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ELECTRICITY

for the 4-H scientist

Safety
Uses
Economy

DIVISION III
4-H ELECTRIC

TEACHING RESEARCH SERVICE

UNIVERSITY OF IDAHO
College of Agriculture

4-H Electric, Division III

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UNIVERSITY OF IDAHO
COLLEGE OF AGRICULTURE
AGRICULTURAL EXTENSION SERVICE

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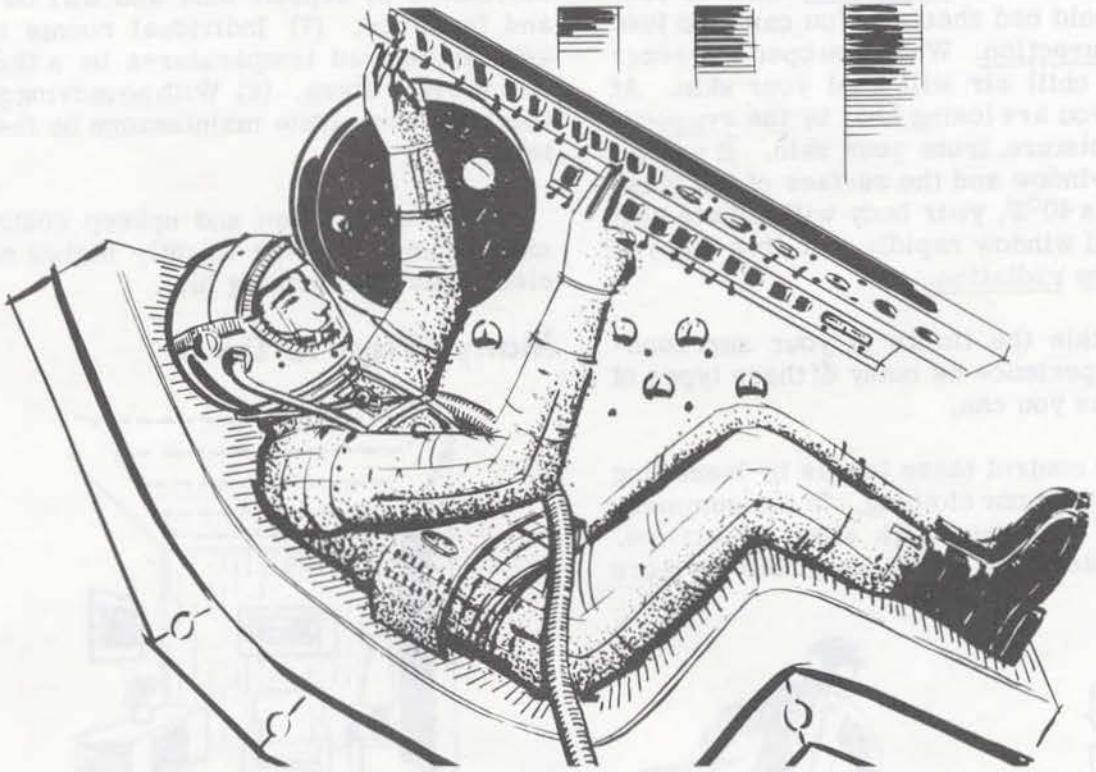
LESSON NO. 41
Credit Points 3

YOU and SPACE...and HEAT



IF you were to take a trip into outer space, one of the most important things would be how to keep you warm.

When and if you did make such a trip, chances are that a combination of two things would be used to keep you warm in the sub-freezing temperatures. These two things would be electricity and insulation.

The electricity would be used to operate resistance heaters, and the insulation would keep down the loss of heat from your body to the outside.

What to Do

1. Learn why you need heat, and how the human body loses heat.

2. Get to know the ways that electricity can be used to keep you comfortable.

3. Obtain a piece of heating cable and a portable electric heater, and see how they work.

4. Get a piece of blanket type insulation and learn how it helps prevent heat transfer and why it should be kept dry.

You Need Heat

Why do we need heat? All of us are "heaters", with a capacity that ranges from 400 Btu (heat units) to 1100 Btu per hour, depending upon whether we are resting or physically active.

In warm weather, we seem to have too much heating capacity. It is often not enough, when outdoor temperatures are low.

Our skin temperature is about 81°F, which is usually higher than its surroundings. It is necessary that the human body lose heat, and we are most comfortable when this necessary loss from the body is effortless. When you are in a room that has a temperature from 70° to 75°F, you feel comfortable.

When we lose heat with difficulty, we feel hot. Too rapid a loss and we feel cold.

You can prove these two statements by putting on a heavy coat and remaining inside, and by standing in the airstream of an operating air conditioner for several minutes with very light clothing on.

How You Lose Heat

You lose heat in many different ways.

You lose heat by conduction while in contact with cold bed sheets. You can also lose heat by convection. When you open a freezer door, the chill air will cool your skin. At all times you are losing heat by the evaporation of moisture from your skin. If you sit next to a window and the surface of the glass is as low as 40°F, your body will radiate heat to the cold window rapidly. In this way you lose heat by radiation.

Try, within the limits of your surroundings, to experience as many of these types of heat loss as you can.

We help control these losses by insulating ourselves with our clothing. In the summer, we clothe ourselves with slight insulation. In the winter, we insulate ourselves more heavily.

"Space" Heating

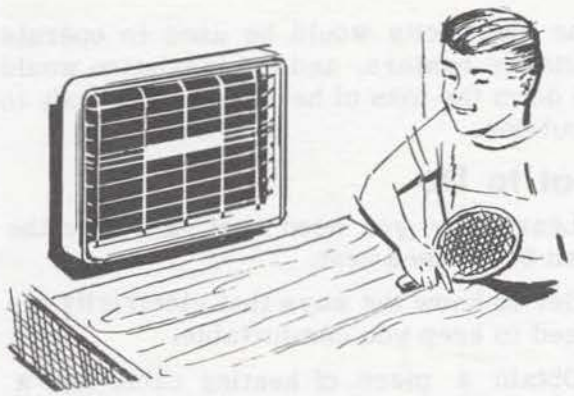
Electricity has been widely used for many years to help keep people warm. It is placed easily in unusual locations, can be directed where wanted, and is installed by simply plugging into a convenience outlet. Most of us are familiar with the so-called portable "bathroom" heater.

Electric heating is practical for a whole house or building. Room-by-room resistance heating, the most common method, has many advantages. (1) It is quiet with no air noise. (2) A blanket of warm, comfortable air is provided. (3) Space is saved since no large furnace is needed. (4) Installation costs are low with no duct work, plumbing, flues, or vents needed. (5) The heat is more uniform and (6) cleaner with no quantities of air movement to deposit dust and dirt on walls and furniture. (7) Individual rooms can be kept at desired temperatures by a thermostat in every room. (8) With no moving parts, there is very little maintenance on the system.

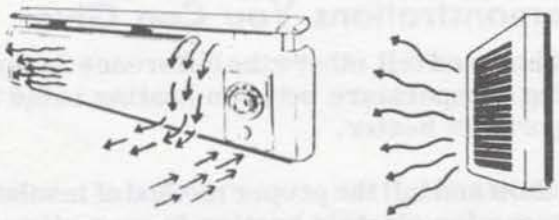
Lower installation and upkeep costs may more than offset the slightly higher cost of electricity as a heating fuel.

Many Ways to Do It

Plastic covered heat cable is installed in the ceiling so that radiant heat rays filter evenly all over the desired living area. The cable is sometimes installed in a concrete slab floor. No floor space is required and favorite chairs can be placed anywhere.



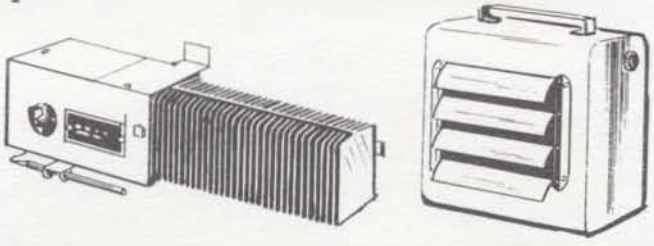
Radiant panels operate on the same principle except they are assembled as a unit. They can be mounted in the wall or ceiling or even be made portable.



Baseboard heating units have become popular for a home already built or where it is desired to concentrate the heat under a large window. They take no usable wall space, and can be painted to match room decoration.

Forced convection heaters have quiet fans that blow air across an electric element, discharging the gently warmed air into the room. Although suitable in most locations, this type is especially good where a large amount of heat is needed from a relatively small unit.

Electric furnaces and boilers are also in use, and they work exactly like the flame-fuel ones, except that they substitute large resistance heaters for the burners or fire-pot.



Special heaters and heat lamps are available for rooms such as milk houses and pump houses where high temperatures are not required. They can be automatically controlled, if you wish.

A resistance type flexible film or paper-like material has copper foil along opposite edges. The whole width of the paper acts as a resistance wire. It can be punctured or cut and still operate. It is easy to apply, safe, and can even be used outdoors on a porch or under a canopy. Surface temperature is under 100°F and it can be controlled to any desired level.

Try Them Out

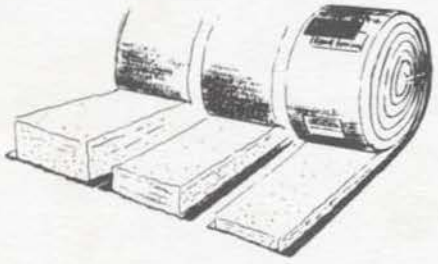
Get a piece of heating cable of a length that can be plugged in to 115 volts. Be sure to uncoil it before operating. Borrow a portable electric room heater. What is the heat output (in terms of watts) of each? Operate both of them. How do the two compare in temperature of the heating element? Get some dust from a vacuum cleaner and sprinkle it on each one. What happens? What advantage does this show for cable and other low-temperature heating equipment?

Insulation a Must

You wouldn't think of trying to keep warm outdoors on a cold day in shorts and a T-shirt. You would insulate yourself with much heavier clothing.

To keep our house comfortably warm without using an excessive amount of electricity we must do the same thing.

In northern climates - - - - - you should install up to six inches or more of insulation in its top-floor ceiling, four inches in the walls, and two inches in the floor.



Insulation loses its value if it picks up moisture from the air, so it must be protected on the warm side with a "vapor barrier" of aluminum foil, treated paper, or plastic.

Get one or more samples of some insulating material, preferably some with vapor barrier attached.

Aim a 250-watt heat lamp at your hand for a few seconds at a distance of 6 inches. Next, place a piece of insulation between the lamp and your hand. Notice the difference.

Wet one corner of your sample of insulation, using room temperature water. Put one hand on this wet area, another on a dry area of the material. What difference do you detect? Why?

What Did You Learn?

1. If the human skin temperature is about 81°F, why aren't you most comfortable at 81°F?

2. List all the advantages you can think of for using electric resistance heat for comfort heating.

3. Tell why winter clothing is usually dark in color and summer clothing light.

4. Can you think why man could not exist if it were not for radiant heat?

5. When you sit next to a cold window, why do you feel uncomfortable even if the temperature around you is 75°F?

Demonstrations You Can Give

Show and tell others the difference in operating temperature between heating cable and a portable heater.

Show and tell the proper method of insulating a home for electric heating in your climate.

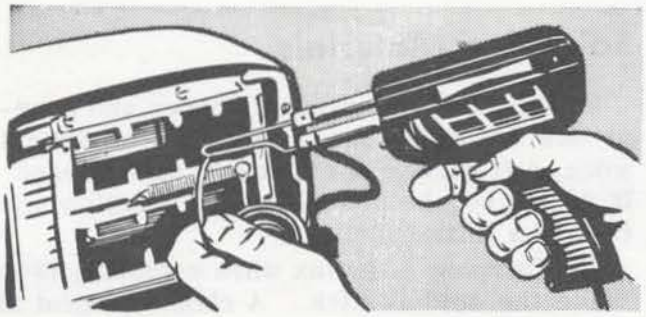
Show how the presence of moisture affects the value of insulation.

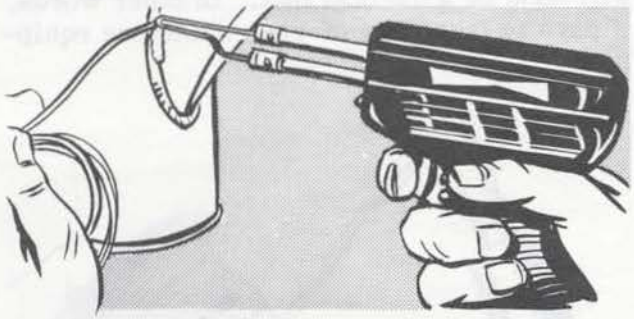
For More Information

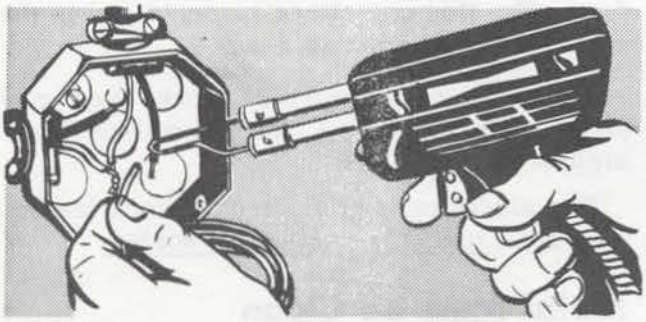
Ask your power supplier representative, electric supply house, or electric heat contractor for literature.

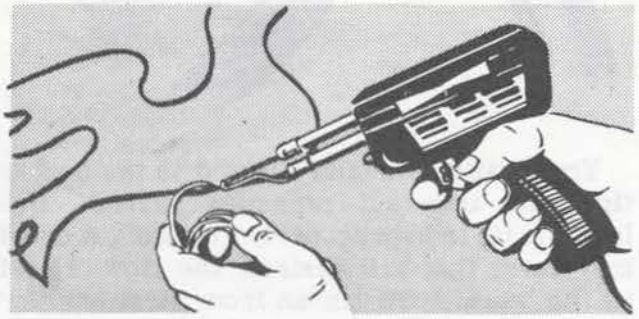
See Farm Electrification Leaflets
No. 23 Supplemental Electric Heat for Farm Buildings
No. 39 Electric Heat for the Farm Home
No. 53 Electric Heating Cable for Farm Applications
No. 47 Electric Heating Devices for Winter

SUCCESSFUL SOLDERING









In any farm or home, metal objects will need to be repaired, built, or assembled with solder. Soldering requires a minimum of tools and supplies, and the needed skill can be learned quickly. Soldering is the process of joining 2 pieces of metal with another metal called solder. Solder is a combination of lead and tin.

Sometimes you have to join two or more electrical wires. These joints are called splices. They should be made as strong and conduct electricity as well as an unbroken wire. Poor electrical contact in the connections may cause heating, radio interference, or poor operation of equipment. Solder is used to make good tight connections so that there is no restriction to the flow of electricity.

What to Do: Learn to Solder

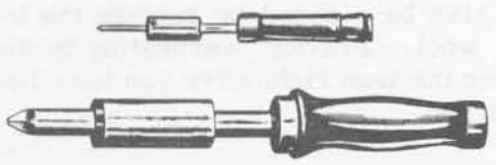
Decide on the proper size and type of electric soldering equipment for your needs. Learn the proper care of it.

Prepare, solder, and re-insulate a pigtail splice.

Repair a sheet-metal object such as a leaky pail.

What Size Equipment?

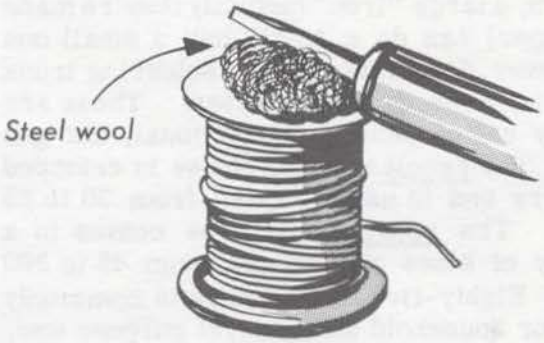
Often, a large "iron" (actually they're made of copper) can do a small job; a small one can never do a large job. Soldering irons come in three different styles. These are usually called pencil, conventional, and gun types. The pencil type is for use in cramped quarters and is usually rated from 20 to 35 watts. The conventional type comes in a variety of sizes and ranges from 45 to 300 watts. Eighty-five to 100 watts is commonly used for household and general purpose use. The gun type has a pistol type grip and is rated from 100 to 250 watts. It is used where quick heat is required such as in radio and TV repair work. Different styles of tips are available to help make varying jobs easier.



How to Care for It

Most home handy men have a piece of soldering equipment. Properly used and cared for, such equipment will give long years of dependable, efficient service. Abused, it will soon be a useless tool. In other words, it pays to take care of your soldering equipment.

You should remember that it is the copper tip of the iron that transmits the heat. Unless the tip is kept properly "tinned", a crust may form that will restrict the flow of heat to the work. To tin an iron, first see that the tip is smooth, clean, and free from pits. If necessary, use a file to recondition the faces. Then apply solder to the tip just before it reaches maximum heat. Rosin-core solder, which we will talk more about later, is best for this purpose.



When using the iron, watch the tinning on the tip. If it becomes discolored, dip it into clean water and instantly withdraw it. This will not only expose the bright tin, but also bring the iron back to a safe temperature if the browning is due to overheating. Tinning may also be cleaned by rubbing the iron on steel wool. Prevent overheating by disconnecting the iron right after you have finished soldering.

The tip of the gun-type soldering iron should also be kept well tinned. Overheating of a soldering gun should be strictly avoided. Since this iron will heat up in about 5 seconds, there is no need to leave it turned on when not in use.

Soldering Materials

Solder comes in various shapes and hardnesses for different jobs. For electrical work, soft wire solder is nearly always used. It can either be a solid wire or hollow and contain a flux.

The purpose of a flux when soldering is to make the solder stick. A cleaning agent is often included in fluxes to assist in removing dirt. The flux can either be contained in the solder or be applied as a paste.

For most non-electrical work, you may use a paste flux, but for galvanized iron, always use acid flux.

For electrical and electronic work (radio, TV, etc.) use only rosin core solder.

Metal Must Be Clean

A soldered joint requires that the solder come in contact with pure metal. If any dirt is in the way, the solder has trouble sticking and makes a poor connection. Wires and metal may be cleaned by scraping with a knife, sandpaper, or emery cloth. They should be bright and shiny before you start soldering.

Rules Get Results

There are no "tricks" to soldering. Anyone who follows the simple rules can successfully solder with a little practice. The four requirements are:

1. The wires or metal to be soldered must be shining clean and free of oil or grease.

2. A little flux must be applied as a paste or be contained in the wire solder.

3. Enough heat must be applied to bring the object up to solder melting temperature. If you are soldering wires, a drop of solder melted on the iron, as it is heating directly under the wires, hastens heating.

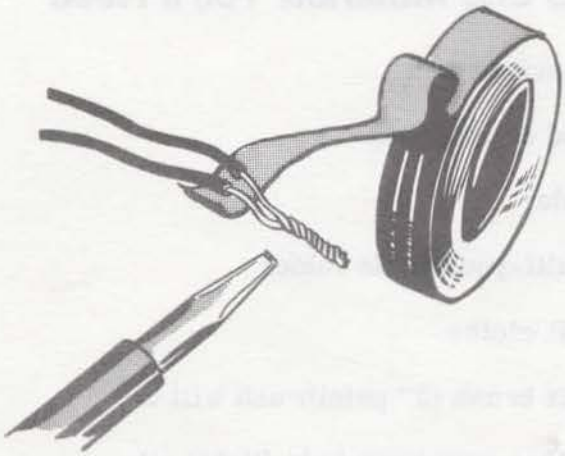
4. When the wires or metal are hot, put the wire solder directly on the wire joint.

For a good job, solder should flow into and around all the wires, or between the pieces of metal you are joining.

Replace the Insulation

After a pair of wires have been soldered, you will have to replace the insulation. This protects the splice from mechanical injury and permits you to handle the wire without shock.

1. Rubber Tape - Any wire which has had rubber insulation must have a layer of rubber or plastic tape around the new joint. Place the tape over the tapered end of the rubber insulation. Wind spirally to the other end, letting the turns overlap a little. Keep the tape stretched so it will come together and seal out dirt and moisture. Put on as many layers as you need to build up the insulation to match what you took off. Be sure all the wire is covered where you have removed any insulation.



