

# **NOTES ON THE GRAPHICS OF MACHINE FORCES**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649307692

Notes on the Graphics of Machine Forces by Robert C. H. Heck

Except for use in any review, the reproduction or utilisation of this work in whole or in part in any form by any electronic, mechanical or other means, now known or hereafter invented, including xerography, photocopying and recording, or in any information storage or retrieval system, is forbidden without the permission of the publisher, Trieste Publishing Pty Ltd, PO Box 1576 Collingwood, Victoria 3066 Australia.

All rights reserved.

Edited by Trieste Publishing Pty Ltd.  
Cover @ 2017

This book is sold subject to the condition that it shall not, by way of trade or otherwise, be lent, re-sold, hired out, or otherwise circulated without the publisher's prior consent in any form or binding or cover other than that in which it is published and without a similar condition including this condition being imposed on the subsequent purchaser.

[www.triestepublishing.com](http://www.triestepublishing.com)

**ROBERT C. H. HECK**

**NOTES ON THE  
GRAPHICS OF  
MACHINE FORCES**



NOTES  
ON THE  
**Graphics of Machine Forces**

BY  
*W. H. O'NEIL*  
**ROBERT C. H. HECK, M.E.**  
PROFESSOR OF MECHANICAL ENGINEERING  
IN RUTGERS COLLEGE

*WITH 39 ILLUSTRATIONS*



NEW YORK  
**D. VAN NOSTRAND COMPANY**  
23 MURRAY AND 27 WARREN STREETS  
1910

Copyright, 1910,  
BY  
D. VAN NOSTRAND COMPANY

THE SCIENTIFIC PRESS  
ROBERT DRUMMOND AND COMPANY  
BROOKLYN, N. Y.

4-13-11  
O  
Revised 5-10-41 M.H.J.

## PREFACE

---

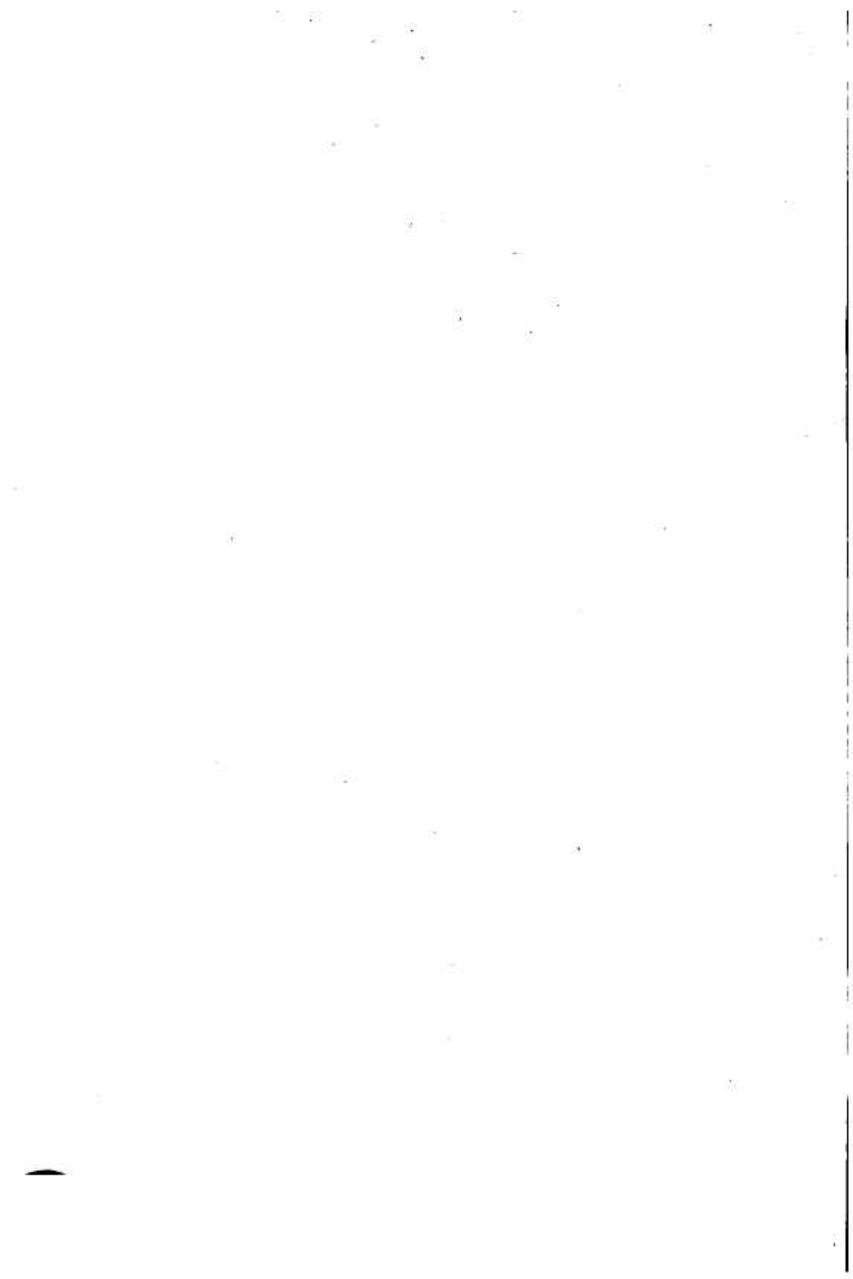
THESE notes are intended to serve as text for a graphical course which has hitherto been based upon Herrmann's "Graphical Statics of Mechanisms." To the latter text there are the objections that it does not set forth the fundamental mechanical principles clearly enough for students with the usual degree of effective preparation, and that it wastes entirely too much space on detailed and repeated explanations of examples. The problems in this course are in the shape of good-sized drawings of machines—on sheets about 20 in. by 27 in.—which are reproduced from tracings as positive prints, with dark lines on a light ground. The student is thus saved the labor of mere drawing, and at once takes up the force determination. On the drawing there is room for such special notes and suggestions as may be called for; but the emphasized purpose is to have the student think for himself, with needed help and suggestion from the instructor, and not follow a ready worked example.

