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THE HISTORY OF SUPERHEATED STEAM

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The subject of superheated steam is so well known, and the savings obtained through its use so well recognized on nearly all sides, that any further introduction of the subject is unnecessary. Very few complaints are on record where superheated steam has not done all that was expected of it where intelligently applied in lines defined by considerable experimental work on the part of the principal exponents of the subject. In marked contrast to the present development of superheating in Canada and the United States, is the reported disfavor into which superheating appears to have fallen in Germany, where it is stated that much more economical operation may be obtained through compounding rather than superheating. Consequently, there is a material decrease in the number of locomotives being built that are equipped with superheaters, the compound locomotives growing proportionately greater in number.

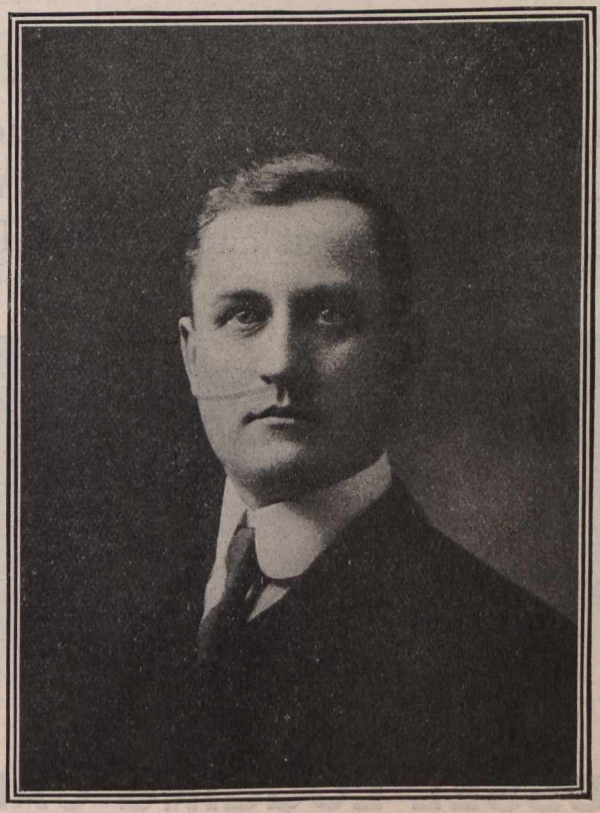
This, however, is digressing from the historical phases of the subject, which are many and varied, for while, as will be noted in the following, many attempts have been made to introduce superheated steam into use in both stationary engine and locomotive practice, nothing of practical value in that direction was accomplished until within the last few years.

Early Attempts.

The earliest recorded attempt at using the principles of superheating was made in 1828 by Richard Trevethick at the Birnie Down Mines in Cornwall, on a condensing pumping engine, making 8 revolutions per minute, with a boiler pressure of 45 lbs. per square inch. At this slow speed, and with such lagging materials as were in use in those days, the condensation was very great. Trevethick conceived the idea of reheating the steam in the cylinder to re-evaporate the condensation. To attain this end, the cylinder and piping were surrounded with firebrick and heated from a fire on a grate beneath. A remarkable saving was noted; ordinarily 9,000 lbs. of coal were consumed per day, whereas with a fire under the cylinder, only 6,000 lbs. were required, including the coal for the superheating grate. This led to further experiments by Trevethick, resulting in his tubular boiler and superheater in 1832, which, it is claimed, is quite modern in appearance.

The same year saw another superheater produced, this one being invented by I. Howard, of Bermondsey; an economy of 30% was obtained. In 1835, Dr. Haycroft, of Greenwich, advocated the use of superheated steam, and in experiments which he conducted, practically the same savings as those noted by Howard were obtained. It will thus be seen that at a very early date, it was realized that as steam expanded, in order to prevent condensation, it was necessary to add heat; this is the superheat.

The period from 1835 to 1848 furnishes no records of any work having been performed on the principles of superheating. In the latter year, the first superheater ever applied to a locomotive was introduced by John Cockerill, of Serang, Liege, Belgium, so that this date is, so to speak, a very important landmark in locomotive development. This superheater consisted essentially of a shell in the smokebox, with an annular space around the stack, and, while nothing is known of its actual operation, it has been inferred that from its nature and position, it cannot have done more than dry the steam, naturally affecting the economy, but slightly. Several more modern attempts at obtaining economy have failed from the same cause.



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The next attempt made was by M. Moncheuil, for the Montereau and Troyes Railway, the types used being ones patented by M. A. De Quillacq in 1849. M. De Quillacq devised three types, all of which were used by M. Moncheuil. The first two types had the same principle, having flame flues containing the superheater tubes, the former, however, having only one flame-flue with coils for superheating, while the latter had several. These two kinds were applied to 2-2-2-type locomotives. The third kind was unique in design, consisting of a drum on top of the boiler, in the top of the firebox; part of the gases ascended through a damper-regulated opening, and through a large pipe in the centre of the drum to the stack. The pipe passing through the drum longitudinally, formed an annular space for the superheating of the steam.

The next type was that devised in 1852 by Mr. Haswell, of the Vienna Locomotive Works. It consisted of a coil located in the firebox for the superheating; it is doubtful if one was ever constructed. Shortly after, in 1855, M. Montety, a French engineer, devised a new type, consisting of a coil in a large flame-tube, similar to one of the Moncheuil types, with the exception that the coils were secured to steam reservoirs corresponding to headers of the modern types.

Early Scientific Investigations.

About this period, superheating was being investigated scientifically by the Alsatian engineers, who are known in engineering history for their discoveries in thermodynamics, laying down many of the underlying principles that are now in common use. In 1857, Mr. Hirn, the leading light of this group, issued a report of trials and experiments made by him on the value of superheating, which showed that a large gain might be expected. The boiler pressure used by him was 55 lbs. per square inch, with a temperature of from 410 to 490 degrees F., obtaining economies of from 20 to 47%, which would seem to be greater than those at present. This, however, is due to the fact that saturated steam engines are much more efficient now than at that time.

This scientific investigation begun by Hirn, was continued by John Penn, who, in a paper on superheating, presented before the Institute of Mechanical Engineers, referred to several cases of superheating then in successful use. In 1860 a total of 5,000 horse-power had been equipped with superheating devices, the surface employed being from 2.25 to 2.75 square feet per nominal horse-power; most of the experimenters were agreed on this particular, and obtained about the same efficiency.

In 1860, also, Parsons and Pilgrim's method of superheating, as applied to steamboats on the Thames, was explained in an Institute of Mechanical Engineer's paper. Their method was the first to embody the present-day principle of placing the superheater as near the fire as practicable to obtain a high degree of superheat, for in this case the superheater consisted of iron pipes in, and forming part of the fire-grate. This was a radical change, for all other cases of marine superheating used the waste gases.

Mr. Haswell devised still another locomotive type in 1862, using the waste gases, the superheater being concentric with the stack. Still another change occurred in 1863, when a Mr. Crawford invented a new type, in which part of