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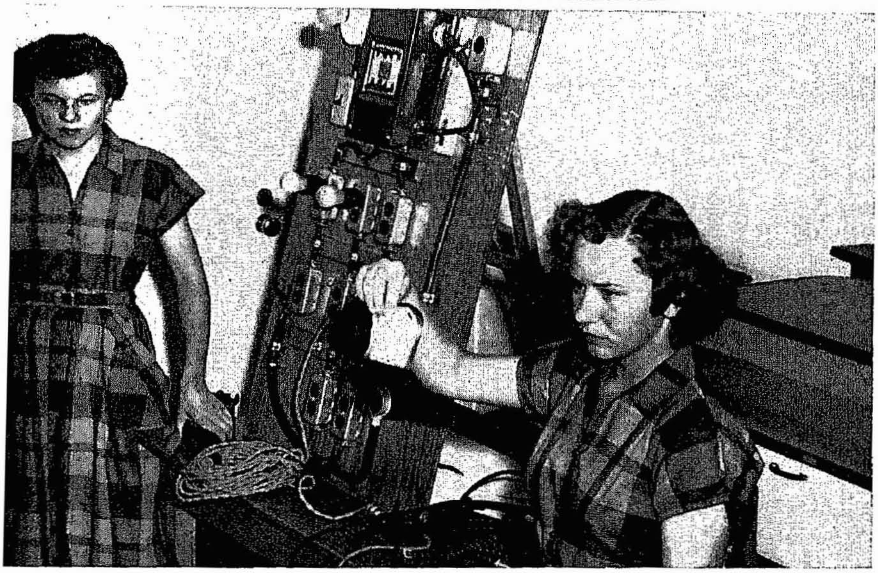
learn to USE ELECTRICITY



as a 4-H project

EXTENSION SERVICE - MONTANA STATE COLLEGE - BOZEMAN, MONTANA

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Montana Extension Service in Agriculture and Home Economics, R. B. Tootell, Director.
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Learn to Use Electricity

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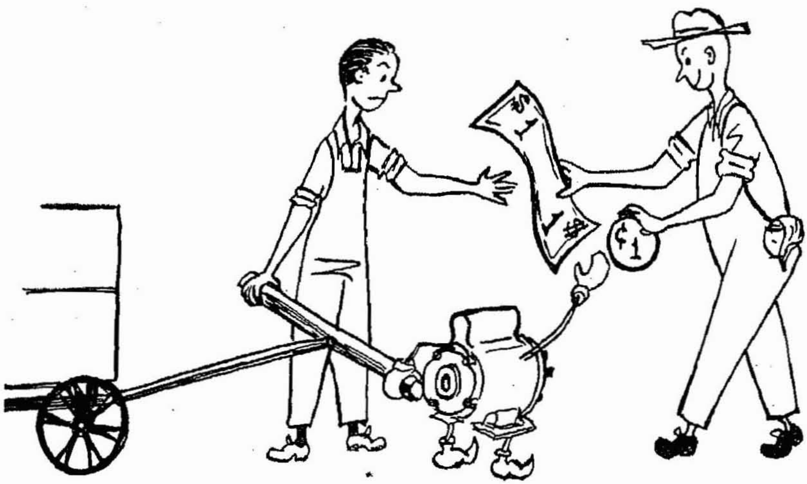
Are you using electricity to your best advantage? Are you still pumping water by hand, filling granaries with a scoop shovel, or hoping for good weather at hog farrowing time? Did you know that 1 cents' worth of electricity will do as much work as 1 dollars' worth of hand labor? Are there jobs around your home or farm that could be done better with electricity?



Electricity takes the drudgery out of everyday chores. It adds comfort, convenience, and enjoyment to our homes. It makes it possible for our farms to produce more at lower costs.

The more we know about electricity, or anything, the better we are able to use it. The purpose of this bulletin is to help you learn more about electricity and how to use it.

Learn the Common Electrical Terms

To help understand electricity better, the following terms, expressions, and relationships are given. You should learn their meaning and be able to use them correctly.

1. **Volt.** The **Pressure** which forces the electricity to flow through a wire, appliance, or machine, is measured in volts,

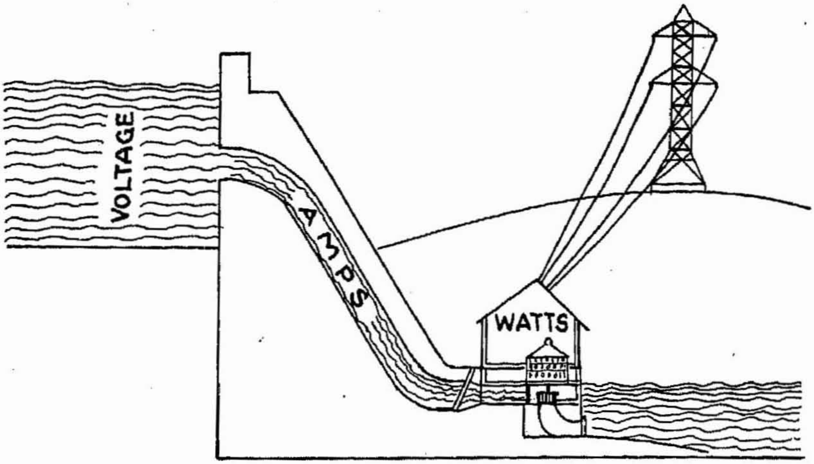
just as the pressure which forces water through a pipe is measured in pounds per square inch. The common pressure, or voltage, is 115 to 120 volts for lighting and small appliances, and 230 to 240 volts for electric ranges, water heaters, welders and large motors.

2. **Ampere.** When a current of electricity is forced through a wire, the **rate of flow** is measured in amperes. Similarly, the flow of water in a pipe is measured in gallons per minute.

3. **Ohm.** The unit of **resistance in an** electric circuit. The resistance of a wire compares to the friction in a water pipe. A pressure of one volt will force a current of one ampere through a resistance of one ohm, or, ohms = volts ÷ amps. For example, an appliance is rated 115 volts and 5 amperes. The resistance would be 115 volts ÷ 5 amperes = 23 ohms.

4. **Watt.** The unit of electric **power.** It is similar to "horsepower," the unit of mechanical power. However, the watt is such a small unit of power that the term kilowatt is frequently used, meaning 1000 watts. A definite relationship exists between watts, volts and amperes. That is, watts = volts x amperes.
For example, the appliance mentioned above rated at 115 volts and 5 amperes would also be rated at 115 volts x 5 amps = 575 watts. Many appliances are rated in watts and volts, for example a 100-watt-115 volt light bulb or a 1000-watt, 115-volt electric iron. When watts and volts are given, amperes can always be found by the above relationship, that is watts = volts x amperes. This relationship can also be written amperes = watts ÷ volts. Thus the electric iron would permit a current flow of 1000 watts ÷ 115 volts = 0.87 amperes.

Look on the nameplate of several appliances around your home. If watts and volts are given find by arithmetic what



the amperes might be. If volts and amperes are given, find the watts.

5. **Kilowatt-Hour.** The unit of electric energy or work done. If an appliance uses 1000 watts (1 kilowatt) for one hour, then it has consumed 1 kilowatt-hour of electricty. For example, if the 1000-watt electric iron was "on" continually for 3 hours it would use 3 kilowatt-hours of electric energy. This is the unit of electricity that is bought and sold. One Kilowatt-hour may cost from 1 cent to 7 to 8 cents depending upon the amount used per month. The average farm will use enough electricity so that each kilowatt-hour will cost about 3 or 4 cents.

6. **Voltage Drop.** The difference in voltage between the load end of a circuit and the source of power end. Voltage drop is caused by a flow of electricty (amperes) through a wire having resistance (ohms). The amount of voltage drop can be calculated by multiplying the amperes times the ohms of the wire. For example, if 20 amperes flow through a wire that has ½ ohms resistance, then there is a voltage drop of (½ x 20) 10 volts.

7. **Circuit.** A path over which electricty flows. Usually two wires, one bringing electricty to the load or appliance and the other wire carrying it back to the source. Most homes have several circuits, usually called branch circuits.

8. **Branch Circuit.** That part of the wiring system extending beyond the last fuse or circuit breaker.

9. **Fuse.** A piece of wire or metal, in a special container, which melts and opens the circuit (breaks the path) if the rate of flow of electricty (amperes) becomes too great. Fuses are rated in amperes such as 15 amp, 20 amp, etc. When a fuse "blows" (melts), it cannot be repaired, but must be replaced by a new one.

10. **Circuit Breaker.** A mechanical device which opens the circuit if the rate of flow of electricty (amperes) becomes too great. Circuit breakers are rated in amperes the same as fuses, but they may be reset after they "blow" (break the path).

11. **Switch.** A device for opening or closing a circuit, usually by hand.

12. **Short Circuit.** An improper or accidental contact or connection between two wires carrying current or between a "live" wire (one carrying electricty) and ground.

13. **Ground.** An electric connection to the earth. Usually made by driving a metal rod into the earth or by connecting to water pipes that are buried in the earth.

14. **Direct Current (D. C.).** Electricty flowing in one direction only, such as that supplied by a battery.

15. **Alternating Current (A. C.).** Electricty flowing first in one direction and then the other in the circuit. Nearly all power line electricity is alternating current. It usually flows one direction, reverses and changes back to its original direction 60 times every second.

16. **Insulation.** A substance that will not carry electricty such as rubber, glass, bakelite, etc.

To be sure you understand these electrical terms, discuss them with other 4-H members, your leader, parents, and electricians. Calculate the missing factors for various electrical items around your home.

How to Repair Cords and Plugs

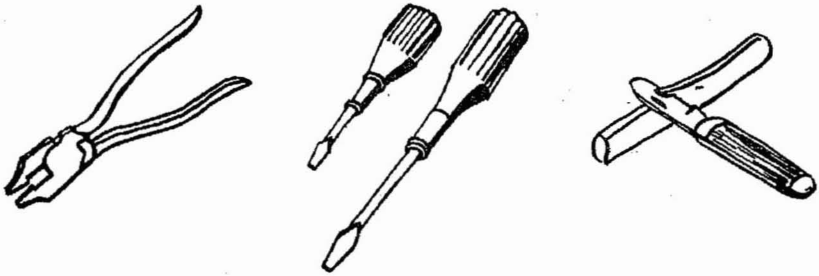
Splices

1. Requirements of a good splice:

   a. The wire should be as strong at the splice as elsewhere.

   b. The windings or wrappings should be tight and held in place with solder.

   c. The splice must be as well insulated with rubber and friction tape as the rest of the wire.



2. How to make two types of splices:

   a. **The common splice** is used where it is desired to splice two wires to form one continuous wire.

      (1) Remove about 2 inches of insulation from the end of each wire.

      (2) Scrape the wires clean with a knife.

      (3) Using pliers, make a right angle bend on each wire.

      (4) Hold the wires tightly at the joint and wrap the loose ends to form a splice as shown.

METHOD OF MAKING COMMON SPLICE

(5) With pliers make the wraps tight and the ends smooth so they will not puncture the insulation that will be put on over the splice.

(6) Apply soldering paste. **Be sure that acid is not used** as it will make the connection corrode.

(7) Heat the splice with a soldering iron until the wires are hot enough to melt the solder, then apply the solder. Use just enough to fill the spaces between the wires of the splice. **Use Resin Core Solder.**

(8) Have your leader inspect the splice before taping.

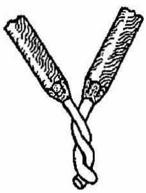
(9) Wrap the splice with rubber tape. Stretch the tape as it is wrapped. Apply at least two thicknesses of rubber tape over all parts of the copper wire and see that it makes a moisture tight joint with the original insulation on the wire.

(10) Wrap friction tape over the rubber tape. Pull it tight as you wrap. It should extend over the insulation on both ends of the splice.

b. **The "Rat-Tail" Splice** is used where there is no pull on the wires.

(1) Remove about 1 inch of insulation from the wires and scrape them clean.

(2) Twist the wires together as shown.



"RAT-TAIL" SPLICE

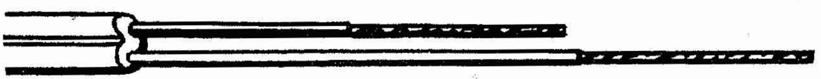
(3) Solder the splice as before.

(4) Apply rubber tape, stretching well and being sure to cover all copper as well as making a moisture proof joint with the original insulation. Start by wrapping the splice lengthwise, that is over the end of the wires and through the crotch where the wires come together. Then wrap "around" the splice.

(5) Wrap with friction tape in the same manner.

Repairing An Appliance Cord

1. Cut the broken or worn piece of cord so that one wire on each end of the cord will be about two inches longer than the other. Remove about two inches of insulation from the wires.



