

Raker

Appliance Repair Professionals

Introduction & Automatic Washers

Manual 1

Harry D. Raker

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WARNING

SAFETY PRECAUTIONS

Safety is very important when working on any appliance .

Disconnect power before servicing any appliance.

Always keep the work area and your shoes dry.

All appliances have sharp edges and should be handled carefully.

Before working on any gas appliance extinguish all open flames and before attempting any gas associated repair, cut off the gas feed.

Always sniff for gas leaks and soap bubble test any parts that may have been disturbed by repair work.

To minimize any potential buildup of gas in case there is a leak, always have the room open to the outside.

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Preface

Welcome to the beginning of your new and exciting career. I will be working closely with you for many months as we progress through the program. I'm sure that you are going to enjoy the learning experience as many other students have.

Certain assumptions are made in this program. It is assumed that you are familiar with the common hand tools and wrenches. We don't waste time with obvious clips, bolts, etc. that need to be removed for access and disassembly. Instead, we cover areas that cause confusion and difficulty. The program will cover all special tools and every technique needed to master major appliances.

Safety is very important when working on any appliance and particularly when working in the homes of others. However we do not feel that it is necessary to remind you of the hazards on page after page as some manuals do. Our instruction assumes that you have enough sense to unplug appliances at the proper times and are very careful during "live tests". We describe certain procedures that may be dangerous if done improperly but are often used by experienced service technicians to save time. These are not recommended to anyone that is unfamiliar with electricity. For those, a more conservative approach with the power off, is much safer. (Electrical procedures are covered in a Manual 5 and as they apply.)

It is highly recommended that you obtain one or more popular model washers for your own education (any Kenmore is fine.) Any dryer, dishwasher, refrigerator or range that you disassemble can only help. Complete disassembly, repair, and rebuilding will prove very valuable, particularly if done while you are studying the program. Overhauling your own washer or any other appliance will provide you with additional skill and confidence. Don't blame it on me if your spouse gets angry. Overhauled appliances can be easily sold after they are completed.

Men and women are equally suited for appliance service. However for simplicity and clarity the male gender is used occasionally in the text. This is not intended to insult any of our excellent female students.

Sincerely,

Uncle Harry

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Studying

It's very likely that it has been many years since you have done any studying. A few suggestions are in order to help get you off to a good start.

1. Study regularly. Establish a regular time to study. Setting aside a short time each day, or even each week, is far more important than how long you study.
2. Find a good study area. You need a quiet, well lighted work space. Advise the rest of the family that you wish to be left alone to concentrate.
3. Skim through each manual to get an overview. Then go back and concentrate on reading the material. Make notes as you go along, highlighting anything confusing.
4. To get good grades on examinations (and get your new career properly started), it will be necessary to reread and carefully study parts of the material. Don't rush, each page of each manual is important.

The program deals with understanding concepts rather than memorizing. If at any time you are confused or need help, please call or write. I certainly want you to be successful in your new business and will help you anyway that I can.

Uncle Harry

Raker

Appliance Repair Professionals, Inc.

Complete Table of Contents

Manual 1

Introduction to Major Appliances and Automatic Washing Machines

Introduction to the industry and the history of major appliances. Instructions on analyzing your own marketplace; understanding your customer base, and goal setting. Understanding the profit potential of a technician. General theory and problems common to all brands of automatic washers.

Manual 2

Automatic Washers (cont.)

Understanding and repairing direct and belt drive models of Kenmore, Whirlpool, Roper, and Kitchen-Aid.

Manual 3

Automatic Washers (cont.)

Understanding and repairing General Electric, Hotpoint, Maytag, Norge, Frigidaire, Westinghouse, Montgomery Wards.

Manual 4

Automatic Dryers (Gas and Electric)

General theory common to all dryers; airflow problems; overheating; time and automatic cutoff systems; spots and staining of clothes. Understanding and repairing Kenmore, Whirlpool, Roper, and Kitchen-Aid. Also covered are General Electric, Hotpoint, Maytag, Norge, Frigidaire, Westinghouse, and Montgomery Wards.

Manual 5

Electricity Made Simple

Understanding household wiring & circuits. Testing voltage, resistance and current. Understanding popular electrical components. Safety techniques and avoiding accidents.

Manual 6

Structuring Your Customer Base;

Learning about customer's types and their desirability. Covers homeowners, Realtors, landlords, hotels, schools, coin-laundries, manufacturers, home warranty services, service contracts, brand affiliation, selling and installing.

Manual 7

Refrigerators & Freezers

Understanding freon flow without technical gibberish; diagnosing frost-free refrigeration systems quickly; numerous photos of actual on-the-job failures. Understanding typical components and their failures.

Manual 8

Communications Systems

Designing an economical and ideal communication system. Telephones, answering systems, pagers, and cellular phones, understanding enhanced phone features. Developing potential customer lists.

Manual 9

Understanding, Repairing, and Installing Icemakers.

Includes diagnosis of all popular icemakers made today. Numerous photos of actual icemaker failures make learning easy.

Manual 10

Legal Issues & Paperwork

Dealing with the IRS; zoning, sales tax; legal structures; growth problems; hiring employees; moonlighting; storefronts; insurance; paperwork and record keeping; employees and growth considerations.

Manual 11

Ranges, Cook tops, and Ovens

Gas and electric conventional, continuous and self-cleaning ovens; ignition and safety systems; problems common to all brands.

Manual 12

Customer Relations

Service charges, rate questions, trip charges; routing, time commitments, , warranty, Mr. Fix-it, referrals, collections, credit; credit cards, free info, callbacks, not homes, condemning appliances.

Manual 13

Dishwashers

General theory of operation; plus specifics on typical components and problems with all "popular brands". Special emphasis on Kitchen-Aid..

Manual 14

Marketing Your Company

Analyzing and measuring effective marketing methods; Complete analysis of the various ways to advertise your new business; cost and relative effectiveness of yellow pages, coupons, mailing systems, giveaways, appliance stickers, etc. Details on solid, cost-effective methods that will get you started off right.

Manual 15

Microwave Ovens

General theory and repairing of countertop and wall-hung units; Study all the operating components of a microwave ovens and how to diagnose them.

Manual 16

Disposers, Instant-hots, Compactors, Hot Water Heaters

Learn the different types of disposers available. Also installation and repair. Procedures on repair and installation of instant-hots; compactors and hot water heaters.

Appliance Inventory & Wholesale Parts Pricing Guide. Includes recommended truck parts inventory with emphasis on fast moving parts.

Flat Rate Guide Book for every repair job on every brand studied. (This guide is intended as a handbook for presenting charges to customers.)

Introduction

Congratulations, you have made a very important decision and are now beginning a new career.

Entering the appliance repair business is an excellent choice. It offers many major advantages over all other small business ventures.

1. It can be operated from home using a family vehicle.
2. The initial investment is very small when compared with franchises and other options. And even better the biggest investment , parts inventory, can be made gradually as money comes available.
3. The high hourly rate is hard to beat. Technicians across the United States charge \$30.00 - \$80.00/hour **plus** travel time. Rural areas are at the low end and metropolitan areas such as New York City and Boston are at the high end of the range. (Current and past students frequently contact us with up-to-date rates in their areas.)

However, in life, few good things come easy. There are two major hurdles to overcome to become successful in the appliance repair business.

1. You must learn and understand repair procedures on all major appliances.
2. You must learn how to economically create service calls and understand how to take each opportunity and turn it into profit dollars.

Both of these hurdles are easily overcome by carefully studying and completing the program that you now have in your hands. Completing a few manuals will not make the grade. Each manual blends technical information and business secrets that are essential. Depending on your background, you will find some manuals easier than others. They gradually build and combine to teach you everything that you will need to ensure your success. The program is separated into three types of manuals.

1. All technical manuals have a yellow outline. They concentrate on subjects such as refrigeration, electricity and specific appliances. The eleven technical manuals are:

Manual 1

Introduction to Major Appliances and Automatic Washing Machines

Manual 2

Automatic Washers (cont.)

Manual 3

Automatic Washers (cont.)

Manual 4

Automatic Dryers (Gas and Electric)

Manual 5

Electricity made Simple

Manual 7

Refrigerators & Freezers

Manual 9

Understanding, Repairing, and Installing Icemakers.

Manual 11

Ranges, Cook tops, and Ovens

Manual 13

Dishwashers

Manual 15

Microwaves

Manual 16

Disposers, Instant-hots, Compactors, Hot Water Heaters

2. All business-oriented manuals have red outlines. They focus on marketing, building a customers base, advertising and communications. The information in these manuals applies equally well to any small service business, such as an electrician, plumber, computer repair companies and numerous others. The five business manuals are:

Manual 6
Structuring Your Customer Base;

Manual 8
Communications Systems

Manual 10
Legal Issues & Paperwork

Manual 12
Customer Relations

Manual 14
Marketing Your Company

3. All reference manuals have blue outlines. These are used for truck inventory, parts identification & pricing, and job pricing. A partial list of reference manuals follows:

1. Appliance Parts Inventory & Wholesale Pricing Guide.

2. Flat Rate Guide Book

3. Appliance Parts Reference Manual

4. Refrigeration Reference Manual

5. Range Reference Manual

6. Microwave Reference Manual

7. Business Forms Reference Manual

(These manuals are edited often and not all of them are included in the Associates Program.)

Several fictional characters, for example, *Straight Arrow* and *Scofflaw*, are introduced where appropriate as examples of various personality types found in the business world. The program is based on the personal experiences over the last 35 years of Harry D. Raker (affectionately referred to as *Uncle Harry*). All of the *italicized stories* throughout the manuals are true. They provide an excellent way to relate the true flavor of what really happens in the life of a small businessman and in particular, one in the appliance repair business.

Uncle Harry's Trick of the Trade

Every page contains essential information. For special emphasis, certain concepts are highlighted by a box entitled:

Uncle Harry's
Trick of the Trade #1-1

You must eventually learn how to properly operate **all** major home appliances. Customer's often misuse or improperly use their own appliances. Naturally, some customers are embarrassed by their own stupidity. A knowledgeable technician must be prepared to educate and help them in a kind and friendly way.

Popular 1980's Kenmore Washer (Fig. 011-01)



The manuals include over 300 valuable tricks of the trade. Following these tricks will give you a great head start and a huge advantage over all competitors.

The tricks along with the other materials combine the knowledge gained in over 40,000 service calls.

Many of the tricks teach you ideas and procedures that are different and may conflict with those recommended in factory service manuals or books on small business. Trust your *Uncle Harry*, the tricks all work and have been used by true professionals for many years. Follow his suggestions and you will save a great amount of time, energy, and money.

The Technical Study Method

All technical subjects are covered in the same way. First the overall theory of each appliance is studied to gain a feel and grasp without technical details. Common problems are explained, such as unjamming a disposer or finding a pinched drain hose on a washer. Next, all the components that interchange between brands are analyzed. Finally, individual problems on specific brands are studied with the most popular brands and the most common problems coming first.

