

**LOCOMOTIVE COMPOUNDING AND
SUPERHEATING. A PRACTICAL TEXT-
BOOK FOR THE USE OF RAILWAY AND
LOCOMOTIVE ENGINEERS, STUDENTS,
AND DRAUGHTSMEN, PP. 1-187**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649638536

Locomotive Compounding and Superheating. A Practical Text-Book for the Use of Railway and Locomotive Engineers, Students, and Draughtsmen, pp. 1-187 by J. F. Cairns

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Cover @ 2017

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J. F. GAIRNS

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Four-cylinder Compound Express Locomotive, North-Eastern Railway. Designed by Mr. Wilson Worsdell.
Compounded on Mr. W. M. Smith's System (1906).

LOCOMOTIVE COMPOUNDING AND SUPERHEATING.

A Practical Text-Book

FOR THE USE OF RAILWAY AND LOCOMOTIVE
ENGINEERS, STUDENTS, AND DRAUGHTSMEN.

BY
John
J. F. GAIRNS.

With Frontispiece and 148 other Illustrations.



LONDON:
CHARLES GRIFFIN & COMPANY, LIMITED,
PHILADELPHIA: J. B. LIPPINCOTT COMPANY.

1907.

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P R E F A C E.

It is now just upon thirty years since the first practical compound locomotives were built, but even yet the compound locomotive does not occupy the universally accepted position which theory would suggest that it should do. But whereas in the early years of its existence as a definite feature of locomotive engineering practice it was looked upon in most quarters with disfavour and distrust, and the engineers first concerned with the design of such engines had to contend against prejudice and opposition, and had no easy task to obtain even a trial of their systems, now the position is far more favourable, and compound locomotives according to many different systems are to-day in use to the number of many thousands in various parts of the world. In fact, it is not claiming too much to say that the compound locomotive occupies to-day an assured position, and it is probable that before many years have passed it will become a standard feature of locomotive engineering in all countries.

As regards compounding for locomotives, Great Britain has maintained its reputation for conservatism, for its record in this respect is not a very satisfactory one as compared with the experimental and original work to be attributed to foreign locomotive engineers; but this is largely the result of different circumstances and policy.

In this country the Locomotive Superintendent or Chief Mechanical Engineer of a railway is responsible for the design and efficiency of large numbers of locomotives doing very hard and greatly varied work; but he is not encouraged to experiment or to depart radically from standard methods: and in most cases he has to design engines which are developments of previously existing designs, each class being somewhat more powerful, more reliable, and yet more simply and cheaply constructed proportionately than its predecessors. The engines are also generally required to be capable of doing much work for which they are not specially designed. Consequently, actual novelties are few in British locomotive history, and notable experiments and changes in methods of design occur only once or twice during, it may be, a long term of service of a particular engineer as locomotive chief. Individual originality of persons not occupying principal positions has very little opportunity in this country, rightly

so in view of the important interests at stake when a change of engineering policy may entail the expenditure of many thousands of pounds, probably with no satisfactory benefit, but unfortunately also with the loss of much valuable experimental work, which, even if a failure, may add greatly to engineering knowledge.

In the case of British locomotive building firms little scope is provided for original work on their part, though, as they deal with many railways both at home and abroad, their experience and opportunities are, in some ways, more extensive than in the case of the railway officials; but as a rule they are employed to build engines to designs provided by the railway officials, and such an occurrence as the building of an engine by the Vulcan Foundry Co., Ltd., to their own designs, for the Great Northern Railway, in 1905, is very rare indeed.

Abroad, however, the Chief Mechanical Engineers or Motive Power Superintendents are in many cases responsible principally for the maintenance and repair of locomotives, and the design of new engines is largely the duty of superior engineers retained by the railway, or of consulting engineers whose position is more independent than our own Locomotive Superintendents, while the various locomotive building firms are encouraged to introduce novelties and to experiment in new directions, sometimes in competition with one another; their orders being, in many instances, to provide engines which are capable of doing certain work with the greatest efficiency, the builders having, in a large measure, a free hand. As an example of this may be mentioned the official competition instituted in Germany at the beginning of 1905, when a number of locomotives designed wholly by individual firms, and in several cases embodying radical departures from ordinary methods, were officially tested, a number of similar engines being afterwards ordered for regular service in two or three instances, though not all the competing engines were successful.

On the other hand it must be remembered that Great Britain is only a small country, without an extensive assortment of varying circumstances and conditions of work, while Europe comprises many countries of large area which provide almost every conceivable set of conditions to be provided for by locomotive engineers. There is therefore much greater justification for special and unusual locomotive design abroad than in Great Britain, where, generally speaking, all requirements can be met by locomotives of selected standard classes.

The foregoing remarks will, it is thought, go far to explain the fact that, as regards the compound use of steam for locomotives, three or four names only can be mentioned as of special note among British engineers in this respect, whereas thirty or forty engineers and firms require corresponding mention in connection with Continental and American practice, while, as regards the use of superheated steam, the credit must almost entirely be divided between German, Canadian, American, and Belgian engineers.

Having thus provided some explanation of the fact that in this work about 80 per cent. of the matter included relates to the work of foreign engineers, a few notes regarding the scheme followed by the writer in its preparation will be in place.

The subject of compounding for locomotives has received frequent attention in the technical press of this and other countries, articles in some cases being fairly comprehensive within their scope, and containing much valuable information as regards technical and theoretical matters; but, so far as the present writer is aware, only three really technical publications may be considered as being properly indicative of the world's practice. These are:—

(1) The late Professor Wood's book on *Compound Locomotives*, published in the United States in 1892-3.

(2) Mons. Edouard Sauvage's articles, which appeared in 1897 in *La Revue des Mécaniques*.

(3) Herr E. Brückmann's paper, which appeared in 1896 in *Der Zeitschrift des Vereines deutscher Ingenieure*.

As will be seen, none of these are sufficiently up to date to cover recent practice, and although Mons. Sauvage has to some extent noted later development by many contributions to the French Engineering Press, and by papers presented to our own Institution of Mechanical Engineers, it is correct to state that no approximately thorough review of locomotive compounding has ever been published in this country, nor has any work of this kind been published for many years in any country.

To provide a substantially complete and systematic work on this subject has been the object of the writer, who, in addition to his own very considerable knowledge of the world's locomotive practice, has been favoured with private information from locomotive engineers and locomotive building firms. Articles which have appeared in technical magazines and journals, as well as papers read before engineering societies, have also been carefully considered, and general acknowledgment is hereby made of such assistance. Specific reference is gratefully made to the following gentlemen, firms, and journals in particular:—

(a) Messrs A. Mallet, A. G. de Glehn, C. Baudry, G. du Bousquet, Walter M. Smith, S. M. Vauclain, F. J. Cole, the late A. von Borries, K. von Gölsdorf, A. Lindner, A. Brunner, etc.

(b) The firms of Alsatian Works, Hanover Engine Works, Saxon Engine Works, Baldwin Locomotive Works, American Locomotive Co., Rogers Locomotive Works, A. Borsig, J. A. Maffei, C. Breda, etc.

(c) The chief engineers of the French State, Eastern and Southern Railways, and of the Hungarian and Swedish State Railways, etc.

(d) The Proceedings of the Institutions of Mechanical and Civil Engineers, the American Master Mechanics' Association, the French Institution of Civil Engineers, *The Engineer*, *Engineering*, *La Revue Générale des Chemins de Fer*, *Railroad Gazette*, *Locomotive Magazine*,