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STEAM IN THE GARDEN

Merlin "Avonside"

Bringing a Historical Locomotive Back Into Steam

Freelance Heisler Project - Part 3, Building the John Wilkes - Part 3, Steam Boats... and lots more!

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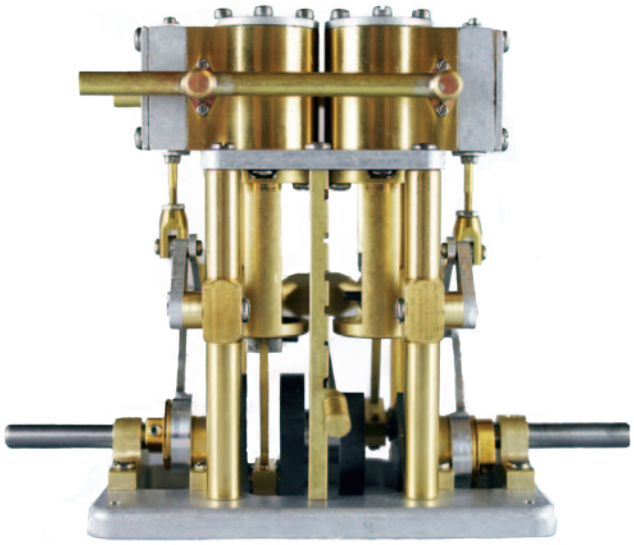
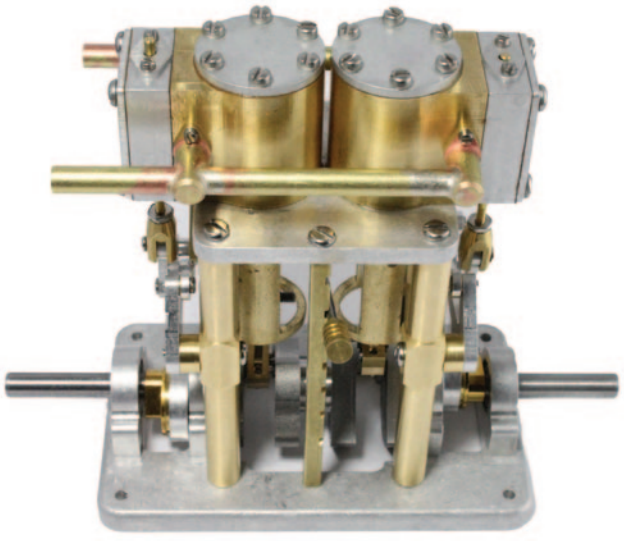


TVR1A

Ready to assemble steam engine kit: $245
Fully Assembled and Tested: $350
Includes all hardware
Double acting, twin cylinder
Hackworth reversing gear
Includes full-color assembly manual
Dimensions:
Base: 3.000" x 1.844"
Crankshaft end-to-end: 4.344"
Height: 3.375"
Weight: 327 g



TVR1ABB

Ready to assemble steam engine kit: $295
Fully assembled and tested: $400
Includes all hardware
SAME AS TVR1A but with shielded ball bearings
Includes full-color assembly manual
Dimensions: Same as TVR1A
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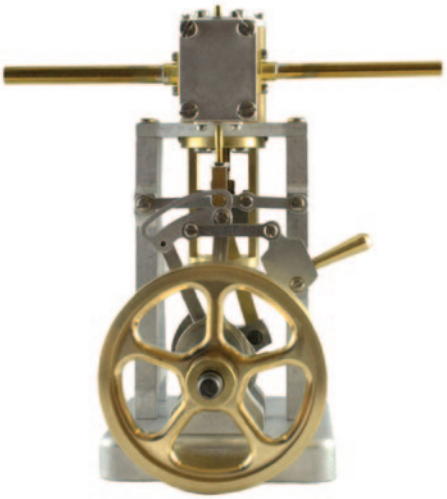
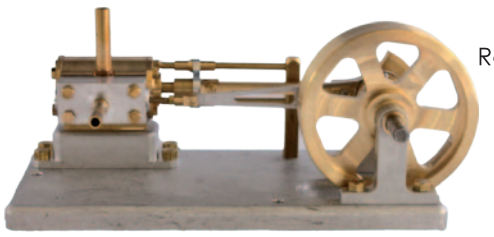
MFLY: $20
1 3/8" DIA
(Solid Marine)

BFLY1: $25
1 3/4" DIA (5 Spoke)

BFLY2: $30
1 3/4" DIA (6 Spoke)





HM1

Ready to assemble steam engine kit: $95
Fully Assembled and Tested: $145
Kit includes all hardware
.344" bore, .500" stroke
Double acting, single cylinder
Includes full-color assembly manual

VR1A

Ready to assemble steam engine kit: $119
Fully Assembled and Tested: $175
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Includes full-color assembly manual

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STEAM IN THE GARDEN

Gather friends, while we inquire,
into trains, propelled by fire ...

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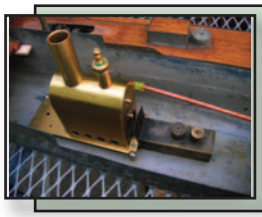
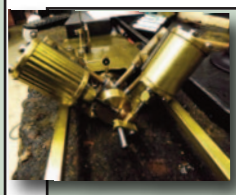
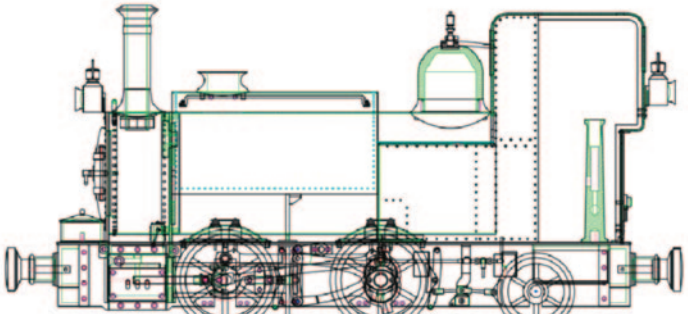




Cover: Merlin "Avonside"ready for steaming after a full restoration by Rob Kuhlman. Photo by Rob Kuhlman.

Also inside:

LATEST WAYBILL



The Train Department

Hazlet, NJ, USA: TTD has announced that they are scrubbing the plans to produce the Dolgoch in favor of Talyllyn No1. This change will make a great pair of models available to the hobby never widely available in production until today. A production sample is expected by around June 2019 with production beginning shortly thereafter.

Specifications include:

- Butane ceramic burner with fine gas valve (est 30min run time)
- Boiler with fine throttle, superheater, 6mm sight glass and Goodall valve
- Full working Stephenson valve gear
- Slide valve cylinders 1/2-inch bore
- 45mm/32mm chassis options
- Fully bronze-bushed chassis and rods

Air pump will be supplied loose. Sand pots will be able to be moved from early location to modern for the pump install

The locomotive will be available in Furness Red, Deep Bronze Green, and Black. All will be available fully lined.

RAILWAY POST OFFICE

Tin-Can Cruiser Update

Casey S. of Eldersberg, Maryland recently wrote to us about Joe Rothwell's "Tin Can Cruiser" featured in the March/April 2019 issue of the magazine:

"The "Tin Can Cruiser" electric to steam conversion article in SitG #160 piqued my interest. The March 1953 issue of Popular Science magazine featured a construction article (with scaled drawings) for a watercraft that looks remarkably like the one featured in the SitG article.

A web search will turn up other sources for the March 1953 issue of PopSci.

Good hunting!

V/r,

Casey S.

O Scale Kings #8

Our Author Joe Rothwell gave us his reply to Casey:

"Hello Casey,

The editor of SitG forwarded your email to me and you are correct...the cruiser is from the Popular Science article! My guess that it was post-war Japanese was incorrect and I have to thank you for setting me straight. I found another boat on ebay awhile ago and bought that one too. Incredibly, the photos in the article (I found the issue on eBay for $7 and just received it) show the exact same anti-freeze can I showed in my article. He even states that oil or anti-freeze cans be used for the boat.

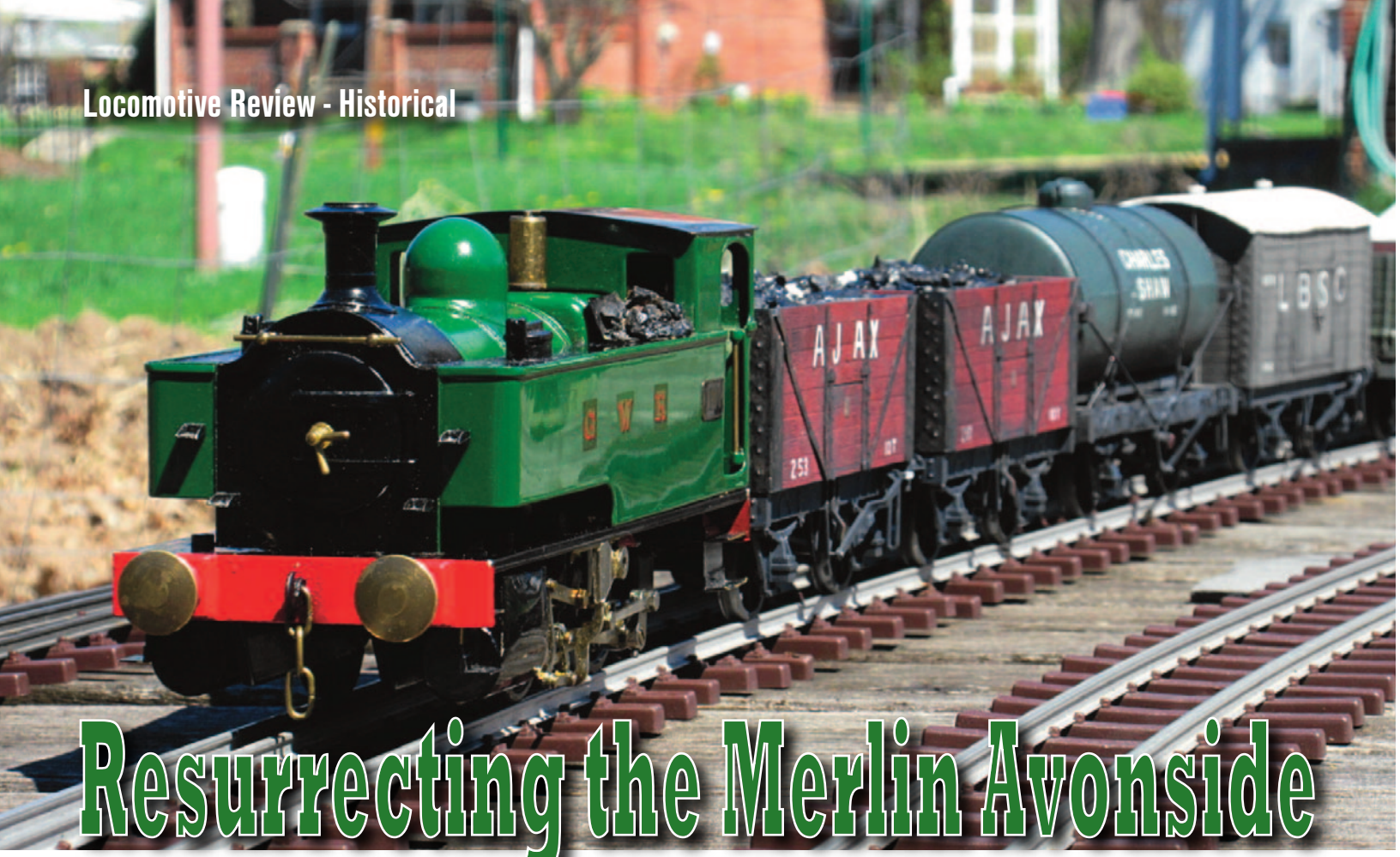
Also the paint is in the same colors he suggests in his article. In fact, both cruisers I found on ebay were painted exactly the same, both in color and type of paint, leading me to believe that both these boats were made by Gus Hall himself. Another guess, to be sure, but the odds of two separate builders using the same paint and colors, applied exactly the same way, not to mention the anti-freeze cans, is a bit of a stretch. It seems that Gus had a little side-line building this model and selling them.

I couldn't find anything about Gus on the web, but my search skills lack somewhat. I did find a pdf of the article in the model forum RCGroups and someone posted that they had started the hull, but never finished the model.

Thanks again, Casey, for the heads up. It's better to know the facts...it sweetens the humble pie a bit."

Regards, Joe

Mystery solved! -- Ed.



Resurrecting the Merlin Avonside

Text and Photos by Rob Kuhlman

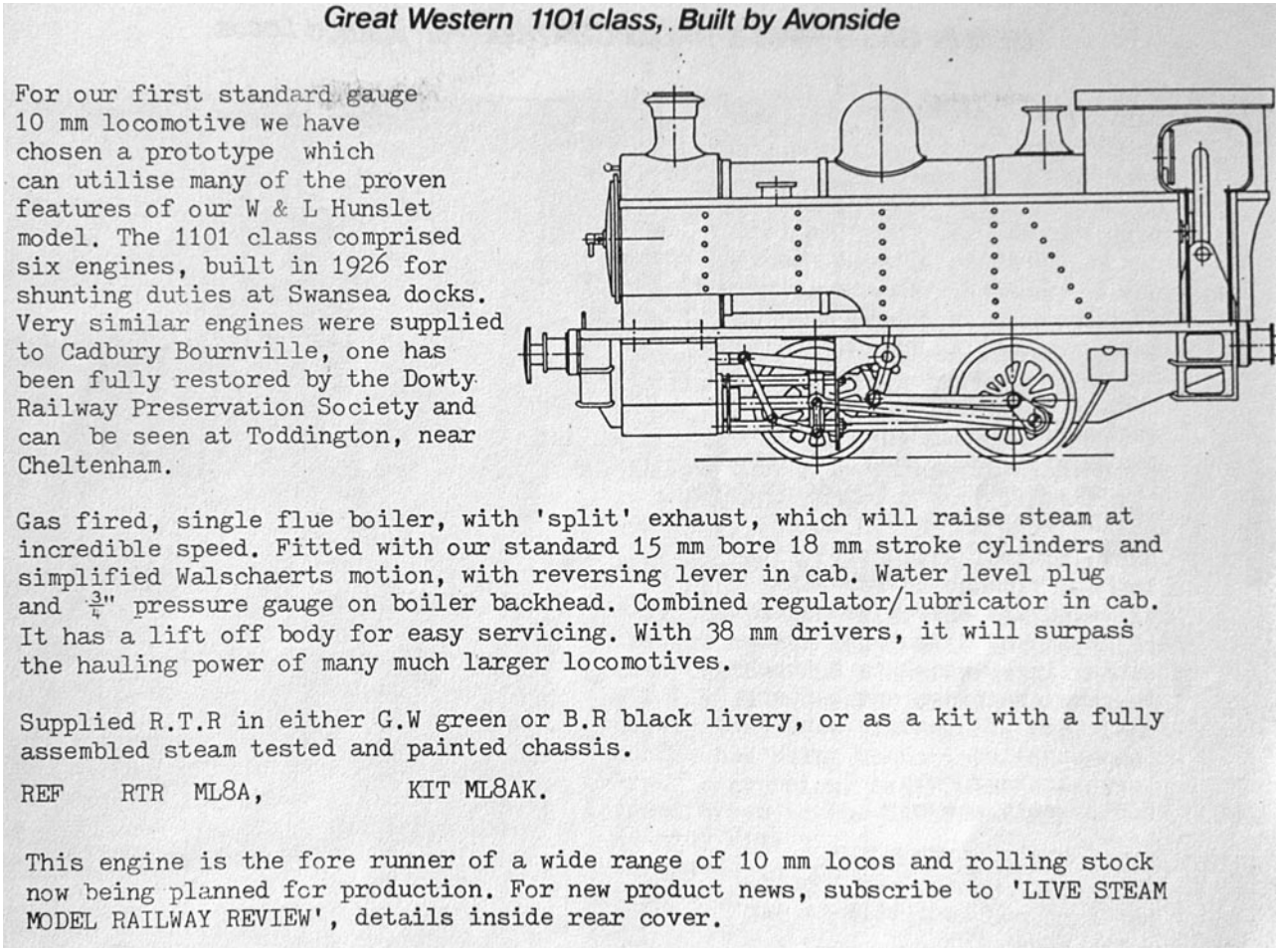
Since I got into this wonderful hobby of ours in the late 1980s I've always been an SM32 person. *(SM32 equals 1:19.05 scale, commonly used to model two-foot gauge on "0" gauge track–Ed.)* But in the last several years I've been indulging two flirtations: with British standard gauge Gauge One, and with the heritage side of our hobby. When last wintertime an opportunity arose to acquire an early Merlin loco, and a British standard gauge one to boot, I jumped at the chance.

The Prototype

The Great Western Railway purchased from the Avonside Engine Company of Bristol six 0-4-0 side tank locomotives to replace worn and obsolete shunters in the dockyards of Swansea; they were delivered in 1926. Commonly known as the '1101 Class' they were numbered 1101 through 1106. Avonside constructed them with 'half-pannier' side tanks to enhance access to the Walschaert valve gear. Early in their GWR careers the locos had the upper corners of their cab sides cut down and curved to relieve clearance issues; and several photos, but not all, show the characteristic Swindon brass safety valve bonnet. All six survived into ownership by the British Railways; withdrawals were complete by 1960 and all were scrapped. However, very similar versions of the Avonside 0-4-0T, with full side tanks and different cab windows, were constructed for the Cadbury chocolate works at Bournville, and one of these has survived into preservation and can be seen as a static display at the Birmingham Railway Museum at Tyseley. If you were a cartoon illustrator what you would want to emphasize about these locos is the compact chunky outline and the enormous round buffer heads.

Merlin Production

Tom Cooper, live steam entrepreneur extraordinaire, produced mostly SM32/SM45 locomotives with his Merlin Locomotive Works and later on with his Steamlines company. These locomotives have a well-deserved reputation for popularizing gas-firing within the garden railways narrow gauge community. Tom attempted to break into the world of 10mm scale British standard gauge live steam with the introduction of a model of the GWR Avonside 1101 class. His 'press release' published in the May 1984 issue of his in-house publication Live Steam Model Railway Review acknowledged the



Great Western 1101 class, Built by Avonside

For our first standard gauge 10 mm locomotive we have chosen a prototype which can utilise many of the proven features of our W & L Hunslet model. The 1101 class comprised six engines, built in 1926 for shunting duties at Swansea docks. Very similar engines were supplied to Cadbury Bournville, one has been fully restored by the Dowty Railway Preservation Society and can be seen at Toddington, near Cheltenham.

Gas fired, single flue boiler, with 'split' exhaust, which will raise steam at incredible speed. Fitted with our standard 15 mm bore 18 mm stroke cylinders and simplified Walschaerts motion, with reversing lever in cab. Water level plug and $\frac{3}{4}$" pressure gauge on boiler backhead. Combined regulator/lubricator in cab. It has a lift off body for easy servicing. With 38 mm drivers, it will surpass the hauling power of many much larger locomotives.

Supplied R.T.R in either G.W green or B.R black livery, or as a kit with a fully assembled steam tested and painted chassis.

REF RTR ML8A, KIT ML8AK.

This engine is the fore runner of a wide range of 10 mm locos and rolling stock now being planned for production. For new product news, subscribe to 'LIVE STEAM MODEL RAILWAY REVIEW', details inside rear cover.

A photo of the page in the 1984 Merlin catalog which features the Avonside. Notice Tom Cooper's ambitious plans to introduce a "wide range" of 10mm mainline products; unfortunately this never happened.

challenge of producing a model in 10mm scale while using many off-the-shelf components from his narrow gauge line of locomotives – hence the choice of the compact chunky outline of the Avonside with its Walschaert valve gear and long side tanks which could hide the butane reservoir. He chose to model the Avonside 1101 as constructed, and with the enormous round buffer heads there's no mistaking the prototype. Tom announced that this locomotive would be the first of many in 10mm scale, but to my knowledge no other standard gauge locomotive was produced by Tom until he had separated from Merlin, formed Steamlines, and introduced in 1989 the Austerity 0-6-0 ST locomotive featuring his 'Osmotor'.

The first advertisements for the Merlin Avonside appeared in the April 1984 issue of the G1MRA Journal and listed the loco as costing £425 (about $595 at that time). Around the same time Roy Scott, founder of Tenmille Products, began advertising the Avonside for £465 (about $650) with several of his GWR goods kits (extra cost). The 1984 Merlin catalog shows a list price of £450 (about $630) (with a kit version for £375 [$525]). By 1985 the price had climbed to £500 ($700); and by 1986 the Merlin advertisements no longer featured the locomotive and Tenmille's ads dropped it soon thereafter. I don't know how many of these Avonsides were ultimately produced, but I have heard anecdotally that it was as few as 10. I had never seen one before I purchased mine, and there are very few YouTube videos which feature it.

Merlin constructed this loco utilizing features and design elements previously developed for the 16mm narrow gauge line. Its gas tank sits astride the boiler on the port side, there are lots of banjo fittings, teflon washers, teflon pistons, and a distinctive lift-off superstructure which exposes the boiler and mechanical gubbins for easy access. The throttle is a globe valve integrated with the displacement lubricator at waist level on the starboard side; the throttle wheel is accessed through the cab

(Above) The back head of the loco with the carapace removed. Across the footplate from left-to-right can be seen the gas supply valve, the reversing quadrant, the burner, the pressure gauge, and the integrated lubricator and throttle.

doorway. Once the superstructure is emplaced access to the gas supply valve is difficult. Distinct from typical Merlin production, however, is that the Avonside came as manual control only – no R/C.

The Model

I acquired my Merlin Avonside, numbered 50 on its Merlin builder plate, from an estate sale, and I picked it up and trial-fired it at the annual Scranton steamup in February 2018. At the time it was missing the reach rod from the quadrant in the cab, so reversing had to be done with the hot fingers method. From the first I was impressed and delighted with how sedately and smoothly this loco ran. During the next several months the missing reach rod was replaced and I fabricated brass steps to replace the several broken stock white metal castings. But steaming the loco became frustrating because it would develop a hitch in its motion as the loco got warm, until finally the drive train would lock up with the port side crankpin at the three o'clock position – i.e., with the port piston at rear dead center. Next the burner jet got clogged, and then the banjo bolt which connects the jet assembly to the feed line from the gas tank sheared off. I cleaned the jet and turned a new banjo bolt the week before the Scranton 2019 steamup; I was eager to run this locomotive on its first year anniversary.