As an example, consider automatic washing machines. Automatic washers generate a great number of service calls and are therefore studied first. But before studying any specific brands or any specific problems, we will cover general problems. These include power and water supplies, along with the drainage system. After covering these household connections, we will study the overall operation of the all-automatic washers. Problems are often **not in the equipment itself but in the supply, drain piping and electrical supply**. Many washer problems cross all brands. These will be discussed and mastered before we advance to specific brands.

The first automatic washer that we study in detail will be the most popular, thereby learning the most important things first. Why spend time on Westinghouse front-load washing machines or on a stackable Frigidaire. Chances are good, if you are lucky, that you may never even see one!

Conversely, it is important to understand in detail **all** the tricks and **all** the failure patterns of **Whirlpool** equipment. Why is Whirlpool so important? Whirlpool products and its many brand names make up 55% of all the washers (in fact all appliances) that exist in homes today.

We are teaching you the most useful information first, so that you quickly gain confidence. *Uncle Harry* wants you to soon start running service calls. The odds are that the failures encountered will be exactly the ones mastered early in the program.

Teaching you to understand, rather than just memorizing, prepares you to solve any and all problems. Gaining a good understanding prepares you for problems that you have never seen before. Solving unfamiliar problems is what makes a true professional.

History and Development of Major Appliances

Before we jump into technical material, it is important to become familiar with the history and development of major home appliances. First, what is a major appliance? Major appliances over the years have often been referred to as "white goods". Why?. Simply, for many decades, all appliances were white. "Brown goods" included furniture, radios and most electronics. Today, there are a few hybrids, such as microwave ovens, but basically white goods have remained the same. They include:

- washers and dryers
- refrigerators and freezers
- dishwashers and disposers
- free-standing ranges and ovens
- countertop ranges
- microwave ovens

There are a few lesser lights such as:

- trash compactors,
- instant-hots (sink-mounted hot water heaters)
- under-the-counter icemakers and under-the-counter refrigerators.

All of these appliances require in home service. Only microwave ovens are occasionally carried to a service depot.

Appliances stayed white until the 70's when green (avocado) and yellow (harvest gold) became popular. In the early 80's, white and off-white (almond) were the rage. With the 90's, came the black glass look. Now in 2003 and beyond, white, stainless steel and black are all strong. Women's fashions don't have anything on appliance manufacturers.

Uncle Harry's

Trick of the Trade # 1-2

Gradually learning when certain colors and styles were used can assist in approximately dating appliances. Dating is a factor in selling service work.

Appliances have undergone major changes since the 40's. A basic understanding of the differences between the old and the new will help you talk knowledgeably with your customers.

"Conventional" Washers

The original washing machine (replacing a scrubbing board or rock) was known as a *conventional* washer. They were the "wringer" type. The operator had to wring water out of the clothes by running them through a set of rollers mounted on the side of the agitator tub. There are still quite a few people alive today with funny looking fingers that resulted from getting them stuck in the rollers. (Today a wringer manufacturer would no doubt include a large label saying "Do not insert fingers, damage may result!")

Most people consider wringers ancient history but believe it or not, wringer washers were manufactured by the Maytag Company until 1993. Many were gasoline powered and intended for export; they are used where there is little water and electricity is not available. Wringer washers were and still are extremely reliable; a few are still in operation being operated by elderly people who have resisted the change to an automatic washer. Except for special circumstances it is best to leave any wringer service calls to an antique dealer.

**Sample Wringer Washer
(Fig. 011-02)**



*Uncle Harry's
Story Time*

*Not too long ago, I received a call from an old timer. It turned out he wanted me to repair a 40-year-old wringer. The old **wooden bearings** in the wringer head were worn out. Of course, the supply houseboys laughed at me when I called for parts as I knew they would. I only called to convince the customer that the parts were obsolete.*

He really wanted his washer fixed. He used it solely for long horse bandages. He claimed his much newer automatic washer tied the bandages up in knots. I hesitated. It was winter and I wasn't busy.

"If I custom made you a set of wooden bearings, it would cost over a \$100.00."

He said, "That's fine. Do it!"

I turned it into a Cub Scout project for my den and made several sets of bearings out of oak. It was more of a challenge than a moneymaker.

After a few adjustments, they worked fine and he was very happy.

In appliance service, there is always something different.

Automatic Washers

Automatic washers were developed and gained popularity during the 40's and 50's. They were significantly different from "conventional types" and those seen today. "Automatic" only meant that the operator didn't have to wring out the clothes. The washer spun the clothes to damp dry, instead of pushing them into the wringer roller system. Early automatic washers were mostly front loaders. They were small versions of the large machines found in the coin laundries today. Bendix was a big name in the 40's. Another big name was Westinghouse with its tilt-front load design, known as the Laundromat (A word now part of the language). Both Bendix and Westinghouse front loaders needed to be bolted to a concrete floor. In the early years automatics were made in many ways by a great number of manufacturers.

As the years passed, top load automatic washer emerged as the market share winner and front load machines gradually disappeared. Floor bolting and balance problems were a big factor. (It is interesting to note that in mid 90's, Maytag introduced a new of front loader, the "Neptune" line, washer priced at about \$1000.00.)

One of the first popular top load washers was made by Frigidaire. Frigidaire was owned by General Motors back in the 60's. (Their early refrigerator was so popular that even today older people use "frigidaire" as a synonym for refrigerator.)

Frigidaire automatic washers were unique. Their agitator hopped up and down to wash rather than the familiar swishing back and forth. In their heyday, Frigidaire Pulsamatic, Rollomatic and Unimatic were excellent products.

An automatic washing machine requires the addition of several complex items in the basic design. A timer is needed to switch from wash to drain and from drain to spin. On wringer types this was all done manually. Automatics also required a support and bearing system, heavy enough to allow clothes to spin at high speed. Also required is a mechanism to shift from agitate to spin. These additional devices are the ones that break and create moneymaking opportunities for today's servicemen and women. (See manuals 1-3)

In recent years there has been a trend back to front loaders. This is driven by their water efficiency and better cleaning ability. American manufacturers have introduced washers similar to European front load designs. While front loaders do have certain advantages, price, reliability and size are not among them. Front loaders are very expensive, complex, small, and hard to maintain. It seems that memories are short; people seem to have forgotten why top loaders quickly became popular in the first place.

Even though there is much talk about front loaders in the media, only a tiny number have been installed in homes. As they gradually sell, more and more service calls will result.

*Uncle Harry's
Story Time*

Nearly all pictures in this program were taken in customer's homes during service calls. The customer that owned the old Frigidaire washer shown below was ninety-six years old. With some assistance from his niece, he lived by himself in one of Baltimore famous "rowhouses". On this repair call, his niece and I coordinated meeting at his home. Her uncle had had some trouble with vandals and would no longer admit strangers.

**Frigidaire Washer From the Forties
and Still Going Strong
(Fig. 011-03)**



She had a front door key, but we still couldn't get in. Her uncle had neglected to remove the security chain from the door. We opened the door the 3" the chain would allow and yelled inside to no avail. We pounded on the windows and the front and back doors. We went to the car and called him from a cellular phone. No luck.

Finally, a neighbor, hearing all the commotion, came out a few doors down. No spring chicken himself, he shuffled over to the edge of the porch and yelled, "He's probably asleep, he sleeps like he's dead."

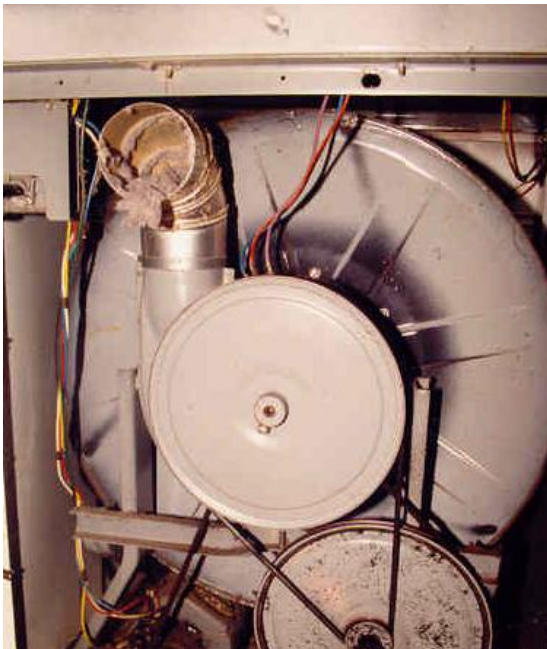
This echoed my exact thoughts but I was wrong. We gave up for that day but succeeded on a second try, another time, and I repaired the washer and got my picture.

Automatic Dryers

Automatic dryers, in contrast to the automatic washers, have not drastically changed. The clothes have always tumbled within a closed drum while hot air blows through them. Early automatic dryers were all "V" belt drive, with pulleys and belts similar to those on most automobile engines.

Rear View of a Maytag "V"-Belt Model

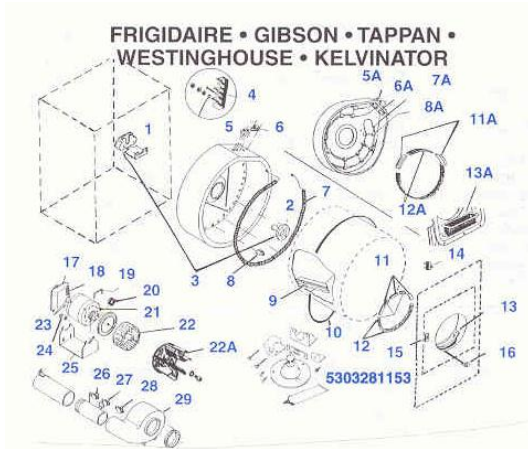
(Fig. 011-04)



Baskets that held the clothes had a shaft welded to the back. That basket was hung in a heavy bearing housing and suspended forward. Heating systems, both gas and electric, are still similar to today's, except that, the early gas systems had pilot lights instead of automatic ignition systems.

Cost savings resulted from elimination of the heavy-duty pulley and heavy shaft systems on the back of the dryer drums. Today, all dryers have a long, skinny belt that uses the drum itself as a pulley. This is called "the belt around the drum design". The shaft support has been replaced by front felts and rear rollers that holdup the lightweight basket as it tumbles. Pilot light systems have been replaced with automatic ignition systems. Ceramic glow bars now ignite the gas. (See Manual 4, Automatic Dryers.)

**Exploded View of Typical Belt-Around-the Drum Design
(Fig. 011-05)**



Ovens And Ranges

During the twentieth-century major changes have taken place in range and oven designs. Early in the century, cooking was done on a wood-fired stove or range. Gradually, in urban areas, various types of flammable gas were piped underground and gas cooking spread. Most of the early gas cook stoves were freestanding ranges, with burners on top and an oven below. They had no pilot lights and were very basic in design. As the century progressed various pilot and thermostat systems were developed. Gas systems were very reliable with safety systems built into the pilot lights. With the exodus to the suburbs in the 60's and 70's into areas where natural gas was not available, electric ranges and bottled gas became popular.

