The ROMANCE

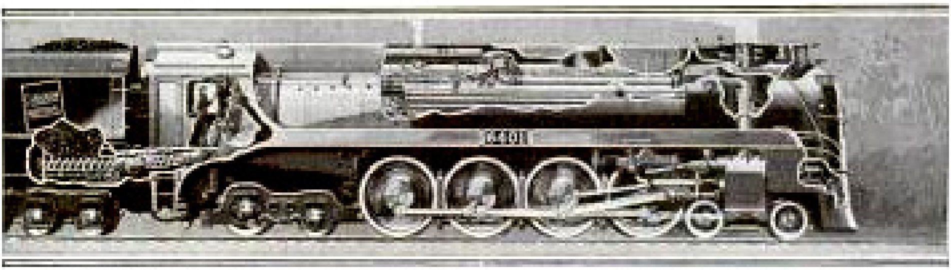
Stephenson did not invent the steam locomotive or construct the first one. But this English mine engineer who turned locomotive builder contributed much to railroading because in his "Rocket" he combined in one engine all the primary elements of a successful locomotive.

The biggest, fastest and most economical modern steam locomotives are but refined and enlarged "Rockets." Thousands of locomotives have been built since the advent of this little pacemaker, and all of them have succeeded or failed as they have adhered to, or departed from, the basic design of the "Rocket."

Stephenson's achievement is all the more remarkable because he applied knowledge which had been available to others for years. Long before the Christian era, Hero of Alexandria wrote of the expansive force of steam and described most of the basic elements of a steam engine. But it was not until late in the seventeenth century that steam was put to work.

At that time Thomas Savery, an Eng-

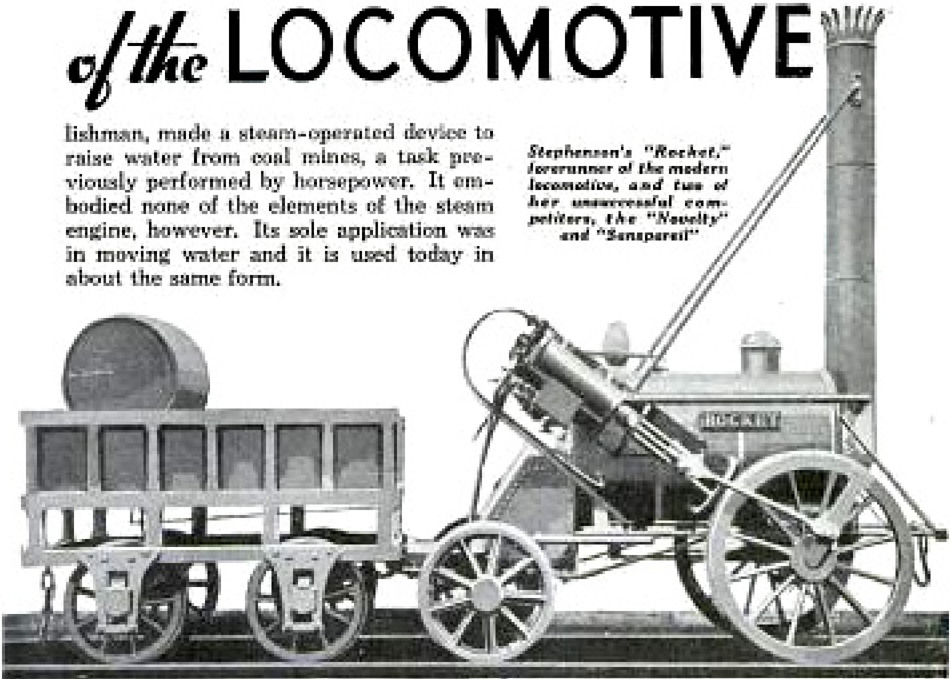
STEAM power, ruler of the rails for more than a century, today is being challenged by Diesel. Basically, this struggle for supremacy is a contest between the internal combustion engine and the principles which George Stephenson embodied in the "Rocket" more than 100 years ago.