2. Friction Tape - Friction tape is used to replace the tough outer braid on the wire. It is made of cloth soaked in a sticky compound. Put it on the same way as the rubber tape, winding diagonally from one end to the other. Two layers are usually enough.

3. Plastic Tape - This kind of tape has many uses. It is a very good insulator, stretches easily, sticks to most anything, and the glossy backing does not gather dirt or lint. In covering splices, it can take the place of both rubber and friction tape. However, with plastic tape, extra care should be taken to protect pigtail and center tap splices. Make sure enough material is around sharp points to prevent them from rubbing through the tape.

What Have You Learned? (True or False)

1. Solder is a combination of zinc and tin.

2. A poorly soldered joint can cause static on a radio.

3. The expected life of a soldering iron is two years.

4. The conventional type soldering iron is widely used for radio and TV repair work.

5. When the tinning wears off the tip of the soldering iron, a new tip should be installed.

6. A paste flux is usually not necessary for soldering wires when rosin-core solder is used.

7. When the splice becomes hot, apply solder directly to the wires for a good job.

8. Plastic tape would be a practical tape for your tool kit.

Demonstrations You Can Give

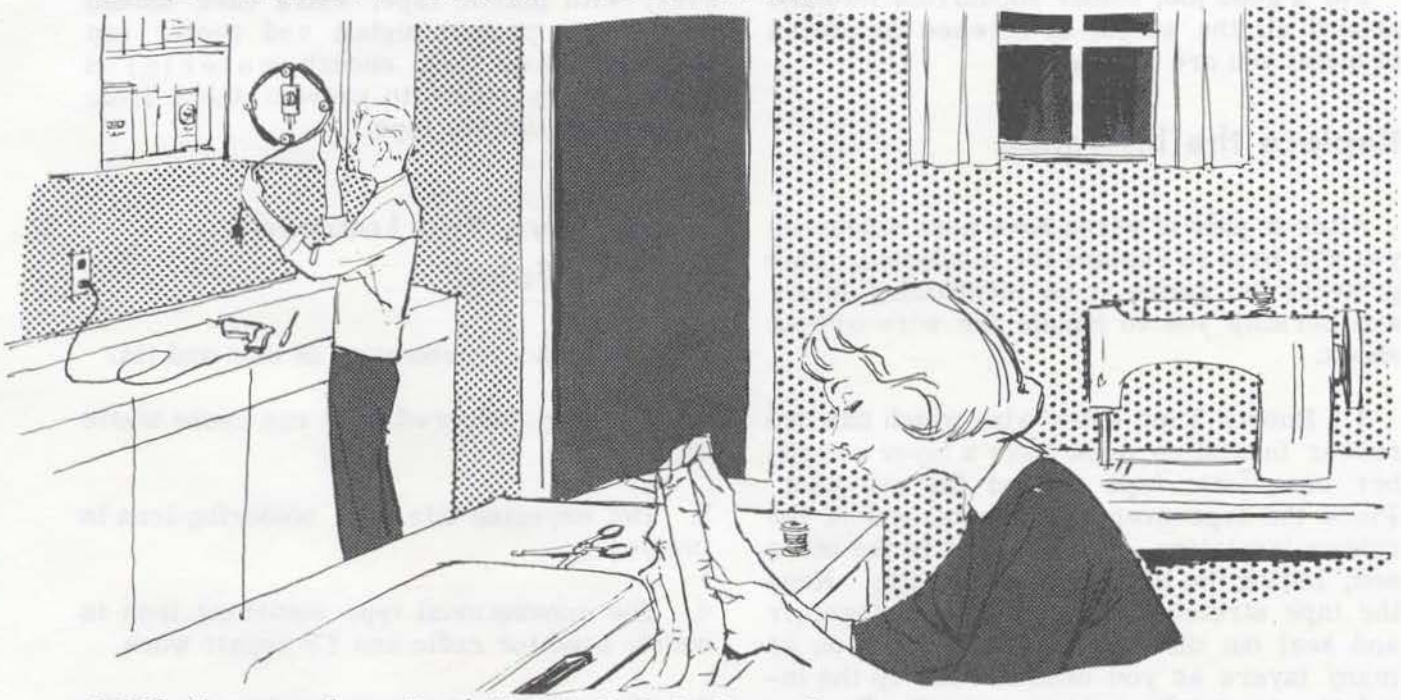
Show and tell how to prepare, splice, solder, and tape the wires that need to be connected when a ceiling fixture is replaced in the home.

Show and tell how to repair a leak in the spout of a sprinkling can.

For More Information

See the instruction book that accompanies a soldering gun or soldering iron. Read the soldering instructions that accompany electronic kits.

SHOW THAT YOU CARE



What's your favorite 4-H activity? Is it cooking, sewing, clothing care, or home improvement?

Whichever it is, chances are that you depend on one or more electric appliances to help you carry on this activity.

There are literally dozens of different electrical helpers, but they all have one thing in common: They'll serve you better and last longer if you take care of them. You can show others that you understand and appreciate appliances by learning how to care for them.

What to Do

1. Make a list of all the electric appliances in your home.

2. Make a file of the instruction books, warranty tags, and other information that came with each appliance.

3. Learn the basic care that all appliances should have. Clean and oil at least one small appliance.

4. Make a service chart covering all the appliances in your home.

5. Improve on the method or place of storage of at least one appliance or its cord in your home.

Tools and Materials You'll Need

Pencil or pen

Pad or notebook

Ruler

Multi-pocket file folder

Soft cloths

Soft brush (2" paintbrush will do)

Oilcan with household (light) oil

Screwdriver and pliers

How Many In Your Home?

Have you ever counted up the number of electric appliances in your home?

Start in the kitchen, and going from room to room, make a list of all of them. You'll use it in the next step.

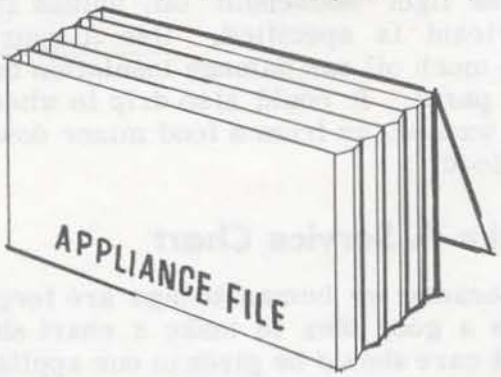
Make An Appliance File

When the appliances in your home were first bought, they came with an instruction booklet or card telling how they should be used and cared for.

This is valuable information, prepared at considerable cost by the manufacturers for the sole purpose of helping you get the most out of the appliances.

Most people save such information, but sometimes it cannot be found just when it's needed most.

To keep all this material in one place where it can be found and referred to easily, you should make a simple file. Because this material is in different sizes, perhaps the best way to keep it all together is to use an expanding multi-pocket file folder. (Available at stationery and variety stores.)



Label the sections of the folder alphabetically and file the information according to appliance names. (If the file has five pockets, you could label them A-E, F-J, K-O, P-T, and U-Z.)

Use the list you have made of the appliances in your home as a checklist to be sure that you have information for each one. In case you can't locate any information for some appliances, ask your dealer for it, or write to the manufacturer.

Show others in your family how to use this appliance file so that they will know where to find this information when they need it.

As new appliances come into your home, you can file the instruction book and warranty after studying them carefully. Be sure to write the date of purchase, model number, and serial number (if there is one) on the instruction booklet, too.

Get to Know Each Appliance

Read all of the information in your appliance file, and refer to it from time to time. Others in your family who use these appliances can do the same.

From this reading you will learn that each appliance is made to do a specific job, and that each one requires a special kind of care. But there are certain basic principles of care that apply to almost all appliances.

They are: Keep them clean, protect cords from damage, and lubricate those with moving parts that are not permanently lubricated.

Keep Them Clean

Dirt is the enemy of just about everything (other than your garden) and appliances are no exception. Dirt causes moving parts to wear or stick, it interferes with the function of heating appliances, and it is unsanitary.

For safety's sake, always disconnect the cord of a small appliance from the wall outlet before starting to clean it.

Appliances with chromium, porcelain, or enameled finishes can be kept clean by wiping with a soft cloth. To remove spots, use a little mild soap or detergent and water on your cloth. Then use a dry cloth to polish.

Immersible or not?

Be sure you know before immersing it.

Check the instructions on small cooking appliances to see if they can be immersed in water to clean. If they can be, immerse them. Otherwise, don't do it.

Be careful not to damage the heating element when cleaning a toaster or other heating appliance.

Some manufacturers suggest using fine steel wool soap pads to remove cooked-on food, (except on chromium or enameled finishes) but avoid scraping a metal surface with a metal scraper or using coarse scouring powders. Pretreated surfaces such as on a waffle maker need only wiping with a damp cloth.

Coffeemakers made of metal other than aluminum may be made clean and sweet every once in a while by putting a tablespoonful of baking soda in and proceeding as though you were making coffee. There are special cleaners made for use on aluminum pots.

It may be necessary to remove a grill or guard on some appliances to clean them thoroughly. It may be necessary, too, to remove an accumulation of oil and dirt with a cloth or brush dipped in petroleum solvent. (Make sure appliance is dry before using it again.) Always be sure to replace guards securely.

Protect Cords From Damage

Many appliance troubles result from failure of the cord. The many fine strands of wire that make a cord flexible will break if they are flexed too many times, or if they are mistreated in some way. Insulation will break down from exposure to heat and sunlight.

To make your cords last as long as possible, avoid these: kinking them, hanging them over a sharp object, wrapping them around appliances that are still warm, and storing them in the sunlight.

A good way to store cords is to coil them not too tightly around the appliance (if it does not have sharp corners). Detachable cords can be wrapped around four spools fastened to the inside of a door. Or they can be coiled loosely and put in a convenient drawer.

Oil, But Only As Needed

The need for lubrication is determined by two things: the way the appliance was built, and the use it gets.

Appliances with few or no moving parts may need little or no lubrication. The same is true of those appliances that are permamently lubricated at the factory.

For a reliable guide, see the instructions that came with the appliance.

Here are some general rules for oiling:

Use light "household" oil, unless another lubricant is specified. Use it sparingly. Too much oil can damage insulation or rubber parts. It could also drip to where it's not wanted, as from a food mixer down into the food.

Make A Service Chart

Because we human beings are forgetful, it is a good idea to make a chart showing what care should be given to our appliances, and how often we should do it.

Leave plenty of room to write in the dates that the motor was oiled, the filter was cleaned, and so on. Then a glance at the chart will tell us when to do the job again. Post your chart on the inside of a door where you will see it from time to time to remind you to follow up on service.

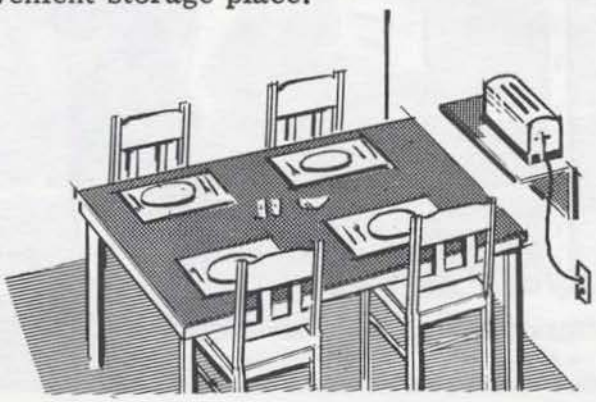
Appliance	Service Needed	How often	Dates done
Portable heater	Oil fan motor Clean fan blades and heating element	Once a year	11/60, 10/61

Store Appliances For Easy Use

Large appliances are not usually "stored" because they are kept right where they are used at all times.

With small appliances, however, we often do not have the room to keep them out at the point of use. Or their use may be seasonal, and they would be in the way at other times of the year.

We should store these appliances for convenience. The place of storage should never be a barrier to their use. You may find that putting up a simple shelf will make a convenient storage place.



Of course, we should keep them where they won't be damaged, and we should protect them from dust and excessive amounts of sunlight.

Plastic or fabric covers can be brought for toasters, mixers, air conditioners, washers, and dryers. But if you sew, you might like to make covers to fit more of the appliances in your home. You can use plastic or a tightly-woven washable fabric. First, cut your own paper pattern, allowing for seams and a loose fit for ease in putting the cover over the appliance. Seams and edges can be turned in or bound with bias tape.

What Did You Learn?

(Underline the answers.)

1. The best place to keep the instruction booklet for an appliance is (somewhere in the desk) (in a complete appliance file).

2. Appliance records should include (the warranty) (date of purchase) (model and serial numbers) (all of these).

3. The best information you can get on the appliances in your home is from (the manufacturer's instruction book) (hearsay).

4. Dirt is a problem to appliances because it (causes wear and poor operation) (looks bad).

5. You can immerse (all portable cooking appliances) (only those that state that they are immersible).

6. Many appliance troubles come from (cord failure) (termites).

7. Appliances should be oiled (sparingly) (liberally).

8. The best place to keep a service chart is (in your appliance file) (where it can be seen occasionally).

9. One of the best friends of a small appliance is (a plastic dust cover) (a marble pedestal).

Demonstrations You Can Give

1. Show how to clean and store (a) a toaster, and (b) a small appliance with a detachable cord.

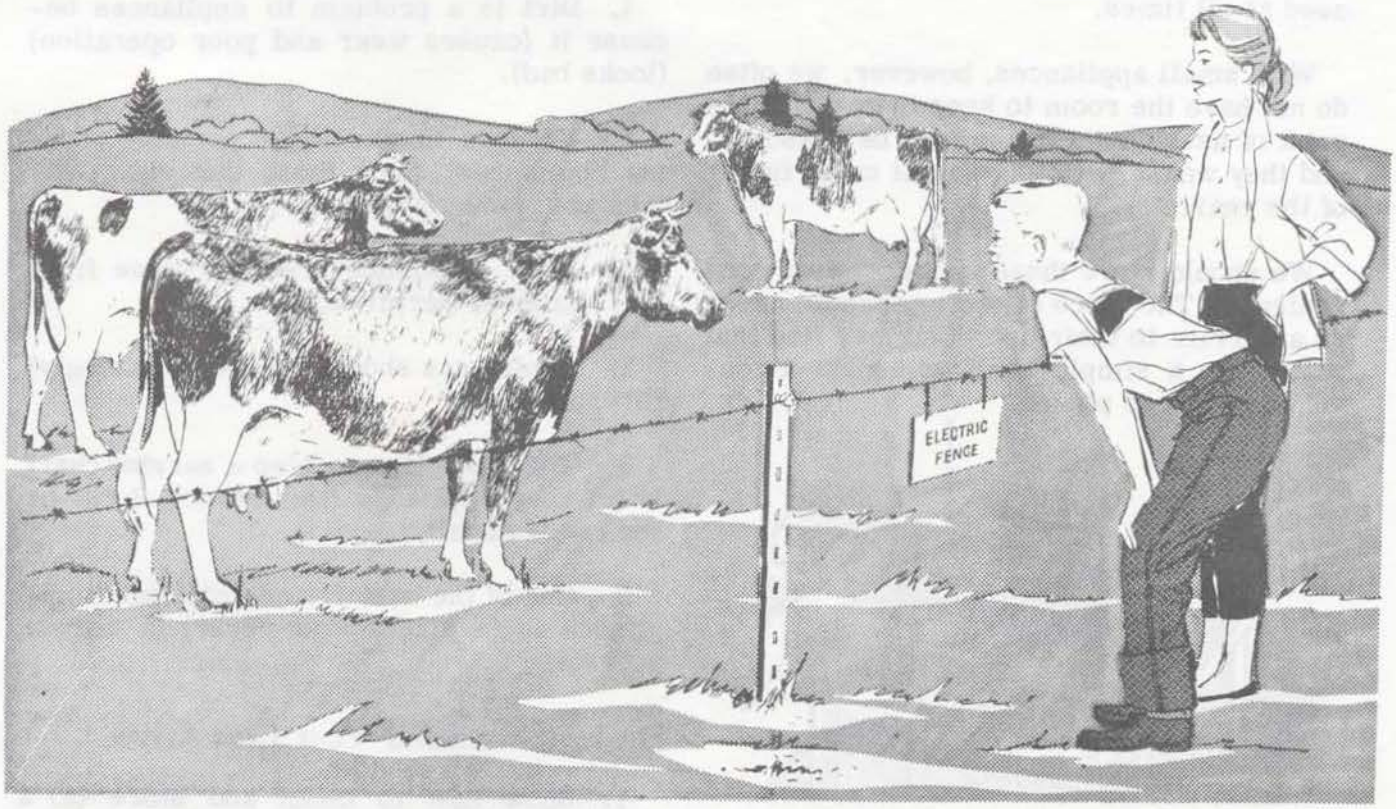
2. Show the right way to clean and oil a portable fan, or a portable fan-equipped electric heater.

For More Information

Ask your County Extension workers and power supplier representatives for bulletins and other information on appliance care.

Invite a local appliance dealer to tell your club what the lack of care can cost.

SHOCKING FACTS—ABOUT FENCES



Why don't you touch the cooking surface of the range in your kitchen--when you know that it's hot?

There's no physical barrier, and yet you will be almost as unlikely to come in contact with the hot surface as if there were a solid wall between you and it.

The reason is that you have been conditioned to the fact that a hot surface will cause you pain if you touch it. And so, unless by accident, you do not touch it.

Your knowledge that the surface is hot becomes as effective as a wall!

The knowledge that animals acquire about an electric fence is the reason why it will control them, and its economy and ease of construction are the reasons why it is so popular.

What to Do

1. Learn how electric fences work, how to select the controller, how to install it, how to build the fence, and how to train animals to respect it.

2. Learn the electric fencing safety precautions.

3. Demonstrate to others what you have learned about electric fences.

How Fences Work

When we build a non-electric fence--of boards, rails, woven wire, or of several strands of barbed wire--we are erecting an actual physical barrier to the animals. If they try to get through, they are stopped because they just can't penetrate it.

An electric fence, however, depends on the unpleasant effect of a safe electric shock to:

1. Condition animals so that they will respect it and stay away from it.

2. Repel them if they forgetfully or accidentally come in contact with it.

There Are 5 Main Parts

A controller, to supply a measured amount of electricity.

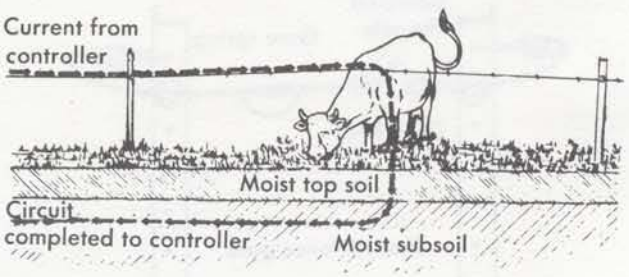
A wire, smooth or barbed, to carry the electricity around the area we want to fence. Barbed wire must be used sometimes to penetrate the animal's coat.

Posts, to support the wire.

Insulators, to prevent the electricity from short circuiting to the ground.

A ground rod, to provide contact between the permanently moist earth and the controller.

The other main part, which already exists, is the earth beneath the fence wire. This serves as the return path for the current if an animal or person touches the fence.



An electric fence, then, is an open electrical circuit--with the animal or person touching it acting as the link that closes the circuit.

Electric Fencing Is Economical

Because it uses only 1 or 2 strands of light wire, an electric fence is easily and quickly built, and can be removed in even less time. It can be permanent or temporary. It is readily portable for strip grazing.

The cost is low when compared with other types of fencing. The total material cost for a mile of single strand electric fence can be as low as $50 or $60, including the posts and the controller.

Operating costs are also low. Ten to 15 cents a month is an average cost, even with 24-hour-a-day operation.

Because of its low cost and its effectiveness, it is used for many kinds of animals, including poultry. It has also been used to fence out predators, such as foxes.

Select a Good Controller

The controller is the power source for the fence. There are those that can be operated by either a 6-volt or 12-volt battery, and others by 115-volt alternating current. The battery-operated types enable farmers to use electric fences in parts of their farms where 115-volt current is not available.

It should be tested and approved by one or more of the three agencies that do this. They are: the Underwriters' Laboratories, the Industrial Commission of Wisconsin, and the U. S. Bureau of Standards. A fence controller thus approved can be considered safe if properly used. Do not buy or use any other type!