Unique Frigidaire Pull-out Flair Range Era 1950's (Fig. 011-06)



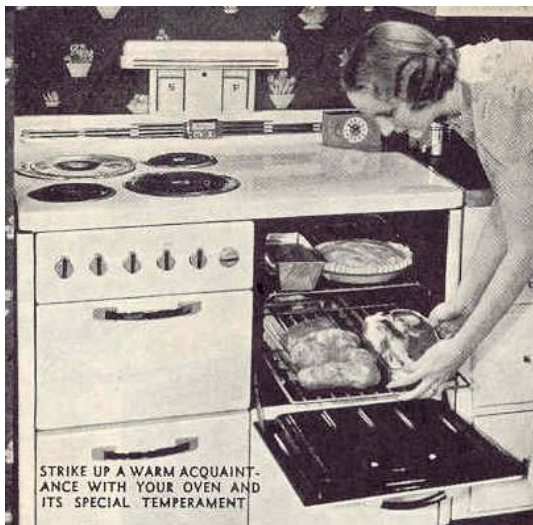
One unusual innovation, other than the evolving gas control systems, was the advent of a porous oven surface, known as a "continuous clean" oven. Replacing porcelain, the continuous clean system was a surface on which spillage was not supposed to stick and would gradually flake off.

Overall the new system was a flop. Once a stain did appear on the oven interior (and invariably they did), there was no practical way to clean it. Persistent stains drove many housewives to distraction. It is true that continuous clean ovens initially stayed cleaner than and a porcelain one, but the clean interior did not last. Over years of complaints, manufacturers stopped making them.

**A Beautiful Antique Wood Stove
(Fig. 011-07a)**



**An Early Electric Range
(Fig. 011-07b)**



Self-Cleaning Ovens

Another revolution in oven design was “self-cleaning” electric ovens.

Self-cleaning ovens are designed to lock and heat to a very high temperature for three hours. During this period, any food spillage is burned into a fine gray powder that can be wiped out with a wet paper towel. Self-cleaning ovens work very well. However, the design is complex and generates a lot of service calls. Customers often get confused and forget how to operate their self-cleaning ovens.

Thermostats controlling very high temperatures and the automatic locking system are constantly in need of service. In the early development stages, self-cleaning ovens were more prone to failure than they are today. Ovens would bake fine but fail during the self-cleaning cycle. Many customers got tired of paying the frequent and high repair bills caused by the cleaning feature and just stopped using it. Instead they cleaned it manually. Gradually designs improved and today, more than half of all ovens sold are self-cleaning. But, overall, the inherent complexity of self-cleaning ovens has been a great boon to oven service calls.

The newest renovation in cooking equipment is the use of touch control panels. Computer boards are now used to control oven temperatures and locking mechanisms. All this is combined into a single panel. Repairing and replacing these “smart boards” is another great source of service work.

Styles change and today few kitchens install freestanding ranges. Instead a countertop electric range, a single or double wall-oven and a microwave oven are installed.

Some brands, like GE, Thermador, and Whirlpool, are available with double, self-cleaning wall ovens. Thermador even made one in which the top oven doubles as a microwave oven. A microwave oven has replaced the upper conventional oven on many new double-ovens.

Designs start getting complicated when all these tasks are accomplished in one control panel and in one cabinet. More complicated, of course, means more repairs. Are you beginning to see a pattern? (See Manual 11, Ranges, Cook tops & Ovens)

Dishwashers

Dishwashers came along in the 50's with Kitchen-Aid leading the way. Their first dishwasher was extremely well made. The spray arm was cast iron and weighed at least 10 lb. The pump and pump housing were also cast iron; it was built like a tank and often lasted 30 years. Since then, Kitchen-Aid designs, as well as all other brands have gotten cheaper and lighter.

Cast Iron Kitchen-Aid Spray Arm Era 1950's (Fig 011-08)



Today, the entire wash tank and door are totally plastic. Porcelain is rapidly disappearing. What do you think has happened to the porcelain manufactures? High-end models use stainless steel as the interior. Stainless is tough but compared to the old porcelain, it very dark inside.

Compared to the old ones, today's dishwashers are very lightweight and very flimsy. But, other than lowering manufacturing costs, the basic design of dishwashers has stayed virtually the same. High temperature water is still sprayed under pressure against the dishes. (See Manual 13, Dishwashers)

There has been one major improvement in recent years, reduction of noise levels. Medium and higher priced models offer a "quiet pack", a very effective sound absorption system. It is now possible to hold a conversation and run the dishwasher at the time!

Refrigerators

Back in the 40's and 50's, after the Second World War, electric refrigeration became commonplace in households. Prior to automatic refrigeration, an iceman would deliver ice to the door for storage in an insulated box. A few early units were operated on natural gas (seems strange to **cool** with natural gas doesn't it?). Gases other than freon were also used as a refrigerants (See Story Time). By the 50's, nearly all-household refrigeration was powered electrically and used freon. All refrigerators were manual defrost.

A Manual Defrost 1940's Refrigerator (Fig. 012-09)



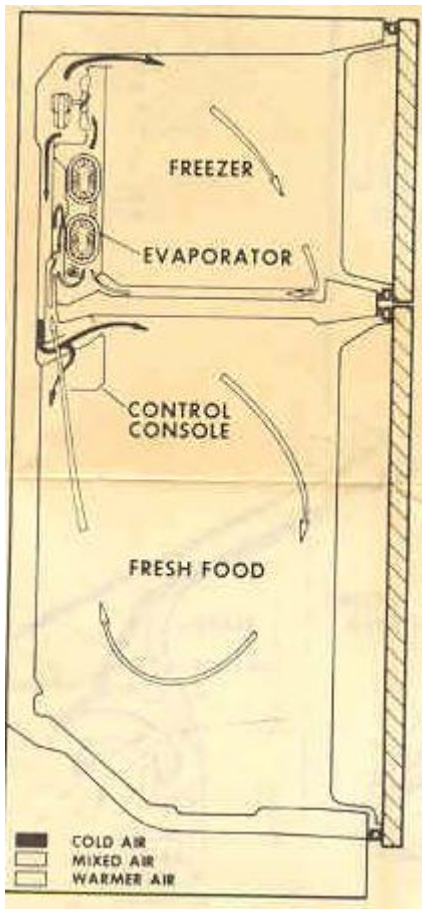
Uncle Harry's Story Time

As a child, around 1950, I remember playing around with an old chest type freezer at a friend's house. It was shot and we were removing the compressor to play with it. Anyway, we cut a copper line and much to our surprise we instantly were gasping for breath. Our eyes were burning as we ran up the basement stairs and outside for fresh air. The entire house filled with an incredibly strong odor of ammonia. Fortunately the odor blew away after a while and no damage was done. Ammonia has properties similar to freon and in the early years it was used as a refrigerant.

Manual and Frost-Free Refrigerators

A manual defrost refrigerator had no provision for melting out frost accumulation. Every few months, mom had to empty out the frig, shut it down, melt out the frost with pots of hot water, and give the refrigerator a fresh start. Many small freezers and refrigerators made today are still manual defrost. They are found as spare basement units, in small apartments, and in trailer homes. They are highly reliable, with few moving parts, and generate few service calls.

Inside View of a GE Top-Freezer Refrigerator (Fig. 012-10)

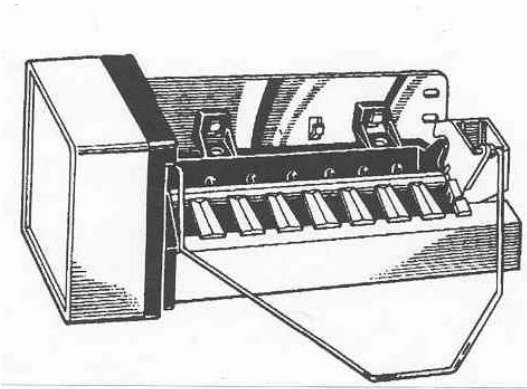


The advent of frost-free refrigeration drastically changed the refrigeration service industry. It greatly increased the complexity of a refrigerator. To accomplish frost-free refrigeration, engineers added a heater, fans, a drain system and a clock. The defrost heater is turned on by the clock two or three times a day to melt out accumulated frost. Fans were needed to circulate hot or cold air over the various freon coils. These new components are the ones that generate the bulk of today's service problems. (See Manual 7, Refrigeration) Hooray for frost-free refrigeration!

Icemakers

Close on the heels of frost-free refrigeration came domestic icemakers mounted in the freezer section. In the early years, many manufacturers made icemakers, they were complicated, Rube Goldberg designs. Paralleling the development of reliable automatic washers, there were many types for a few years.

Typical Icemaker (Fig 012-11)



Most of these early designs were highly unreliable and caused a lot of customer and serviceman frustration. As the decades passed, the poorer designs were discontinued. Only three of the best survive today. These three and a review of the old ones are covered in detail in Manual 9. Icemakers are great moneymakers. Many service men hate them, but with *Uncle Harry's* Tricks of the Trade, they will be no problem for you.

Disposers, Instant-Hots, Water Heaters, & Trash Compactors

Disposers, instant-hots, water heaters, and trash compactors represent a small part of the appliance market.

They are relatively simple in design and haven't changed much over the years. (See Manual 16, Disposers, Compactors and Water Heaters.)

Typical Disposer (Fig 012- 12)



Corporate Structure of Today's

Manufacturers

The interconnections between appliance brands can be very confusing. The name on the front panel really tells you very little. For instance, Montgomery Wards refrigerators have been made by Frigidaire, Norge, Admiral, and others. In recent years, with industrial consolidation, a lot of buying and selling of brand names and manufacturing facilities have taken place. With Wards gone, it is getting more difficult to look up Wards parts. On the following pages are *Uncle Harry's Appliance Trees*. The "trees" give you the interconnections between brands.

