

Mountaintop Treasure

By Larry Evans

Perched over a mile high in the San Gabriel Mountains and only a 25 mile drive from Pasadena, California is the Mount Wilson Observatory. This historic site is home to many technical treasures of a bygone era including not only the finest telescopes of the time, but also the equipment needed to support them and the astronomers who used them. This is a very special place in the history of astronomy and I am sure that a very high percentage of the 13 or so million people living within a 50-mile radius have no idea what a treasure it is. The Observatory was established in 1904 by George Ellery Hale who was an astronomer primarily interested in the study of the sun, but he was also well aware of the importance of studying the stars and planets. By the end of 1908, besides the instruments for studying the sun, there was a telescope with a mirror 60 inches in diameter and in 1917 a 100-inch telescope was added. Both telescopes were the largest in the world when they were first used. Later, Hale was the guiding force leading to the development of the 200-inch telescope at Mt. Palomar near San Diego, California.

Even though it is just a few miles from a large city there was no paved road to the site until the 1930's. In the early years the only routes consisted of narrow winding trails about four feet wide that gained over 5,000 feet of elevation in just a few miles. All material was transported using either pack animals or small carts pulled by animals. As time progressed one of the trails was widened, allowing for the use of powered trucks. Due to the remote location, the Observatory had to be self sufficient with regard to water, power, housing for the staff and such, which leads to the main subject of this tale – a 1911 50 HP Fairbanks Morse Type “RE” engine.

My brother Ken worked at the California Institute of Technology's Jet Propulsion Laboratory (JPL) for many years and let it be known around the Lab that he was interested in antique gas engines. In the spring of 1994 another employee at the lab, who also worked with an educational program at Mt. Wilson, asked Ken if he was interested in taking a look at an old engine located there. Ken called me to see if I was interested in going and it didn't take long at all to set a date for us to meet at the Observatory. We had no idea at that time that we were in for a delightful surprise. With our host we walked down a small road past the “No Trespassing” sign and were led into a small building. The room we entered was a small machine shop that included a lathe, drill press, small milling machine, and power hacksaw, mostly powered by an overhead line shaft system. Seeing this would have been enough to make the trip worth the time and effort, but our host just kept on going through the shop and opened a door and led us into a room holding the real reason for our trip. There in front of us was a large two cylinder vertical engine directly connected to a very large electric generator. We had a little time to poke around and try to digest just what we were looking at. Bear in mind that up to this time our experience with old engines consisted of our own 2 and 3 HP engines and a little time with our club's 15 HP Fairbanks Morse Z. This thing in front of us seemed huge. It had a tag on it that said “Fairbanks, Morse & Co., 50 HP, 300 RPM.” The flywheels were

about 6 feet in diameter, the cylinder heads and valves practically at ceiling height, and brass plumbing was all over the place. Unfortunately, at about this time another staff member showed up and suggested that it was time for us to leave. It seems that our host really had no authority at all to show us around this part of the facility. At this point we now had some pleasant memories of a nice day in the mountains and a chance to look at a big engine that we knew nothing about – and to which we had no further access.

I have now pushed the fast forward button and it is mid-1999. Again, due to his known interest in old machinery Ken was asked if he would be interested in joining a small group of volunteers from JPL that was being formed to help solve problems with some of the old mechanical equipment located at Mt. Wilson. The next weekend found both of us at Mt. Wilson again but this time meeting with the group inside the dome of the 60-inch telescope. It seemed that the mechanism that rotates the dome was not working reliably and this became the first project for the group. It took a year of weekend work parties but the 200-ton dome rotates just fine now. As we got to know the staff at the Observatory we got an “official” chance to see the big engine again and this led to us being allowed to refurbish it so that we could operate it for demonstration purposes. As part of our permission to work on the engine, we were given certain rules to follow due to the crowded conditions in the machine shop building and the other potential dangers in the room. Among other things, Ken and I were allowed to have only one other person work with us and we had to provide a safety barricade in front of the electrical distribution panel.

Finally we had a chance to see what the big engine really was and start researching its history. We enlisted Mike Jones, a good friend of ours as the third person, and in September of 1999 started our endeavors of understanding and eventually operating the engine. When members of the Observatory staff realized what we were attempting, one of them gave us a poor quality copy of the operating manual and parts list he had obtained from Fairbanks Morse several years prior to our involvement and another came up with a couple of interesting early pictures.

