

HOME HEATING AND AIR CONDITIONING SYSTEMS

James L. Kittle

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James L. Kittle
Line Drawings by
Gary McKinney

TAB Books

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To the homeowner/handyperson:
To assist you in doing a better, safer job
of installing, repairing, and maintaining
your equipment.

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Introduction

MANY HOW-TO BOOKS ON HEATING AND AIR CONDITIONING SYSTEMS ARE ON the market today. Although many are well written and illustrated, others have poor or stylized drawings that do not resemble actual objects. More important, most are not written by people who have “worked with the tools,” but by writers who obtain information from journeymen, inspectors, engineers, and others who are knowledgeable in their field. Often, these types of how-to books are based on second hand accounts, and, at best, are not always correctly written or explained.

This book is written for the homeowner/handyperson who is interested in maintaining, altering, or installing heating or cooling equipment in their own home. Every government entity, whether township, city, or county, has rules that prohibit anyone who is not licensed from working on electrical, plumbing, heating, and cooling equipment other than in their own home.

I have written this book by drawing on my many years of practical experience, not as a do-it-yourselfer, but as a journeyman with hands-on experience in all of the topics covered in this book. Every procedure, operation, repair, new installation, rebuilding, and removal and replacement I have, at one time or another, done, and not under ideal laboratory conditions. *Home Heating and Air Conditioning Systems* contains complete, detailed instructions and illustrations so that you can get the work done correctly, in accordance with local regulations.

In this book, I'll show you how to do a procedure the easiest, best, and fastest way. Over the years, individual journeymen have developed methods and special procedures that are actually shortcuts, improvements, and safer ways to perform necessary work. Some of these procedures should *not* be done by a handyperson or homeowner, because they might be hazardous to equipment, such as a heat pump or air conditioning compressor. I recommend that these complicated procedures be done only by a trained technician in that particular

field. Many of the procedures are illustrated, and diagrams are furnished to accompany the written instructions. Some of the procedures that are explained in this book are detailed, and although I've tried to write everything in clear, easy-to-understand terms, it might be necessary for you to read the instructions more than once. Follow directions sequentially, and do not skip steps. Doing procedures out of order could result in damaged equipment.

Chapters 1 and 2 cover safety precautions and selecting and using tools correctly. Be sure to read these chapters before you begin any work so that you are aware of the potential hazards of handling flammable materials or explosive gases such as propane and natural gas.

Chapters 3 and 4 explain how to detect faulty installations and how to evaluate gas- and oil-fired furnaces. Chapter 5 explains how different heating systems work and provides practical advice for choosing a new system or upgrading an older one. In Chapters 6 and 7, you'll learn how to install an oil-fired furnace and replace a boiler.

There is also information on how to install central air conditioning and window units, as well as a complete chapter on using a heat pump for supplemental heat or alone. There is also a complete chapter on servicing heating and air conditioning systems as well as a time-saving troubleshooting index.

For the most part, all of the work is within the ability of the average handyman, do-it-yourselfer. Exceptions might be making the final connection to a live electrical panel, or replacing a burned-out air conditioning compressor. Other than these few instances, all of the work explained and illustrated in this book can easily be done by the do-it-yourselfer.

I hope you will find this book informative and helpful in enabling you to keep your mechanical heating and cooling equipment maintained in excellent condition.

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Safety

SAFETY IS AN IMPORTANT CONSIDERATION IN ALL WALKS OF LIFE, AND ESPECIALLY in the home where there are young children. Keep safety in mind at all times when working on any mechanical equipment such as heating and air conditioning appliances. Do not work on equipment when it is in operation, even though the equipment has shut itself off. In this mode, the equipment can start at *any* time and cause injury to anyone attempting to service or adjust it.

FIRE HAZARDS

Fire that is controlled, as in heating equipment, *is* safe. The nature of fire must be thoroughly understood, however, even when working with heating equipment. Most materials will burn when their temperature is raised to the ignition temperature of that material. Paper and wood shavings ignite at a very low temperature. Wood has a much higher ignition point.