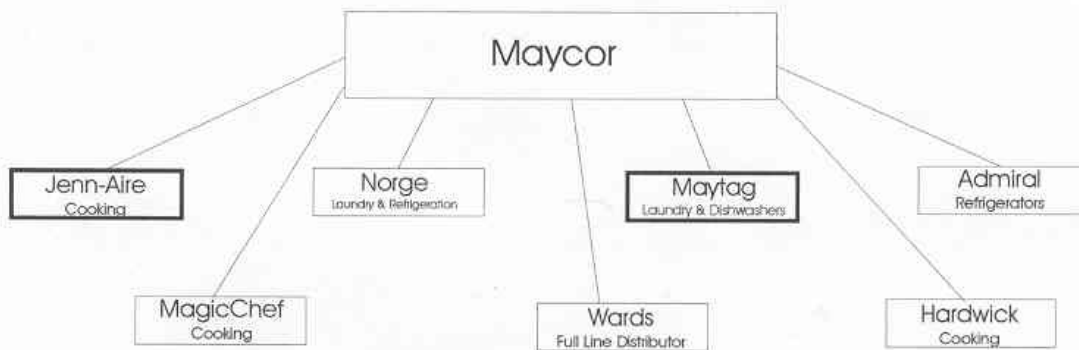
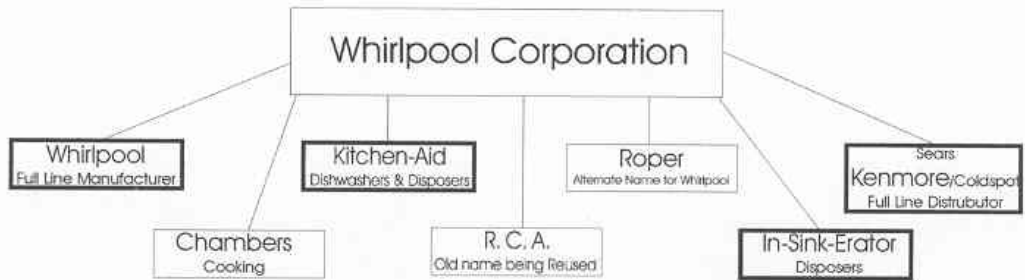
Sample Label from a Parts Box (Fig. 012-13)



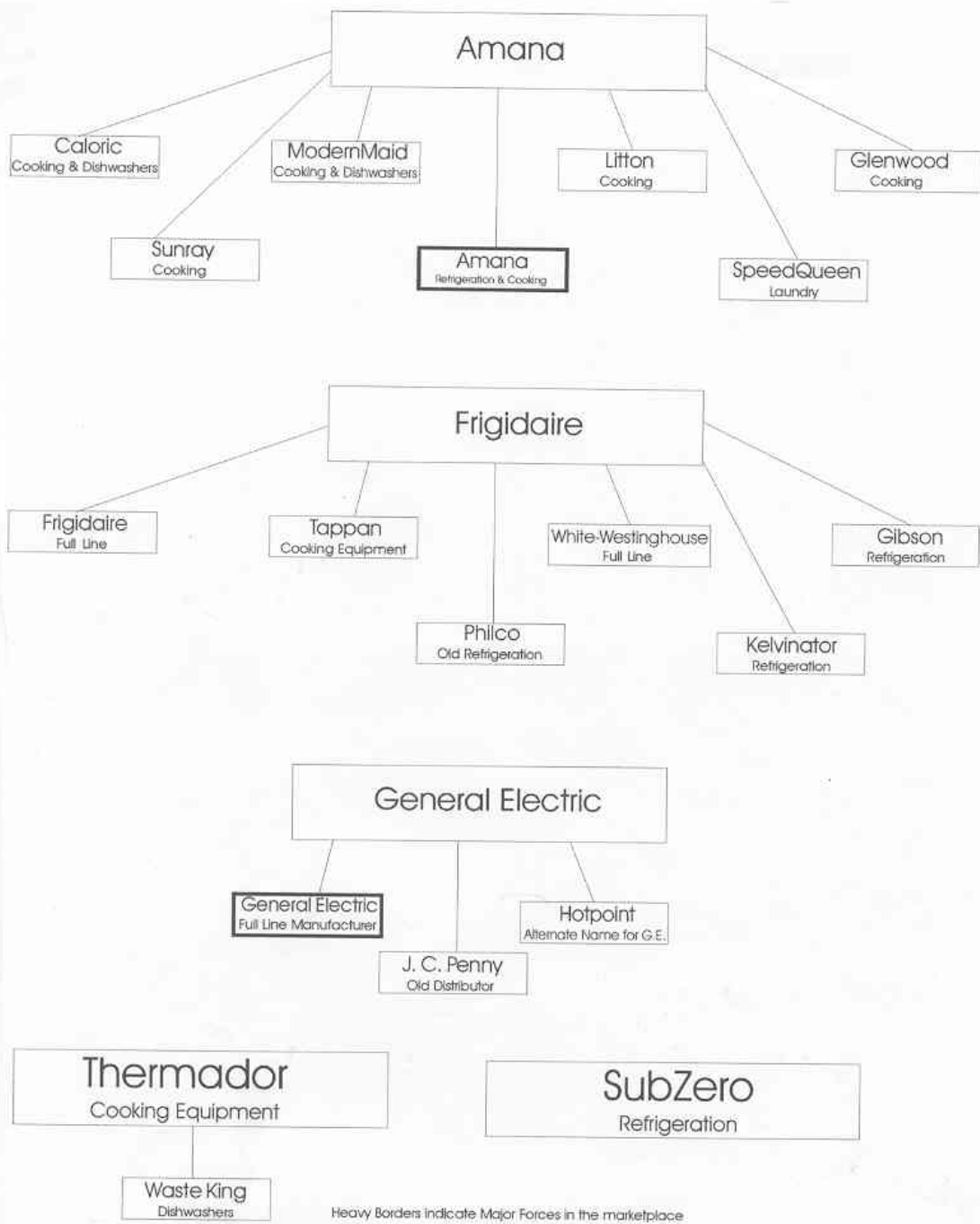
Expect exceptions and don't be surprised at anything you see. Any brand with name recognition may be found glued on almost any equipment. For instance, about 1990, Whirlpool bought KitchenAid. Prior to that time, KitchenAid only made dishwashers and disposers. Whirlpool capitalized on strong name recognition and soon after the takeover, KitchenAid began appearing on washers dryers, ovens, and refrigerators. (All made by Whirlpool, of course.) As manufacturers try to steal market share from one another, the same thing is gradually happening with Amana, In-Sink-Erator, Roper and Maytag.

Between 2000 and 2003, a British company, Eureka, purchased Frigidaire and Maycor purchased Amana. Stand by for news!

Uncle Harry's Appliance Trees



Heavy Borders indicate Major Forces in the marketplace



Overall Structure of the Appliance Service Industry

The Big Guns

Each large appliance manufacturer operates its own fleet of trucks. Examples are Whirlpool, GE, Amana, and Frigidaire. Major distributors such as Sears does the same thing. Others, like Maytag, fulfill warranty and out of warranty service requests through "Authorized Service Companies". Special arrangements are made with small independent repair companies scattered across the country. The manufacturer reimburses the independent company for running its warranty calls. (See manual 6, Structuring Your Customer Base)

Utilities in many areas also operate large service fleets. They both repair and sell appliances. Many large manufacturers use Authorized Service Companies to supplement their own service fleets. The combinations are endless. Up until about 1984, manufacturers or distributors, such as Sears, only repaired the equipment that they sold. This old practice has changed. Sears and G.E. now repair **all** brands.

This policy change by upper management has resulted in a great amount of confusion and poor service for many consumers. It is unrealistic to expect a crew of technicians to overnight expand their repair capabilities from one to twenty brands. The backlash has been good for the independent companies as consumers search for competent service work. For example, any customer that calls Sears with a problem on a Thermador self-cleaning oven ought to have their head examined. Sears has enough trouble competently servicing Kenmore.

Uncle Harry's Story Time

I was referred by my parts supplier to repair an old GE self-cleaning oven. It was in the kitchen of a restored colonial farmhouse. The repair was straight forward (for anyone familiar with 25 year old GE designs, see Manual 11) and I had the necessary part on the truck to complete the call immediately. The customer was quoted and I proceeded with the repair.

As I worked, the customer revealed the rest of the story. Her husband, now a doctor, had put himself through medical school as a baker and still loved to bake. His only oven had been out of service for six weeks while he waited vainly for Sears to repair it. So far, Sears had made three trips bringing out their best technicians.

If this simple repair stumped them, what do they do on the tough ones, and how often does this happen?

The Small Guns

The country has over 16,000 independent appliance companies (according to American Business Lists Inc.) ranging from the single individuals working part-time up to large fleets. They may have no affiliation with any one manufacturer, although, frequently they do specialize in one brand. Most independents have diversified to stay busy year round and repair all brands and nearly all types of appliances.

Prospective students often open their locals yellow pages and are intimidated by a large number of appliance service ads. They think,

“How in the world am I ever going to survive against all these other companies?”

An Old Baltimore Independent Company
(Cummins is so independent, they only service what they sell!)
(Fig. 011-14)



Actually the opposite reaction is more appropriate. Consider the fact that any intelligent owner, running expensive ads, would immediately discontinue the ad if it didn't pay off. A great number of ads indicate an abundance of service calls. There is always plenty of room for a well-run appliance company that provides true personal service using the techniques taught in this program. Incidentally, *Uncle Harry's* marketing methods do not depend on a large investment in the yellow pages. (See Manual 14)

“When I started this program back in 1997, I was concerned that start-up companies would have a problem finding enough service work. I was wrong. Time has shown that marketing a new service business has been far easier and cheaper than I thought. It seems that large companies have an increasingly difficult time providing personal service. A dedicated individual finds it comparatively easy.”

Uncle Harry

**The Biggest Gun of All
and the Easiest to Beat
(Fig. 012-15a)**



**Montgomery Wards, Was Big Gun #2 and went bankrupt.
Who got all the service calls?
(Fig. 012-15b)**



Uncle Harry's Approach to Appliance Service

By now you may have realized that this program is truly different from any other. Unfortunately, manuals available at the library, parts supply houses, and from manufacturers are virtually useless for anyone aspiring to be a professional. Although they do teach repair and have some value, they never teach the sort cuts that the pros use. There are over three hundred in this program. These tips describe real problems encountered in the field, (like repairing washing machines full of water without bailing them out). They deal with rust and reality.

The methods described by most manuals just take too long. The typical repair manual covers absolutely everything in infinite detail. However, the manual never tells you what is, and what is not important. There is just too much useless information. For instance, the complete set of only Maytag service manuals shown fills a large box and weighs over 50 pounds. A full set of all brands of appliance manuals would cost a fortune and fill a good-sized room.

**A Complete Set of Maytag Manuals
(Valued at over \$900.00)
(Fig. 012-15c)**



The trick in becoming a proficient appliance repairman is to learn quick methods and concepts, to remember only the important things, and to disregard the rest.

You don't have to be brilliant or well educated, only properly focused.

Of course knowing all of the technical information included in this program makes life a lot easier, but style also plays an important part. Following is a very important chart that you should study carefully. Anytime in the future when you are really stuck on a problem, take a deep breath think back to *Uncle Harry's* simple diagnostic rules. They will save you a lot of time and energy.

*Uncle Harry's
Story Time*

One of my best technicians was an old West Virginia hillbilly who quit school in the third grade. He could barely read and write and couldn't begin to understand a circuit diagram. His lack of education didn't slow him down one bit. He had an excellent memory, could handle tools well, was great at customer relations and he knew how to collect money for his work.

I knew another successful competitor. He was successful in spite of being a truly incompetent mechanic. Even he admitted his technical failings. Why was he still successful? His customers loved him. I'll never forget what one of his customers said to me,

"I know Joel seems to have a lot of trouble repairing things, but he's so nice and he tries so hard!"

Uncle Harry's Diagnostic Rules:

For quick diagnosis of appliance problems, first break the problem into manageable pieces. Try not to waste time checking the wrong components. Here is how it's done:

1. Listen carefully to the customer for clues.

If you listen, the customer will often tell you exactly what is wrong and point you in the right direction.

