4-H Electricity PROJECT

2nd Year

FEDERAL COOPERATIVE EXTENSION SERVICE · OREGON STATE COLLEGE · CORVALLIS

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4-H *Electricity* PROJECT

2nd Year

HAVING completed one year in 4-H Electricity Club work, you will naturally wish to know still more about the use of electricity. You will want to apply what you have learned to different, actual applications of electricity in your home and on your farm.

During the year's work, each member will complete some project, such as building an electric pig or chick brooder or using an electric motor to drive a machine (such as a grindstone, churn, etc.), or similar practical application of electricity to some home or farm duty. Experiments are included to broaden your knowledge of how electricity works in industry too. More "Electrical Terms" will be explained.

If you wish to get the greatest good from your second year work, you should be sure you thoroughly understand the first year's work. One or two review meetings will be desirable to "brush up" on what you once knew. When your leader is sure that you know your basic subjects, it will be time to start on the new projects of the second year. Materials required will be listed with each job.

You should always remember that all electric equipment and appliances are built to be connected to some certain specified voltage source. This voltage is usually marked on each device. If the voltage is too high, excessive current may flow and burn out the device unless the fuse in the circuit blows. Too low voltage results in dim lights, or perhaps a late supper, because the range does not heat as fast as it should.

Particular care should be used to connect each device to its proper voltage source through conductors of sufficient size to properly handle the current necessary for its operation. Certain standard voltages have been adopted. Lights and small appliances are generally designed to operate at 110 to 125 volts. Motors above fractional horsepower sizes, ranges, and water heaters generally operate at double this voltage.