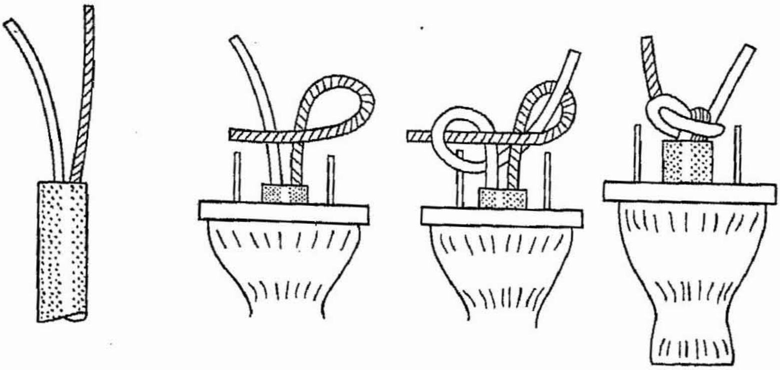
2. Splice the long wire from one end of the cord to the short wire on the other end of the cord. Repeat with the other long and short wire. This will prevent the two splices from being directly across from each other.

3. Tape each splice separately. Then tape over both splices.

Attaching a Plug to a Cord

1. Remove about 2 inches of the insulation that covers both wires. Be careful not to damage the insulation around the individual wires.

2. Remove about ½ inch of the insulation from the end of each wire.



TYING AN UNDERWRITER'S KNOT

3. Slip the wire through the plug and tie an Underwriter's knot.

4. Bring the wires around the plug prongs to take the strain off the small wires under the screws.

5. Wrap the wires around the screws in the **same** direction that the screws are turned. This prevents the wires from working out from under the screws as they are tightened down.

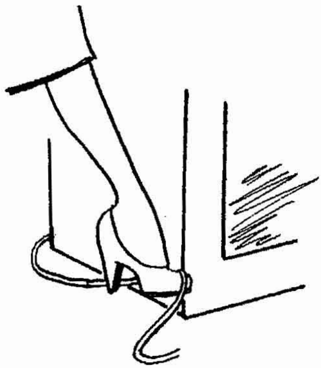
6. Be sure that strands from the individual wires do not get loose so that they might touch together in the center of the plug.

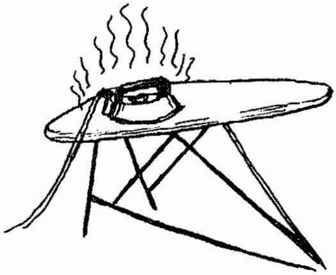
7. Have your leader inspect the cord and plug before using it.

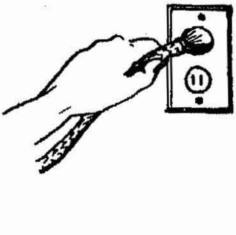
SAFETY

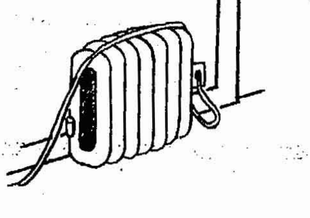
Electricty is safe if handled properly. It is an excellent source of power, light and heat. It also affords systems of communication and entertainment. However, if electricty is not handled properly, it can burn, shock, or even kill you. It also can kill livestock and cause fires.

Make it your responsibility to recognize and remove electric hazards.









Here are some **Do Nots** for electrical safety:

1. **Do Not** run appliance cords through a doorway.
2. **Do Not** run appliance cords under rugs.
3. **Do Not** use worn appliance cords. Repair or renew them.
4. **Do Not** leave heating appliances plugged in when not in use.
5. **Do Not** put in a bigger (higher amperes) fuse than the one that blew out.
6. **Do Not** put anything in a fuse socket except the correct size fuse.
7. **Do Not** remove a plug by pulling on the cord. Pull on the plug.
8. **Do Not** turn on, or work with electric appliances, if your hands are wet or if you are standing in water.
9. **Do Not** place appliance cords over stoves, heaters, radiators, steam pipes or water pipes. The insulation will rot or wear off, causing a short circuit.
10. **Do Not** try to repair a cord or anything electrical without disconnecting it. Be sure the line is "dead."
11. **Do Not** fly kites near electric power lines.
12. **Do Not** stack hay under a power line.
13. **Do Not** touch an electric wire to hold it up while you drive a tall machine under it, **not even with a stick.** Call your power supplier if

you have to move a high machine or building across a power line.

14. **Do Not** locate an outside radio aerial on the same side of the house as the electrical service wires. An aerial should not cross over or under a power line.

15. **Do Not** have a radio in the bathroom or near any plumbing fixtures.

16. **Do Not** use any electrical appliance near plumbing fixtures unless it has a metal case that is well grounded.

17. **Do Not** continue to work with an appliance from which you have received an electric shock.

18. **Do Not** operate a 230-volt motor without having the frame well grounded.

19. **Do Not** use wiring materials unless they are approved by the Underwriters Laboratories.

20. **Do Not** use pull chain sockets without an insulating link in the pull chain.

21. **Do Not** use pull chain sockets of any kind near plumbing fixtures or where your hands may be wet or you may be standing in water.

22. **Do Not** overload a circuit or cord. If the wires get warm, they are overloaded.

ELECTRIC MOTORS,

Their Operation, Lubrication and Care

Make a list of all the electric motors around your home or farm. Indicate where they are and what they are used for. For instance, the washing machine in the basement, the sewing machine in the west bedroom, the feed grinder in the granary, and so on.

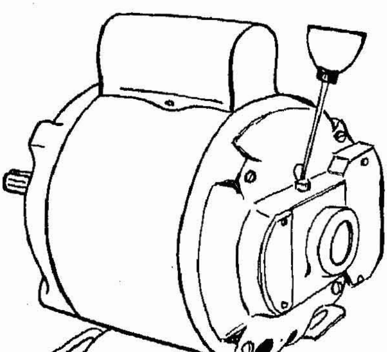
Next wipe all dirt, oil and grease from each motor. Copy on your list all of the information on the nameplate. Also copy down any other information or instructions that may be found on the motor. Note particularly anything about lubrication.

Lubrication. Determine from the instructions that came with the motor, or from instructions printed on it **How Often it Should Be Lubricated,** what **Kind of Grease Or Oil** to use and **How Much.**

Write this information on your list. If you do not have definite instructions, be guided by the following general information:

If there are oil holes, use a light (S.A.E. 10) oil on small motors of less than 1 horsepower. Use S.A.E. 20 on larger motors that require oil.

Always be sure the oil holes are capped or covered to keep dirt and dust out.



If there are no oil holes, there are two possibilities. (1) The most likely is that the motor has ball bearings which have been sealed with grease at the factory. This type needs no lubrication at any time. (2) It may be a bearing that requires grease. Generally there will be a grease cup. On this type use special ball bearing grease, not just ordinary cup grease.

If the motor needs periodic oiling or greasing determine how often it is needed, indicate this on your list and do it regularly. How often you oil or grease it depends upon how much use the motor gets. A motor that runs about as much as a refrigerator motor should be oiled every three months. Any motor, except those sealed at the factory, should be lubricated at least once a year.

For small motors only 2 or 3 drops at a time is enough for each bearing. Too much oil or grease is worse than not enough, because it gets into the motor and destroys the insulation. Always wipe off any excess or spilled oil.

Cleaning. Wipe the outside case of the motor frequently. **Be Sure Motor is Turned Off** so that it will not start and catch your cloth, fingers or clothing. If the motor has openings in the ends, use a vacuum cleaner to suck out dust, dirt, leaves, straw and chaff. Do this regularly and as often as necessary to keep it clean. If you don't have a vacuum cleaner, a tire pump might be used to blow it out. Do not use air from a compressor because it generally has so much force it is apt to do damage to the wiring inside the motor.

Keep Dry. Keep the motor dry. If a motor is used in a wet location be sure that water cannot drip or splash into the motor case. If the motor has been flooded, dry it thoroughly, then have it tested for short circuits before using it again.

Temperature. It is normal for a motor to get warm. However, you should be able to hold your hand on the motor case for 3 or 4 seconds without getting a burn. If you cannot, the motor is too hot and the cause of overheating should be found before it is used again. If you find an electric motor that is too hot, turn it off immediately, feel the bearings and try to determine whether they are hotter or cooler than the rest of the motor. If the bearings are hotter the trouble is there. Oiling or greasing may remedy the situation. If it does not, the bearings will probably have to be renewed. Take it to a good electric shop.

If the bearings do not seem as hot as other parts of the motor, it is very likely that either the load is too heavy or that the voltage is too low. About the only way to be sure is to have an electrican make voltage tests. However, if you can lighten the load and this results in the motor running cool, that is satisfactory.

Motors should have an overload protection device. If the load gets too heavy or the voltage gets low so that the current is too high, the overload device will automatically shut off the motor. All motors **should** have such a device, but many do not. Determine whether or not each motor has overload protection. Many motors have been burned out because they did not have an overload protection device.

As part of your project, make it a point to test the temperature of each motor by feeling it at least once. Unless the motor is in full view, **Be sure it is not running** when you lay your hand on it.

Types of Electric Motors and Their Selection

All of the common small electric motors operate on essentially the same principle. They differ chiefly in their ability to start loads. A number of different starting methods are used and the motors have been named for their starting methods.

The four most common types are, (1) Split phase, (2) Capacitor, (3) Repulsion Induction and (4) Universal.

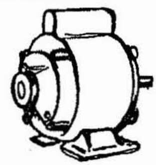
Split-Phase. The split-phase motor is the simplest and least expensive. It has a starting winding that is "out-of-step" with the running winding. From this it gets its name. It is generally available in sizes up to ⅓ horsepower. It has a **Low starting ability.** That is, if the load turns hard at the start, this motor may not be able to start it. Full power is not developed until the motor reaches full speed. It can be used on any machine that is easy to start, or one where the load is thrown on after the motor has reached full speed. Common uses are for washing machines, tool grinders, and bench saws. The direction of rotation can be reversed by interchanging the starting winding leads.

Capacitor. Capacitor motors have become very popular in recent years. It has a "Capacitor" which enables it to start loads 1½ to 2 times heavier than will the split-phase motor of the same horsepower rating. Also, it will start this bigger load with about one-half as much current. Common sizes are up to ¾ horsepower. Many capacitor motors have the capacitor on top of the case in a cylindrical container 1 to 2 inches in diameter. However, the capacitor is built-in on some motors, so it is not readily seen. Generally, the name plate will tell if it is a capacitor motor. It is customarily used on such machines as refrigerators, pumps, and compressors. The first cost of a capacitor motor is a little higher than a split-phase, but it will start bigger loads and is a little more efficient. The direction of rotation can be reversed by interchanging the starting winding leads.

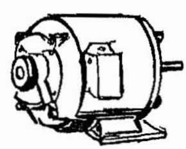
Repulsion-Induction. The repulsion-induction motor will start a bigger load than either of the other two. It will start any load that it can carry within its rating. It has a wound rotor, that is, the rotating part contains a wire winding. This wound rotor is used for starting. Common sizes are ½ horsepower and larger. It is used on hard-to-start machines, such as cream separators, feed grinders and ensilage cutters. The first cost is higher than the other two types. The direction of rotation can be reversed by changing the position of the brushes.

SPLIT-PHASE

CAPACITOR

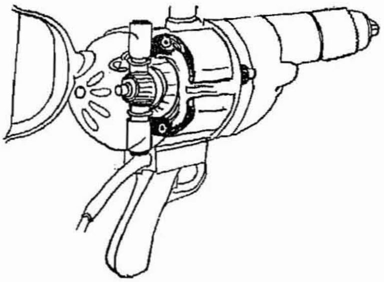


REPULSION-INDUCTION



All three of these types run at a fairly constant speed regardless of load. If the load becomes too heavy they will stall. In the case of stalling, the motor that will start the heaviest load will be the hardest to stall, so that is another advantage for the more expensive motors.

Universal. The universal motor will operate on either direct current or alternating current. The speed will vary widely depending upon the load. With no load it may run dangerously fast. For this reason, a universal motor is almost always permanently attached to the machine it drives. It is commonly used on vacuum cleaners, fans and electric drills. It is also used on sewing machines and food mixers where variable speed control is essential. It is usually made in very small sizes such as those mentioned.



To complete this goal in the 4-H Farm and Home Electric Project, you should list all of the motors around your home or farm. Indicate what kind of work the motor does and what type it is. Then make a statement as to whether each is the right type motor for the job.

Following are some hints to determine the type:

(1) Read the nameplate carefully.

(2) Look for the cylindrical container on top. Only capacitor motors have this, however, not all of them do. If they don't, the word "capacitor" usually appears on the name plate.

(3) Look for brushes and a commutator on a Repulsion-Induction Motor. These look much the same as the brushes and commutator on an automobile generator. Sometimes though, the commutator is in the shape of a disc on the end of the rotor instead of a cylinder. It always has the brushes which make contact with the commutator while starting.

(4) If the motor does not have the features of the capacitor or the repulsion-induction, it is almost certain to be a split-phase.

