

CONTENTS

<i>Preface to the Second Edition.</i>	vii
<i>Preface to the First Edition.</i>	xi
<i>List of Tables</i>	xxix

<i>Chapter I. THE STORY BEHIND THE NAMEPLATE.</i>	1
1- 1. Manufacturer	1
1- 2. A.C.	2
1- 3. Type.	2
1- 4. "Thermoguard" Type	3
1- 5. H.P. (Horsepower).	15
1- 6. R.P.M..	15
1- 7. Cycles	17
1- 8. Frame Sizes.	18
1- 9. Volts.	18
1-10. Amperes	19
1-11. Phases	20
1-12. °C—Rated Rise	23
1-13. Hours	23
1-14. Locked Kva.	24
1-15. Style.	24
1-16. Serial.	25
1-17. Open.	25
1-18. Other Information on the Nameplate.	25
1-19. Fan-duty Motor.	25
1-20. Service Factor.	26
1-21. What Is a Fractional Horsepower Motor?.	26

<i>Chapter II. WHAT MAKES AN INDUCTION MOTOR RUN?</i>	27
2- 1. Single-phase and Polyphase Motors.	27
2- 2. Rotation of a Copper Disc Produced by a Rotating Magnet.	28
2- 3. Rotation of a Squirrel-cage Rotor Produced by a Rotating Field Magnet.	30

PRODUCTION OF A ROTATING FIELD IN A TWO-PHASE STATOR

2- 4. A Simple Two-phase Motor and Generator System.	31
2- 5. Windings of a Two-phase Motor.	32
2- 6. How the Rotating Field Is Set Up	33
2- 7. Conditions Necessary to Set Up a Rotating Field in a Two-phase Motor	35

PRODUCTION OF A ROTATING FIELD IN A SINGLE-PHASE INDUCTION MOTOR

2- 8. The Single-phase Motor a Special Case of the Two-phase Motor. . .	35
2- 9. Field Set Up by Stator Winding Alone	37
2-10. Field Set Up by the Rotor	37
2-11. Rotating Field.	38

COMPARISONS BETWEEN SINGLE-PHASE INDUCTION MOTORS AND
POLYPHASE INDUCTION MOTORS

2-12. Differences in the Rotating Field.	38
2-13. Losses, Breakdown Torque, and Torque Pulsations.	39
2-14. Necessity for Starting Arrangement for Single-phase Induction Motors	40

MISCELLANEOUS

2-15. Number of Poles.	40
2-16. Electrical Degrees	40
2-17. Synchronous Speed.	41
2-18. References for Further Study of Induction-motor Theory.	41

Chapter III. SINGLE-PHASE INDUCTION MOTOR WINDINGS AND CONNECTIONS 44

3- 1. Concentric Winding	44
3- 2. Necessity for Different Types of Connection Diagrams	46
3- 3. Distribution Chart.	46
3- 4. A Stator (or Rotor) Connection Diagram	47
3- 5. Wiring Diagram.	48
3- 6. Line Connection Diagram.	48
3- 7. Magnetic Polarity	48
3- 8. Hand or Gun Winding	49
3- 9. Mold Windings—Concentric Coils	50
3-10. Mold Windings—Progressive Coils.	52
3-11. Skein Windings	54
3-12. Windings with Dissimilar Coils, and Consequent-pole Windings . . .	55
3-13. Some Practical Hints on Winding	56
3-14. Points to Note before Stripping a Winding	57
3-15. Stripping a Winding	58
3-16. Varnish Impregnation—General	60
3-17. Kinds of Insulating Varnishes	60
3-18. Dipping Procedures	64
3-19. Baking Windings.	65
3-20. Varnish Stripping	66
3-21. Points to Check after Rewinding.	66
3-22. Electronic Winding Insulation Tester.	67

Chapter IV. SPLIT-PHASE INDUCTION MOTORS 69

4- 1. Split-phase Motor Defined	69
4- 2. Essential Parts of a Split-phase Motor	69
4- 3. Split-phase Starting Principle	70
4- 4. Purpose of the Starting Switch.	71

4- 5. General-purpose and High-torque Motors	73
4- 6. Torque Characteristics of Split-phase Motors	74

