A BRIEF HISTORY OF LOCOMOTIVE SUPERHEATING

A superheater is a device used to convert saturated (or 'wet') steam into superheated (or 'dry') steam. Superheated steam is used in steam turbines for electricity generation and marine propulsion, steam engines (including locomotives), and in other industrial applications.

The superheater re-heats the steam generated by the boiler, increasing its thermal energy and decreasing the likelihood that it will condense inside the engine. Superheaters increase the thermal efficiency of the steam engine and have been widely adopted. The main advantages of superheating are a reduction in fuel and water consumption but there is a price to pay in increased maintenance costs. In most cases the benefits have been found to outweigh the costs.

In steam locomotive use, the most common form of superheater is the fire-tube type. This takes the saturated steam from the boiler *dry pipe* into a superheater header mounted against the tube sheet in the smokebox. The steam is then passed through several superheater elements. These are long pipes which are located inside large-diameter fire tubes, called flues. Hot combustion gases from the locomotive's firebox pass through these flues just as they do the firetubes, and as well as heating the water they also heat the steam inside the superheater elements over which they flow. The superheater element doubles back on itself so that the heated steam can return. Most do this twice at the firebox end and once at the smokebox end, so that the steam effectively travels four times the length of the flues while being heated. The superheated steam, at the end of its journey through the elements, passes into a separate compartment of the superheater header and then to the cylinders when the throttle valves are open.

Dr Wilhelm Schmidt, of Kassel, Germany—whose investigations extended over a period of forty years—is considered to be the pioneer of practical superheating. In 1898 Dr Schmidt—assisted by Dr. Robert Garbe, Chief Mechanical Engineer of the Berlin division of the Prussian State Railways and Jean Baptiste Flamme, Chief Mechanical Engineer of the Belgian Railways—started the commercial application of superheaters to railway locomotives, the first superheated engines being placed in service on the Prussian State Railway. It is from that date that the practical history of superheating commences, but his successor company—Schmidt'schen Heissdampf—became ALSTOM Power Energy Recovery GmbH GmbH (now called Schmidtsche Schack, a division of the ARVOS Group, following a 1995 merger with Rekuperator Schack GmbH, Düsseldorf). The company develops and builds apparatus for the processes involved with the transfer of heat in the petrochemical, chemical and metallurgical industries (e.g. cracked gas coolers for the manufacture of ethylene, gas coolers for the manufacture of methanol, ammonia and hydrogen and a multitude of equipment for special purposes). The company continues to be highly innovative and a market leader in its field.

The first superheated locomotive—a Prussian S4 series—was built in 1898 and produced in series from 1902. The benefits of the invention were demonstrated

in the U.K. by the Great Western Railway in 1906. The GWR Chief Mechanical Engineer, G. J. Churchward believed that the Schmidt type could be bettered, and eventually developed the Swindon No. 3 superheater in 1909.

Early locomotive superheaters—which were of the smoke-box type—achieved only a moderate degree of success; the total number of engines fitted being less than 150. In 1902, however, Dr Schmidt introduced his Smoke Tube Superheater, which proved so successful on the Continent, that—in 1908—the Schmidt Superheating Company Ltd, was formed to develop the use of this design in Great Britain.

In 1910 the progress made by Dr Schmidt in Europe resulted in the formation of The Locomotive Superheater Company (now The Superheater Company) in the United States, to develop the use of his apparatus in that country. The Schmidt Superheating Co Ltd was reorganised in 1919, and renamed Marine & Locomotive Superheaters Ltd, and, finally—in 1924, after amalgamation with the Superheater Corporation Ltd—assumed its present title of The Superheater Company Ltd.[1]

The *MeLeSCo* emblem (also seen as 'MLS') found in catalogues and other literature is thought to have derived from abbreviation of the ***M***arin***E*** and ***L***ocomotiv***E S***uperheater ***Co***mpany.

Improved superheater adaptations were introduced by John G. Robinson[2] of the Great Central Railway at Gorton locomotive works, by Robert Urie of the London and South Western Railway at Eastleigh railway works, and by Richard Maunsell of the Southern Railway, also at Eastleigh.

In the early days of practical superheating only moderate final steam temperatures were employed, particularly in the case of marine and stationary reciprocating engines, about 550 °F (288 °C) being the maximum temperature in this class of work. In the case of locomotives, temperatures were somewhat higher and, for a time, progress in superheating was largely confined to this field. The introduction of the turbine gave a further great impetus to the use of superheated steam for stationary engine work, and the advantages of higher final temperatures were recognised.

This demand for higher superheat has persisted, and now the use of steam at 900 °F (482 °C) is common. In locomotive and marine work there was a similar trend in development, higher steam pressures were also being employed, and revolutionary changes in boiler design and methods of firing occurred.

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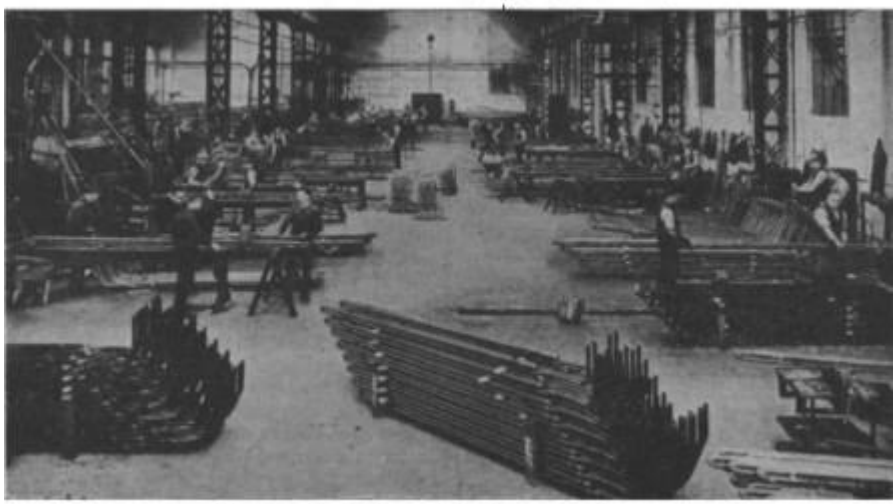
[1] The Superheater Co (New York, Chicago, and Montreal) later represented The American Throttle Co Inc, manufacturers—among other things—of *American* Multiple-Valve front-end locomotive throttles and *Elesco*-brand equipment. For later-model NZR steam locomotives, the terms 'MLS' and 'American'—to define the front-end MV throttles fitted—are interchangeable.

[2] *Robinson* superheaters eventually became one of the products manufactured and sold by The Superheater Co.

The works of the Superheater Company Ltd were built in 1914 and situated in Mosley Road, Trafford Park, Manchester, close to the Ship Canal, with easy access to the main Manchester-Liverpool road, and with private sidings affording direct communication with the LMS and LNER. From the outbreak of the WWI the works were engaged on the production of munitions as a controlled establishment until 1918.

The works became well-known for the "MLS" integrally-machine-forged return-bend superheater elements for marine, locomotive, and stationary boilers.

WORKS OF THE SUPERHEATER CO., LTD., MANCHESTER, ENGLAND.



View shewing the locomotive element forging plant.

The Superheater Company had associations as follows:
The Superheater Co Ltd (Canada), The Superheater Co (Australia) Pty Ltd, The Superheater Co of New York, Compagnie des Surchauffeurs (Paris), and agencies in India, the Union of South Africa, the Dominion of New Zealand, and a few other countries.