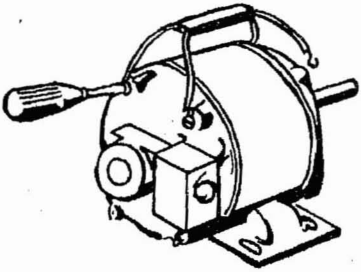
(5) The universal motor has brushes and a commutator, too, but is nearly always built into the machine. Also the nameplate will nearly always say either "Universal" or AC-DC. The latter means it will operate on either alternating or direct current.

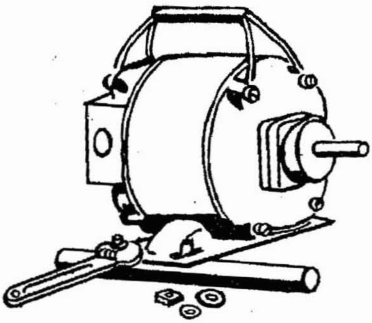
For more complete information on small electric motors get U.S.D.A. Farmer's Bulletin 1858, **Electric Motors for the Farm,** from your county extension office.

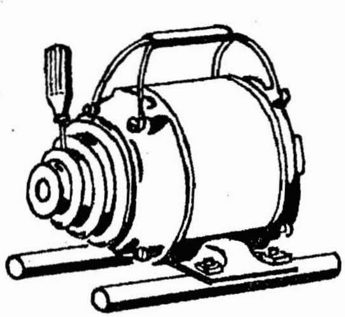
Making Electric Motors Portable

You can use one motor in many places and save time and expense, by making it portable.

A separate motor on each machine is, of course, very convenient, but unless the machine is used very frequently, it is unnecessarily expensive. Since many machines around a farm can use about the same size motor, you may find it convenient to have a motor that can easily be taken from one job to another.







The Small Portable Motor

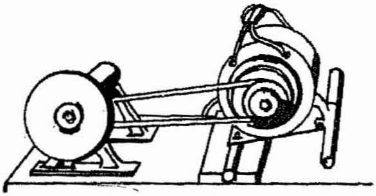
1. **Make a handle** of wire and fasten it under the top frame bolts of the motor as shown. A short piece of No. 12-2 or 10-2 wire with all of the insulation left on except at the ends, is satisfactory. It may have to be flattened under the bolt heads.

2. Make two rails for the motor from ¾ inch pipe, or hardwood such as a pitchfork handle. Cut about 10 or 12 inches long and fasten them to the motor base. Use ¼ inch stove bolts with the heads countersunk into the rails.

3. Fasten a pulley on the motor shaft. It should have enough size-steps to provide the correct speed for each machine you wish to operate.

4. Fasten two wood strips at each place where the motor is to be used. They should be the approximately correct distance from the machine so that the belt can be kept tight. The weight of the motor balancing between the wood strips keeps the belt tight.

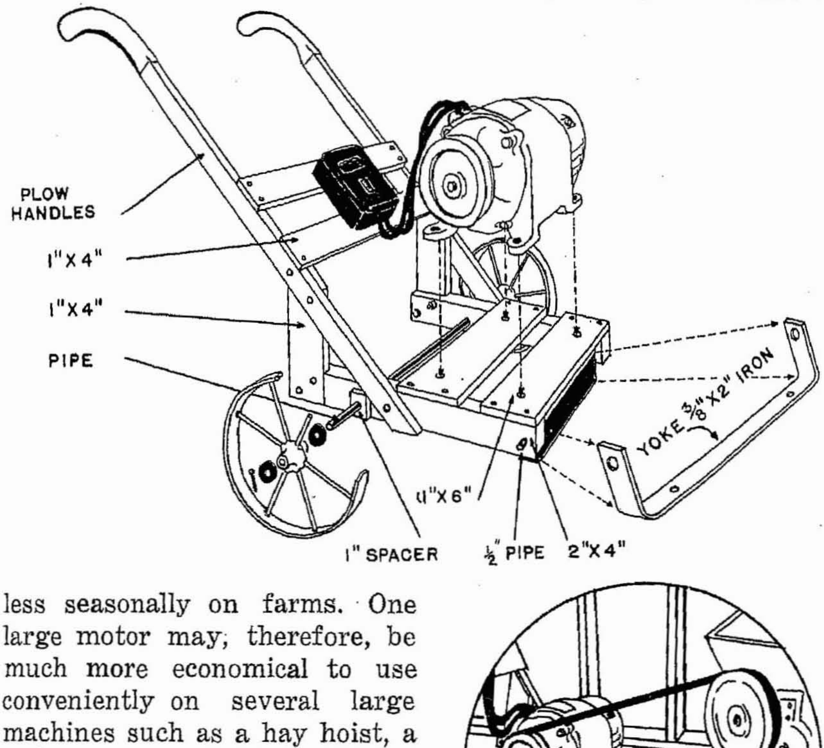
There are two rails recommended. Either one can be used, depending upon which direction of rotation is required. In some cases it will be much more convenient if the motor has a re-



versing switch. If your motor does not have one, you may want to see an electrician about putting one on.

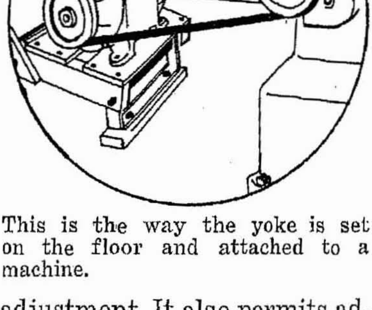
The Large Motor Toter

Large motors are expensive and are generally used more or



less seasonally on farms. One large motor may, therefore, be much more economical to use conveniently on several large machines such as a hay hoist, a feed grinder, large grain elevator, wood saw, feed mixer, hay baler and irrigation pump.

Build a wooden cart with wheels so that the motor can be easily moved from one machine to another.



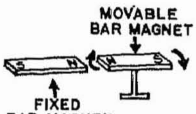
This is the way the yoke is set on the floor and attached to a machine.

The **yoke**, at the front of the cart, provides a quick and easy way to fasten the cart frame rigidly in position to permit proper belt adjustment. It also permits adjustment of the tension. With the yoke fastened down, the motor cart can be raised up or down to loosen or tighten the belt. A large motor may be too heavy to use its weight to keep the belt tight, but the effect can be obtained by using blocks of varying thickness under the back of the cart.

How to Build an Electric Motor

How an Electric Motor Works. In a way, an electric motor is simply a spinning magnet. The earth itself is a huge magnet. We know it has magnetism because it causes a compass needle—also a magnet—to swing around. Ordinary horseshoe and bar magnets effect a compass needle this same way.

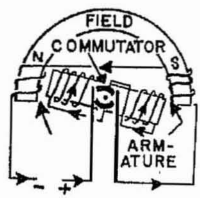
Magnets act like this because they have **magnetic fields** composed of **magnetic lines of force.** These concentrate at the ends of a magnet to form two opposite **magnetic poles—**the **North** and **South** poles. **Like** magnetic poles **repel** each other; opposite poles **attract.** As shown here, the movable magnet swings around because its N pole is repelled and its S pole is attracted by the N pole of the fixed magnet. It stops turning when its S pole is nearest the N pole of the fixed magnet.



Now suppose that just as the S pole of the moving magnet nears the N pole of the fixed magnet, there were some magical way suddenly to reverse its magnetic poles. Then it would keep turning for another half turn. If we could change its poles every half turn, the moving magnet would spin around and around.

We cannot reverse the poles of a bar magnet this way. But, we can do even better. In place of the movable bar magnet, we can use a coil of wire wrapped around an iron core—an electromagnet. Like a bar magnet it has N and S poles, but they can be instantly changed by reversing the current in the wire. This can be done automatically as the coil of wire spins around.

Then, instead of the fixed bar magnet, we can substitute an electromagnet, shaped to fit around the spinning coil. What we now have is a simple direct-current motor. The fixed electromagnet is the **field,** the spinning electromagnet is the **armature,** and the arrangement for reversing the current in the armature is the **commutator.** This is the simple sort of motor you will build.

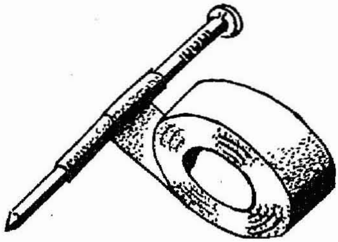


Materials Needed

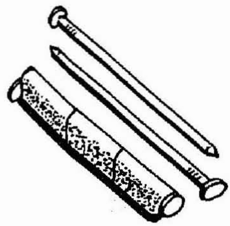
One roll No. 24 enameled wire	Wood board for motor base
One roll friction tape	Two staples or four small brads
Three 4-inch nails (20-penny)	Two Tacks
Four $2\frac{1}{2}$-inch nails (8-penny)	Two dry cells

How to Make the Armature

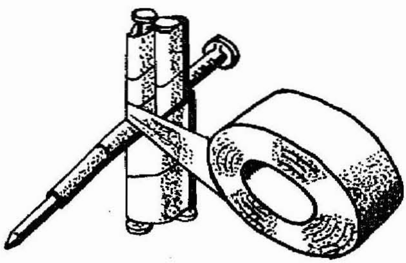
1. For armature shaft, wrap $1\frac{1}{2}$ inches of 4-inch nail with two layers of tape.



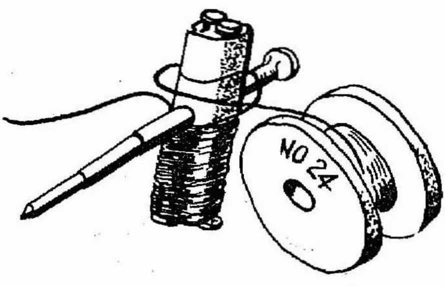
2. For armature core, tape two pairs of $2\frac{1}{2}$-inch nails alternating heads and points.



3. Center one pair of core nails on each side of shaft nail about 1 inch from head. Wrap with two layers of tape from tip to tip.

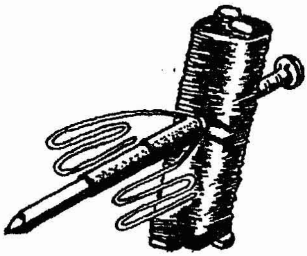


4. Wind armature with two layers of wire. Start at shaft, wind out and back on each half of core. Always wind in same direction. Leave 6 inches of wire at start and finish.

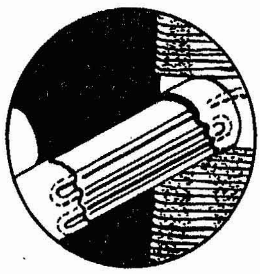


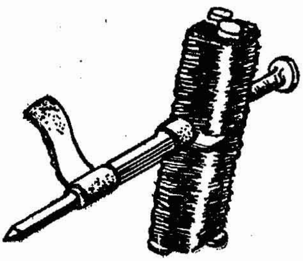
How to Make the Commutator

1. Scrape all insulation off ends of armature windings.



2. To form commutator, bend bare ends of wire as shown. Lay against tape on sides of shaft half-way between the armature coils.

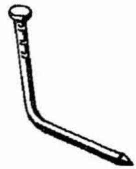




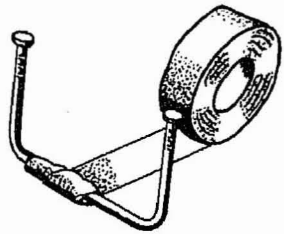
3. Hold commutator down with narrow strips of tape as shown.

How to Make the Field

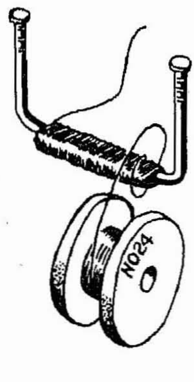
1. Bend two 4-inch nails in center for field core.



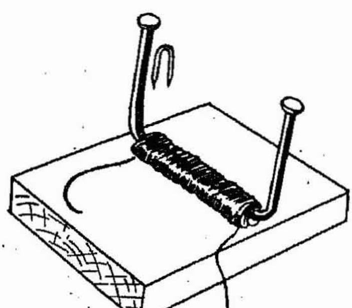
2. Space heads of nails about 3 inches apart. Wrap nails together with two layers of tape.

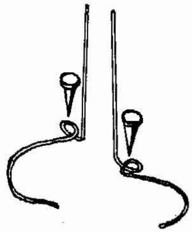


3. Wrap field core with about 400 turns of wire. Leave 3 or 4 inches of wire at start and finish.



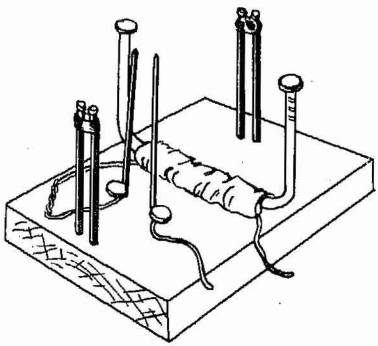
4. Attach to wood base with staples or bent over brads.





