25 HP Swan – 21 HP Otto – Montgomery Ward Air-cooled Engines

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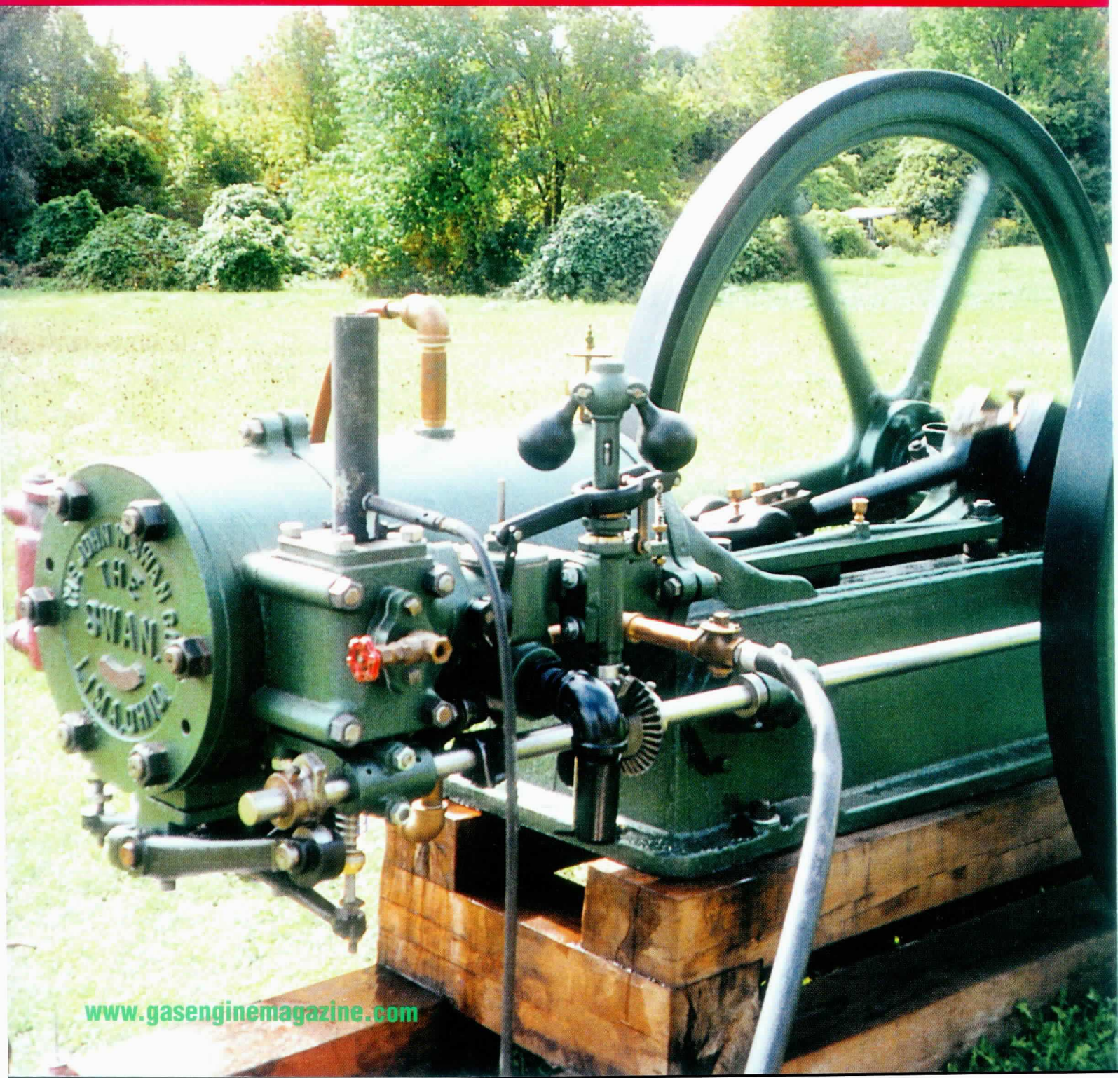

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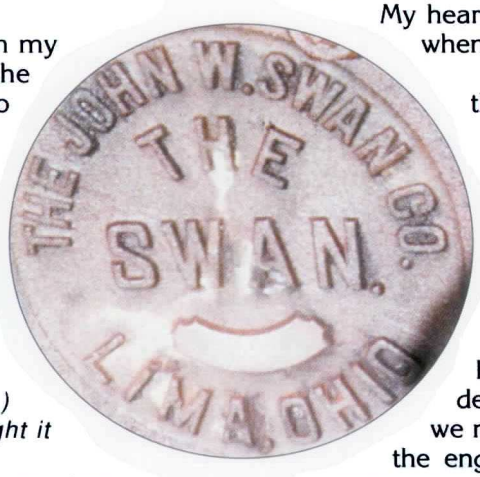
Oil Field Masterpiece

By Craig Prucha

New York Collector's Determination Brings Rare 25 HP 1901 Swan Back to Life

Editor's note: *This article is the first of a two-part series chronicling the restoration of a 1901 Swan oil field engine.*

In mid-October 1998 I drove from my home in Pavilion, N.Y., to the Coolspring (Pa.) Power Museum to lend a hand on a volunteer work detail at the museum. In the middle of things, I was talking to Paul Harvey, the museum's co-founder, about a Swan engine behind one of the museum's buildings. Paul told me he owned the 25 HP Swan, and that he had purchased it about 30 years earlier. I needed a winter project, so I asked him if he would be interested in selling the Swan. My heart stopped for a few short seconds when, to my surprise, he said "yes."



