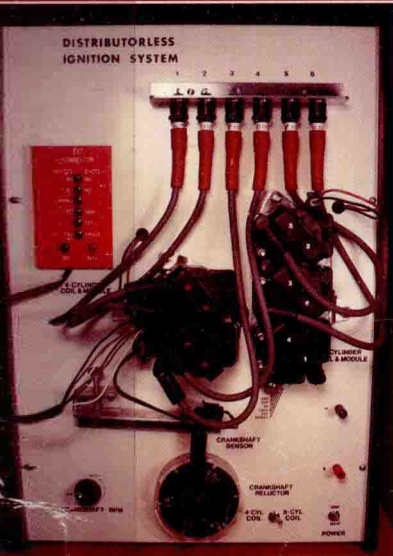
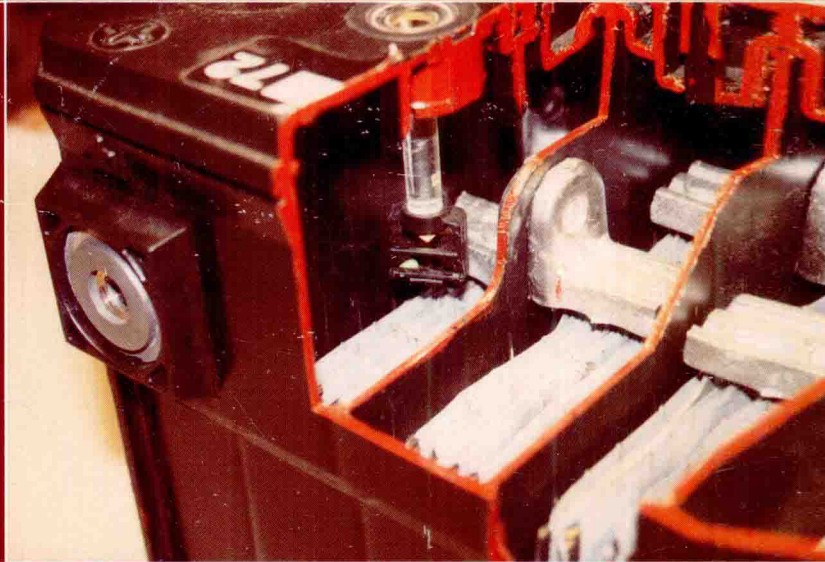


Diagnosis and Troubleshooting of Automotive Electrical, Electronic, and Computer Systems



2nd
Edition



James D. Halderman

DIAGNOSIS AND TROUBLESHOOTING OF AUTOMOTIVE ELECTRICAL, ELECTRONIC, AND COMPUTER SYSTEMS

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James D. Halderman

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PREFACE

This second edition is updated and streamlined to make learning electrical and electronic systems easy. At the request of service technicians and instructors from throughout the United States and Canada, information on computer sensors, high-intensity discharge (HID) headlights, antilock brakes, OBD II, and digital meter usage have been included. A sample, ASE-style test is included in the appendix.

Like the first edition, this book presents automotive electrical and electronic system concepts and operation in a simple, concise format with more detail than is found in most electrical systems books. Also provided is an explanation of the effects that one component or circuit can have on another, with the goal of improving diagnostic and troubleshooting skills.

Incorporated into this edition are the following:

1. Objectives at the beginning of each chapter
2. Clear, concise definitions of terms in the text and glossary
3. Symptoms of defective components and troubleshooting
4. Hundreds of photographs and line drawings
5. Detailed captions that provide a greater understanding of the illustrations
6. Examples of troubleshooting, using actual problems experienced by professionals in the field

7. Explanation of operation, with an emphasis on why they work
8. Examples and practical application in every chapter
9. Diagnostic trouble codes for General Motors, Ford, Chrysler, Honda, Toyota, and OBD II generic
10. Sample ASE certification test in the appendix

To ensure that the needs of the reader are met, every topic has been presented in the following format:

1. Basic operation
2. Parts involved
3. Testing methods and results, using both low-cost equipment and electronic test equipment
4. Symptoms of defective operation (characteristics)
5. Diagnosis and service procedures
6. Troubleshooting examples with solutions
7. Troubleshooting guides included in selected chapters
8. Chapter summaries at the end of each chapter.
9. Multiple-choice ASE-type questions at the end of each chapter
10. Tech tips included throughout

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James D. Halderman

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◀ Chapter I ▶

ELECTRICAL SYSTEM PRINCIPLES

OBJECTIVES

After studying chapter 1, the reader will be able to

1. Define electricity.
2. Explain the units of electrical measurement.
3. Discuss the relationship among volts, amperes, and ohms.
4. Explain how magnetism is used in automotive applications.

The electrical system is one of the most important systems on a vehicle today. Every year more and more components and systems use electricity. Those technicians who really know and understand automotive electrical and electronic systems will be in great demand.

ELECTRICITY

The word *electricity* comes from the Greek word *elektron*, meaning amber (a fossil resin). The ancients produced electric charges by rubbing amber with wool. This produced **static electricity**, which was the first known type of electricity. It is called static (motionless) because the charge is at rest and not moving through a wire.

It was detected that there are actually two types of electrical charges. When a rubber rod was rubbed with flannel or fur, a **negative (-) charge** was generated in the rod. When a glass rod was rubbed with silk, the glass rod had a **positive (+) charge**. See figure 1-1.

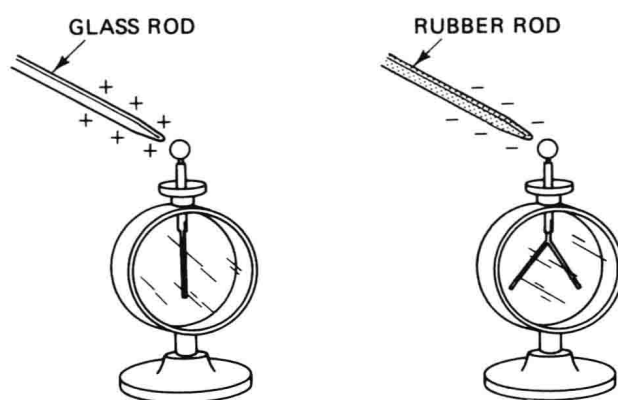


FIGURE 1-1 A test instrument called an electroscope illustrates that positive and negative charges are opposite.

It was also discovered that objects with like charges (both positive or both negative) repelled or moved away from each other. Objects with unlike charges (one positive and one negative) attracted or moved toward each other. The negative charges were determined to be caused by an atom with an extra number of negative-charged electrons. See figure 1-2. Electricity is actually the movement of electrons from one atom to another.

THE ATOM AND ELECTRONS

To begin to explain electricity, one must convey an understanding of the composition of an atom. An atom is the smallest unit of all matter in the universe.