SLIDE VALVE GEARS: AN EXPLANATION OF THE ACTION AND CONSTRUCTION OF PLAIN AND CUT-OFF SLIDE VALVES

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Slide valve gears: An explanation of the action and construction of plain and cut-off slide valves by Frederick A. Halsey

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FREDERICK A. HALSEY

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Trieste

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AN EXPLANATION OF THE ACTION AND CONSTRUCTION OF PLAIN AND CUT-OFF SLIDE VALVES.

BY

FREDERICK A. HALSEY,

ASSOCIATE EDITOR OF THE "AMERICAN MACHINIST."

CONSULTING ENGINEER OF THE RAND DRILL COMPANY; MEMBER OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Analysis by the Bilgram Diagram

ELEVENTH EDITION, REVISED AND ENLARGED.

NEW YORK:
D. VAN NOSTRAND COMPANY,
23 MURRAY AND 27 WARREN STREETS,
1908

TO

Professor John E. Sweet,

TO HAVE BEEN WHOSE PUPIL I CONSIDER ONE OF THE
GREATEST PRIVILEGES OF MY LIFE,
THIS LITTLE VOLUME IS GRATEFULLY INSCRIBED.

PREFACE.

THIS work has been prepared to meet what the author considers a real want. It has been written with the aim of making it intelligible to any one who might be willing to make a serious effort to understand it. High authority exists for a mathematical treatment of the subject, but with this the author has no sympathy. Designing a valve gear is essentially a drawing board process, and a mathematical treatment of it is simply an uncalled for use of heavy artillery. The graphical treatment is therefore adopted throughout.

Acknowledgment is due to Mr. Hugo Bilgram for his courtesy in kindly permitting the use of his valve diagram. The author has all due respect for the Zeuner diagram, but that respect is not incompatible with the conviction that Mr. Bilgram's method is a marked improvement upon it. Valve diagrams are used for two purposes—to analyze existing valve motions and to design new ones. The Zeuner diagram fulfils the first purpose perfectly, but is unsatisfactory when applied to the second. The leading data that are given in designing a valve motion are the point of cut-off, the port opening, and the lead of the valve (not the lead angle of the crank, as is often conveniently assumed). It is the radi-

cal defect of the Zeuner diagram that none of these dimensions can be laid off from known points. The lead must be laid off from an unknown point of the centre line, and the port opening from an unknown point on an unknown line. Finally, through these unknown points and the centre of the shaft the valve circle is to be drawn from an unknown centre and with an unknown radius. Under these circumstances the result sought is found only through blind trial. With Mr. Bilgram's method all this is changed. The lead is laid off from a fixed line, the port opening from a fixed point, and the cut-off position of the crank is located. The lap circle is then drawn tangent to these lines, and the problem is solved. Moreover, the awkward conception of the backward rotation of the crank is obviated. Finally, these marked advantages are not accompanied by any compensating disadvantages whatever.

Acknowledgment is also due to the *American Machinist* for the use of a number of engravings originally prepared to illustrate some of the author's articles in that paper.

The irregularities due to the connecting rod introduce peculiar difficulties into the study of the first principles of the slide valve, which difficulties were first overcome by the happy expedient of using the slotted cross-head instead of the connecting rod in the preliminary study. For this, together with many other original and highly valuable contributions to the subject, we are indebted to Mr. W. S. Auchincloss, who first published them in his well-known and standard work entitled *Link and Valve Motions*, to which those who wish to prosecute their studies beyond the scope of this work are referred.

The author has gone more fully than is customary into the methods of equalizing the various events of the stroke. The sections relating to these methods will be found more difficult to follow than the others, while at the same time they form no necessary part of a *general* treatment of the subject. Those who begin their studies of valve motions with this book, may find these chapters too difficult for the first reading. They have, therefore, been marked with a star (*) in the Table of Contents and in the body of the book, in order that they may be omitted, if desired, in the first reading: and it should be understood that the chapters not so marked form of themselves a complete connected treatise, of a more elementary character than the book as a whole.

PHILADELPHIA, Oct. 19, 1889.

PREFACE TO THE SIXTH EDITION.

THE chief addition to this edition will be found in Part IV, which comprises some articles written for the *American Machinist* and republished here by permission of the American Machinist Publishing Co.

The analysis of the action of the link motion here given, while qualitative rather than quantitative, is believed to recognize two sources of error in that gear for the first time, and to show that the error due to the angular vibration of the connecting rod, heretofore considered the chief error of the gear, is really of minor importance, and, in fact, properly considered, is a corrective and not a disturbing factor, since its effect is to partially compensate another and much larger error.

Advantage has been taken of the opportunity offered, to make a few minor changes, the most important of which is the extension of the section upon Exhaust Lap, with the addition of two full page diagrams to it. The author's observations have shown him that much confusion prevails among students regarding this subject, which seemed to justify a more detailed treatment of it than that given in previous editions.

The author desires to acknowledge his obligations to the Schenectady Locomotive Works for facilities afforded for examining their present-day practice in link motion construction, without which the study here embodied in print would not have been undertaken.

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