A Motorcycle Full of Steam

by David Sarlin

The challenge of shoehorning a steam power plant into a cycle frame and to, one day, mount the flaming steed and woosh down the street - these thoughts must have gripped Niles Gillenwaters. Being a machinist by trade and a onetime owner of a White and two Stanley steam cars, he was provided with ample qualifications to bring into focus the steam cycle that glimmered in his imagination. He started with the tank, wheels, and part of the frame from a 1914 Thor motorcycle which partially survived a collision with a streetcar. Thor later became associated with the manufacture of washing machines and electric drills. The fenders, with their angular cross-section, seemingly came from a Pope motorcycle. The pressure gauge, fuel automatic, automatic bypass, steam automatic, safety valve, water hand pump and needle valves are all early Stanley Steamer, while the crankshaft and flywheel are from some unknown vintage piece of machinery (1). The rest was made from scratch.

In 1922, after several years of construction, Gillenwaters took his 550 pound, 67½" wheelbase machine for its first test ride. On many a Sunday thereafter he got together with a few of Sacramento's cycle-mounted police. Gillenwaters thought that his Steam Flyer would do better than the
police Harley Davidsons. Since the police thought otherwise, the only way to settle it was to go to a nearby country road and "stir up some dust." Invariably the police were left in a cloud of it as the Steam Flyer took the early lead and continued to pace ahead. On one run, with a 2 to 1 reduction and the pressure at 1000 psi, he pushed the Steam Flyer up to 110 mph. Typically, the machine worked at 650 psi and maintained this pressure under virtually all conditions.

Gillenwaters claimed in his later years that the fuel and water tanks did not need refilling during a 150 mile trip that he made. However, with respective fuel and water tank capacities of 3.1 and 2.1 gallons, it would appear that the water would require replenishing every 15 miles or so.

Striving for perfection, Gillenwaters constantly tinkered with the machine and made many changes and adjustments over the years. One such alteration was conversion of the burner from a vaporizing to an atomizing type. In the atomizing system, two flat fan-shaped flames were directed toward each other so that they met in the middle of the burner. An engine-driven generator powered the burner, spark plug igniter, and lights. Control was by a pressure-regulated bypass. This equipment was later removed and the cycle converted back to a vaporizing system.

At one time, the French Government wanted to purchase the machine, but Gillenwater did not sell because their offer was too low. Socony Vacuum Oil Company also showed an interest in purchasing it. After driving it several thousand miles, Gillenwaters sold the machine in the late 1930s to the Cliff House Museum in San Francisco. One story has it that the machine was fired up weekly and a reward offered to anybody who would drive it wide open for two minutes. Later, the cycle was moved a few doors to a front window in the Sutro Bath's museum, where it sat for many years as a lure to draw customers in to see the museum's other marvels. During these years, the cycle's original respectable dark green paint was hidden by a coat of fire engine red and the name "Steam Flyer" inscribed on the side of the boiler. A sign sat next to the cycle and boldly (mis)informed viewers that the Steam Flyer was "The first and only steam-powered motorcycle made in America," and that it "may have been the fastest thing on wheels - the speed limit being unknown as no one has dared to open her up."

As she sat in the window over the years, many had their imaginations swept away wondering what it would be like to ride it. The late Roy Anderson recounted that once, while he was admiring the cycle at the museum, a gentleman came by and carefully inspected it. After a few moments his eyes became transfixed by the handsome brass pressure gauge. He evidently mistook it for a speedometer as he exclaimed, "1000 miles an hour, that's a damned lie - nothing could go that fast!"

I recall seeing this unique steam vehicle while still a child. In fact it kindled my interest sufficiently that I now have data and photos on over 80 steam-powered two wheelers. When the Cliff House museum closed, I kept track of the Steam Flyer's whereabouts and in 1975 was given an opportunity to restore it. The fuel and water tanks had both accumulated numerous cherry pits, pebbles, and cigarette butts. Being pitted with rust, they were replaced with duplicates in stainless steel. A sandblast job prior to painting was the probable source of the sand found in the burner and the half-inch oil/sand layer found in the engine's crankcase. The 28 x 3 tires had to be sawn off as age had petrified the rubber. They were replaced, along with the drive chain, fuel pressure tank, numerous valves, saddle, boiler casing, and many feet of sinuous tubing. The tank filler caps and whistle were missing, so new ones had to be made. The metal reinforced handlebar grips went limp with age so new ones were machined and coated with rubber to simulate the original. Half of the grip was cantilevered from the handlebar to cushion road shocks, a feature that must have been appreciated when traveling over cobblestone roads of bygone years. Miraculously, the original boiler survived through the years more-or-less unscathed and still works at 650 psig. It has even witnessed a couple of overheatings that resulted from letting the water get too low.

Gillenwaters used a watertube boiler similar to that in the 1917 Double-Detroit steam car. Most of its 24.3
square feet of heating surface comes from the twenty grids which are each comprised of fifteen vertical tubes (Photo 2). The grids are made of plain ¾" welded steel pipe and the four horizontal main headers from ¾" pipe. Two oval-shaped steam storage drums and an economizer coil are mounted on top of the boiler grids while an 8-foot long superheater coil sits underneath them. Amazingly compact, the boiler fits into a casing only 12" wide by 16" long and 10½" high.