2. Focus totally on the appliance with your eyes, ears, fingers, and nose.

Each sight, noise, vibration, and odor is a clue to solving the mystery. For instance, a faint burned wiring odor or an unusual clicking or humming noise may give you a clue.

3. Isolate problem areas.

If a leaking washer has numerous possible leak points, eliminate the easiest to check first. In seconds you can check the sanitary tub, fill and drain hoses. Quickly narrow down the possibilities.

4. Play the odds.

First check the components that are prone to failure. Look at the most likely first. All brands have their individual failure patterns. **LEARN THEM!**

5. Run, quick reliable tests on suspicious components.

Use *Uncle Harry's* Tricks-of-the-Trade to test components. Forget the fancy meters, most components can be diagnosed by sight and feel.

6. Confirm your diagnosis.

Cross check your diagnosis whenever possible. Many components can be tested several ways. For instance, connect 110 VAC directly to a suspicious motor before replacing it.

7. Proceed with repair and check out.

Replace the failed component and fully test the appliance. To minimize call backs, always run an appliance as long as you can after the repair. Let it run while you clean up and collect your fee.

Being Observant is Critical to Diagnosis

Uncle Harry's

Trick of the Trade # 1-3

When you are testing appliances, it is vital to observe everything that is happening.

Start watching and listening to the appliances in your own home. Pay attention to when they are on or off. Listen to the dryer, dishwasher, etc.. Being a good diagnostician is much like being a good detective. You have to pay attention to all the clues.

It is really amazing how little theory you have to understand in order to be a good technician. Experience is what is needed, and information. Digging in with sophisticated test equipment is certainly one technique, but pros use much faster ways.

Many technicians can't use an ohmmeter, a wattmeter, or voltmeter. But somehow, they still properly fix things and make plenty of money.

Uncle Harry's

Story Time

I remember diagnosing a thawing refrigerator one Saturday morning. I was standing in the kitchen with the homeowner, listening to his refrigerator,

I commented, "The compressor is not running right now but it will click on in a few seconds,". When it did, I asked the customer, "Did you hear that?"

"No," was the response.

"Didn't you notice that the ceiling lights flickered slightly? Well, wait another minute, it'll shut off because I think the cooling fan is jammed and the compressor's overheating. I can't feel any air coming out of the front, can you?"

Soon the compressor clicked off again. Again I said, "Did you hear that click?"

"No."

Now, I have poor hearing, but I was tuned into the key sounds and airflow that the customer was completely missing. I quickly found a piece of paper jamming the condenser fan motor.

I had fully diagnosed and repaired the refrigerator just by paying close attention to critical clues.

Testing Components

There are many ways to test components in order to find out whether they are good or bad. This is true on all equipment in any service business. Most factory service manuals recommend tests with the parts removed, and the power turned off. The factories are very conservative and lawsuit conscious. A professional does things differently. He knows the value of time. He learns how to run quick, reliable tests, while the appliance is still turned on. Dangerous maybe, but quick and effective, like a MASH FIELD HOSPITAL. He also knows how to run tests that require little or no disassembly. Tests that **really tell the tale**. All of these professional tricks are included in the appropriate manual. By following *Uncle Harry's* techniques, you will be able to diagnose 95% of all appliance failures **within 10 minutes**.

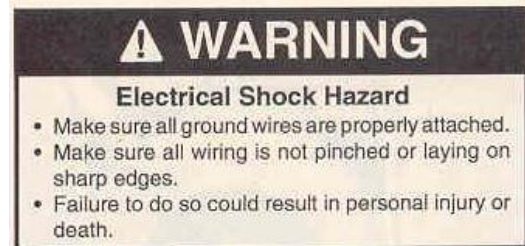
It's true, trust your *Uncle Harry*.

When you've finished taking this program, you will be fast. When you are both fast and competent, you start making money.

A Sample from a Whirlpool Service Manual

(Safety Advisories average about four to a page)

(Fig. 12-16)




⚠ WARNING

Electrical Shock Hazard

- Make sure all ground wires are properly attached.
- Make sure all wiring is not pinched or laying on sharp edges.
- Failure to do so could result in personal injury or death.

STEP 11 Replace the front cabinet panel (section K, proc. 5; Type A or B).

STEP 12 Replace the toe panel if used (section K, proc. 4).



⚠ WARNING

Personal Injury Hazard

- Do not use your fingers to straighten out any seals. You may get stuck by pins or other objects that may have come from your clothes.
- Failure to do so could result in personal injury.



⚠ WARNING

Fire Hazard

- Never operate dryer without the rear drum seal in place.
- Clothes may get between the drum and bulkhead.
- Failure to do so could result in product or property damage.

Profit Potential of a Well Trained Technician

What are the typical rates charged and how much money do service companies really make? The difference between sales and profit in a major company is huge because the inefficiencies and enormous inherent costs of maintaining a fleet.

There is a tremendous overhead associated with large organizations like Sears, Whirlpool or G. E.. They provide a great number of company benefits and have a lot of overhead expenses. The high operating costs of the national firms keeps their prices high. This fact helps the small guys. A well-run small company charging similar rates with fewer expenses gets to keep more of the receipts.

Time wasted driving rather than repairing has necessitated charging a "service charge." A service charge is a minimum charge, often called a "charge to ring the doorbell." Inside sources claim that it **costs** the major appliance manufacturers about \$75.00 to ring the doorbell. Notice, the emphasis on "**costs \$75.00**". (See Manual 12, Customer Relations.)

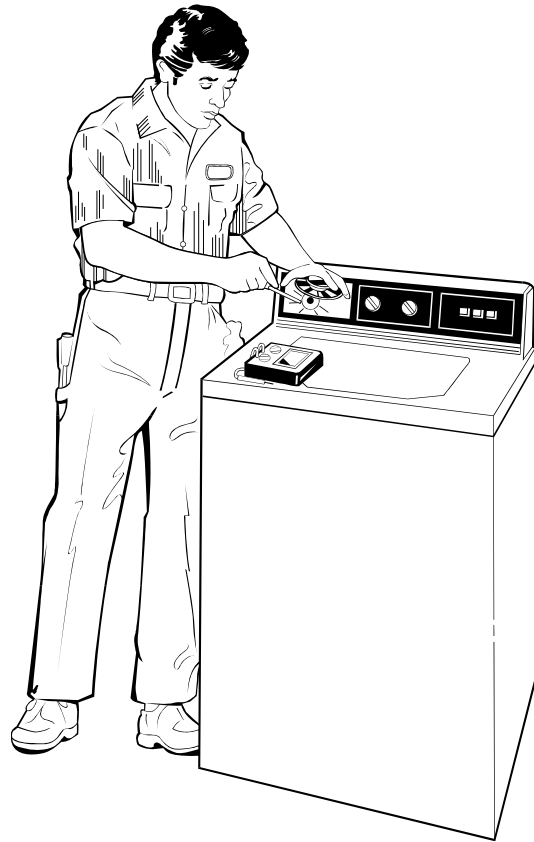
An average service truck grosses about \$100,000 to \$150,000 per year. (Gross profit in this case is defined as the cash available after the cost of parts has been subtracted from the total receipts. Wages or other expenses of running the truck or other overhead operations are not subtracted.) A man that is willing to work more than 8 hours a day, and all day Saturday can generate in **excess of \$150,000 a year in gross profit!**

This is a tremendous amount of money, where does it all go? Do all service men own a Lexus? Remember, in a large corporation, such as Sears, they have huge overhead costs, sales costs, and operating costs. All these costs use up most of the money. A serviceman for a national firm gets about 25% of the gross profit, the rest goes to overhead. See how the figures tie together? Twenty-five percent of \$100,000 is \$25,000,- a typical income of a Sears tech. An experienced Sears tech will gross considerably more and may make over \$40,000 per year.

As previously mentioned an independent technician is more efficient and will net far more than 25% of the gross profit. It is not unusual for an independent tech to net \$50,000-\$75,000 per year. The harder working ones do considerably better than that. And, yes some do own a Lexus.

A Day in the Life of an Appliance Technician

What does a technician have to do to bring in \$100,000 or more gross profit per year? A technician normally works an 8 or 9 hour day. He will be in 6-9 different houses and will bring in a average profit of \$400.00 per day. Let's look at these numbers more carefully. Some detailed definitions are in order to establish a standard language:



A typical day in the life of an appliance technician.

First Call: 8:30 AM ... Reset breaker on electric cook top.....	\$48.00	Profit.....	\$48.00
Second Call: 10:00 AM...Install pump on Kenmore washer.....	\$135.00	".....	\$120.00
Third Call: 11:30 AM...Clean air gap on dishwasher	\$70.00	"	\$70.00
Fourth Call: 1:30 PM...Install water valve on washer	\$105.00	"	\$97.00
Fifth Call: 3:00 PM...Install defrost clock on refrigerator.....	\$138.00	".....	\$128.00
Last Call: 4:30 PM...Replace broken dryer belt	\$95.00	".....	\$90.00

Profit for the day.... **\$553.00**

Types of Service Calls

All service calls fit into one of these three categories.

Definitions:

1. Completed Call:

The work is done and the **money collected**, no further contact is necessary with the customer.

2. Incomplete Call or Parts Call:

Work partially done, but unfinished, and a return trip needed. No money is collected except maybe a deposit. Obviously, this situation is to be avoided

3. Callback or Warranty Call:

A free return trip to correct previous work. No money is collected here either.

Uncle Harry hates callbacks. We will teach you everything possible to avoid creating a callback. But, if you get one, complete it immediately. Don't ever postpone a callback. (See Manual 12, Customer Relations.)

Uncle Harry's Story Time

A customer once told me this and it rings true to me.

"The Three to Eleven Rule"

Statistics show that if you do a particularly great job for a customer, they will refer you to three new customers.

*Statistics also show that if you do a particularly poor job, the customer will be sure to tell **eleven** others about it.*

Back to a day in the life of an appliance technician. Following is a chart of an ideal day:

The Ideal Eight-Hour Day

Calls Run -	8
Completed Calls -	8
Parts Calls -	0
Callbacks -	0
Avg. Profit per Call -	\$95.00
Gross profit -	\$769.00

Following is a chart that is closer to the truth:

A Realistic Eight-Hour Day	
Calls Run -	7
Completed Calls -	5
Parts Calls -	1
Callbacks -	1
Average Profit per Call -	\$90.00
Gross Profit -	\$450.00

Obviously, the trick is to maximize the percentage of completed calls, and minimize the other two. Keeping completed calls up and callbacks and incompletes down keeps profitability high.

A highly skilled technician, with a good inventory on his truck, can complete 80-90% of his fresh calls on the first trip. Callbacks should be under 5%. Eighty-five percent of all service calls should be money-making completed calls. Six completed calls in a day is ideal. Good technicians are able to do this with consistency in an 8-hour day. Getting the average above six requires a very hard-working technician putting in longer hours or very little time driving (close routing.)

Quotes from seasoned professionals

"All I want are my four or five calls each day and I'm happy," Richard Anderson.