CONNECTION DIAGRAMS FOR SPLIT-PHASE MOTOR WINDINGS

4- 7. Motor Connections and Terminal Markings	74
4- 8. How to Tell the Windings Apart and How to Identify the Leads	75

THE MORE COMMON WINDING CONNECTIONS

4- 9. Both Windings Series-connected	77
4-10. Parallel-connected Main Winding, Series-connected Auxiliary Winding	79
4-11. Both Windings Parallel, Cross-connected	82
4-12. "Short-throw" and "Long-throw" Connections	82
4-13. Switch in Center of Auxiliary Winding	83
4-14. Motors with Direction-connection Plug	85
4-15. Connecting Motor Windings for a Definite Direction of Rotation	85
4-16. Predetermining Direction of Rotation	86
4-17. Nonreversible Motor with One Line Lead on the Starting Switch	88
4-18. Motor with Cord and Plug and Built-in Line Switch	88

THERMALLY PROTECTED MOTORS

4-19. Reversible—Five or Six Line Leads	89
4-20. Nonreversible—Two Line Leads	90
4-21. Motors with Terminal Board	91
4-22. Heating Coil of Protective Device in Auxiliary Phase Only	93
4-23. Oil-burner Motor with Automatic-reset Thermal Overload Protection	93

SPLIT-PHASE MOTORS WITH A MECHANICAL CLUTCH

4-24. Construction	94
4-25. Characteristics	95
4-26. Windings and Connections—Single-voltage Motors	96
4-27. Windings and Connections—Dual-voltage Motors	96

OTHER SPECIAL CONSTRUCTIONS

4-28. Split-phase Motor with Revolving Primary	97
4-29. Two-speed, Pole-changing Motors	98
4-30. Two-speed, Pole-changing Motors with Four Windings	98
4-31. Two-speed, Pole-changing Motors with Three Windings	101
4-32. Dual-voltage Split-phase Motors	103
4-33. Motor System for a Hermetic Refrigerator	104
4-34. Resistance-start Split-phase Motors	105
4-35. Reactor-start Motors	105

MISCELLANEOUS SERVICE PROBLEMS

4-36. How to Reverse the Various Types of Motors	106
4-37. Rewinding or Reconnecting Motor for a Different Voltage and the Same Performance	106
4-38. Rewinding for Different Torques at the Same Voltage	107

PRODUCTION OF A ROTATING FIELD IN A SINGLE-PHASE INDUCTION MOTOR

2- 8. The Single-phase Motor a Special Case of the Two-phase Motor. . .	35
2- 9. Field Set Up by Stator Winding Alone	37
2-10. Field Set Up by the Rotor	37
2-11. Rotating Field.	38

COMPARISONS BETWEEN SINGLE-PHASE INDUCTION MOTORS AND
POLYPHASE INDUCTION MOTORS

2-12. Differences in the Rotating Field.	38
2-13. Losses, Breakdown Torque, and Torque Pulsations.	39
2-14. Necessity for Starting Arrangement for Single-phase Induction Motors	40

MISCELLANEOUS

2-15. Number of Poles.	40
2-16. Electrical Degrees	40
2-17. Synchronous Speed.	41
2-18. References for Further Study of Induction-motor Theory.	41

Chapter III. SINGLE-PHASE INDUCTION MOTOR WINDINGS AND CONNECTIONS 44

3- 1. Concentric Winding	44
3- 2. Necessity for Different Types of Connection Diagrams	46
3- 3. Distribution Chart.	46
3- 4. A Stator (or Rotor) Connection Diagram	47
3- 5. Wiring Diagram.	48
3- 6. Line Connection Diagram.	48
3- 7. Magnetic Polarity	48
3- 8. Hand or Gun Winding	49
3- 9. Mold Windings—Concentric Coils	50
3-10. Mold Windings—Progressive Coils.	52
3-11. Skein Windings	54
3-12. Windings with Dissimilar Coils, and Consequent-pole Windings . . .	55
3-13. Some Practical Hints on Winding	56
3-14. Points to Note before Stripping a Winding	57
3-15. Stripping a Winding	58
3-16. Varnish Impregnation—General	60
3-17. Kinds of Insulating Varnishes	60
3-18. Dipping Procedures	64
3-19. Baking Windings.	65
3-20. Varnish Stripping	66
3-21. Points to Check after Rewinding.	66
3-22. Electronic Winding Insulation Tester.	67

