John Malone and the Invention of Liquid-based Engines

It is hard to imagine using a liquid instead of a gas in a heat engine, but John Malone did—perhaps partly because he was not prejudiced by a proper scientific education. Malone was born in England in 1880. His formal education ended in his eighteenth year, when (probably in part to avoid some trouble with the police) he joined the merchant marine. He remained at sea for nearly all of the next fourteen years; during that time he was wounded seventeen times in Arab and Latin-American wars.

Leaving the merchant marine, Malone founded the Sentinel Instrument Company and, later, the Fox Instrument Company. He began experimenting with liquids as engine working fluids in the 1920s. As part of that project, he measured the compressibilities and thermal-expansion coefficients of many liquids, including hydrocarbons, mercury, carbon dioxide, and sulfur dioxide. In 1925 he completed his first liquid-based engine, shown on the title page of "Malone Refrigeration. It burned coal, used high-pressure liquid water as working medium, and produced 50 horsepower. Malone referred to that first engine as crude and cumbersome, but claimed that with perseverance it would have eventually produced 500 horsepower.

Instead, in 1927 Malone completed a much smaller and more versatile 50-horsepower water engine and began an extensive program of experimentation with it. Malone claimed that his second engine was very efficient. In 1931 he wrote, "Trials by three different independent engineers gave 27% indicated efficiency. Thus, after allowing for furnace and mechanical losses in a commercial engine, 20% overall efficiency between the heat in the coal and the shaft horsepower can be expected." The efficiencies of the steam engines that powered ships at the time were between 9 and 12 percent and those of locomotives were between 5 and 7 percent, much lower than the efficiency of Malone's engine.

Curiously, the "27% indicated efficiency" quoted above is the only quantitative experimental datum in any of Malone's publications and patent disclosures. In a 1939 letter to Selwyn Anderson, Malone wrote about his measurements, "I refused to publish this information because it cost me a lot to learn it and I may yet obtain some reward if it is not known. Also because to my amazement I found my enemies were alleged centers of learning. Universities and the like." Later in the same letter his bitterness is more evident: "A study of liquids as mediums in thermodynamics will teach an engineer more about the art of thermodynamics than all the universities on earth, or the memory men who infest them, and knowledge for knowledge's sake is better than their parasitical life." After Malone's death in 1959, his son Ray wrote, "Now as patent rights have long expired I can see no advantage in publishing any of the information which he accumulated while developing his liquid engine."

We can only guess why Malone's promising work came to an end. The worldwide economic depression of the 1930s must have made venture capital scarce. Some may have dismissed the idea of liquid working fluids because it contradicted conventional wisdom. Large coal-fired steam turbines with 20 percent efficiency were in the ascendancy for applications above 10,000 horsepower. The internal-combustion engine (including what we know today as the diesel engine) was already more advanced than Malone's engine, and its incomparable power-to-weight ratio made it seem the only practical choice for airplanes and automobiles. By the time the Great Depression and then World War II had ended, the steam engine was disappearing, internal-combustion engines and turbines were becoming ubiquitous, and Malone's work had been forgotten. It took another independent thinker, the late John Wheatley, to see the promise in Malone's work fifty years later and resume the study of liquid-based engines. □