The Shock Must Be Safe

Approved controllers provide on-and-off current with the impulses carefully limited and spaced. The current must be limited to a few thousandths of an ampere and its duration to a small fraction of a second. The off-period must be long enough to permit a person to release himself from the circuit, when accidental contact occurs.

The voltage in the controller is boosted as much as 30, 000 volts in some controllers. This high voltage is necessary to give the sudden penetration to the shock. The current, however, is necessarily limited to no more than 25/1000 of an ampere on approved controllers. This much current is known as 25 milli-amperes. The duration of the shock on approved controllers has been limited to 1/10 of a second "on" and 9/10 of a second "off."

One milli-ampere of current is about the smallest amount of electricity a human can feel. At about 15 milli-amperes, a man cannot release himself from the wire if the current is continuous. With a controller "on" 1/10 of a second and "off" 9/10 of a second, animals and humans can take up to the limited 25 milli-amperes and still get away from the wire. This gives a good, "stiff" shock which makes the fence effective, yet safe.

NEVER Use Home-Made Controller

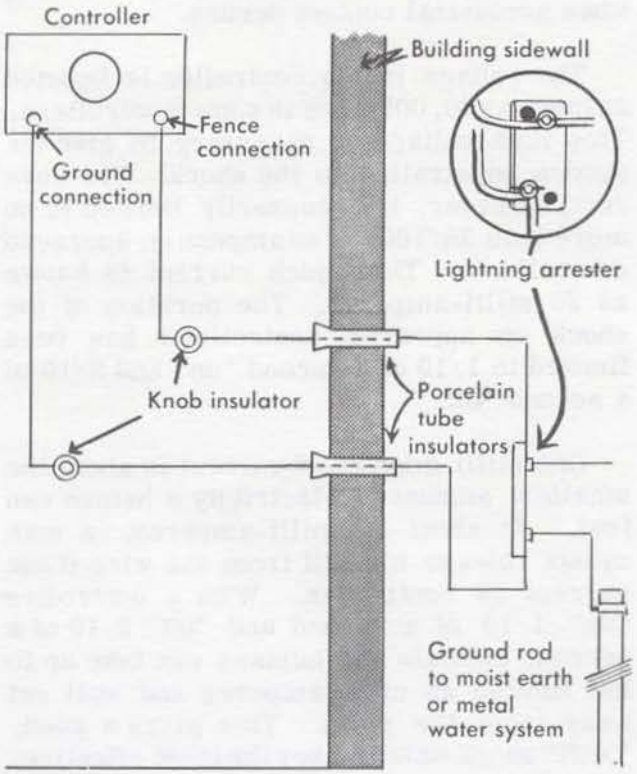
A continuous-current fence using light bulbs or other resistors is a very dangerous instrument. Many head of livestock and a number of humans, mostly children, are killed every year by such devices. Never, ever use a home-made electric fence controller. Some home-made controllers permit a continuous current of about 62 milliamperes. This is over 4 times the current that is capable of making an adult "freeze" to the wire. Children would be even more sensitive, especially barefooted on damp ground.

Another home-made type allows a current flow of 1000 milli-amperes! The only rule or precaution that will make a home-made controller safe is--DON'T USE IT!

Install the Controller Right

If your electric fence controller is weatherproof, it may be mounted outside. Otherwise, put it in a boxlike shelter or inside a building.

To protect it from lightning damage, you should install some type of lightning arrester. The diagram shows how one type of arrester is attached.

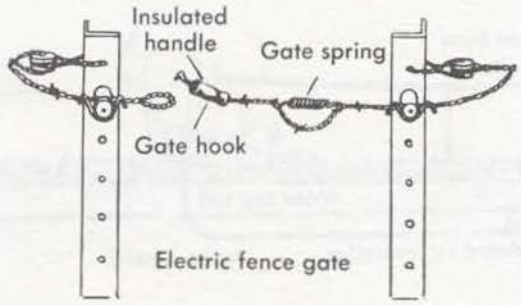


The point of grounding at the controller is important. Use a 3/4-inch galvanized iron pipe, or copper rod, and drive it at least 8 feet into the earth.

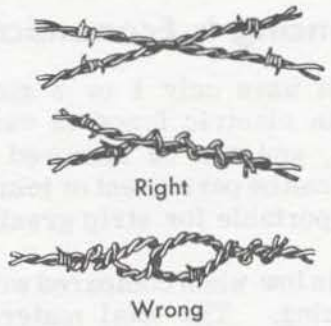
How to Build the Fence

On an ordinary farm, any amount of fence wire can be adequately served with one good controller. Never use more than one controller on one system. The wire can return to the same terminal on the controller as where it starts, but it need not. It can have any number of dead ends. Cross fence connections can be made at any point.

No special types of wire or posts are required for an electric fence. It is important, however, that the wire be completely insulated at each post. Use light weight stakes or posts, spaced sufficiently close to keep the wire from sagging too low to be effective.



Gates may be made as shown here. Splices should be made so that contact between the wires is complete and continuous.



Splice electric fence wire for proper electrical connection

Electric fences along a public highway or lane should be marked with appropriate signs about every 200 feet. If children live or play nearby, be sure to warn them about touching the fence.

Where there's ground that's normally wet --alongside irrigation ditches, farm ponds, or stock water tanks--keep a separation of 10 feet between the fence and the wet areas wherever possible.

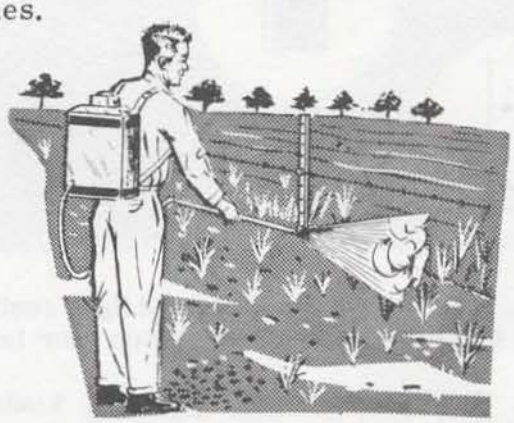
The correct height for the wire depends on the animals being fenced. In most cases, one wire is enough to fence cattle and horses, and it should be 1/2 to 2/3 the average height of the animals being confined.

Never depend on an electric fence alone to confine a bull.

Sheep, goats, hogs, and chickens can best be controlled with a 2-wire fence.

Maintain Your Fence

Keep the wires as tight as possible at all times.



Keep the wires free of weeds or other possible short-circuits by mowing or spraying. Many controllers have a light that indicates the existence of shorts.

Train Your Animals

Most animals need to be trained to respect an electric fence. String a wire tightly across one corner of your barnyard at the proper height. Dampen the topsoil under the fence and attach your controller. Place some attractive feed behind the wire. Make sure that all your animals have an opportunity to "try" the fence before you turn them out into a larger fenced field.

What Did You Learn? (True or False)

1. The electric fence controller can be operated for as little as 15 cents per month.

2. Any controller that is strong enough to control animals is unsafe for humans.

3. 115 volts is too high a voltage to be used on an electric fence.

4. A good ground is needed for the fence controller to provide a shock.

5. The electric fence must make a complete loop around the field back to the controller.

6. A continuous shock from a fence controller is safe as long as it doesn't exceed 15 milli-amperes.

7. A milli-ampere is equal to 1/1000 ampere.

8. The area next to a stock tank could be a good place for the driven ground rod.

9. A single wire is best to confine sheep, goats, and hogs.

10. Animals need to be trained every time before they are turned out to large fenced fields.

Demonstrations You Can Give

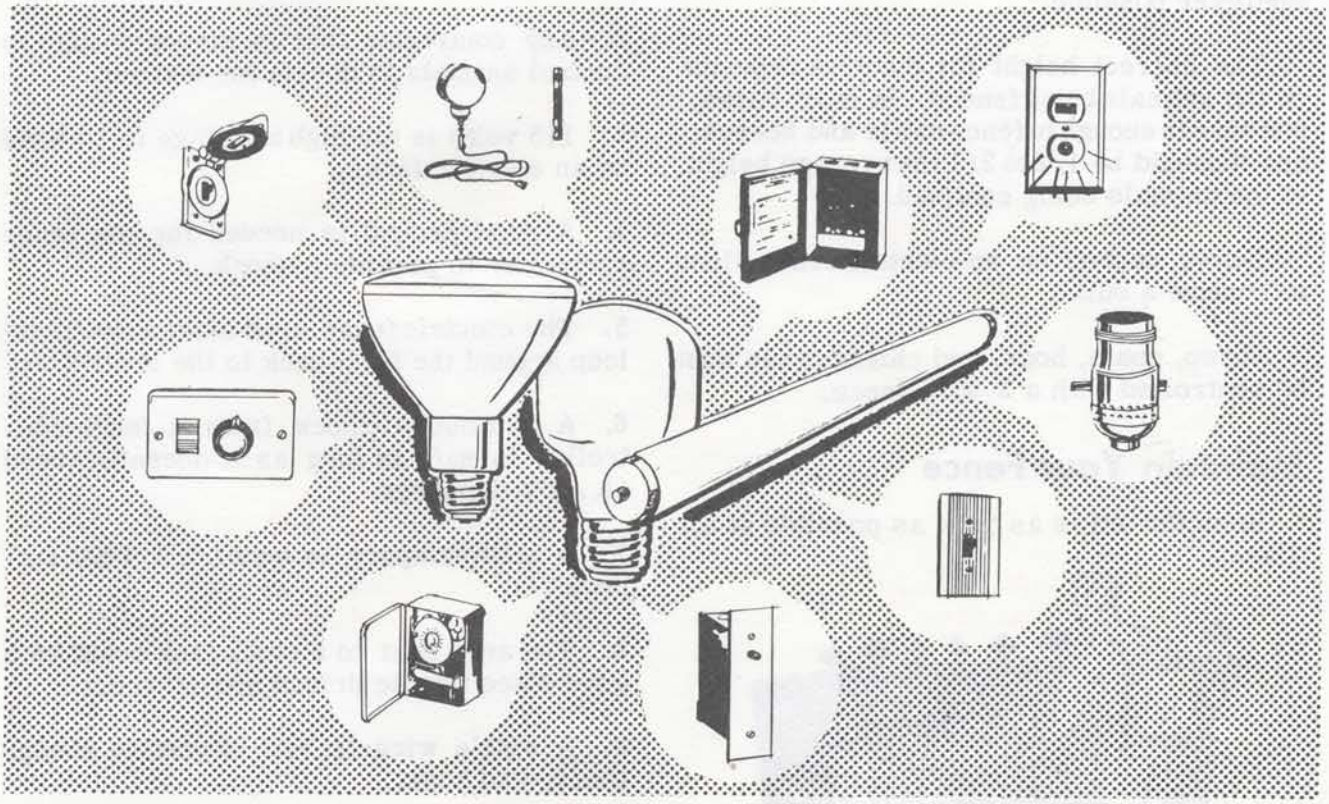
Show and tell others, using an actual controller and a model fence set-up small enough to be placed on a table:

How to identify an approved controller, gate construction, grounding, the need for proper fence maintenance, proper method of splicing, warning signs, corner construction, and the economy of electric fencing.

For More Information

Ask your Extension agent for a bulletin on fencing, and see the instructions that come with approved controllers.

CONVENIENT CONTROLS FOR LIGHTS



Flames, first in the form of campfires, and later in the form of torches, lanterns, lamps, and candles, were man's early attempts to provide himself with other than natural light.

Man's controls of these flame sources of light were simple, but they were neither convenient nor safe. Man had to be right at the light source, with a fire-starter of some kind, to "turn it on." He could let it burn out for lack of fuel, but mostly he also had to be right at the light to "turn if off."

Today, with electricity we have light that we can turn on or off as frequently as needed, whether near it or not. Or we can have it turned on and off for us by one of the many kinds of automatic devices, even if we are miles away.

What to Do

1. Learn about the various kinds of light controls, how they work, and where they are used.

2. List the various kinds of light controls that there are in your home or on your farm.

3. Inspect as many <u>different</u> kinds of light controls as you can. Use the descriptions that follow as a checklist. If possible, help your club leader bring some of these to a club meeting so that you might better understand how they work.

4. Show others how some of these controls work, and tell how they are used.

Why Do We Control Lights?

We could let our lights burn all the time, but there are some very good reasons why we don't. In the first place, it would be very wasteful, both of electricity and of the bulbs and fluorescent tubes.

In addition, there are many times when it is desirable <u>not</u> to have lights burning. This is true in our sleeping rooms, in theaters and churches, and when lights are used in connection with plants and animals.

How Should We Do It?

Our first consideration in deciding how to control a light should be safety. We should never use a control which is unsafe, or which forces us into an unsafe position in order to operate it.

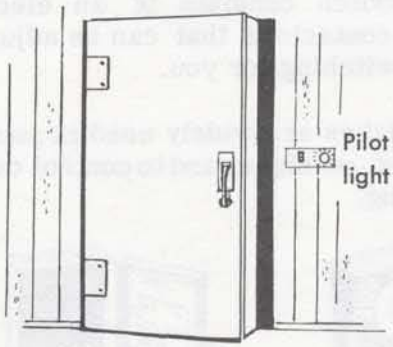
Next, we should try to get as much convenience as we can, without overspending for wiring and equipment. And convenience encourages economy in the use of electricity, making it easier for us to turn lights off when they're not needed.

Convenience also helps us to be safe, making it easier for us to turn on lights where they will help prevent accidents, as on a stairway.

Select the Right Control

There are many different kinds and variations of controls that can be used, and it's important that you select the right one for each light.

You should decide whether the light is to be controlled at the lampholder or away from it, whether manually or automatically, and many other questions.

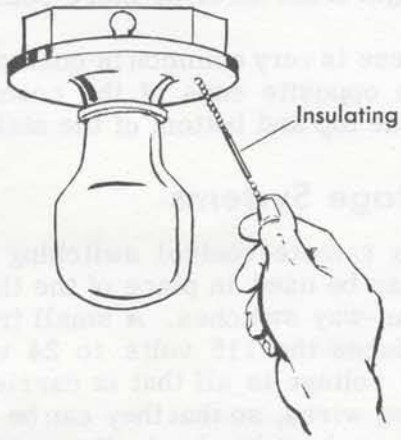


One important need on many manually-operated switches remote from the light is for some kind of a plainly visible indicator--a pilot light or other signal that tells whether the out-of-sight light is on or off.

Switches at the Light

Most of our portable lamps, and many of our wired-in ones have switches built right into them--usually at or near the sockets. These are the push-through, key (turn), pull chain, or push-button types.

In many situations this is the best control to have. You are there, you want light right there, and you simply reach for the switch and turn it on. A disadvantage is that you can only control one light at a time.



There is danger from shock where the person could stand on moist earth or concrete or touch metal plumbing. In these cases, a pull chain should be used, making sure that there is an insulating link in the chain.

Switches away from the Light

Many times we want to control a light from a distance--from only a few inches up to many feet away from it.

This can be done in a variety of ways, but the most common is to install a wall switch at the desired control point. In this case the light can either be wired in permanently, or it can be plugged into an outlet that is controlled by the switch.

Most wall switches are of the tumbler or snap type, for a quick make-and-break of the connection. This helps to eliminate "arcing" or flashing over of the current.

Mercury switches are sometimes used because they are quiet and long-lasting. They have two contacts sealed into a small glass tube containing a few drops of mercury. When the glass tube is tipped, the mercury flows to the end containing the contacts, and closes the circuit. Tip it back, and it opens.

Any wall switch can be secured with a built-in pilot light, or one can be wired into the circuit.

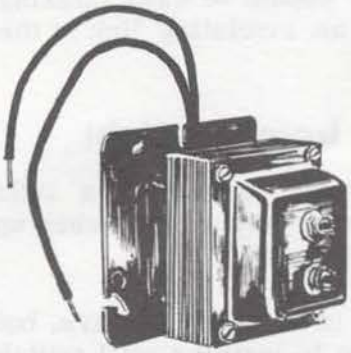
Three- and Four-Way Switches

If you wish to control a light from two places, it is necessary to have two three-way switches. When three-way and four-way switches are combined, you may control your light from three or more points.

Use of these is very common in controlling lights from opposite ends of the room, or from both the top and bottom of the stairs.

Low Voltage Systems

This is a remote-control switching system that may be used in place of the three-way and four-way switches. A small transformer reduces the 115 volts to 24 volts. This lower voltage is all that is carried on the switching wires, so that they can be very small, and need not be physically protected as much as 115-volt wiring. This means a great saving where switching wires must run between buildings.



24-volt transformer

Relay

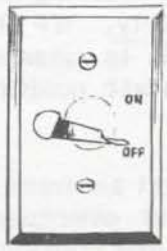
Push-button

As many small push-button switches may be installed in this 24-volt circuit as are needed, and the lights can be controlled from as many locations. A push on any of the buttons actuates a relay or electro-magnetic switch which in turn controls the light.

Special Switches

There are many special situations where switches must be installed, and there is equipment to meet most of these needs.

For outdoor use, you should use only switches in weatherproof housings. For use where unauthorized persons might operate them, there are switches that may be operated only with a key. There is even a switch with a delaying device built into it, and it doesn't turn out the lights until a few seconds after you have operated it!



Weatherproof switch

Door switch

Door Switches

When it comes to automatic controls for lights, door switches are the most common. They are found on refrigerators, ovens, and closets, as well as on automobile doors.

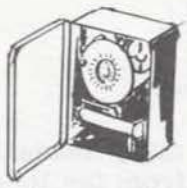
They are spring-loaded, so that the spring closes the circuit when the door is opened and pressure is released from the button which touches part of the door. They may be installed in existing closets by an electrician.

Time Switches

These will turn on lights at a certain time, and off at another predetermined time.

A time switch consists of an electric clock, with contactors that can be adjusted to do your switching for you.

Time switches are widely used in poultry house lighting, on signs, and to control decorative lighting.



Time switch

Photoelectric control

Photoelectric Controls

Because we usually want to turn on the lights only when it's dark, we can rely on a light-sensitive device to do this for us.

The photocell is an electronic device that actuates a switch, and the two parts are sold together as a control unit.

Many times it is not desirable to operate lights all night, or until daybreak the next morning. In these cases, a time switch is used with a photoelectric control. The time switch opens the circuit late at night, then closes it again after daybreak, so that the photocell can resume control.

What Did You Learn?

(Underline the right answers)

1. Early man had (safety, inconvenience) in the control of his lights.

2. The main reason for wanting to control light is (economy, appearance).

3. (Safety, Convenience) should be our first consideration in controlling lights.

4. It is possible to control a portable lamp (only at the socket, from a wall switch and at the socket).

5. To indicate whether a light is on in your attic, you should install a (pilot light, window in the ceiling).

6. On a yard pole, you should (use a weatherproof switch, locate indoor-type switch on the side away from the prevailing wind).

7. Low voltage systems can have (only five, ten or more) switching locations.

8. The better way to control stairway lights is (three-way switches, a network of strings).

9. Door switches usually (open, close) the circuit when the door is opened.

10. If you have a photoelectric control, you (must let the lights burn until daybreak, can use a time switch with it to turn them off at midnight).

Demonstrations You Can Give

Get as many different light controls as you can. Try to arrange it so that you can operate a light (it can be the same one) with each of them.