Chapter IV. SPLIT-PHASE INDUCTION MOTORS 69

4- 1. Split-phase Motor Defined	69
4- 2. Essential Parts of a Split-phase Motor	69
4- 3. Split-phase Starting Principle	70
4- 4. Purpose of the Starting Switch.	71

5-24. Single-voltage Motors—with Thermal Protection.	146
5-25. Dual-voltage Motors—without Thermal Protection.	148
5-26. Dual-voltage Motors—with Thermal Protection	150

SPECIAL-PURPOSE MOTORS

5-27. Motors with a Terminal Board in the Mounted Capacitor.	152
5-28. Motors with Magnetically Operated Switch	152
5-29. Two-speed, Pole-changing Motors	154
5-30. Electrically Reversible Motor for Hoist Service	154
5-31. Miscellaneous Special Arrangements	158

MISCELLANEOUS SERVICE PROBLEMS

5-32. Rewinding or Reconnecting Motor for a Different Voltage and Same Performance.	159
5-33. Rewinding for Different Torques.	161
5-34. Rewinding for a Different Frequency.	161
5-35. Changing a Capacitor-start to a Split-phase Motor.	161
5-36. Regeneration in Capacitor-start Motors.	162

Chapter VI. TWO-VALUE CAPACITOR MOTORS 165

6- 1. Two-value Capacitor Motor Defined	165
6- 2. Essential Parts of the Two-value Motor.	165
6- 3. Effect of the Running Capacitor.	167
6- 4. Purpose of the Starting Switch.	168
6- 5. Torques of Two-value Capacitor Motors	169

CAPACITOR-TRANSFORMER UNITS

6- 6. Construction of the Capacitor-transformer Unit	169
6- 7. Identifying the Leads.	172
6- 8. Testing Capacitor-transformer Units	172
6- 9. Defective Capacitor-transformer Units	173

SINGLE-VOLTAGE MOTORS

6-10. Capacitor Mounted on Motor, Four Leads, Reversible	174
6-11. Separately Mounted Capacitor-transformer Unit.	174
6-12. Thermally Protected Reversible Motor	176
6-13. Motor with Terminal Block on Mounted Capacitor Unit	176
6-14. Nonreversible Motor with Two Line Leads	178

DUAL-VOLTAGE MOTORS

6-15. Dual-voltage Motor with Capacitor-transformer Unit.	178
6-16. Dual-voltage Motor Using Two Capacitors	180

MISCELLANEOUS SERVICE PROBLEMS

6-17. Rewinding or Reconnecting Motor for a Different Voltage but for Same Performance.	181
--	-----

- 6-18. Rewinding for Different Torques, Speed, or Frequency 182
 6-19. Changing a Two-value Motor to a Capacitor-start Motor. 182

*Chapter VII. PERMANENT-SPLIT CAPACITOR MOTORS (SINGLE-VALUE
 CAPACITOR MOTORS)* 184

- 7- 1. Permanent-split Capacitor Motor Defined. 184
 7- 2. Essential Parts of a Permanent-split Capacitor Motor 184
 7- 3. Single-voltage Motors. 185
 7- 4. Dual-voltage Motors. 185
 7- 5. Dual-voltage Motor with Capacitor-transformer Unit. 186
 7- 6. Defective Capacitor-transformer Units 187
 7- 7. Dual-voltage Motor with Series-parallel Windings and Capacitor . . 188
 7- 8. Reversible, High-torque Motors 189

*Chapter VIII. CAPACITOR MOTORS FOR UNIT HEATERS, SHAFT-MOUNTED
 FANS AND BLOWERS* 191

- 8- 1. General. 191

ALL-PURPOSE CAPACITOR MOTORS FOR UNIT-HEATER SERVICE

- 8- 2. Mechanical and Electrical Features. 191
 8- 3. Systems of Voltage Control 194
 8- 4. Fundamental Relationship between Slip, Voltage, and Torque. . . . 196
 8- 5. Speed Control by Means of Voltage Control. 197
 8- 6. Limitations of This System of Speed Control 198
 8- 7. Connection Diagrams. 198
 8- 8. Testing or Checking Adjustable-speed Controllers 202