(Above) The starboard side of the Avonside; note the pressure gauge and the throttle wheel through the cab doorway. There's some paint blistering around the 'R' on the side tank probably due to a gas flare at some time in the loco's life.

I thought my best bet would be to wait on the 'hitch in the motion' problem until I was surrounded by experts at the annual Scranton, Pennsylvania Steamup. Paul Hagglund, from Seattle, provided that expertise by tweaking the alignment of the port side's cosmetic links connecting the crosshead with the valve stem. I then steamed it on rollers and it again developed the bind and lock once warm. Paul attacked the loco again early the next morning, and he found that the upper crosshead U-shaped yoke on the port side was fouling the upper crosshead guide when the crankpin was at the three o'clock position – at last the cause of the bind when hot was discovered. We realigned the upper crosshead guide to provide more clearance, and the motion then moved as smooth as silk. From that point on this loco has done nothing but run smoothly and sedately pulling all eight pieces of my goods stock at a nice unfitted goods train pace. I can't be more pleased; seeing this loco run so well was the highlight of the entire Scranton steamup for me.

You can see the Avonside under steam at the recent East Coast Largescale Train Show held in York, Pennsylvania this past Spring at this YouTube video link -->.

Video Link

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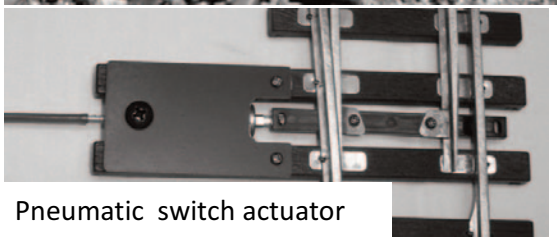

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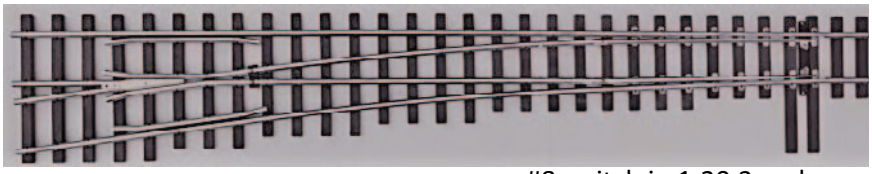

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Streamline Perfection

Text & Construction Photos by Bill Allen

John Wilkes Series
This five-part series includes:

- Part 1 - Chassis, Boiler, Ceramic Burner
- Part 2 - Boiler Wrapper, Nose Cone, Streamline Fairing
- ➔ Part 3 - Component Parts, Cab, Finishing Details
- Part 4 - Tender, Passenger Cars
- Part 5 - Interior & Paint

COMPONENT PARTS

The pilot truck of our John Wilkes, with its 5x9 mm ball bearings, is shown in **Photo 3-1**. The rear pony truck is formed from brass using several pieces soldered together. It also is equipped with ball bearings (**Photo 3-2**). You can also see the rear boiler mount on the chassis.

Copper tubing is run from the axle pump (**Photo 3-3**) to the bypass valve (**Photo 3-4**).

I am using a dead leg lubricator which is fed from a 3/32-inch copper tube that runs from the steam pipe at the cylinders back to the lubricator in the cab. The lubricator is adjustable by the use of a cap nut which screws down over the steam pipe and adjusts the mount of steam entering the lubricator (**Photo 3-5**). **Photo 3-6** shows the steam pipe with the adjusting nut in place and the lubricator body on the right. The lubricator is mounted and painted on (**Photo 3-7**).

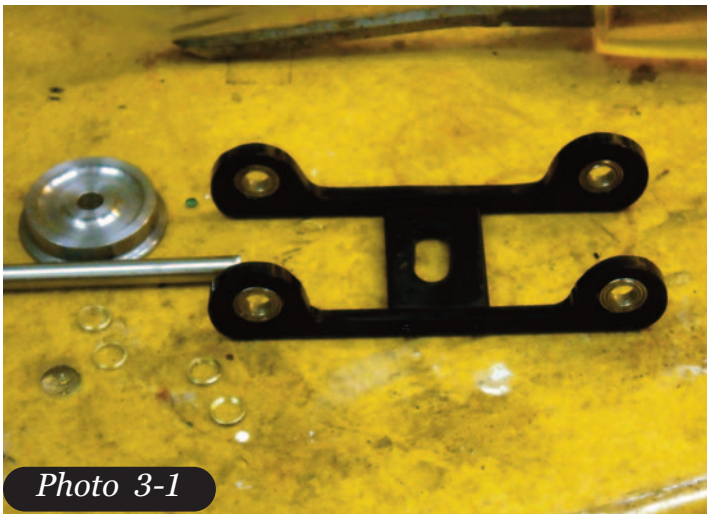


Photo 3-1

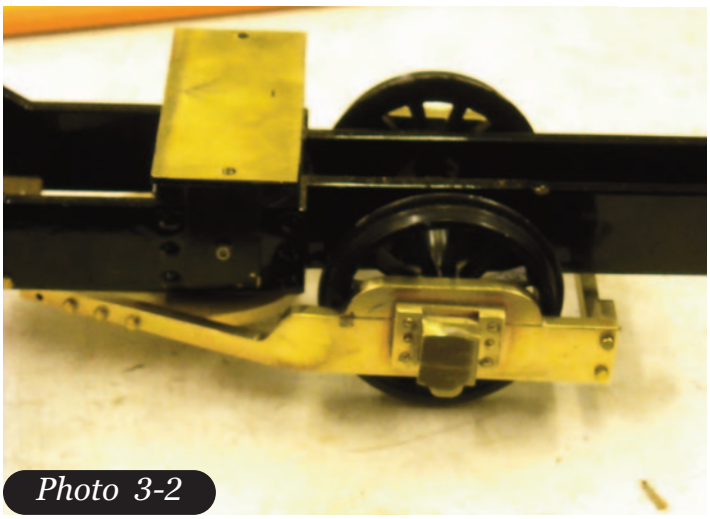


Photo 3-2

I missed the lower vent on the pilot initially, so it was made on the CNC mill (**Photo 3-8**) and installed later.

Building the Lehigh Valley John Wilkes Part Three

Rick Parker Photo

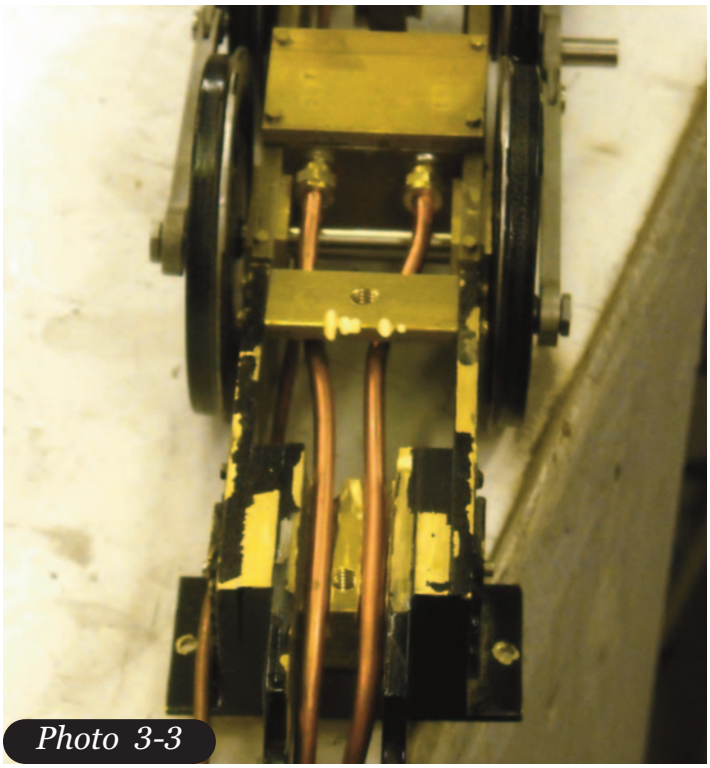


Photo 3-3

Photo 3-4

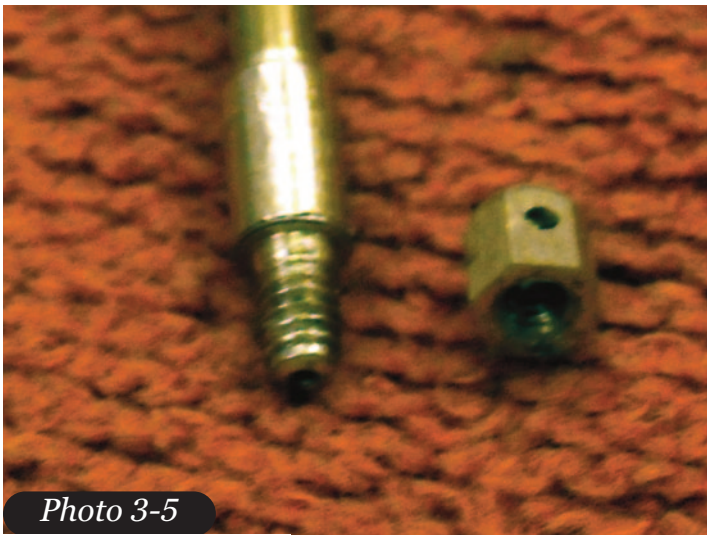


Photo 3-5

Photo 3-6

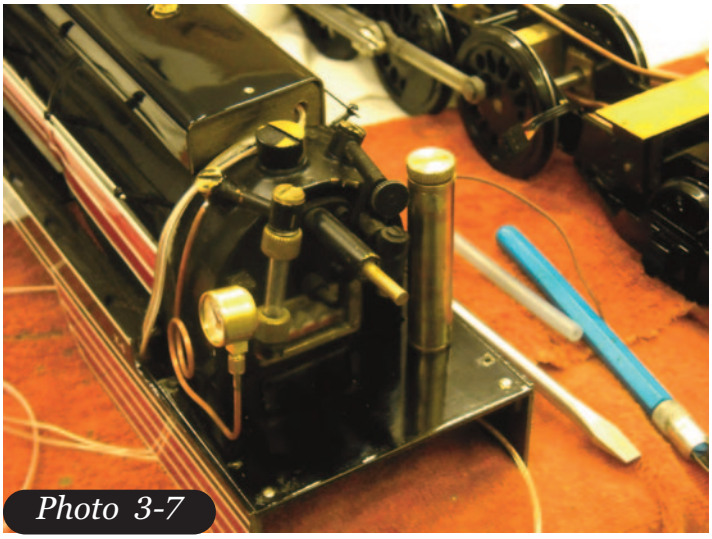


Photo 3-7

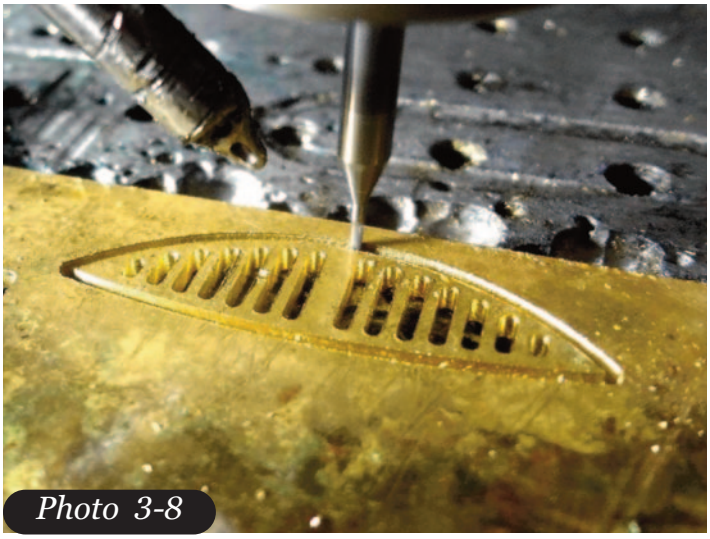


Photo 3-8

CAB

The cab sides bend at the top to meet the roof. This is done by annealing the side and bending it around a brass rod (**Photo 3-9**). I cut the front plate out on the band saw. The windows are cut with a jeweler's saw and started with 1/16-inch holes at the corners (**Photo 3-10**). The arm rest and rain gutter are soldered on with Stay-Brite (**Photo 3-11**).

The roof is bent to shape and 1/16-inch square stock forms the rain gutters. I added a vent and air

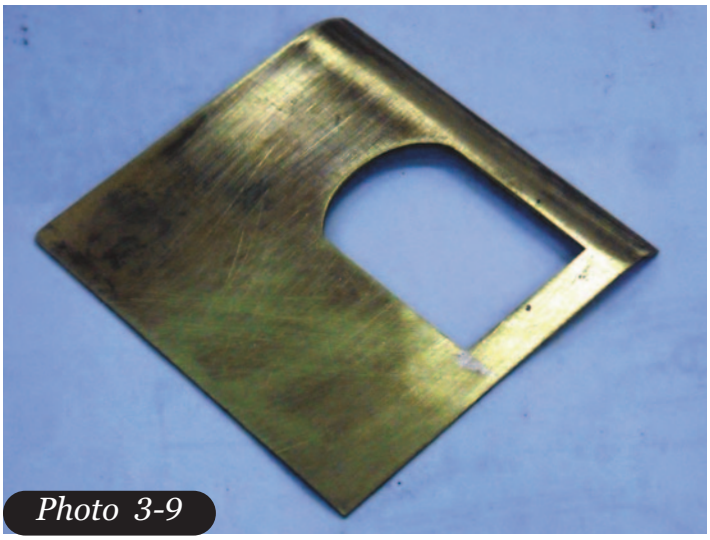


Photo 3-9

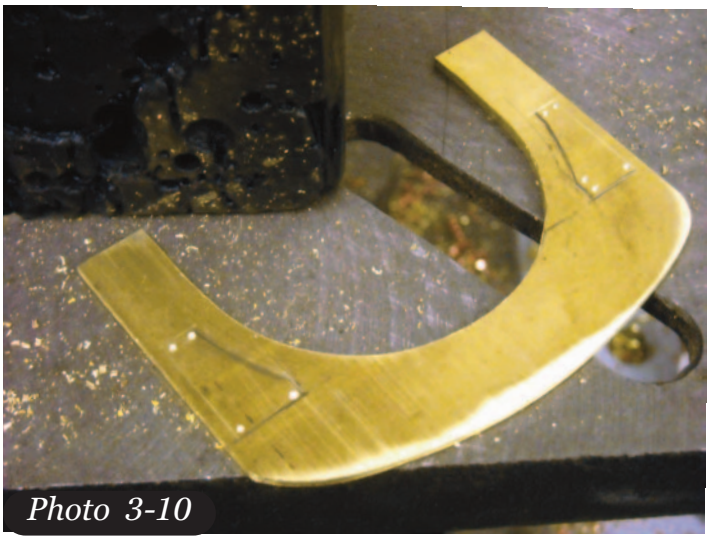


Photo 3-10

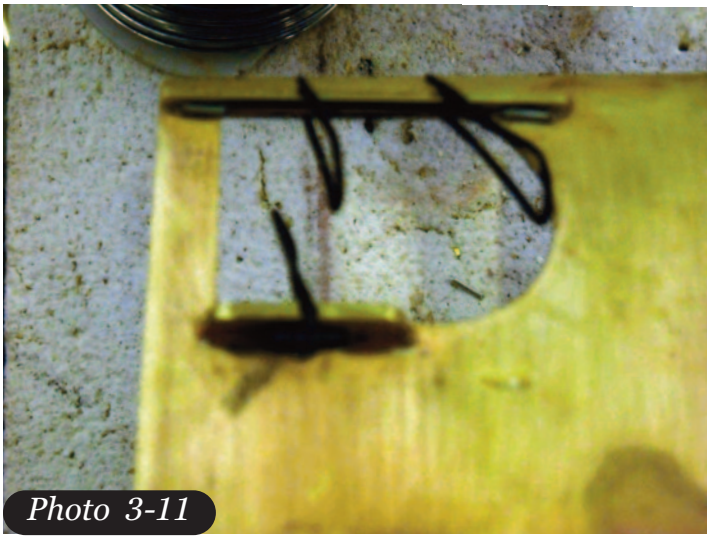


Photo 3-11

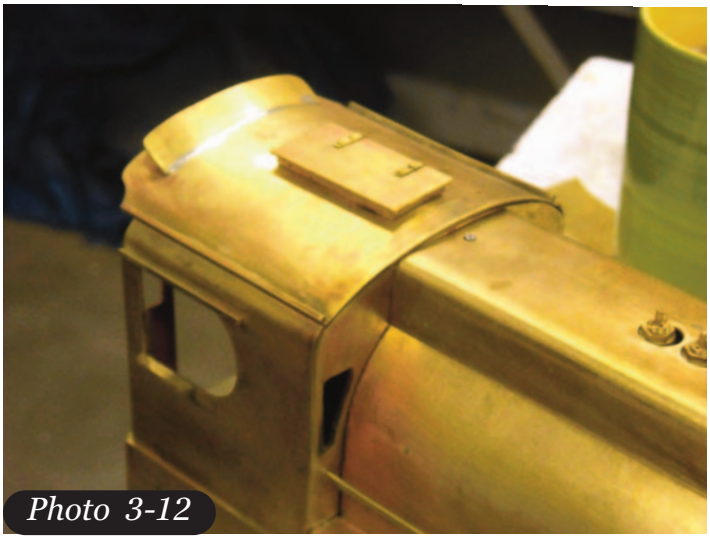


Photo 3-12

shield at the back (**Photo 3-12**).

The roof tilts to the side for access to the back head This pivot is made by slipping a piece of 3/32-inch tubing over a piece of 1/16-inch music wire (**Photo 3-13**). It is then bent so the legs are about one-third the width of the roof. The assembly is then soldered to the underneath of the hood. I soldered female receptors to brass strips and attached those to the cab front and back plate with JB Weld. This allows for setting the roof in perfect alignment and the spring tension of the hinge holds everything in place till things are dry

The faux power reverser is added to the right side (**Photo 3-14**).

The rear of the cab and roof are shown in **Photo 3-15** and the front view of the boiler is seen in **Photo 3-16**.

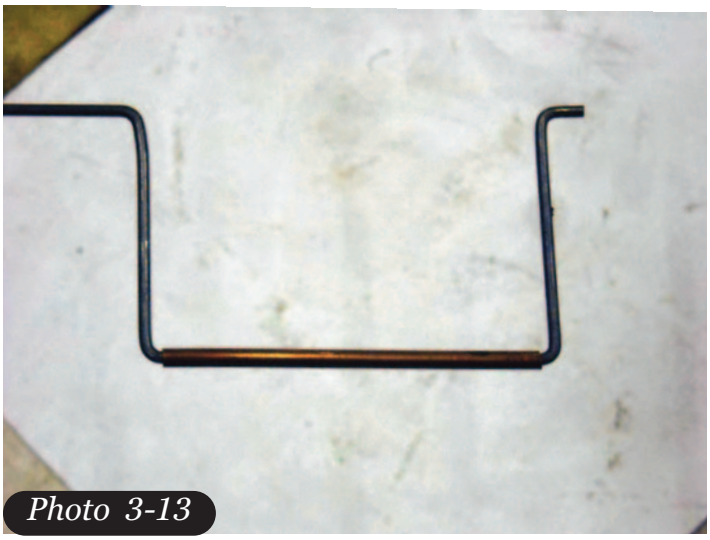
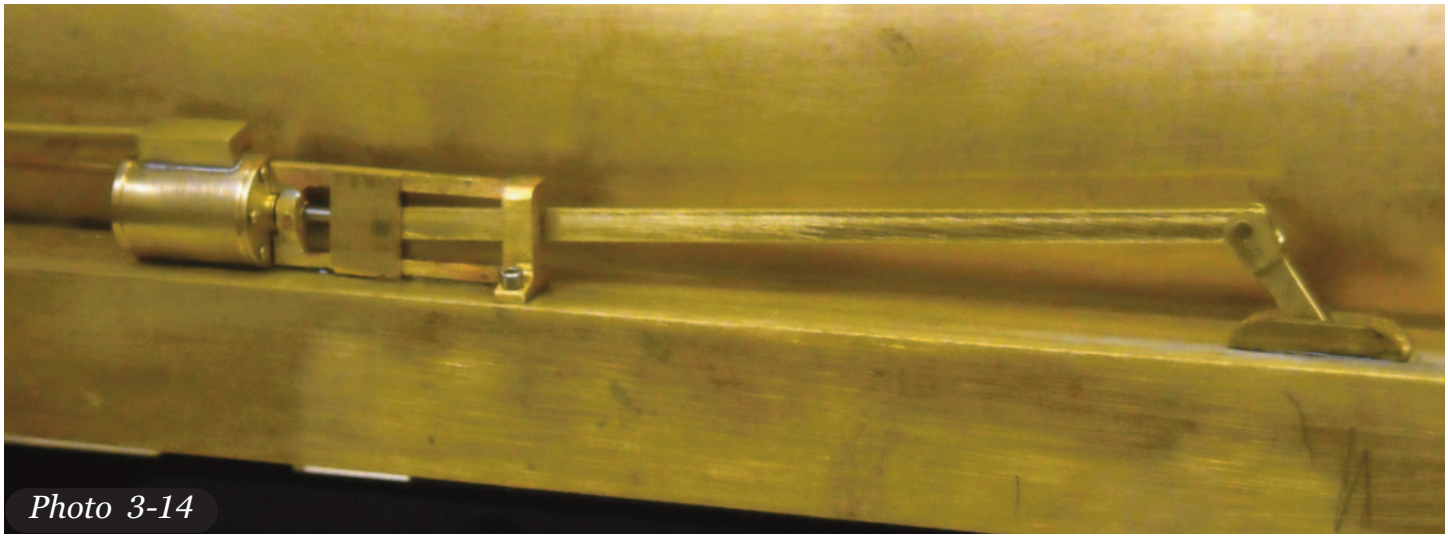


