Hydraulic Systems Volume 8 Advanced Designs for Mobile Applications

Dr. Medhat Kamel Bahr Khalil, Ph.D., CFPHS, CFPAI. Director of Professional Education and Research Development, Applied Technology Center, Milwaukee School of Engineering, Milwaukee, WI, USA.



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Advanced Designs for Mobile Applications

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Hydraulic Systems Volume 8 Advance Designs for Mobile Applications

PREFACE, 6

ACKNOWLEDGEMENT, 7

ABOUT THE BOOK, 9

ABOUT THE AUTHOR, 15

Chapter 1: Hydrostatic Transmissions, 16

1.1- Introduction

- 1.2- Mechanical Travel Drive Systems
- 1.3- Hydrostatic Transmission Systems in Mobile Machines

Chapter 2: Control Blocks in Mobile Machines, **40**

- 2.1- Introduction
- 2.2- Valve-Controlled vs. Pump-Controlled Actuators
- 2.3- Mono Blocks vs. Modular Blocks
- 2.4- Open Center vs. Closed Center Control Blocks
- 2.5- Parallel vs. Tandem Control Blocks
- 2.6- Typical Construction of a Control Section in a Control Block
- 2.7- Mechanical vs. Pilot Control Blocks
- 2.8- Electrohydraulic Control Blocks
- 2.9- Examples From Industry

Chapter 3: Steering and Fan Drive Systems, 62

- 3.1- Introduction to Steering Systems
- 3.2- Concept of Hydraulic Power Steering
- 3.3- Construction of Orbital Steering Valve
- 3.4- Operating Principle of the Orbital Steering Valve
- 3.5- Open Center vs. Closed Center Hydraulic Power Steering System
- 3.6- Non-load Reaction Hydraulic Power Steering System
- 3.7- Electrohydraulic Steering System
- 3.8- Track Steering
- 3.9- Hydrostatic Fan Drive Systems in Mobile Machines

Chapter 4: Hybrid and Electrified Mobile Machines, 76

- 4.1- Introduction
- 4.2- Secondary Control Energy Recovery/Regeneration Concept
- 4.3- Hydraulic Fly Wheel Energy Recovery/Regeneration Concept
- 4.4- Power Regenerative Boom Energy Recovery/Regeneration Concept
- 4.5- Hydraulic-Hybrid Energy Recovery/Regeneration Concept

4.6- Electrification of Control Concepts

- 4.7- Digitalization of Mobile Machines
- 4.8- Automation of Mobile Machines

Chapter 5: Excavators and Shovels, 97

- 5.1- Introduction to Equipment
- 5.2- Hydraulic-Driven Functions in Excavators
- 5.3- Layout of Hydraulic Systems in Excavators
- 5.4- Boom Functions in Excavators
- 5.5- Arm Regenerative Functions in Excavator (Model-X1)
- 5.6- Bucket Functions in Excavators
- 5.7- Swing Function in Excavators
- 5.8- Open Circuit Anti-Cavitation Blocks (HydraForce)
- 5.9- Parking Brake Function in Excavators (Model-X1)
- 5.10- Greasing Function in Mining Shovels (Model-X2)
- 5.11- Mechanical Travel Drive Systems in Wheeled Excavators
- 5.12- Travel Drive and Steering Systems in Tracked Excavators (Model-X3)
- 5.13- Hydraulic Flywheel System (HFW) for Implement Energy Recovery in Excavators
- 5.14- Cooling Systems in Excavators
- 5.15- Excavator Attachments
- 5.16- Excavator Controls
- 5.17- Electric Excavators

Chapter 6: Loaders, 181

- 6.1- Introduction to Equipment
- 6.2- Wheel Loaders
- 6.3- Track Loaders
- 6.4- Swing Loaders
- 6.5- Backhoes
- 6.6- Skid-Steer Loaders
- 6.8- Semi-Electric Loaders

Chapter 7: Dozers, 235

- 7.1- Introduction to Equipment
- 7.2- Layout of Hydraulic System in Dozers
- 7.3- Hydraulic-Driven Functions in Dozers
- 7.4- Blade Tilt and Lift Functions in Model-X4 Dozers
- 7.5- Tipping and Ripping Functions in Model-X4 Dozers
- 7.6- Winch Function in Model-X4 Dozers
- 7.7- Drive and Steering System in Model-X4 Dozers
- 7.8- Cooling System in Model-X4 Dozers
- 7.9- Hybrid Bulldozers