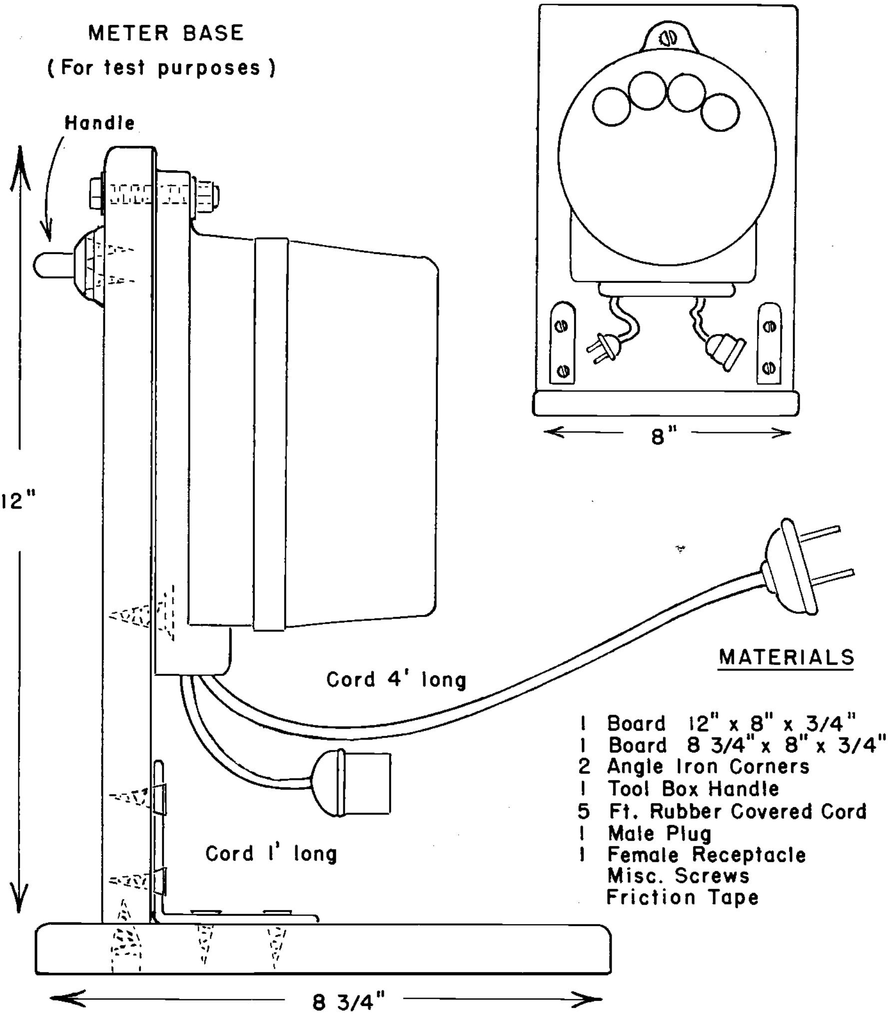

METER BASE
(For test purposes)
Handle
12"
8"
Cord 4' long
Cord 1' long
MATERIALS
1 Board 12" x 8" x 3/4"
1 Board 8 3/4" x 8" x 3/4"
2 Angle Iron Corners
1 Tool Box Handle
5 Ft. Rubber Covered Cord
1 Male Plug
1 Female Receptacle
Misc. Screws
Friction Tape
8 3/4"

Figure 1.

Job No. 1. Meter Reading

Each member should know how to read an electric meter. Your bill for electricity is calculated on the readings your meter indicates.

Materials required:

- A watt-hour meter which your leader will borrow from the local electric service office.
- Plug cap, connector body, 5 to 15 feet of No. 14 double conductor.
- Suitable support for the meter.

This material should be assembled as shown in Figure 1. The things you learned in your first year work will help you in getting this job underway. Remember to be neat and workmanlike and to follow safe practices in everything you do.

You will remember that in your first year Electricity Club work you learned that the kilowatt-hour is the measure of "work performed" or "energy delivered." In other words, when you pay your electric bill you are paying for the "energy" delivered to you. This "energy" was capable of doing a number of things for you, such as operating your radio, baking a cake in your electric range oven or pumping the hundreds of gallons of water you use on your farm and in your home. The "amount of energy" or kilowatt-hours that are delivered to you depends on the amount of work you want done. The heavier the "load" and the longer the hours run, the more kilowatt-hours are used.

An electric watt-hour meter is a device used to measure the "energy" or "kilowatt-hours" delivered to your home. It is built with all the precision of a fine watch and must be very accurate. State laws require that this accuracy be kept within certain limits.

A meter is very easy to read once you have learned the "hang of it." The first thing to remember is that the dial on the right (see Figure 2) must always make *one complete revolution* to cause its next door neighbor, the dial to its immediate left, to turn one point. You will also notice that, while the hands on the dials A and C turn in a clockwise direction, those on the dials B and D turn in exactly the opposite direction. You can tell easily which way the hands turn by noticing which way the figures read on the dials, as the hands always go from 0 to 1, to 2, to 3, and so on.

Looking again at Figure 2, let's see what this meter would read. Starting with the right hand dial, we see the hand points to "2," so we set this figure down. Dial B shows a hand pointing just past "3," so we put the 3 in front of our 2 from dial A and we have "32."

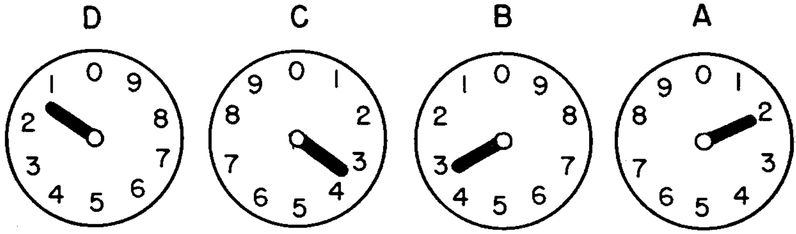


Figure 2.

Dial C shows the hand between 3 and 4, but we know it will not actually reach "4" until dial B has made a complete revolution, so we add another figure 3 to our "32" and now have "332." By the same process of reasoning we used previously, we determine that the figure for dial D should be "1." So our completed meter reading is "1332 kilowatt-hours."

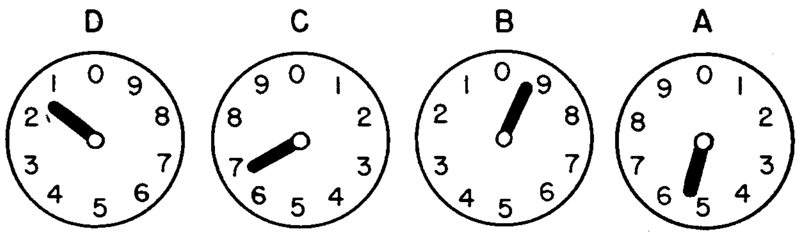


Figure 3.