THREE-SPEED DUAL-VOLTAGE MOTORS

- 8- 9. Motor Connections. 204
 8-10. Controller Connections 207
 8-11. Line Connections to Motor and Controller. 207
 8-12. Controller with Nonadjustable High Speed 208
 8-13. Testing Three-speed Controllers 208
 8-14. Rewinding 210

TWO-SPEED VOLTAGE-CONTROLLED MOTORS

- 8-15. Single-voltage Motors. 210
 8-16. Special Mechanical Features. 212

Chapter IX. TWO-SPEED TAPPED-WINDING CAPACITOR MOTORS 213

- 9- 1. Principle of the Tapped-winding Motor. 213
 9- 2. Winding Arrangement of a Tapped-winding Motor. 213
 9- 3. The L-connection. 214
 9- 4. The T-connection 215
 9- 5. Motors with Separate Controller. 217

9- 6. Motors with Capacitor Attached.	219
9- 7. How to Tell the Windings Apart and How to Identify the Leads . . .	220
9- 8. Rewinding or Reconnecting	221

Chapter X. REPULSION-START INDUCTION MOTORS 224

10- 1. Repulsion-start Induction Motor Defined.	224
10- 2. Application and Torque Characteristics.	225
10- 3. Essential Parts of the Repulsion-start Induction Motor.	225

PRINCIPLES OF OPERATION

10- 4. Repulsion Motor Similar to a Series Motor	227
10- 5. The Simple Repulsion Motor	228
10- 6. Hard Neutral and Soft Neutral	229
10- 7. Function of the Short-circuiter.	230

STATOR WINDINGS

10- 8. Dual-voltage Four-lead Motors	230
10- 9. Rewinding for a Different Voltage	232
10-10. Rewinding for Different Torques.	233
10-11. Rewinding for a Different Frequency or Number of Poles.	233

ARMATURE WINDINGS

10-12. General.	234
10-13. The Lap (or Parallel) Winding.	234
10-14. Lap Windings—Coil Connections to the Commutator.	235
10-15. Lap Windings—Position of the Brushes at Neutral.	235
10-16. How to Lay Out Coil Connections of a Lap Winding for a Predeter- mined Brush Position.	236
10-17. Number of Brush Arms Required with a Lap Winding	237
10-18. Cross-connected Lap Windings.	237
10-19. The Simplex Wave Winding.	238
10-20. Progressive and Retrogressive Wave Windings.	239
10-21. Wave Windings—Number of Dead Coils and Commutator Throw . .	239
10-22. Wave Windings—Coil Connections to the Commutator.	240
10-23. How to Lay Out Coil Connections of a Wave Winding for a Pre- determined Brush Position	241
10-24. Number of Brush Arms Required by a Wave Winding	242
10-25. Number of Circuits in a Wave Winding.	242
10-26. Dead Bars Used with a Wave Winding.	242
10-27. Duplex Windings.	243
10-28. Points to Note before Stripping an Armature	244
10-29. Checking the Rewound Armature	244

CONSTRUCTIONAL FEATURES AND CARE

10-30. Mark Position of End Shield	245
10-31. Commutators	246
10-32. Short-circuiters	246

10-33. Brush-lifting Mechanism	249
10-34. Brush-holder Mechanisms	249
10-35. How to Reverse a Motor Using a Rocker Ring	249
10-36. How to Reverse a Motor with Cartridge-type Brush Holders	251
10-37. Checking or Setting Neutral	252
10-38. Replacement of Brushes	253
10-39. Care and Maintenance—General	254

Chapter XI. REPULSION AND REPULSION INDUCTION MOTORS. 256

11- 1. Repulsion Motor Defined	256
11- 2. Repulsion Induction Motor Defined	256

DUAL-VOLTAGE MOTORS

11- 3. Dual-voltage Repulsion Motor	256
11- 4. Dual-voltage Repulsion Induction Motor	258

ELECTRICALLY REVERSIBLE MOTORS FOR PLUGGING SERVICE

11- 5. Reversing Repulsion-type Motors Electrically	259
11- 6. Electrically Reversible Motor with Single-phase Type of Winding	260
11- 7. Electrically Reversible Motor with Polyphase Type of Winding	261
11- 8. Checking or Setting Neutral	264

