare set of cylinders on my bench. Just need to find some suitable graphite impregnated PTFE and we're in business

When you said you fitted 2 rings, is that one atop the other, or did you machine a new piston head and create two slots for the rings (ala Aster) to sit side by side in?

Besides the Gas/meths GS-4's I think that **ALL** Accucraft engines could benefit from this modification. Proper piston rings reduce drag in the piston and create less resistance when under steam, making for a more lively and easier rolling chassis. Anyone who has pushed an Aster loco with rings in comparison to an Accucraft loco with rings will know what I'm talking about.

The other deciding factor is like Gordon mentioned above, which is bore wear. O-rings tend to roll in their groove (round on round)and this can cause some interesting gyrations in the cylinder. When the o-ring becomes worn from the higher temperatures and stresses that it is not designed for, the piston gyrations become worse, and the head of the piston can contact the cylinder wall (very bad!). I encourage anyone who wants to pursue this further to snag a copy of the G1MRA Newsletter and Journal: Issue # 212 and read the article in there as it is extremely informative.

Reply author: Charles
Replied on: 11 Jan 2008

Ryan
For those who cannot get hold of the article (requires membership) maybe a brief about the better choices/designs for updating the ring on their engines.

Reply author: rbednarik
Replied on: 11 Jan 2008

I'll have to put it in shorthand first. The issue being that none of the pictures or diagrams can be used without permission. I'll have a copy the article at Cabin Fever if anyone would like to read it.

Reply author: Taperpin
Replied on: 11 Jan 2008

Ryan,

The rings are side by side, 2 in each groove..somewhat like the old "Cord" rings of the 50s where said to restore compression in worn auto engines [this will meen nothing to anyone under the age of 60!] the percentage of graphite was 40% , They should be machined to about .008-.006 " over the bore size and slit diagonally using a jewellers saw. this will give them a "set" outwards in the bore.. lathe tools must be sharp, and honed finish to avoid heating/rubbing.

Gordon.

Reply author: rbednarik
Replied on: 12 Jan 2008

Gordon,

Many thanks for the info, have some stock on order, we'll see how it goes on my next job. Already have a home-built honing bar and found it useful for the last gas fired one I worked on as the rings were worn to the point of no compression when a leak down test was done! Buna-N o rings were used as it was the best substitute I had for the stock rings (neoprene??), with a marked increase in performance. Ah, cord rings...sounds like a term I have heard from many an old-hand in the hobby...otherwise termed as "bull rings" by the ranchers here in the states. Have you given any thoughts to the G1MRA article with small o-rings placed in the groove, underneath the compression rings? Seems like it allows more freedom for irregularities in the bore, but at an added hassle of sizing for the other ring

BTW, looks like we have some work to do on the Cab-Forwards, the combo levers aren't fully functional! I'll have photos of disassembly later today.

Jim,

The lighting unit I used is indeed from Richmond controls, and is their EZ-lite model# EZ05-002. I used either the golden white or sunny white LED's, can't remember which, but either give excellent output without reflectors or bezels (there is a 5ft beam that shines from the headlight portion of my install!). Running off a 9v battery, which is a bit on the feeble side, I have had the lights on for 4 hours so far with no issues. Photos coming as soon as I can get that Cab-Forward off of my bench and the GS out of the box.

Reply author: Jim Overland
Replied on: 14 Jan 2008

Now I see why all the hand pump modifications. The standard line from the pump is a press on fitting and it just jumped off on Saturday. Talk about poor engineering design