Now let's see if we can read the dials shown in Figure 3. The first figure is certainly "5." Then we have a "9," making a "95" for the first two dials. The hand on the next dial looks as though it is right on figure "7," doesn't it? But we know that it will not actually reach 7 until the hand on dial B has completed its revolution—in other words, has gone on to the zero. So, for dial C we still have to call it a "6," which gives us "695." Then adding the "1" we find on dial D, we have the completed reading of "1695 kilowatt-hours."

Now, supposing we had taken the meter reading 1332, Figure 2, on November 1; and supposing we had taken the reading 1695, Figure 3, on December 1 and we wanted to find out how many kilowatt-hours we had used through the month. We would just subtract the first reading from the second reading,

1695 — 1332 = 363 kilowatt-hours

and find we had used 363 kilowatt-hours during the month of November.

Now that you have learned to read a meter, you will make a record of the reading of the club's demonstration meter. Then the meter will be plugged in on your leader's refrigerator or radio so that the next time you meet you can read the meter again and figure out how many kilowatt-hours his appliance has used since you last were there.

Each club member should record his or her home meter reading for each month during this second year of Electricity Club work so you can find out how much "energy" is used each month. The meter should be read on the last day of the month or on the same day your regular meter reader reads it. Once you start your record, all other readings should be taken on the same date of each month. Readings should be marked down on a sheet in your record book. Actual use may be found by subtracting the reading of an earlier month from the next month. By placing the first reading toward the bottom of the page, subtractions will be made easy. Suggested headings for columns are:

Date	Reading	Use
	Kwhr	*Kwhr*

Job No. 2. Connecting Light Switches and Lamps

Two very easy but extremely interesting jobs club members can do are to wire up a single pole switch so that it will turn a light bulb off and on; then do the same, using two "three-way switches." "Three-way" switches are used where it is desired to switch a light on or off from either of two different locations. An example would be an arrangement to permit you to turn the basement light on or off by flicking a switch either upstairs or down in the basement.

Materials needed for this experiment are:

- One porcelain lamp receptacle.
- One single pole switch.
- Two three-way switches.
- One plug cap.
- Ten to twenty feet No. 14 rubber covered wire.

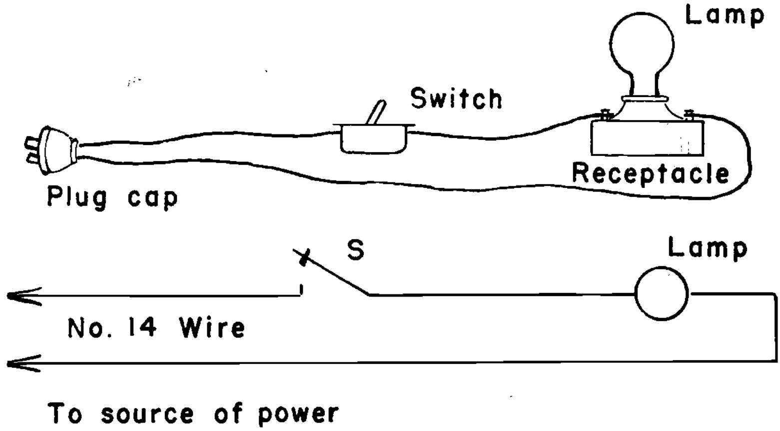


Figure 4. Connections and schematic wiring diagram. Connecting a single pole switch for a light.