Fortunately, because the engine is in a very secure and weatherproof building located in an area not open to the general public, it had not been damaged or vandalized. Even though the engine had not been in use for many years it looked like someone periodically squirted some oil around and rotated the flywheels. The engine was not stuck like so many other old engines.

Now it was time to really start assessing just what we had gotten ourselves into. Fortunately, we did have several avenues of research available. The serial number on the tag matched the number on the end of the crankshaft and indicated that the engine was most likely manufactured in mid 1911. The instruction manual we received indicated that this was a Type “RE” engine. This information confused us at first as Wendel’s big book only mentioned a Type “R” engine of this nature. After some time I found another book by Wendel specifically on Fairbanks Morse engine history. This book was published ten years later and stated the Type “R” was introduced in 1902 and in 1909 the design was modified somewhat and it was renamed the Type “RE”. The major

modification was in the valve train – the Type “R” had overhead intake valves with the exhaust valves in the block and the Type “RE” had both valves overhead. Production of the Type “RE” continued until 1915 when the Type “Y” engine was introduced. I have since seen period catalogs that verify this information. The generator coupled to the engine was tagged as being made by Fairbanks Morse, capable of producing 40 KW at 125 VDC. Since the history of this engine is so closely intertwined with the history of the Observatory I would like to point out that this was the third generator set installed there. The first set was a 15 HP Witte belted to a 7-1/2 KW generator installed in 1904. Around 1910 the original wooden powerhouse was replaced with the present fireproof building and a 25 HP Fairbanks Morse belted to a 17 KW generator was added and used along with the Witte. Sometime in 1912 the Witte was replaced with this 50 HP Type “RE” Fairbanks Morse powered generator. Originally all the power at the Observatory was DC and all the early telescopes had DC motors operating them, rotating the domes, and opening the dome shutters. To this day much of the early DC equipment is still in use. Adjacent to the power house is another building that at one time contained a large number of glass cells wired up into several batteries. So in essence the generators served as battery chargers. In 1917 commercial AC power became available and I believe it was at that time the 25 HP Fairbanks Morse engine was removed to make room for a large AC electric motor driving a DC generator to charge the batteries. We have found no documentation as to what became of the 15 HP Witte or the 25 HP Fairbanks Morse. At the present time the needed DC is provided by solid state rectifiers that are much more efficient than the AC/motor-generator set. The rectifiers eliminate the need for the storage batteries.

Our first order of business was to build the temporary barricade to protect the DC power distribution panel located just a few feet from the engine. We did not want to be responsible for damaging 90-year-old gauges or switches. Finally it was time to really start inspecting what was there. We had been told that it was probably about 25 years since the engine had last been run so we had no idea of its real condition. As we started working with the engine we were absolutely delighted with what we found. It appeared to be complete, no evidence of missing parts. In fact we even found the set of spare ignitors that the factory shipped with the engine properly marked with the serial number and cylinder location. The paint seemed to be original and intact. The only major rust was on the flywheel rims and that proved to be only surface rust with no pitting and it cleaned off fairly easily. Ken was able to locate a source for new mica and he rebuilt all the ignitors. We also removed the lubrication manifold to service its 13 drippers and replace all the sight glasses. The fuel system had to be cleaned up and we modified it some so that a small five-gallon tank could be used for demonstration purposes. The original large fuel tank was no longer serviceable. Since it turned over easily and had good compression, we saw no reason at this point to tear into the innards of it. It was obvious this engine had been retired because it became obsolete, not because it had failed.

What followed next was a long learning period trying to understand how everything worked so we could safely operate the engine. Even though it looked huge to us, we found that this was actually the smallest Type “RE” that Fairbanks Morse made. This

style of engine was made in two different cylinder sizes (25 or 50 HP per cylinder) and was available in two, three or four cylinder configurations. This made for a range of from 50 HP to 200 HP available, thus this 50 HP one was the “baby” of the line. The bore and stroke of this engine is 11 x 13 inches giving a displacement of 2,470 cubic inches. The shipping weight of this “baby” with its generator was 22,000 pounds.