The burner is of the vaporizing type, almost identical to that used in the Stanley and White (Photo 3). Its grate is perforated with 840 holes produced by a No. 50 drill and from which issue a like number of intensely hot blue flames. Originally a mixture of half kerosene and half gasoline was used. A hand pump had to be worked continuously during the starting-up ceremony and whenever the engine was stopped, as the main burner system didn't include a pressure tank. A half-gallon pressure tank existed for the pilot system, however, and this was tied into the main burner during restoration. The pilot burner kindles the main burner and is a miniature version of it, but the pilot more than made up for its size in its cantankerousness. It has performed better since a pressure regulating valve was put into the line leading to the burner. It manages best on a strict gasoline diet—therefore both burners are run on this fuel.

The procedure used in firing up the cycle is much like that used with a Stanley. After restoration of the cycle was completed, numerous "firing ups" were required for me to gain enough confidence to mount the inferno for a steam down the road. Little by little the cycle's idiosyncrasies were learned, and longer trips were ventured. During this period the generator seemed to have a harder and harder time maintaining adequate steam pressure. The burner was suspected, and after much tinkering around, it was realized that air was leaking into the furnace at the joint between the boiler and the burner. Evidently the gasket was blown away by one of the numerous furnace explosions that occurred from reigniting the burner before adequately purging it of all combustible vapors. Asbestos yarn was stuffed into the gap, and performance was restored.

On one trip the machine burst into flames! Quickly the main fuel valve was shut, the machine put on its stand, and the fire put out with the
extinguisher mounted on the right rear. Fortunately, no real harm occurred to body or mechanism. Upon investigation, it was quickly determined that the vaporizer had opened up. The replacement was fabricated from stainless steel.

The prime mover is a 3-cylinder uniflow engine with a 1¾" bore by 2¾" stroke (Photo 4). Its poppet-type inlet valves are actuated by a sliding camshaft which has three profiles: ¼ and ¾ cutoff and reverse. Actually only the ¼ position is useful as the ¾ position results in excessive compression and reverse would only be of use with a sidecar. The reverse probably stems from Gillenwaters' thoughts of developing an engine for a car. Splash lubrication is used for the cams and rod bearings. Originally, two open-type ball bearings were fitted at each end of the crankshaft, but water that found its way into the crankcase caused pitting, so they were replaced with sealed bearings. The rod bearing journals were hard-chromed for a similar reason. In accordance with good steam engine design practice, the pistons are long, have labyrinth

![Diagram of engine components](image)
grooves, and four stepped rings to minimize blowby (Figure 5). They and the cylinders are made of cast iron, while the crankcase is made of cast aluminum.

Engine power is transmitted through a pair of bevel gears via two chains and a countershaft to a two-speed Eclipse planetary transmission on the rear hub. With the transmission in gear, the total reduction is 4 to 1, and while in direct it is 2.3 to 1. In other words, the engine turns 1660 rpm at 60 mph in direct drive. The reputed top speed of the cycle with the present gearing is 85 mph, but I have not ridden her at over 50 mph because of the effect of age on her running gear. Off of the shaft carrying the driven bevel gear is an exposed spur gear set which drives four plunger pumps at one-fourth engine speed. The plungers are all 3/8" diameter and have a 2 3/4" stroke. Two pumps provide the boiler with water; one pumps fuel to the pressure tank, and another pumps cylinder oil to the engine. Visual indication and control of the oil feed rate takes place at a sight feed in the oil pump suction line. A jaw clutch is fitted on the countershaft, but is of little use since raising the cycle on its stand enables the pumps to be used while standing. In order to move the machine backwards with steam up and the clutch engaged, however, the cylinder drain cocks must be opened to vent leakage past the throttle. Two hand pumps, one an original Stanley and one an opposite-hand copy, reside on the cycle’s right side. They are used to charge the fuel and water systems as the need arises.

After the starting ritual has been satisfactorily completed, automatic controls watch over the flow of vital fluids (Figure 6). Fuel goes by way of

FLOW DIAGRAM FOR STEAM FLYER

FIGURE 6

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the fuel automatic, which bypasses fuel back to the main tank to maintain proper pressure, while the steam automatic shuts off the fuel flow to the burner if the steam pressure gets too high. Water flows via an automatic bypass (formerly a Stanley low water cut-off) which bypasses the flow back to the tank when the water level in the boiler is adequate. A trycock was fitted to the steam automatic, but it was supplemented with a reflex water heater. This arrangement may be better for the throttle, but is sure doesn't make life any easier for the rider. This was realized during an early test drive when an attempt was made to turn around on the hill in front of my home. The throttle was closed, and the cycle slowed to a well-mannered stop on the hill. As soon as I attempted to go across the road, steam remaining in the superheater sped the Steam Flyer forward. Quickly the foot brake was stepped on, but the same foot was also needed on the ground to balance the cycle. It was touch-and-go but the turn was finally negotiated with no more harm than a good scare.

The Steam Flyer is remarkably quiet, making only a rhythmic "pht, pht, pht" as she contentedly steams along (Photo 7). Though never accurately measured, the fuel and water consumption are thought to be about 20 and 5 miles per gallon respectively.


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