Photo 3-13



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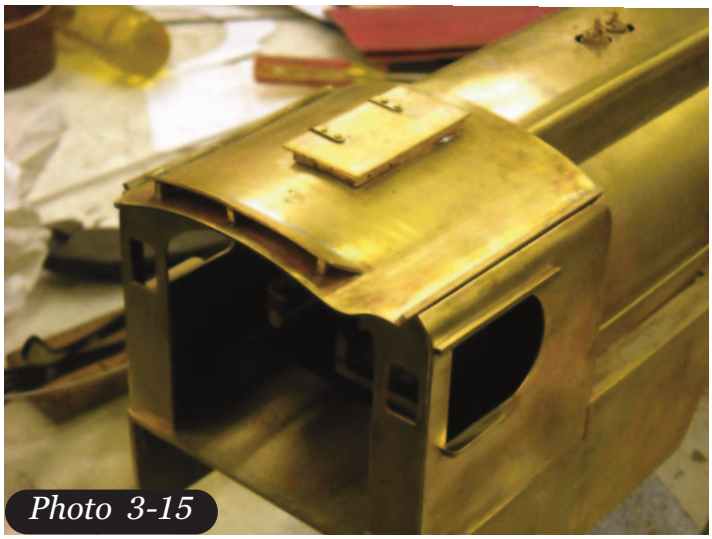

Photo 3-15

Photo 3-16

FINISHING DETAILS

I wanted a substantial paint for the base black because I could not afford to have it peel off when I removed the masking tape, so I got some automotive paint in bulk. It is an acrylic enamel base with a two-part polyurethane clear finish coat. Not only does it give a superior gloss but it is very tough. I also went with automotive paint for the Cornel Red, which was custom mixed and inserted into spray cans for me. I still wanted to make sure that all of the paints, decals and striping tape were com-

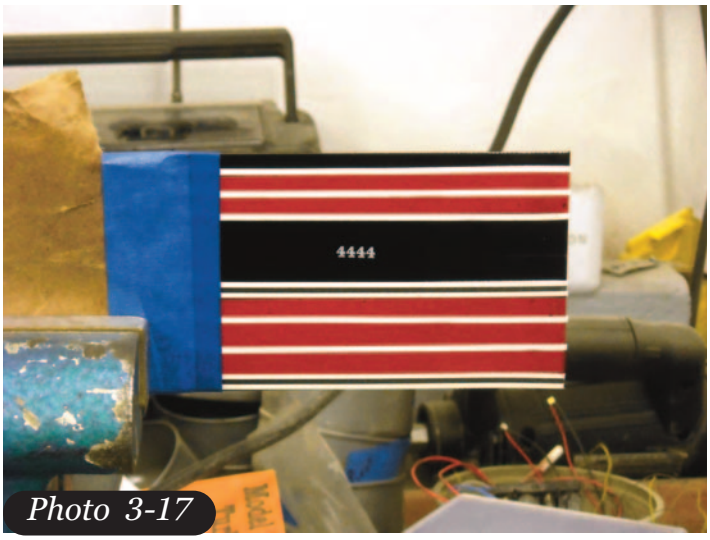

Photo 3-17

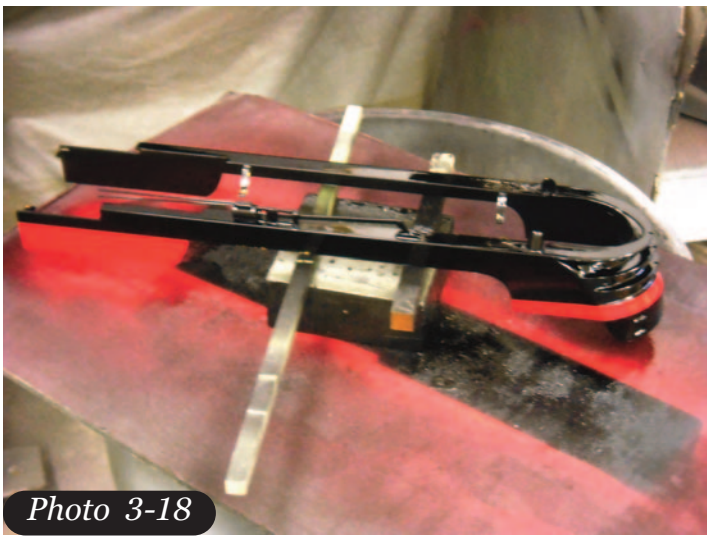
Photo 3-18


Photo 3-19

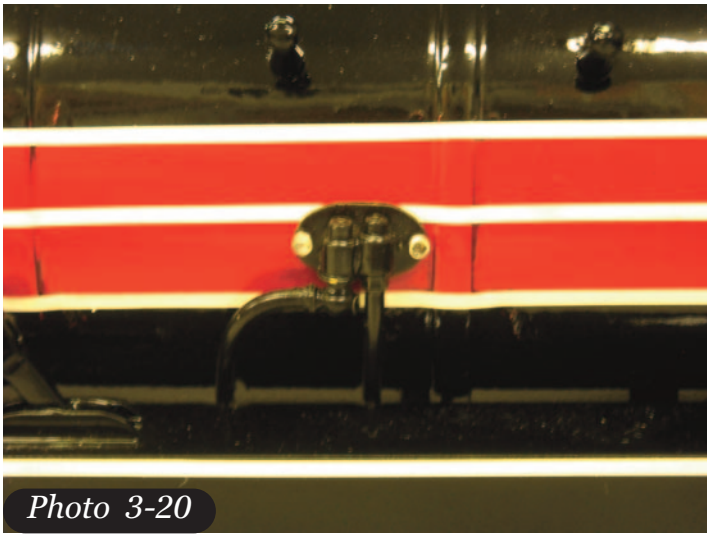
Photo 3-20

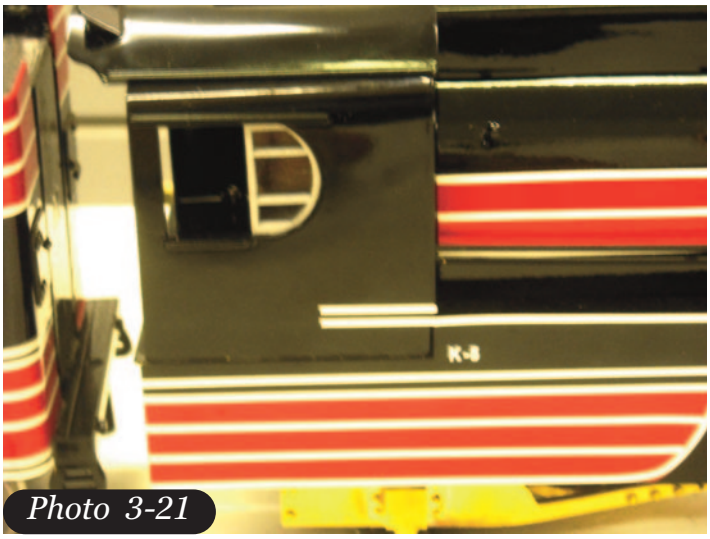
Photo 3-21


Photo 3-22

patible, and learn what the recoat times were, so I made a sample piece first (**Photo 3-17**). You can see how nondescript the colors are on the fairing in **Photo 3-18** but they really pop out once the white striping is added (**Photo 3-19**).

Items such as the clack valve and fins were added after the painting (**Photo 3-20**). Polycarbonate glazed window framing was set in place in the cab (**Photo 3-21**). The headlight was turned from aluminum and polished. The curved lens was turned from clear acrylic rod. The diamond shaped bezel was formed from a soda can, using and polishing the back, and attached with JB Weld (**Photo 3-22**). The combination marker light and number boards were printed by Shapeways in high resolution plastic. Three LED lights are in each unit. They are shown in **Photos 3-23** & **3-24**.

Finally, the Cederleaf decals were applied and the letters for the 'LEHIGH VALLEY' script were designed by Charles Bednarik and cast in nickel silver. Because the spacing is not the same for all letters, I taped a strip of paper in place, with the words printed to size, and then glued the cast letters above each printed one (**Photo 3-25**).

In the next issue, we will show the tender and passenger car builds.

Photo 3-23


Photo 3-24

Photo 3-25

A Piece of Folk Art Becomes a Steamer

Text & Photos by Joe Rothwell

This Three Part Series will cover the conversion and restoration of a historic piece of Folk Art and its transformation into a live steam powered model.

Part 1 - History, Survey, Gutting.
➲ Part 2 - Steam plant and boiler Install
Part 3 - Details, Hull refinish, and first steam

The dimensions of our "Leipzig" tin cruiser are very close to those of Lindberg's plastic model of the WWII destroyer 'Blue Devil'; a model that was the first R/C boat which I built years ago, in the mid-eighties (**Photo 2-1**). This will help the 'Leipzig" project to avoid some of the pitfalls that I encountered back then. The 'Blue Devil' had a spacious interior, so I upgraded the hull with twin 'Mack Marine' electric motors, a double battery pack to extend her run time, and a servo-driven mechanical speed-controller. An emergency water pump, also servo-driven was next, along with a separate, lower voltage battery for the radio receiver and a steering servo. I also added steel prop shafts with brass stuffing boxes which turned three-bladed, counter-rotating brass propellers.

Lindberg did a reasonably good job on the model's detail, so only a few mods, like railings and antenna wires were added, along with a resplendent paint job including hand painted numbers on the bow. It was ready for launching. I figured a float

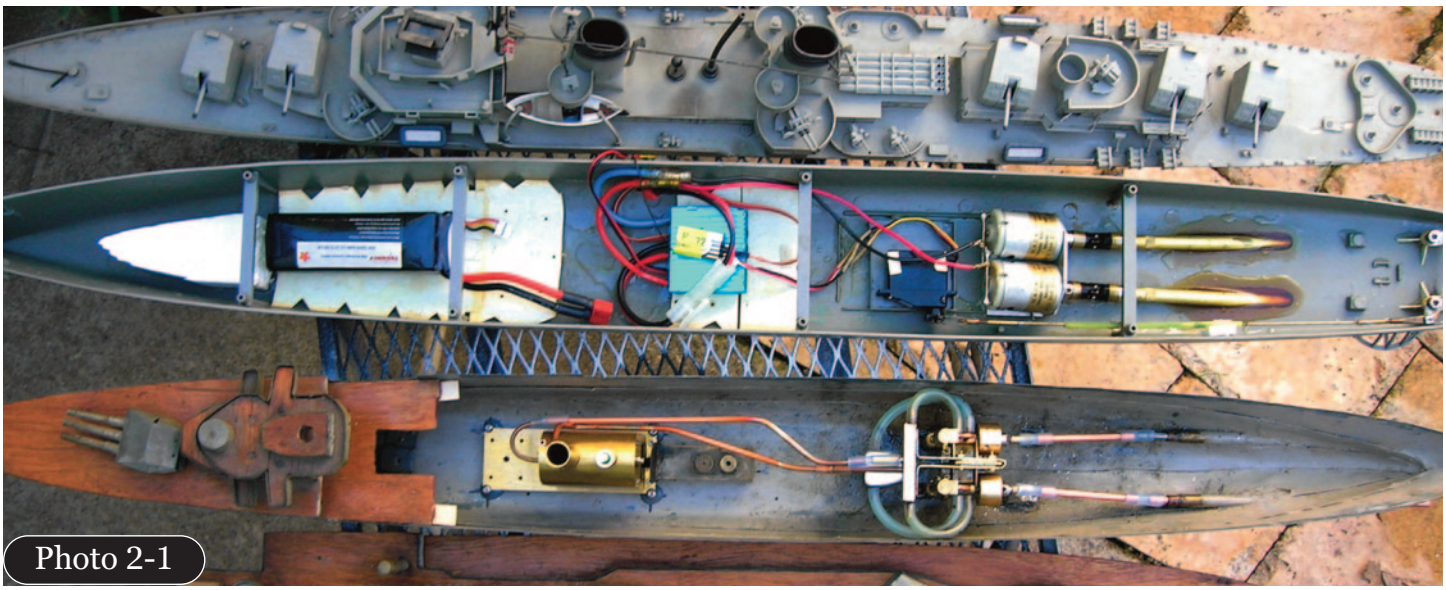

Photo 2-1

WWII "Tin Can"

Part 2

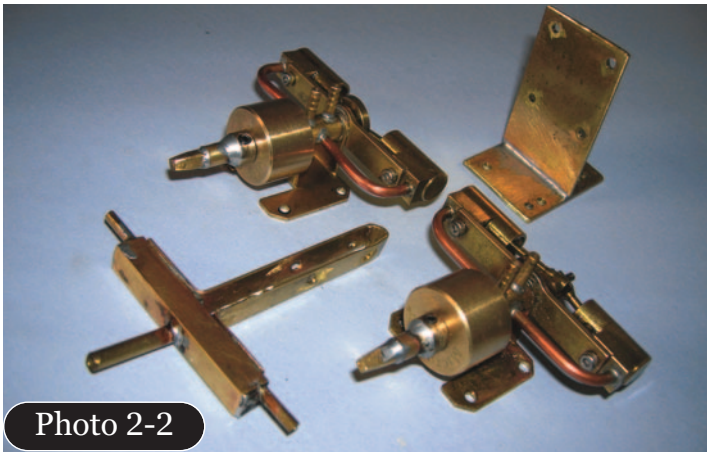

Photo 2-2

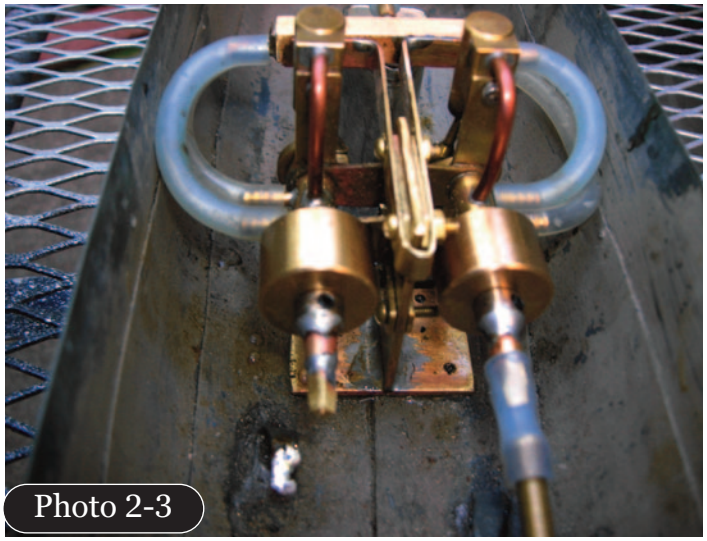

Photo 2-3

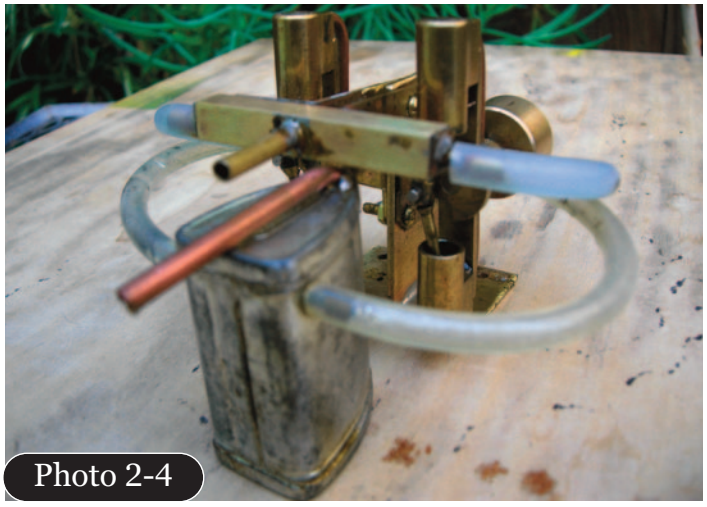

Photo 2-4

test in the bathtub might be a good idea before going to the pond, so in it went...right to the bottom! It had the buoyancy equivalent to a shovelful of wet cement.

After a few rounds of eliminating equipment and losing weight (weight wasn't the only problem), things were squared away and the model still operates today with most of the original gear that survived the cut.

The 'Leipzig' has a large space for equipment and just like the 'Blue Devil', poor carrying capacity. Weight limit for the tin cruiser hull is around three pounds total and she now weighs in around one and three-quarter pounds, empty. That leaves a little less than a pound to play with for the motor, boiler and missing details on the deck and about a half pound for lead ballast. Not a whole lot, this will be tight.

The deck height, from the keel, is two inches, which inhibits equipment size, though we gain another three-quarters of an inch with the main-deck cabin and it is four and three-quarter-inches to the top of the smokestack. This forced height restriction will actually work in our favor, as we'll see in a moment.

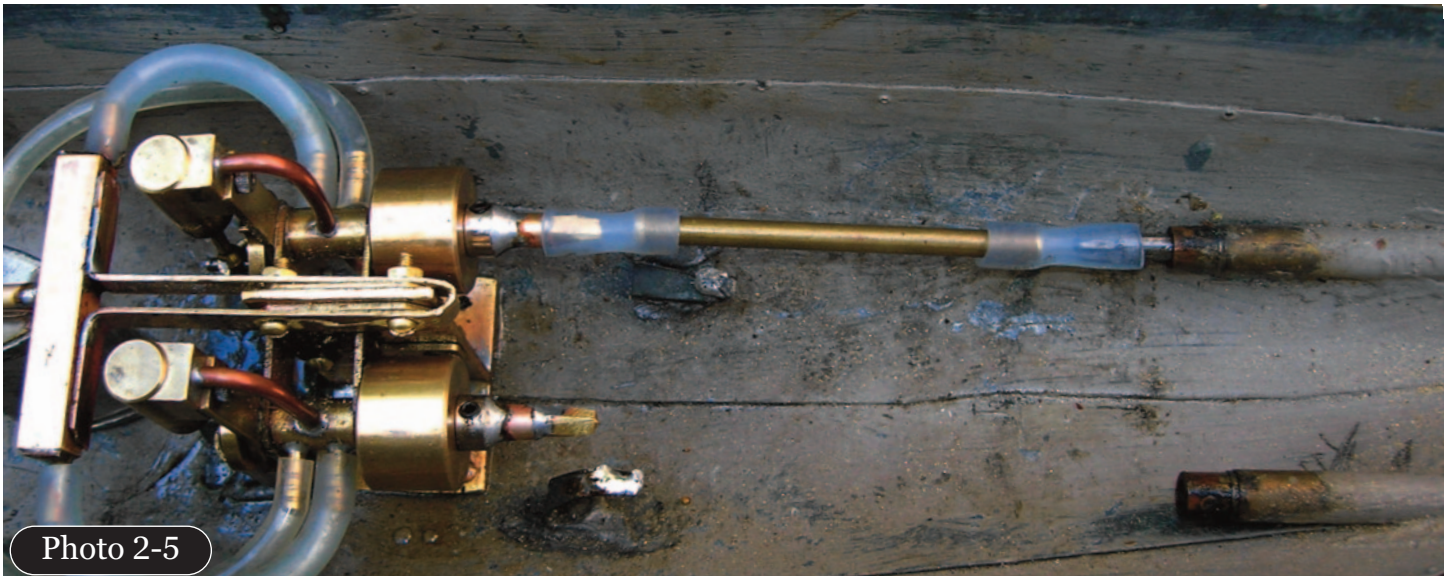

Photo 2-5

The twin, rotary-valve motor used in the tin cabin-cruiser project worked great, but it only had to turn a single prop, and might struggle with the planned twin-screw gearbox when experiencing fluctuations in steam pressure. A motor strong enough to turn the gearbox would push the weight rather high, so I eliminated the gearbox and went with two twin rotary-valve motors, each driving its own propeller (**Photo 2-2**), mounted sideways on an upside-down T-frame. Some of the weight gained by using two motors is offset by the loss of the gearbox. The T-frame tilts the thrust-line slightly downward, getting more in alignment with the prop shafts.

Even though there are now four cylinders to feed, demand is very low on this motor as the diameter of the single-acting pistons is six millimeters. The test boiler (same as the tuna-can boiler used in the cabin cruiser) used to check and run the T-frame/motor set-up holds one and three-quarter ounces of water and gave over 12 minutes (on the bench) of full throttle service.

A box manifold is mounted to the same T- frame. The inlet pipe on the manifold is centered and has a bigger pipe diameter than the two outlet pipes in the lower, outer corners which supply steam to the motors (**Photo 2-3**). The manifold self-drains condensed steam and has even pressure for both motors with rpm's about equal. When one motor quits, the other increases rpm's by 20-30 percent, I'm guessing.