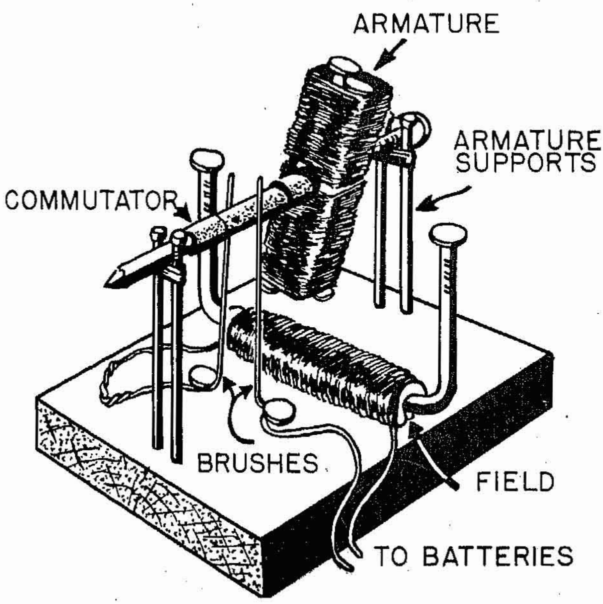
The Armature Supports and Brushes

1. Scrape insulation from ends of two 6-inch pieces of wire. Tack them to base and bend them as shown to form brushes.



2. For armature supports, drive four 3-inch finishing nails in base, locating them so that armature turns exactly between field poles. Wrap wire around armature supports to form armature bearings. Scrape and connect these two wires together.

Assemble the Motor



NOTE: Adjust position of commutator and tension of brushes against it for best operation.

Things To Do With Your Motor

Lift out the armature of your motor. Connect the commutator wires to a dry cell. Test the polarity of each end of the armature with a compass needle. What do you find? Then reverse the battery connections and test with the compass needle again. What happens?

With the armature removed, connect the field coil of your motor to the dry cell. Test the polarity of each end of the field with a compass needle. How can you reverse the polarity of the field? Try it.

While your motor is running, push the field poles slightly out of alignment with the armature. What happens to the speed of the motor? Why?

Push the motor field completely out of the way and test the polarity of the armature as you slowly turn it around by **hand.** Can you explain what you find?

Try to reverse the direction of rotation of your motor by reversing the connections to the battery. What happens? Can you explain why?

Your motor is **series-wound.** Find out how to convert it to a **parallel-wound** motor. Then wire the motor this way and run it. Does the motor seem to run as well as before?

Try to reverse the direction of rotation of the parallel-wound motor by (a) reversing the battery connections (b) reversing only the field connections (c) reversing only the armature connections (d) reversing both field and armature connections. Which of these methods reverses the motor?

Note: A motor which is not running is almost a direct "short" on a dry cell. Do not leave a non-running motor or just the armature or field of your motor connected to the dry cell for any length of time.

How to Check the Wiring to an Appliance

Very often electrical appliances such as toasters, electric irons and motors do not operate satisfactoritly because the wiring system supplying the electricity to them is not good enough.

The trouble may be in the appliance cord, its plug, the convenience outlet, the branch circuit or the entire wiring system.

There are, of course, other causes for unsatisfactory service besides adequate wiring. However, this cause is sufficiently frequent to warrant special consideration.

A very common inadequacy is present when an appliance such as an electric iron or toaster is plugged into a drop cord intended for an electric light. The ordinary shell-socket on a drop cord is usually adequate for only about 250 watts. The drop cord wire is probably good for a maximum of three amperes. Many electric irons use 1000-watts or over 8 amperes.

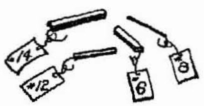
All electrical appliances and cords should be approved by Underwriters' Laboratories. The Underwriters' Laboratories is a concern that makes extensive tests on all kinds of equipment with respect to fire and human safety. It is always recommended that anything used with electricity, including wiring materials, bear the Underwriters' Laboratories label of approval. The label is actually put on by the manufacturer, but only with the consent of the Underwriters' Laboratories after the item has passed their tests. It may contain the words "approved by Underwriters Laboratories", just Underwriters' Laboratories, or the initials UL in a circle.

When appliances are purchased, the Underwriters' label should appear both on the appliance and the cord attached to it. If they are, you can expect them to be reasonably safe and adequate. However, many appliance cords wear with use or deteriorate with age. Occasionally, they are repaired with inferior materials, or materials which are not heavy enough to carry the load. The original plug may have been replaced with a cheaper one, or may have been used in a poor outlet until it was burned and is no longer adequate.

The convenience outlet may be inadequate. It should also be approved by Underwriters' Laboratories. By removing the cover plate you should be able to see the label and also the voltage and ampere rating. Do not use it for more amperes or volts than its rating. Frequently, the metal contacts become worn or burned. The only remedy for this is a new outlet. Worn or burned contacts may be detected by pushing in a good plug. If the plug is held loosely or can be pulled out very easily, the contacts may be badly worn. If the plug is loose part way in and tight part way, the contacts are probably burned and have become rough.

Another cause of poor service from a convenience outlet may be that the screws holding the wires are loose. Before testing or tightening the screws, be sure to **kill the circuit** by opening the circuit breaker or unscrewing the fuse. If not absolutely sure you have "killed" the correct circuit, open the main swith, cutting off all power to the building.

While the circuit is dead is a good time to determine the size of wire supplying electricity to it. There are two ways to determine the size of wire. First and probably best is with a wire guage, which is a disc about 2" or 3" in diameter with notches around the edge. Each notch is numbered with the size of wire that will just slip into it. The second way, much simpler and less expensive, but less accurate is to buy short pieces of the different sizes of wire from your dealer. Tie a tag onto each piece showing the size, or guage number. Hold these pieces close to the wire in question and compare the diameters of the wire not including insulation. Each size of wire has a definite limit to its current carrying capacity as given in the following table:



Size of Wire A.W.G No.	Current Carrying Capacity (amperes)	SOME COMMON USES
18	3	Lamp cords
16	6	Appliance cords
14	15	Some permanent lighting circuits
12	20	Most permanent wiring inside buildings
10	25	Heavy appliance circuits
8	35	Water heaters, electric driers, etc.
6	50	Electric Ranges, Arc welders, etc.
4	70	Large motors—long distances

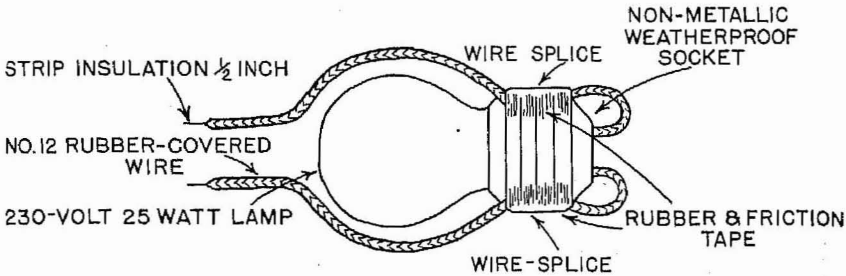
To use the table for checking the size of wire, add up the wattages for each electrical item on the circuit. Some of the appliances, like the flat iron and toaster may not be plugged in at the time, but if they ever are, add their wattage to the list. Find the amperes required by dividing the **total wattage** by the **voltage.** See page 4 under Learn the Common Electrical Terms. If the answer is more than the carrying capacity of the wire, as found from the table, the wiring is inadequate. Probably the simplest way to remedy such a situation is to add another circuit to take a part of the load, or transfer part of the load to another branch circuit.

To accomplish this 4-H goal, select, if possible, appliances that are not working properly. Trace the wiring, inspecting it for adequacy from the appliance through the cord, the plug, the outlet, and the branch circuit as explained above. Record your findings in your 4-H record book.

How to Make a Test Lamp

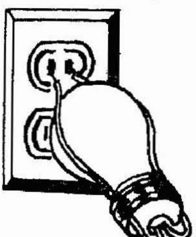
Occasionally an electric appliance does not work at all. You cannot tell immediately whether the electricity is getting to it, or not. In this instance it would be very handy to have a test lamp.

To make a **test lamp**, first obtain all the materials necessary and put them together as shown in the diagram.



The wire splice should be the common or straight wire splice as described on page 7 under How to Repair Cords and Plugs.

The socket is non-metallic and weatherproof so that it can be used indoors or outdoors, in wet or dry places without danger of shock.



The lamp is 230 Volt, so that it might be used on either 115 volt or 230 volt circuits or where the voltage is unknown.

If the test lamp wires are pushed into an outlet or touched to hot terminals, the lamp will be bright if the voltage is 230, dim if the voltage is 115, and, of course, will not light at all if the circuit is dead.

Some Basic Principles of Permanent Wiring

Too often permanent wiring in a building is tampered with and the results are not safe and satisfactory. For best and most convenient use of electricity, however, it is occasionally necessary to change permanent wiring or add to existing systems.

In making changes or additions, there are a few simple rules that should always be followed:

1. Be sure the circuit is "dead".

2. The insulation should never be removed from any permanent wiring except inside of a metal box. (Approved plastic boxes may be used instead of metal if desired).

3. Always solder connections and insulate them with first rubber tape, then friction tape.

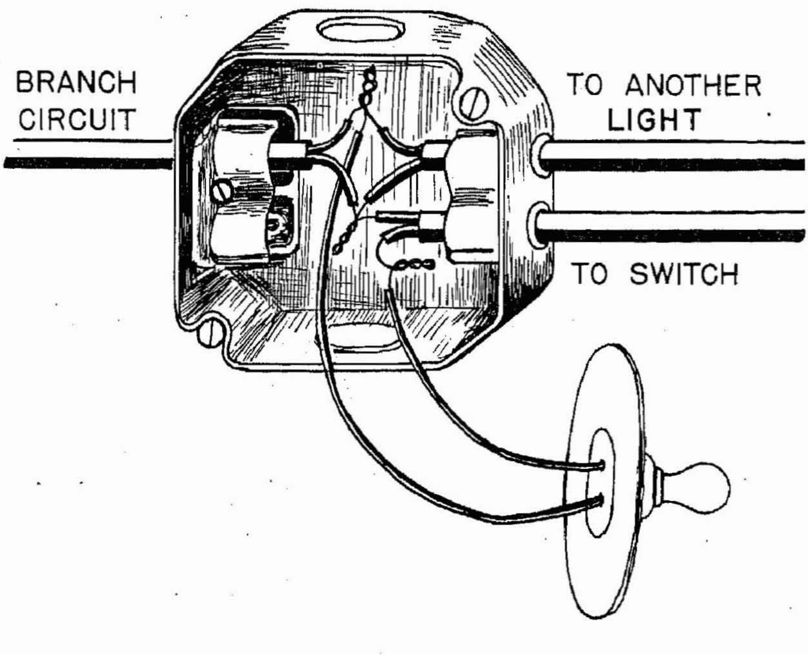
4. Be sure that wiring is securely fastened to framing members at frequent intervals with wide metal staples or straps.

5. The wire cable including all of its insulation should be fastened securely to the metal (or plastic) box with an appropriate clamp, and of course, the box should be sesecurely fastened.

Installing a Wall Switch in a Light Circuit

For this goal, it is recommended that the switch be installed in a building where the inside walls or one side of the joists have not been covered so that the wiring is exposed to view. Follow these steps:

(1) Be sure the circuit is "dead".



(2) A lamp will have two wires leading to it. The switch can be put in either one of the wires. At the metal or plastic box where the wires to the lamps are spliced to the wires of the branch circuit, unwrap and open the splice on **one** side.

(3) Run the switch wires, either #12-2* or #14-2, into the box and clamp them, leaving about 4 inches inside the box.

(4) Splice one of the wires to the loose wire from the light and the other to the loose or open wire of the branch circuit. Solder and tape both connections. Replace the box cover.

(5) Run the #12-2 wire to the switch position. Where it must cross joists or studdings, bore a hole and go through rather than over or under the wood. Staple or strap the wire securely.

(6) At the switch position install a switch-and-receptacle box.

(7) Clamp the #12-2 wire into the box and leave about 6 inches of loose ends.

(8) Remove all of the insulation, inside the box, that is around both wires.

(9) Remove ¾ inch of insulation from each wire and fasten them under the screws of a single pole switch. The wire loop should turn the same way the screw does when it tightens.

(10) Fold the wires into the box, push the switch in and fasten it with screws at top and bottom.

(11) Install the cover plate with two screws.

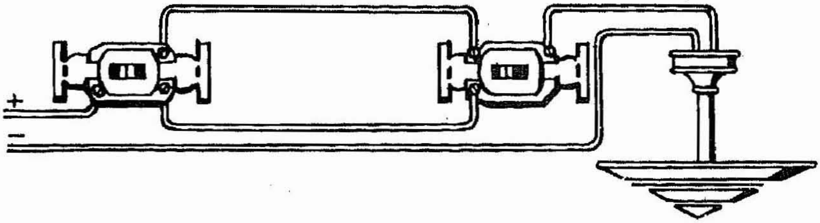
(12) **Have your installation inspected** before you turn it on. It is desirable to have a representative from your power supplier inspect, but at least have it inspected by someone who has done electrical wiring.