These engines are defined by Fairbanks Morse as oil engines but are spark-ignited and were set up by the factory to run on practically any type of fuel. When the engine was ordered, the type of fuel was specified and Fairbanks Morse supplied the proper fuel system. We found some documents regarding the purchase of this engine and it was shipped from the factory to run on “California Distillate” fuel. We run it on gasoline. The spark is provided by ignitors that are powered by a low voltage generator. This generator was originally friction driven by a pulley on the inside of one of the flywheels but someone in the distant past remounted it and coupled it to a 125 VDC motor. This system works fine and provides full spark for engine starting. It is a four-stroke cycle design with both pistons moving up and down together, which requires what is known as a 360° crankshaft. The cylinders fire alternately thus making for very smooth running. The engine is throttle governed.

There is an oil reservoir mounted above the engine, which feeds a manifold of thirteen separate adjustable drippers. After the oil has done its job in the different bearings, it drains into the crankcase where it is channeled through a filter into a canister at floor level. There is a pump operated by the camshaft that returns this filtered oil back to the overhead reservoir. The overhead valves have grease and oil cups for lubrication.

Likewise, the fuel is pumped up to a sight glass that maintains a constant level at the intake manifold. The excess fuel drains back to the tank.

The cooling system is interesting, in that originally there was no recirculation of the water. Cooling water was drawn from the local domestic supply, pumped through the water jackets and eventually just drained down the side of the mountain. However, this water was not completely lost as it was then piped into an adjacent shower room. If you lived there at the time and heard the generator running it was hot shower time. Records show that the generator was run in the afternoons four or five days a week as needed to keep the batteries charged.

This engine uses compressed air for starting. Moving a lever converts one of the cylinders into an air-operated motor. The compressed air will spin the engine at 80 RPM and after the other cylinder fires the lever is returned to the normal operating position so that both cylinders will fire. Normal operating speed is 300 RPM.

After we had serviced all the various subsystems and felt that we would not damage anything, we felt comfortable in spinning up the engine with the compressed air starting system. We listened for bad noises, looked for flywheel wobble, and anything else that might be a potential problem. Fortunately there were no bad thumps, scraping sounds, or grinding noises and the flywheels ran true, so now it was time to start studying the actual

process of starting and running “Big Ben”, which is what we had learned the early engineers called it. We did have a copy of the factory instruction manual, but of course it did not say how far to open the needle valves, exactly where to set the spark advance lever, how much to choke it and the other little things that would help to make this particular engine run correctly. Since we had to spread our available weekend time between this project and working on the problems with the telescope dome, and with bad weather in the mountains, it took several months to get it ready for a trial run. Finally, in February of 2000 the time came to see if we really knew what we were doing. In the ideal situation, we would have liked to have been able to say that after pumping up the starting air tank we cracked open the needle valves, set the choke, retarded the spark, made sure the pistons were just past top dead center, closed the ignition switch, opened the air valve and stood back with huge grins on our faces as it ran perfectly. The ideal situation usually does not happen and this was no exception. Had we not had an interested audience of Observatory staff it might have started on the second or third try. In actuality it probably took four or five tries to get it running but what a feeling it was when it first fired and kept running. The 15 minutes needed to refill the air tank between starting attempts gave us plenty of time to figure out what to try next.

Since that first time we have had the pleasure of running it many times for the enjoyment of engine collectors from around the world. We have had visitors from Australia, Canada, England, Japan, Switzerland, and various parts of the United States. We sometimes are asked by the Observatory staff to run the engine for small private groups. As time allows, we continue the refurbishment and we now are able to generate electricity thanks to the help of an electrical engineer friend of ours which allows us to refill the starting air tank with an old Curtis air compressor belted up to a 7-1/2 HP DC motor if we want. Since the shower room is no longer in use we have been able to set up a system to recirculate the cooling water in the interest of water conservation.

Even though the machine shop and powerhouse are not open to the general public, the Observatory grounds are open daily from 10:00 AM to 4:00 PM April 1 to November 30. You should see <http://www.mtwilson.edu/> for more information regarding the Observatory. Also you can visit my web site at <http://www.oldengine.org/members/levans/> to see more pictures of this engine and a few other interesting things at the Observatory. Ken and I have permission to give tours of the engine to small groups and individuals by prior arrangement. For information, contact the author at LEVANS44@roadrunner.com.