The unit is soft soldered together and this works just fine, but if an alcohol fire breaks out, this could come un-soldered during the conflagration, along with any other soft solder work. Something to consider when running with alcohol inside a hull. Steam exhaust is piped to an old model plane fuel tank (**Photo 2-4**) (I have a box of assorted types of

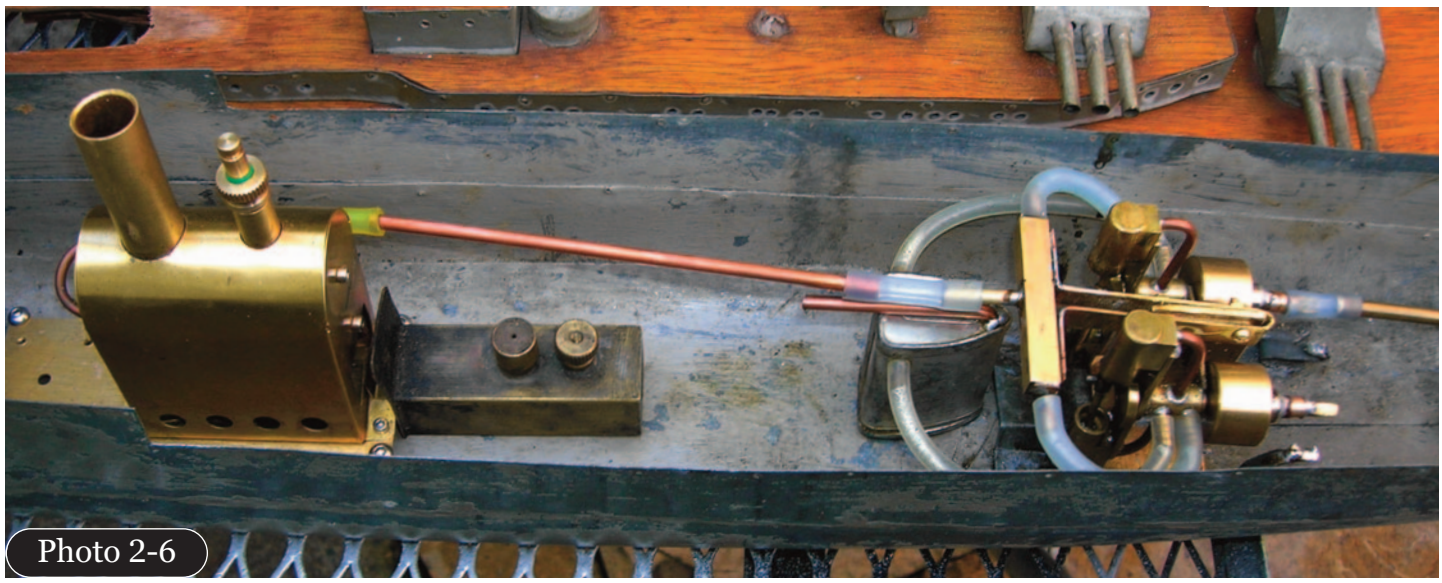

Photo 2-6

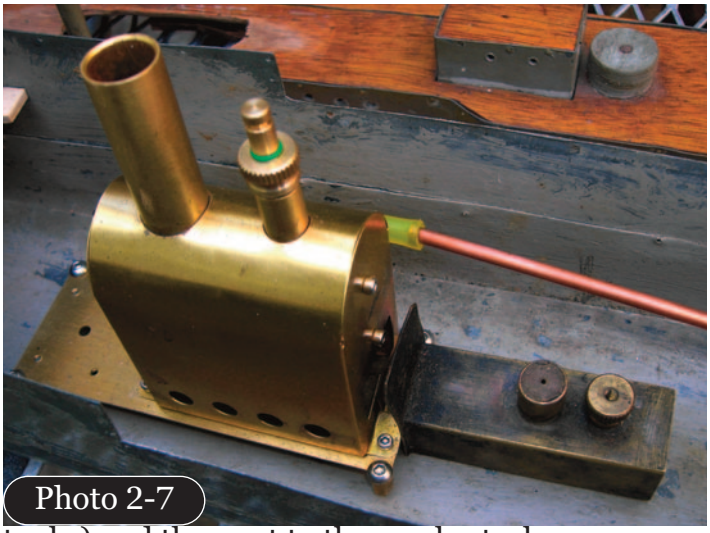

Photo 2-7

tanks) and then out to the smokestack.

I marked and drilled holes for mounting the motors to the hull. Bolted through the bottom, nuts end up on the inside. Placement was based on keeping the amount of angle the u-joints have at the motor end and at the prop shaft end as small as possible. I used to use mechanical u-joints to connect the drive shafts with the prop shafts on past models, but now I like silicone tubing. It's cheaper, there seems to be less friction than mechanical u-joints and the low rpm's are less demanding, so no foul (**Photo 2-5**).

The original u-joints on the wind-up motor were interesting, 3/16-inch dia. x 6 ½-inch long floppy wire springs! They were supported mid-length by a one-inch long brass tube soldered to a narrow, sheet metal support that was also soldered to the bottom of the hull. The long u-joints let the wind-up motor sit more in the middle of the hull for better balance. I un-soldered the two one-inch brass tubes and gently bent the supports down and out of the way for the new copper drive shafts.

One drawback to my power plant set-up is the height. It fits fine under the deck and cabin, but on a long narrow hull such as this, the 'center of buoyancy' is very low and the ship will heel over to the point of capsizing if weight is placed too high above this spot. The set-up is not bad, but less height is always better (**Photo 2-6**). All the equipment on my R/C model of the Lindberg 'Blue Devil', being electrical in nature, was mounted on raised platforms for protection from sloshing bilge water. This was another lesson from the 'Blue Devil' after the weight problem was corrected. Back into the tub, weight was fine, but the ship rolled onto her side at first until all platforms were lowered and everything was placed either directly or slightly above the bottom of the hull, thereby lowering the center of gravity closer to the center of buoyancy and stabilizing the ship. In the end and after many visits to the tub, the equipment arrangement looked entirely different than that first tub test.

Whether electric or steam, balance points are the same. Does it sit on its waterline? Is the bow or stern riding high or low? Does it list or lean left or right? I use trial and error, jostling equipment and ballast around to find these points while the boat is in the tub.

The boiler on the 'Leipzig' presents a problem. It's tall and that will require a bit of lead ballast to be placed on the keel to off-set its height. I'm using it because the boiler is light; it weighs in at 150 grams and the two-wick alcohol burner, which is a left-over from the Mammod/Commodore project, weighs 55 grams (**Photo 2-7**). The light weight will allow more lead ballast to be added, so it's a push with the height issue. Also, the smokestack of the boiler lines up perfectly with the smokestack on the ship, so this helps with the design.

The boiler mounting plate has four short, threaded standoffs underneath. I JB Weld'ed them to the bottom of the hull instead of through bolts. There isn't any vibration or movement with the boiler (like you get with the power plant), so I figured this was easiest. The base can still be unscrewed, leaving the standoffs adhering to the bottom inside of the hull.

I would like to put a gas fired, center flue boiler in so it can sit right on the bottom of the hull, thereby lowering the c/g, but the arrangement is a bit awkward with the boiler, butane tank, burner direction and boiler-smokestack position. This will require a bit more work and will be a fun challenge down the line. Weight gain would be offset with the lower c/g. Or maybe a custom alcohol burner that's not as tall and has more capacity. Even with this steam-sipping twin motor set-up, there's only a few minutes with the lightweight boiler I'm using now.

In our next installment we move on to the final finish and assembly.

Digital Readout (DRO) for Lathe or Mill

Photo 1

Text & Photos by Jim Gabelich and Michael Martin

Background

Seven years ago, I bought a Grizzly 9X20 lathe that, like many hobby-level lathes, has always had quite a bit of backlash. Initially I was not concerned with this because I was focused on learning the basics of using the machine. Over time, I read lots of books on using a lathe and mill, and became semi-proficient at making parts to maintain and modify my collection of engines. I also used it in the scratch building of engines and to make or finish parts for a few stationary steam engine kits.

As I got better at the lathe, the backlash was becoming a real problem when it came time to make things dimensionally accurate or in trying to make two objects precisely the same. I looked at DROs advertised in hobby magazines and on the internet but found them too pricey to justify the expense.

I wanted something inexpensive but much more accurate than plus or minus multiple thousandths. Enter the digital tire depth gauge. It answered all of the criteria; price, small size, re-settable at any point. It offered 28mm (1.1-inch) of travel and was reasonably accurate (probably within 0.002-inch to 0.004-inch of actual) (**Photo 1**).

The accompanying photos should help in understanding how I went about fabricating the gauge attachment and bracket when attaching it to my lathe cross slide.

Build Process

Start by cutting off the plastic wings from the tire gauge, as they are not needed (**Photo 2**). You may or may not have to open the gauge to reduce the force of the friction spring, but do so only if it is found to be tight. Mine was OK. Next measure the probe diameter (usually three to four mm). Drill a corresponding hole three to four mm in diameter to a depth of five mm in a one-inch long piece of quarter-inch round steel, then drill a cross hole for a locating pin. Your choice of hole size is determined by the size of pin you want to use. I used a #55 and was going to tap it to a 0-80, but tapping a hole that small in cold rolled steel seemed difficult so I chose the pin method. Next cut the quarter-inch round to six-seven mm total length, facing it off square (**Photo 3**). Place a quarter-inch magnet on the squared end with a drop of cyanoacrylate, which is probably overkill because

Materials

- Rare earth magnets 1/2-inch X 1/8-inch
- Rare earth magnets 1/4-inch X 1/8-inch
- Digital Tire tread Gauge of your choice
- 1/4-inch diameter X 6-inch long cold finished steel rod
- 1-inch wide X 1/8-inch thick X 6-inch length flat stock
- 3/32-inch thick X 4-inch X 4-inch steel sheet or whatever is in your scrap box that would make a sturdy bracket.

Note: The probe on the particular Gauge I used is not round but 3.5mm wide X 2.5mm thick. I chose it because it had the longest travel at 28mm. I have since seen some with a perfectly round probe but less travel. The round probe may be easier to work with, but the choice is yours.

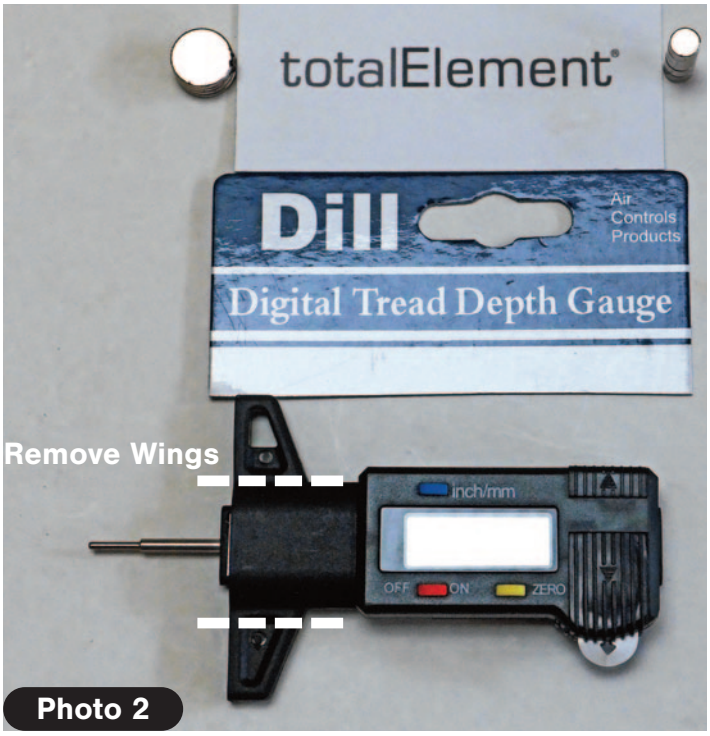

Photo 2

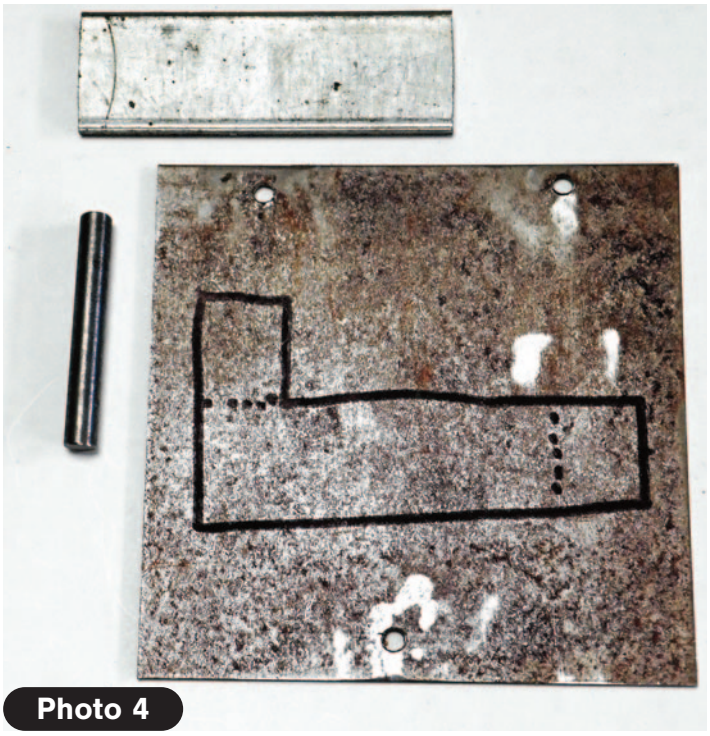
Photo 4

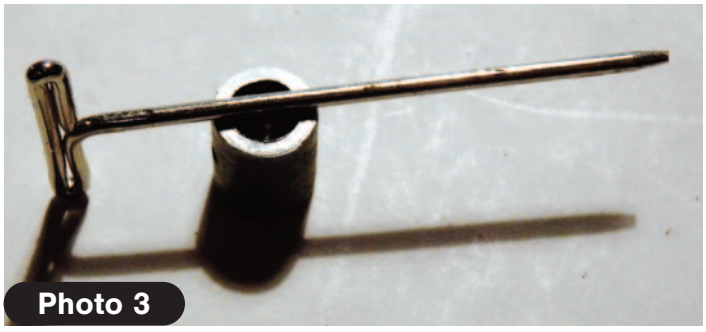
Photo 3

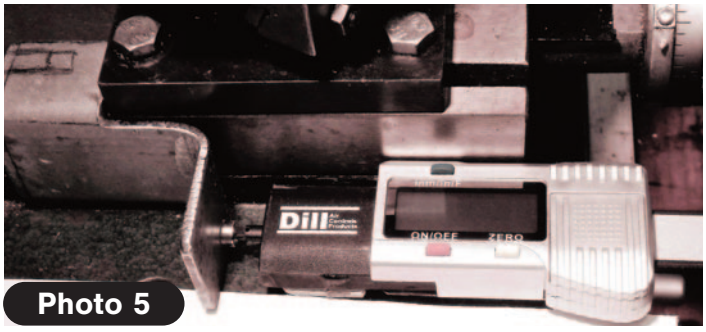

Photo 5

the magnet has a pull rating of 0.7 to 0.9 pounds .

Insert the completed fitting over the probe and hand drill through the plastic probe, using the previous cross drilled holes as a guide. Add a drop of cyanoacrylate to the probe fitting as well as to the pin that is thru the probe, and carefully align it axially.

Next, using a 1-inch piece of one-eighth inch flat bar stock, epoxy it to the bottom of the gauge where the magnet will be attached.

Last to be made is the bracket. A simple bracket attached via magnets is usually all that is needed (**Photo 4**). You may want to get a little fancier and attach the bracket to the cross slide using a tee nut and bolt (**Photo 5**).

The cost of the magnets and tire gauge was about $50.

Mike Martin shared photos of a similar setup he uses on his Taig Micro Lathe using their vertical slide for milling operations (**Photos 6&7**). He used

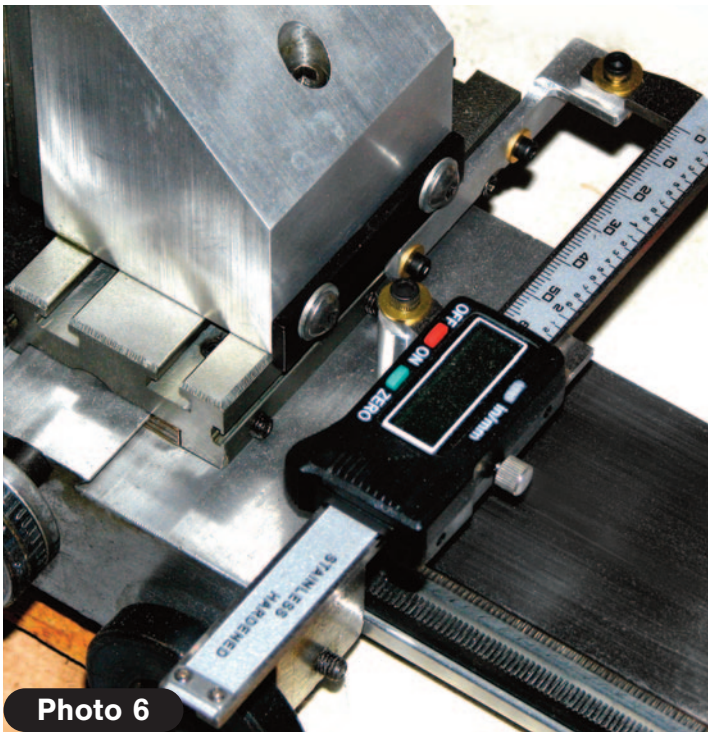

Photo 6

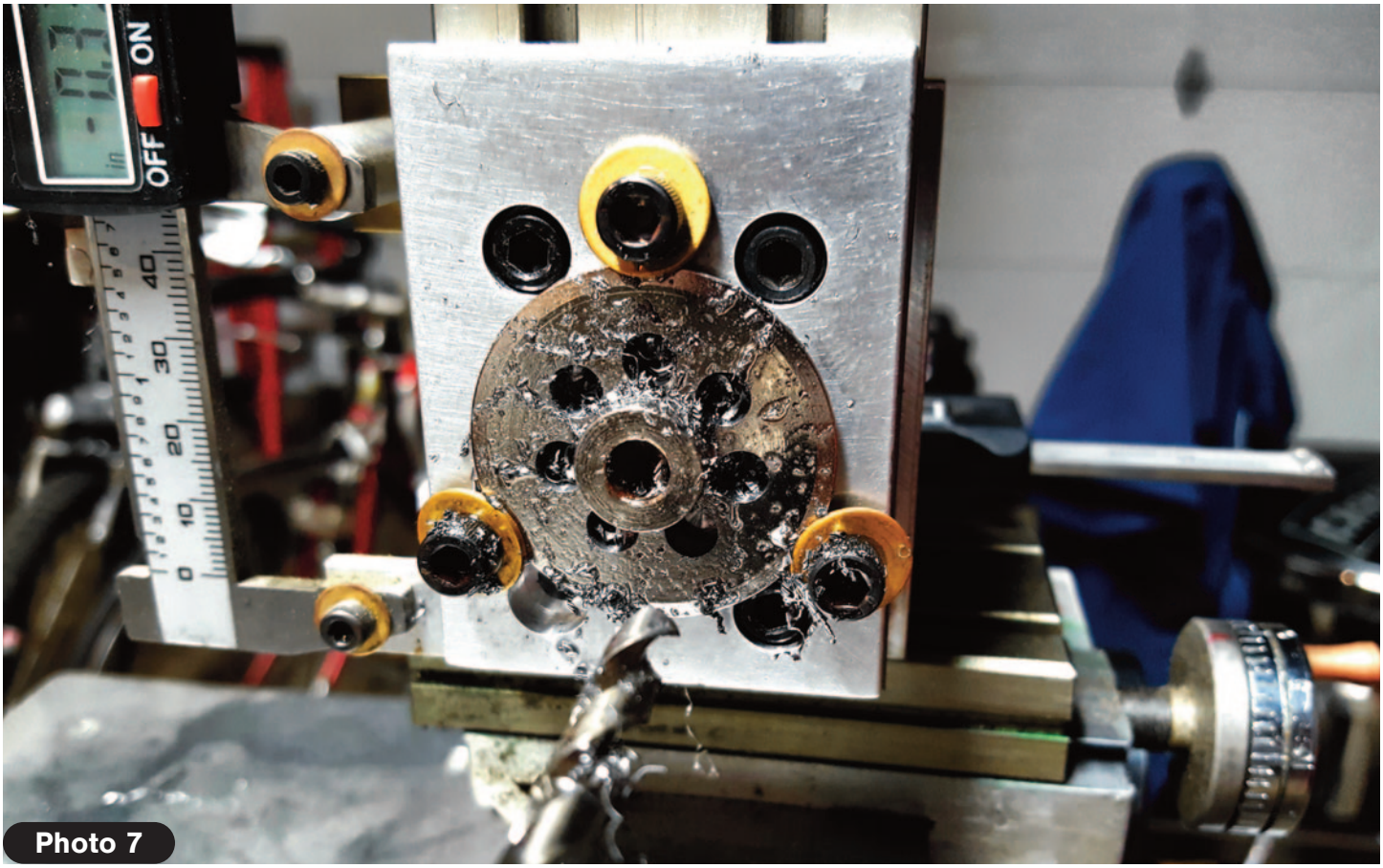

Photo 7

inexpensive 100mm travel digital calipers on the X and Y axes of his setup. The brackets and standoffs were made from aluminum and the calipers modified by removing the ID jaws and the depth probe. The modified Roundhouse wheel shown in **Photo 8** has a seven-hole pattern that was laid out in CAD to obtain the X-Y coordinates of each hole. The accurate hole pattern was easily added to the wheels by simply "dialing-in" the coordinates of each hole after zeroing the readouts on the center of the wheel.

The end results of these efforts are home-brew DROs that work well. They are of great help on all sorts of tasks done on the lathe or mill. The display can be reset to zero at any time or the tool (or workpiece) can be returned to the original starting point by backing it out.


Photo 8

If you do not have a scrap box and had to buy every item, the cost would still be only $75 to $80 versus $300 to $1800 for an off-the-shelf DRO setup. I did purchase a gauge with a round probe and drilled and tapped the fitting 00-80. I then used 00-80 grub screws to attach the fitting to the probe. Just do it slowly and carefully and it is not that hard.