Chapter 8: Graders, 265

- 8.1- Introduction to Equipment
- 8.2- Hydraulic-Driven Functions in Graders
- 8.3- Implement Valve in Model-X5 Graders
- 8.4- Ripping Function in Model-X5 Graders
- 8.5- Blade Lifting Function in Model-X5 Graders
- 8.6- Blade Side Shifting in Model-X5 Grader s
- 8.7- Blade Tipping in Graders
- 8.8- Blade Circle Drive Function in Model-X5 Graders
- 8.9- Blade Articulation Function in Model-X6 Graders
- 8.10- Brake System in Model-X6 Graders
- 8.11- Steering System in Model-X6 Graders

Chapter 9: Road Construction Machines, 281

- 9.1. Introduction to Equipment
- 9.2. Trenchers
- 9.3. Cold Planers
- 9.4. Asphalt Pavers
- 9.5- Compactors (Road Rollers)

Chapter 10: Aerial Work Platforms, 304

10.1- Introduction to Equipment10.2- Scissor Lifts10.3- Boom Lifts10.4- Manlifts10.5- Aerial Ladders

Chapter 11: Forklifts and Telehandlers, 350

11.1- Introduction to Equipment11.2- Forklifts11.3- Telehandlers

Chapter 12: Cranes, 373

12.1- Introduction to Equipment
12.2- Truck-Mounted Cranes
12.3- Carry Deck Cranes
12.4- Rough Terrain Cranes
12.5- Cranes Versus Boom Trucks
12.6- Floating Cranes
12.7- Telescopic Cranes
12.8- Crawler Cranes
12.9- Travel Drive Systems in Mobile Cranes
12.10- Tower Cranes

- 4 Hydraulic Systems Volume 8: Advanced Designs for Mobile Applications Table of Contents
- 12.11- Gantry Cranes
- 12.12- Harbor and Offshore Cranes
- 12.13- Stacker Cranes
- 12.14- Electric Cranes
- 12.15- Lattice Boom Versus Hydraulic Boom
- 12.16- Hydrostatic Fan Drive Systems in Cranes
- 12.17- How to Choose a Crane
- 12.18- Crane Safety Guidelines

Chapter 13: Mining Equipment, 395

- 13.1- Introduction to Hydraulics
- 13.2- Coal Mine Roadheaders
- 13.3- Mining Crushers
- 13.4- Rotary Drilling Rigs

Chapter 14: Municipal and Hauling Trucks, 404

- 14.1- Introduction to Equipment
- 14.2- Garbage Trucks
- 14.3- Mining Haul Trucks
- 14.4- Hoisting Function in Mining Trucks (Model-X7)
- 14.5- Braking Function in Mining Trucks (Model-X8)
- 14.6- Park Brake Function in Mining Trucks (Model-X8)
- 14.7- Steering System in Mining Trucks (Model-X7)
- 14.8- Steering System in Mining Trucks (Model-X8)
- 14.9- Cooling System in Mining Trucks (Model-X9)
- 14.4- Commercial Vehicles e-Powertrain

Chapter 15: Concrete Pumps and Mixers, 446

- 15.1- Introduction to Equipment
- 15.2- Concrete Pumps
- 15.3- Concrete Mixers

Chapter 16: Tractors and AG Machines, 458

- 16.1- Introduction to Equipment
- 16.2- Tractors
- 16.3- Crop Sprayer (Model-X10)
- 16.4- Combine Harvesters
- 16.5- Cotton Pickers
- 16.6- Sugarcane Machines
- 16.7- Corn Harvesting Machines
- 16.8- Silage Machines
- 16.9- Forestry Machines
- 16.10- Cattle Feed Mixers