Above: *Craig Prucha and the 25 HP Swan at the Coolspring (Pa.) Power Museum on the day he bought it in 1998.*
Right: *The Swan's cylinder head cover plate.*

We walked over and looked at the Swan. Paul knew a little of her history, telling me she had pumped oil for a living in eastern Indiana. She was taken out of service 24 years before Paul purchased her, and at some point she had been in a fire. I could see Paul had a great affection for this engine and that he had a great appreciation for its design and style. With his decision, we made arrangements for me to pick the engine up during the museum's fall swap meet two weeks away.

The Swan's combustion chamber after disassembly (left) and piston (above).

Bringing it Home

For the next two weeks all I could think about was the Swan, and as show time approached I readied my truck and trailer to bring the Swan home. I arrived at the museum on Thursday – the day before the show started – so I would have a full day to get her loaded without a lot of people around. With Mike Murphy operating the museum's Army crane, we got the Swan loaded and secured. I spent the next few days at the swap meet talking to friends and enjoying the engines at the museum.

When people at the swap meet saw the Swan strapped to my truck, they asked if I was nuts. The engine looked in pretty sad shape, and it was. It had been sitting outside for 54 years, it had been in a fire, and all the babbitt (except for the mains) was gone. It really needed some tender loving care. I couldn't wait to get home and start working on her.

25 HP Swan

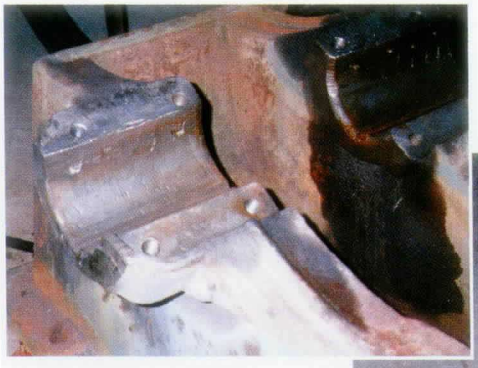
- Manufactured 1901, Lima, Ohio, by The John W. Swan Co.
- Engine Specs: 25 HP, 12-1/4-inch bore by 18-inch stroke, 69-inch flywheels.
- 4-cycle "T" head, crosshead, sideshaft, vertical flyball governor.
- Mechanically actuated intake and exhaust valves.

After returning to Pavilion from the swap meet, I spent a few days getting my shop ready for my new restoration project. Once the Swan was in my shop, I just stood there and savored the moment. I couldn't believe what I was getting to restore.

The first thing I did was spray all the nuts and bolts with penetrating oil to help loosen them up. It was mostly rusted, and I knew I'd probably have to use a "heat wrench" to get things apart. My first objective was to remove the head and answer some basic questions: How badly is the piston stuck? What does the cylinder bore look like? These were all unknowns I couldn't answer until I removed the head.

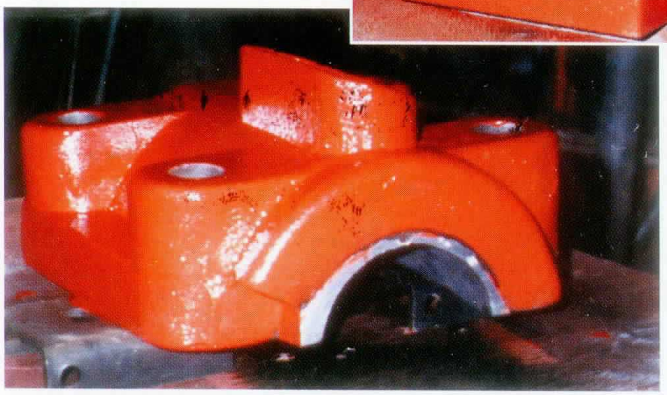
I started by removing the intake and exhaust valve chests. The Swan is a "T" head, with intake and exhaust valve chests located 180 degrees apart on each side of the head. The intake valve chest came apart pretty easily, but the exhaust valve chest didn't, probably a result of the heat it suffered in its working life.

The cylinder sleeve, combustion chamber, head and cover plate are mounted to the engine bedplate and held together by six, 38-inch-long tie rods. I removed the tie rods first, and then the cylinder head cover plate came off. The cover plate, which has the engine's manufacture information, horsepower and serial number cast into it, is a thing of beauty. The head, unfortunately, was badly stuck to the combustion chamber. By applying heat and driving thin chisels between the head and the combustion chamber the head finally let loose, followed by the combustion chamber – complete with piston.



Left: *A main bearing saddle prior to rebabbitting.*
Below: *Freeze crack ran the entire length of the cylinder water jacket.*

Crosshead after pouring new babbitt (above) and after a coat of primer (right). A freshly babbitted and primered bearing cap (below).



Looking at the exposed piston, I discovered why the engine quit running: The threaded end of the connecting rod (the rod shoulders up to the bottom of the piston and a large nut at the top locks the piston and rod together) was broken off even with the top of the piston. That meant nothing was holding the two parts together. I found signs of welding on both the piston and the connecting rod, probably a field-fix to keep the engine running after the rod end broke. Who knows how long that fix lasted.

