HANDBOOK OF PRECISION ENGINEERING

HANDBOOK OF PRECISION ENGINEERING

- Volume 1 Fundamentals**
- Volume 2 Materials**
- Volume 3 Fabrication of Non-metals**
- Volume 4 Physical and Chemical Fabrication Techniques**
- Volume 5 Joining Techniques**
- Volume 6 Mechanical Design Applications**
- Volume 7 Electrical Design Applications**
- Volume 8 Surface Treatment**
- Volume 9 Machining Processes**
- Volume 10 Forming Processes**
- Volume 11 Production Engineering**
- Volume 12 Precision Measurement**

Philips Technical Library

HANDBOOK OF PRECISION ENGINEERING

Edited by A. Davidson

Volume 5 Joining Techniques

MACMILLAN EDUCATION

Original Dutch edition © N. V. Philips' Gloeilampenfabrieken, Eindhoven, 1968

English Edition © N. V. Philips' Gloeilampenfabrieken, Eindhoven, 1972.

Softcover reprint of the hardcover 1st edition 1972

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, without permission.

SBN 333 11824 3

ISBN 978-1-349-01022-6 ISBN 978-1-349-01020-2 (eBook)

DOI 10.1007/978-1-349-01020-2

First published in English by

THE MACMILLAN PRESS LTD

London and Basingstoke

Associated companies in New York Toronto Melbourne

Dublin Johannesburg and Madras

PHILIPS

Trademarks of N. V. Philips' Gloeilampenfabrieken

Foreword

During the last twenty or thirty years, precision engineering, although not strictly a separate branch of engineering, like shipbuilding and the aircraft industry, has emerged as a specialized technology, involving methods and ideas foreign to conventional mechanical engineering.

Precision-engineered parts (or fine mechanisms, as they are often termed) are very often of limited size, and vary in quantity from one-off to very long runs. But they don't have to be small, of course. For example, the driving mechanism of an observatory telescope, which is fairly large, has to be designed and constructed with extreme precision, whilst an ordinary watch, which is quite small by comparison, is relatively crude as far as tolerances are concerned.

Examples of fine mechanisms are to be found in telecommunications equipment; optical apparatus such as microscopes and comparators, as well as cameras and projectors; office machines like typewriters, accounting and calculating machines; various toys of a technical nature, mentioned because of their often ingenious design and the consummate tool-making that goes into them; electric shavers; and various electronic equipment used in the home.

There is a need, in industry and in training schools, for a Handbook such as this, covering, in a convenient form, the different subjects that are related to the design of fine mechanisms. Much of the material dealt with is not new in itself, of course, but, because it is presented specifically in the context of precision engineering, it should be invaluable to designers, manufacturers and users of precision-engineered parts.

The authors, each of whom is a specialist in his own field, do not claim to have covered the individual subjects fully in the chapters assigned to them. They have presented the main features as clearly as possible, and provided international references from which the reader can obtain more details as required.

The Handbook is divided into twelve parts, of which Volume 1 deals with the general principles to be observed when designing a product, and Volume 2 with the materials available. Theoretical and practical data useful to designers and draughtsmen is given.

Volumes 3–6 discuss production techniques, and production staff will find them to contain comprehensive information on production methods and plant. Volumes 7–12 deal with the practical design of precision-engineered products, and the equipment and components required for this purpose. Designers, manufacturers and users can all profit from them.

The editor would like to take this opportunity of thanking the authors and all who have helped to produce the Handbook.

Contents

Foreword

Introduction

A. Davidson 1

I. Mechanical Joints (Permanent)

C. A. Nottrot 3

1.1 Flanging

1.1.1 General

1.1.2 Pressure flanging

1.1.3 Rotary flanging

1.2 Cold riveting

1.2.1 General

1.2.2 Impact riveting

1.2.3 Other riveting methods

1.3 Various connecting methods

2. Welding

J. O. Zwolsman 26

2.1 Introduction

2.2 Welding methods

2.2.1 Introduction

2.2.2 Oxy-acetylene welding

2.2.3 Arc welding

2.2.4 Resistance welding

2.2.5 Thermit welding

2.2.6 Cold pressure welding

2.2.7 Friction welding

2.2.8 Hot pressure welding

2.2.9 Special welding methods

2.3 Weldability of metals

2.3.1 Introduction

2.3.2 Weldability by the resistance welding process

2.3.3 A few metals difficult to weld

2.4 Quality control

2.4.1 Introduction

2.4.2 Non-destructive inspection

2.4.3 Destructive inspection

3. Soldering and brazing

F. van der Hoek 110

3.1 Introduction

3.2 Principles, physical and chemical aspects

3.3 Fluxes

3.4 Solder alloys

3.5 Base metals

3.5.1 Introduction

3.5.2 Various base metals

3.5.3 Soldering metal to glass and ceramics

3.6 Soldered constructions

3.6.1 Introduction

3.6.2 Construction forms

3.6.3 Positioning the solder

3.6.4 Gap width and gap strength

3.7 Soldering techniques

3.7.1 Introduction

3.7.2 Methods

3.8 Quality control of soldered connections

4. Adhesive bonding

F. Abels 230

4.1 Introduction

4.2 Application techniques and equipment

4.3 Auxiliary tools

4.4 Equipment for hardening and/or accelerated drying

4.5 A few special techniques

5. Wire Winding

H. G. de Cock 250

5.1 Introduction

5.2 Wire tension control

5.2.1 Subdivision of wire brakes

5.2.2 Requirements wire brakes must satisfy

5.2.3 Kinds of wire braking system

5.3 Winding in wire manufacture

5.3.1 Requirements for winding-up

5.3.2 Shapes of reels and bobbins

5.3.3 Winding-up

5.4 Winding wire products

5.4.1 Wire dispenser

5.4.2 Wire guide

5.4.3 Winding mechanism

5.4.4 Coil shapes

5.4.5 Toroidal coils

5.5 Coil winding in manufacture

6. Applying Texts

J. O. M. van Langen 282

6.1 Introduction

6.2 Diecasting, casting, pressing, etc.

6.3 Forming techniques

6.4 Cutting and machining techniques

6.5 Etching techniques

6.6 Metallisation

6.7 Transfer techniques

6.8 Silk screening

6.9 Other printing techniques

6.10 Anodised aluminium

Index

293