OTHER TYPES OF REPULSION MOTORS

11- 9. Synchronous Motor of the Repulsion Type	264
11-10. Synchronous Motor of the Repulsion Induction Type	265

Chapter XII. UNIVERSAL MOTORS 266

12- 1. Universal Motor Defined	266
12- 2. Application and Torque Characteristics	266
12- 3. Essential Parts of the Universal Motor	271

PRINCIPLES OF OPERATION

12- 4. Operation on Direct Current	273
12- 5. Operation on Alternating Current	273
12- 6. Compensated Universal Motors	275

STATOR WINDINGS

12- 7. Concentrated-pole Noncompensated Motors	277
12- 8. Split-series Electrically Reversible Motors	279
12- 9. Tapped-field Winding	280
12-10. Two-field Compensated Windings	281
12-11. Two-field Compensated Split-series Windings	282
12-12. Single-field Compensated Motor	282

ARMATURE WINDINGS

12-13. General	284
12-14. Front-lead Windings	284

12-15. Back-lead Windings	286
12-16. Points to Note before Stripping an Armature	288
12-17. Notes on Rewinding and Reconnecting	288
12-18. Refinishing the Commutator.	288
12-19. Checking the Rewound Armature	289

GOVERNOR-CONTROLLED MOTORS

12-20. General.	289
12-21. Two-brush Governors.	290
12-22. Single-brush Governors.	292
12-23. Other Governors.	293
12-24. Care and Adjustments of Governors	293
12-25. Wiring Diagrams of Governor-controlled Motors.	293

MISCELLANEOUS SERVICE PROBLEMS

12-26. Setting or Checking Neutral.	294
12-27. Predetermination of Direction of Rotation.	295
12-28. Rewinding for Different Characteristics.	295
12-29. Use of an External Resistor for Speed Reduction.	295

Chapter XIII. SHADED-POLE INDUCTION MOTORS AND FANS. 297

CHARACTERISTICS OF SHADED-POLE MOTORS

13- 1. Shaded-pole Motor Defined	297
13- 2. Essential Parts of a Shaded-pole Motor.	297
13- 3. Construction of Shaded-pole Motors	298
13- 4. Principle of the Shaded-pole Motor.	302
13- 5. Vector Diagram of a Simple Shading Coil.	303
13- 6. Performance Characteristics.	304
13- 7. Reluctance-start Motor.	306
13- 8. Reversible Shaded-pole Motors	306
13- 9. Variable-speed Motors	309

REWINDING SHADED-POLE MOTORS

13-10. Rewinding for the Original Characteristics.	309
13-11. Rewinding for Different Characteristics.	310

FAN-MOTOR WINDINGS

13-12. General.	311
13-13. Series Motor.	311
13-14. Induction-type Motors	311
13-15. Capacitor Windings	312

Chapter XIV. POLYPHASE INDUCTION MOTORS. 315

14- 1. Essential Parts of a Polyphase Induction Motor	315
14- 2. Principle of the Polyphase Induction Motor.	317

WINDINGS AND CONNECTIONS

14- 3.	Lap Winding for Polyphase Motors	317
14- 4.	Number of Groups and Number of Coils per Group	319
14- 5.	"Throw-up" and "Throw-down" Windings	320
14- 6.	"Short-throw" and "Long-throw" Connections	321
14- 7.	Stator (or Rotor) Connection Diagrams, Single Voltage, Two- and Three-phase	321
14- 8.	How to Check a Diagram or Winding	321
14- 9.	Windings with Unequal Coil Grouping	334
14-10.	How to Determine Coil Groupings for Three-phase Fractional-slot Windings	337
14-11.	Two-phase Fractional-slot Windings	338
14-12.	Irregular Windings	339
14-13.	Wound-rotor Motors	340
14-14.	Dual-voltage Motors	340

REWINDING OR RECONNECTING

14-15.	General	341
14-16.	Chord Factor, Distribution Factor, and Effective Conductors	344
14-17.	Changes in Voltage	347
14-18.	Changes in Number of Phases	347
14-19.	Changes in Frequency	348
14-20.	Changes in Number of Poles	349
14-21.	Figuring Magnetic Densities to Check a Proposed Winding	350
14-22.	Allowable Densities	353