When the weld eventually broke, the connecting rod came out of the piston, and on the next forward stroke the connecting rod pushed the piston up into the combustion chamber 3 inches farther than normal. This explained why the piston was stuck so close to the head. Thank God for a large combustion chamber, or who knows what other parts would have broken.

I set the combustion chamber with the stuck piston on my press, heated it all up and pressed the piston out. After cleaning the piston, I found it had three rings, and once I got the rings freed up I removed them from the piston. They were shot.

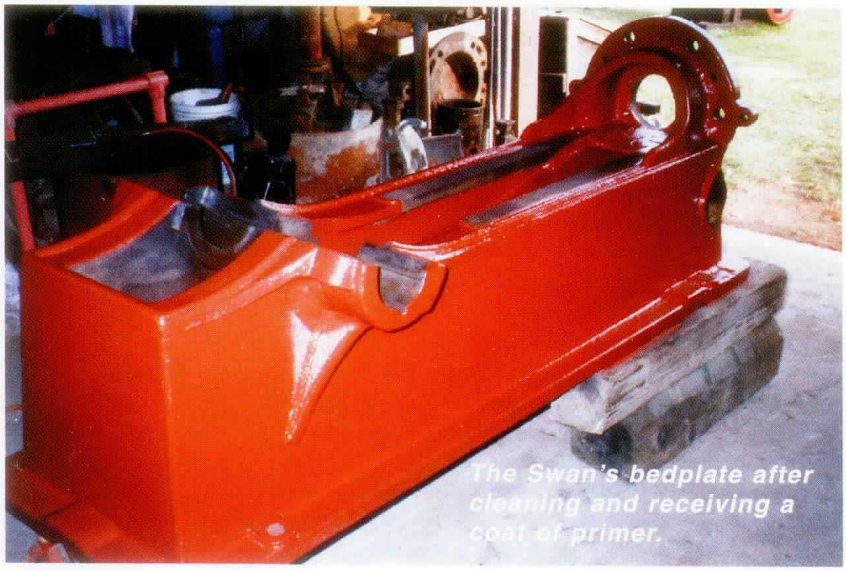
Now I had to decide whether to try and save the cylinder bore or have it bored and then build up the piston. It really was a no-brainer. The removable cylinder sleeve had to be bored and the piston built back up to the proper clearance with the new bore. At that point in the restoration I didn't have the capability in my shop for cylinder boring, so I sent the cylinder sleeve and piston out to another shop.

Bedplate and Babbitting

Next, I worked on getting the rest of the engine dismantled. The crosshead top rails and the crosshead came off without a problem. After removing the crankshaft and flywheels, I decided to re-pour the main bearings. They might have been useable, but I went ahead and melted out the original babbitt, forcing me to pour new ones. This way I didn't have to think about it. In the time I spent thinking it over I could have had them poured. I cleaned up the crankshaft bearing surfaces and prepped everything for pouring new babbitt bearings.

To line up the crankshaft, I took measurements off the crosshead, and it was actually a lot easier to line up than an engine where you have to line up with the cylinder bore. To adjust the crankshaft position I used a little trick I learned years ago from two engine friends from Michigan: Tom and John McCubbin.

They taught me to drill and tap two, 1/4-20 holes in each bearing saddle and then install brass flathead screws located approximately 90 degrees apart forming an upside down "V" to locate the crankshaft. This allowed me to remove and re-set the crankshaft out as many times as I wanted and always get back to the same position. The screws stay right where they are during the babbitt pour, and because they are brass they won't hurt the crankshaft when the engine's running. This is really a great trick because it seems like I'm always



The Swan's bedplate after cleaning and receiving a coat of primer.

pulling everything apart and putting it back together again, especially just before the actual pour to cook out all the moisture.

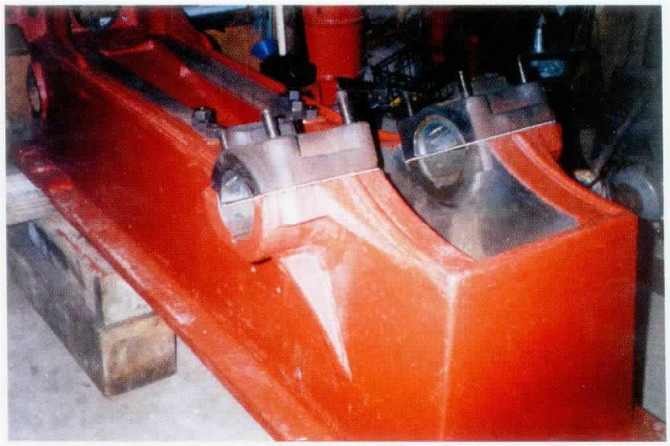
I poured the bearing caps and then put in some hard work cleaning up the bedplate to ready it for primer. I cleaned and sanded the crosshead slide surfaces, removing most of the pits, and I cleaned out or chased all the threaded holes in the bedplate with a tap. I also made new studs for mounting the crosshead top rails. Then I applied a couple of primer coats to the bedplate.

With the bedplate mostly completed, I wanted to get it mounted on the skid. The skid is made out of 8-inch by 8-inch lumber 11 feet long. The cross bunks were also made from 8-inch by 8-inch lumber, but the top rails were made from 6-inch by 6-inch lumber. Making the skid was a lot of work, but when I was all done and saw the engine mounted on it, it was worth the effort. It is very handy to have the bedplate mounted on the skid because it raises the engine up to where I can work on it.