Switches for Control from Two or More Places

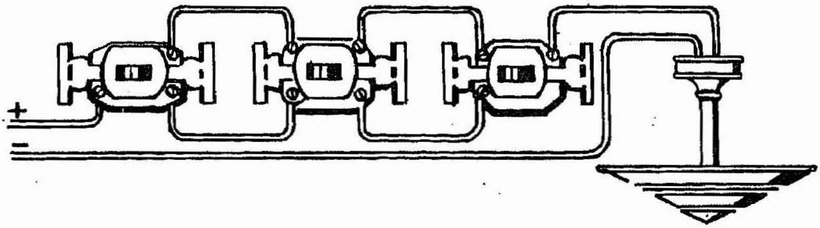
The same basic principles of wiring should be followed when switches are installed to control lights or appliances from more than one position.

*The expression #12-2 means there are 2 No. 12 wires in one sheath or cable, #14-2 means 2 No. 14 wires

The following diagrams may be followed. These diagrams are schematic and not actual. For example, the two wires between switches would be the usual #12-2 or #14-2 cable. The two wires are enclosed in the same overall insulation. However, the individual insulation on each wire is a different color so you can know which is which.



Use two 3-way switches for control from two places.



Use a 4-way switch and two 3-way switches for control from three places. For each additional control point add a 4-way switch between the two 3-way switches.

How to Add a Circuit to an Electric Wiring System

Frequently, you need another branch circuit in a house or building. Perhaps you have purchased some new motor or appliance and do not have an outlet for it. We recommend that this goal be selected only when there is definite need for an extra circuit.

Procedure

1. Survey the situation. Determine if there is an extra or unusued circuit on the entrance breaker or fuse box. Decide where the wires will run, what obstacles they will meet and how you can get by them. Decide whether one convenience outlet or more should be installed. Will the voltage be 115 volts or 230 volts? Do

not add a 230-volt circuit until you have first successfully added a 115-volt circuit.

2. Provide all necessary wiring materials before you start. Remember that 230 volt plugs and outlets are different from 115-volt materials.

3. If the entrance breaker or fuse box has an extra circuit, clamp your wire to the box, but do not connect the wires until your installation has been completed and inspected.

If an extra circuit is not available, you can either get a box with more circuits or you can install another breaker or fuse box near the present one. **Note: These instructions do not include changing the breaker or fuse box or wiring an additional box to the present one.** An experienced electrician should be employed for that part.

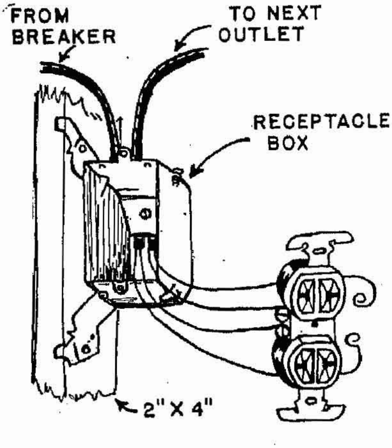
4. If an additional box is to be used, start your wiring from the load side of the breaker or fuse of the new box.

5. Run your wire to the first convenience outlet.

6. If more outlets are to be wired in, start another piece of wire at the first outlet. Connect it under the second set of screws provided for that purpose.

7. Use outlet receptacle boxes for each outlet. Be sure they are fastened securely. Be sure the wire and all insulation is clamped into each box and that the wire is securely fastened all along the way.

8. Leave about 6 inches of the wire in each receptacle box. Remove all the insulation common to both wires, in the box, and about ¾ inch of the insulation from the end of each individual wire.



9. Make a loop in the ends of the wires and fasten one on each side of the outlet, being sure the wire turns under the screw in the direction the screw tightens.

10. Fold the wires into the box and fasten the outlet in with the screws provided.

11. Put on the cover plate.

12. When the circuit is installed, **have it inspected.** Perhaps

the electrician who will connect it to the present breaker or fuse box, or who will install the new box with more circuits, will inspect it.

Automatic Lighting in the Poultry House

Artificial light in the poultry house definitely contributes to the production of more eggs in the winter when egg prices are high. Automatic controls are very convenient and will insure the regular use of lights during the seasons they are needed.

Times of using artificial light in poultry houses are:

1. **Morning Lights** turned on at 3 a.m. or 4 a.m. and off at daylight.

2. **Evening lights** turned on at dusk and off at 9 p.m. or 10 p.m. They cannot be turned off suddenly, but must be dimmed for about 20 minutes, while the hens find their roosts.

3. **Morning and Evening Lights** are turned on in the morning, off at daylight, on at dusk, dimmed later in the evening, and then off.

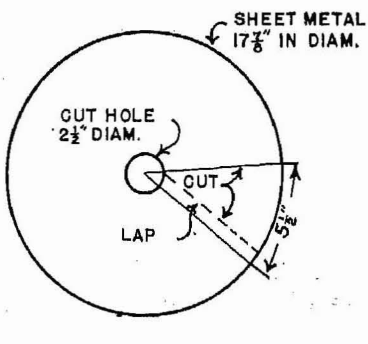
Automatic lighting is relatively simple to install for morning lights, but much more difficult to install for evening lights because of the necessary dimming arrangement. There are, however, time switches on the market for both systems.

If a time switch including a dimming device is obtained, two circuits, one for the bright lights and one for the dim lights can be installed.

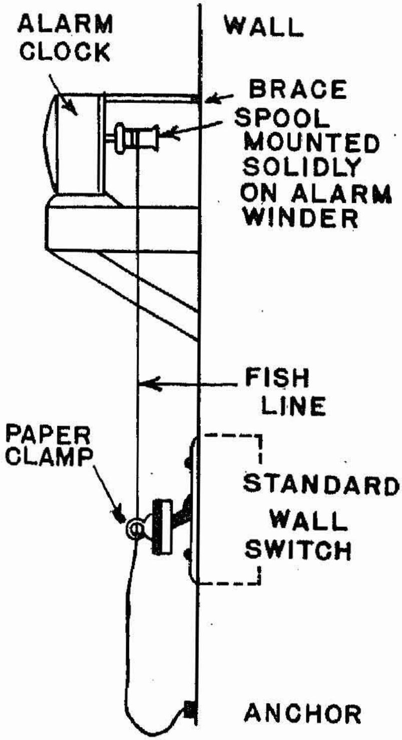
If a time switch is provided which will only turn lights on and off once every 24 hours, then only the bright lights should be installed and used in the mornings.

Instructions here will deal only with the system of automatic morning lights. If another system is desired, it is recommended that the Montana Extension Mimeograph Bulletin, "Electric Lights in the Poultry House," be obtained from your County Extension office, and followed.

Lights in the poultry house are most effective if they have a reflector. An ordinary 12-inch shallow dome reflector, white enameled inside is recommended. However, a suitable reflector can be made from a piece of sheet metal, either galvanized or aluminum, 17 7/8 inches in diameter as shown.



Size and Number of Lights. A 40-watt light in a reflector for each 200 square feet of floor area is necessary. Without a reflector at least a 60 watt light for every 200 square feet would be necessary. The lights should be 6 or 6½ feet above the floor. They should be located so that all parts of the house are well lighted, although the roosts need less light than any other part.



Wiring. Non-metallic sheathed cable (#14-2) can be used satisfactorily. Either galvanized metal boxes or the plastic boxes may be used.

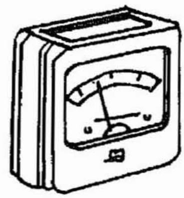
Controls for poultry house lighting should include (1) an entrance circuit breaker (2) a wall switch and (3) the time switch. The time switch can be either manufactured or homemade.

Homemade Time Switch. One simple homemade time switch is made as shown from a regular alarm clock. A spool is slotted and mounted solidly on the alarm winder. As the alarm goes off, the spool winds up a fish line attached to the wall switch with a strong paper clamp. The line can be anchored to the wall so the clock cannot run down each time.

Check Your Lighting

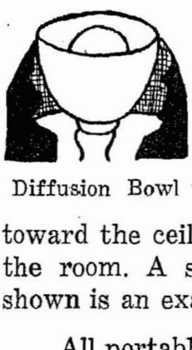
Principal Points of Good Lighting.

Good lighting in the house or even in the workshop or barn depends upon several important things. First, there should be enough light for the job. Have it in the right places and see that it is free from glare for the worker. Some jobs require more light than others. To measure the amount of light on any surface, we use a light meter. The unit of measurement is the foot-candle. Do not confuse this with the wattage rating of your light bulbs.

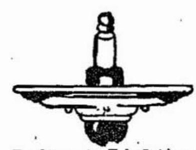

Light Meter

For close, fine work like sewing on dark goods, as much as 75 to 150 foot-candles of light are needed on the surface of your work. For moderately close work such as reading small print or studying for long periods, from 20 to 70 foot-candles are needed. Reading large type, dressing , preparing foods and other average work requires only 15 to 30 foot-candles. General lighting in dining rooms, halls, shops, and barns can be well lighted with only 5 to 15 foot-candles. Your power supplier may be able to help you measure your light intensity and plan for better illumination. However, if you are unable to obtain the use of a light meter, you may inventory your lighting without it by using your own judgment as to the correct amount of light.

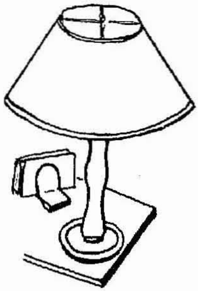
Many rooms that are lighted with only a center fixture, need light in more places. No one likes to work in his own shadow at the kitchen sink or workshop bench. Neither does anyone like to gaze directly into a bright light. Use inside frosted bulbs and place them in a diffusion bowl. This is called diffused lighting. It helps to eliminate glare and sharp shadows by breaking up or diffusing the light rays. Glare causes discomfort and eyestrain.


Diffusion Bowl

Indirect lighting may be best for some rooms. This is where all of the light is directed toward the ceiling and so reflected throughout the room. A silver bowl bulb and fixture as shown is an example.


Indirect Lighting

All portable lamps such as floor lamps and desk lamps should be shaded. Place the lamp so the light will shine on your book or other work, but not in your eyes. The larger the lamp wattage, the larger the shade should be. See that your table study lamps are about 28 inches tall, have at least a 100-watt bulb, and a shade with an 18-inch diameter at the bottom. Use floor lamps that are from 56 to 62 inches tall and use a 100-200-300-watt three-light bulb with an 18 to 20 inch shade. Be sure to keep your shades and diffusion bowls clean. A light coating of dust will cut the light strength



Shaded Desk Lamp

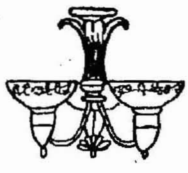
by 25 percent or more. Clean them all regularly and be sure of good lighting efficiency.

Interior Lighting

Good lighting in one room of your house may not be suitable in others. Fit the light to the need. The effective use of light in any room depends partly on the reflective qualities of the walls and ceilings. Dark colors absorb light while light colors reflect and disperse it. Here are some suggestions for types of fixtures and size of lamp bulbs to use in your various rooms.

Ceiling Diffusing Globe

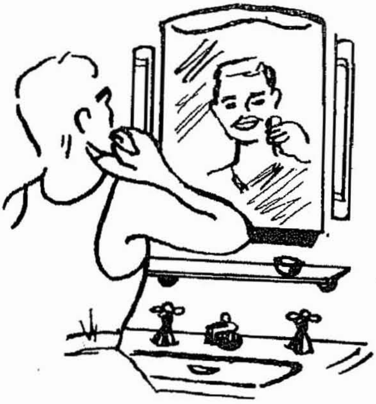
The kitchen will normally need at least two lights. A center ceiling fixture with a 10-inch glass diffusing globe and a 100 or 150-watt lamp bulb will give good general lighting. Operate this from a wall switch. In addition to this you will want another light over the sink and work table or over the range. An 8-inch diffusing globe with a 75-watt bulb is often sufficient here. Also, a small lamp or a fluorescent fixture under the cupboards is convenient for close work.



Dining room lighting is probably more effective when coming from a center ceiling fixture directly over the table. This may be a single or multiple type fixture with a total wattage of 150 to 200 watts. Add wall bracket type fixtures if the room is large and needs them.

The living room of the modern home can be well lighted with portable lamps. If the room is large, you may use two floor lamps, each with 100-200-300 watt three-light bulbs. End table or study table lamps with either 100 or 150 watt bulbs will add both comfort and convenience for your reading or study hours. Most home owners prefer a soft effect in their living room lighting. Any under-lighting or glare detracts from the pleasantness of the room. If you do not have center fixtures, at least one light should be on a wall-switched convenience outlet so you can turn it on as you enter or off as you leave the room. Provide other outlets at least every 8 or 10 feet. This allows for rearrangement of your furniture and lighting.

Bedroom light is pleasing when it comes from a ceiling fixture of the indirect diffused type. A 100 to 150-watt bulb is sufficient. A small shaded light with at least a 60-watt bulb on each side of the mirror or dressing table will give plenty of light for dressing. Some folks like a reading lamp at the head of the bed for night reading. Don't skimp on the bulb size here or you'll strain your eyes.