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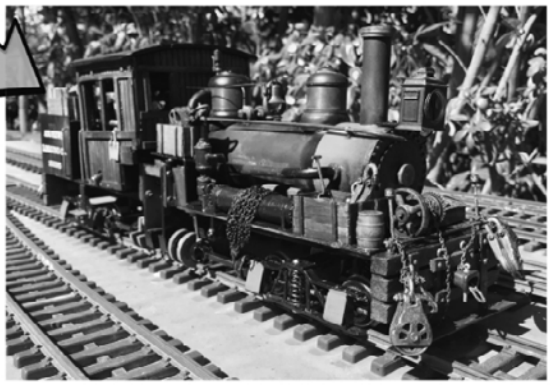

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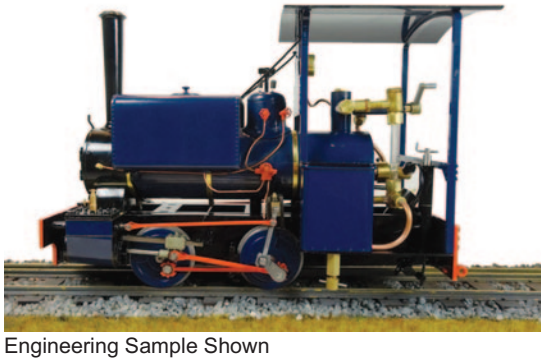

Engineering Sample Shown

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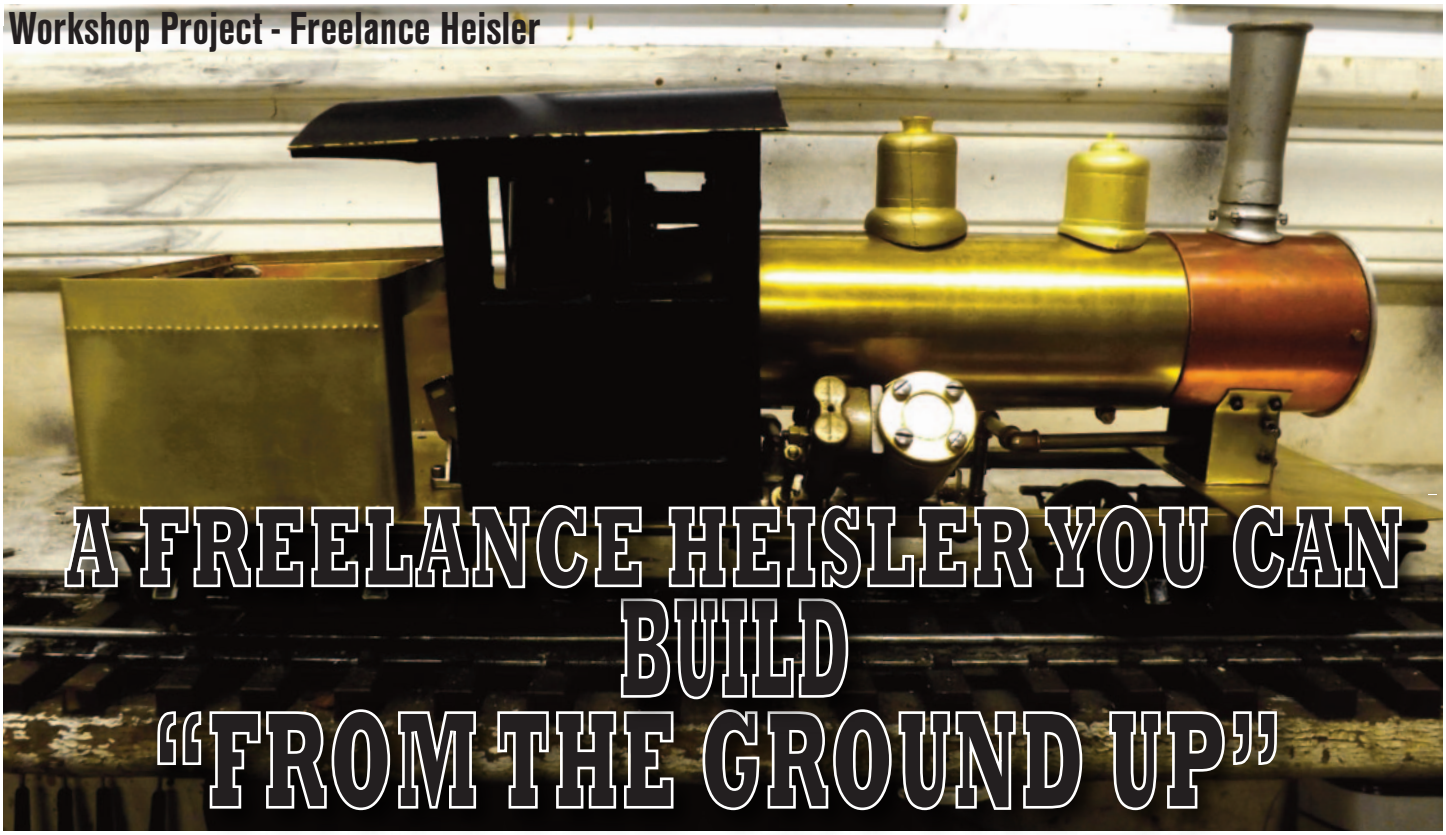


A FREELANCE HEISLER YOU CAN BUILD "FROM THE GROUND UP"

Part Three

Text, Drawings and Photos by
Les Knoll, P.E.

In this segment, I'll be going through building the Heisler engine kit and modifying it for locomotive use, building the universals to connect the driveshaft to the trucks, and installing the control system.

We'll start with the engine itself. The PM Research #8M engine is a two-cylinder V-twin configuration with a half-inch bore and three-quarter-inch stroke, with a cast bronze base, aluminum cylinders, Oilite bushings and 3/16-40 UST pipe fitting inlets and outlets that match up with the PM's line of plumbing components. A front view of the assembled engine mounted in the locomotive chassis is shown in **Photo 3-1**. Reading PM's literature on the engine, it is clear that it was produced for marine use, but its size and configuration make it a pretty decent fit for use in a G scale model of a Heisler locomotive. Certain modifications, none of them major, need to be made to make this marine engine suitable for locomotive use. It's "a fish out of water" but does quite well on the rails. The pilot Heisler locomotive chassis was run daily at Diamondhead 2019 and had no mechanical difficulties whatsoever. The locomotive pulled a mod-

Freelance Heisler Construction Series

Part 1 - Intro, trucks.
Part 1 Addendum - Machine-free trucks.
Part 2 - Building the frame.
➔ Part 3 - Assembling, modifying and mounting the PM Research engine.
Part 4 - Smokebox
Part 5 - Plumbing, Boiler modifications and steam testing
Part 6 - Cab and bunker, misc details and wrap-up.

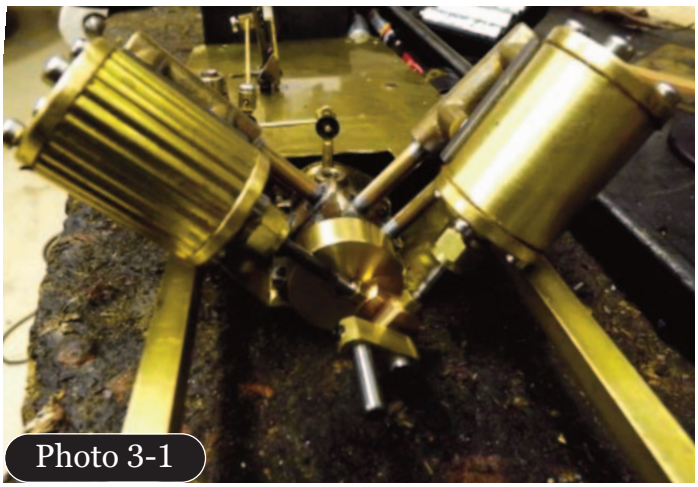


Photo 3-1

erate string of cars with no effort and had a very good looking exhaust plume to boot.

The PM Research #8M is advertised as a fully machined kit but needs a bit of fitting up to make it operational. It can be assembled on the workbench with hand tools and a drill press to open up some bores and modify some components. At the same time you order the PM 8M engine, it might be a good idea to obtain a 0.126-inch reamer (McMaster Carr 3087A31), a 0.1885-inch reamer (McMaster Carr 3087A32), and a 0.251-inch reamer (McMaster Carr 3087A33). You will most likely need each of them during the assembly. Having assembled two of these kits now I can say that the fit up issues appear to be consistent from kit to kit.

Drawing 3-1, labeled EN-0, shows the assembled engine, parts required for modification and modification instructions. Before modifying the engine for locomotive use, I built it up as originally designed to familiarize myself with it and make sure everything worked correctly. The instructions are clearly written, and if you refer to the exploded view as well as the descriptions in the bill of materials, there should be little difficulty recognizing what parts go where. Take special note of what length screws go where – some screw sizes are supplied in more than one length. Also note that there are two sizes of wavy springs. Don't mix them up. Also check which screws should use thread lock. Loctite Thread Locker Blue (#242) should work as a low strength thread locker and is recommended.

The PM instructions say to read them through before starting. Do that and read this article through before assembling, too. I would also recommend that you assemble the engine in a large baking sheet with raised sides to retain all parts. There are many small pieces, and you do not want any "Amelia Earhart" parts; the ones that vanish without a trace and are never seen again. I don't know about your workshop, but mine has its own Bermuda Triangle.

If you want to paint the engine, I suggest doing so before assembly, or at least after inserting the driveshaft bushings and a test fit of the major moving parts. After test fitting, disassemble and paint all parts loose. PM recommends using a good grade of primer, and I would use an etching primer available at auto supply stores.

For my own West Side project, I used Rustoleum High Heat Ultra paint for use on BBQ grills. Rustoleum recommends that a primer not be used with this paint, and I followed their instructions. I degreased the parts to be painted using acetone then immersed all but the base in full strength muriatic acid for a short period, then rinsed in water and dried before painting. For the base I brushed the acid on with a toothbrush until surfaces were shiny, then rinsed and dried. I wore rubber gloves all the time as evidenced by the fact that I still have 10 fingers. Paint the top and bottom cylinder covers (heads), base, flywheel and maybe the crank connectors. Do not paint such things as piston rods, the aluminum pistons, drive shafts, etc. Only the outsides of the cylinder heads are to be painted. You will be making replacement cylinder covers for the engine, and these would also look good painted. Be sure to mask the steam inlet and outlet and the oscillating valve plate surfaces on the base, the three lube access holes in the base and the flat for the control valve on the rear of the base before priming and painting. **Repeat: Do NOT paint the aluminum cylinders.** A small portion of these parts will be exposed after assembly and can be touched up.

The assembly issues I encountered are all the result of what appear to be undersized holes. The first step in the assembly requires a press fit of Oilite bearings in each end of the engine casting. This is normally straightforward and can be done with either some taps of a hammer or with a vise. The interference fit between the Oilite bushings and the engine casting was so great on the first kit I assembled that the pressing operation was difficult. The second kit had an easier press fit. This is likely due to variance in manufacturing tolerances. The assembly instructions do state that the bearings should be reamed to 0.1875-inch if necessary.

After the bearings are pressed in, there was an interference fit between the driveshaft and bearings. The driveshaft did not turn freely. A simple line reaming operation through both bearings (that's what 'line reaming' means – reaming through two or more pieces) with a 0.1885-inch oversize reamer and the driveshaft turned freely. An oversize reamer is used to prevent binding in case the driveshaft is exactly on size and to compensate for any misalignment. It is too bad that a reaming operation is required here. It is usual shop practice NOT to ream Oilites because doing so closes up the pores in the bearing walls that con-

tain lubricant, defeating the auto-lubrication properties of the bearings. Don't worry about the extra one-thousandths running fit you add by line reaming oversize, it's not like this engine is balanced to run at 8,000 RPM or anything. This is a slow running logging locomotive. There is probably no worry about the Oilite bushings, either, there are accessible lube ports in the engine base for lubricating the driveshaft bearings.

The end of the first paragraph of PM instructions says to assemble the crankshaft to the crank, which is also the flywheel. Again there is an interference fit between the hole in the crank/flywheel and the shaft that is to go through it. This is clearly unintended since there is a setscrew hole in the crank to secure the shaft once the crank is slid onto it. Again, the 0.1885-inch reamer to the rescue. After the reaming operation, the assembly was easy.

In the same paragraph there are instructions for locating the control valve onto the rear bearing, which has deliberately been left protruding one-eighth-inch expressly for this purpose. Again we run into interference problems. Either from tapping (more like pounding) or pressing the bearing into the tight interference fit in the engine base, or due to an undersized hole in the valve, in my first kit the valve would not begin to fit over the bushing. I measured the bore in the valve, and it was undersize. This valve is to run freely over a 0.250-inch shaft, or in this case, bushing. The bore must enable a running fit. I carefully filed the ends of the bushing in an effort to eliminate any 'mushrooming' that might have occurred at the end as a result of the force required to execute the press fit. In addition, I opened up the bore in the center of the valve with the 0.251-inch reamer, and the valve turned freely before introduction of the wave spring in the next step. A very small running clearance between the valve and the bushing it rides on is not a concern, since the valve is positioned by the considerably larger flat surface it presses against.

Instructions say to tighten the screws holding on the valve retainer plate, compressing enough to prevent leakage but still allowing adequate rotation of the valve. The plate in reality will be quite compressed against the valve, and the valve will turn with some resistance, which will diminish over time and with lubrication. It is important to minimize leakage between valve faces in oscillating engines because when running in steam, this is where a good deal of power is often lost. I have used other oscillators that were poor performers but came alive when I increased spring tension on both the reversing valve and the springs that hold the cylinders against the valve faces. The same will apply to this engine. Looking ahead to the future, you may want to loosen this spring tension just to the point where there is no steam leakage to make the reversing control easier. This is particularly true if you radio control the locomotive, since excessive force requirements could burn out a servo. Miniature servos are used in this application, and they only have so much torque. To make sure this would not be the case on the West Side project, I used a high torque servo which required drilling additional holes in the rear deck.

If you experience leakage in the reversing valve even with very tight spring pressure, the valve surface on the base may be a bit rough. This is fixed by making a 'doughnut' of 600 grit sandpaper, the outside diameter being the same as the diameter of the valve face and the inside quarter-inch to match the protruding bushing. Disassemble the reversing valve and place the sandpaper grit side on the valve face on the base. Take the rotary valve and press it against the sandpaper and base and turn it a number of revolutions to polish the valve surface on the base. Remove the rotary valve and sandpaper and carefully clean off any grit that may remain on the valve face. I had to do this on the second kit I built (for the West Side project) because there was evidence of some corrosion on the valve face. The 600 grit sandpaper cleaned this right up and the valve is steam tight.

A small sheet of paper 'gasket material' is provided and you are essentially on your own to cut gaskets to fit the cylinder heads. In Roundhouse kits, these are precision cut for you and all you have to do is install them. In this kit, you must reverse engineer the top and bottom cylinder heads (They're the same) to cut gaskets to fit. So little material is provided that if you make one mistake, there is no longer enough material for all four gaskets.

To help alleviate this, there is a full-sized template on EN-0 for all four gaskets that fits on the sheet of material that PM provides. To transfer this template to the gasket material, a good printer/copier is needed. Most that are used with


Photo 3-2

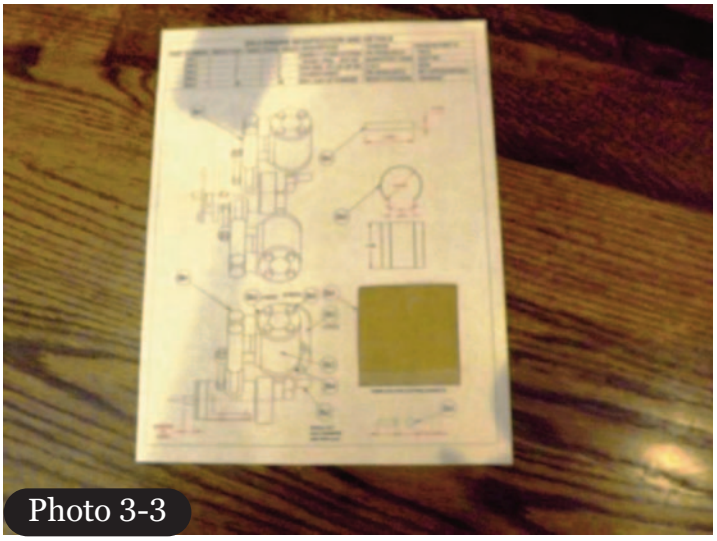


Photo 3-3


Photo 3-4

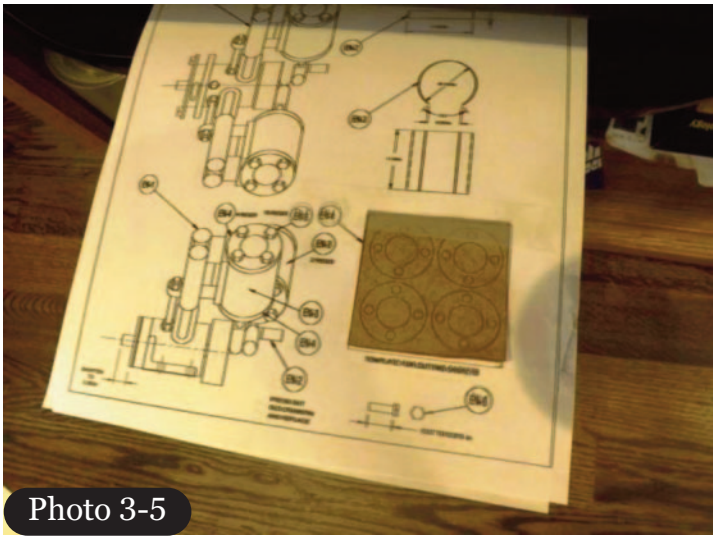


Photo 3-5

PC's today will be accurate enough for the task.

Place this magazine on your printer/copier flatbed and make a regular paper copy of the page with the gasket template on it (**Photo 3-2**). Do not remove the magazine from the copier, or even disturb it. Next take the gasket paper and carefully tape the edges to the template outline on the paper copy you just made. You might want to tape down the leading edge of the template (the edge that would go into the printer's paper feed first) all the way across. This minimizes potential paper jams (**Photo 3-3**). Next place the paper with the gasket material taped to it into your printer's paper feed so that the side with the gasket material taped to it gets printed (**Photo 3-4**). Make sure the paper is in the same orientation as the page in the magazine. Now copy the magazine page again, this time onto the paper with the gasket material taped to it. If everything lined up right, the gasket outlines are now on the material from which they are to be cut (**Photo 3-5**).

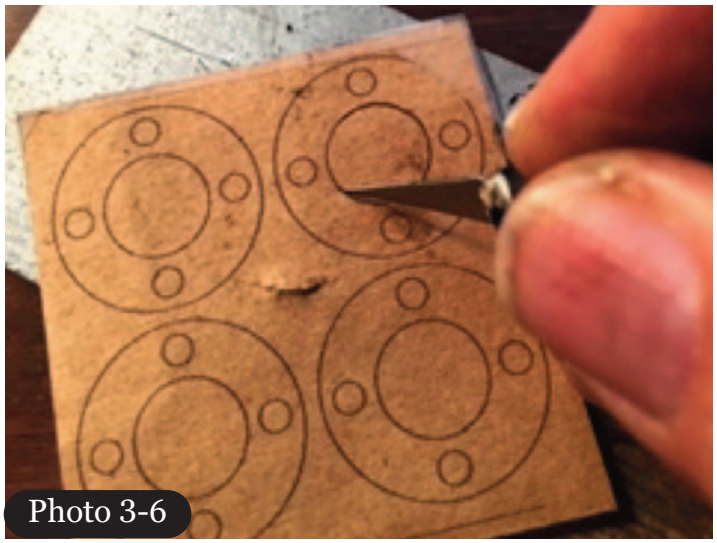


Photo 3-6

The cutting process is straightforward. Remove the gasket material from the paper sheet and put it onto a cutting board. Scrap wood does just fine. Using an Exacto knife with a #11 blade, carefully cut out the gasket outline (**Photo 3-6**). It's probably

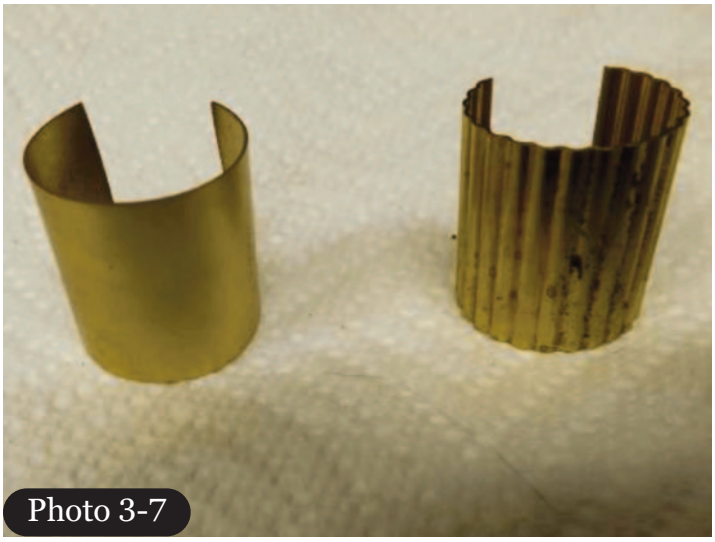


Photo 3-7

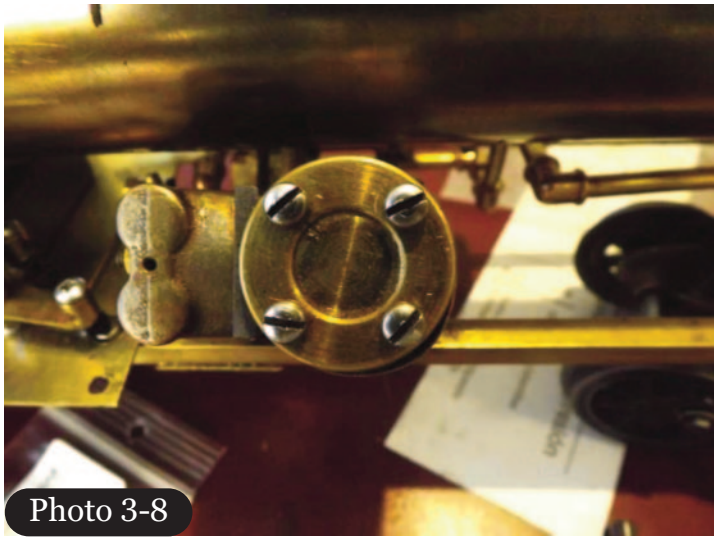


Photo 3-8

easier to start with the four small screw holes, then the half-inch hole for the cylinder bore, and finally the outer diameter of the gasket. That way you are working on the largest possible piece all the way up to the final cut.

If mistakes are made, additional gaskets can be cut from the thick paper used in grocery store bags. Use the thickest you can find, usually from the priciest grocery stores in your area. I have been using this material and transfer method on cylinder rebuilds for decades and the gaskets work just fine. I have made CAD drawings of the gaskets and print those instead of copying from a page, but otherwise the method is the same.

Before installing the paper gaskets, give them a good soaking in steam oil so that some oil is absorbed in the paper, then install them in the cylinders as per the instructions.

The final hurdle I ran into in assembling the engine came when assembling the piston rod into the cylinder bottom cap. Once again I ran into an interference fit. The piston rod should freely pass through the bottom cap. A quick pass with the 0.126-inch reamer fixed this. This clearance is not meant to be steam tight. There is an 'O' ring seal and tightening nut on the end of the cap that accomplishes the sealing.

The rest of the assembly went according to plan and no further problems were encountered.