Cracking Issues

The cast iron cylinder water jacket had a crack on the bottom side running the entire length of the jacket. I cleaned the water jacket up, and using an angle grinder I cut a "V" into the crack on both the inside and outside. With the water jacket ready to weld, I brought the crack together by strapping it tight and then tacked it with Ni-rod using a DC welder. I left the straps on during most of the welding process just to help keep some of the pressure off the new weld. I welded about a half-inch at a time skipping around from the inside to the outside, stopping when I couldn't put my hand on the welded area. Then I peened the weld for a few minutes to help relieve the stress in the weld. This process took about four days to complete. The weld came out really nice and very strong. Next, I ran a pipe tap through the inlet and outlet holes to clean the threads up, followed by a couple of primer coats.

With some of the major jobs completed I started work on the valve chests. Both were in pretty bad shape, with the exhaust-valve chest the worst of the two. The valves were stuck in both valve chests, so I soaked them in penetrating oil while I did the other restoration work. On the intake-valve chest I cut the valve stem off flush with the valve guide and housing. Then, I put it in my press and started to press the valve out. Not wanting to break things I applied heat with the torch, and after repeatedly heating and cooling the valve stem it finally started to move. I pushed the intake valve out the rest of the way and then got my first look at the intake valve seat: What a mess! The exhaust valve was a little tougher to remove, and I used the same process of heating, letting it cool and trying to press it out. I even let it sit for days with pressure on it, but I just couldn't get the exhaust valve stem to move. I didn't want to break the exhaust valve-chest housing, so I wound up drilling the valve stem out. Needless to say, the exhaust-valve seat was in bad shape.

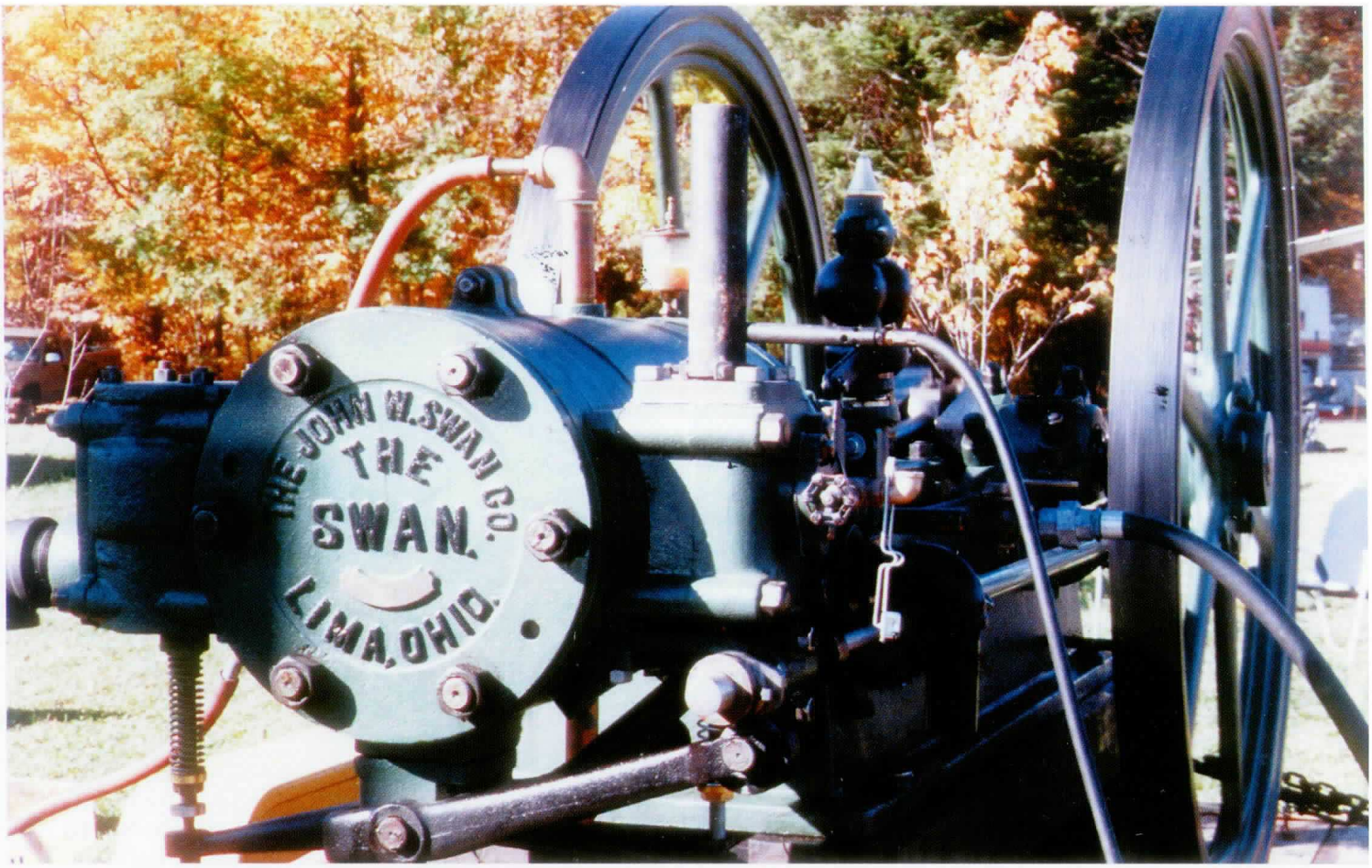


The Swan's bedplate and main bearing caps are fitted and ready for rebabbitting.