The bathroom needs lighting at the mirror. Two 60-watt bulbs —one for each side of the mirror in a small enclosed glass diffusion bowl is good. Substitute two 15 or 20 watt fluorescent lamps on either side of the mirror if you choose. Unless the bathroom is small, it needs a ceiling fixture controlled by a wall switch. A 100-watt bulb in an 8-inch diffusion globe is about right.

The laundry needs at least one 100-watt bulb in an 8 or 10 inch diffusion globe placed over the working area. Control this by a wall switch.

The storage cellar will require a center fixture similar to the one in the laundry for general lighting. If you have separate sorting and grading tables for fruits and vegetables, you will want another light similar to the one over the kitchen sink.

SILVERED BOWL

Halls and stairways must have ample light. A silver bowl bulb is good. A similar sized inside-frosted bulb in a flush or semi-flush fixture will serve. Switch these from both ends of the hall or stairs.

Closets normally need a 60 or 75-watt bulb in a small bowl. A small glass globe with an inside frosted bulb is good. This light can be switched by a pull chain.

Porches need at least a 100-watt bulb in an 8-inch glass globe. Switch the light at the door.

List each light around your home, describe it, indicate what it is used for. Does it give enough light, does it glare, is it in the right place? For a more complete study of lighting, get a copy of the USDA bulletin, "Making Light Work For You" from your County Extension office.

HOW TO MAKE A STUDY LAMP

A Study Lamp

A properly designed table lamp in your home makes reading, studying, and sewing easier and more comfortable. It conserves eyesight, saves energy, and gives your room new attractiveness. You can make one, cheaply and easily, with materials readily available.

You Need These Materials.

2 1"x2"x18" lumber for stem of lamp

2 ¾"x8"x8" lumber for lamp base

1* Lamp socket with switch (threaded for ⅛" pipe)

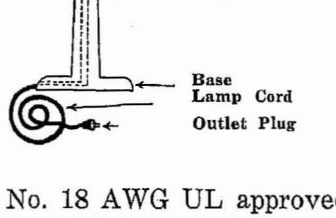
⅛" pipe nipple 1" or 1½" long (to fit socket above)

1 shade holder to fit socket (supports diffusing bowl)

1 Diffusing bowl (8" for 100-watt or 9⅜" for 150-watt bulb)

1 Shade (white lined, with bottom diameter 16" to 18")

1 100-watt or 150-watt bulb



1 Lamp cord, 9-foot (not smaller than No. 18 AWG UL approved conductor)

1 Outlet plug (preferably of rubber, easy to grasp)

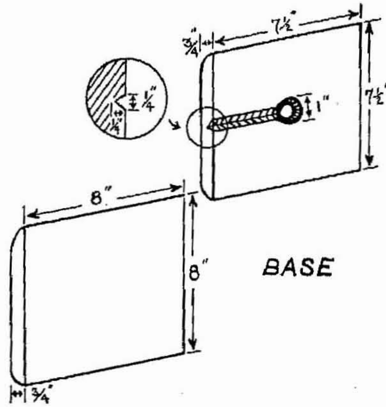
2 No. 10 wood screws; glue for wood; fine sandpaper; tools.

First read the directions from start to finish. Better examine the sketch closely as you read.

*Be sure to buy a socket with a three-position switch if you use a 3-light bulb (50-100-150-watt).

Steps in making a Base and Stem.

Base. The base is made of two flat pieces, each ¾″ thick (before planing and sandpapering), glued together. The lower piece should be 8″ square, and the upper piece 7½″ square.

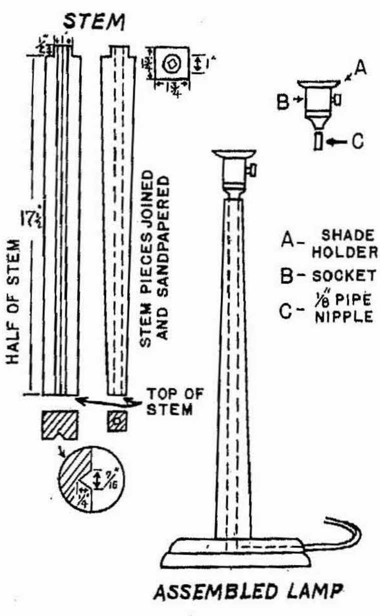


1. Cut the pieces to dimensions given above—plane and sandpaper.

2. Round the upper edges and corners with wood rasp and sandpaper for smooth appearance.

3. Drill a 1″ hole through the center of the upper piece. Cut a groove ¼″ wide and ¼″ deep on the underside of this piece, from the edge of the hole to the edge of the piece. Rub this groove with sandpaper to provide a smooth channel for the cord through the base.

Stem. The stem is made of two pieces 1″x2″x18″ grooved and shaped as sketched, then glued together.



1. Cut the pieces, then cut a V-groove 7/16″ wide and ¼″ deep the length of each piece.

2. Sandpaper the groove so that all rough spots which might wear the cord are removed.

3. Trim and plane the stem so that it is 1¾″ square at one end and 1″ square at the other. Rub with fine sandpaper to make smooth.

4. Glue the pieces together so the grooves match to form a square hole in the center of the stem for the lamp cord. This hole will be about 5/16″ square.

5. Round off the last half-inch of the large end of the stem to fit into a 1″ hole in the base.

Easy to Modify Design. This plan shows only one design of lamp. You may want to make a stem from a single piece 2″ square with a 3/8″ hole through it lengthwise. Or a round stem turned on a lathe to any desired pattern, or a plain round stem wrapped in thick cord, reed, or raffia tacked and glued into place and shellacked for an interesting appearance.

You may want to make a round base with two 3/4″ pieces dressed to 5/8″, the bottom piece 8″ in diameter, the top piece 5″ in diameter. Or . . .

An octagonal base from two 3/4″ pieces, 8½″ and 6½″ square, by cutting off their corners. Cut the design in paper first.

How to Assemble Lamp.

1. Thread the lamp cord through the base and through the stem.

2. Glue stem and base together. Two flat-headed wood screws* through the base into the stem will strengthen the joint.

3. Thread the cord through the pipe nipple. Screw nipple into hole at top of stem so that about 3/16″ of it extends above the stem. To do this more easily, attach the socket to the nipple temporarily; grasp the socket to turn the nipple.

4. To insure a solid union, remove the nipple, add glue and replace nipple.

5. Screw socket base onto the nipple, attach cord to socket connectors and assemble socket.

6. Attach outlet plug to end of cord.

7. Screw the shade holder onto the socket. Fit diffusing bowl onto shade holder. Then turn screws to hold it firmly in place. Insert bulb and place the shade on the completed lamp.

Decorative Lamps

Old fashioned oil lamps can be converted into electric lamps with the aid of a few simple parts and materials, available in an electrical appliance, hardware or variety store. If your oil lamp base is more than 11 or 12″ high, you can remodel it into an efficient reading lamp with a diffusing reflector. Oil lamp adaptors

*If wood screws are used, they must not be close to the cord. Put them through the under side of the upper part of the base into corners of the larger part of the stem. Screw in, then remove them, glue the base and stem together, replace the screws and tighten them.

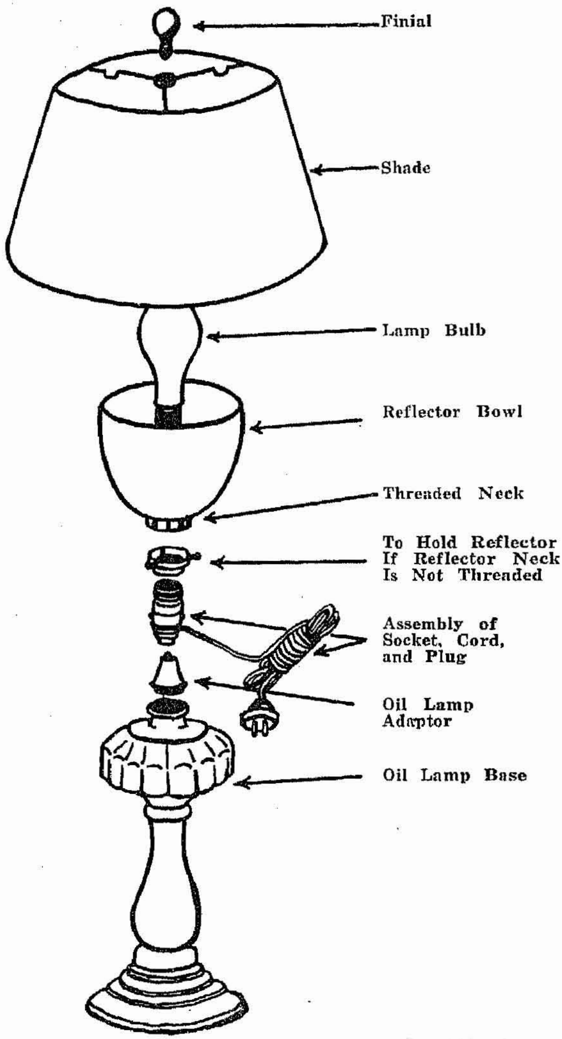
that are threaded to screw onto an oil lamp base are made in three sizes: Numer 1—7/8", number 2—1¼", and number 3—1⅞". Number 2 size is the most common.

Beside the adaptor, you will need a socket and cord assembly, lamp bulb, reflector, shade, and finial. The adaptor, socket and cord may come as a complete unit.

You can fill the oil font with water tinted to harmonize with the shade or room decorations.

For most efficient spread of light, the bottom of the shade of your converted lamp should not be less than 14" from the table. If it is lower, you should set your lamp on a wooden stand that will bring the bottom of the shade to a point between 14" and 15" from the table. This stand can be stained or painted to match the shade or furniture.

An extremely short oil lamp cannot be converted into an acceptable reading light. This type of lamp is for decoration only; occasionally a pair, without diffusing bowls, can be used for dressing table lamps.



Most of these lamps need an 8" diffusing bowl, 100-watt bulb and 16" white-line shade.

Lamps can be made also from large bottles, vases, candlesticks, blocks of wood, etc. Unless your old lamp or vase is inherently beautiful, or has sentimental value, do not waste time and money converting it—the results may be disappointing. Usually, the cost of conversion might be more profitably applied to buying a new lamp.

How to Build an Electric Pig Brooder

Pig brooders save on the average 1 or 2 more pigs per litter. They also make possible earlier farrowing with the total result that more pigs can be marketed earlier, usually at a higher price.

You will need the following materials:

Lumber

1 1" x 12" x 8'.

1 1" x 4" x 12'.

1 1" x 6" x 12'.

1 piece ½", 5-ply plyboard, triangular shaped, 48" x 67¾" (a piece ½" x 4' x 8' will provide material for 4 roofs).

Other Materials

1 strip hardware cloth, ½" mesh, 18" x 18".

½ lb. 8d common nails.

½ lb. 6d common nails.

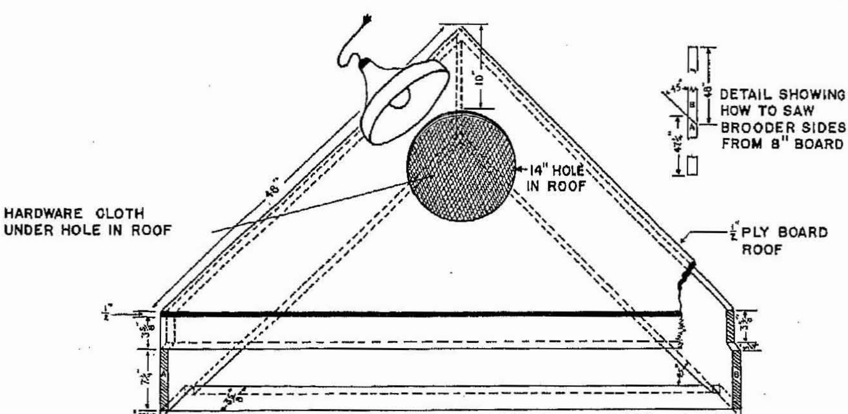
½ lb. wire staples.

1 14" reflector, enameled.

1 weatherproof electric socket.

1 10' rubber-covered extension cord.

1 100-watt or 150-watt electric lamp.



Cut materials to required size. Saw the 1"x12"x8" board as shown in the detail drawing to make two boards, A and B. (Letters A and B refer to notation on drawing). The longer edge of A is 47¼" and the longer edge of B is 48".

Cut 45° notches in the beveled ends of these boards. Cut the

1″x6″x12′ in two pieces for brooder guard rails. Cut from the 1″x4″x12′ board 2 pieces 67¾″ long for braces.

Cut hardware cloth to size 18″x18″.

Cut the ½″x4′x4′ sheet of 5-ply plyboard into 2 triangular pieces, size 48″x48″x67¾″. Only one is needed unless 2 brooders are being made at the same time.