Chapter 17: Tunnel Boring Machines, 519

17.1- Introduction to Equipment

17.2- Hydraulic Systems in Tunnel Boring Machines

Chapter 18: Aerospace Applications, 523

- 18.1- Introduction to Aerospace Applications
- 18.2- Flight Control Systems
- 18.3- Landing Gears
- 18.4- Example of Hydraulic Power Generation/Distribution in Aircrafts
- 18.5- Flight Simulators
- 18.6- Runway Snow Blower/Broom
- 18.7- Runway Vacuum Cleaners

Chapter 19: Marine and Military Applications, 551

- 19.1- Introduction to Marine Applications
- 19.2- Steering Systems in Marine Applications
- 19.3- Winch Drive Systems in Marine applications
- 19.4- Hydraulic Propulsion Systems in Marine Applications
- 19.5- Hydraulic Stabilizing Systems in Marine Applications
- 19.6- Hydraulic Systems in Military Vehicles

Chapter 20: Railways Applications, 565

- 20.1- Introduction to Hydraulics in Railways Applications
- 20.2- Hydraulic Dampers in Railways Suspension
- 20.3- Track Switching Mechanisms
- 20.4- Hydraulic-Powered Tie Replacement Machines
- 20.5- Hydraulic Systems in Railway Spike-Driving Machines

INDEX, 576

6 Hydraulic Systems Volume 8: Advanced Designs for Mobile Applications Preface

PREFACE

Mobile machines are extensively relied on hydraulic power because of the high-power density of hydraulic actuators that aren't reached by other actuators so far. However, for the sake of saving energy, reducing emission, and improving machines' performance, hybrid and electrification concepts are considered in mobile machine designs.

This book targets industry professionals who are in charge for operating, maintaining, and designing mobile machines. The book has twenty chapters. The first four chapters cover conceptually the systems that are commonly found on all mobile machines. In the rest of the chapters, the book presents sixteen different categories of mobile machines. In each category of mobile machines, the book presents a brief introduction to equipment, hydraulic-driven functions, hydraulic circuit diagrams, and hybrid or electrified models, if found. Some of the presented systems are just generic, and the others are aided by examples from industry.

The author is working hard to finish his goal of supporting fluid power professional education by developing the following series of volumes and relevant software:

- Hydraulic Systems Volume 1: Introduction to Hydraulics for Industry Professionals.
- Hydraulic Systems Volume 2: Electro-Hydraulic Components and Systems.
- Hydraulic Systems Volume 3: Hydraulic Fluids and Contamination Control.
- Hydraulic Systems Volume 4: Hydraulic Fluids Conditioning. Under Development
- Hydraulic Systems Volume 5: Safety and Maintenance.
- Hydraulic Systems Volume 6: Troubleshooting and Failure Analysis.
- Hydraulic Systems Volume 7: Modeling and Simulation for Application Engineers.
- Hydraulic Systems Volume 8: Advanced Designs for Mobile Applications.
- Hydraulic Systems Volume 9: Advanced Designs for Industrial Applications (Under Development).
- Hydraulic Systems Volume 10: Design Strategies of Hydraulic and EH Systems (Under Development).

Dr. Medhat Kamel Bahr Khalil

7 Hydraulic Systems Volume 8: Advanced Designs for Mobile Applications Acknowledgment

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ABOUT THE BOOK

Book Description:

Mobile machines are extensively relied on hydraulic power because of the high-power density of hydraulic actuators that aren't reached by other actuators so far. However, for the sake of saving energy, reducing emission, and improving machines' performance, hybrid and electrification concepts are considered in mobile machine designs.

This book targets industry professionals who are in charge for operating, maintaining, and designing mobile machines. The book has twenty chapters. The first four chapters cover conceptually the systems that are commonly found on all mobile machines such as hydrostatic transmission, control blocks, steering systems, fan drive systems, hybrid systems, and mobile machine electrification.

In the rest of the chapters, the book presents sixteen different categories of mobile machines such as excavators & shovels, loaders, dozers, graders, road construction machines, aerial work platforms, forklifts & telehandlers, cranes, mining equipment, municipal & hauling trucks, concrete pumps & mixers, tractors & AG machines, tunnel-boring machines, aerospace applications, marine and military applications, and railways applications. In each category of mobile machines, the book presents a brief introduction to equipment, hydraulic-driven functions, hydraulic circuit diagrams, and hybrid or electrified models, if found. Some of the presented systems are just generic, and the others are aided by examples from industry.