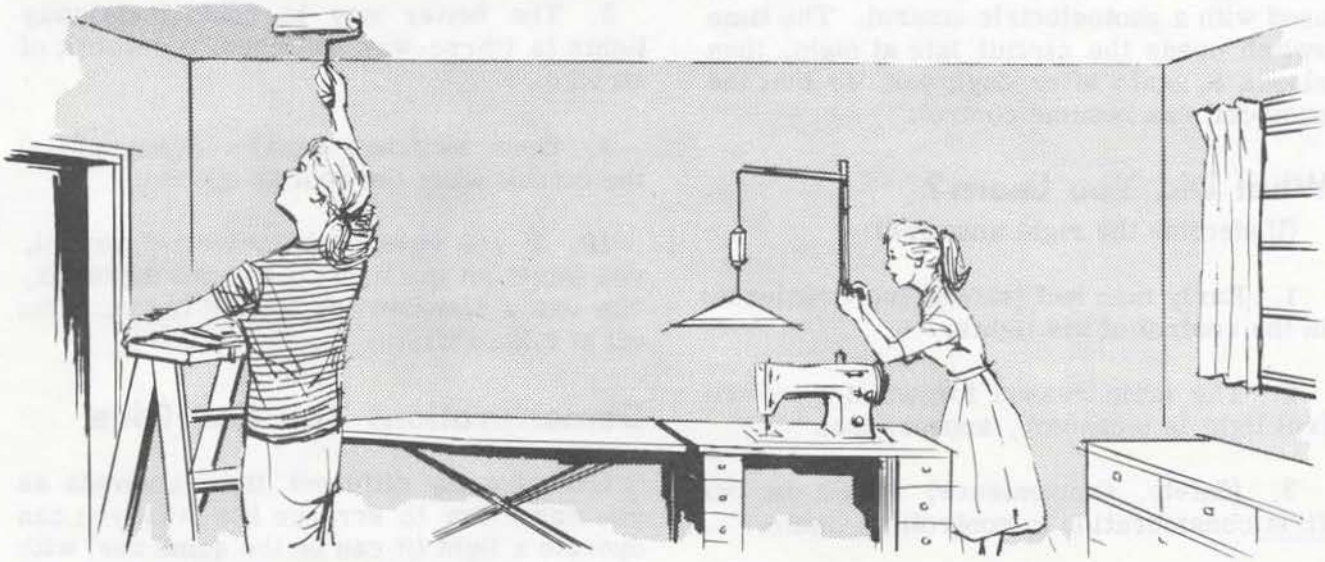
Show how lights can be controlled with each of them. Describe how each one works, and tell its advantages.

For More Information

Ask your power supplier representative, Extension agent, electric supply store, or electrician for literature on various kinds of light controls.

LIGHT	TYPE OF CONTROL
Kitchen Ceiling	Wall Switch
Post Lantern in yard	Photoelectric

SEEING YOUR SEWING



Do you like to sew? Are you becoming quite expert at using the sewing machine?

In your sewing projects, you've learned how to sew, and along with this you should learn how to have the right light to make sewing easier on your eyes.

With good light, you'll enjoy sewing more because you'll not be straining your eye muscles to see and will not get so tired. You'll do a better job of sewing, perhaps in less time, when you can see well.

What to Do

1. Make a chart listing all the places where you sew by hand, as well as your usual sewing machine location; the kinds of lamps there; wattages of the bulbs; distances of light from sewing; and improvements to be made. (Make your chart like the one below.)

2. Visit the lamp (lighting) department of a store to become familiar with the many styles of lamps and bulbs on the market, or study the pages on lighting in a catalog. Clip pictures from the homemaking pages of magazines showing well-lighted and well-arranged sewing centers.

3. Improve the lighting in the area where you do most of your machine sewing and hand work, making best use of what you have and are able to buy.

4. Check to see that you and others in your family who sew always sit in a place properly lighted for sewing.

5. Demonstrate to your club or another group something you've learned and done to have better light for sewing. Or:
Set up an exhibit comparing good and poor lighting for sewing.

Tools and Materials You'll Need

1. Pencil, paper, and tape measure.
2. Up-to-date magazines, catalogs, and other sources of information on home lighting.

Places where I sew (room and location in it)	Kind of lighting	Bulb wattage	Distance of light from sewing	Improvements to be made
machine:				
hand:				

Where Have You Been Sewing?

To make something better, it is necessary to be sure of what you have been doing. So make a chart using the headings given. For now, fill out all but the last column.

Describe Light Sources Correctly

One thing you are sure to learn from a visit to the lamp department in a store or from a catalog is that there are lots of sizes and shapes of light sources.

There are a few general terms which you can use in describing the kinds of light you now work by: ceiling fixtures--stationary or pull-down type; portable lamps--floor lamps, table lamps, wall or pin-up lamps, flexible arm, clamp-on, and pole lamps.

Know Your Bulbs And Tubes

Your sewing area most likely will have incandescent (glowing filament) light. You should understand the differences in incandescent bulbs and the ways to use them.

Size--Many times portable lamps and fixtures will give us better light for a specific task by just changing to a different bulb. The size of a bulb is measured in watts, and is marked on the end of each.

Base--Another thing you should note about the bulb is the base, the metal part that screws into the socket. Some of the three-light bulbs have an extra large or "mogul" base, for use in some floor and table lamps.

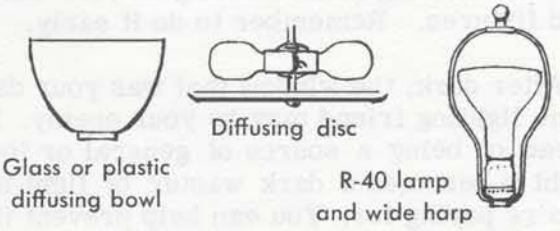
Finish--Most popular size bulbs have a delicate etching inside the glass to diffuse (to spread out) the light. They are known as inside frosted bulbs. A newer type has a milky-white coating on the inside that provides greater diffusion with no "hot" spot near the center, and softer light and shadows. Tinted bulbs are not recommended for sewing.

Fluorescent tubes are mostly used in ceiling fixtures, wall brackets, and in desk lamps. An important thing to remember is that fluorescent tubes give approximately three or four times as much light as incandescent bulbs of the same wattage.

Also remember that each fixture or lamp is designed for a specific size fluorescent tube. Larger or smaller sizes cannot be substituted. Fluorescent tubes of different wattages are of different length. But when you buy replacement tubes, you do have a choice of color. Deluxe warm and deluxe cool are most popular for the home. Deluxe tubes give less light than "standard" white tubes, but it is more pleasing in living areas.

Diffusers Spread And Soften Light

The light coming from a bare incandescent bulb is very annoying to look at or work by. Shades were first used on lamps to cut glare and to direct the light. In addition, a lamp should provide a wide spread of diffused, soft light.



Some lamps have a bowl-shaped diffuser of glass or plastic. These can be bought separately to add to any lamp.

Another simple way to diffuse the light is to attach a diffusing disc of plastic or frosted glass below the bulb or bulbs about one inch above the bottom of the shade.

Another means of diffusing the light is to use the white indirect bulb (R-40) in the 150-watt or 50-100-150 watt size for good upward and downward diffused light. If the harp in your present lamp is not at least 6" wide, you must replace it with a wide harp to let you use this bulb. Caution: it may be difficult to find a wide harp and this bulb. Check your stores and catalogs.

First, Good General Lighting

Sharp contrasts in lighting are tiring to eye muscles. Thus, good general lighting throughout a room is important whether you are sewing by machine or by hand. General room lighting may come from ceiling fixtures, portable lamps with open top shades, wall brackets, or lighted valances and cornices. Combinations of these lighting types

are suggested to provide the soft, background general lighting needed to make higher levels of local sewing light comfortable.

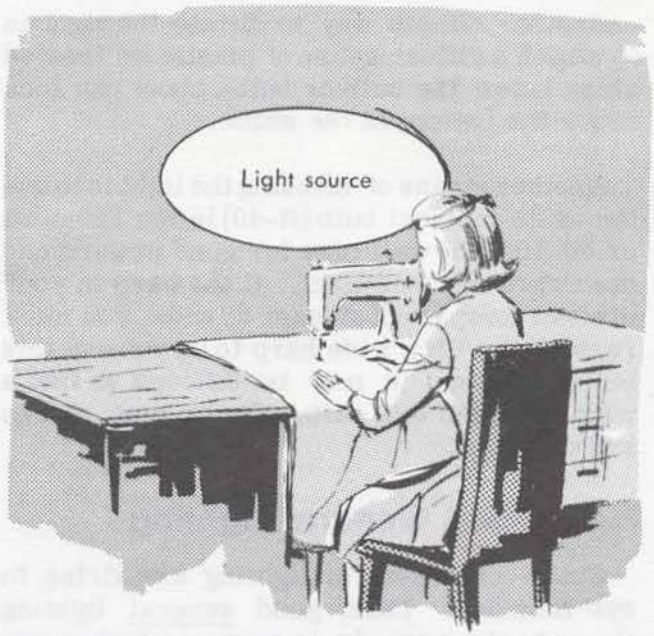
Don't Waste Your General Light

All color absorbs some light, but lighter colors absorb the least amount. Thus, to get the most from your general lighting, white ceilings are best. The walls may be of a light color (tint), but large areas of dark paint or wallpaper are not recommended.

Make good use of the light that comes from the outside, too. It may provide enough general light for the room in which you sew. One danger is that in the late afternoon or evening darkness comes on very gradually. It is easy to wait too long before turning on your lamps and fixtures. Remember to do it early.

After dark, the window that was your daytime lighting friend may be your enemy. Instead of being a source of general or local light it becomes a dark waster of light that you're paying for. You can help prevent this by closing light-colored curtains, drapes, or blinds over the window.

Extra Light At The Sewing Machine



Ideal position for light source:
Bottom edge of shade 14" above work surface, center of shade 12" to the left of and 7" behind the needle.

Amount: About 150 watts of incandescent, or at least 30 watts of fluorescent lighting.

Getting good light means placing the right light source at the right distance and in the right direction from the place where the light is needed. The small bulb attached to most sewing machines gives a little extra light, but by no means is sufficient.

Study the drawing at left to learn how much and where the light for machine sewing should be.

There are several ways to provide this:

Wall lamp--this may be a pin-up or permanently mounted lamp with an incandescent bulb; a pull-down lamp; or a flexible arm fluorescent lamp attached to the wall. Keep the lower edge of the shade just below eye level.

Floor lamp--either the swing-arm or regular floor lamp, placed behind the machine to allow freedom of arm movement for the one sewing. Keep the light at the left of the needle so as to avoid a shadow on your work.

In some cases, you may find you can have better light by just moving the sewing machine.

Extra Light For Hand Sewing

Even sewing by hand for a short time requires twice as much light as for casual reading, if you are to do it with comfort and a minimum of eye fatigue. And of course, you should have a chair which allows you to sit with correct posture.

Study the drawing which shows the amount of light and position of lamps for hand sewing by a right-handed person (a left-handed person would reverse the position).

For most hand sewing, the light can come from one of these:

Table lamp--many styles available. Shade should measure 14" across the top, 16" across the bottom, and be at least 13" in depth.

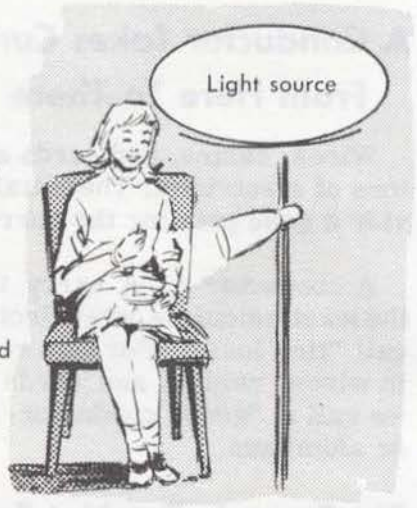
Floor lamp--swing arm or standard. This shade should also be at least 16" across the bottom to allow for sufficient spread of the downward light.

Ideal position for light source:
15" to left of center of sewing, and 6" back if bottom of shade is at eye level, or 12" back if shade is above eye level.
Amount: 300 watts of incandescent light

"Plus" lighting:

Position:
below eye level, and about 12-18" from work.

Amount:
60-75 watts (R-30 reflector flood recommended)



"Plus" lighting is needed for such sewing tasks as using dark thread on a dark material, for doing needlepoint or other fine detail sewing. This light can be had by clamping an adjustable holder to the floor lamp stem. Or if you have a pole lamp with adjustable bullet-shaped reflectors, direct the bottom one to give you this extra light at the proper position. Another way to secure "plus" lighting is to use a gooseneck type lamp, placing it on a table with the light directed on the sewing. Do not use this form of light alone.

What Improvements Can You Make?

A good home management rule is to make the best use of what you have. Apply this now to improving the lighting for your machine and hand sewing. Write down the improvements you would like to make, using the last column on the chart. You will probably find some things you can do now with the time and money you have available. But also list those things which you can aim to do in the future to have the best possible light for all who sew in your family. Keep in mind what might be done to the walls and ceilings to increase the amount of light they will reflect.

Make the improvements that you can at this time, after talking them over with your parents.

What Did You Learn? True or False

1. When you go to buy a bulb, all you need to know is the wattage of the bulb.

2. Fluorescent tubes give more light than incandescent bulbs of the same wattage.

3. The R-40 white indirect light bulb requires a wide harp.

4. Good general lighting in a room is important for all sewing.

5. Dark colored walls are best in the room where you sew.

6. Extra light at the sewing machine can come from wall or floor lamps.

7. A ceiling light will usually provide enough extra light for hand sewing.

Demonstrations You Can Give

Using a chair and floor lamp, show how they should be placed for hand sewing. Show how the lamp meets the requirements for seeing your sewing. Show how to use a clamp-on lampholder for "plus" lighting.

Using a portable sewing machine, or a carton placed on a table to represent it, show where a floor lamp or wall-mounted lamp should be placed for better sewing vision. Take measurements and explain why this placement lessens fatigue.

Or

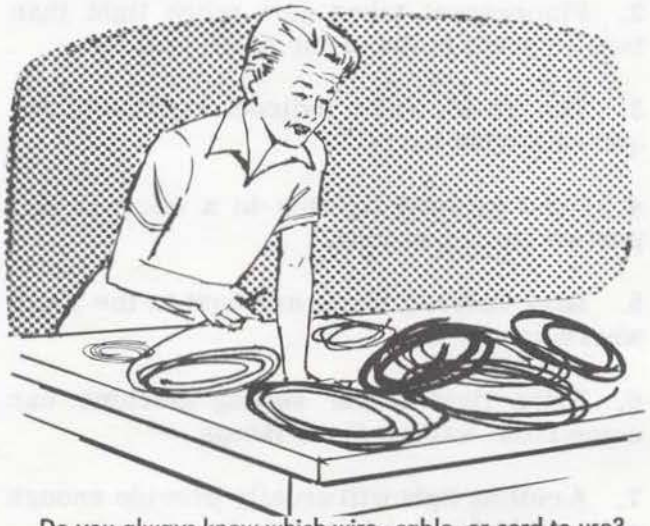
Set up an exhibit comparing good and poor lighting for either machine or hand sewing.

For More Information

Ask your power supplier's home service representative or your county home demonstration agent to demonstrate good lighting to your club, or help you prepare a demonstration.

Ask her to bring a light-meter, if possible, and to show how it can be used to check on the amount of light at sewing locations. She may be able to show you how to use a photographic exposure meter to do this.

WHICH KIND OF WIRE ?



Do you always know which wire, cable, or cord to use?

Wires for carrying electricity come in many different types and sizes.

Each type is right for a certain use, but it may be very wrong for many other uses. Because you will be using electricity all the rest of your life, you should know which kind of wire to use.

What to Do

1. Collect samples of various types of wires, cables, and cords.

2. Learn the characteristics, advantages, and limitations of each.

3. Learn where and how to use each type.

4. Learn how to determine the proper size of wire, cable, or cord.

5. Prepare a demonstration or an exhibit on what you have learned.

Tools and Materials You'll Need

Samples of as many different types of electric wires, cables, cords as you can get.
Labels or tags, pencil, or pen
Piece of hardboard (perforated or plain) or plywood. (Size to be determined by the number of samples you collect.)

A Conductor Takes Current From Here To There

Wires, cables, and cords are all conductors of electricity. Their main job is to provide a good path for the current.

A conductor must carry the current with the least amount of what electrical engineers call "line loss." For this reason, the metal in wires, cables, and cords is always what we call a "good" conductor--usually copper or aluminum.

Big Enough, But Not Too Big

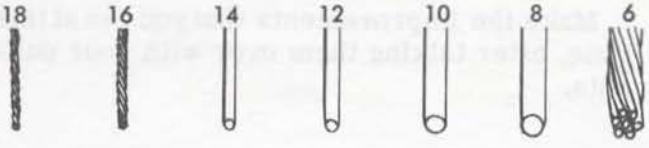
The larger the amount of current to be carried, the larger the conductor must be. The use of too small a conductor results in wasteful (and sometimes damaging) heating of the conductor, and poor operation of the lights or appliances being served. And the use of too large a conductor may mean that we have invested too much money in it, and that it is too bulky and stiff.

On the other hand, it is often wise to select conductors that are somewhat larger than needed, so as to allow for a growth in the electrical load to be served.

The length of a conductor affects size, in addition to the load to be placed on it. The greater the distance to the load, the larger the conductors should be. Voltage (115 vs. 230) and the amount of voltage drop permissible, also affect wire size.

Conductors come in many sizes. They are designated by American Wire Gauge (AWG) numbers such as 14, 12, 10, and so on. The size of wire increases as the number becomes smaller. See the section WHICH SIZE? for guidance in selecting the right size for various loads and distances.

Actual size of some commonly used conductors



Insulation Protects

All electrical conductors are insulated. Some, like the wires that your power supplier uses to carry very high voltages on the tops of poles, may be insulated only where they are attached to the poles. Of course, the air surrounding such wires serves as effective insulation.

The conductors in your house are insulated with rubber or plastic or other non-conductive materials that are wrapped around the individual wires. This material prevents electricity from leaving one conductor if it should touch another (or your body, or an appliance frame, or the ground).

Insulation may also have another function --that of protecting the conductor from damage. Or, this physical protection may be provided by other material wrapped around the outside.

There are many different types of insulation and protective wrapping and coatings. Most of the insulation on the wires, cables, and cords used in a home or on a farm is rated at 600 volts. This provides a good margin of safety because such wire usually carries only 115 or 230 volts.

Stranded or Solid?

In many sizes, conductors may be either stranded (made up of many small wires) or solid (made up of one piece).

The use to which a wire, cable, or cord is to be put determines whether it be made up of stranded or solid conductors. However, larger sizes (6 and heavier) are always stranded, so that they might be flexible enough to be coiled and handled while being installed. Their strands are rather coarse.

Stranded Solid

Stranded wires are, therefore, more flexible, and will flex many more times than a solid wire before breaking.

Cords, of the type used on appliances and in extension cords, may be designated either "Stationary" or "Constant Service." The latter type has many more (and smaller) strands, and as a result will be more flexible and less subject to breaking.

Is It Wire, Cable, Or Cord?

In the classification of conductors which follows, the terms wire, cable, and cord are used. You should know what they mean.

Wire--a single conductor. It may be solid or stranded, bare or covered with a wide variety of materials. Generally, "wire" is permanently installed, either overhead on poles or between buildings, in conduit (electrical tubing), or as a grounding conductor at an electrical service entrance.

Cable--two or more conductors, for installation in the permanent electrical system of a building. They are coarsely stranded in the larger sizes.

Cord--two or more stranded conductors, for use where portability or movement is required. Cords are used on appliances and lamps which are not built in, and on permanently installed equipment which may require electrical service to a part that moves.

Both cables and cords may or may not have an uninsulated ground wire in them. This is to connect to the ground the frame of the wiring device or appliance they serve.

Types Of Wires

Rubber covered wire--types R, RW, RH, and RHW. This type is used in conduit. It is insulated with rubber (R). If the rubber is moisture resistant, it is called type RW. If it is insulated with rubber that resists heat, it is called type RH. If resistant to both moisture and heat, it is type RHW. It has an outer braid covering available in a variety of colors such as black, white, red, and green.

Thermoplastic covered wire Armored ground wire

Weatherproof wire--type WP. This is used outdoors overhead between poles and buildings. It is insulated either with neoprene or an asphalt impregnated braid.

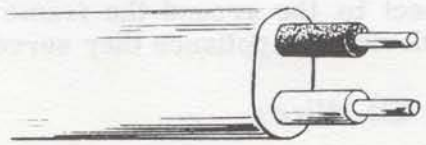
Trench wire--type USE. This can be buried directly in the earth. (U for Underground)

Thermoplastic covered wire--types THW and TW. For use in conduit. THW is heat-resistant, and moisture-proof. TW is moisture-resistant, and flame retardant. Plastic insulation is thinner, because of its higher insulating value. It does not support combustion. It comes in many colors.

Ground wire--This is either bare or armored. It is used to ground the service entrance at each building (or on a pole, if the meter is located there). Armored ground wire consists of a bare copper wire that has a metal strip wrapped spirally around it, to protect it from injury.