In section J are added some special force constructions which are useful chiefly in the problems of graphical dynamics, but which are needed to round out the presentation of graphical methods for determining impressed forces in machines.

It is thought that the title here used is more appropriate and descriptive than "graphical statics of mechanisms."

R. C. H. HECK.

NEW BRUNSWICK, N. J.,  
May, 1910.

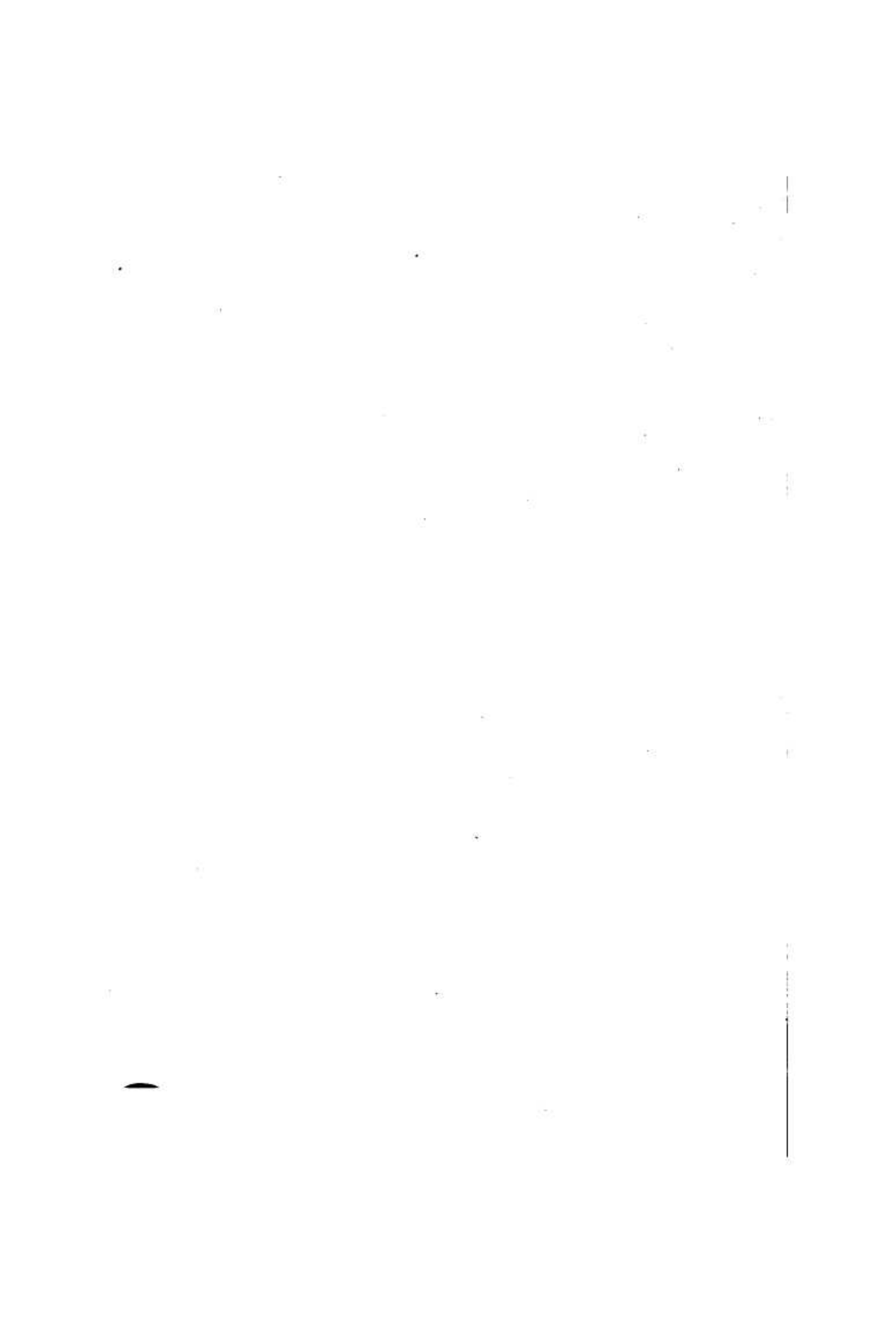




## CONTENTS

---

SECTION	PARAGRAPHS	PAGE
A. GENERAL CONDITIONS OF PROBLEMS . . . .	1 to 2	1
B. FORCE DIAGRAM CONSTRUCTIONS . . . .	3 to 11	2
C. THE ACTION OF FRICTION . . . . .	12 to 18	9
D. JOURNAL FRICTION . . . . .	19 to 26	13
E. THE EFFICIENCY OF MACHINES . . . . .	27 to 32	19
F. RESISTANCE TO ROLLING . . . . .	33 to 35	23
G. (TOOTHED-GEAR, CHAIN, AND ROPE RESISTANCES) .	36 to 42	25
H. (BELT TRANSMISSION) . . . . .	43 to 48	29
I. (GENERAL PROCEDURE) . . . . .	49	33
J. SPECIAL FORCE CONSTRUCTIONS . . . . .	50 to 60	34
K. FRICTION AND LUBRICATION . . . . .	61 to 64	40



## GRAPHICS OF MACHINE FORCES

---

### A. General Conditions of Problems

1. In order to determine, by the simpler methods of graphical analysis, the principal forces acting in machines, we make the following assumptions:

(a) The weight of the machine members, or the force of gravity acting upon them, may be disregarded.

(b) The force of inertia need not be taken into account: this idea involves either a slow running of the machine or a practically uniform motion of the parts.

A great many problems may be solved with quite sufficient correctness under these assumptions. If the need of greater accuracy or their increase in relative magnitude requires that these forces (which are functions of mass or of mass and motion) be included, the solution becomes much more complicated. (See Section J.)

2. For present purposes, the machine is considered as made up of rigid bodies, or of members which are fixed and definite in form so far as the forces entering into the problem are concerned. These are all impressed forces, imposed through the contact of one machine part with another. The forces which act upon one piece get at each other and come into equilibrium through the medium of internal forces or stresses within the body. We pass over all questions as to the magnitude or the manner of action of these stresses, and use simply the resultant relations among the imposed forces; which relations are the same as if the forces acted upon and met in a single material particle.