I made new valves and guides, plus I had the seats in both valve chests re-cut. I didn't have tooling and a mill big enough to re-cut the seat, so I took the valve chests over to my friend Dave Johnson's shop. With his vertical Bridgeport mill this was an easy task for Dave.

Next issue: The restoration continues, and the Swan runs again for the first time in over 50 years. Contact engine enthusiast Craig Prucha at: 6810 Ellicott St. Road, Pavilion, NY 14525; e-mail: cprucha@antique-engine.com

The Swan starts coming together for a trial fit of the crankshaft with the newly babbitted main bearings.



Oil Field Masterpiece – Part II

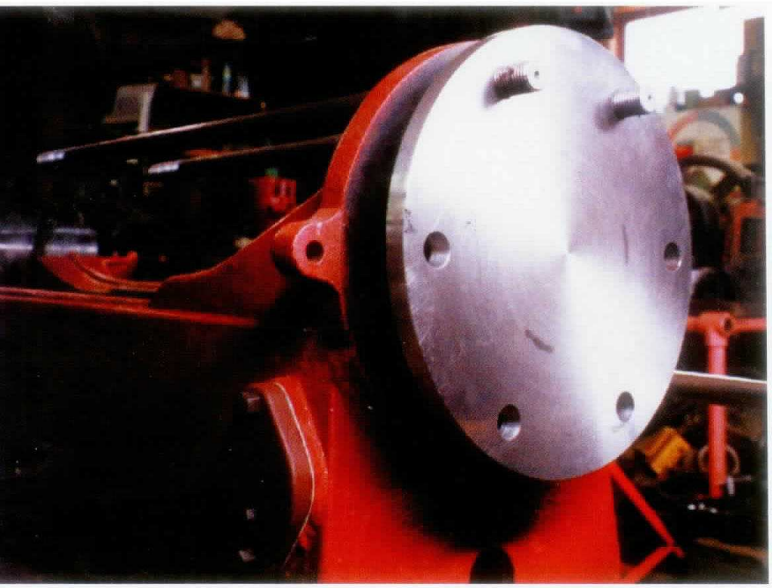
By Craig Prucha

The Restoration Comes to an End, and the Swan Runs for the First Time in Over 50 Years

Editor's note: *This article is the second installment of a two-part series chronicling Craig Prucha's restoration of a 25 HP 1901 Swan oil field engine. Part I appeared in the March 2004 issue of* GEM.

With the engine bed and cylinder prepped, I turned my attention to the sideshaft assembly. The sideshaft was pretty well rotted away, so I made a new one from stainless steel and bought a new set of gears for driving the governor. The new gears are nice, and they came with a small hole bored in the center so I could machine the gear's bore for my particular application. I was very fortunate to find gears that exactly matched the center distance of the sideshaft and the governor shaft. There are, however, some differences between the original gear set and the new gear set. For one, the number of teeth per gear is different (although the ratio is the same), and the tooth profile of the new gear set is different.

The governor assembly was the next part of the restoration to tackle. The governor shaft was rusted solid in the governor housing, and the governor housing had a crack in it from rust and moisture swelling and expanding. The governor parts are pretty fragile, so to make sure nothing broke during disassembly I drilled out all the pins holding the governor balls. I cut off both ends of the center shaft and heated up the housing with a torch. I did this repeatedly – followed by a good soaking in kerosene – but I still couldn't get the parts to free up. Finally, I put the governor housing in a press, and the shaft started to move. The shaft finally came out, and I repaired the cast iron governor housing by welding the crack with Ni-rod and grinding it flush.

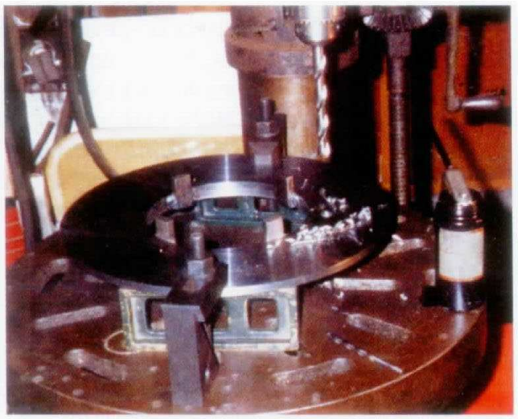


Facing page: *Craig Prucha's 25 HP Swan out in the sun at the Coolspring Power Museum where it's on long-term display.*

Left: *Fitting the new head in February 1999. Note the fixing bolts, two of six 38-inch-long tie rods that bolt the cylinder assembly together and to the bedplate.*

Heads Up

With a materials list in hand, I made another trip over to my friend Dave Johnson's shop and got the necessary stock to fabricate a new head and cylinder sleeve mounting plate. The engine was also missing the brass bearing halves for the connecting rod big end and the strap that holds the big end and bearings together on the crankshaft. Using a bearing half of similar size from another engine, I fabricated a pattern for two bronze castings, one for each bearing. I fabricated the strap for the connecting rod, and after getting the bearings back from the foundry, I machined them up.