Chapter XV. SYNCHRONOUS MOTORS 355

15- 1.	General	355
15- 2.	Types of Synchronous Motors	355

RELUCTANCE MOTORS

15- 3.	Reluctance Motor Definitions	356
15- 4.	Construction	356
15- 5.	Polyphase Reluctance Motors	357
15- 6.	Split-phase Reluctance Motors	359
15- 7.	Capacitor-type Reluctance Motors	359
15- 8.	Making a Synchronous Motor in the Repair Shop	360

HYSTERESIS MOTORS

15- 9.	Hysteresis Motor Defined	361
15-10.	Construction	361
15-11.	Polyphase Hysteresis Motors	362
15-12.	Capacitor-type Hysteresis Motors	363
15-13.	Shaded-pole Hysteresis Motors	363
15-14.	Telechron Motors	364
15-15.	Multipolar Shaded-pole Hysteresis Motor with a Single Stator Coil	364

INDUCTOR MOTORS

15-16. Construction	366
15-17. Principles of Operation	367
15-18. Characteristics and Applications.	370

Chapter XVI. POSITION-INDICATING AND SYNCHRONOUS-DRIVE SYSTEMS. . 372

16- 1. General.	372
16- 2. These Systems Are Known by Many Names.	372

MOTOR-AND-GENERATOR SYSTEM WITH SINGLE-PHASE EXCITATION

16- 3. Components and Connections of the System.	373
16- 4. Construction of Salient-pole Generators and Motors	374
16- 5. Construction of Distributed-winding Machines.	375
16- 6. Principles of Operation	376
16- 7. Performance Characteristics.	379

OTHER SELF-SYNCHRONOUS SYSTEMS

16- 8. Use of a Control Transformer and Generator	379
16- 9. Construction of a Control Transformer	382
16-10. Differential Generators and Motors.	382
16-11. Position-indicating System for Direct Current.	383

POLYPHASE EXCITATION (SYNCHRONOUS-DRIVE MOTORS)

16-12. Polyphase Synchronous-drive System.	384
16-13. Connecting Up a Polyphase Synchronous-drive System.	386

MISCELLANEOUS SERVICE PROBLEMS

16-14. Rewinding Self-synchronous Machines	387
16-15. Reversing a Self-synchronous Motor	387
16-16. Building Position Indicators in the Repair Shop	387
16-17. Rewinding a Polyphase Synchronous-drive Motor	388

Chapter XVII. DIRECT-CURRENT MOTORS. 390

17- 1. Types of D-c Motors.	390
17- 2. Essential Parts of a D-c Motor	391

PRINCIPLES OF OPERATION

17- 3. How Torque Is Developed	393
17- 4. How the Shunt Motor Works	393
17- 5. How the Compound Motor Works.	396
17- 6. How the Series Motor Works	397

APPLICATION CHARACTERISTICS

17- 7. Ratings.	398
17- 8. Operating Characteristics	398

DIAGRAMS FOR GENERAL-PURPOSE MOTORS

17- 9. Standard Lead Markings	400
17-10. Wiring around Frame Diagrams—Shunt and Series Motors	400
17-11. Wiring around Frame Diagrams—Compound Motors.	401

SPECIAL-PURPOSE MOTORS

17-12. Motor with Direction-connection Plug	404
17-13. Split-series Motors.	405
17-14. Electrically Reversible (Plug-reversing) Motors	405
17-15. Adjustable-varying speed Motor for Fans and Blowers	407
17-16. Two-speed Motor	408
17-17. Motor for Material-handling Electric Trucks	408

SERVICE PROBLEMS

17-18. Armature Windings—Lap.	409
17-19. Armature Windings—Wave.	411
17-20. How to Change the Speed without Rewinding.	411
17-21. How to Reverse a D-c Motor	412
17-22. Rewinding for a Different Voltage	412
17-23. Rewinding for a Different Speed.	413
17-24. Finding the Neutral Position	413
17-25. Brushes.	413

Chapter XVIII. CONSTRUCTIONAL FEATURES COMMON TO MORE THAN ONE

TYPE	415
----------------	-----

BEARINGS

18- 1. Sleeve Bearings—Constructions	415
18- 2. Sleeve Bearings—Service and Maintenance	419
18- 3. Ball Bearings—Construction.	420
18- 4. Ball Bearings—Service and Maintenance	422