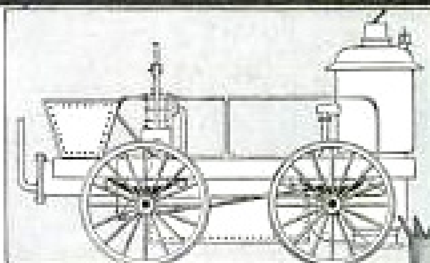
Action shot and cross-sectional view of modified streamliner of the Canadian National Railways. It is more than ninety-four feet long. Note automatic stoker

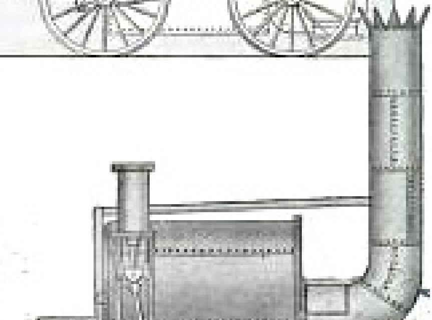
of the LOCOMOTIVE

lishman, made a steam-operated device to raise water from coal mines, a task previously performed by horsepower. It embodied none of the elements of the steam engine, however. Its sole application was in moving water and it is used today in about the same form.



Stephenson's "Rocket," forerunner of the modern locomotive, and two of her unsuccessful competitors, the "Novelty" and "Sanspareil"





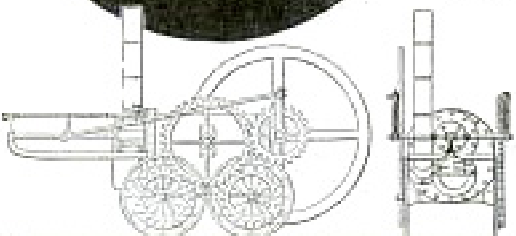
A few years later, Thomas Newcomen, an English blacksmith, built a steam engine operated by atmospheric pressure. His idea was to produce a vacuum on one side of a piston in a cylinder, utilizing the air pressure on the other side to do the work. He accomplished this by filling the space below the piston in an upright cylinder with low-pressure steam which was condensed by injecting cold water.

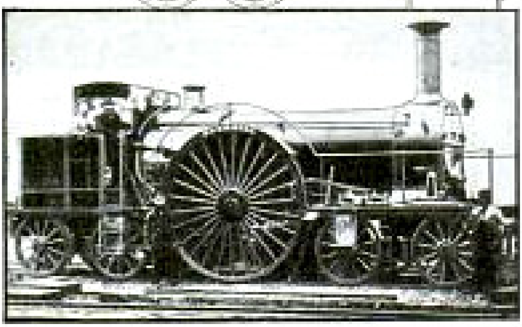
Newcomen's engine had a twenty-inch cylinder nearly eight feet long. It made twelve strokes per minute and was used to lift water from a coal mine, raising fifty gallons per minute from a depth of 156 feet. Early engines of this sort were used and gave good service until quite recent times.

It has been claimed that a boy was hired to operate the valves of Newcomen's engine. The lad was lazy, so the story goes, and devised a system of ropes to do the work for him. A copper-plate engraving of the engine, however, shows the valves were operated by mechanically actuated tappets.

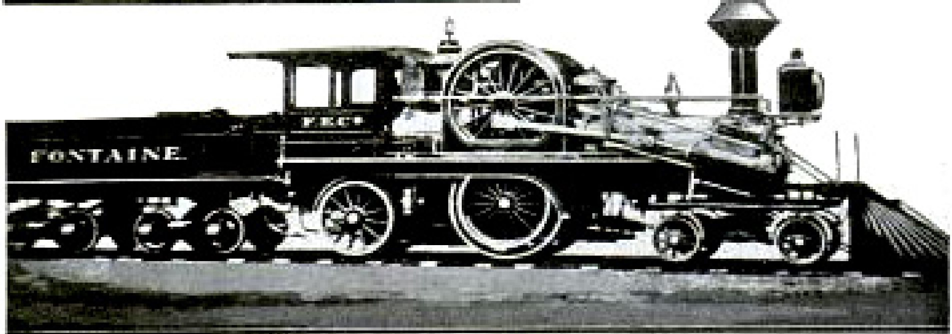
Another myth is that James Watt conceived the idea for his steam engine after watching steam raise the lid of a teakettle. Watt examined one of Newcomen's engines and from it got the idea for increasing the steam pressure to a point greater than atmospheric pressure and making the steam do the work, then condensing the exhaust steam in a separate vessel. Watt contributed much to human progress but little to the locomotive. His ponderous, slow-moving engines worked at pressures little above that of the atmosphere.

The first real attempt at steam locomotion was made, not upon one of the many mine tramways then in use, but on a country road. A French military engineer, Nicholas Joseph Cugnot, built a steam-propelled gun carriage which carried four passengers at two and one-fourth miles an hour. News of this invention eventually reached Richard Trevithick, a talented, ingenious Englishman who has been called the "father of the locomotive."