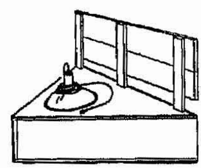
Draw a line from the point of the triangular plyboard, opposite the long side, to the middle of the long side. Mark out a circle with 7-inch radius, using the mid-point of this line as center. Cut out this circle of 14-inch diameter, using a keyhole saw or other appropriate cutting tool.

Assemble the Brooder. Nail the square end of the 1″x12″x48″ board to the square end of the 1″x12″x47¼″ board. Be sure the ends are flush. Use 8d common nails.

Fit and nail braces into the notches which were cut in one end of each side as shown in the dawing. Saw off and smooth up the protruding corners after the braces have been rigidly nailed into place.

Staple the 18″x18″ piece of hardware cloth to the lower side of the plyboard roof, directly under the 14-inch hole.

Fit the plyboard roof into place as indicated in the drawing. Nail to the top edges of the sides and top front brace of the brooder. Use 6d common nails.



Assemble extension cord, weatherproof socket, 100-or-150-watt lamp and 14″RLM reflector. Insert lamp assembly and 14″ reflector in roof hole so that lamp cannot move out of position. Pack asbestos into the hole around the reflector so as to conserve as much of the heat as possible.

Place completely assembled brooder in one corner of the farrowing pen. Nail 2-1″x6″x6′ (or 1-1″x12″x6′ pieces across the corner of the pen above the brooder and flush with its front edge, the top about 2′3″ above the floor to form a guard. Nail perpendicular braces to the top of the brooder and to the back of the guard.

Have it inspected by your power supplier before using it.

Pig Brooder Operation. Place the sow in the pen a day or so before farrowing and turn the lamp on in the brooder several hours before the pigs arrive. Block the brooder entrance for several hours after the pigs arrive, to make sure that they keep warm and dry.

Keep the heat on continually for 10 days, not including the time before the arrival of the pigs.

If the weather is cold, this may be extended to two weeks, or as long as it is thought necessary.

Place the pigs in the brooder by hand until they learn to go voluntarily. In some cases it will be sufficient to place the pigs under the brooder only once or twice; in other cases a day or two of training will be necessary. You will be surprised at the way the little pigs run for the electric light instead of the sow, and you will be pleased at the number of pigs you save from cold and crushing.

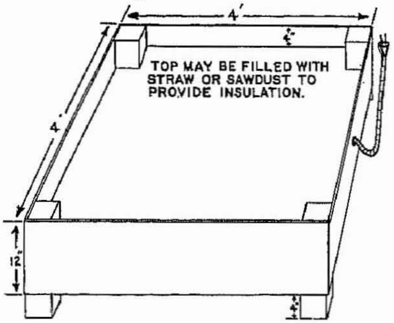
Fasten the brooder securely in place each time it is moved from one farrowing pen to another.

How to Make a Chick Brooder

Electric chick brooders are very simple to use and are safer than other types.

These materials will be needed:

1 piece ¼" plywood 4'x4'—(top)
4 pieces ¼" plywood 1'x4'—(sides)
4 pieces 2"x2"x16" (corner posts)
4 pieces 1"x1"x46" (cleats to support top)
2 porcelain lamp sockets.
20 ft. No. 16 Rubber covered appliance cord with plug
1-250 watt infra-red lamp.
1-150 watt spot or flood lamp.
4 strips of cloth for curtains.



Top of Brooder

How to build it:

1. Nail sides to posts.
2. Nail cleats to sides 4 inches down from top.
3. Notch corners of top to fit around posts.
4. Nail top to cleats on sides.
5. Fasten lamp sockets in centers of two opposite sides.
6. Wire the two lamp sockets together. Use a piece of the No. 16 rubber insulated cord. Fasten the cord to the top with staples.
7. Bore a hole in one side near the lamp socket. Insert the cord and attach it to the socket.
8. Keep the heat in by putting shavings or straw on top of the brooder.

9. Tack a curtain to the sides so it will reach almost to the floor.
10. Have it inspected by your power supplier before using it.

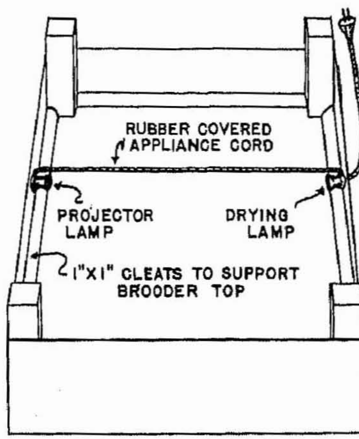
Using the Brooder.

1. Screw in the lamps and plug in the brooder for an hour or so before putting the chicks under.
2. Place the chicks under the brooder and watch them.

If they spread out comfortably, the heat is about right.

If they bunch together, there is not enough heat.

If they get far away from the lamps, there is too much heat.

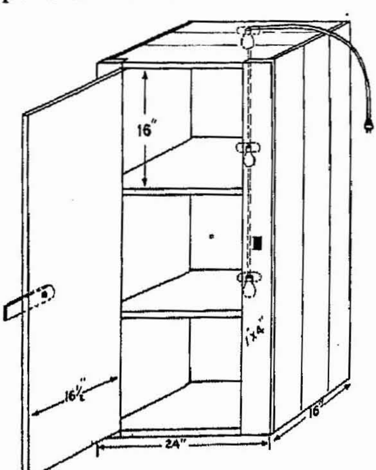


Bottom of Brooder

3. Regulate the heat by screwing out one lamp or the other. **Caution: Do not leave a socket empty.** A chick may reach in and be electrocuted. Screw in a small or burned out lamp bulb.

How to Make a Lamb Brooder

There are two types of lamb brooders. One type is used to warm a newly born, chilled lamb, for a short period of time. The other is to keep lambs warm for the first few days if the lambing pens are cold.



Making the First Type:

Use shiplap or tongue and groove lumber.

1. Build a box 24 inches wide, 16 inches deep and 51 inches high.
2. Build in two shelves, making three compartments each 16 inches high.
3. Make one door on the front side.
4. Mount a lamp socket in the back, top center of each compartment.
5. Wire the lamps together with No. 16 rubber covered appliance cord.

6. The cord should be long enough to attach a plug and reach to a convenience outlet.

Making the Second Type: This is exactly the same as the pig brooder described on page 40 except that the sides are higher. Use two 1″x10″ boards for each side instead of one 1″x12″ board as for the pig brooder. Two more cleats will be needed to nail these side boards together. Use the same lamp, reflector and everything else.

How to Make an Electric Hotbed

A hotbed heated with electricity is clean and nice to work with. It keeps the right temperature regardless of weather. It can be used as a coldframe just by turning off the electricity.

The hotbed shown here is called a **two-sash** size. It requires only a 115-volt outlet to supply the electricity.

The Materials that Will Be Needed:

A 6 ft. x 6 ft. box frame 12 inches high in front and 18 inches high in back.

2 hotbed sashes each 3 ft. x 6 ft. (Home-made frames and glass substitutes are good).

60 feet of soil heating cable (400 watts, lead covered).

A thermostat with bulb and adjusting knob.

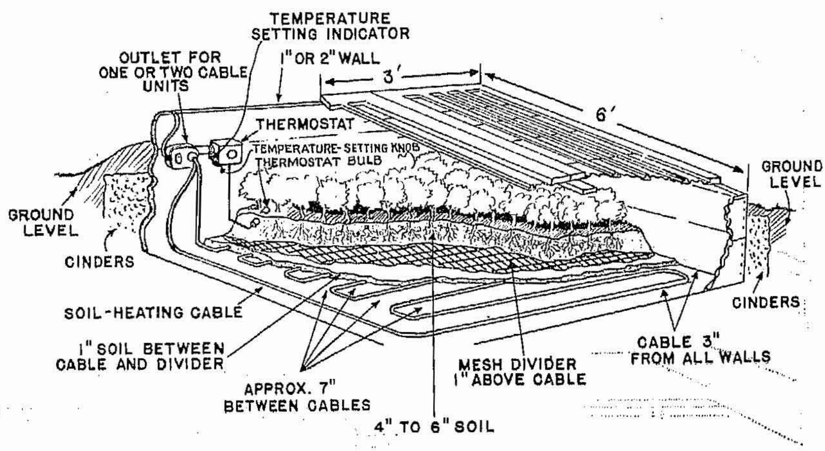
A convenience outlet.

Two strips of ½ inch mesh hardware cloth 36 in. x 6 ft.

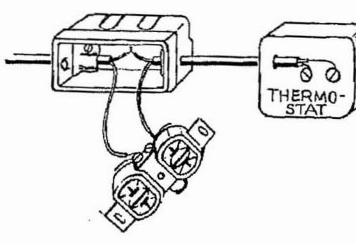
8 screen door hooks and eyes.

How to Put it Together

1. Locate it where the top can slope to the south in the sunshine.



2. Is your soil well drained? If it is, dig a pit about 14 inches deep and 6 feet 8 inches square. If not well drained, build the hot bed on top of the ground.
3. Cover the bottom with four inches of coarse cinders for heat insulation.
4. Set in the box frame.
5. Put a 1 inch layer of sand or dirt in the bottom.
6. Lay the 60 feet of soil heating cable as shown. It should be about 3 inches from the walls and 7 inches between cables.
7. Cover the cable with 1 inch of dirt or sand.
8. Lay the hardware cloth over the entire surface. This is to protect the cable from your spade.
9. Spread on about 5 inches of fertile top soil.
10. Mount the outlet box and thermostat in the upper corner of the box.
11. Install a wire to bring electricty to the outlet. This may be either permanent or temporary wiring. If it is to be permanent, use weatherproof materials. Have a qualified electrician install it. If it is to be temporary, use a rubber covered cord of No. 16 wire. Plug it into a convenience outlet in a nearby building. Use larger wire if the cord is **longer than 50 feet.**
12. Wire the convenience outlet and thermostat as shown in this diagram.
13. Fasten each sash to the frame with hooks and eyes.
14. Have it inspected by your power supplier before using it.

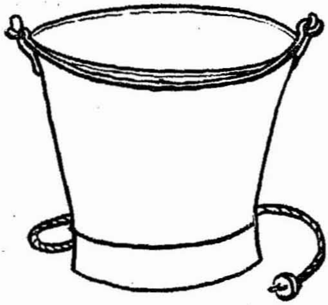


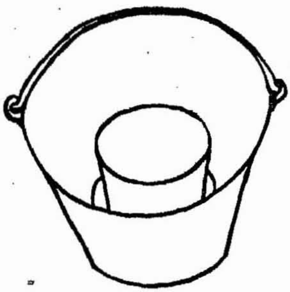
Operation.

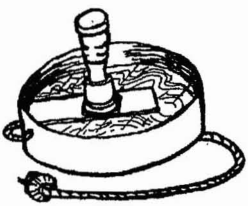
1. Place the thermostat bulb in the top soil with the end exposed to the air. Set it to hold the temperature between 55° and 70°. Plants that can be planted outside early in the spring such as radishes, peas, and lettuce can use the lower temperatures. Plants that must be planted late outside, such as tomatoes, cucumbers, and cantaloupe, must have the higher temperature.

2. Ventilation is important, so the sun will not cook the plants. The lower end of the sash may be propped up for a little air, or taken off entirely when the sun is very hot.

How to Make a Poultry Water Warmer







Poultry water may be kept warm by more or less elaborate heating elements and thermostats, or it may be kept from freezing with a simple light bulb. It is most important to have water available to poultry at all times. For example, if morning lights get the poultry up early in the winter time, much of the advantage is lost if their water supply is frozen. Therefore, the first need is to supply just enough heat to keep the water from freezing. The small cost of the electricty may be recovered many times by increased production. On the other hand, there is some question regarding the economic value of maintaining the water at some specified temperature above freezing.

One simple piece of equipment to keep poultry water from freezing is an ordinary bucket fitted with a light bulb as follows:

1. Cut a hole in the bottom of the bucket to fit a tin can 4 to 6 inches in diameter.

2. Invert the can in the bucket and solder it in. Make it watertight.

3. Cut a circular piece of wood from a 2 inch plank the exact size of the bucket bottom.

4. Mount a lamp holder in the center of the wood.

5. Fasten a strip of sheet metal around the edge of the wood with screws. The metal should be flush with the bottom of the wood and extend about ½ inch above forming an edge to hold the bucket.

7. Attach a rubber insulated cord. Drill a hole just large enough for the cord through the sheet metal to the center of the wood. Drill a larger hole under the lamp holder. This makes it possible to have the cord completely concealed.

8. Screw in a 60-watt light bulb. Set the bucket of water on the base and plug the cord into a convenience outlet.

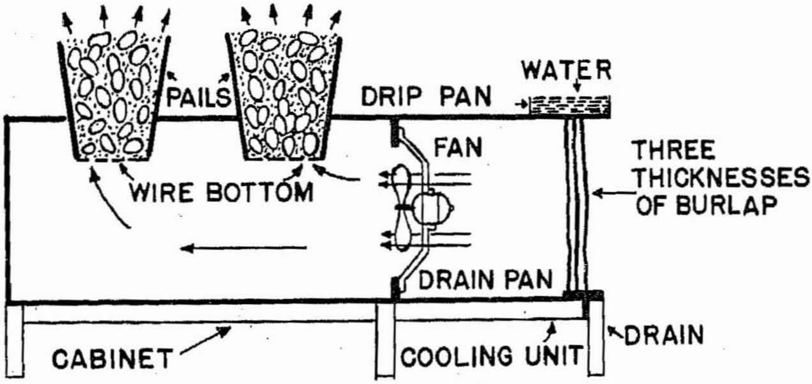
9. Have it inspected by your power supplier before using it.