Number 2 fuel oil is not easily ignited in liquid form, but when sprayed into the combustion chamber of an oil-fired furnace or boiler, ignites easily. This is controlled combustion, and is safe. Natural gas and liquified petroleum gas (LPG), also called “bottled gas,” are extremely flammable and must *always* be treated with respect. Both of these gases are under pressure and the piping must be gastight to prevent leaks. Natural gas is lighter than air and tends to rise. LPG is heavier than air and, if leaking, will flow along the floor or into a crawl space under a building for great distances. Odor-producing substances are added to both gases for leak detection purposes. A leak of either gas presents a *very hazardous condition!* An accumulation of either gas, if ignited by a spark or flame, can demolish a large building.

The only safe way to find a gas leak is with soap bubbles or leak detection solution (similar to a child’s bubble liquid). Paint *all* joints with the thick ropey

Safety

solution. Bubbles will form at the location of a leak. When testing a new or repaired gas line, shut off all gas-using equipment, and pilot lights. As an additional check on leaking gas, observe the one-half or one-cubic foot dial on the meter. This dial is separate from the usage dials and is usually below or to one side of these dials. If the hand moves, there is a leak. If the hand does not move, the system is gastight.

GAS UTILITIES

All public utilities are regulated by a state Public Service Commission. Gas is supplied to the utility lines at high pressure, which is reduced to about seven inches water column (WC), about a half pound, by a pressure regulator (reducer) near the meter. Another regulator on the furnace, ahead of the automatic gas valve, reduces the pressure further to three inches WC. If this is a new installation or an extensive remodeling project, you will have to contact the gas utility before you start working. You will also need a permit from the governing authority, city, township, or other administrative body.

Gas connections, such as gas-fired clothes dryers and gas-fired barbecues are sometimes piped using $\frac{3}{8}$ -inch O.D. copper or aluminum tubing. NOTE: *All* tubing connections on gas lines *must* be the flare type. This type of connection is the most leak-proof and is very reliable.

OIL-FIRED FURNACES

Oil-fired equipment is much different than gas-fired types. Oil leaks are also not as dangerous as gas leaks. An oil leak will show as an oily spot on the floor, or as a wet line near a fitting (a crushed line may also leak). Leaking fuel oil is a fire hazard and must be repaired as soon as possible. Oil lines of copper (do not use aluminum) are connected using flare fittings, as are gas lines. CAUTION: *Always* run oil, gas, and water lines so as to minimize the chance of damage to them. It is better to cut a trench in the concrete basement floor, bury the oil line, then cement over the line, rather than run the line where it would be subject to damage.

Formerly, oil-burning furnaces were required to have a red shutoff switch located near the entrance to the basement so that the burner could be shut off in case of emergency. This is no longer required. A fire extinguisher is now recommended for this location. The fuel oil tank, if located in the basement, must be at least 10 feet from the oil burner. Most building codes require this minimum distance.

BUILDING CODES

Before you can install new heating equipment, you must obtain a permit from the building department of the governing body for that area. Talk with the inspector and bring an outline of your installation, showing the location of the burner and the oil tank. Outside tanks are satisfactory, except that water in the oil tank can freeze during winter and cause the burner to stop.

Many times, a substandard installation results from poor workmanship, ignorance of standard practices, and violations of applicable building codes. Electric wiring is one example. Polarity of wires are not maintained; the white and black wires are interchanged, posing the danger of shock. The National Electrical Code (NEC) makes it mandatory that the white wire (neutral) cannot be broken, except when all live (hot) wires are broken (disconnected) simultaneously with the neutral wire. Another rule that is mandatory: The green insulated or bare wire must be continuous, from the service entrance panel entirely through all of the wiring circuits. This is the bare “ground wire” found in all electrical cable. These requirements might seem minor, but they are vitally important in practice for the safety of people who will be coming in contact with the electrical equipment.

2

Tools

THE AVERAGE HOMEOWNER/HANDYPERSON WILL HAVE MANY OF THE STANDARD hand and power tools described in this chapter. People who specialize in wood-working projects might not own many of the tools used for working on mechanical equipment. Tools that you will only use occasionally can be borrowed or rented. Many fine tools are often on sale at reduced prices and are worth buying, *if* you have a future use for them.

