History and Development
of the
American Steam Locomotive.

By
R. H. Brown, '98.
History and Development of the American Steam Locomotive.

In this brief history of the development of the locomotive, only a few of the most important points can be considered.

Two hundred years ago, a harmless vapor arose with the morning sun, and floated away unheeded by all, except perhaps, the artist and poet. How is it today? From myriads of towering columns, o'er which the fierce firching flings his mantle, rushes in mimic clouds the quick breath of our newborn Titan.

The first steam engine of which we have any knowledge in America was at Schuyler copper mines in Passaic, N.J. It was more properly speaking an atmospheric engine and was imported from England in 1736.

The first engine constructed in America was built by Christopher Colles, in 1772. It was similar to the one which was imported, but was, however, very defective.

Thus it will be seen that it was less than a hundred years from the time America took her first lesson in a science that was
destined to work a revolution in the whole world, before she was a leader.

In 1787, Jos. Fitch built the first condensing engine, and this without the help of Watt's experiments. Then came Fulton, and the improvements of Stevens, and Oliver Evans, the first to apply high-pressure engines to common use, and show its advantages not only to stationary, but portable engines, from which we may date the invention of the locomotive engine, for it was only the experience of Stevenson in tram-roads that led him at a later day to the invention of the latter; and Watt's engines could never have been used on account of their great size.

Engines were first applied to common road carriages. Then the introduction of railways turned the attention of mechanics to them, and steam-carriages were abandoned.

The first railway built in the United States was from Milton to Quincy, Mass., a distance of two miles, in 1826. The Baltimore and Ohio, was the first passenger railroad, and was opened in 1830, a distance of 15 miles, with horse-power.

The first locomotive, upon a railway
A. Boiler
B. Smoke-box
C. Steam-chest
D. Cylinder
E. Pilot
F. Front truck
G. Air head & guides
H. Main rod
I. Connecting, or parallel rod
J. Driving wheels
K. Smoke stack
L. Headlight
M. Bell
N. Sand box
O. Steam dome
P. Whistle
Q. Cab
R. Fire box
S. Suction pipe for injector
T. Air pump
U. Injector pipe
V. Sand pipe
W. Links, and valve motion
X. Valve stem
Y. Running board
Z. Tender, or tank
in this country, was built at Stourbridge, Eng., called "Stourbridge Lion", and imported by a
Mr. Allen.

The first locomotive built in this country
was built by Peter Cooper, in 1829. It was a
small crude affair, the boiler not as large as
as kitchen boilers attached to many a range in
modern houses of today. It could run 15
miles per hour on slight down grade.

The second engine, and the first built for
actual service was the "Best Friend" built at
West Point Foundry, New York, in 1830. The
wheels were made with iron hubs, wooden spokes
and fellows with iron tires. It had a
successful run, until one day the negro
fireman, becoming tired of hearing the noise
of escaping steam, put his weight on the safety-
valve, and exploded the boiler, killing the
fireman and scalding the engineer, thus
we have in the "Best Friend" the first loco-
motive built for use, and the first locomotive
boiler explosion on record.

The third locomotive was called "West Point"
built in 1830, by West Point Foundry. It was
about the same as "Best Friend" only that
it had a horizontal tubular boiler, instead
of a vertical one. The working of this engine in actual service was very satisfactory.

The fourth engine was the "DeWitt Clinton", built in 1831. Its cylinders were 15 1/2 inches in diameter and 16 inch stroke, the four wheels were connected; they had cast-iron hubs and wrought iron spokes. This engine weighed nearly four tons, and could run about 30 miles an hour on level road. It used anthracite coal.

In 1832, several engines were built for the Baltimore and Ohio Railroad. In Nov. 1832, Mr. Baldwin, (founder of the Baldwin Locomotive works) built a locomotive called "Old Ironsides" which did good service for 20 years. This engine was the last copy of English Engines.

In 1834, Mr. Baldwin built another engine for a South Carolina Railroad. This engine was six wheeled, cylinders 10"x16". His boiler also had a high dome over the firebox, which has been improved, but never changed, even up to date.

By this time, several builders entered the field, each improving the then existing types until we have the American locomotive of today— one of the most perfect pieces of
mechanism brought by the hand and mind of man.

Mr. Baldwin now introduced outside cylinders and connected engine, doing away with crank axle, and placing the machinery where the engineer could see it.

It would be tedious to follow the construction and alterations of various locomotives. We will, however, mention a few most important improvements.

The truck frame in front of the engine, used in 1832. The four eccentric, patented by J. H. Long, in 1830, and first used in 1833.

The Rogers works began in 1837. This shop made several material improvements: enlarged the boiler in proportion to the cylinders, established link-motion, and covered the steam chest and cylinder to prevent radiation. They were the first to adopt the fuel stroke pump.

Coal rapidly superseded wood as fuel for engines; while it is true that some of the first engines were coal burners, yes wood had been the principle fuel for years.

The American engine has several marked
distinctions from the English. What strikes
the eye of the observer the most is the cab, or
house for protection of the enginemen. This
is peculiar to our locomotives. We have
our driving wheels on outside of the frame and
each set is arranged separately from the others.
The English engines are encased by the frame-
work, and all bearings fastened to this frame.