Types Of Cables

Non-metallic sheathed cable (plastic)--type NMW or UF. Plastic cable is resistant to moisture and corrosion and can be used in livestock buildings and other places where moisture is a problem. It can be "fished" into the hollow cores of block or tile walls. When marked UF it can be buried directly in the earth.



Non-metallic sheathed cable (plastic)

Non-metallic sheathed cable (neoprene)--type NMC. This cable has an outer jacket made of neoprene. It resists rot, acids, mold, and mechanical abuse. It is not affected by water and is quite resistant to fire. It can be used in livestock shelters and other buildings where tough, moisture-proof wiring is needed.

Non-metallic sheathed cable (fiber)--type NM. Commonly used in homes, this type of cable should be used only in dry places.

Service entrance cable--type SE. This cable is used to carry the electricity into a building. It is connected to the overhead wires at the place where they are attached. The cable is run down the outside and into the service entrance cabinet. Usually it has two insulated conductors and one bare one--with the latter stranded and wrapped around the other two. It also is often used to serve ranges, water heaters, and clothes dryers.

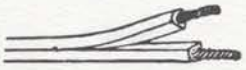
Service drop cable (triplex)

Service drop cable--Often called "triplex", this is used by power suppliers from their transformer to a consumer's house or meter pole. It can also be used between buildings and has the advantage of being neater in appearance than three weatherproof wires. Two of the conductors of this cable are insulated with either neoprene or polyethylene. The third conductor is bare and serves as the ground or neutral. The three are twisted together to form a cable, but no outside covering is used.

Armored cable--type ABC. Commonly called "BX", it has a metal armor spirally wrapped around the conductors for protection and to serve as a ground. The insulated conductors are wrapped with a special type of paper. It is for use in dry locations only.

Types Of Cords

Parallel cord--types SP and SPT. This flat cord is used on lamps, clocks, radios, and electric toys. These types replace green-and-yellow twist and other braided cords formerly used on such equipment. A groove down the center of the insulation makes it easy to separate the conductors for making connections. Type SP has rubber insulation, and type SPT has thermoplastic. It is available in sizes 16 and 18, in black, brown, white, or ivory.



SP and SPT cord

Type S cord

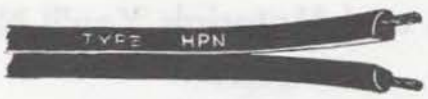
Junior hard service cord--types SJ, SJT, and SJO. This has many uses, as on washing machines, drills, and trouble lamps. The outer jacket may be rubber (SJ), thermoplastic (SJT) or an oil-resistant rubber compound (SJO). This cord is round, and available in sizes 16 or 18, with two to four rubber-insulated conductors.

Hard service cord--types S, ST, and SO. Similar to junior hard service, this has a thicker outer insulation for rough use. The S stands for rubber outer jacket: ST for thermoplastic: SO for oil-resistant rubber. It is available in sizes 10, 12, 14, 16, and 18, with two to four conductors.

Heater cords--type HPN and HSJ. Type HPN is the most popular heater cord. It has neoprene insulation which will withstand heat. It is waterproof, can be used on any appliance, and comes in sizes 16, and 18.

Type HSJ has asbestos insulation around each conductor, with a rubber outer jacket. It is waterproof.

Braided heater cords, while formerly very common, are being replaced by type HPN, and this is what to ask for when you need a new cord for a heating appliance.



HPN (neoprene) heater cord

Special cords--Range and dryer cords are used to connect these appliances to their special wall outlets, and are usually all made up with a special plug on one end and attaching lugs on the other.

Christmas tree lighting cords are made for either outdoor or indoor use. Only the outdoor type is waterproof.

Look For The U. L. Label

The Underwriters' Laboratories (U. L.) is a non-profit organization that examines and tests electrical items.

You should look for their label on the wire, cable, and cords that you buy.

Which Size?

For short distances, do not exceed these loads for these commonly used sizes of wire:

Wire Size	Maximum watts at 115 volts	230 volts
18	800	1600
16	1100	2200
14	1800	3600
12	2400	4800
10	3600	7200
8	4800	9600
6	6600	13200

For longer distances, refer to this 115-volt wire size chart based on a one per cent voltage drop. (If you know your load in watts, you can convert it to amperes by dividing by the voltage: $\frac{750 \text{ watts}}{115 \text{ volts}} = 6.5$ amps.)

Load, amps	Length of run, ft. 30	40	50	60	70	80	90	100
5	14	14	12	12	12	10	10	10
6	14	12	12	12	10	10	10	8
7	14	12	12	10	10	10	8	8
8	12	12	10	10	10	8	8	8
9	12	12	10	10	8	8	8	8
10	12	10	10	8	8	8	8	6
12	12	10	8	8	8	6	6	6
14	10	10	8	8	6	6	6	6
16	10	8	8	6	6	6	6	4
18	10	8	8	6	6	6	4	4
20	8	8	6	6	6	4	4	4

Note: Conductors in overhead spans must be at least No. 10 for spans up to 50 ft and No. 8 for longer spans, for mechanical strength.

Demonstrations You Can Give

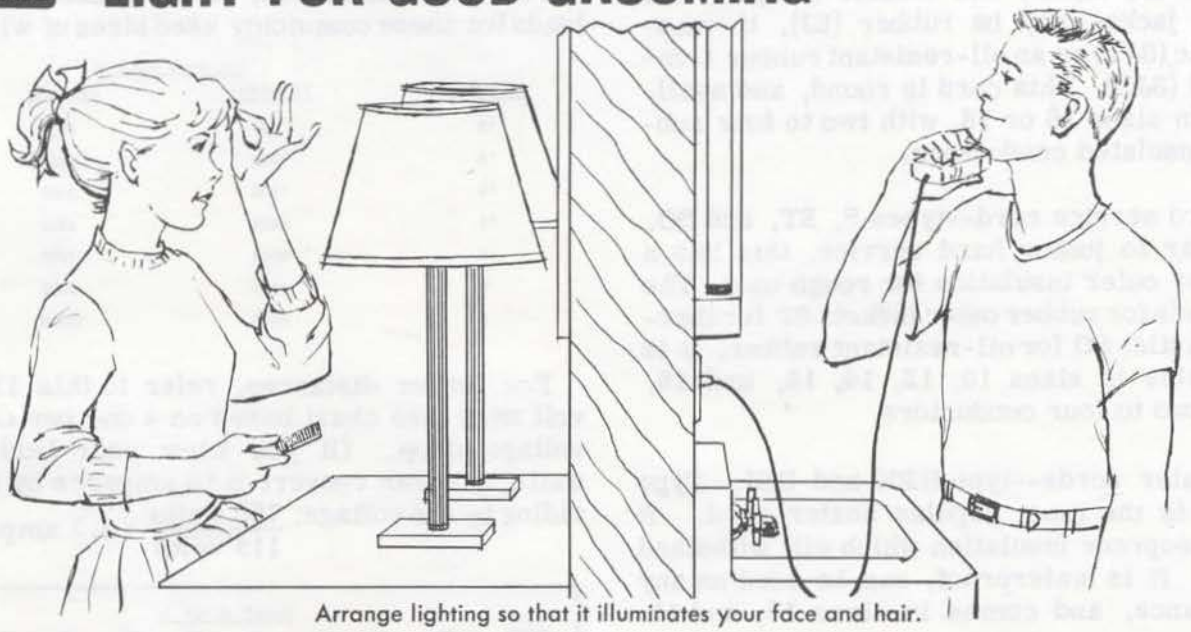
Select two or three different appliances that have worn or defective cords, and show how to replace the cord on each with the right type, explaining why you chose the type that you did for each.

For More Information

Ask at your library or power supplier office for books or booklets on wiring design. Look up the wire size chart for higher voltage, greater distance, and heavier loads than the one given here.

LESSON NO. 48
Credit Points 3

LIGHT FOR GOOD GROOMING



Arrange lighting so that it illuminates your face and hair.

"Mirror, mirror on the wall, who's the fairest one of all?" Obviously, everyone can't be the fairest, but everyone should try to look his or her very best.

Boys and girls who have the best appearance follow a regular schedule of good grooming. One thing which helps you to make grooming easier and makes you more sure of the best results is the correct light on you.

Most homes are similar in that grooming is done in the bathroom in front of a mirror or in the bedroom in front of either a dresser or dressing table. For these two common situations, lighting specialists have made studies and recommendations as to position and kinds of light for grooming.

What to Do

1. Learn the recommended positions, kinds, and amounts of lighting for the bathroom mirror and the bedroom grooming center.

2. Help plan a good-grooming center available to every member of your family.

3. Make as many changes now as are necessary and possible to make your lighting better. Make plans for future improvements as time and money are available.

4. Take before-and-after pictures of your lighting changes. (Tell or write your power supplier representative about your project. They may be interested in a picture for their publication.)

Tools and Materials You'll Need

Pencil Paper
Six-ft. rule or yardstick
Catalog pages covering portable lamps and bathroom fixtures

Light "The Task"

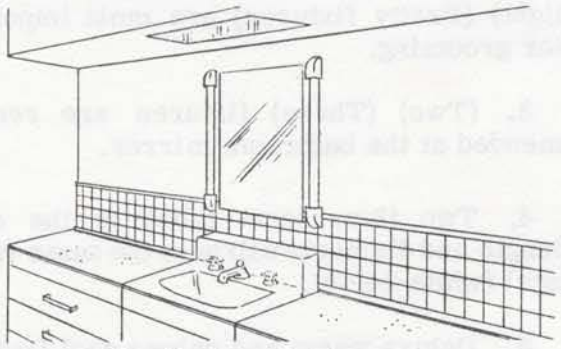
When electricity was new, it was generally the practice in wiring a house to put one fixture in the center of the room. This was an improvement over the oil lamp, but research and new lighting devices have made it possible for us to have much better light.

Today we have changed from "the plan of lighting a room" to "the plan of lighting for specific tasks." The task that we are concerned with in this project is grooming one's self--brushing and combing one's hair, and for older club members -- shaving, and applying make-up.

You should be able to see well enough to be sure that your hair is all in place, or that you have a clean shave, or that make-up is just right. To be able to do this, you need even light and a sufficient amount of it. The kind of fixtures and bulbs and the position of these make the difference.

Use 3 Fixtures In The Bathroom

In the bathroom, an even light is best supplied by three fixtures: one at each side of the mirror, placed so that the light is at cheek height, and a ceiling fixture directly above the mirror, 12-18" away from the wall or over the front edge of the lavatory.



Good bathroom lighting.

Actually measure the distance from the floor to the center of the cheek of each member of your family who will be using the bathroom mirror for grooming. Find the average distance. The vertical center of the light fixture should be at this height. It will probably be about sixty inches from the floor.

If you have a conventional mirror and medicine cabinet, the side fixtures should be placed thirty inches apart. Where a 36-inch or wider mirror is used and side lights would be too far apart, one answer is to mount a long (almost as long as the mirror is wide) fixture above the mirror.

Be sure to plan for a grounded outlet for plugging in electric shavers and other equipment used at the mirror.

Use The Right Fixtures

Bathroom lighting fixtures may be ones which use either incandescent lamp bulbs or fluorescent tubes.

There are several styles of fixtures using the incandescent bulb for wall and ceiling use. The fixture should have an opal (frosted) or ceramic enameled glassware shade to give an even spread of light. A fixture that has two sockets is preferred, with a 40 watt bulb used in each socket. In case a single socket unit is used, 60 watts is the minimum size bulb that will give enough light.

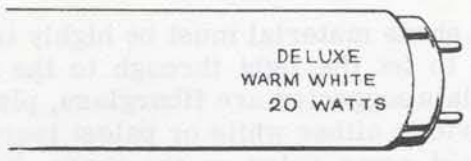
Careful selection of fluorescent fixtures should be made when they are bought, because the wattage varies with the length of the tube. In replacing the tube, the same length and thus the same wattage must always be used.

At each end of a fluorescent tube is a small filament which heats when electricity flows through it. The filament sends out electrons which strike mercury atoms in the tube and these produce ultraviolet rays or energy. But these are invisible. To produce usable light, the inside of the tube is coated with a phosphor powder which transforms the ultraviolet energy into visible light. By using chemically different phosphors, various shades of "white" light can be produced ranging from a very blue-white to a red or orange-white. Thus with fluorescent lighting, you can select the type of "white" light for the room. There are several "whites" available.

The deluxe warm white and the deluxe cool white are recommended where color appearance is important. However, the deluxe fluorescent tubes give about twenty-five percent less light than the standard tubes.

The recommendation for using the deluxe tube is that the wattage be at least 20. Fixtures for this size should be selected, unless you plan to use one of the standard colors, in which case 15-watt tubes are the minimum.

The name of the color as well as the wattage is printed on the glass at one end of the tube. All white fluorescent tubes look alike unlighted, so read the printed label carefully.



Look for the color and wattage.

Use Lamps In The Bedroom

Most boys will have a chest of drawers at which they stand to comb and brush their hair. Perhaps girls will prefer dressing tables where they can sit down to do their grooming. In either case the lighting rule is the same: use two lamps with translucent shades at cheek level. The reason is that the light must come through to the face evenly so that there will be no shadows.

The lamps may be suspended from the ceiling, may rest on the dresser or table, or may be the pin-up type. Have someone measure the distance from the floor to your cheek as you sit or stand at your grooming center. This measurement tells you where the center of the lamp shade should be.

These lamps should be at cheek height.

Place the lamps 18 inches to the right and to the left of the center of the mirror. They should also be six inches away from the wall to give a good spread of light. In each lamp, use a 30-70-100 watt, three-lite frosted bulb or a standard 100 watt bulb.

If yours is a double dresser or dressing table with a wide mirror, you may wish to use larger-scale lamps with 50-100-150 watt three-lite bulbs, placed about 48" apart.

Make sure that your grooming center has a wall outlet, where your lamps, hair dryer, and other electrical equipment may be plugged in. Long extension cords are to be avoided. Ask your parents about having an outlet installed if you do not have one.

Use Translucent Shades

The shade material must be highly translucent to let the light through to the face. Materials suggested are fiberglass, plastic, or fabric in either white or palest ivory. If you want some color on the shade, keep it at the top and bottom for trim.

Use a shade that has a bottom diameter of at least nine inches and a depth of at least seven inches. The top of the bulb should come about two inches below the shade top. Either harps or clip-on shade holders are acceptable.

What Did You Learn?

(Underline the right answer.)

1. In lighting for grooming, one is more concerned about lighting the (room) (person).

2. (Even spread and sufficient amount of light) (Pretty fixtures) are most important for grooming.

3. (Two) (Three) fixtures are recommended at the bathroom mirror.

4. Two fluorescent tubes of the same length and diameter will have the same (wattage) (white color).

5. Deluxe warm and deluxe cool fluorescent tubes give (the same) (more) (less) amount of light as the other white colors.

6. (Decorative shades) (White shades with little or no trim) are recommended for use at the bedroom grooming center.

Demonstrations You Can Give

Using two panels, to represent the wall and dresser or dressing table, show a well lighted and a poorly lighted grooming center, explaining the differences.

Using several different lamps, shades, and bulbs, explain what makes a good lamp for grooming.

For More Information

Ask your home demonstration agent or power supplier representative to demonstrate the effects of using the different "whites" in fluorescent tubes.

Suggest to your club leader that a good grooming filmstrip or movie be shown to the club. "Look At Your Future", a filmstrip, is available from the National 4-H Supply Service.

THE ELECTRIC IRON
YOUR PERSONAL SERVANT

Most girls are going to do a lot of ironing as teenagers and later on as housewives too. Boys will also find there are many times when they will need some knowledge about ironing, especially how to press their trousers. If you learn now how to iron and press efficiently, it will save a lot of time for other things and make the ironing chore go much easier. The iron is your personal servant, but it's up to you to be sure it does its work correctly. You should also know how to select the iron that will do the job best for you, and will give you the longest service.

Selecting the Iron

For home use there is the automatic dry iron, the automatic steam iron and the combination steam-and-dry iron. For travel there is a smaller iron, but it is not so efficient for regular use. Some travel irons will operate on either AC or DC current.

The important points in selecting an iron are:

1. You should consider the ironing and pressing jobs you will do most often.
2. Remember that lightweight irons, from 2-1/2 to 4 pounds, are preferred. Heat, not weight, does the job in ironing.
3. The temperature control should be easy to read, to set, and should indicate the setting for different kinds of fabrics.
4. The sole plate should be smooth, well-polished, and should heat evenly.
5. Beveled edges and button ledges are convenient for ironing around buttons.
6. A narrow, pointed nose is helpful in ironing pleats, gathers, and corners.
7. The handle should fit your hand comfortably and stay cool.
8. The cord should be reinforced at the end nearest the iron.
9. Steam irons should be easy to fill and should hold at least one cup of water.

The control for changing from steam to dry and for cutting off steam should be easy and convenient to operate.

Tips On Ironing

1. Use a convenient outlet to plug in your iron. Never use a drop cord or lighting outlet - the wires are not large enough to carry the electrical load.

If you have to use an extension cord, be sure the wires are asbestos insulated and at least No. 16, and that the iron cord and the extension together are not over 10 feet long. If the wires are too small or the cord too long, you will waste electricity and your iron will not operate properly due to the electrical resistance in the wire.

2. Set the temperature control for the fabric you are going to iron or press. The thermostat will shut off the electricity when the iron reaches the proper temperature and will turn it on again as soon as the iron

starts to cool. The thermostat is the heart of the automatic iron. It maintains the temperature that you have selected, automatically.

Start ironing with fabrics requiring the lowest temperature, such as dynel, dacron, orlon and rayon. Finish with those needing the higher temperatures (such as cotton) because your iron will heat much faster than it will cool.

4. Heavy cottons, linens, and starched materials do best when sprinkled before being dry-ironed. The steam iron is popular for wool fabrics that require light ironing and for steaming such materials as corduroy and suede. In sewing, a steam iron can be used to press each seam as you go, which results in a professional-looking job.

5. When using a steam iron, follow the manufacturer's instructions. Some manufacturers recommend the use of distilled water. Minerals in the tap water can shorten the life of your iron. You may also use clean rain or snow water.

6. Steam irons should be drained, and all irons should be allowed to cool before storing.

7. Never put your iron in water. You can keep the sole plate clean by wiping it when cool with a damp, soapy cloth. To remove starch or stains let the iron cool and rub off with a damp cloth or use a moistened fine steel wool soap pad. Or you may heat the iron slightly and glide it back and forth over waxed paper.

8. Iron around buttons and zippers - not over them - to prevent scratching the sole plate.

9. Be careful not to drop the iron. Store it in a clean place where it cannot fall.

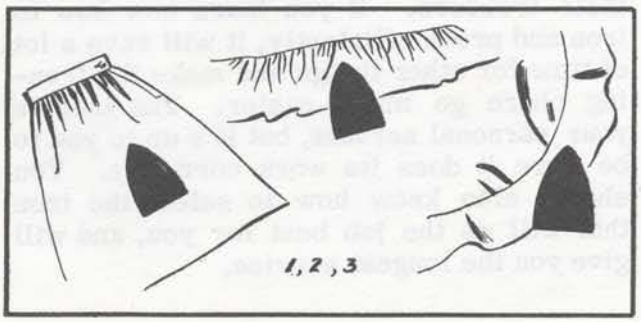
10. Keep the cord in good condition. Disconnect it from the outlet by pulling on the plug. Never pull on the cord and never wrap it around a hot iron.

11. Be sure to disconnect and turn the iron to "off" when leaving it for even a few minutes.

Suggested Ironing Routines

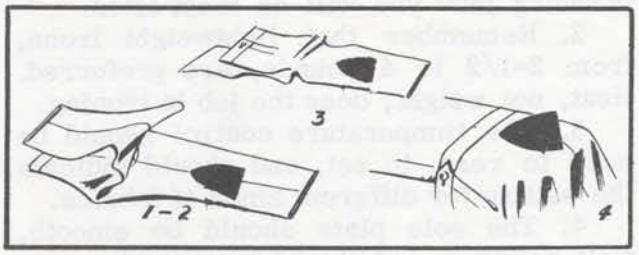
Gathers and Straight Gathered Ruffles

1. Manipulate garment, or iron so that point of iron works into fullness.
2. Use in-and-out strokes
3. Don't iron over top of gathers



Creased Slacks and Shorts

1. Lay one leg flat on board, underleg side up, other leg folded back over top.
2. Fold so creases appear in center front and center back of leg. Iron.
3. Turn over and iron outer leg up to point where crotch begins.
4. Repeat with other leg. Finish top over end of board. Note: Pajama pants, play slacks and shorts are often ironed with legs folded side to side. Finish top over end of board.