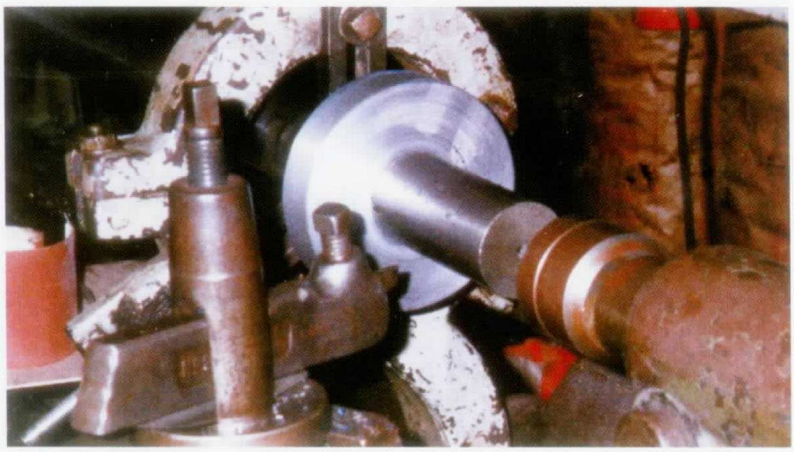
I first squared up the bearing halves on a shaper and clamped them in a four-jaw chuck on my lathe. I put a piece of 0.060-inch nylon shim stock between the two bearing halves and machined the bore to size. I faced each side of the bearing assembly, and machined a chamfer into the inside diameter of the face to make clearance for the radius of the crankshaft. Finally, I drilled an oil hole and cut oil grooves in the bearing surface. I assembled the bearing halves together with the strap and the connecting rod.

Next, I turned to pouring the crosshead babbitt. Before I could pour the babbitt, however, I had to finish the cylinder sleeve mounting plate and mount the cylinder sleeve. And that meant I had to finish fabricating the new piston connecting rod – all of which play a critical role in aligning the crosshead.

The cylinder sleeve and piston came back from the shop, and the connecting rod turned out nice and fit the piston well. I temporarily rigged the sleeve to the bedplate, installed the piston and piston connecting rod in the sleeve, connected the rod to the crosshead and spent a lot of time lining everything up to make sure the crosshead ran true with the piston. Once this was done, it was time to pour the babbitt. The pour went great, and I poured extra babbitt on the top side of the crosshead so I could machine the final height of the crosshead bearing surface. This also insured that the top of the crosshead would be parallel with the bottom: A final inspection showed the crosshead was properly located. The Swan was starting to look like an engine again.

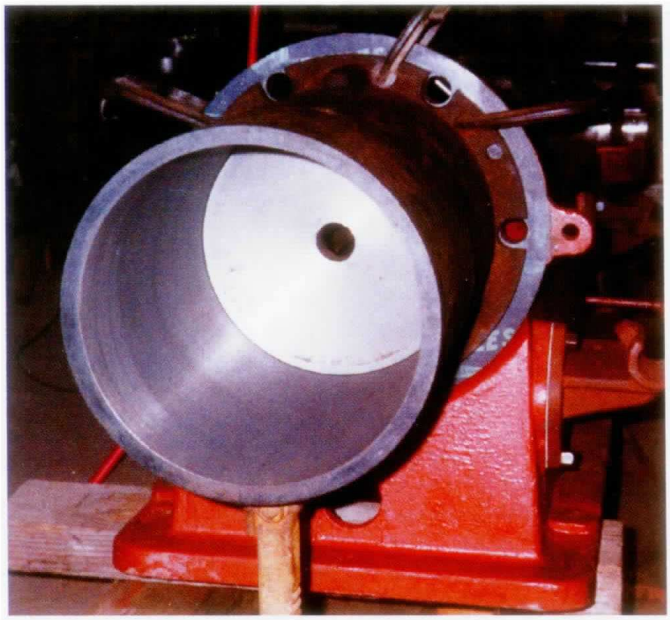
Cylinder Mounting

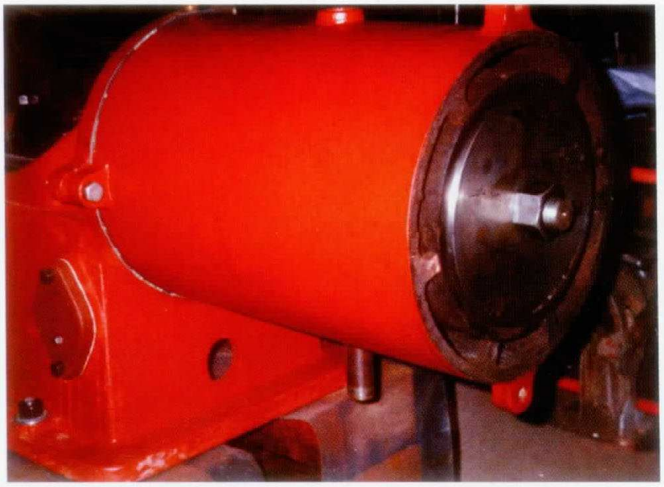
I fabricated six new 38-inch-long, 1-1/4-inch-thick tie rods (the rods that bolt the head and cylinder assemblies together and also to the bedplate). I also had to finish turning the outside diameter of the new head and drill the six mounting holes for the tie rods. This wasn't without its challenges, as I discovered the six holes for mounting the head were not evenly spaced. I wound up having to transfer the position of the holes from the existing head and labeling the new head's orientation. Also, the original head had a boss or protrusion that went 3-1/2 inches into the combustion chamber. That's an awful lot of mate-



Center: *Machining the cylinder-locating plate.*

Right: *Machining the shoulder on the new piston-connecting rod.*





Left: *Trial fitting cylinder sleeve (with piston).*

Above: *Cylinder sleeve, cylinder jacket and piston assembled to bed plate.*

rial to machine, so as an experiment I made the new head flat. I did this to increase the combustion chamber size, which also lowered the compression.