"As I recall, in the last sixteen years, I have only had one day where I ran twelve calls," Guy Almond.

Factors That Affect Profitability

Poor routing and long travel distances between calls is to be avoided. Every minute spent behind the wheel is wasted productive time. Getting travel time down to five or ten minutes between calls will result in a high income (See Manual 12). The heat of summer is also helpful. When it's hot refrigerators frequently break down. Money-making calls are as easy as picking cherries off a ripe cherry tree. Some days just go as smoothly as silk. Technicians will be heard saying:

*"Well, I ran 10 calls the other day",
or
"I had an \$800.00 day yesterday!"*

Such high numbers are possible but only on rare days. A technician lives off of **averages**, not an occasional high day.

*Uncle Harry's
Story Time*

Twenty years ago I often traveled 30 miles one way to run a single service call. Today I wouldn't dream of going that far. Back then I just didn't know any better. I had not yet learned how to market my talents in a local area. In the 80's, I was getting smarter and my servicemen usually clocked about 25,000 miles per year on their trucks. Now, I concentrate even more and only drive about 15,000 miles per year running 1000 calls.

I have a friend, Brent Brewer, who has a very successful local plumbing business. Recently he replaced his rusted out 17 year old service truck. It only had 80,000 miles on it. He only drives a few miles between service calls and less than 5,000 miles per year! He has achieved near perfect routing.

High days are interesting to talk about but not really important. We are teaching you to aim for realistic numbers, not pie-in-the-sky numbers; numbers that you can consistently achieve if you follow *Uncle Harry's* guidelines. A completion average of four or five per day **is** realistic. Most service managers are satisfied if their men can accomplish that. Having been a service manager and hired and trained hundreds of service technicians in the last 25 years, *Uncle Harry* knows what the averages really are. Few technicians really understand long term averages. Those that do usually have either been to a professional service management school, attended "peer group" meetings or spent a lot of time analyzing numbers. With the information presented here your operation may be small but you will quickly develop the insight of a professional service manager.

Uncle Harry is going to teach you how to keep accurate records. Knowing your own percentages will allow you to set achievable goals and teach you to gradually improve your own production.

We will get into more of the pricing details as the program proceeds. At this point in time, it suffices to say, that the average gross profit on a completed service call should be \$90.00. An average of \$90.00 takes into account high dollar “timer jobs” and low dollar “service charge only” jobs. The average will vary up and down about 20% in different cities depending on prevailing hourly rates. (See Flat Rate Guide Book)

Reviewing and assuming a \$90.00 average gross profit, multiply that times 4 or 5 completed calls per day and then again times 5 days per week. Multiply again times 50 work weeks.

$\$90.00 \times 5 \text{ calls} \times 5 \text{ days per week} \times 50 \text{ weeks} = \$112,000.00 \text{ per year!}$

These are realistic averages and ones that all successful service companies achieve.

Running Calls Part-time

Many part-time technicians run service calls in the evenings and on Saturday. Maybe they do one or two a night, and three or four on a Saturday morning. Completing only five calls will bring in over \$400.00 per week. What a **very** nice way to supplement your income. As a part-time mechanic with no overhead, you can undercut the large service company prices by 20%, and still make a very healthy income for yourself. By undercutting, customers will soon realize that they are getting a deal, and the word will quickly spread.

Your Flat Rate Book

One of the many helpful items provided later in the program is a Flat Rate Book (a price guide book). Each and every job, on every brand, is clearly defined. All the prices are accurately based on national averages. When quoting a job, follow the Flat Rate Guide Book as gospel and you won't go wrong. (Many servicemen are timid when it comes to quoting jobs.) Use it as a reference book and show it to customers.

Blame the high (but competitive) prices on the book!

Everybody knows, if it's in a book it must be gospel

Planning For The Future

You will have the choice, once you have completed this program, of starting your own independent appliance service operation, or of going to work for an appliance company.

We recommend the first because it is more profitable for you. Most of the business guidelines included in this program are directed at starting a small business. However, working for a utility or Sears or another large company is not all bad. They provide vacations, medical insurance, sick leave, and many other benefits. A salary of \$20,000-\$40,000 a year, is customary. The salary will depend on how long you've been there, and how good you are. For many individuals, the comfort of a large corporation is reassuring. All large companies are always looking for qualified technicians that can repair a wide variety of equipment .

Regardless of which path you choose the future is very bright. A great many people, make a very comfortable living doing appliance service.

Choosing Your Market Area

You are now in the early stages of setting up your own home appliance repair business. One of the early decisions is choosing your own market. An evolving business needs direction and it's important that you clearly understand the marketplace in which you plan going to compete. What is a "marketplace"? Defining a marketplace could be described as finding your own "Acre of Diamonds".

An ideal service area is one that can be reached in less than twenty minutes travel time. It will be within a circle less than 25 miles across. It should include at least 25,000 residents. In rural areas it may be necessary to travel to concentrations of population. In metropolitan areas, a much smaller carefully selected area should be defined. Within that area, "your own field of diamonds" you need to gradually learn the answers to the following questions.

1. What major appliances have been sold there over the last 20 years? These are the ones that you're going to be repairing.

2. Who are the major sales and service companies in your area? You may have a large, well-established Sears store; you may have an independent GE appliance center, or perhaps a Maytag Home Appliance Center. There may be large discount houses nearby, like Circuit City or Best Buys or other national discount firms.

3. Look over the newspapers and find out who is selling appliances.

Take a ride on a Saturday. Go to the locations of the various local service companies found in the Yellow Pages. Find out how big they are. How do they look? Is the place prosperous? Is it a dirty, run-down looking operation? How do the trucks look? Are they bright, clean, and well lettered? Begin forming your opinions on the style of business that they are running. Do they have a show room? Do they have a store front at all, or is it a residential address with no sign out front? You want to know as much as possible about the competition in your own marketplace.

For example, Rod Snyder in Gettysburg, PA reported that there were about seven competitors in his local phone book. He visited everyone and found that most were quiet unmarked street addresses. (Some very successful operations are almost invisible.) One had numerous appliances in the yard and one had several clean and well-lettered trucks. The last one is the one he choose to copy.

You may find an operation that is exactly like the one you're dreaming about. Take some pictures. The way to reach your goal is to analyze what your competitor is doing. Lay out a plan with *Uncle Harry's* help and immediately begin copying your future competitor. As you begin to run calls, you will begin filling up your own "bag of diamonds" with each new customer.

Marketing Made Very Simple

Step 1. Find out where the people with lots of money and many expensive appliances live.

Step 2. Market your services in their neighborhood.

Copy a Successful Competitor

(Fig 013-16a)



Goal Setting

You now have a good idea of the program content, the history of appliances, profit potential, industry structure, and some early marketing ideas. Where are you going to fit into this industry?

Uncle Harry will supply you with the tools necessary to build your business to any size. It is up to you to set your own target.

Begin by defining your goals for the next six months, one year, and two years. You may want to supplement your steady income right now. Perhaps your present plan is running one or two service calls each week or a few on Saturday morning. Great, thousands of individuals around the country do exactly that. "Moonlighting" is the proper term. It's an American tradition and a great way to get started. Do you want to begin as a moonlighter and grow from there?

Do you want to develop your business so that you can quickly generate twenty service calls per week? The information needed is provided in Manual 14, Marketing. (It is possible to purchase any of the business oriented manuals out of sequence.) You may have aspirations of building a twenty-truck independent service organization that competes head-to-head with Sears or GE in your local area. NOW is the time to begin forming those goals.

Of course, as business grows modify your goals as you go.

Don't be shy. Don't be afraid to dream. This business can make those dreams a reality.

It's time to get to work! First you need to decide exactly where you are going and then



Uncle Harry will teach you how to get there.

Automatic Washers

Introduction

Let's begin our first technical effort with washing machines. Automatic washers create a greater percentage of service calls than other appliances. By far the vast majority of washing machines in the United States are automatic top-loading machines.

We will focus on the brands that make up 99% of the market. That market is dominated by The Whirlpool Corporation.

(Fewer than two in a thousand will be a front-load design.)

A 70's Kenmore Washer (Fig. 013-17)



As shown earlier under “Appliance Trees” that soon follow, Whirlpool sells under several names. The bulk of their automatic washers are labeled “Kenmore” and are sold by Sears. Others of identical design, except for the console, are sold as Roper, Kitchen-Aid and, of course, Whirlpool. This combined group will total approximately 55% of all automatic washing machines

The next two popular manufacturing companies are Maytag and GE. They and their various brand names are about equal in market share with about 15% each. The remaining 15% of the market is made up of off-brands including Frigidaire, White-Westinghouse, Speed Queen, and a few others. (Historically, some mechanics have done well only repairing Whirlpool products.)

Soon we will focus on the various brands in the order of their popularity. However, before we start on brands, we are going study subjects common to every laundry operation.

Universal Washer Problems

All top loading washers are very similar in many ways. If you don't already operate your own washer at home, it is very important for you to go in the laundry room and learn to run it. Stand around for a full cycle and listen to it run. Eventually you must be familiar with each and every sound that it makes.

All automatic washers go through the following sequence:

1. The washer fills with temperature-controlled water.
2. It begins to agitate. The period of agitation is determined by the timer. The first agitation cycle is known as the wash cycle.
3. When the agitation finishes, the water is drained into a drain pipe or a sanitary tub.

4. The clothes are spun damp dry.

The washer starts up again and repeats 1-4. The second wash is known as the rinse cycle; mechanically it is identical to the first. Its purpose is to flush out the soap suds.

To accomplish these six steps all automatic washers need power, plumbing connections, and certain components.

Water Supplies

Hot and Cold Water

Two rubber hoses connect from the household plumbing to a plastic valve on the back of the washing machine. A cutoff on the wall controls water flow. Hot and cold supply hoses occasionally leak or worse burst, and the fittings are frequently rusted. Most customers leave pressure on the rubber hoses 24 hours a day. Unfortunately, every once in a while, a hose will break and flood the house. Manufacturers always recommend that the valves be shut off whenever the washer is not in use. Few people heed that advice.

Keep in mind that in the dead of winter, water lines freeze up, hoses burst, copper lines leak or burst, and even drain systems freeze too. Below 32°F, if any portion of the supply water line begins to freeze, a water valve may crack open. A plastic valve is weaker than a copper line and will split first.

Rusted Supply Hoses (Fig. 013-18)



Insufficient water can cause problems. A washing machine will not agitate in the wash cycle or in the rinse cycle until it is properly filled with the selected water.

For instance, suppose someone has accidentally turned off the cold water. If the machine is set on warm wash and cold rinse it will fill fine for wash and then pause and sit forever at the beginning of the rinse cycle. It is waiting for cold water.

“My washer quits on the rinse.”

A common service call

If the cold valve is turned off or the flow is restricted, a trickle or no water will come in during rinse. Frequently, such a problem is caused by clogged strainers in the hoses or in the water valve on the back of the washing machine.