This book is colored and printed in the size of standard A4. The book is associated with a workbook that contains colored-printed power point slides. This book is the sixth in a series that the author plans to publish to offer complete and comprehensive teaching references for the fluid power industry. The book contains a total of fourteen chapters distributed over 250 pages with very demonstrative figures and tables. The contents of the book are brand non-biased and intends to introduce the latest technologies related to the subject of the book.

Book Objectives:

Chapter 1: Hydrostatic Transmissions

This chapter, aided by examples from industry, overviews the concepts of travel drive functions in mobile machines. This chapter focuses on the construction and operating principles of HYDROSTATIC TRANSMISSIONS. Among the presented topics are the various configurations of hydrostatic transmissions, the various methods of integrating hydrostatic transmissions in mobile machines, and the various methods of varying the displacement of the main pump.

Chapter 2: Control Blocks in Mobile Machines

This chapter, aided by examples from industry, overviews CONTROL BLOCKS construction, central position, architecture that sets the priority of the operations, and methods of actuation. This chapter also briefly presents the difference between using control block versus controlling actuators directly by a pump.

Chapter 3: Steering and Fan Drive Systems

This chapter overviews STEERING and FAN DRIVE systems in mobile machines, with a focus on hydraulic power steering. This chapter presents the construction and operating principle of orbital steering valve including open center, closed center, and load reaction type of steering valves. The chapter also presents the concept of steering in track-drive mobile machines. This chapter also overviews hydrostatic fan drive systems as applied in mobile machines using hydraulic-driven cooling fan systems.

Chapter 4: Concepts of Hybrid and Electrified Mobile Machines

This chapter discusses HYBRID and ELECTRIFIED concepts as applied to mobile machines. This chapter presents various concepts for energy recovery/regeneration and electrification of mobile machines. The presented concepts for energy recovery/regeneration are secondary control concept, hydraulic fly wheel concept, and hydraulic-hybrid concept. In the area of emission reduction concepts for semi-electric and full electric mobile machines are further explained. This chapter also discusses the feasibility and barriers for mobile machine electrification.

Chapter 5: Excavators and Shovels

This chapter, aided by examples from industry, presents and explains the hydraulic-driven functions, hydraulic systems layout, and the related hydraulic circuit diagrams in EXCAVATORS & SHOVELS. Among the presented examples are boom functions, arm functions, bucket functions, swing functions, brake functions, travel drive systems, steering systems, cooling systems, and excavator attachments. The chapter also presents the effort for replacing the conventional functions to run as hybrid or electrified functions for reducing the emission and improving fuel efficiency and machine performance.

Chapter 6: Loaders

This chapter, aided by examples from industry, presents and explains the hydraulic-driven functions, hydraulic systems layout, and the related hydraulic circuit diagrams in LOADERS. Among the presented concepts are boom functions, passive versus active boom suspension, bucket functions, other auxiliary functions, travel drive systems, steering systems, cooling systems, and attachments. The chapter also presents the effort for replacing the conventional functions to run as hybrid or electrified functions for the sake of reducing the emissions and improving fuel efficiency and machine performance. This chapter considers various types of loaders such as wheel loaders, track loaders, swing loaders, backhoes, and skid-steer loaders.

Chapter 7: Dozers

This chapter, aided by examples from industry, presents and explains the hydraulic-driven functions, hydraulic systems layout, and the related hydraulic circuit diagrams in DOZERS. Among the presented concepts are blade tilt & lift functions, tipping & ripping functions, winch functions, drive systems, steering systems, and cooling systems. The chapter also presents the effort to replace the conventional functions to run as a hybrid or electrified functions for the purpose of reducing the emissions and improving fuel efficiency and machine performance.

Chapter 8: Graders

This chapter, aided by examples from industry, presents and explains the hydraulic-driven functions, hydraulic systems layout, and the related hydraulic circuit diagrams in GRADERS. Among the presented concepts are blade tilt & side shift functions, tipping and ripping functions, blade circle drive function, blade articulation function, steering systems, and brake system. This chapter also presents the effort to replace the conventional functions to run as hybrid or electrified functions for the purpose of reducing the emissions and improving fuel efficiency and machine performance.