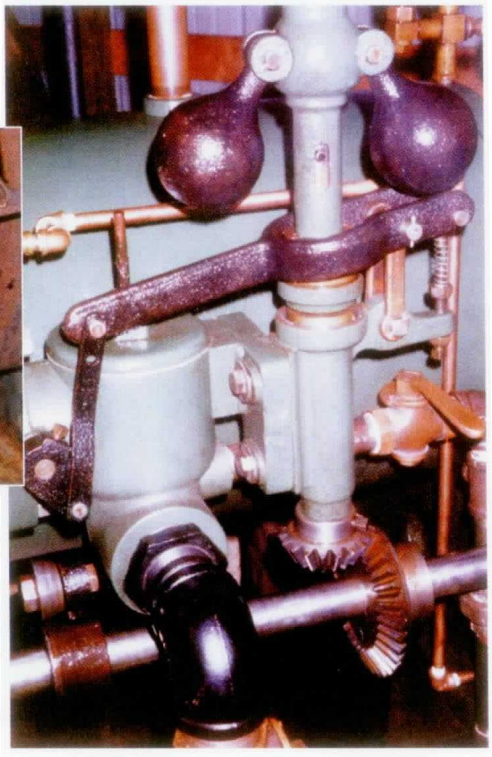
Now it was time to start assembling the cylinder. I had already bolted the sleeve on with some temporary "T" bolts. The water jacket and the combustion chamber each have two cast ears to bolt them together and hold them in position while assembling the six tie rods. The head and cover plate were the last two pieces that had to go together, and I cut gaskets for every interface. With everything lined up – checked and double-checked – I started tightening up the tie rods. Before I put the final torque on the tie rods, I loosened the bolts holding the water jacket and combustion chamber together so they would not fight against the tie rods.

Mixer

With this done, I cut gaskets and put the valve chests on. Next up was the mixer, which needed a little work before I could bolt it up. I re-cut the seat for the gas valve (it holds the gas back until it sees a vacuum from the engine) and made a new shaft for the butterfly valve. I reamed out the shaft holes in the mixer housing and installed new bronze bushings. With that work done the mixer was like new.

With the mixer installed, I could install the governor assembly and line things up to pour the babbitt for the governor and the sideshaft. This required a lot of measuring, as the governor, sideshaft and crankshaft have to line up and have the correct relationship with each other so nothing binds up. After checking the setup a couple times, I poured the sideshaft bearings.

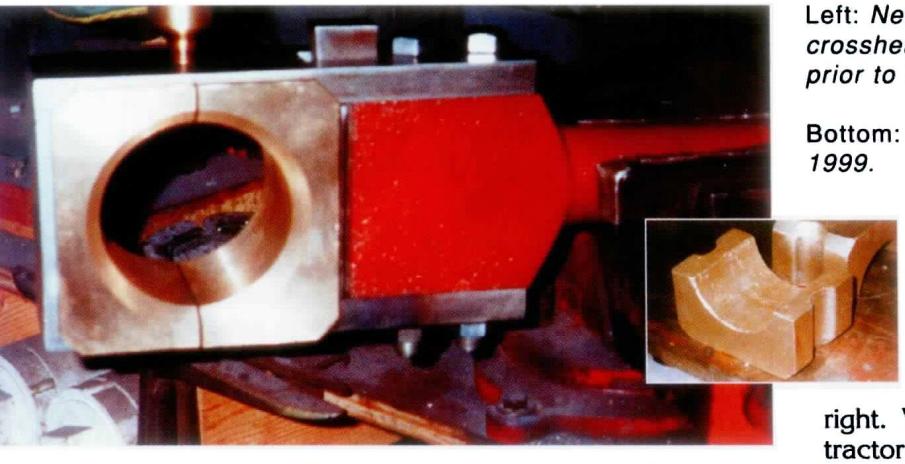
Above: *Mixer and governor before disassembly.*



Right: *The restored mixer and governor highlight the work that went into this engine's restoration. Note the new governor gears.*

The next step was attaching the connecting rod to the crankshaft, and with those parts assembled it really started looking like an engine again. For the first time since I'd bought the Swan, the piston and crosshead moved together when the flywheels were rotated. What a great feeling! I noticed in setting up the engine that it got tougher to set the bearings as I progressed – it's tough to feel the drag on things like the crankshaft and crosshead when the mass of parts starts coming together. Yet, everything seemed to be working well as the flywheels rotated: The governor balls actually went around – what a site!

I still had to fabricate the exhaust cam lobe, which was



Left: *Newly fabricated big-end bearings and strap for crosshead connecting rod and fresh bearing castings prior to final machining (inset).*

Bottom: *The Swan is really coming together by June 1999.*

missing from the engine. I made the lobe of the exhaust cam quite wide to make sure I had enough material to achieve the right duration on the exhaust valve. I used the existing intake cam lobe as a reference, since they are effectively similar aside from the exhaust cam lobe profile being different than the intake cam lobe.