Power Supplies

A standard 110 VAC outlet supplies electrical power to the washing machine. The quickest and easiest way to determine if an outlet is functioning properly is to unplug the washer line cord and plug in a utility light. There is no need to get out a voltmeter. If the light works, the washing machine is getting power.

It is common to discover a thrown breaker or a blown fuse. Some modern homes use special GFI (ground fault interrupt) outlets. Push the reset on a GFI outlet to test it.

“My washer is dead.”

An embarrassing call for the customer,
a dead circuit

**A Standard Outlet
(Fig. 013-19)**



The Drain System

Getting the water out of the machine and into the sewage system during the drain cycle presents another set of potential problems. The rubber hose from the washer to the drainage system is easily kinked. Any restriction will result in slow pumping, poor spinning or no spinning at all. The customer will complain:

*“My washer won’t drain”
or
“My clothes keep coming out wet.”*

Washer drain water flows into a sanitary tub or a standpipe. A clogged standpipe can cause a leak or worse a flood as shown in the following picture

A Clogged Stand Pipe (Fig. 013-20)



Sanitary tubs are more common in older homes and also present problems. They crack with age, the traps leak, and they can backup and overflow. Customers often tie a screen or pantyhose over the drain hose to catch lint and cause drain hose restrictions. A long drain hose sticking into the bottom of the sanitary tub can also cause a problem.

If the sanitary tub has a slow drain, water will sometimes siphon back into the washing machine after it shuts off. Back siphoning can also occur with standpipes. It is important that the drain hose from the washer not be sealed into a standpipe.

Modern Utility Setup Without Sanitary Tub and Hidden Standpipe (Fig. 013-21)



Occasionally a high drain in a basement will require that the washing machine pump raise the drain water 6 or even 8 ft. high. This extreme height approaches design limitations of all washing machine water pumps and can cause early pump failure.

**A Typical Sanitary Tub
(Fig. 013-22)**



Some clogged piping and sink problems must be referred to a plumber. As you can see, to accurately diagnose the variety of problems encountered, a good appliance tech needs to understand plumbing.

Universal Washer Components

Washing machines have many common components. They are:

1. Water Valves to control the water inlet cycle. Particularly in rural areas, they are a great source of service calls.
2. Water Pumps to drain out the wash and rinse water. They are our main source of service calls. They fail with great frequency.
3. Drive belts to connect the various drive pulleys to the motor. Belts and water pumps run a dead-heat in frequency of failures.
4. A Clutch which allows the motor to gradually bring a heavy, wet load of clothes up to full speed and spin them damp dry. All clutch mechanisms are prone to failure. A washer clutch is a wearing part just like a clutch in a car.
5. A Timer to control sequencing of the various functions.
6. A Motor providing power for agitation and spin. Novices often think motors fail frequently but motors are basically reliable and not a frequent source of service calls.

7. A Transmission to provide agitating action. In most cases, transmissions are too expensive and too time consuming to replace. They rarely fail and are a small source of revenue.

These various components may look different with each brand, but their operating logic is very similar. Once you understand basic theory, an unfamiliar model is not difficult to repair.

Washers, of course, have a lot more components:

- a water level switch
- selector switches
- filtering systems
- all the console parts
- a wiring harness
- suspension parts and legs
- a frame and cabinet

Of these components none are an important service issue and except for a few unusual instances that we will study later; we will ignore them for now.

Each important universal component will now be studied in detail.

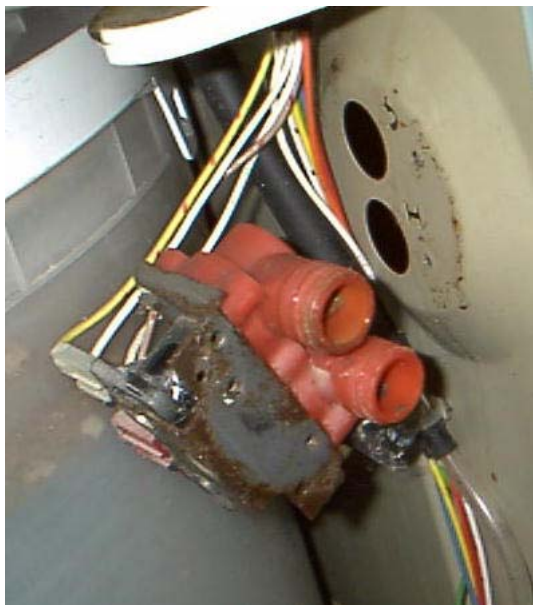
The Water Valve

The water valve, also called a “supply” or “mixing valve” is on the back of the washing machine and is a frequent source of service calls. This is particularly true in rural areas where well water includes small stones, silt, and various kinds of sediment that clog up the fine holes in the strainers of the valve.

The following customer complaints should guide you to a potential water valve problem:

1. *"My timer won't advance."*
2. *"I can't get any water."*
3. *"My washing machine overflowed."*
4. *"It takes forever to do a load of laundry."*

Typical Water Valve During Replacement (Fig. 013-23)



A water valve is a relatively simple plastic device with two rubber hoses connected to it. The valve has one solenoid for controlling hot water and a second for cold. Both hot and cold combine into one nozzle that connects by a small rubber hose to the washtub.

There are three common water valve failures:

1. The most common is partial clogging of the strainers built into the valve restricting the water flow. This usually happens to the cold side first. (Grit in the hot water side tends to collect in the bottom of the water heater.)
2. Failure of the valve to shut off 100%. If grit and corrosive chemicals get inside the valve, they either eat away the seat or clog up the shut-off orifices of the valve. The machine may continue to fill and overflow even though electrically it is off or even unplugged.
3. It's rare, but possible, for one of the solenoids to burn out. A bad solenoid will prevent one side of the valve from opening.

Diagnosing Valve Failures

The easy way to diagnose condition 2. is by asking the customer,

"When your washing machine overflowed, how did you stop the water?"

If their response is,

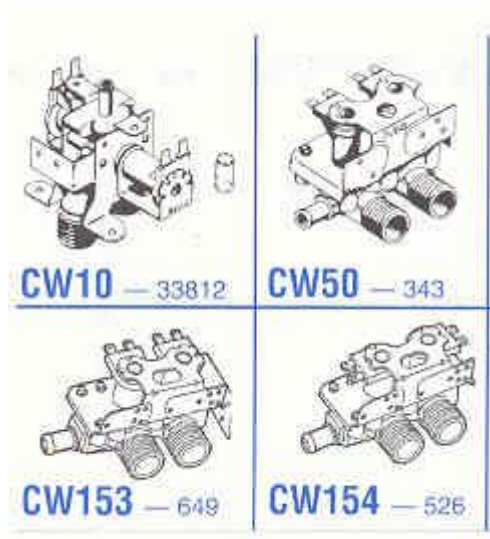
"I had to turn off the hot and cold faucet because turning the machine off didn't any good!"

Immediately you know that the valve is bad. Similarly, if the customer complains,

"My washing machine has water in it when I come down in the morning."

This is the same basic problem.

Sample Water Valves (Fig. 013-24)



Uncle Harry's

Trick of the Trade # 1-4

Never clean the strainers on the water valve itself. They are not meant to be serviced.

Always replace the entire valve.

Cleaning the strainers loosens up grit that can get into the valve and cause a flood, which may be your responsibility. It is much safer to replace the entire valve.

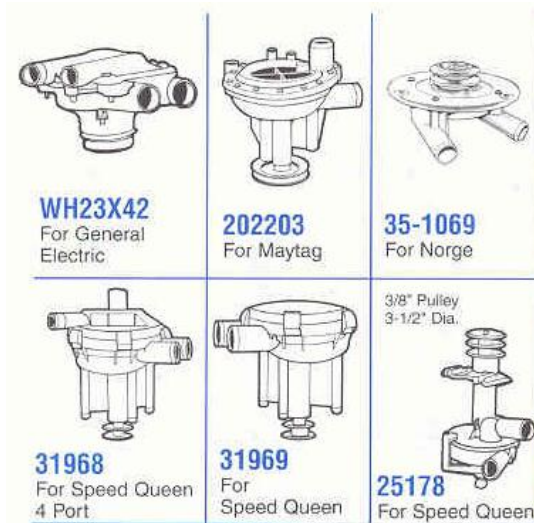
Bad water valves are moneymakers. The generic ones only cost \$6.00-7.00, but a manufacturer's original retails for \$35.00 or \$40.00. It's competitive to charge \$100.00 to install a water valve and net a quick \$90.00-95.00 profit for ten minutes work. (See Flat Rate Guide Book.)

Water Pumps

The washer pump, is an impeller built in a simple housing that includes two hose connections. The spinning impeller sucks water in one side and blows it out the other. Most of today's washers reverse the impeller rotation (by reversing the drive motor) to stop the drain cycle. The timer controls the rotation of the pump by controlling the direction of the drive motor. This same reversing action also switches the washer from agitate to spin.

A reversing design eliminates any valving on the drain line or pump. In the wash mode, the pump is harmlessly trying to suck water out of the drain hose. In the spin or drain mode, it reverses and pumps water from the washtub into the drain.

Various Water Pumps (Fig. 013-25)



Maytag, GE, direct-drive Whirlpool (the current design), Norge, and Frigidaire all utilize a reversing pump design. In a few cases, the pump may have more than two hoses. The additional hoses are used for circulating through a filtering system water back into the washtub. GE, for instance, often uses a four-hose pump with a lint filter.

Whirlpool Belt-Driven Pumps

A second very popular pump design, was used on belt-driven Kenmore/Whirlpool washers until the mid 80's. The basic pump is still a two-hose style as we just discussed. However the motor never reverses on belt-driven Whirlpools. Without reversing a valve is required on the pump to turn it on and off. An arm on the side of the Whirlpool belt-driven pump operates an internal valve. The additional third and fourth hoses on other Whirlpool pumps shown supply filtering water like on GE.

Sample Whirlpool/Kenmore Water Pumps

(Fig. 013-26)



Uncle Harry's

Trick of the Trade # 1-5

If one day you are desperate for a two hose Kenmore pump, it is possible to use a three or four hose pump as a two by blocking off the extra ports and save a trip. (The three hose pump even comes with a cap for the third hose.)

Belts

Bad drive belts are a very common source of calls. They fail for two basic reasons:

1. After many hours of use a belt just wears out.
2. Excessive loading such as a dragging pump or transmission may cause premature failure

Drive Belts are covered extensively under each brand.

Whirlpool Drive Belts (Fig. 013-27)



Timers

All washing machines need a brain to turn on and off the various components at the proper time during the cycles. A timer accomplishes this task. Timers may be complex but they are pretty easy to diagnose.

Timers are diagnosed by knowing failure patterns and by elimination. Rarely is it necessary to use a continuity tester to check contacts (like they tell you to do in the factory manuals). It is easy to go crazy trying to figure out what contacts are supposed to be open and closed at any particular point in a cycle.