Chapter 9: Road Construction Machines

This chapter, aided by examples from industry, presents and explains the hydraulic-driven functions, hydraulic systems layout, and the related hydraulic circuit diagrams in ROAD CONSTRUCTION MACHINES. Among the presented concepts are implement functions, travel drive systems, and steering systems. The chapter also presents the effort for replacing the conventional functions to run as hybrid or electrified functions for the purpose of reducing the emissions and improving fuel efficiency and machine performance. This chapter considers various types of road construction machines such as trenchers, cold planners, asphalt pavers, and compactors.

Chapter 10: Aerial Work Platforms

This chapter, aided by examples from industry, presents and explains the hydraulic-driven functions, hydraulic systems layout, and the related hydraulic circuit diagrams in AERIAL WORK PLATFORMS. Among the presented concepts are implement functions, brake systems, travel drive systems, and steering systems. The chapter also presents the effort for replacing the conventional functions to run as hybrid or electrified functions for the purpose of reducing the emissions and improving fuel efficiency, and machine performance. This chapter considers various types of aerial work platforms machines, such as scissor lifts, boom lifts, manlifts, and aerial ladders.

Chapter 11: Forklifts and Telehandlers

This chapter, aided by examples from industry, presents and explains the hydraulic-driven functions, hydraulic systems layout, and the related hydraulic circuit diagrams in FORKLIFTS AND TELEHANDLERS. Among the presented concepts are implement functions, brake systems, drive systems, steering systems, and attachments. The chapter also presents the effort for replacing the conventional functions to run as hybrid or electrified functions.

Chapter 12: Cranes

This chapter, aided by examples from industry, presents and explains the hydraulic-driven functions, hydraulic systems layout, and the related hydraulic circuit diagrams in CRANES. Among the presented concepts are implement functions, brake systems, travel drive systems, steering systems, and cooling systems. The chapter also presents the effort for replacing the conventional functions to run as hybrid or electrified functions. This chapter considers various types of mobile and stationary cranes such as truck-mounted cranes, vary-deck cranes, rough terrain cranes, floating cranes, telescopic trains, crawler cranes, tower cranes, gantry cranes, harbor and offshore cranes, and stacker cranes.

Chapter 13: Mining Equipment

This chapter, aided by examples from industry, presents and explains the hydraulic-driven functions, hydraulic system layout, and the related hydraulic circuit diagrams in material extraction MINING EQUIPMENT. Among the presented concepts are implement functions in open and closed-circuit architectures, cutting head drive function, slewing function, travel drive systems, and steering systems. This chapter considers various types of mining equipment such as coal mine roadheaders, mining crushers, and rotary drilling rigs.

Chapter 14: Municipal and Hauling Trucks

This chapter, aided by examples from industry, presents and explains the hydraulic-driven functions, hydraulic systems layout, and the related hydraulic circuit diagrams in MUNICIPAL and HAULING TRUCKS. Among the presented concepts are implement functions, hoisting functions, brake functions, travel drive systems, steering systems, and cooling systems. This chapter considers the selected types of vehicles such as municipal garbage trucks, and mining haul trucks. The chapter also presents the effort for replacing the conventional functions to run as hybrid or electrified functions.

Chapter 15: Concrete Pumps and Mixes

This chapter, aided by examples from industry, presents and explains the hydraulic-driven functions, hydraulic systems layout, and the related hydraulic circuit diagrams in CONCRETE PUMPS and MIXERS. Among the presented concepts are running the drum to mix the concrete and pump the concrete in tubes.

Chapter 16: Tractors and AG Machines

This chapter aided by examples from industry, presents and explains the hydraulic-driven functions, hydraulic systems layout, and the related hydraulic circuit diagrams in TRACTORS and AG MACHINES. Among the presented concepts are various implement functions and travel drive systems, steering systems, cooling systems, and attachments. This chapter considers various types of AG machines such as Tractors, Crop Sprayers, Combine Harvesters, Cotton Pickers, Sugarcane Machines, Corn Harvesting Machines, Silage Machines, Forestry Machines, and Cattle Feed Mixers.