A Man's Shirt

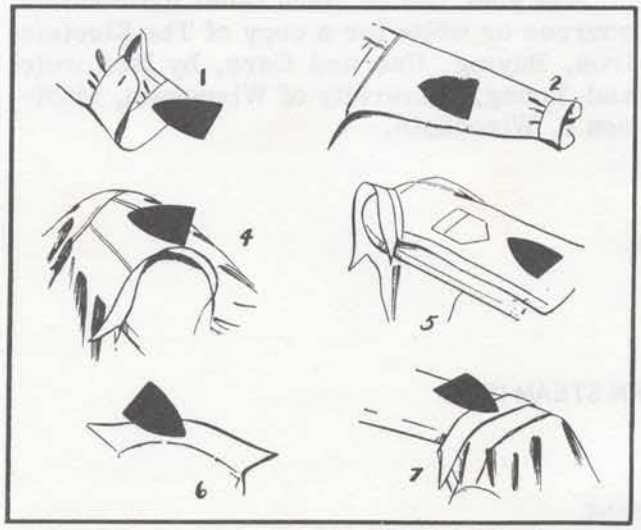
1. Iron cuffs first; inner surface first, outer surface second.
2. Iron body of sleeve, cuff opening side first.
3. Repeat on other sleeve.
4. Iron yoke. Slip one shoulder over end of board. Iron from center of back to

shoulder. Reverse and iron other side of yoke.

5. Iron body of shirt beginning with one front and continuing to other front (or iron both fronts first if fabric is drying out quickly).

6. Iron collar, under surface first, upper surface second, working iron inward from edges.

7. Fold collar down and press over end of board.



WHAT TO DO:

1. Visit a nearby appliance store. Compare irons, study prices, value, and compare your needs. Which type of iron would you buy?_____

2. Set up a good place to work or arrange an ironing center. List the important items needed in an ironing center:
_____

3. For one month press or iron all your own clothes and those of another member of your family. How many articles did you iron?_____ How many did you press?_____

4. For one week, iron all the flat work for your family. How many articles did you iron?_____

5. List four cases where a steam iron could be used to advantage:

1._____ 2._____
3._____ 4._____

6. List four cases where a dry iron should be used:

1._____ 2._____
3._____ 4._____

7. Explain how to protect a sole plate and keep it clean.

8. Study cord repair and learn the type, size and length of cord needed for your iron.

What Did You Learn?

Is it best to use tap water or distilled water in your iron?_____

What is distilled water?_____
_____

What is a good substitute?_____
_____

Why is some tap water undesirable?_____
_____

Should you start ironing with fabrics requiring high or low temperature?_____
_____ Why?_____
_____

If you are a slow ironer, should you set the iron to a higher heat? Yes_____ No____

Should you store the iron when it is hot_____ or cold_____.

What is the device in your iron that maintains proper temperature?_____
_____

Ironing efficiency is the result of the weight of the iron. Yes._____ No_____.

Ideas for Demonstrations and Exhibits

Demonstrations

Demonstrate the proper use of dry and steam irons on various materials.

Demonstrate what voltage drop will do to your iron.

Show and explain the importance of a proper outlet when using an iron.

Give tips in handling and resting an electric iron.

Show and explain how to care for an iron and cord.

Show how to polish and clean the sole plate.

Exhibits

Exhibit different types of irons identified as to purpose and use.

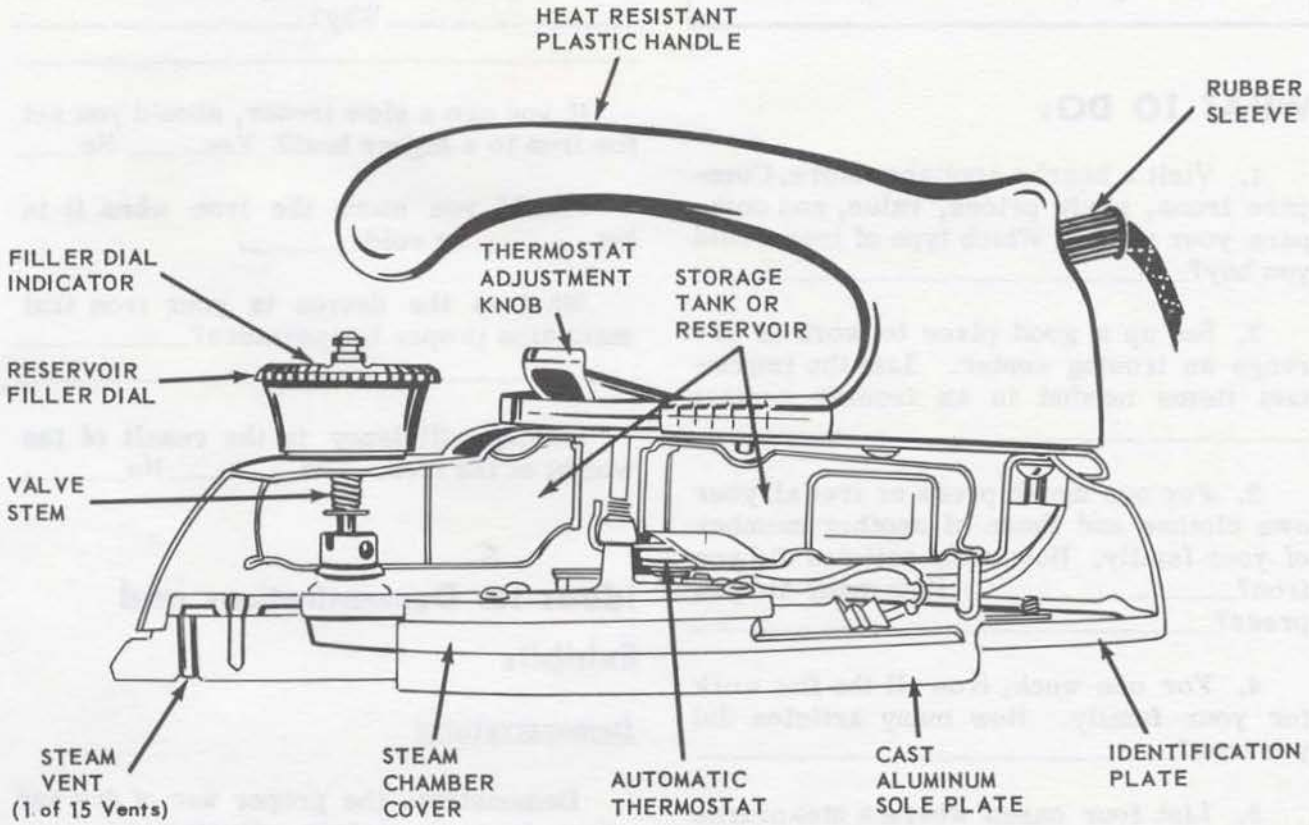
Exhibit garments ironed properly and improperly.

Exhibit an ironing center.

For Further Information:

Ask your leader about other information sources or write for a copy of The Electric Iron, Buying, Use and Care, by McCordic and Young, University of Wisconsin, Madison 6, Wisconsin.

A TYPICAL MODERN STEAM IRON



Basic principles of the steam iron are incorporated into each design, although irons vary from make to make.

HOT FACTS on a COLD SUBJECT

DO YOU KNOW all of the things that electric refrigeration does for us?

It keeps a supply of fresh food safe from spoiling right in our kitchens; it preserves food for future use; it helps make many of our most popular desserts; it cools milk and eggs to safe storage temperatures right at the farm; it conditions and dehumidifies the air in our homes.

What to Do

1. Experiment with melting ice and boiling water to see what happens to heat in each of these processes.

2. If possible, look at an open type refrigeration unit (one that is not hermetically sealed and preferably one without an enclosure around it). Perhaps your leader could arrange to have such a unit brought in, or you could go to see one at a food store or dairy plant. Try to name the main working parts. Ask someone who knows to help you identify them. If the unit is operating, feel the difference in temperature of the working parts. Explain what is happening.

How Refrigeration Works

Although all electric refrigeration works on the same principle, suppose we stick to the household refrigerator.

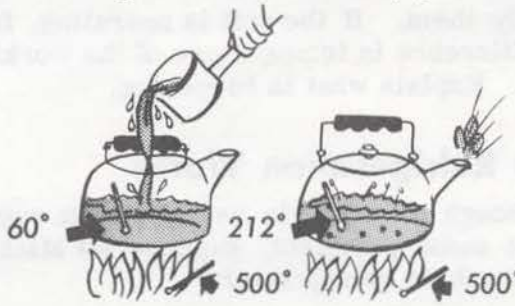
It is a simple mechanism that works much like a teakettle boiling on a range. That may seem far-fetched, but actually a refrigerator cools only because a liquid boils inside it.

There is no such thing as "cold". Your feet on a winter day are uncomfortable only because heat has been taken away from your shoes. "Cold" is simply the lack of heat. We can't make things cold directly but we can remove heat they contain. As a result, they will become cold. This is the main job of a refrigerator, a device for removing heat.

The next thing we must know is that heat only moves one way--from a warm object to a colder one. When you hold your hands out toward the fireplace, heat flows from the hot fire to your cold hands. When you make a snowball, heat always flows from your hands to the snow. In a refrigerator, the freezing coils are colder than the stored food, so heat is drawn out of the warm food by the coils.

Measuring Heat

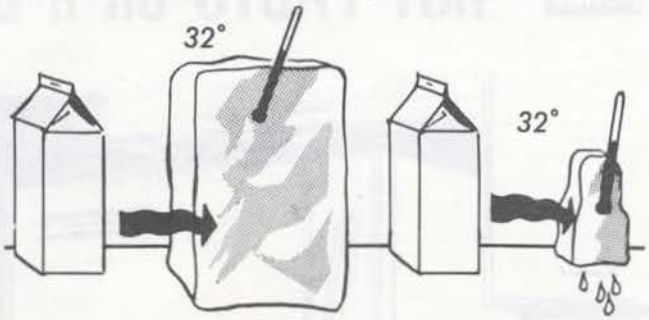
A thermometer will show you that a source of heat is just as hot when you first put a teakettle on as it is when the water finally boils. Then why doesn't the water boil right away? And why does it take longer to boil a quart of water than a cupful using the same heat setting? Thermometers, you see, in-



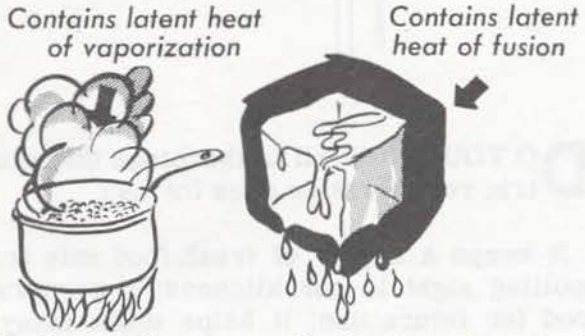
dicate only the intensity of heat. But, there is no instrument for measuring the quantity of heat. Instead, scientists have agreed that a unit of heat would be the amount necessary to make one pound of water one degree warmer. We call this quantity of heat a British Thermal Unit (Btu).

Heat "Disappears"

Sometimes heat seems to disappear. Consider an old-fashioned icebox. Why did your grandparents have to put ice in it? Wouldn't a pan of really cold water have done the same job? It was a good idea but it didn't work. Remember, each Btu of heat added to a pound of water makes it one degree warmer.



Use a thermometer and see what happens to a cake of ice in an ice chest or cooler. Put the thermometer on top of the ice and soon it will read 32°. Hours later check again and the thermometer will still read 32°. Even when most of the ice is melted, the thermometer continues to read 32°. All this time the ice has been soaking up heat, yet it never gets warmer regardless of how much heat is drawn from the food. This heat, which has been absorbed by the ice-turned-water, is called the "latent heat of fusion". Latent means hidden and fusion means melting--the hidden heat of melting.

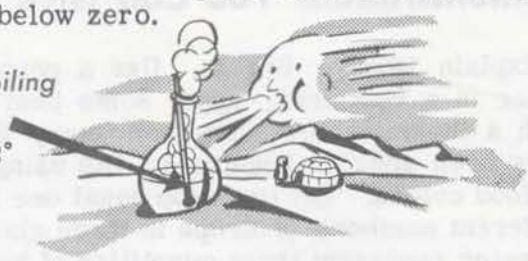


Let's continue our simple experiment. If we heat water in a teakettle, the thermometer tells us that the water gets hotter until it starts to boil. Then the mercury seems to stick at the 212° mark. Even though many won't believe it, you can't make water hotter than 212°, unless you confine it tightly as you do in a pressure cooker. As a liquid is changed into a gas, large amounts of heat are absorbed without any increase in temperature. This is called "latent heat of vaporization" or simply the hidden heat of evaporation.

It may seem as though we have drifted into a story about heat instead of refrigeration. But, in doing so, we have learned how heat moves, which is what refrigeration is.

Steaming Cold

Whenever we think of anything boiling, we think of it as being very hot. However, that's not always true. Some substances would have to be put into a blast furnace to make them bubble and give off vapor. Others, like pure ammonia, will boil violently while sitting on a cake of ice. Household ammonia is so highly diluted that it is practically all water, but in its pure form it would boil at 28° below zero.



Maybe that doesn't mean very much until we picture a flask of ammonia sitting on the North Pole boiling away just like a teakettle on a stove. If you put this same flask inside a refrigerator cabinet, it would boil, getting its heat from everything around it. In fact, at one time ammonia was the most popular refrigerant used. Today, better and safer refrigerants are manufactured.

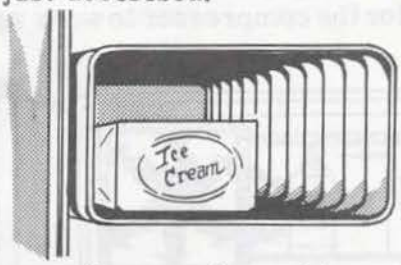
Now we can begin to see the similarity between a boiling teakettle and a refrigerator. Both draw in heat to boil although they do so at different temperature levels. Also, in comparing the icebox to the refrigerator, water from melting ice literally carried heat out of the icebox while vapors now do the same job in the refrigerator.

Water is cheap and can be thrown out, but ammonia or any other refrigerant is too expensive to let float away into the air. Some way must then be found to remove the heat from the vapor and change it back into a liquid so it can be used over again. If the kitchen were very cold, this could be done easily--but room temperatures are quite high. How can you cool the gases with only warm air available?

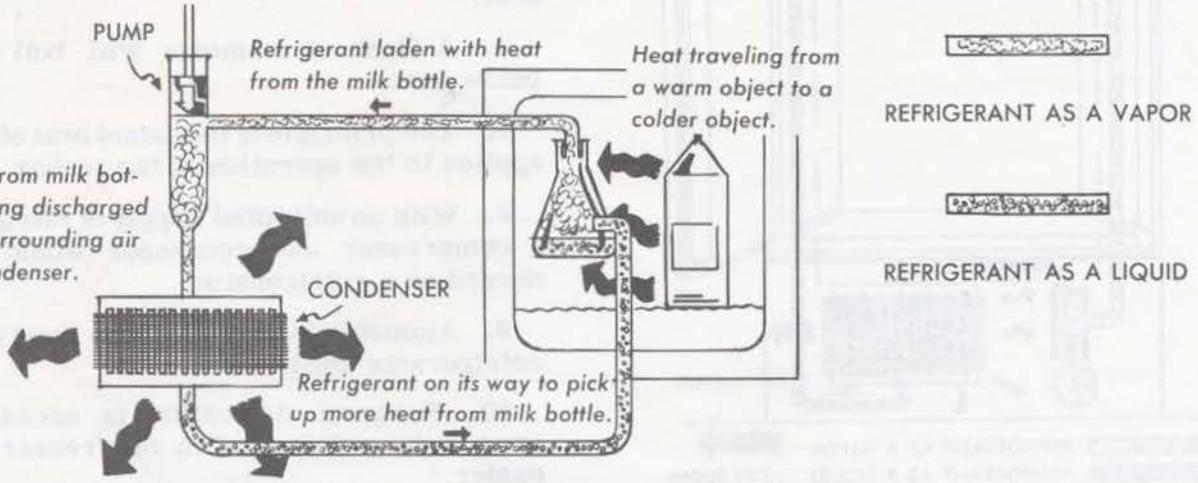
This is where pressure comes to the rescue. With pressure we can compress the vapor, thereby concentrating the heat it contains and raise the temperature without adding heat. While blowing up a bicycle tire, you may have noticed that the pump got hot. This is another example where compression raised the temperature above the surrounding air. With enough compression we can make the refrigerant vapors so hot that they can be condensed back to a liquid using air from the kitchen. We've now covered all the scientific rules that apply to refrigeration.

Meet Your Refrigerator

Now let's open the door of the refrigerator at home to see how closely it resembles the one we just described.



There are three main working parts of the refrigerator. These are the freezer (sometimes called evaporator), compressor, and condenser. The freezer is a double-walled tank or coil that provides a place for the refrigerant to boil, absorbing heat as it does.

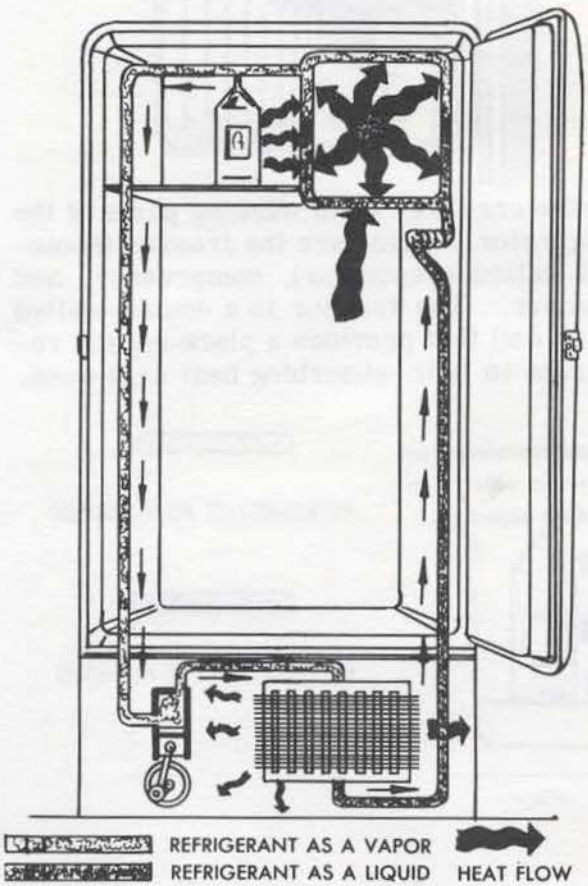


If you listen carefully with the door open and the motor off, you can even hear a faint gurgling noise inside the freezer. This is the sound of the refrigerant boiling and changing into a vapor.

Actually the vapor coming off the freezer through a pipe outside the cabinet is very cold. The problem is to cool this enough with room air to change it back to a liquid. It is the job of the compressor to exert pressure to make the vapor hot enough to lose its heat, and at the same time help it to condense.

When it leaves the compressor, it is still a vapor although it is quite hot and ready to give up the heat it has carried out of the cabinet. One of the easiest ways to cool it is to send it through a radiator called a condenser. In giving up its heat, the refrigerant vapor condenses back into a liquid which collects in a pool at the bottom of the condenser.

The refrigerant then moves back to the freezer. Its flow is restricted by means of a valve or capillary tube--thus controlling the rate of evaporation and maintaining a pressure for the compressor to work against.



These then are the main working parts in any typical refrigeration system. The freezer inside the cabinet is the place where the refrigerant boils and changes into a vapor, absorbing heat as it does so. The pump or compressor concentrates the refrigerant so it can get rid of its heat. The condenser outside the cabinet helps discharge the heat into the surrounding room air.

Demonstrations You Can Give

Explain what a Btu is. Use a pound of water in a container, apply some heat and with a thermometer show how many Btu's have been added. Illustrate a Btu using ink or food colors. Let one drop equal one Btu. Different numbers of drops in three glasses of water represent three quantities of heat.

