PREFACE

This is the third edition of *Mechanisms & Mechanical Devices Sourcebook*, a well illustrated reference book containing a wide range of information on both classical and modern mechanisms and mechanical devices. This edition retains a large core of the contents from both the first and second editions, (published in 1991 and 1996, respectively), that has been supplemented by new and revised articles reflecting present and future trends in mechanical engineering and machine design.

The new articles in this edition address topics that are covered regularly in mechanical engineering and science magazines as well as being the subjects of technical papers presented at engineering conferences. Among these new articles is an overview of motion control systems, highlighting the influence of programmable computer and digital technology on those systems. Other articles discuss servomotors, actuators, solenoids, and feedback sensors—important electromechanical, and electronic components used in motion control systems. Also included are articles on gearheads, single-axis motion guides, and X-Y motion systems assembled from stock mechanical components.

Other articles in this edition describe commercially available 2D and 3D CAD (computer-aided design) software and update previous articles on industrial robots and rapid prototyping (RP) systems. Another article reviews recent research in MEMS (microelectromechanical systems) and recent spinoffs of that technology. All of these subjects are continuing to influence the direction of mechanical engineering, and they are having a profound impact on engineering education and practice.

Since the publication of the second edition, the term *mechatronics* has gained wider acceptance as a word that identifies an ongoing trend in mechanical engineering—the merging of mechanics, electronics, and computer science. Coined in Japan in the 1970s, mechatronics describes the synergistic blend of technologies that has led to the creation of many new functional and adaptable products that could not have been produced with a purely mechanical approach. While there is no formal definition of mechatronics, most mechanical engineers agree on its meaning.

The concept of mechatronics has been illustrated as a Venn diagram showing four overlapping circles representing the fields of *mechanics, electronics, computers,* and *controls*. Over the years, this convergence has spawned the more specialized disciplines of *electromechanics, computer-aided design, control electronics,* and *digital control systems*, all considered to be within the purview of mechatronics. These specialties have, in turn, fostered the creation of the even more focused technologies of *system analysis, transducers, simulation,* and *microcontrollers*.

Some of the important consumer products that have been identified as resulting from the practice of mechatronics are the computer hard-disk drive, the inkjet printer, the digital video disk (DVD) player, and the camcorder. Examination of these products reveals that they are eclectic assemblies of different kinds of mechanical devices, motors, electronic circuits, and in some of them, optics.

The inclusion of such classical mechanical elements as gears, levers, clutches, cams, leadscrews, springs, and motors in those advanced products is evidence that they still perform valuable functions, making it quite likely that they will continue to be included in the new and different products to be developed in this century.

A major attraction of the earlier editions of this book has been their cores of illustrations and descriptions of basic mechanisms and mechanical devices, accompanied by useful applications information. This material has been culled from a wide range of books and magazines that were published during the last half century. In an era of rapidly changing technology, most of this hardware has retained its universal value. As a result, this book has become recognized worldwide as a unique repository of historical engineering drawings and data not available in other more formal books. These earlier editions have served as a convenient technical reference and even as inspirational "mind-joggers" for seasoned professional machine designers as well as learning aids for engineering students.

Readers trying to arrive at new and different solutions for machine design problems can thumb through these pages, study their many illustrations, and consider adapting some of the successful mechanical inventions of the past to their new applications. Thus, proven solutions from the past can be recycled to perform new duties in the present. An old invention might be transferred without modification, or perhaps it could be improved if made from newer materials by newer manufacturing methods. What is old can be new again! For those unable to find instant solutions, this book contains a chapter of tutorial text and formulas for the design of certain basic mechanisms from scratch.

It is assumed that the reader is familiar with the basics of mechanics gained from formal education, practical experience, or both. This book is expected to be of most value to practicing machine designers and mechanical engineers, but its contents should

also be of use to machine design instructors at the college and vocational school level, amateur and professional inventors, and students of all of the engineering disciplines and physical sciences. Last but not least, it is hoped that the book will be attractive to those who simply enjoy looking at illustrations of machines and figuring out how they work.

The drawings in this edition have stood the test of time. Certain material published in the previous editions has been deleted because reader feedback suggested that important design details were missing or unclear. Also, some material considered to be obsolete and unsuitable for new designs was deleted. For example, clockwork mechanisms for timing, control, and display have almost universally been replaced in contemporary designs by more cost-effective electronic modules that perform the same functions.

References to manufacturers or publications that no longer exist were deleted so that readers will not waste time trying to contact them for further information. However, the names of the inventors, where previously given, have been retained to help the reader who may want to do further research on any patents now or once held by those individuals.

Many of the mechanisms illustrated in this book were invented by anonymous artisans, millwrights, instrument makers, and mechanics over the past centuries. They left behind the sketches, formal drawings, and even the working models on which many of the illustrations in this book are based. It is also worth noting that many of the most influential machines from the water pump, steam engine, and chronometer, to the cotton gin, and airplane were invented by self-trained engineers, scientists, and technicians.

By themselves, many of the mechanisms and devices described in this book are just mechanical curiosities, but when integrated by creative minds with others, they can perform new and different functions. One need only consider the role of basic mechanisms in the crucial inventions of the past century—the airplane, the helicopter, the jet engine, the programmable robot, and most of our familiar home appliances.

Have you noticed how the size of objects is both increasing and decreasing? There is now a 142,000-ton cruise ship that can accommodate more than 5000 passengers, and plans have been announced for building jumbo jet aircraft capable of carrying more than 500 passengers. Moreover, laptop computers now have more computing power than mainframe computers that filled a room a quarter century ago. Work is progressing in efforts to combine the functions of computer, cellular telephone, personal digital assistant (PDA), and Internet-access terminal in a single wireless handheld device.

MEMS are expected to evolve beyond their current prime roles as sensors to become security locks for computers, optical switches, and practical micromachines. Meanwhile, scientists are studying the feasibility of microminiature, self-propelled capsules made with even smaller-scale nanotechnology that could navigate through the human body and seek out, diagnose, and treat diseases at their source.

—Neil Sclater