Chapter 17: Tunnel Boring Machines

This chapter overviews the basic construction and operation of TUNNEL BOARING MACHNES. It also presents the hydraulic system that controls the thrust cylinders.

Chapter 18: Aerospace Applications

Hydraulic systems are widely used in AEROSPACE APPLICATIONS, weather on the aircraft itself or the other equipment that serves the aircraft on the ground. This chapter presents an example of the hydraulic-powered functions on the aircraft, such as flight control, landing gear, steering, shock absorbing, and braking. This chapter also presents ground services trucks, such as runway snow blowers/brooms, and runway vacuum cleaners.

Chapter 19: Marine and Military Applications

This chapter, aided by examples from industry, presents and explains the hydraulic-driven functions, hydraulic systems layout, and the related hydraulic circuit diagrams in MARINE AND MILITARY APPLICATIONS. Among the presented concepts are steering systems, winch drives, propulsion systems, stabilizing, missile launchers, rescue and recovery armored vehicles, armored vehicle-launched bridges, air defense mobile radars, and gun elevation systems.

Chapter 20: Railways Applications

This chapter, aided by examples from industry, presents and explains the hydraulic-driven functions, hydraulic systems layout, and the related hydraulic circuit diagrams in RAILWAYS APPLICATIONS. Among the presented concepts are the dampers in suspension systems, track switching mechanisms, and tie replacement machines.

Chapter #	Pages	Figures	Workbook	Words	Editing Time
•			slides		(Hours)
Chapter 1	24	23	28	4751	277
Chapter2	23	26	22	3119	281
Chapter 3	13	13	14	1615	166
Chapter 4	21	24	27	4148	190
Chapter 5	84	74	75	11143	256
Chapter 6	54	75	60	6887	138
Chapter 7	30	28	29	3454	163
Chapter 8	16	16	17	1874	171
Chapter 9	23	25	23	3164	180
Chapter 10	46	47	46	5731	216
Chapter 11	23	25	26	2395	165
Chapter 12	22	33	27	2896	173
Chapter 13	9	11	11	982	193
Chapter 14	42	39	40	4687	174
Chapter 15	12	14	14	1934	168
Chapter 16	61	71	73	8028	225
Chapter 17	4	3	4	645	151
Chapter 18	28	33	34	4029	183
Chapter 19	14	16	13	2341	161
Chapter 20	11	14	10	1579	165
Others	24	0	0	0	3796
Total	584	610	593	75402	3796 Hours/24 = 158 Days

Book Statistics:

ABOUT THE AUTHOR (IFPS Hall of Fam Reciepient)



Medhat Khalil, Ph.D. is the Director of Professional Education & Research Development at the Applied Technology Center, Milwaukee School of Engineering, Milwaukee, WI, USA. Medhat has consistently been working on his academic development through the years, starting from bachelor's and master's degrees in mechanical engineering in Cairo Egypt and proceeding with his Ph.D. in Mechanical Engineering and Post-Doctoral Industrial Research Fellowship at Concordia University in Montreal, Quebec, Canada. He has been certified and is a member of many institutions such as: Certified Fluid Power Hydraulic Specialist (CFPHS) by the International Fluid Power Society (IFPS), Certified Fluid Power Accredited Instructor (CFPAI) by the International Fluid Power Society (IFPS), Member of Center for Compact and

Efficient Fluid Power Engineering Research Center (CCEFP), Listed Fluid Power Consultant by the National Fluid Power Association (NFPA), and Listed Professional Instructor by the American Society of Mechanical Engineers (ASME). Medhat has balanced academic and industrial experience. Medhat has vast experience in teaching Fluid Power courses for industry professionals. Being quite aware of the technological developments in the field of fluid power, Medhat had worked for several world-wide recognized industrial organizations such as Rexroth in Egypt and CAE Inc. in Canada. Medhat had designed several hydraulic systems and developed several analytical and educational software. Medhat also has considerable experience in modeling and simulation of dynamic systems using Matlab-Simulink. Medhat is the founder of the state-of-the-art Universal Fluid Power Trainer. Medhat has received the awards of Pioneers in Fluid Power by NFPA (2012) and Hall of Fame in Fluid Power by IFPS (2021).

