

THE HEAT TREATMENT OF TOOL STEEL

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The Heat Treatment of Tool Steel by Harry Brearley

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HARRY BREARLEY

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OF TOOL STEEL**

HEAT TREATMENT OF TOOL STEEL

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THE
HEAT TREATMENT
OF TOOL STEEL

*AN ILLUSTRATED DESCRIPTION OF THE PHYSICAL
CHANGES AND PROPERTIES INDUCED IN
TOOL STEEL BY HEATING AND
COOLING OPERATIONS*

BY
HARRY BREARLEY
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WITH ILLUSTRATIONS

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LABOUR AND LEARNING HAVE BEEN AGREEABLY COMBINED

FROM 1883 TO THE PRESENT TIME

THESE PAGES ARE RESPECTFULLY DEDICATED

BY THE AUTHOR

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PREFACE

THE following pages are intended to be helpful to the trained artizan and foreman, whose business it is to produce steel objects and tools for various purposes. Also to the merchant, manufacturer's representative, and other official, who frequently meet complaints which they would like to fathom, and are often called upon to assume a knowledge of the properties of steel somewhat out of proportion to the opportunities afforded by the daily routine of their business.

In the steel trade, perhaps more than in any other trade, the consumer looks to the manufacturer to furnish instructions about all materials and processes relating to the properties of steel. This state of affairs arose quite naturally at a time when the means at our disposal for investigating and classifying tool steels were confined exclusively to an examination of the fractured ingot or bar. This kind of examination the steelmaker developed into an art, which he practised with wonderful proficiency and accuracy long before the science of analytical chemistry was competent to replace his "tempers" by percentages of carbon.

From the combined experience of the maker and user of steel there arose eventually a system whereby material of approximately the same kind was supplied, from whatever source it came, for the same purpose. As this system was based on appearances intelligible only to the competent steelmaker, it was inevitable that he should, in most cases,

become arbiter and judge as to defects and remedies incidental to the heat treatment of tools.

Although the small ingots into which tool steel is originally cast are still for the most part graded according to the appearance of their fractured surfaces, it has long been possible for general purposes, to replace arbitrary signs denoting "tempers" by definite figures representing chemical composition. In this form the "temper" of a steel bar, and its fitness for any particular purpose may be understood and appreciated by the user quite as intelligently as by the maker. The observant toolmaker, therefore, assisted by his personal experience, should be equally as competent as the steelmaker to face his own difficulties.

The ultimate value of a tool may depend as much on the manner in which it is worked into its finished shape, as on the material from which it is made. The skill and knowledge of the toolsmith and hardener must therefore always be taken into account. If for any reason whatever these cannot be relied upon, then softer steels which are not so readily overheated in forging, or cracked in hardening, are invariably introduced at the cost, and finally to the dissatisfaction, of the tool user.

Reference is repeatedly made in the text to the value of patient observation and careful experiment, in however modest a degree they may be exercised. The writer hopes that the subsequent pages, aided by these twin brothers, will enable the toolmaker to improve his products, and also to locate and avoid some of his troubles. He may at any rate easily convince himself that the destiny of his tools is not altogether in the hands of the steelmaker, and that not all defective and broken tools can justly be ascribed to bad steel, but are often due rather to various causes which may be detected and remedied.

The Author is greatly indebted to his colleagues for

the cheerful manner in which they have offered their leisure and special talents: Stone in making drawings, Atkinson in reading proofs and preparing the Index, Wild in making photographs, and Nelson in making an orderly arrangement of much of the text from rough pencil notes. He is also inexpressibly indebted to the firm of Thos. Firth & Sons for pleasant associations, and the exceptional facilities afforded by their works at home and abroad.

H. B.

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