To make something hotter without adding heat--use a tire pump to blow up a tire. Have someone feel the pump. Explain how this shows the principle of the operation of a refrigeration compressor.

What Did You Learn? - True or False

1. There is no such thing as cold because cold is regarded as the absence of heat.

2. The purpose of the refrigerant is to boil inside the condenser.

3. A cake of ice remains at 32° the entire time it is melting.

4. Fifty pounds of water at 32° will absorb as much heat as 50 pounds of ice.

5. Water can be heated to over 212°F. under normal pressures by increasing the heat.

6. A flask of ammonia will boil at 128° below zero.

7. The principle of the latent heat of fusion applies to the operation of the icebox.

8. With an unlimited supply of refrigerant, a compressor and condenser would not be needed on a refrigerator.

9. Ammonia is still one of the most popular refrigerants used.

10. Frequent defrosting is necessary to permit the refrigerant in the freezer to boil easier.

KEEP MOTORS HEALTHY

BE A MOTOR DOCTOR

Electric motors, like people, must be kept healthy if they are to work at their best. Motors, too, can get sick and, like people, need a check-up from time to time. It is important, therefore, that we know what can make a motor sick and, when signs of illness appear, remedy the trouble before it becomes serious or is too late.

You can and should learn what these common ailments are and examine your motors from time to time. In fact, it is well to frequently lend eye, ear, and nose to a motor when it is running, so you may see, hear or smell any trouble that may be in the making. If a motor doesn't look, sound or smell just right, or is otherwise ailing, doctor it without delay because the equipment in your home or on your farm that is run by motors cannot do its best if the motors do not run properly.

Motors Can Have Many Ailments

If motors could talk, probably some motor about your house, shop or barn would be shouting, "Help! I'm just shaking to pieces! Fasten me down," or "I'm burning out!" or "I'm getting sick! Do something quick."

HOW YOUR MOTOR BREATHES

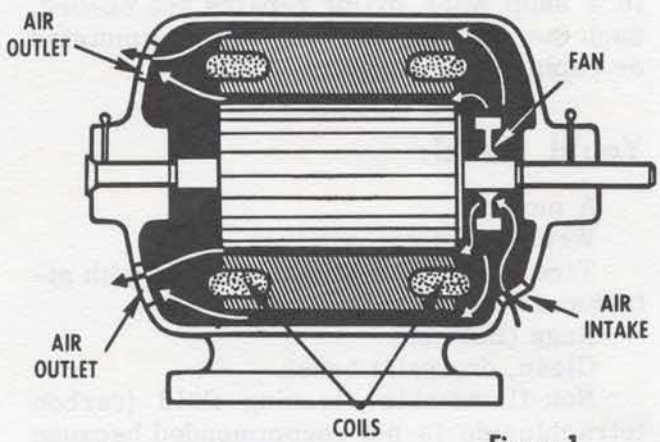


Figure 1

Dirt and dust, moisture, vibration, over-heating, greasiness, and sparking--any one or a combination of them -- can cause a motor to be sick.

Dirt, Dust and Lint:

When open motors run, they breathe in air. All air contains some dust, and some air in which motors work is very dusty. As dust, lint and dirt is drawn into a motor, some naturally collects on the frame and on all the working parts. The motor cannot get rid of this dirt by itself and in time the air vents may become clogged so much that the motor cannot "breathe" as it should. This will cause the motor to heat and in extreme cases could cause the motor to burn out.

Dampness

Air contains some moisture. Moisture, whether you can see it or not, is an enemy of motors. In damp places and during damp, humid weather, moisture may condense on the motor windings and other motor parts and soak into the insulation in the motor to cause serious trouble. Water may drip on the motor or be splashed on it from a wet floor.

Vibration

One might say that motors do their work by pulling, turning, or pushing their load. That means that they must have solid footing and not be sliding, slipping or vibrating around if they are to work their best. A motor may stand a slight vibration for a time, but too much vibration, if it continues, can damage a motor by literally shaking it to pieces. Then, too, when an electric motor vibrates, some of the electricity is wasted. This increases your electric bill.

Over-heating

Motors like people, cannot work well when too warm or over-heated. Dirt and

dust, vibration, over-loading or a combination of these, can cause a motor to overheat. If motor windings become too hot, the insulation can become damaged and if they stay too hot long enough, they can burn out. This can ruin a motor or at least it can cause an expensive repair job. Just the same as with vibration, over-heating is produced by wasted electric current that does only harm and increases the electric bill.

Oil and Grease

Oil and grease may leak out of bearings and when warmed by the motor can spread onto the windings and other insulated wires in the motor. Most insulation can be harmed by oil and grease. A good motor doctor will look for this ailment when he checks a motor.

Sparking

When the motor brushes become worn or the commutator on which they run become too rough, sparking may occur. Water or dust, also, may cause sparking. Sparks are wasted electricity and can cause heating at the brushes. If the motor sparks, it needs adjustment or repair, or both.

MOTOR INSPECTION

Motor Serial No. 2643

Located: Feed Room

Used: Feed Grinding

Date Insp.	Trouble Found	Date Corrected
2/10/60	Dirty frame	2/12/60
4/8/60	Sparking	4/9/60

Figure 2

What To Do

1. Inspect your motor or motors regularly.
2. Make an Inspection Tag for each motor.
3. Clean a motor.
4. Give a motor cleaning demonstration.

How to Do It

1. Inspect your motor regularly.

When you inspect your motors, look for:

- Dirt, dust, lint
- Moisture
- Sparking
- Vibration
- Stray oil and grease
- Over-heating
- Poor belt alignment
- Too tight or too loose belt

2. Make and keep an Inspection Tag for each motor.

Have a regular schedule for inspecting your motors. Make a tag for each motor (Figure 2). Then you'll have a case history on each motor, and can notice if the same difficulty keeps recurring. If it does, you can find out what causes the trouble, and have repairs made accordingly.

3. Clean a motor.

By being careful, you can clean a motor, put it together again, and have it running in apple-pie order. Once you've learned to do this, you can keep your motors in tip-top shape. Then you'll only need to take them to a shop when major repairs are needed, such as rewinding, repairing commutator or replacing worn parts.

You'll Need:

A motor
Wrench and screwdriver
Tire pump or vacuum cleaner with attachments for blowing
Rags (lintless)
Clean, dry paint brush
Non-flammable cleaning fluid (carbon tetrachloride is not recommended because

of its toxic effects, and its injurious effect on insulating varnish. A motor repair technician can recommend a good cleaning fluid).

Steps To Take:

1. Make sure that the motor is completely disconnected from the power line.

2. Remove the pulley from the motor shaft, if necessary.

3. Take the motor apart (Figure 3) by removing the rotor, shaft, and fan assembly. Be careful not to break any connections or wires. Before loosening the end bells, mark the position of the bells on the motor frame.

4. With a tire pump or vacuum cleaner attachment, blow loose dirt from the windings and from inside the end plates. Use a dry paint brush or rags to carefully wipe away any dirt that remains.

5. Wash metal parts with non-flammable fluid (Figure 4). Be sure to remove all dirt from air passages in the frame and in the rotor. Do not apply cleaning fluid to the coils of the motor unless absolutely necessary - then use a solvent-moistened cloth. Never immerse motor windings in the solvent.

6. Wipe motor parts dry.

7. Inspect the starting switch, the commutator and brushes, if any, to see whether they need repair.

8. Reassemble the motor. Be sure that all parts go back in their correct positions.

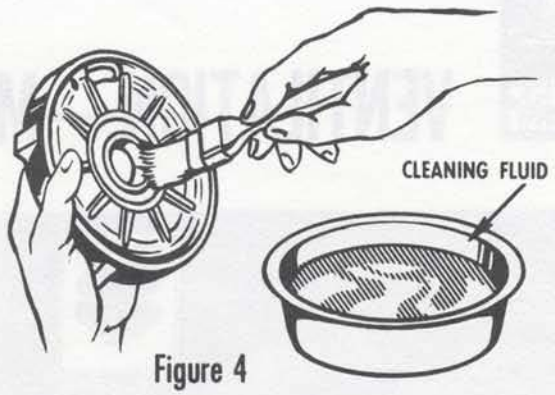


Figure 4

Tighten the end plate nuts one after the other, a little at a time, to pull the end plates up evenly. Make sure the shaft turns freely as you tighten the end plates.

9. If necessary, sparingly lubricate the motor bearings. The kind and amount of lubrication will be shown on the motor nameplate or in the manufacturer's instructions.

10. Re connect the motor to check its operation.

4. Give a motor cleaning demonstration.

- Show how you took your motor apart for cleaning.
- Identify the parts and tell or show how each part should be cleaned.

For Further Information

Ask someone from your power supplier, or a motor repair technician to give a talk on common motor troubles and how you can correct them.

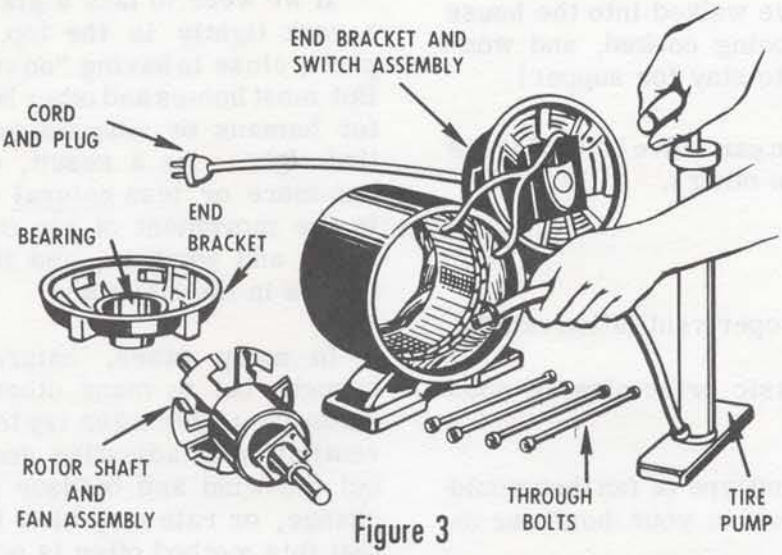
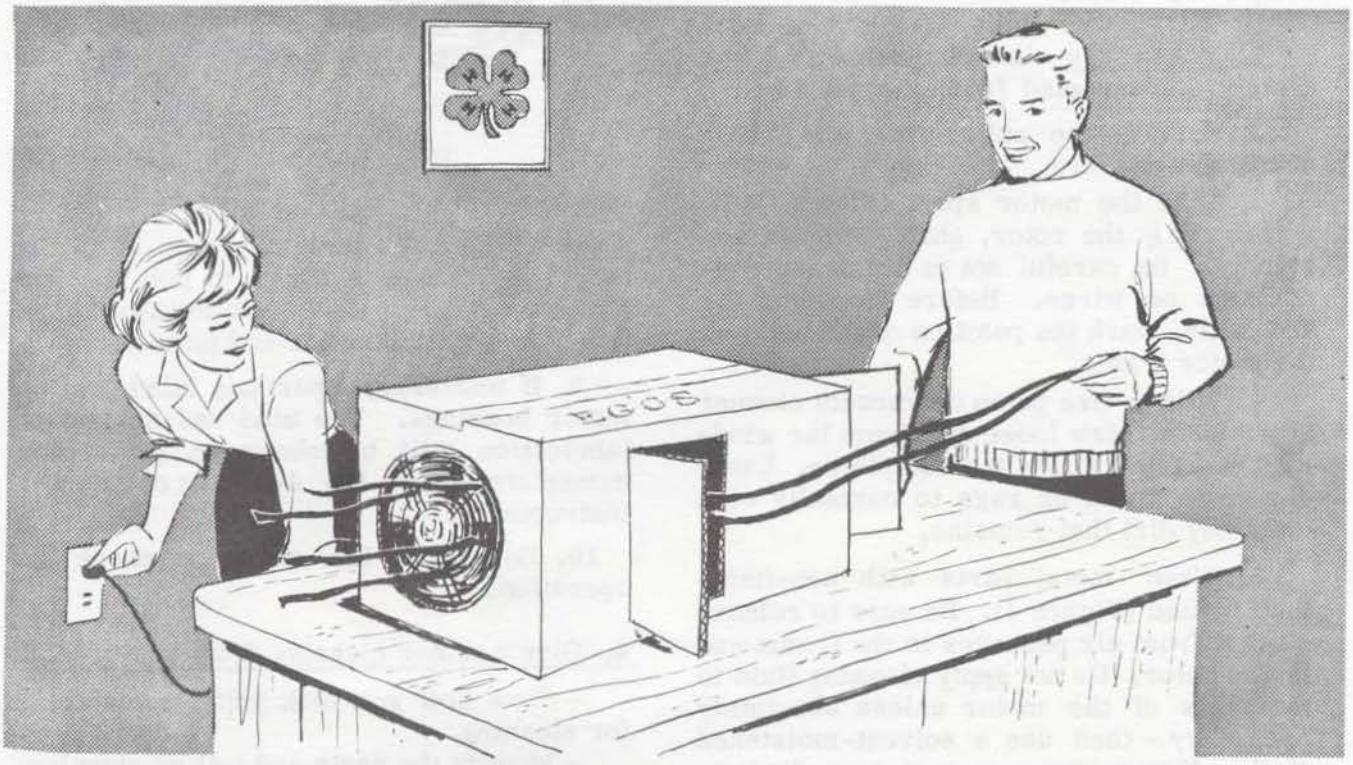


Figure 3

VENTILATION—Moving air with a purpose



Good ventilation is something you aren't likely to miss until you are without it.

Have you ever attended a meeting where the air was "stuffy" and where you had trouble keeping awake, or where you even got a headache?

Or maybe you have walked into the house when cabbage was being cooked, and wondered if you wanted to stay for supper!

Proper ventilation can solve both of these problems, as well as others.

What to Do

1. Learn what proper ventilation can do.

2. Learn the basic principles of good ventilation.

3. Select a size and type of fan that would be right for some job in your home or on your farm.

4. Determine the proper location and method of control for this fan.

5. Demonstrate the principles of ventilation to others using a portable fan.

Ventilate the Sure Way

If we were to take a glass bottle, and put a cork tightly in the top, we would come pretty close to having "no ventilation" inside. But most homes and other buildings designed for humans or animals are far from being that tight. As a result, every such place has more or less natural ventilation. This is the movement of air through or around doors and windows, and through other tiny cracks in the structure.

In many cases, natural ventilation is enough, but in many other situations it is inadequate. We often try to increase natural ventilation by adjusting doors and windows, but the wind and outdoor temperature may change, or rain may blow in. The result is that this method often is not dependable.

An electric fan, properly sized and installed, and equipped with a suitable control and anti-backdrafting device, is a very dependable and positive means of providing the ventilation we need.

Ventilate to Remove Heat

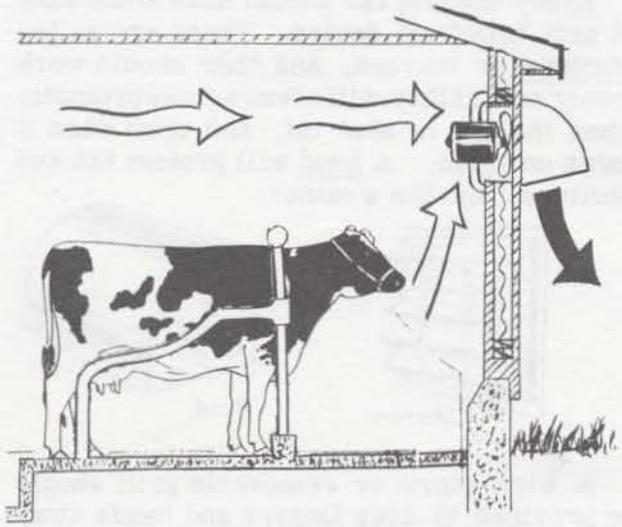
Ventilation is sometimes used to remove excessive amounts of heat in situations like these:

In a kitchen where much cooking is being done, we have an excess of heat, as well as odors and moisture.

In a meeting hall, the heat given off by a crowd of people, together with that produced by the heating system, makes the room too warm.

In bedrooms during warm weather, the buildup of heat during the day is often so great as to interfere with comfortable sleeping at night.

In dairy stables, the heat produced by the cows often raises the temperature above the 50-55 degrees that's been proven best for milk production.



Ventilate to Remove Odors

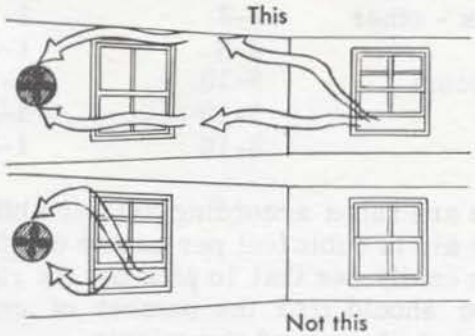
We talked about removing odors from the kitchen, but there are other areas from which odors should be removed, including: places where dry cleaning or painting are being done, bathrooms and powder rooms, and poultry houses.

Ventilate to Remove Moisture

If there's too much moisture vapor in a room, it condenses on windows, mirrors, woodwork, and walls to cause an unsightly appearance and eventual peeling of paint and rotting of wood. Ventilation is used to help remove such moisture in kitchens, basements, bathrooms, milking parlors and milkhouses, dairy stables, and poultry houses.

Intakes Are Important

The area to be ventilated must be located between where most of the air enters, and where it is exhausted. This means that you can't open a window right next to a fan - you'll get an air "short circuit"-and the rest of the room will not be ventilated properly.



If drafts are to be avoided, the air intakes must be small in size and more or less uniformly distributed. In warm weather, we usually aren't much concerned about drafts, and we can often open windows on the opposite side of our fan-ventilated room without any ill effects.

In cold weather, however, there's the danger of making persons or animals ill as a result of large quantities of cold air striking them.

Sometimes the natural small cracks and openings in a building are enough to admit the air that a fan exhausts. However, if a fan speeds up when you open a door, that's a sign that you should open one or more windows very slightly to let more air in.

Get the Right Size Fan

The size of fan needed depends on the size of the room and the job to be done, or on its animal population.

General ventilation of rooms and buildings is that amount needed to remove excess heat, moisture, and odors.

Comfort cooling, on the other hand, is ventilating to create a cooling breeze, and calls for more air movement.

Here's a table that tells how frequently you should change the air--for both types of ventilation in various kinds of rooms:

Frequency of Air Change--In Minutes

Kind of Room	General Ventilation	Comfort Cooling
Assembly Halls	3-10	1-2
Attics	3-6	1-3
Churches	2-4	1
Kitchens - home	2	1
Kitchens - other	2-3	1
Offices	2-6	1-2
Rest Rooms	5-10	1-2
Schools	5-10	1-2
Stores	5-10	1-2

Fans are rated according to their ability to move air in cubic feet per minute or cfm. You can easily see that to pick out the right fan, you should find the number of cubic feet of air to be moved per minute.

To get this, you must first find the cubic contents of the room. Multiply width by length by height (in feet).

Then, look in the table for the frequency of air change in minutes recommended for general ventilation or comfort cooling (whichever you want). Divide the number of cubic feet in the room by this figure. Check your answer.

Animal shelter ventilation is usually based on the number of animals, and you should see your Extension agent for the recommendations for your part of the country. Multiply the number of animals by the recommended cfm per animal.

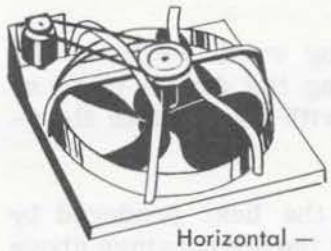
Select a fan or combination of fans that will move this amount of air. (Use the fan rating given for 1/8-inch pressure--about equivalent to the resistance that the average fan works against.)

Get the Right Kind of Fan

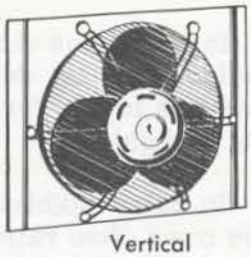
Fans can be equipped with motors that are either totally enclosed or are of the open type. The open type are suitable for relatively clean installations, but the enclosed models should be used in dairy barns or poultry houses where dust and dirt could cause trouble. If the fan will run for long periods, the motor should be of the "continuous duty" type.

If the fan is belt-driven, the motor should be of the right speed, size, and type for it.