Uncle Harry's
Trick of the Trade # 1-6

Diagnosing Timers

1. Learn From Failure Patterns
2. Use a Simple Voltage Test While the Machine is Operating.

Universal Timer Facts

Before you can easily diagnose a timer, it is necessary to understand how they work. A timer consists of three parts:

1. A **motor** that drives the contacts through an “escapement”. The small-timer motor is geared down to a very low speed and slowly drives the input gear of the escapement section. Except for Maytag, timer motors are not available separately. Any failure requires replacement of the entire timer. If the motor fails, the timer will not advance.

2. An **escapement** which converts the continuous motion of the motor into spaced segments of motion. The timer advances in little jumps about once every minute and pauses in between. The escapement stores up the motor rotation and releases it, providing incremental motion. An escapement may develop weak spots at different places on the rotation. In some cases it is possible to see inside and confirm a tentative diagnosis by watching the gears move and advance the main drum.

3. A **drum and contacts** section that controls the flow of electricity to various components. The contact section is a group of metal fingers following a rotating drum. The drum has high and low spots that bend the fingers up and down as it rotates. Various positions of the drum make and break connections between the metal fingers.

Electrical connections are made at the tips of the metal fingers. These contacts fail two ways:

1 As they make and break electric current, small arcs form that gradually wear down the metal. Naturally the contacts that handle the largest amount of current wear out first. The two contacts that fail most often are the on-off switch and the motor contacts.

2 Dirt or insects will get in between the contacts and keep them from touching.

(Remember the caution about carefully listening to a customer? This is particularly true in timer diagnosis.)

Timer replacement on most machines is a fifteen-minute job. The wires are bundled together in big quick-disconnects making replacement easy.

Unfortunately, except for a few fast-moving Kenmore timers, it's impractical to stock them on a truck. In most cases, a timer replacement requires a double trip. Each model, each year, and each brand requires a different timer. There is virtually no interchanging between models.

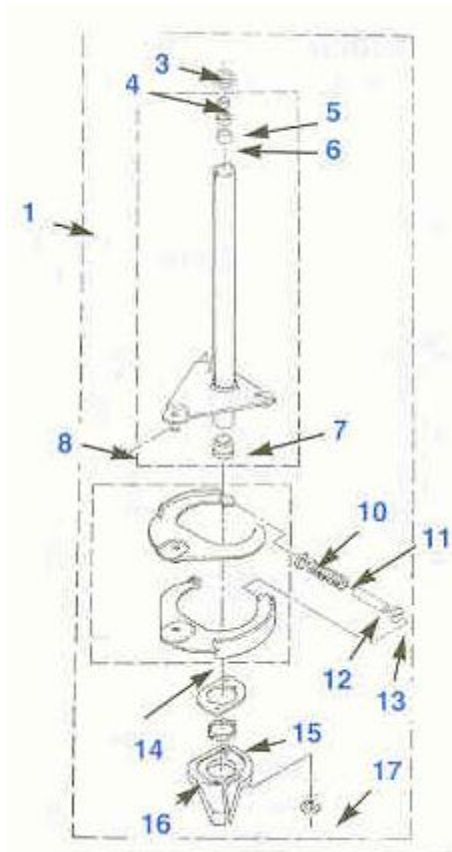
Generally a small quantity of parts allows you to complete a tremendous variety of repairs. There are interchanges between brands on many different things, timers being the exception.

A few new washer models incorporate computer timers like those in microwaves. Diagnosis is still the same and is often assisted by a tech sheet hidden in the console. Tech sheets provide test procedures or flow charts specific to a particular model.

The Clutch Mechanism

A clutch is needed on all washers to delay, until most of the water is drained out, direct coupling between the drive motor and a basket full of heavy wet clothes. If the full weight is applied too quickly, a motor will be overloaded. Clutches vary by brand and there is no interchangeability.

Kenmore Direct-Drive Clutch (Fig. 013-28)



However there are only three basic designs:

1. A spring loaded slipping belt.

Maytag, Westinghouse, Kelvinator and some Frigidaire use a special belt with a slipping surface that acts as a clutch. Belt tension is controlled by a spring that allows slippage as the clothesbasket gradually increases speed.

2. A small clutch similar to that used in an automobile brake system.

GE, Whirlpool, old Frigidaire, old Kelvinator/Franklin, and old Speed Queen all used a spring loaded clutch shoe rubbing against a steel drum. (Old Speed Queen also used a fluid drive.)

3. A slipping spring inside an oil filled transmission.

All Norge washers use this concept.

Drive Motors

Motors on washing machines are reliable. They're expensive to replace and not a common source of service calls. Except for belt-driven Whirlpool, nearly all the motors reverse between wash or spin. Reversal, as mentioned before, is done by the timer.

The design of all appliance electric motors is very similar. The General Electric Company makes a great many. They all have a start winding and a main winding. The start winding is only connected for a few seconds when the motor is starting (when else), and is quickly disconnected by a centrifugal switch within the motor (or by the gravity switch) when the motor reaches operating speed.

One word of general caution on some motors. GE washers, for instance, have a remote starting switch mounted on the back of the cabinet. If you try to operate the machine while it's on its side, you will burn out the motor. The switch needs to be operated upright to function. Part of the switch is operated by gravity. Whirlpool and KitchenAid dishwashers also use remote gravity switches. The starting switch is not inside the motor.

Listen carefully and watch as a motor starts. A trouble (utility) light will dim a little when a motor starts and then brighten back up again as the start winding is disconnected. There is an audible click as the switch in the motor disconnects the start winding.

Motors are the main source of current draw for washing machines as they are for most appliances. They dim lights just like a compressor does in a refrigerator.

Note: The wiring and timer contacts that control motor current fail most often.

Uncle Harry's

Trick of the Trade # 1-7

Pay attention to the intensity changes of a trouble light, it is a helpful diagnostic tool.

Maytag Washer with Motor Removed (Fig. 013-29)



Transmissions

Transmissions are unique to each brand. All provide the needed agitate motion and all are oil-filled housings with gears inside. With the exception of GE, it is rare to replace one. The repair cost is just too high. Specifics that apply to transmissions will be dealt with on a brand by brand basis.

Conclusion

This completes the introduction to all appliances, appliance service and begins our study of specific automatic washers.

Previews of Coming Attractions

Manual 2 is an exhaustive study of all Whirlpool washers, including Kenmore, Roper, RCA, KitchenAid and InSinkErator. The manual includes a set of complete diagnostic flow charts designed to make repairs easy. The two Whirlpool designs, belt-driven and direct-drive, are carefully studied component by component, along with all failures and repair procedures.

NOTES PAGE

Examination

Manual 1

Introduction to Appliance Repair & Automatic Washers

(Note: More than one answer maybe correct.)

1. What company manufacturers the most washers and dryers?
 - A. Amana
 - B. G.E.
 - C. Maytag
 - D. Whirlpool
2. In a quick diagnosis, what is most important?
 - A. to check every component.
 - B. remove parts for tests.
 - C. test the most likely first.
 - D. replace after one test.
3. How long does it take, on average, for a trained technician to diagnose an appliance?
 - A. 10 minutes
 - B. 5 minutes
 - C. 30 minutes
 - D. 1 hour
4. Which of the following is not a major appliance?
 - A. toaster
 - B. washer
 - C. freezer
 - D. electric cook top
5. Which of the following will not be covered in this program?
 - A. customer relations
 - B. use of the telephone
 - C. advertising your new company
 - D. repair of weedwackers and hand tools
6. Which of the following is sometimes taken to a depot for service?
 - A. microwave oven
 - B. icemakers
 - C. freezer
 - D. dishwasher
7. Today's dryers utilize the following design:
 - A. a heavy duty pulley system
 - B. a simple belt around the drum
 - C. a cast iron heating element
 - C. match light pilots
8. Continuous-cleaning ovens were:
 - A. a great success
 - B. a great source of customer complaints
 - C. spotless
 - D. easy to clean
9. Which of the following is a major source of service calls on self-cleaning ovens?
 - A. broken door glass
 - B. worn out hinges
 - C. the locking system
 - D. clocks
10. A major component of today's dishwashers is:
 - A. plastic
 - B. copper wiring
 - C. cast iron
 - D. porcelain

11. The first icemakers were:
 A. much better than today's
 B. unreliable
 C. costly to operate
 D. well designed
12. White-Westinghouse is part of what manufacturing group?
 A. General Electric
 B. SubZero
 C. Frigidaire
 D. Amana
13. A good technician can keep his callbacks down to:
 A. 15%
 B. 20%
 C. 1%
 D. 5%
14. Working a normal 8 hour day, a technician should average how many completed calls per day?
 A. 2-3
 B. 5-6
 C. 10-12
 D. 8-10
15. What is a realistic gross daily profit for an experienced technician?
 A. \$100.00 B. \$200.00
 C. \$300.00 D. \$400.00

16. A washer overflowed. Which of the following is the most likely suspect?
 A. timer
 B. pump
 C. water valve
 D. water level switch
17. What is the fastest and simplest way to test an outlet?
 a. wet your fingers and stick them in the holes.
 B. a voltmeter
 C. a trouble light
 D. an ammeter
18. Which of the following is the fastest moving inventory item?
 A. suspension parts
 B. motors
 C. timers
 D. pumps
19. Washer clutches
 A. interchange between brands
 B. do not allow slippage
 C. allow slippage
 D. are inside the motor
20. A motor starting switch
 A. disconnects the start winding
 B. is sometimes mounted remotely
 C. is sometimes operated by a centrifugal switch
 D. A, B, & C

Extra Credit Question:

Which national companies are present in your area?

Examination Answers

Manual 1

Introduction to Appliance Repair & Automatic Washers

1. D Whirlpool by far manufactures the most washer and dryers. Whirlpool products appear in the marketplace as Kenmore, Whirlpool, Roper and KitchenAid and represent over 50%.
2. C. A quick diagnosis requires that the technician test for the most likely problems first.
3. A. A trained technician will average a diagnostic time of 10 minutes.
4. A. A toaster is not considered a major appliance. They are thrown out rather than repaired.
5. D. Hand tools and weed whackers are not covered in this program.
6. A. Microwave ovens are occasionally carried to a depot for service.
7. B. Most of today's dryers use a belt-around-the-drum design with an idler pulley for tension.
8. B. Continuous cleaning ovens were taken off the market primarily because of customer dissatisfaction.
9. C. The complex locking system causes more service problems than the other three choices combined.
10. A. The cabinet and door liner on all major brand dishwashers today is made of plastic.

11. B. Early icemakers were unreliable and hard to keep in operation.

12. C. White-Westinghouse is part of the Frigidaire Corporation.

13. D. A good technician can keep his callbacks to approximately 5%.

14. B. Five to six completed calls per day is a realistic average for a skilled technician.

15. D. A realistic gross profit for an average day is \$400.00.

16. C. Water valve problems cause more overflows than any other component.

17. C. A trouble light is the fastest way to test an outlet. A voltmeter will work, but it takes longer.

18. D. Pumps are by far the fastest moving inventory item.

19. C. The purpose of a clutch is to allow for slippage.

20. D. A motor-starting switch disconnects the start winding, is sometimes mounted remotely, and is sometimes operated by a centrifugal switch