This led me to the rocker arms, which needed some attention. I had to make a new rocker arm pivot shaft and had to bore the pivot holes in the rocker arms and press in new bushings. Both rocker arms also needed new rollers and shoulder screws, which I made. I also fabricated new valve adjusters.

Fresh Air and First Fire

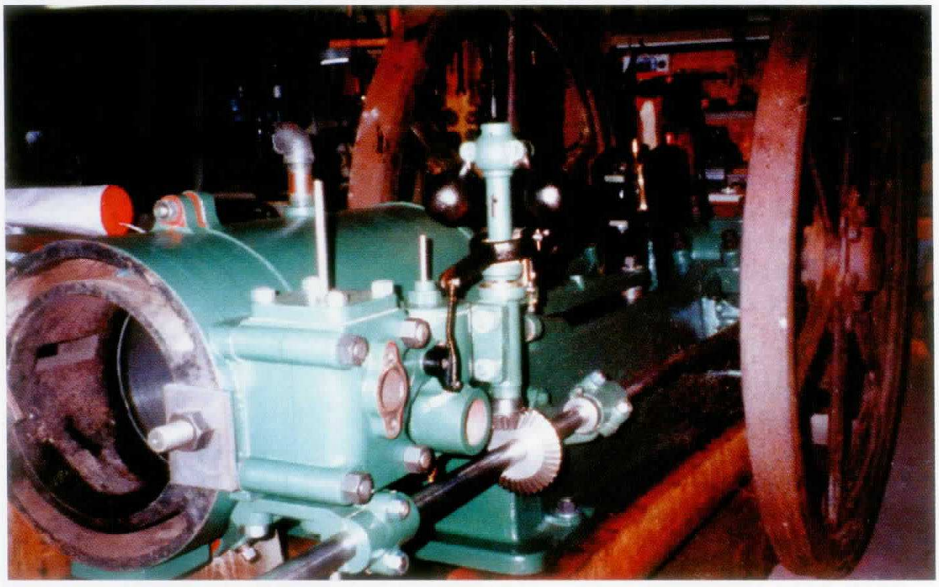
Suddenly, it was time to pull the Swan out of the shop and put the final touches on it. The flywheels still had to be painted, a chore my two sons Joseph and Christopher took care of once the engine was outside. I installed the gas line and gas valve, and also fabricated and mounted an air intake pipe and choke plate. I fabricated a hot tube chimney and plumbed up its gas line. I finished rebuilding the governor linkages and welded up the pivot holes, re-drilled them, reamed them to size and made new pivot pins. All this work made for a nice, responsive governor.

The day finally arrived to start the Swan. I hooked up propane tanks and an accumulator, lit the hot tube and oiled up the engine. I rotated the flywheels to make sure everything was working properly and stopped the engine on its power stroke for priming. Not sure exactly where to set the gas and air, I made an educated guess. Was the hot tube the right length? How much fuel would it need? How much air? I'm sure many of you have been in this situation.

When I felt things were ready, I primed the engine with gasoline and back-kicked it. I did this quite a few times, but I didn't even get a pop out of it. Looking around my shop, I saw my Ferguson TO30 tractor. I backed the tractor up to the engine and put a belt over the flywheel. I don't really like starting an engine this way, so I spent a lot of time making sure everything was lined up right. With the compression release open and the tractor pulling, the Swan's flywheels started to rotate. After making sure the belt was tracking okay on the flywheel and everything on the engine was working properly (sideshaft, rocker arms, valves, etc.), I closed the compression release, opened the gas valve, and the Swan fired in a few short seconds. It was firing erratically and running lean so I gave it a little more gas – but it was running. Quickly, I went over to the tractor and put the PTO in neutral. With a small pipe, I slid the belt off of the flywheel. Wow! I wondered how long it had been since the Swan had last run under its own power.

It wasn't knocking or making any load-related noises, so I started adjusting the gas and air mixture (it's a throttle-governed engine). After a few minutes of adjusting, the Swan started slowing down and hit every time – it sounded nice. After about 20 minutes of running – and my heart going a mile a minute – the engine made a loud bang, but kept running. Listening, I could hear a hissing sound every time the piston came up on compression. I discovered that a cover gasket on the exhaust valve chest had blown, so I shut the engine down. Also, I didn't have any water in the engine, and it was starting to get a little warm.

After removing the cover and gasket from the exhaust valve chest, I decided to machine the cover-



mounting surface and true it up. I cut a new gasket and reassembled the cover.

I plumbed cooling water to the Swan, then checked and readjusted anything that needed attention. My good friend Stiles Bradley stopped by to lend a hand, and I lit the hot tube and oiled the engine again. We primed it and backkicked it, and with the two of us working together the engine fired. I had left the gas and air settings where they were from the last running, and the Swan took off right where it left off. What a day! We watched the Swan run and fiddled with adjustments here and there, but boy, it was running nice. When the engine fires I can hardly hear a bang. It's more like a whisper.

A justifiably proud Craig Prucha runs the Swan during the Coolspring Power Museum's fall show in October 2000.

I have the entire restoration on a four-hour video, and I love watching it and reliving the experience. It's a great-running engine, and it's currently on display at the Coolspring Power Museum in Coolspring, Pa.

I would like to give special thanks to Stiles Bradley and everyone else who helped me with the Swan's restoration. I couldn't have done it without them. Thanks.

Contact engine enthusiast Craig Prucha at: 6810 Ellicott St. Road, Pavilion, NY 14525; cprucha@antique-engine.com