The adjustment of the cylinder wave springs can be a bit tricky since there seems to be about a quarter turn-of-the-nut difference between good operation and enough friction to cause a seize-up. There are two nuts holding each spring down. One is the adjustment, the other is a lockdown. It is a good idea to have the engine under air when making these adjustments. Around 20 PSI should be enough. The nuts are 3-48, but a pair of 6BA wrenches will do the trick for adjustment. I tightened one nut on each cylinder (like the reversing valve, almost to full lock) and ran the engine via the reversing valve for just a second or two to test operation. The reason for the short operation is the oscillation motion will loosen an unlocked nut almost instantaneously. When you get good operation, firmly tighten both nuts with opposing wrenches being careful not to tighten or loosen the inner nut. They can be loosened and re-tightened if necessary, and you may find you will have to do this after a steam test. My second build ran fine under 20 PSI air, but I saw steam leakage when 40 PSI steam was applied. A re-tightening took care of that.

With everything assembled and adjusted, I mounted the engine in a vice and did a pressure test. A 3/16-inch-40 pipe nipple is provided to hook up to an air or steam supply. I put a few drops of steam oil down the pipe before putting on the air line, and used machine oil in the conveniently placed lube points in the engine base and at the top of the cylinders. The engine came alive with slightly over 20 PSI and after a short break-in period ran on even less pressure. Operation was uniform in forward and reverse. I found that on air, the full 45 degree valve rotation is not necessary for full speed. The same goes for steam. This will be useful to know for R/C operation. I had made a mockup frame and engine mount to prove out my design, the same chassis that was run at Diamondhead. The engine was first mounted into its recessed cra-

Photo 3-9

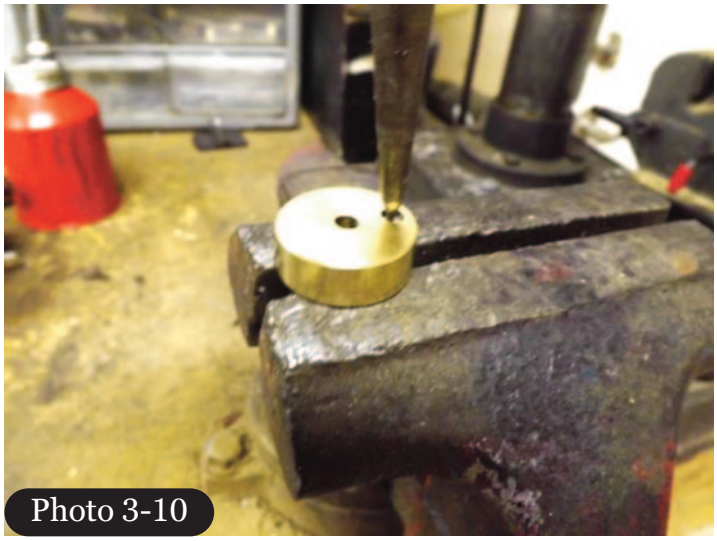


Photo 3-10

Photo 3-11

dle, the engine and cradle mounted to the mainframe and run for a while to break in. The reversing valve doubles nicely as a speed control in testing, although in actual operation a Roundhouse steam regulator will ultimately control steam flow to the engine.

The engine's cylinder castings are not 'round' as such. To make them look more like actual steam cylinders, PM provides corrugated cylinder covers which look out of place on a steam locomotive, so these have been replaced by duplicates made of 0.016-inch brass strip (K & S 8234) (**Photo 3-7**). The strip is cut to 1.125-inch width, then rolled around a half-inch dowel and straightened out until the 1-inch diameter is obtained. The length of the strip is oversize (3-inch), and is cut down in actual assembly to fit over the cylinder casting in the same way the covers supplied by PM did. **Photo 3-1** shows the comparison between the originally supplied covers and the plain cover. Which looks more prototypical?

Another touch that makes the cylinders look more like they belong on a locomotive is the substitution of the 5-40 cheese head screws on the cylinder heads with 5-40 stainless hex head bolts from Micro Fasteners. These come long and must be cut to the required three-eighth-inch length. You will be cutting 16 of them. **Photo 3-8** shows a cylinder head with the original cheese head screws and **Photo 3-9** shows the same cylinder head with the hex head bolts. This is optional; the engine runs just fine with the original screws, but looks cooler with the hex heads.

The biggest change that has to be made on the engine is to add a front output shaft since, unlike marine applications, power takeoff on a Heisler locomotive is from both front and rear. In order to accomplish this, the existing crankpin must be removed and be replaced with a longer one to which a front drive crank is attached.

The crank/flywheel was placed in a vise with the crank downward and the existing 3/16-inch crankpin knocked out from the back with a hammer and center punch (**Photo 3-10**). A one and 3/16-inch long pin was cut from a piece of 3/16-inch 12L14 carbon steel rod (McMaster Carr 5227T45–many others will do). Both ends were chamfered for ease of insertion in bores. The pin was pressed through the crank/flywheel by positioning the crank and pin in a vise as closely to 90 degrees to each other as possible (**Photo 3-11**), then slowly closing the vise, letting the pin 'find' its position in the crank/flywheel (**Photo 3-12**). Like other PM fits, this press fit is tight. Care was taken in the insertion of the pin not to bend it. The crank/flywheel was put back into the engine as-

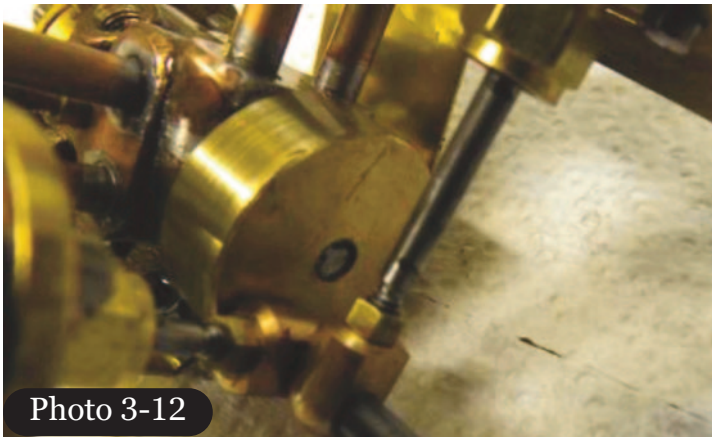


Photo 3-12

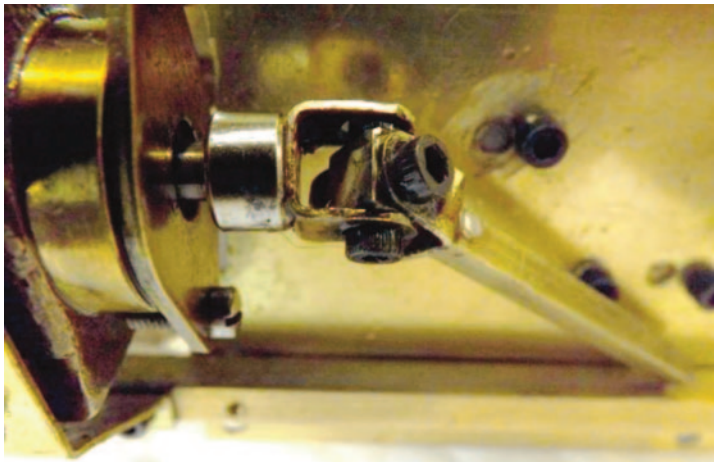


Photo 3-14

sembly and test run. The engine ran the same as with the original crankpin with no noticeable imbalance or crookedness of the pin. Note that with some steel rounds, the OD might run slightly oversize. You may want to bring this down by chucking the shaft in a drill press and running the drill press while wrapping the shaft in sandpaper. Start with a fairly rough grit and work down to 600 grit. (Don't forget to do both ends). This may save difficulty in the press fit with the crank/flywheel as well as having a good running fit with the crank connectors on the ends of the piston rods.

The front crank is a soldered assembly, shown as DR-20 on the Drivetrain Sub-Assemblies. It consists of a 3/16-inch collar and a bent brass fabrication. This part serves both as a front crank and a portion of the front universal drive. The two functions were combined into one because the distance from the front of the engine to the driveshaft of the front truck is short and the universal shaft should be as long as possible.

Solder the brass front crank to the collar as shown on DR-20 in the Drivetrain Sub-Assemblies, with the setscrew location at the top. Put this on the end

Photo 3-13

of the 3/16-inch crank on the engine and align the coupling portion as close to the crankshaft as possible, rotating the crankshaft (maybe with the engine under air) to check for alignment. This does not have to be perfect since the universals compensate for misalignment, but the closer the alignment is, the less the universals will have to work. Tighten down with the setscrew on the collar. The front crank is shown in the engine in **Photo 3-13**.

Modifications are completed by trimming the rear output shaft to about one quarter-inch to accommodate the shaft collar that contains the parts for the universals. The engine has now made its transformation from a marine engine to full-fledged locomotive power plant. When you mount the engine to your mainframe, it is a lot easier to have the engine mount MF-7 loose and mount the engine and spacers (MF-13 and MF-14) to it before bolting the engine and its mount to the mainframe. The screws that fasten the engine to the engine mount are more accessible that way.

The universals are made from 0.032-inch x quarter-inch brass strip, quarter-inch brass square, 5/32-inch brass tube, one-eighth-inch brass tube, and 16 very short 4-40 cap screws. There are seven identical fork assemblies (one additional is built into the front output crank) and four center joints, so there are a good number of repetitive parts to be made.

The holes in the forks for the universal pins can be put in either before or after bending the parts. Dimensions are provided for both methods. If the holes are put in prior to bending, some adjustment may have to be made prior to assembling the universals.

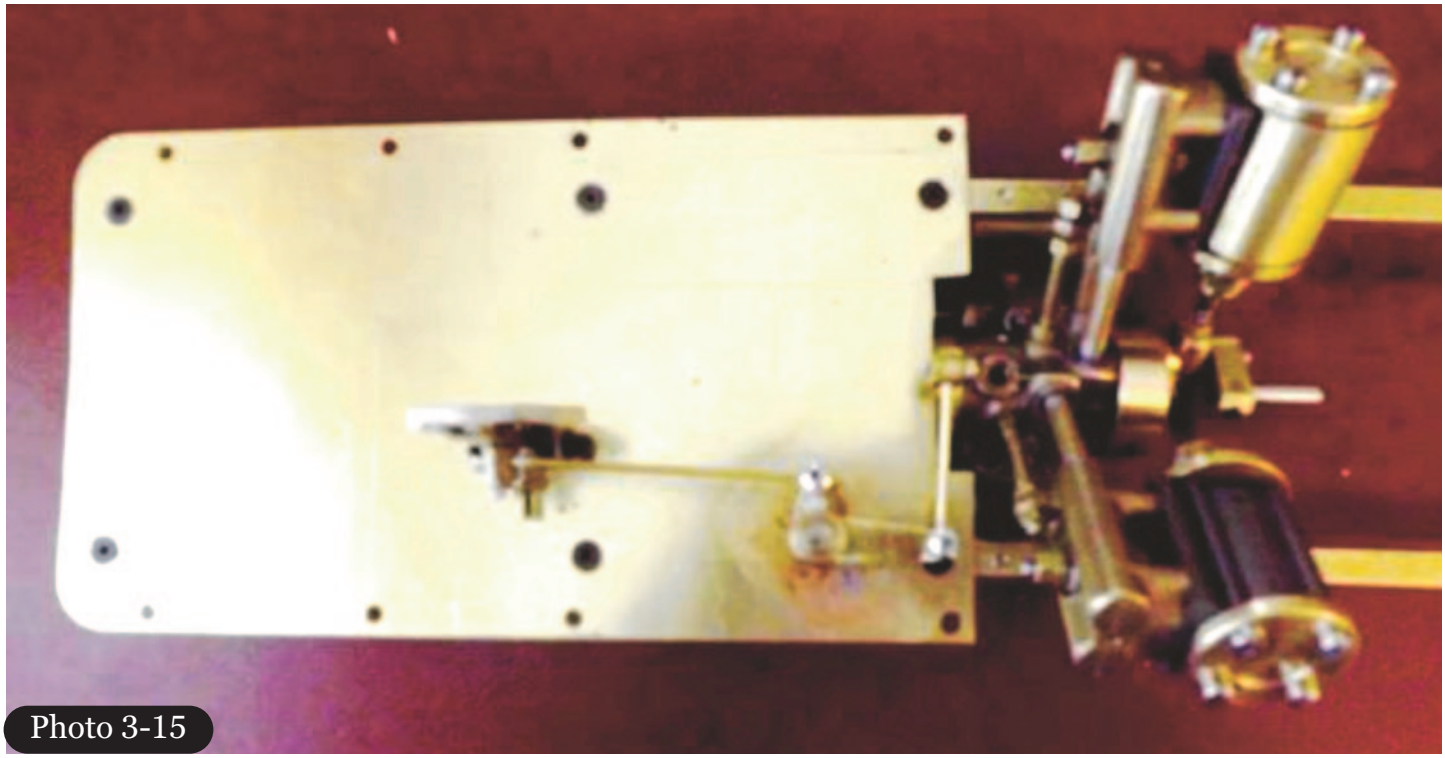


Photo 3-15

The universals are assembled as shown in **Drawing 3-4** labeled DR-0F (Front) and DR-0R (Rear) by attaching the sub-assemblies DR-20 (which may still be on the engine) thru DR-26 to pivot blocks DR-3, using cap screws DR-10 which act as universal drive pins. I have successfully used this construction for universals on my Shay and Climax and have run both locomotives for years without mechanical problems. This design represents an upsizing in drive components to make them more robust than on my previous geared locomotives. The rear universal is shown assembled to the engine in **Photo 3-14**.

If you have completed the trucks and mainframe, you should now be able to attach the universals to the engine and trucks and have a powered rolling chassis. With engine and drivetrain installed and connected, set the control lever of the PM engine reverser valve at the twelve o'-clock position and attach the 3/16-40 nipple supplied with the engine to the steam inlet. Attach the other end to a flexible air line and apply about 20 PSI of air to start. Crack the PM engine valve by turning clockwise, maybe 10-20 degrees to start. If all is in order, your chassis should come to life, running on either track or floor. I admit I stopped at this point for some time and just played with it! This moment was a long time coming.

The engine control linkage completes this segment. This turns out to be relatively simple but was a real head scratcher to figure how to get the engine's reversing valve with its 90 degree overall rotation and placed in the worst possible location for a locomotive application, to be actuated by a cab-mounted Johnson bar with the option of an R/C linkage. There were also a good number of boiler and firing components to duck around in the process.

The control linkage is based on bell crank linkage commonly used in R/C planes and cars and uses some of its components, which are commonly available at most hobby shops. The control linkage for manual operation is shown in **Photo 3-15**. The base for the bell crank unit was soldered in when the mainframe was constructed. This is a 3/16-inch shaft collar, into which is inserted a short length of 3/16-inch shafting used as a pivot for the bell crank. Construction of the bell crank is straightforward, soldering another 3/16-inch collar onto the bell crank constructed of brass strip. The crank is assembled onto the pivot shaft with no setscrew in its collar, and another collar placed on top of this and fastened with a setscrew as a keeper. Put the top collar on so that the bell crank can turn freely.

The rest of the linkage consists of Du Bro E-Z connectors and 1/16-inch steel shaft, installed as shown in the drawings and photos. Drill the hole at the top of the control lever of the PM engine reversing valve out to accept the 1/16-inch pivot pin

in the DU BRO E-Z connectors. The Roundhouse Johnson bar is bolted to the mainframe and the rod between it and the bell crank installed. Adjust all linkages so that when the Johnson bar is in neutral or twelve o'clock position, the long arm of the bell crank is parallel with the outside edge of the mainframe rear deck, and the control lever on the reversing valve is also in the twelve o'clock position.

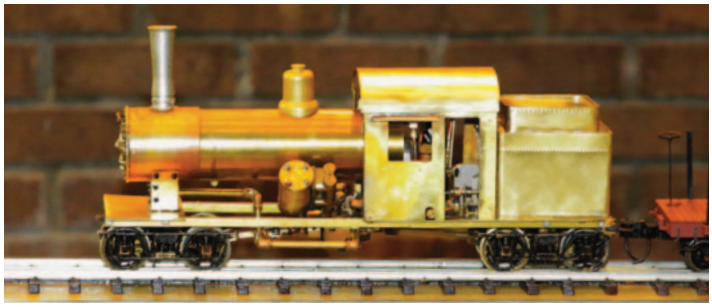
The chassis can be air tested again using the Johnson bar as both throttle and reverser. Pushing the bar forward will move the chassis forward. The further you push, the faster the chassis will travel. Pulling back will put the chassis into reverse, again with control of speed. With installation of the boiler, speed will be ultimately be controlled by the steam regulator or throttle.

It is possible to eliminate the manual Johnson bar and attach a longer control rod to an R/C servo in the bunker of the locomotive for a single-channel R/C setup. When running under steam, maximum speed will be set by the regulator or throttle, the same as in manual operation, but speed can be varied up to that maximum point and the locomotive be reversed through the single R/C servo.

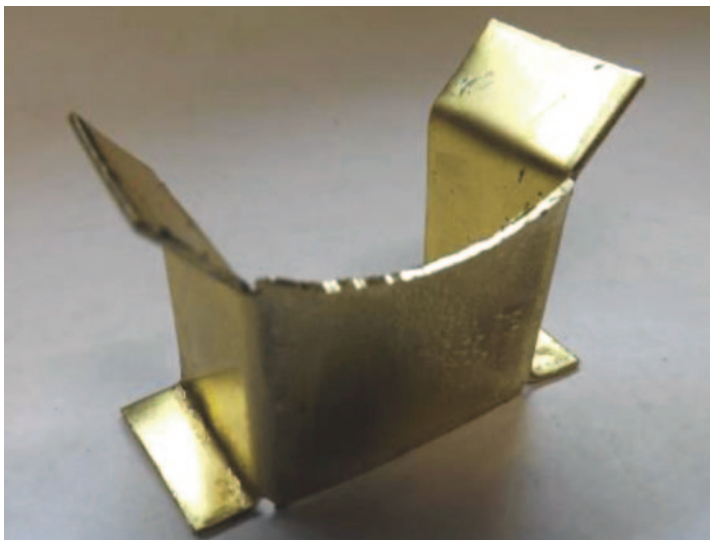
The R/C control system is based around either the HI-Tec HS 82MG or optional HS 645MG servo. The HS 82MG is less costly, but the HS 645MG has considerably more torque. The reverser valve linkage takes a significant amount of force to actuate, especially if the valve spring is tightly compressed. It was found with continuous running at Diamondhead that the HS 82MG ran hot on occasion, so I substituted the HS 645MG in my West Side project. If you choose the HS 645MG, you will have to drill the rear deck to suit. Both servos mount in the same manner. Assembly details for manual control, R/C with the HS 82MG or R/C with the optional HS 645MG are shown in CS-0 Control Systems Assembly with details on Control Systems Details Page 1.

The choice of R/C receiver and battery is left to the modeler since there are a number of good options available. I personally prefer the Spektrum series transmitters and receivers. Their AR410 4 channel receiver, available for under $30, works well for this application, is extremely compact, and has no need for an antenna. Radioshack.com sells AA and AAA battery packs easily adapted to this application, and the locomotive's bunker was designed to accept them.

PDF files of all drawings and the materials list are available for free to registered users online at: *https://www.steamup.com* under the Workshop Plans Menu that will appear after logging in to the site.



Coming in the Next Issue

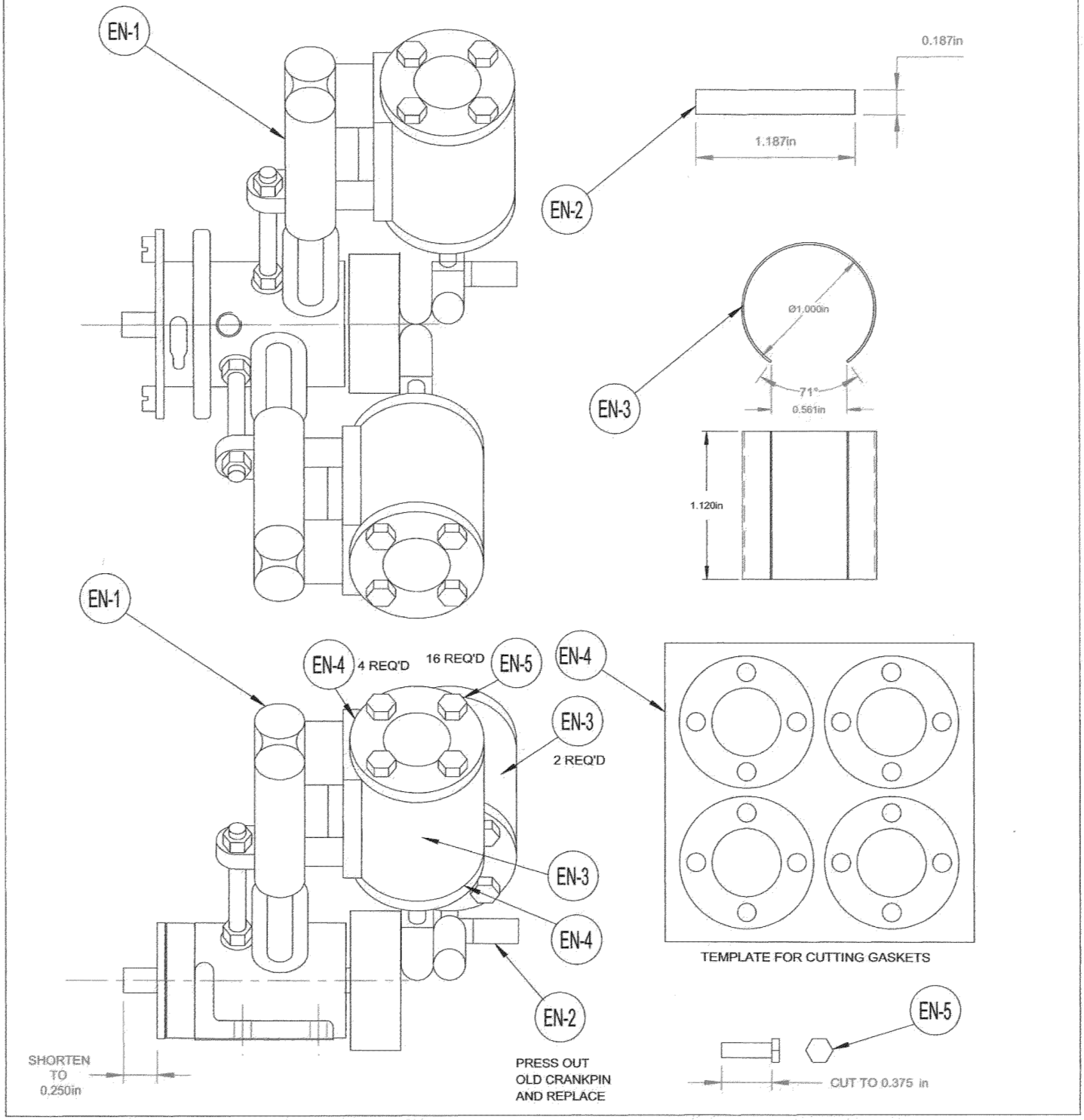


In Part Four of this series we will build the smokebox and saddle in preparation for the the boiler installation.

