

Preface

With the rapid development of mechanical manufacturing industry, the demands for high-strength and high-precision shaft parts are increasing gradually in the fields of aeronautics and astronautics, automobile, wind power, petrochemical, national defense industry, and major equipment manufacturing. Such components as thread, hollow thread, leadscrew, spline, and screw rod are very important for power transmission and play a key role for the safety operation of equipments. Traditional machining method of shaft parts as spline and screw is mainly metal cutting, which has the characteristics such as lower efficiency, and higher material and energy wasting. Meanwhile, because the metal fibers are cut off in the machining, poor mechanical property and surface quality of the components will be resulted in, and the requirements of various industrial fields cannot be satisfied.

The principle of cold rolling precision forming technology is plastic forming. It is a less and non-cutting technology, in which the metal billets are continuously rolling at room temperature to produce shaft parts with complex features. Compared with traditional metal cutting processes, the production rate of this process can be improved for about 30~40 times, the forming microstructure and comprehensive mechanical property of the components can be greatly improved, the materials can be saved for 15%~30%, and the production cost can also be decreased for about 30%. This technology has been more and more focused in the production of higher strength and precision complex components, which will have an extensive application prospect, and good social economic benefit can be obtained.

Cold rolling forming of shaft parts is a continuous local deforming process, the deforming mechanism is very complex, and relatively fewer researches on the process theory and mechanical analysis of spline and thread components have been carried out. In present production, experiences of technicians and workers are mainly depended on, which has limited the popularization and application of this kind of high efficient and material saving chipless technology in conditions lacking of systematical and advanced theoretical guiding.

The research team of the authors has established a cold rolling precision forming joint laboratory with the Cold Rolling Technology Research and Development Center of Qingdao Shengjian Machinery Factory, Shandong, China. The cold

rolling forming process of shaft parts, theory, and equipments has been studied systematically, and parts of the contents of this book are based on the research results collaborated with cold rolling research and development center and the theory and engineering practices of the research team. The research has also been supported by the National Natural Science Foundation of China (No. 50675145, No. 51275331), the Major Special Science and Technology Projects of Shanxi Province (No. 20111101034), and the Research Foundation for the Doctoral Program of Higher Education of China (No. 20131415110001).

In this book, spline and thread components have been selected as the main research objects. The theory, process, and equipments of cold rolling precision forming of shaft parts have been introduced. This book is divided into 10 Chapters. In Chap. 1, the current situation and development trends of cold rolling precision forming technology have been introduced. In Chap. 2, the principle of the cold rolling process and the mechanism of the forming process of spline have been analyzed. Chapter 3 introduces the design of the cold rolling precision forming process parameters of spline, which includes the contact area of the spline shaft, rolling force and rolling moment, the calculation of the cold rolling workpiece diameter, and so on. In Chap. 4, finite element modeling and numerical simulation analysis of the spline cold rolling precision forming process have been carried out. And the metal flow and deforming rules of the cold rolling spline tooth during the forming process, the accuracy, defects, and the forming quality control of the cold rolling forming process have been described in Chap. 5. Chapter 6 analyzes the cold rolling precision forming process and principle of threads. In Chap. 7, the cold rolling forming process parameters of threads have been narrated, including calculation of the workpiece billet diameter, selection of the rolling force, rolling speed, feed rate, and the minimum wall thickness criteria in cold rolling of hollow threads. In Chap. 8, the rolling force, velocity field, and stress and strain field in the cold rolling forming of threads are analyzed with numerical simulation methods. The failure process of threads has also been analyzed. In Chap. 9, metal flow rules and parameter optimization of thread cold rolling precision forming are analyzed. In Chap. 10, design of the cold rolling forming machine and dies and measurement of the mechanical parameters of the cold rolling precision forming equipment at home and abroad have been described. Cold rolling forming equipment production enterprises, product properties, characteristics, and technique parameters have also been briefly introduced. Hope this book would provide some theoretical references for scholars and technicians who engaged in the researches and production of cold rolling precision forming of shaft parts.

The authors would be grateful for the assistance of the research team colleagues and graduate students, and this book could not have been written without their help, especially doctor Zhang Dawei in Xi'an Jiaotong University and vice professor Qi Huiping and director Zheng Quangang in Cold Rolling Technology Research and Development Center of Qingdao Shengjian Machinery Factory. Many thanks for their contribution and supports.

During the edition, many research achievements and essences have been adopted from the literatures in the Internet and the Web site of the cold rolling equipment

manufacturers. The authors may not be listed distinctly, but the contributions should be specifically acknowledged. The authors would be very grateful for any comments from the readers regarding any suggestions about the contents presented or any errors that may escaped our attention during the preparation of this book.

Many thanks to director Yingheng Tang and the executive editor Shu Xiao of the National Defence Industry Press for their beneficial suggestions and kind help.

Beijing, People's Republic of China
Taiyuan, People's Republic of China

Jianli Song
Zhiqi Liu
Yongtang Li

Cold Rolling Precision Forming of Shaft Parts
Theory and Technologies

Song, J.; Liu, Z.; Li, Y.

2017, XVII, 276 p. 179 illus., 85 illus. in color.,
Hardcover

ISBN: 978-3-662-54046-6