Any belt-driven or direct-driven fan can be operated in a wall. If the fan is to be installed in a ceiling, however, it should be equipped with ball bearings throughout (in motor and fan if belt-driven).



Horizontal — Ball bearings required



Vertical

Every exhaust fan should have some kind of anti-backdraft device. These are called shutters or louvers, and they should work freely so that they will always close promptly when the fan is shut off, and open when it turns on again. A hood will protect fan and shutters from the weather.

Shutters

Hood

A wire guard or removable grill should be provided to keep fingers and hands away from moving parts. It should permit cleaning and oiling.

Pick the Right Location

Consider noise, appearance, the source of whatever it is you're removing, and construction of the building when you plan to install a fan.

A kitchen fan is placed directly over the range, because that is the source of most of the odors, moisture, and excess heat. But such a fan may be connected to a hood on another wall of the house for the sake of appearance.

Sometimes a fan is installed in the cold part of a dairy stable so as to use heat in the air to help warm that area.

Avoid installing a fan near a loose-fitting door so as not to get an air "short-circuit." In an exposed building, you may want to locate the fan away from prevailing winds.

Use the Right Control

Fans can be controlled with manual switches, thermostats, and time switches, and by other means.

Most kitchen and other exhaust fans are controlled with a manual switch, but an attic fan could be controlled with a thermostat. The fan in a powder room could be wired in with the light switch so that it would always run when the light was on.

Animal shelter ventilating fans are almost always controlled with a thermostat. (Select a thermostat of the "cooling" type--that is, one that turns the power on when the temperature rises.) The location of such a thermostat is important--it should sense the average temperature in the shelter.

What Did You Learn?

(Underline the right answers)

1. Most buildings have (no, some) natural ventilation.

2. Always locate a fan (near, away from) places where air can enter freely.

3. (Comfort cooling, general ventilation) means ventilating to create a cooling breeze.

4. Select a fan based on its delivery at (zero, one-eighth inch) pressure.

5. Exhaust fans should (always, never) be equipped with shutters.

6. Cfm is an abbreviation for (cubic feet per minute, central fan measurement).

7. Moisture must be in the form of a (liquid, vapor) to be exhausted by the ventilating fan.

8. If a thermostat control is used for ventilation, a (cooling, heating) type is needed.

Demonstrations You Can Give

Secure a corrugated paper box, longer than it is wide. An egg case or citrus box would be fine. Using a knife, cut a round hole in one end and position a small portable fan in it so that air can be exhausted from the box. Attach paper streamers to the output side of the fan. Next, make one hinged door in the side of the box adjacent to the fan, and another in the end opposite the fan. Seal the top with tape.

1. With both doors closed, operate the fan, pointing out that not enough air is entering the box (you may have to insert nails in the edges of your doors so that they aren't drawn inward.)

2. Open the door opposite the fan just slightly, and operate the fan. Show that the fan is now getting enough air for general ventilation.

3. Open this same door all the way, showing that the fan is now moving air at full capacity, and is comparable to comfort cooling.

4. Close this door to the position it had in 2, and open the side door all the way. With some paper streamers, show where most of the air is entering and tell about air "short circuits."

5. If possible, get a second fan and some automatic shutters. Let the second fan represent the wind and aim it at the first fan (with the first fan off) both with and without shutters in place over the first fan. Explain how the wind can cause a serious draft by blowing in through a fan that's not running.

For More Information

Ask your county Extension agent, power supplier, or a ventilating fan dealer for literature on ventilation.

MOTORIZE YOUR LAWNMOWER--ELECTRIFY

Have you ever wished you were fishing instead of mowing the lawn? Are you tired of shoving on the old mower? It's easy to solve these problems. Electrify that old hand mower. The job will be easier and go faster and give you spare time for fishing, fun, or custom mowing jobs. Or if you have a power mower, perhaps you'd like to help a neighbor power his mower.

What Do You Need?

A lot of the materials can be found right in your own basement or tool shed. Just make sure that they are in good working condition.

You'll Need:

A hand lawn mower (preferably a heavy one)

A 1/4 horsepower, 1750 r.p.m. motor (capacitor type, with overload protection). Make sure motor rotation is the right direction to drive the lawn mower forward

A 1-1/2" motor pulley

A V-type pulley to fit reel shaft of mower. Use a 5" pulley for a 5 blade mower, or a 4" pulley for a 4 blade mower (make sure pulley hole will fit the reel shaft)

V belt, size and length to fit (use an "A" belt)

Board for motor base (about 3/4" thick) large enough to fit

About 4' to 6' of strap iron 1-1/4" to 1-1/2" wide, for support frame

6 nuts and bolts (1/4" will do)

Several washers (at least 6)

No. 16 rubber covered, 2 wire cord (long enough to reach from outlet to far corners of lawn)

Snap switch (heavy duty, external mount type)

Tools Needed:

Hack saw, wrench, screw driver, hammer (ball peen preferred), vise or anvil, drill (to fit bolt size)

You're Ready to Start

1. The first thing to do is take the mower apart. Start with the handle. That's usually just held on with cotter keys or spring tension of the handle itself.

2. Disassemble the reel. Remove the pawls and gears from the wheels. These will no longer be needed.

3. On one side of the reel cut off the end of each blade. Cut just enough to slide the larger belt pulley on the shaft and fit it up against the reel spider (Figure 1).

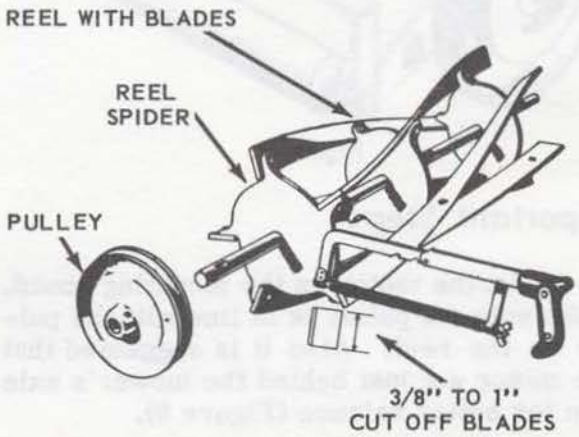


Figure 1

4. Drill a pair of holes in the pulley and matching holes in the reel spider (Figure 2). Although the pulley has a set screw, you'll need this extra insurance against its slipping during operation. When this is done, slip the pulley over the shaft and bolt it on. When pulley is bolted on, put the V belt over the pulley, and assemble the reel in its proper place in the mower.

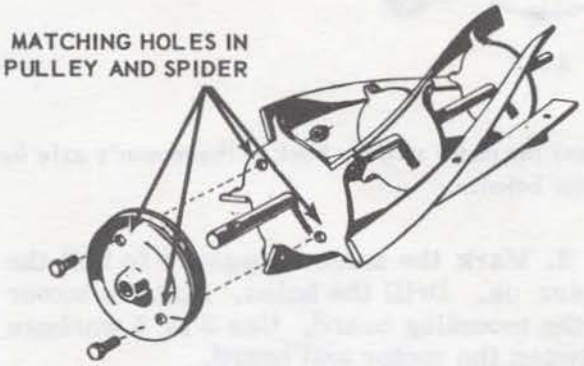


Figure 2

Support Frame Comes Next

1. Measure the horizontal distance from the tie rod to a point exactly above the rear roller. Add enough extra length so the strap iron support can be wrapped around the tie rod (Figure 3). Measure off this distance and bend two pieces of strap

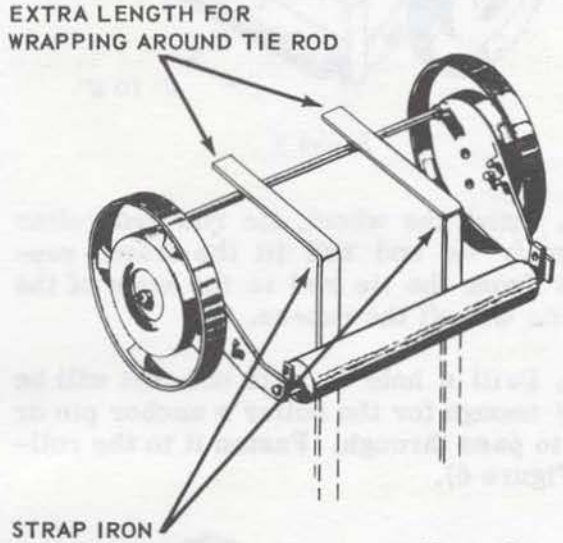


Figure 3

iron to right angles. Use a vise or anvil and hammer. (Note: in Figures 3-7, the mower reel is not shown. This is for the sake of clarity. In actual assembly, the reel is already back in place.)

2. Just beneath the angle on the long end, make a short twist in both straps to 90 degrees. Be sure you twist them in opposite directions. After the twist, bend the straps to right angles again (Figure 4).

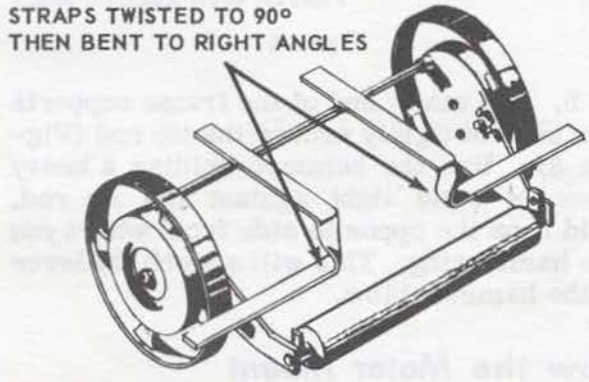


Figure 4

Remember, bend each strap in the opposite direction. About 4" to 6" from the last angle, make still another twist, this time, away from the rest of the strap (Figure 5).

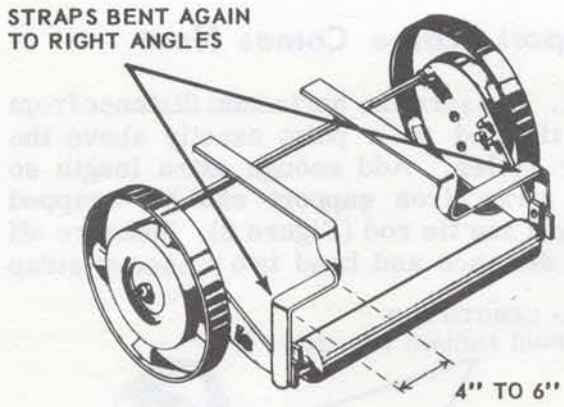


Figure 5

3. Stand the wheel, tie rod and roller assembly on end and fit the frame supports from the tie rod to the ends of the roller. Cut off the excess.

4. Drill a hole in each one that will be large enough for the roller's anchor pin or bolt to pass through. Fasten it to the roller (Figure 6).

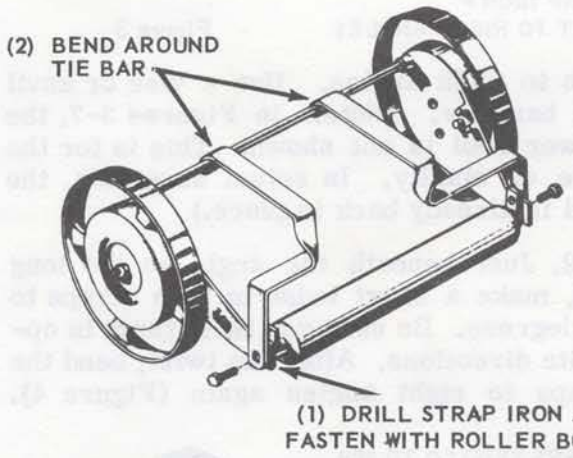


Figure 6

5. The other end of the frame supports can be bent tightly around the tie rod (Figure 6). Use the hammer holding a heavy piece of steel tight against the tie rod. Hold it on the opposite side from where you are hammering. This will absorb the force of the hammer blow.

Now the Motor Mount

Cut the mounting board to fit over the frame (Figure 7). Drill 2 holes in each of the frame supports and 4 in the mounting board to match them. Bolt the mounting board to the frame supports. Use washers between the nuts and the board on top.

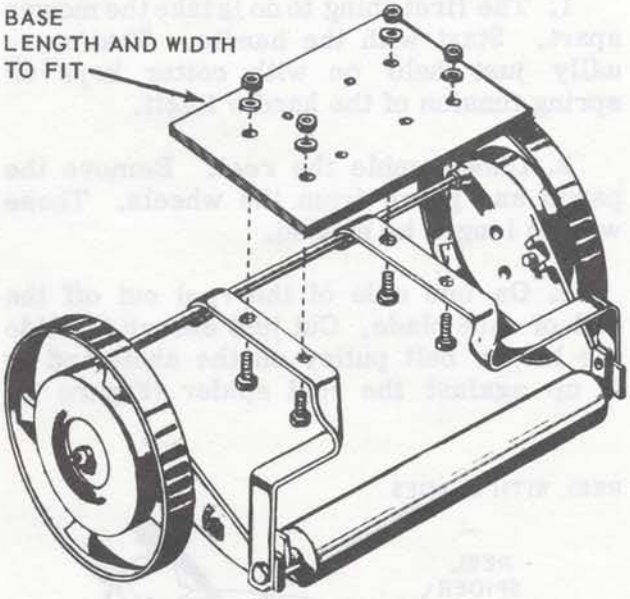


Figure 7

Important Steps

1. Set the motor on the mounting board. Make sure its pulley is in line with the pulley on the reel. Also it is suggested that the motor set just behind the mower's axle line for better balance (Figure 8).

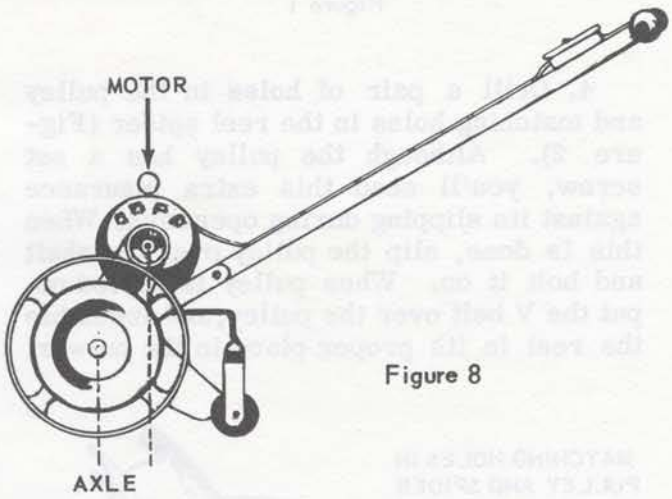


Figure 8

Mount the motor slightly back of the mower's axle for better balance.

2. Mark the holes necessary to bolt the motor on. Drill the holes. Bolt the motor to the mounting board. Use 3 or 4 washers between the motor and board.

3. Attach motor's ground wire to a frame support bolt. If the motor doesn't have one, make one out of a short piece of wire. Wrap one end around a motor mounting bolt and the other around one of the frame support bolts. As with any electric wire, wrap it around clockwise when tightening the bolt.

Now, Where Are We?

The V-belt is ready to adjust. Here's a hint: A properly fitted V-belt is sometimes hard to put on. Make the job easy by loosening 2 frame bolts on the opposite side from the pulley. Raise the mounting board so the motor pulley can move a bit closer to the reel. The V-belt will just slide on. The V-belt should have about 1/2" of slack midway between pulleys. Measure slack with a straight edge and ruler. Lay the straight edge on the belt at both pulleys and push in with the ruler to read the amount of slack. Adjust by removing or adding washers under the motor.

Ready to Hook Up

1. Put the snap switch on the handle (Figure 9) near the top so it can be reached in a hurry. If small stones or heavy twigs are caught in the blades, you'll be able to stop the mower fast and avoid damage.

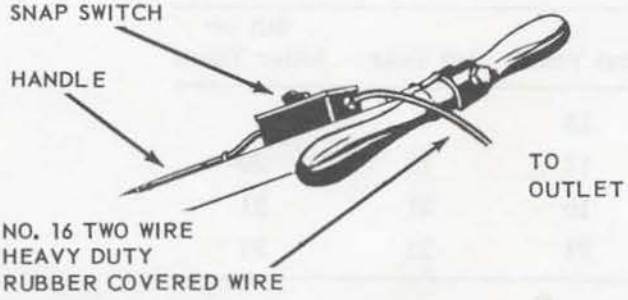


Figure 9

2. Attach the handle and connect the motor to the long electric cord through the switch. Now, you're ready to plug it in and start mowing.

Some Facts You Might Like to Know

Without the pawls and gears in the wheels, the major part of the friction is gone. Pushing will be a lot easier. Actually, the powered reel helps pull your electrified mower as it cuts the grass.

Using a 5-blade mower, you've been told to use a 5" reel pulley. This turns the reel shaft at about 500 r.p.m. The 4" reel pulley rotates the shaft at about 650 r.p.m., and is recommended for 4-blade mowers. Why? Because those speeds are needed for cutting while pushing the mower at a fast walk.

Plan the Job

Place the cord in a roll at the outlet. Always operate the mower away from the outlet and the cord will not get in the way of the mower.

A convenient accessory is a bracket on the lower-side handle on which to coil the cord over the handle and bracket. Place as far from handle as necessary to coil all the cord (Figure 10).

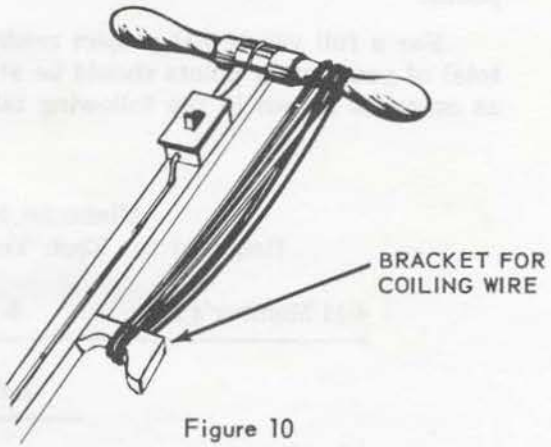


Figure 10

Demonstrations You Can Give

Show how you built your electric mower.

Through a chart, show how to mow a lawn with an electric mower so the cord gives no trouble.

Demonstrate proper mowing techniques.

For Further Information

From your county extension agent you can get booklets on the proper care of lawns and how to mow them. Your electrical supply dealer can give you booklets on the different types of electric mowers - reel types and rotaries.

HOW TO USE THIS BOOK IN FULFILLING THE GOALS OF THE 4-H ELECTRIC PROJECT FOR THE FIRST AND SUCCEEDING YEARS

The minimum goals for credit in the 4-H Electric project vary according to the 4-H member's age and the number of years he or she has taken the electric project. For example, if you are a 4-H member beginning the 4-H Electric project at the age of 10, you will not be required to earn as many credit points as a 14-year-old 4-H member beginning the 4-H Electric project. However, if you are a 12-year-old in your second year of electricity you must earn as many credit points in that year as a 14-year-old does in his or her first year.

Each lesson or goal has been designated a certain number of credit points. These are shown near the title of each lesson or goal. You decide on the lessons you want to study, list them, and add up the credit points.

For a full year's 4-H project credit, the total of your credit points should be at least as many as shown in the following table:

Examples of reading the table below are as follows: (a) An 11-year-old member is required to complete 13 credit points the first year. (b) A 14-year-old is required to complete 17 credit points his first year. (c) A 14-year-old taking the electric project for the third year must complete 21 credit points that year.

There are enough lessons in this book to give you credit for two or more years in the 4-H Electric Project. Do at least all of the lessons that interest you. If you wish, and your leader approves, you may combine any of the lessons in this Division with those in other Divisions to earn credits for a year's work.

Minimum Number of Credit Points
Required for Each Year's Work in the 4-H Electric Project

4-H Member's Age	4-H Member's Year in 4-H Electric Project			
	1st Year	2nd Year	3rd Year	4th or Later Years
10 - 11	13	15		
12 - 13	15	17	19	20
14 - 15	17	19	21	21
16 & over	19	21	21	21

This system of credit points makes it possible for you to do the things you want to do with electricity and get credit for them in the 4-H Electric project.

Supplemental Information Available

T-5 Leaders Idea Book
T-21 Members Idea Book

See your County Extension Office concerning the availability of electrical kits, films and other information.