See you next issue!

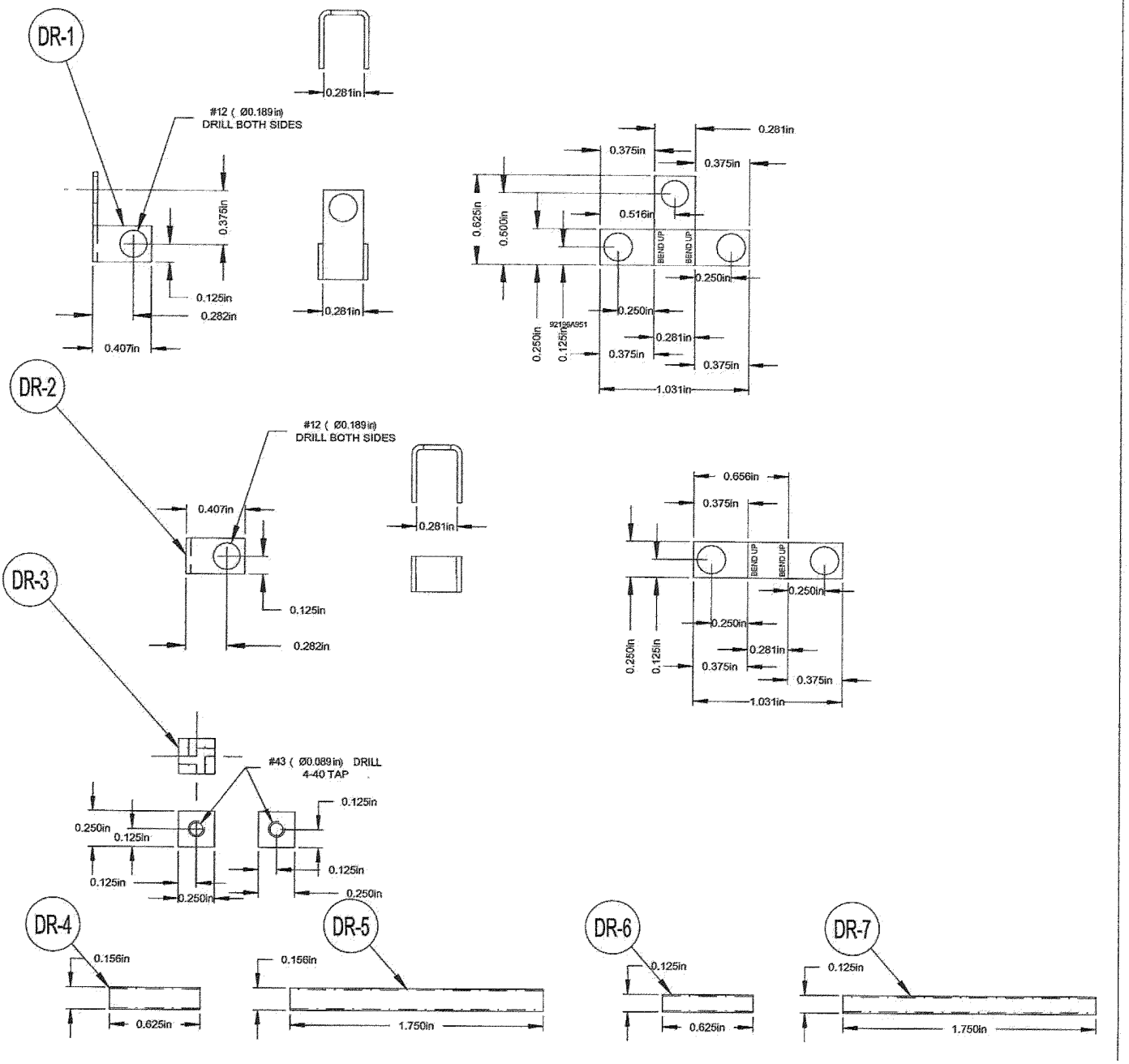
EN-0 ENGINE MODIFICATION AND DETAILS

PART NUMBER	REQ'D FOR 1 ASSY	TOTAL REQ'D	DESCRIPTION	VENDOR	VENDOR PART #
EN-1	1	1	ENGINE-V-2 1/2" BORE 3/4" STROKE	PM RESEARCH	PM-8
EN-2	1	1	ROUND, STEEL, .1875" DIA	McMASTER CARR	5227T45
EN-3	2	2	STRIP, BRASS, .016" x 2.00, 3.00" LONG	K & S	8234
EN-4	1	4	CYLINDER GASKET	PM RESEARCH	MAT'L SUPPLIED WITH ENG-1
EN-5	16	16	BOLT, 5-40 x 1/2" STAINLESS	MICRO FASTENERS	HBS0508



Drawing 3-1

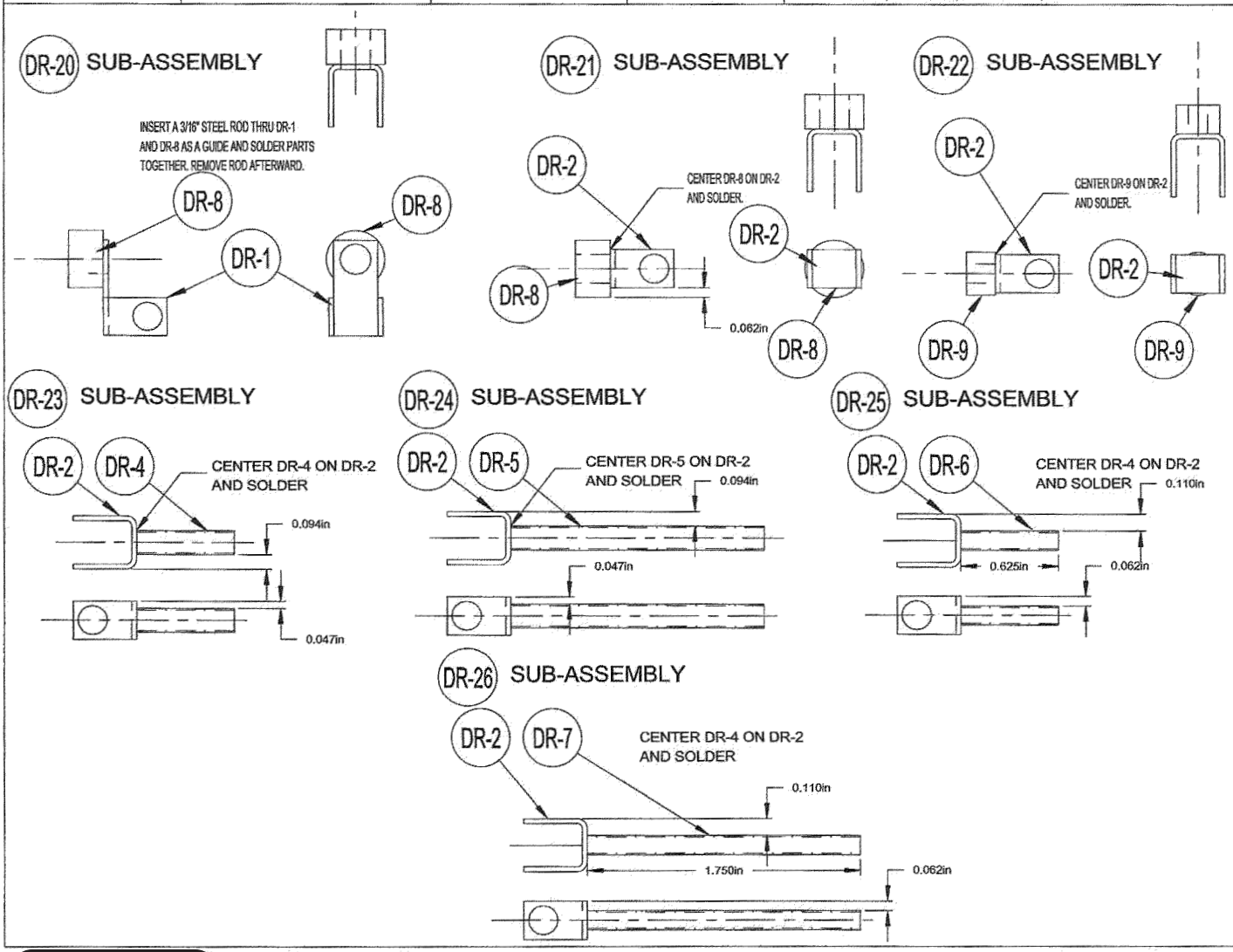
DRIVE TRAIN DETAILS PAGE 1				
PART NUMBER	REQUIRED	DESCRIPTION	VENDOR	VENDOR PART #
DR-1	1	STRIP, BRASS, .032" x 2.00"	K & S	8244
DR-2	7	STRIP, BRASS, .032" x .1/4"	K & S	8240
DR-3	4	360 BRASS BAR 1/4" x 1/4"	McMASTER CARR	8954K13
DR-4	2	TUBE, BRASS, SQUARE 5/32"	K & S	8152
DR-5	2	TUBE, BRASS, SQUARE, 5/32"	K & S	8152
DR-6	2	TUBE, BRASS, SQUARE, 1/8"	K & S	8151
DR-7	2	TUBE, BRASS, SQUARE, 1/8"	K & S	8151
DR-8	2	COLLAR, 3/16"	DU-BRO	141
DR-9	2	COLLAR, 1/8"	DU-BRO	139
DR-10	16	SOCKET HEAD CAP SCREW, 4-40 x .0625"	McMASTER CARR	92196A951



Drawing 3-2

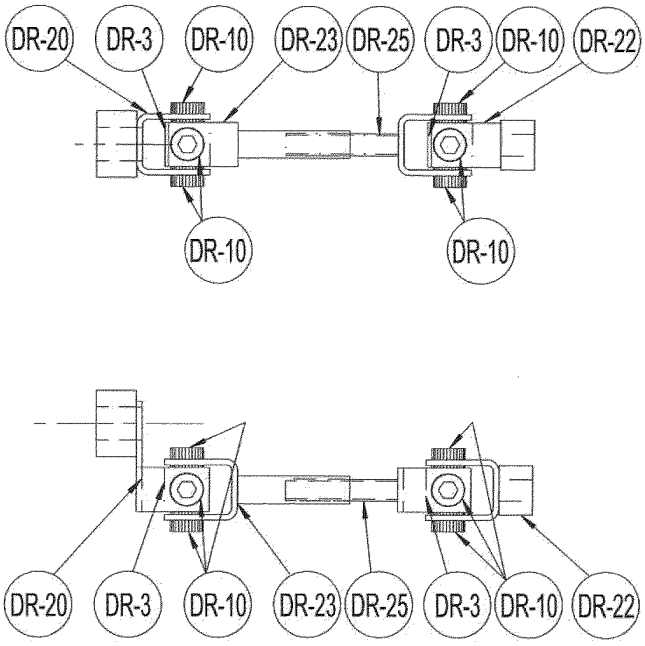
DRIVE TRAIN SUB-ASSEMBLIES PAGE 1

ASSEMBLY NO.	REQUIRED NO. OF ASSEMBLIES	REQUIRED EACH ASSY.	PART NO.	DESCRIPTION
DR-20	1	MADE FROM		
		1	DR-1	STRIP, BRASS, .032" x 2.00"
		1	DR-8	COLLAR, 3/16"
DR-21	1	MADE FROM		
		1	DR-2	STRIP, BRASS, .032" x 1/4"
		1	DR-8	COLLAR, 3/16"
DR-22	2	MADE FROM		
		1	DR-2	STRIP, BRASS, .032" x 1/4"
		1	DR-9	COLLAR, 1/8"
DR-23	1	MADE FROM		
		1	DR-2	STRIP, BRASS, .032" x 1/4"
		1	DR-4	TUBE, BRASS, SQUARE 5/32"
DR-24	1	MADE FROM		
		1	DR-2	STRIP, BRASS, .032" x 1/4"
		1	DR-5	TUBE, BRASS, SQUARE, 5/32"
DR-25	1	MADE FROM		
		1	DR-2	STRIP, BRASS, .032" x 1/4"
		1	DR-6	TUBE, BRASS, SQUARE, 1/8"
DR-26	1	MADE FROM		
		1	DR-2	STRIP, BRASS, .032" x 1/4"
		1	DR-7	TUBE, BRASS, SQUARE, 1/8"

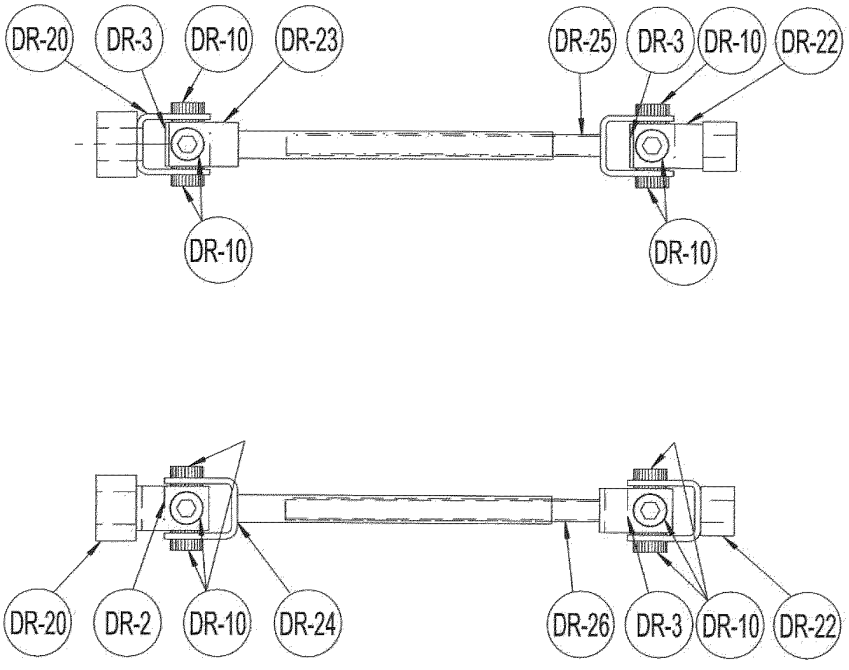


Drawing 3-3

DR-0F DRIVE TRAIN FRONT UNIVERSAL ASSEMBLY



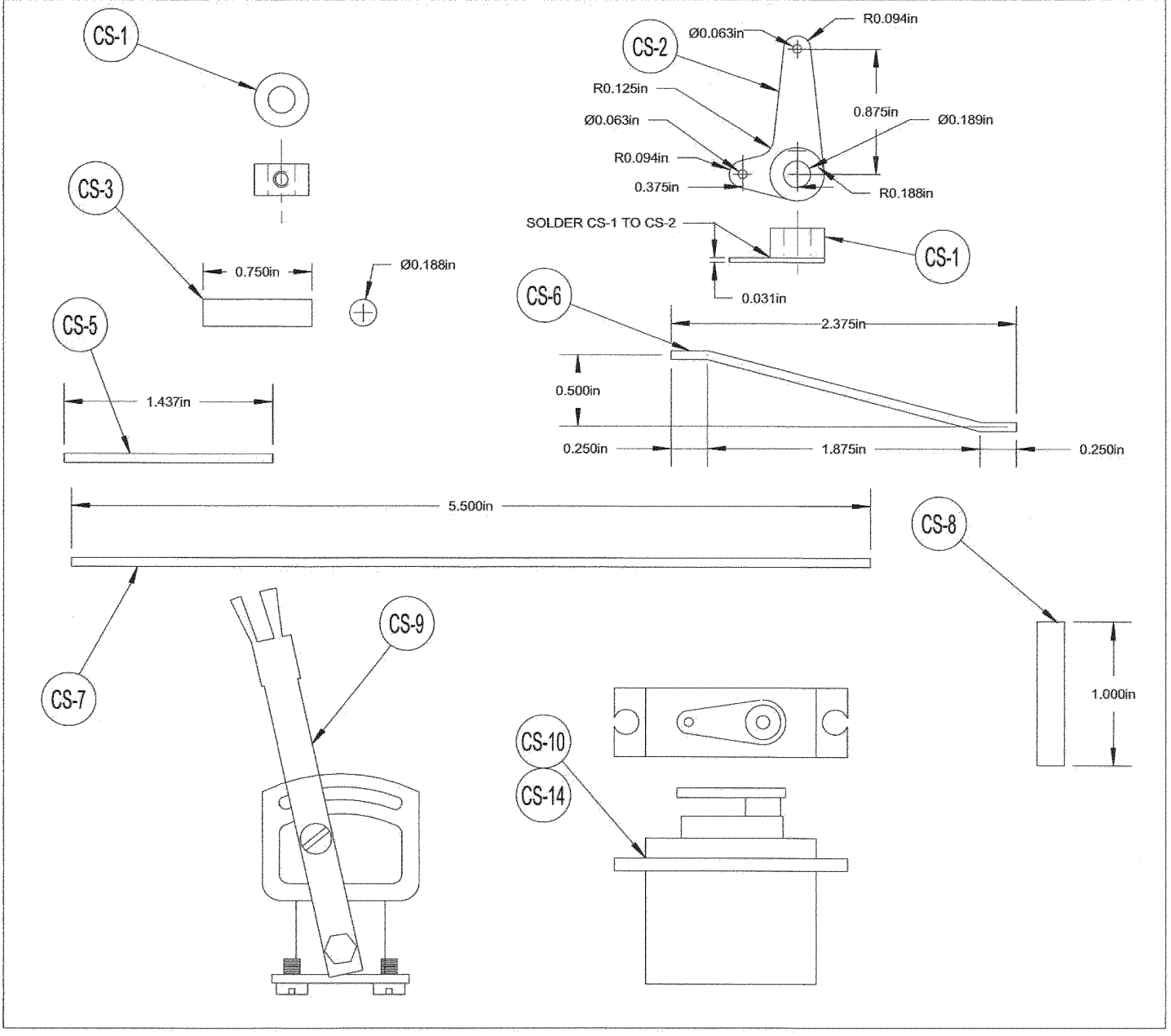
DR-0R DRIVE TRAIN REAR UNIVERSAL ASSEMBLY



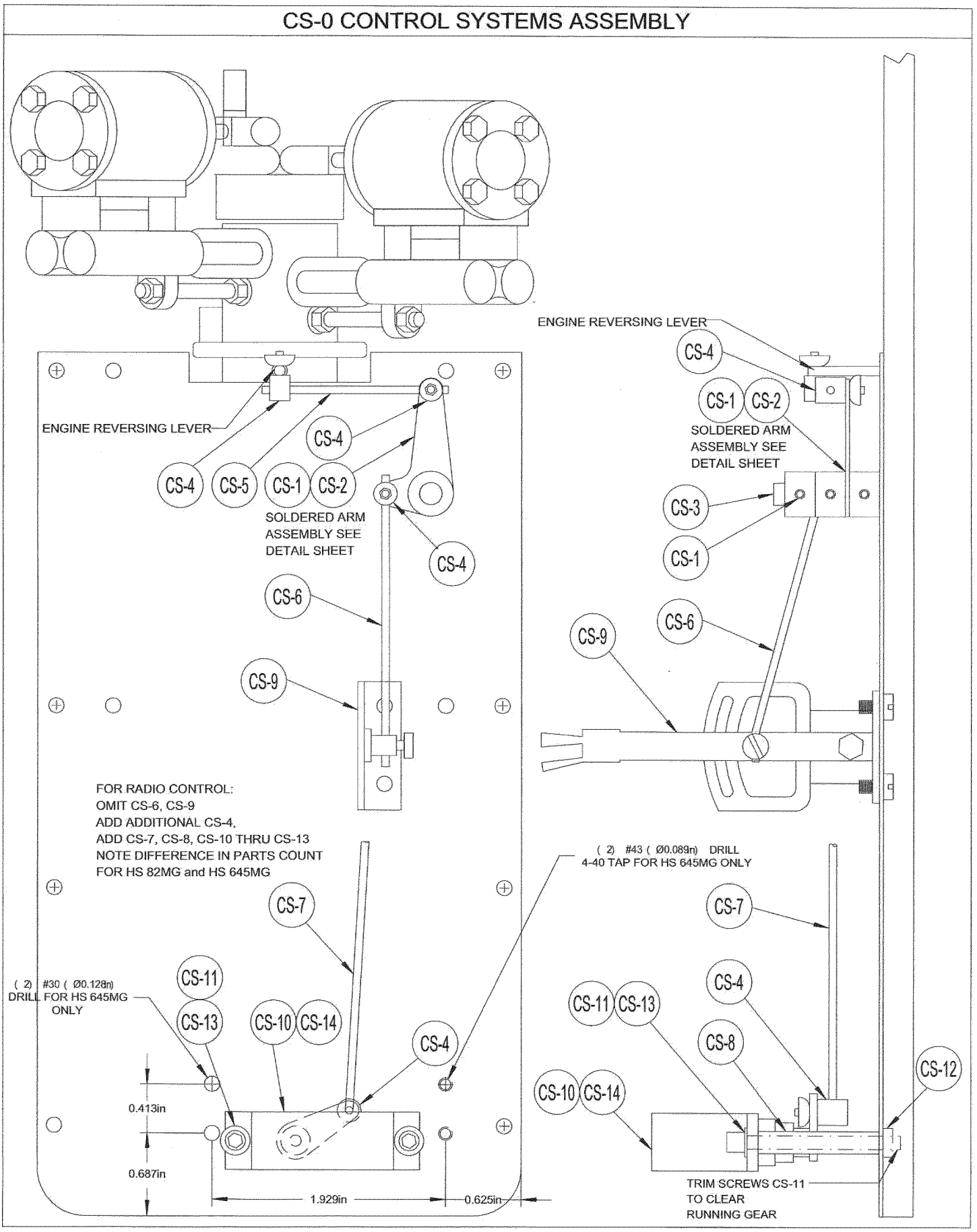
Drawing 3-4

CONTROL SYSTEMS DETAILS PAGE 1

PART NUMBER	MANUAL	R/C HS 82MG	R/C HS 645MG	DESCRIPTION	VENDOR	VENDOR PART #
CS-1	2	2	2	COLLAR, 3/16"	DU-BRO	141
CS-2	1	1	1	.032" BRASS STRIP 1.00" x 12.00"	K & S	8242
CS-3	1	1	1	ROUND, BRASS, .1875" DIA	K & S	8166
CS4	4	4	4	DU-BRO EASY CONNECTS	DU-BRO	121 (1 PAC)
CS-5	1	1	1	.062" STEEL ROD	K & S	87131
CS-6	1			.062" STEEL ROD	K & S	87131
CS-7		1	1	.062" STEEL ROD	K & S	87131
CS-8		2	4	TUBE, BRASS, 3/16" SQUARE	K & S	8153
CS-9	1			REVERSING LEVER	ROUNDHOUSE ENGINEERING	RL
CS-10		1		SERVO, MINIATURE	HI-TEC	HS 82MG
CS11		2	4	SCREW, SOCKET HEAD 4-40 x 1.50	DU BRO	314
CS-12		2	2	NUT, 4-40	DU BRO	170
CS-13		2	4	WASHER, #4	DU BRO	3109
CS-14			1	SERVO, HIGH TORQUE	HI-TEC	HS 645MG