HAND TOOLS

Pliers, screwdrivers, and small wrenches are usually on hand. Because quality tools “work right” and last, literally forever, they are the best buy, even though the cost is more. Brand name tools, made by reputable manufacturers will give excellent service and will usually be replaced at no charge if broken. See Figs. 2-1 through 2-7. The pliers you will need are “waterpump pliers,” and Channellock is the best. Electrician’s pliers, side cutting lineman’s and diagonal type can be either Klein or Channellock. They also make good long-nose and other types of pliers. You will need several screwdrivers: a small pocket size, a medium size, and a medium large size. A Phillips medium size screwdriver will fit most Phillips screws found on heating and cooling equipment. Small sets of open-end wrenches are nice to have, but adjustable wrenches are my favorites. The six-inch, eight-inch, and 10-inch sizes will fit almost every nut and bolt found on heating and air conditioning equipment.

Standard hacksaws have an adjustable frame that will accept 10- or 12-inch blades. The 12-inch blade allows a longer stroke, which can be less tiring when doing a great deal of metal sawing. The “keyhole” type allows sawing in confined spaces not large enough to accept the large saw frame. This saw has a

Tools

tapered blade fastened at only one end in a pistol-grip handle. A standard hack-saw blade will substitute for the keyhole saw. Tape one end for use as a handle. The teeth must point forward when using the blade alone and in the frame. Standard blades come in various "teeth per inch," such as 16, 24, and 32 teeth per inch. The thickness of the metal will determine the number of teeth. Thin brass tubing on a sink drain line will catch the teeth of a 16 tooth blade. To better cut sheet metal, use sheet metal snips. The newer style of snips, known as "aircraft snips," are usually better to use than the large, older type, except for long, straight cuts. Wiss makes the best quality. Aircraft snips are available in "cuts right," "cuts left," and "cuts straight." These types of snips are favored by sheet metal workers for cutting holes in ductwork.

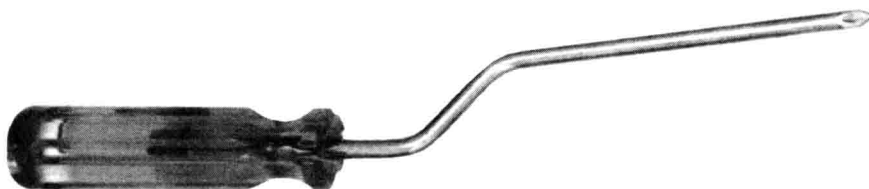


Fig. 2-1. A Rapidriv screwdriver. Courtesy of Vaco Products Division.

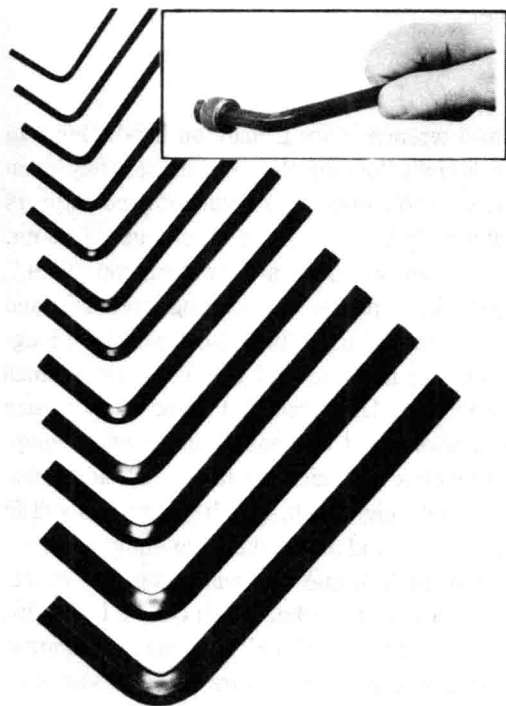


Fig. 2-2. Hex keys come in long and short series. Pictured here are short series hex keys.

Courtesy of Vaco Products Division.