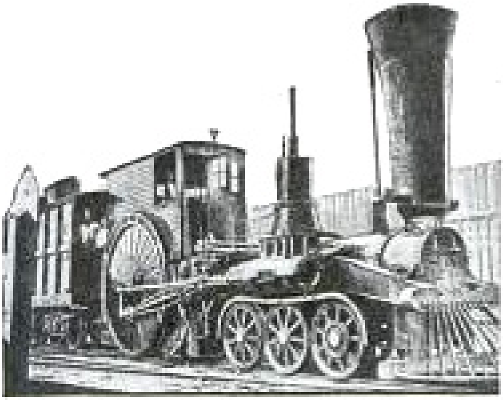




Trevithick, convinced that Watt's system of low pressure and condensation could be improved upon, had designed and built engines and boilers, some of which used the then unprecedented pressure of 145 pounds per square inch. He had discussed the steam-propelled gun carriage with a friend and this friend, sensing the possibilities, made a bet of 500 guineas that ten tons of iron could



Richard Trevithick and his "Tram Wagon," first steam-propelled locomotive to run on rails. Bottom, Pearson's "Bogie Tank" and the "Fontaine" which had speed, but little else



be hauled nine and three-fourths miles by steam power alone. Then he asked the inventor to help win the bet.

In trying to aid his friend, Trevithick built his "tram wagon," a steam engine and five cars or "wagons" to be operated over a mine tramway. The test was made in 1804. Ten tons of iron and seventy men were hauled over the distance specified in four hours and five minutes. The engine attained a speed of five miles an hour but was delayed, Trevithick wrote, because "we had to cut down some trees and

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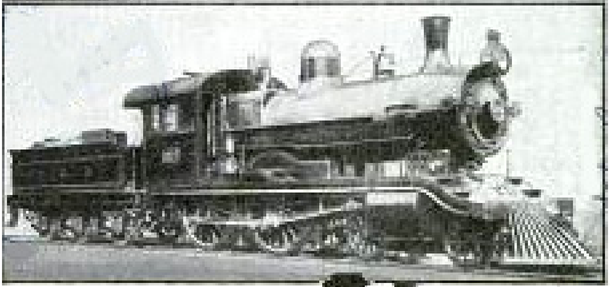

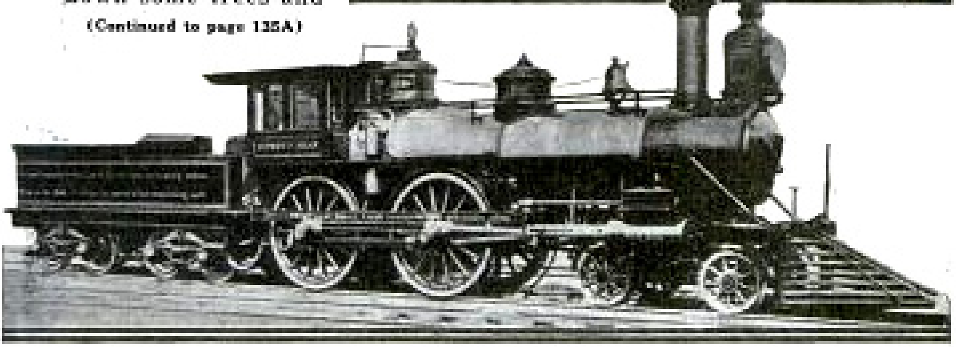

Stephenson and some unsuccessful locomotives which did not follow principles of his "Rocket." Top to bottom, a "Crampton," the "Speeding Truck," compound engine and so-called "balanced" locomotive

The Romance of the Locomotive

(Continued from page 867)

move some large rocks out of the road." Such was the first trip of the first steam-operated locomotive to run on rails.

Stephenson, whose life had been spent operating mine machinery, saw a second engine built by Trevithick, decided he could build a better one and began trying. Some of his locomotives were used in mines and on a short railway, but the attempts of Stephenson and others, up to this time, to solve the problems of steam locomotion with little six-ton creations, burdened with upright cylinders, walking beams, cog wheels and chain drives, and with steam pressures often as low as ten pounds, were almost pathetic.

About this time the merchants of Liverpool and Manchester decided to build a railway between the two cities to avoid the high rates and delays imposed by canal shipping. No one gave much thought to the power to be employed until the road was almost finished. Then Stephenson, who had established a locomotive building shop at Newcastle, urged the adoption of steam locomotives. Every prominent engineer was against him. Finally, however, he built one locomotive which was used in the final stages of the construction project.