Drawing 3-5


CS-0 CONTROL SYSTEMS ASSEMBLY
ENGINE REVERSING LEVER
CS-4
CS-5
CS-1
CS-2
SOLDERED ARM
ASSEMBLY SEE
DETAIL SHEET
CS-4
CS-6
CS-9
FOR RADIO CONTROL:
OMIT CS-6, CS-9
ADD ADDITIONAL CS-4,
ADD CS-7, CS-8, CS-10 THRU CS-13
NOTE DIFFERENCE IN PARTS COUNT
FOR HS 82MG and HS 645MG
(2) #30 (Ø0.128n)
DRILL FOR HS 645MG
ONLY
CS-11
CS-13
CS-10
CS-14
CS-7
CS-4
0.413in
0.687in
1.929in
0.625in
ENGINE REVERSING LEVER
CS-4
CS-1
CS-2
SOLDERED ARM
ASSEMBLY SEE
DETAIL SHEET
CS-3
CS-1
CS-6
CS-9
(2) #43 (Ø0.089n) DRILL
4-40 TAP FOR HS 645MG ONLY
CS-7
CS-4
CS-11
CS-13
CS-8
CS-12
CS-10
CS-14
TRIM SCREWS CS-11
TO CLEAR
RUNNING GEAR

Drawing 3-6

THE CUPOLA VIEW

Merging Print and Tech

You may notice that something which has been in the magazine on our Table of Contents page since 2011, is now part of an article. I'm talking about QR Codes. QR stands for Quick Response and is a technical development that began back in 1994 originally for the automotive industry. Basically a different type of bar code that we've all become accustomed to on our groceries, magazines, and mail, this QR code will allow you to link from the magazine to content enhancing video that makes your reading experience come alive. In the past we have published links to YouTube videos in text form that look something like this:

https://youtu.be/DMbBpPvv6u8.

Well that's a bit much to type in; it is also case sensitive, and you can't very well cut and paste from a paper magazine to your computer, so scanning the code with an app on your smart phone will complete that interface and you will immediately be taken to a supporting video. You can download a QR Reader app from your provider's application store. By the way, that funny line of code shown above is in fact the link to this month's featured video for Rob Kuhlman's review on the Merlin Avonside. I know not everybody embraces new technology, but these ubiquitous codes have now been a part of our culture for almost a quarter of a century, and in the magazine for the past seven years as a link to our website. Hopefully you will find this an enhancement to your reader experience and make getting to content enhancing videos a bit easier.

Cheers, and Happy Steaming — *Scott*

'Cupola view' is written by Editor Scott E. McDonald: you can contact him at sitgeditor@gmail.com or P.O. Box 1539, Lorton, VA 22199.

TIMETABLE

Special or Annual Meets

Third Annual Gathering of North American Members of the Association of 16mm Narrow Gauge Modellers - May 23-27, 2019. Hamilton Museum of Steam and Technology, Hamilton, Ontario, CANADA. Visit *www.northamerican16mmmodellers.org* for more information.

National Summer Steamup 2019 - July 10-14, 2019. McClellan Conference Center, McClellan, California. Visit *www.steam-events.org* for more information.

Staver Locomotive Fall Steamup - September 19-22, 2019. Staver Locomotive, Portland, Oregon. Visit *www.staverlocomotive.com* for latest information.

International Small Scale Steam Steamup. January 20-26, 2020. 103 Live Oak Drive, Diamondhead, Mississippi. Visit *www.diamondhead.org* for more information.

Regular steamups

Crescent City High Iron. Steamups as necessary on an elevated backyard layout on Northern California's upper coast. Info: Don Cure, diamondd1947@msn.com.

Greater Baton Rouge Model Railroad Club Open House and Gauge One Steamup. Info: Ted Powell, (225) 236-2718 (cell), (225) 654-3615 (home), *powell876@hotmail.com*.

On the Brink Live Steamers. Wednesday, and occasional weekend, greater Sacramento, Calif., steamups on elevated live-steam tracks at two locations, as well as special events. Info: Paul Brink, (916) 935-1559, *paulbr@aol.com*.

Puget Sound Garden Railway Society. Two steamups per month, one at the Johnsons' on the second Saturday and a steamup at a member's track on the fourth Saturday.
Info: *http://psgrs.org/* or call Pete Comley at (253) 862-6748.

Southern California Steamers. Contact Jim Gabelich for dates, places and other pertinent information. (310) 373-3096. *jfgabelich@msn.com*

Spring Steamups

Portland, Oregon - Larry Staver of Staver Locomotive hosts a couple of steamups each year. His Spring Steamup held over the last weekend of April brought in steamers from many states to operate on his indoor-outdoor railway.

Left - Steamup host Larry Staver checks on the progress of his Bowande-Wuhu Decapod.
Mike Martin Photo

Right - Mike Martin (left) and Adrian Sherrill (right) operating on a portable track supplied by Puget Sound Garden Railway Society Live Steam Special Interest Group. The additional track ensures that there are plenty of steamup options for the attendees.
Kevin Schindler Photo

Below Left - Steve Shyvers checking the steam pressure on his Aster "Jumbo" before heading out onto the mainline.
Mike Martin Photo.

Above Right - An Accucraft Rio Grande Narrow Gauge C-21, which has been converted to coal by Rob Lenicheck, prepares to cross a bridge on the outside portion of the railway

Kevin Schindler Photo

More to come for the Staver Spring Steamup in a future issue.

Palos Verdes Estates, California - Jim Gabelich hosts a Wednesday Water Boil Club. He refers to it as a "Perfect club. No officers, No dues, No roll call, just fun".

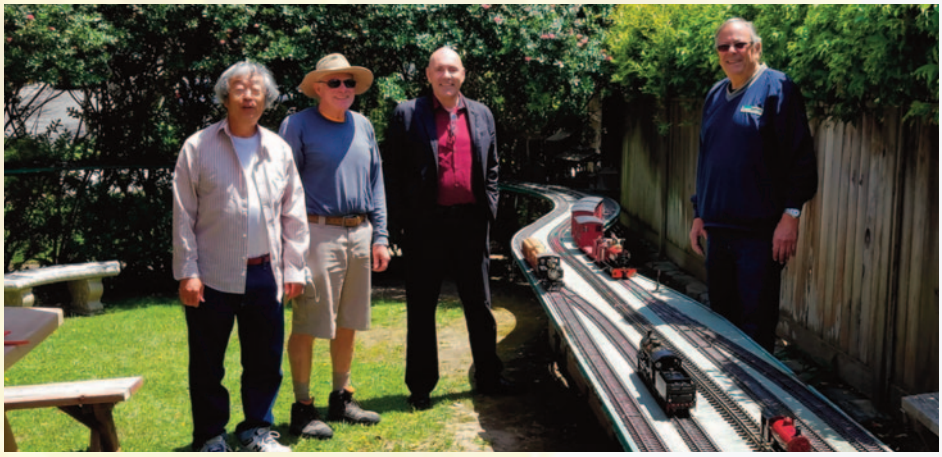


Photo to right by Jim Gabelich
Photos below by Mike Martin

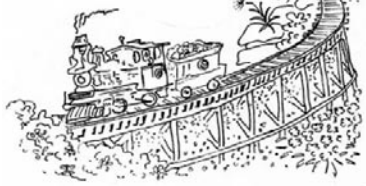
In attendance for the first boil of May was (*above photo L-R*) Dorian Nakamoto running an Aster K.P.E.V. P8, Tom Woolson with a superb running Ruby, Mike Martin taking pictures, John Polen running a beautiful clock work loco.

Regular attendees missing for this running were Sonny Wizelman, Bill Wilbanks, Cliff Lusher, Brian Beckham, Rick Parker, John "Buzz" Barry, and Greg Dahlem.

Right - Host Jim Gabelich tends to his 7/8ths Accucraft Hunslet with coaches by Dave Frediani before bringing it out onto the mainline.

Below - Even in the shade this locomotive sparkles with its polished brass and bright crimson livery. Jim's 7/8ths Hunslet makes for a stunning picture on a beautiful Spring day.

Have you hosted or attended a steamup recently? Send us your photos for inclusion in our **Steam Scene** pictorials. The world is waiting to see your fun!



CONTRIBUTOR BIOS

The magazine couldn't exist if it were not for the dedicated individuals who take time from the hobby to chronicle their endeavors, interests, and joy of live steam. If you get a chance to meet any of our contributors at a steamup, please thank them for their contribution.

Bill Allen - Bill lives in Woodside, California and first became interested in live steam in 2008 when he saw Richard Murray's layout at a BAGRS open house. He proceeded to buy a Ruby, C16 and Forney before deciding to start building his own. He bought a mill and lathe and with the help of some BAGRS members learned to use them and was soon making chips. Since then he has completed 20 projects, some of which have been featured in Steam in the Garden, and currently has a multi part article running in Live Steam. All of his builds are one-of-a-kind, as he only builds those which have never been done before and probably will never be done again in G gauge live steam. Bill's prior hobby was building fine furniture and he uses some of those skills and tools in his engine building.

Jim Gabelich - On Christmas Day 1952 Jim received an alcohol fired Stationary Steam Engine and was hooked. At the time, the only locomotives he knew about were those he remembered as a kid at the port of San Pedro switching freight cars in the 40's and 50's. Fast forward to 1998 when he saw an advertisement in a model train magazine about a Steamup in Pleasanton Ca. So Jim and his wife obtained reservations at the hotel for those dates and just showed up. Who knew about event registration? Jim's wife bought him a Roundhouse Sammie and as they say, the rest is history. After retiring as a pharmacist in 2008 Jim bought a Sherline lathe and mill to aid in making small replacement parts for old engines, both stationary and wheeled. Jim and his wife have lived in Palos Verdes Estates, California for the last 35 years.

Les Knoll - Les started his railroading experience with a Lionel F7 freight set at Christmas at age six. This grew to a tabletop layout in the family basement, later to be supplanted by a theater pipe organ and a rock band practice space in his teens. Later in life the HO/HOn3 bug bit, and the first incarnations of his Rivendell & Midland Railroad, one of the first JRR Tolkien-based railroads in the US, took shape. The R & M moved outdoors with his discovery of live steam in the early 90's, and after two purchased locomotives, five scratchbuilt live steamers followed, ranging from a 14-ton Shay to a 2-4-4-2 logging Mallet. The current Rivendell & Midland is in the back yard of Les's and wife Ruth's lake home in North Carolina. Les is a retired Forensic Engineer and a Registered Professional Mechanical Engineer.

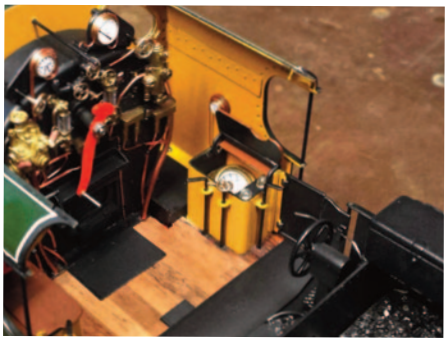
Rob Kuhlman - Rob is a retired geologist who lives in southeastern Pennsylvania. He began modeling trains with HO during the adolescent years, moved up to quarter-inch scale during the '80s and '90s, and then discovered live steam with the earliest issues of SitG. The years spent in 0 scale pointed him to SM32 and the use of many 0 scale raw materials in those early days when commercial products were scarce. Though SM32 remains his primary interest, he also steams early 0 gauge tinplate and has recently been flirting with British mainline live steam in Gauge One. For the last 20-plus years he has produced the electronic bimonthly 32mm/0 Gauge Newsletter.

Joe Rothwell - Joe started building models as far back as he can remember, mostly due to having an older brother. He would simply follow his brother's lead. Plastic kits gave way to balsa/tissue planes. U-control planes gave way to R/C planes. The family always had a train set; O scale at first (both wind-up and electric), then HO and ending with N scale. Joe now has a 4-foot x 6-foot table top N scale layout, running mostly NYC equipment. Steam interest was rather late — he purchased his first engine in 2006. Joe finds the hobby very satisfying and still looks forward to working on the various projects he has lined up. In real life Joe is a land surveyor in order to foot the bills.

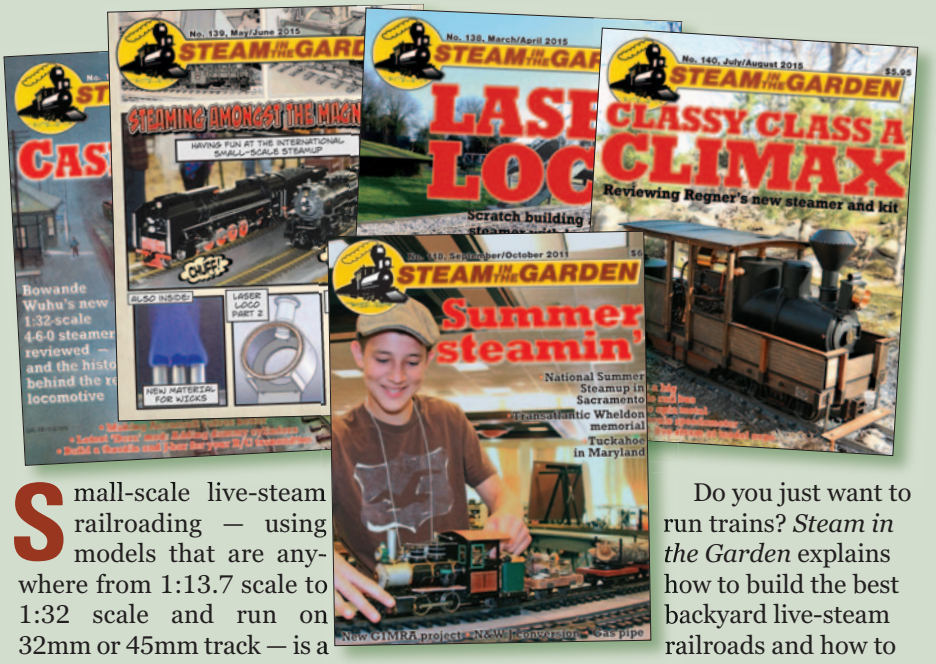
Advertiser Index

Coming Soon!
Issue #163
July/August 2019

Building Scale Back Heads
New Series by
Chris Tolhurst &
Derek Pollard



Steam ... it's the real thing!



Small-scale live-steam railroading — using models that are anywhere from 1:13.7 scale to 1:32 scale and run on 32mm or 45mm track — is a fun hobby that has room for rivet counters and freelancers, prototype purists and lovers of whimsy.

Steam in the Garden is the only magazine devoted entirely to covering the small-scale live-steam hobby. Since 1990 the magazine has taken readers inside the railroads and inside the workshops of the leading modelers and shown how fun and easy live steam model railroading can be. Six times a year, *Steam in the Garden* gives subscribers a look at the current trends in the hobby and reviews the latest products available.

Are you a builder of live-steam models (or do you want to be)? *Steam in the Garden* has detailed articles that explain how experienced builders create those once-in-a-lifetime projects that can't be found anywhere else.

Do you just want to run trains? *Steam in the Garden* explains how to build the best backyard live-steam railroads and how to build portable layouts as well.

Want to make improvements on your locomotive? *Steam in the Garden* has dozens of articles every year that show you in detail how to add features to your small-scale loco or make your rolling stock run better.

Want to know what's happening at the leading live-steam events? *Steam in the Garden* will take you there, to give you a flavor of what's happening, both on the track and in the clinic rooms, as well as the latest products shown by exhibitors.

Steam in the Garden is sticking to its 20-year history of giving hobbyists the best information, illustrated profusely, in an easy-to-read format. Fill out the form below and subscribe today to *Steam in the Garden*.

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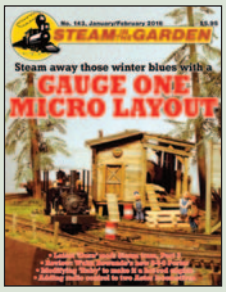

Vol. 26, No. 1; Issue 143; Jan./Feb. 2016
Micro layout: Building an indoor Gauge One track • Review of Wuhu Bowande Porter • Hot-rod 'Ruby': Hopping up a 1:20.3-scale engine • Rolex Asters: Adding radio control • Learning to model in tinplate with a 'Dora' modification, Part III • Latest waybill: Llagas Creek Railways sold, U.K. distributors merge.

Vol. 25, No. 6; Issue 142; Nov/Dec 2015
In memoriam: Andre Anderson, Wuhu G5: Locomotive review — 1:32-scale, 4-6-0 , Topaz: Alchemy, building an Accucraft 'Ruby' kit, Tram: Learn to model in tinplate, Sacramento stationaries: NSS 2015 highlights miniature machinery. WWI car: Creating a 7/8ths-scale Fort Benning railroad observation car.

Vol. 25, No. 5; Issue 141; Sept./Oct. 2015
Mamod's latest: 'Brunel' • Learning to model in tinplate with a 'Dora' modification, Part I • Live-steam group makes sixth appearance at Maker Faire • Adding mesh to Accucraft burner • Salute to Tom King • New products: Aster 0-4-0, Wuhu Bowande German 2-6-2T, Train Dept. with two 7/8ths-scale.

Vol. 25, No. 4; Issue 140; July/August 2015
Classy Class A Climax — Regner steamer and kit review • Big 'Dora' — Making it a 1:13.7-scale rail bus • Spinning metal • Cabin Fever • Speedometer • Latest waybill: Garratt from Roundhouse; in memoriam — Peter Jobusch; Accucraft UK goes with an African steamer; Mamod saddle-tank loco.

Vol. 25, No. 3; Issue 139; May/June 2015
Steaming amongst the magnolias: Diamondhead 2015 • Laser Loco: Aspinall 0-6-0 (series Part Two) • Workshop: sample tools and equipment • Wicks: A new material • Open cab 'Dora' • Latest waybill: Swiss, U.S. locomotives on the way; a new version of Saxonian in 1:20.3 scale.

Vol. 25, No. 2; Issue 138; March/April 2015
Laser Loco: Scratch building with laser-cut brass. Part 1 • How steamers in Seattle created a community • Getting an LED onto the front of Accucraft's C-19 • Two former ride-on live steamers decide to go to Gauge One • Romance, realism of coal firing: factors to consider before taking the plunge.

Vol. 25, No. 1; Issue 137; January/February 2015
Expand Accucraft cylinder ports • Casey Jones: a new 10-wheeler from Wuhu and the engineer's history • R/C J-bar: adding steam controls to transmitter • Dummy cylinders: Give 'Dora' a more realistic look • Railroad librarian: 'Great American Railroad Stories'; 'The State Belt.'

Vol. 24, No. 6; Issue 136; November/December 2014
Sacramento steams. The 2014 National Summer Steamup provides a fun time for more than 150 steamers • Replacing axles • Scratch-building the four-cylinder Heisler, Part Three • The backyard Rivendell & Midland Railroad, Part Two • 'Dora' gets a snow plow (and a bell and a ...).

Vol. 24, No. 5; Issue 135; Sept./Oct. 2014
A big little locomotive: Accucraft's 7/8ths-scale 'Fairymead' • Scratch-building the four-cylinder Heisler, Part Two • The backyard Rivendell & Midland Railroad, Part One • Build a train barn • Review: Regner's 'Otto' • Latest Waybill: Accucraft 1:32-scale rolling stock; end of boiler detection; new wheels..

Circle the issue number of the back issue(s) you want delivered:

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131	130	129	128	127	126	125	124	123	122	121	120
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107	106	105	104	103	102	101	100	99	98	97	96
95	94	93	92	91	90	89	88	87	86	85	84
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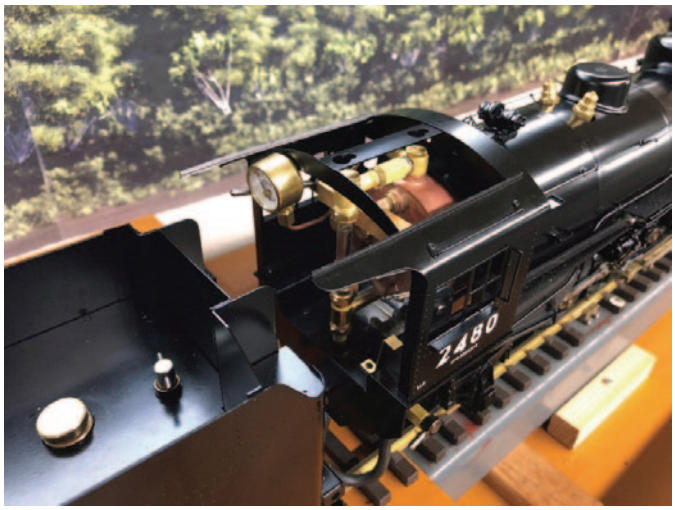

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