An English engine could not run 20 miles
per hour with safety on our tracks, on account
of its rigidity. A common criticism
is that the American engine is too loose-jointed
to speak; but there is not an engine in
the world that excels it, and put one of our
best express engines on the English tracks, and
we can show them some speed. As it is,
we started out with engines that could run
from 15 to 18 miles per hour, and have
gradually developed to ones that make from
100 to 112 1/2 miles per hour, and regularly
haul trains from 70 to 80 miles per hour.
However, 40 miles, is about the average.
This is accounted for by poor roadbed, and
not enough tracks.

Now that we have traced the first
locomotive down to modern ones, a few
points on the construction of the modern locomotive, may be interesting.

A locomotive must combine within itself, the means for generating steam, its application to produce motion within the engine, and also the propulsion of the whole upon the road.

A complete engine then, combines three distinct arrangements for realizing these conditions.

The source of power is boiler and firebox. The means to produce motion within itself, are, the cylinders, valves, pistons and various connections; and the tractive force, by the adhesion of the wheels, secure the motion.

The surplus power is used to draw great loads upon the rails.

The engine consists of a frame; and boiler, cylinders, driving wheel axle boxes, and forward truck which are securely fastened to it.

The driving wheels are placed under the back half of the frame with their axles placed in the axle-boxes; these wheels are connected by main rod to the cross-head, and that to the piston, and so motion produced in the cylinder, on the piston is transmitted to the driving wheels.
A rough drawing will show the position of the parts, much better than a large number of words. So on the next page is an illustration taken from a model locomotive, made by myself, in the shops, last year. It is one seventh of a full size locomotive, but as the figures may be omitted it will answer as well as if drawn from a large one.

The steam is produced in a boiler "A", cylindrical in shape with a rectangular firebox at one end, surrounded by a water casing to prevent the destruction of plates from hot fire. A large number of tubes convey the heated air and gases and products of combustion, through the boiler to smokebox "B". These tubes are small and thin so as to give off the heat rapidly to the surrounding water. The surface of the firebox and the tubes, constitute the heating surface of the boiler.
From the smokebox, these gases, etc., escape to the open air through the smoke stack "K", the draught of the fire is produced artificially by the exhaust steam going up the chimney; the stack is smaller in diameter than the cylinder, and when a cylinderful of steam is exhausted it more than fills the stack and as it has considerable force yet, it pushes all of the smoke out of the stack and also creates a vacuum behind it and draws more smoke up the stack, and the next exhaust acts the same way, and so on, so that, when running fast there is a powerful draught produced.

The second division of the arrangement of the engine is that where the power is applied to produce motion within the engine itself.

On top of the boiler at the back end is the steam dome "O". In this is a large pipe, which conveys the steam to the cylinders. Its mouth is placed in the dome so as to raise it as high from water level as possible also that it may be over the firebox to get the driest steam. The throttle valve is placed on mouth of this pipe, and is connected by a rod to the throttle lever which is in easy reach of the engineer.
Within the smokebox, this pipe divides into two branches, each end going to a steamchest. This steamchest communicates with the cylinder by means of openings called ports, and steam is alternately admitted to each end by means of the slide-valve. When the steam is in the cylinder, it exerts its force upon a moveable piston, and after the piston has moved the length of the cylinder, the used steam is allowed to escape, and is called exhaust steam. The mouth of the nozzle for exhaust steam is contracted somewhat, and this forms a powerful blast. In this short history, the theory, construction, and working of the valve gear cannot be discussed, as this in itself would require a long and complicated article.

Let us now see how the motion given to the piston is transmitted to the driving wheels, thus propelling the machine. Within the centre of the piston is the “piston rod,” which is fastened to a crosshead, which slides back and forth in the guides. This insures the piston moving in the line of the axis of the cylinder. To this crosshead is fastened the “connecting-rod” and this connects with the crank-pin of the driving wheel. As there
are two cylinders and two connecting rods, the
pivots are set at right angles to each other, so
that when one side is on "dead centre" the other
side is exerting the most force, and thus pulls
the wheels over this point.

The motion of the slide valves is derived from
eccentrics. These are four of them on forward
set of driving wheels, between the wheels.

There are two eccentrics to each valve, one
placed so as to give forward motion to the engine,
and the other a backward motion. These are
encircled by eccentric strips, and to these are fastened
a rod, and these rods are joined by a link. Two
eccentrics to a link. These two links can be
raised or lowered by a lever in the cab, called
"reverse lever," it works as follows: - When the
links are down, the 'go-ahead' eccentric are
brought in a line with the valve steam, and the
valve is operated by that eccentric, but if the
links are raised the valve is operated by the
backing eccentric, and thus the engine can be
made to go backward or forward at will.

It can easily be seen that there must be a
neutral point between full gear forward and
full gear backward, and so there is, called
"centre." This is when the centre of link is
in a line with valve stem, so that neither eccentric has any effect on the valve. This is useful in case of a mishap to the throttle valve.

It is now easy to trace the operation of steam and the machinery put in motion by its action on the piston.

The remaining parts of the engine are the rear pair of drivers coupled to forward pair. The only object of these is to obtain greater adhesion to the rails and help share the weight.

The bell and whistle are for signals; the headlight, to illuminate the track ahead at night; the sandbox and pipe, to put sand on the rails when slippery; the running board is to enable the engine men to get to front of the engine while it is in motion; the injector is used in place of a pump to fill the boilers with water raised to certain degree of temperature.

The average American locomotive has a maximum life of about 30 years.

The annual cost of repairs is 10 to 15 percent of first cost. Each engine requires one quart of oil and about one ton of coal for every 50 miles run.

END.