The heater should be plugged in when there is any possibility that water might freeze in the poultry house. Experience will show whether a smaller bulb may be used or not. If the poultry house is well insulated, it is very likely that a 40 watt bulb is large enough.

Avoid spilling water on the lamp as it is liable to break. Also, avoid letting the lamp burn when there is no water in the bucket. The intense heat will shorten the life of the lamp bulb considerably.

How to Make an Egg Cooler

Eggs must be cooled to 50° as quickly as possible. At the same time, the humidity must remain high. A simple arrangement that cools and humidifies can be made from a box and wet burlap. What to do:



1. Make a box about 5 feet long and 16 inches square. Use a wood frame and cover it air tight with either plywood or sheet metal.

2. A 10-inch fan should be solidly installed about one-third of the distance in from the open end. Unless a fan with a square frame is used, make a frame from plywood or sheet metal. Cut a round hole with a diameter large enough to clear the fan blades by ½-inch on all sides.

3. Cut holes in the top of the box to fit the egg buckets.

4. Cut out the bottom of the bucket and replace it with ½-inch hardware cloth, soldered in.

5. Tack 3 thicknesses of burlap in the end of the box.

6. Prick two very small holes in a water pan. Use an awl or sharpened nail as a punch.

7. Drill ½″ holes in the top of the box under the holes in the pan so the water will drip onto the burlap.

8. To begin operation, pour water on the burlap, fill the drip pan and start the fan.

9. If the burlap does not stay damp open the drip holes slightly. If water runs off the bottom, close the holes a little. To close them, turn the pan upside down on a block, and hammer the hole shut.

How To Install An Electric Motor on a Machine

Before you can install an electric motor on a machine, it is important to know (1) how much power is needed and (2) the correct speed of the machine's drive shaft.

Size of Motor. Machines previously operated by hand will usually take a ¼ or ⅓ H. P. Motor. On other machines it will be necessary to find out from the dealer or manufacturer what size motor it will take. Sometimes a neighbor may have a similar machine with a motor already installed and operating satisfactorily.

Types of Coupling. For the majority of installations, V-belts are very satisfactory. Occasionally, a flat belt is used and sometimes a roller chain. Direct coupling of motor shafts to machine shaft through a flexible coupling has several advantages, but it is more difficult to install.

Since V-belts are generally used satisfactorily, they will be discussed here. If you are considering another type of coupling, be sure to obtain complete information before hand.

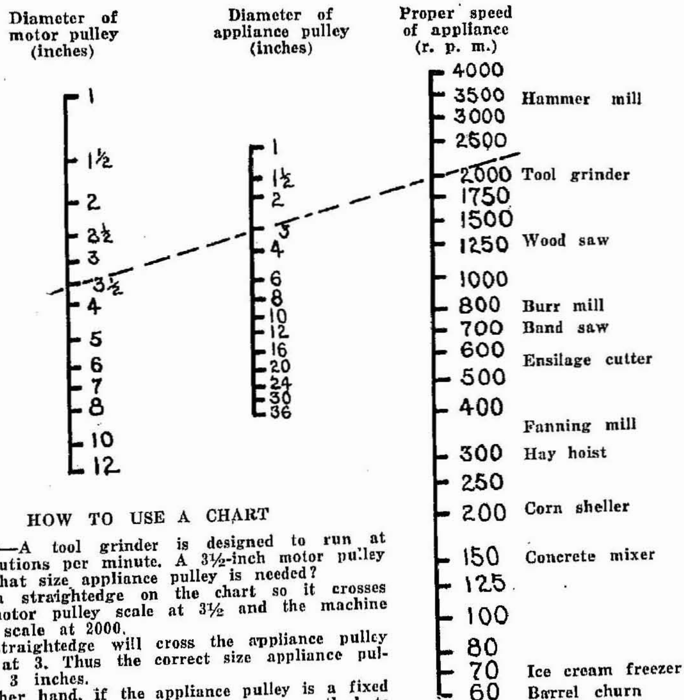
V-belts are commonly supplied in two widths, A and B. The A belt is ½″ wide and good for up to ¾ horsepower. The B belt is 21/32″ wide and is sufficient for 1½ horsepower. For larger than 1½ H.P. Motors, 2 or 3 V-belts or some other type of drive may be used.

Size of Pulley and Speed. Determine the speed of the shaft on the machine. This may be obtained by operating it by hand and counting the number of revolutions per minute, or it may be obtained from a nameplate or manufacturer's information. It might also be operated with a variable speed motor, such as a gasoline engine, and when it is operating about right, measure the speed with a speed indicator or tachometer.

Next determine the shaft speed of the motor. It is usually on the nameplate, but can be measured with a speed indicator. If the size of one pulley is known or assumed, the size of the other pulley can be calculated from the formula: speed of motor shaft times diameter of motor pulley equals speed of machine shaft times diameter of machine pulley. For example, suppose a machine shaft is to be driven 500 R.P.M. with a motor having a rated speed of 1750 R.P.M. Also, suppose the motor has a V-pulley with outside diameter of 4 inches. The diameter of pulley for the machine should be $1750x4=500xD$ or $D=\frac{1750x4}{500}=14$ inches.

A simple method of determining sizes of pulleys when motor speed is 1725 to 1760 R.P.M., is the accompanying chart.

Other factors to be considered when installing a motor on a machine are: (1) Type of motor. Is this motor the correct type for this load. See page 13 on Types of Electric Motors and Their Selection. (2) Is the motor to be permanently installed or is it to be used as a portable motor. See page 16 on Making Electric Motors Portable.



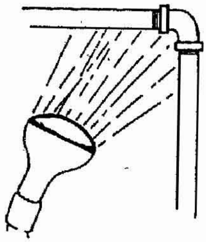
HOW TO USE A CHART

EXAMPLE—A tool grinder is designed to run at 2,000 revolutions per minute. A 3½-inch motor pulley is used. What size appliance pulley is needed?

1. Lay a straightedge on the chart so it crosses the motor pulley scale at 3½ and the machine speed scale at 2000.
2. The straightedge will cross the appliance pulley scale at 3. Thus the correct size appliance pulley is 3 inches.

On the other hand, if the appliance pulley is a fixed size, say 4 inches, then follow the same method to determine the correct motor pulley size.

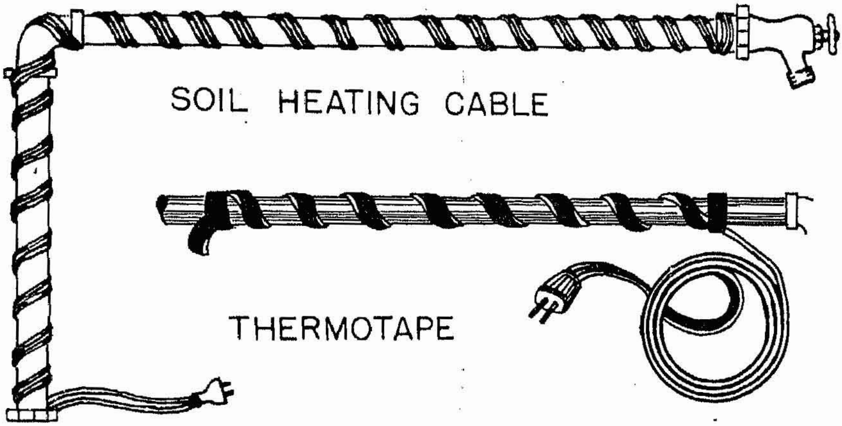
How To Thaw Frozen Water Pipes



Frozen water pipes may be thawed with three different types of electrical equipment as follows:

1. **Heat Lamps,** or even just ordinary large wattage light bulbs may be used. These are practical when the frozen portion of the pipe is very short and the rays of the lamp can be directed at the pipe. Results may be expected after several hours if drafts of cold air are not allowed to strike the pipe.

2. **Soil Heating Cable or Thermotape** can be wrapped around the pipe. A 60 foot length of soil heating cable can be used for long lengths of pipe.



The thermotape is available in shorter lengths and is used on short pieces of pipe. Either the tape or the cable can be left on the pipe all winter. They are excellent to **prevent** freezing. They can work automatically if a thermostat is wired into the circuit and fastened to the pipe.

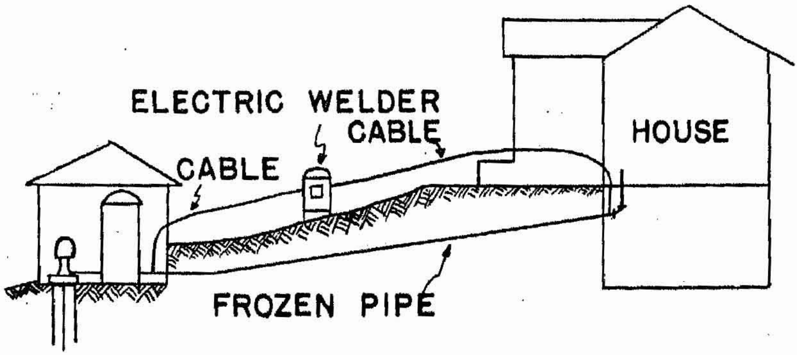
3. **Electric Welders** may be used to thaw pipes buried in the ground or wherever the heat cannot be applied directly. In this system, the electric current runs directly through the pipe and causes the heat.

Any kind of an electric arc welder can be used, but there are several precautions that must be taken.

How to hook it up:

1. Hook the welder electrodes to the pipe, at the closest points possible, on either side of the frozen part.

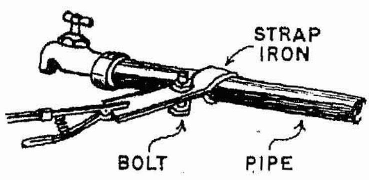
2. Be sure the electrodes make a good connection with the pipe. Generally, the welder's ground clamp can be attached to the pipe directly. However, the electrode holder will probably not open



wide enough. In this case, fasten a piece of strap-iron tightly around the pipe with a bolt. Clamp the electrode holder to the strap-iron.

3. Open the tap at the end of the pipe so the water will start to run as soon as it begins to thaw. If the tap or faucet is frozen, **thaw it first** by pouring hot water on it.

4. Set the welder current as follows:



a. For ½ inch pipe—125 amperes.

b. For ¾ inch pipe—200 amperes.

c. For 1 inch pipe—250 amperes.

d. If the maximum ampere rating is less than the figure shown above, use the maximum ampere rating for the welder. It will take longer, but ordinary size water pipes should thaw in a reasonable time. However, **Do Not** leave the welder on for more than **15 minutes** at a time. **Let It Cool** for 20 minutes after each 15 minute "on-period."

Precautions:

1. Be sure your welder electrodes make **Good Contact** with the pipe. A poor contact is apt to result in burning a hole in the pipe.

2. Do not let the welder run at more amperes than its maximum rating. Watch the ammeter if it has one. Most alternating current welders do not have an ammeter, but they will not exceed their maximum ampere rating very much, even on a short circuit.

3. Do not let a welder run more than 15 minutes on full ampere rating.

4. Do not connect the welder to a faucet. Connect to the pipe back of the faucet.

5. **Watch Three Points Carefully.** (1) The welder, (2) the connection at one end (3) the connection at the other end. This will probably take three people. When any part gets so hot you cannot hold your hand on it, shut the welder off, make the connections better, or cut down the welder amperes.

6. Some A.C. welders have a special arc starting device. It may be called a "booster." Be sure this is not used. Set a starting switch in the position for **thin metal.** If the arc starting device cannot be **switched-out,** set the amperes for 2/3rds of maximum rating.

7. Do not attempt pipe thawing by yourself. Have your parents or other adults, including some one familiar with the welder with you.

Demonstrations

A demonstration is simply **showing people how** to do something. Almost any of the subjects covered in this book may be used for a demonstration. For example, if you have made a pig brooder, you can show other people "how to build it," and that is a demonstration. You can **show** others **how** to repair a cord, care for a motor, install a switch or make any of the many items described in this bulletin.

You can show voltage drop by comparing the results of two identical pieces of electrical equipment. Supply electricity to one through large wires, and to the other through small wires. For example, try to toast bread with two identical toasters. One toaster may be fed through 100 ft. of No. 12-2 wire and the other through 100 ft. of No. 18-2 wire.

You can show how to do certain wiring jobs by building a small wall panel and wire it up in front of your audience. At the same time you can tell them what you are doing and why.

For further information on demonstrations, get bulletin 1002, **The Demonstration Way,** from your county extension office.