Meanwhile the directors were deluged with plans for drawing trains along the line by water power, hydrogen, carbonic-acid gas and atmospheric pressure. They inspected locomotives in use at Newcastle but could not agree. Two engineers hired to report on the best kind of power suggested stationary engines and cable traction, involving the building of twenty-one fixed engines, with cables and machinery.

The harried directors objected to the expense. At last they offered a prize of 500 English pounds for the best locomotive for the purpose. The engine was to cost not more than 550 pounds and was to rest on six wheels if of the maximum weight of six tons. A lighter engine was preferred, so the rules specified that if it did not weigh more than four and one-half tons, it could rest on four wheels. If of maximum weight, the engine must be able to draw a weight of twenty tons, including the tender, at ten miles per hour and steam pressure was not to exceed fifty pounds per square inch.

(Continued to page 136A)

Continued from page 135A)

Engine and tender were to be mounted on springs, the "chimney" was not to exceed fifteen feet in height, and the engine was to "effectually consume its own smoke" because many declared that if locomotives came into general use, the sun would be obscured most of the time.

A straight stretch of track near Liverpool was selected as the testing ground. The length of the test run was to be one and one-half miles. Each engine was to travel the distance forty times, pulling on twenty runs in one direction and pushing on twenty in the opposite direction.

As the time for the test approached, four engines were nearing completion, among them Stephenson's "Rocket" which made her historic test run on October 8, 1829. Stephenson had learned from previous mistakes, and instead of upright cylinders, those on the "Rocket" were in an inclined position and applied the power direct to the drive wheels.

The multitubular boiler contained twenty-five copper tubes three inches in diameter, and the engine, being of the lesser weight prescribed, rested on four wheels. With the boiler full of water, the "Rocket" weighed 8,500 pounds, exclusive of the tender which weighed 6,400 pounds. On her test run, the "Rocket" hauled two "wagons," the total weight of engine, tender and train being seventeen tons.

The first twenty to-and-fro runs, totaling thirty miles, were made in two hours and fourteen minutes. The last twenty required only two hours and six minutes, an average of more than fourteen miles an hour. The quickest run was made in three minutes and forty-four seconds, equivalent to twenty-four miles an hour. Fourteen years later the "Rocket" attained a speed of sixty miles an hour. Two other engines eventually competed for the prize. One was the "Novelty," a "tank" engine which carried fuel and water on its own frame. The other was the "Sanspareil" with upright cylinders and return flue boiler. Both broke down during test runs, and the prize went to the "Rocket."

Thus George Stephenson, who did not invent the locomotive or any essential part of it, triumphed where others had failed. His happy combination of the multitubular boiler with the power of two cylinders applied directly to the drive wheels, and a proper relation between cylinder size and drive-wheel diameter established a principle which, after the lapse of more than a century, still holds good. To Trevithick, however, must go the credit for inventing what has been called "the greatest civilizing force of all time." He built and operated the first locomotive to run on rails and broke through Watt's system of condensation and low pressure.

Railroad history is filled with freaks which ignored the principles established by Stephenson. When the seven-foot gauge Great Western Railway was built in England, many innovations were tried out. One, the "Hurricane," had two ten-foot driving wheels and the boiler on a separate carriage from the locomotive proper. She hit 100 miles an hour when running light, but could not pull even a light train.

Passenger engines with nine-foot drivers were designed for the seven-foot gauge Bristol and Exeter Railway and ran for some years, but the design was not perpetuated. About the middle of the last century, the London and Northwestern Railway produced the "Liverpool" which developed high speed but had little hauling capacity. Similar engines were built in this country and later discarded.

The "Fontaine" locomotive employed the principle of the large and small pulley to obtain a high rate of revolution for the drive wheels. One such engine reached a speed, with two light coaches, of a mile in thirty-two seconds, a record for many years. When hooked to a heavy train, however, the "Fontaine" failed to deliver.

The return flue boiler, favored by many early designers, was revived in improved form several years ago. Theoretically, the return flue type saves fuel but higher cost of manufacture and upkeep more than offset this. Elimination of the "hammer blow" of the drivers on the rails at high speed was claimed for the "Henry Shaw," called a "balanced" locomotive. There were four cylinders and connecting rods but the remedy was worse than the disease.

Near the close of the last century, the compound locomotive was hailed as the engine of the future. Then came superheated steam with its greater economy and the compound engine disappeared—leaving the simple, two-cylinder locomotive first designed by George Stephenson again in possession of the field.