STARTING SWITCHES

18- 5. Centrifugal Starting Switches—General.	423
18- 6. Delco Starting Switches.	425
18- 7. Ohio Starting Switches	429
18- 8. Reynolds Electric Company Switches.	429
18- 9. Westinghouse Starting Switches	429

RIGID AND RESILIENT MOUNTINGS AND COUPLINGS

18-10. Types of Mounting.	436
18-11. Torque Pulsations in Single-phase Motors.	436
18-12. How Resilient Mounting Eliminates Noise Due to Torque Pulsations .	439
18-13. Flexible Couplings	441

THERMAL OVERLOAD PROTECTION

18-14. Thermal Overload Devices	442
18-15. Inherent Overheating Protection.	448

18-16. Underwriters' Laboratories Standards for Inherent Overheating Protection	450
---	-----

GEAR MOTORS

18-17. Worm-gear Reducers	451
18-18. Spur-gear Reducers	452
18-19. Double-parallel Reduction Gear	452

<i>Chapter XIX.</i> TESTING FRACTIONAL HORSEPOWER MOTORS.	454
---	-----

METERS AND EQUIPMENT

19- 1. Power Source	454
19- 2. Measurement of Voltage	454
19- 3. Measurement of Current	456
19- 4. Measurement of Power Input (Watts)	456
19- 5. Measurement of Power Factor	457
19- 6. Measurement of Frequency	457
19- 7. Measurement of Speed	457
19- 8. Measurement of Slip	459
19- 9. Measurement of Resistance	460
19-10. Measurement of Temperatures	461
19-11. Meter Loss Corrections	462
19-12. Meter Connections for Single-phase Circuits	463
19-13. Meter Connections for Polyphase Circuits	464
19-14. Measurement of Mechanical Output	466

TESTS TO TAKE—SINGLE-PHASE INDUCTION MOTORS

19-15. A Commercial Test	467
19-16. A Complete Engineering Test	469

TESTS TO TAKE—OTHER TYPES

19-17. Adjustable-varying Speed Fan Motors	475
19-18. Polyphase Induction Motors	475
19-19. D-c Motors	475
19-20. Universal Motors	476
19-21. Reluctance-type Synchronous Motors	477
19-22. Dielectric Tests	477

SEGREGATION OF LOSSES

19-23. General—Polyphase Motors	478
19-24. Single-phase Induction Motors	479
19-25. Capacitor Motors	481

APPLICATION TESTS

19-26. Determination of the Power Requirements	481
19-27. Determination of the Torque Requirements	483

<i>Chapter XX.</i> SELECTING A MOTOR FOR THE JOB.	485
---	-----

20- 1. General-purpose and Special-purpose Motors	485
---	-----

GENERAL-PURPOSE MOTORS

20- 2. Selection of the Type. 485

20- 3. What Full-load Speed? 488

20- 4. Choosing the Horsepower Rating. 488

20- 5. Constructional and Design Features 489

20- 6. Service Conditions. 490

20- 7. Effects of Variation of Voltage and Frequency upon the Performance of
Induction Motors 491

20- 8. Operation of 60-cycle Induction Motors on 50 Cycles. 492

20- 9. Shaft Extensions—Dimensions and Tolerances. 493

SPECIAL-PURPOSE MOTORS

20-10. Hermetic Motors. 497

20-11. Motors for Belt-drive Refrigeration Compressors. 497

20-12. Washing-machine Motors 498

20-13. Motors for Shaft-mounted Fans and Blowers 499

20-14. Motors for Belted Fans and Blowers 500

20-15. Stoker Motors. 501

20-16. Oil-burner Motors 501

20-17. Jet-pump Motors 501

20-18. Cellar-drainer and Sump-pump Motors. 501

20-19. Gasoline-dispensing Pump Motors 502

MISCELLANEOUS

20-20. Performance Specifications for Single-phase Induction Motors 503

20-21. Maximum Inputs for Single-phase Induction Motors 505

20-22. Inputs for Polyphase Induction Motors. 506

20-23. Relationships between Power, Torque, and Speed 506

20-24. Radio Interference and Suppression Devices. 507

Appendix 509

Glossary 525

List of Visual Aids 535

Index 539