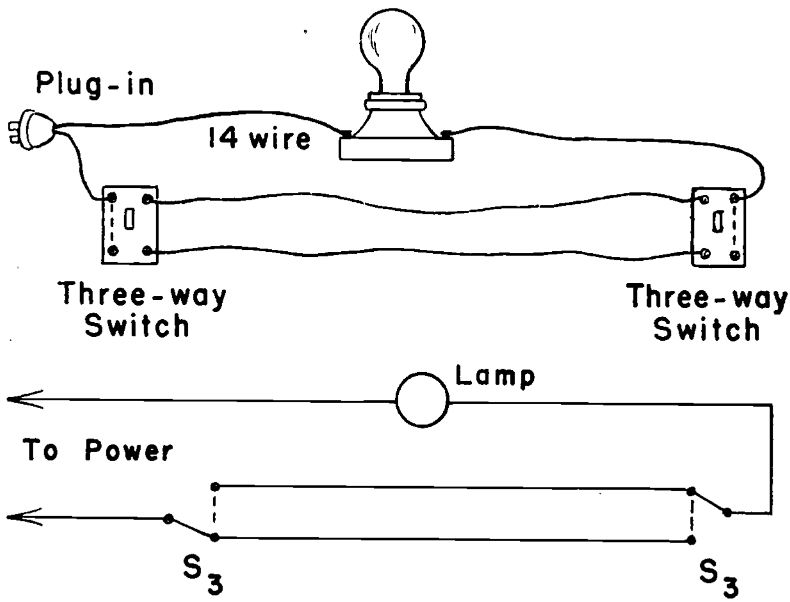


Figure 5. Connections and schematic wiring diagram for a three-way circuit.

The diagrams in Figure 4 will show how the connection should be made for the single pole switch. For safety's sake, be sure that the cord is disconnected from the electric supply source any time you want to do work on the circuit.

Figure 5 shows the connections for a three-way circuit. Three-way switches are usually made with two of the four contact points permanently connected.

In actual house wiring, the two wires going to the plug caps are connected to the two wires of proper voltage source.

Job No. 3. How Wiring Plans Are Made

Job No. 3 will give you an opportunity of developing either one of two types of wiring plans. You will choose the one which seems to you to have the greatest application to your own situation.

You may draw an over-all wiring plan of your farm, including the service, the house, and all outbuildings. Or you may draw a more detailed plan to include the house only.

All plans for new home or farm construction, or remodeling, should include drawings of the wiring, electric outlets, types and location of switches, etc. By doing the drawing suggested, you will gain valuable experience needed to evaluate or plan an adequate and desirable electric installation suited to your own needs.

About now you might feel like saying, "Oh, I can't draw, there is no use of my trying this." Anyone can do the type of drawing required in this job because anyone can draw a straight line by means of a ruler, or make a perfect circle by the use of a compass.

Materials required:

- Several sheets of 8½ x 11″ or larger graph paper with 4 or 8 divisions per inch.
- Two sharp, fairly hard pencils.
- One ruler.
- One triangle.
- One piece art gum or other suitable eraser.
- One compass (a 10- or 15-cent one will do).

If you have a set of drawing instruments used in school, so much the better. A small drawing board and T-square will be helpful. Any help that you can get from your parents in working out these drawings will be good.

Drawing choice "A"

This choice will include a drawing of a complete electric service diagram of your home and farm buildings. In Figure 6 you will see an example of the type of drawing you will wish to make. Some hints are given below as to what this drawing should include.

▶ Drawing should show the location of the residence with respect to the highway and driveway. It should also show the location of the garage, the barn, the chicken house, the pump house and any other farm buildings on your property.

▶ A single line on your drawing will represent all of the wires from the electric company's pole to the central distributing point on your place. From this central distributing point another line should be drawn to represent the electrical connections to any other buildings now connected. In each case the actual number of wires will be indicated on the drawing by figures. For example, 3/No. 8 would indicate 3 size 8 wires.

▶ The voltage of the service wires* is understood to be 120 volts if only two wire and 120/240 volts if three wire. Other combinations should be distinctly marked.

▶ Every effort should be made to make this drawing approximately in scale. In any event the distance between the buildings, their proper relative position and the length of the service wires should be indicated on the drawing. Show on your drawing what scale you are using.

▶ The appliances and pieces of electrical equipment used in each building should be indicated, along with the horsepower of any motors that are connected and also the total wattage of all lamps used in each building.

Drawing choice "B"

Instead of drawing a complete farm wiring diagram, you may elect to draw a plan of your home. This will probably interest town boys, and girl members in particular. It will have special interest for you whose folks are building a new home, remodeling your present one, or making plans for doing considerable rewiring of your present home. The drawing of your house should be made on a considerably larger scale than would be possible in the previously described drawing. A scale of ¼" or ½" to the foot is recommended.

* If at any time you run across an electrical term such as "central distributing point," "service wires," "A.W.G.," or other word with which you are not familiar, you may look it up on page 22 in "Electrical Terms and Their Meanings."

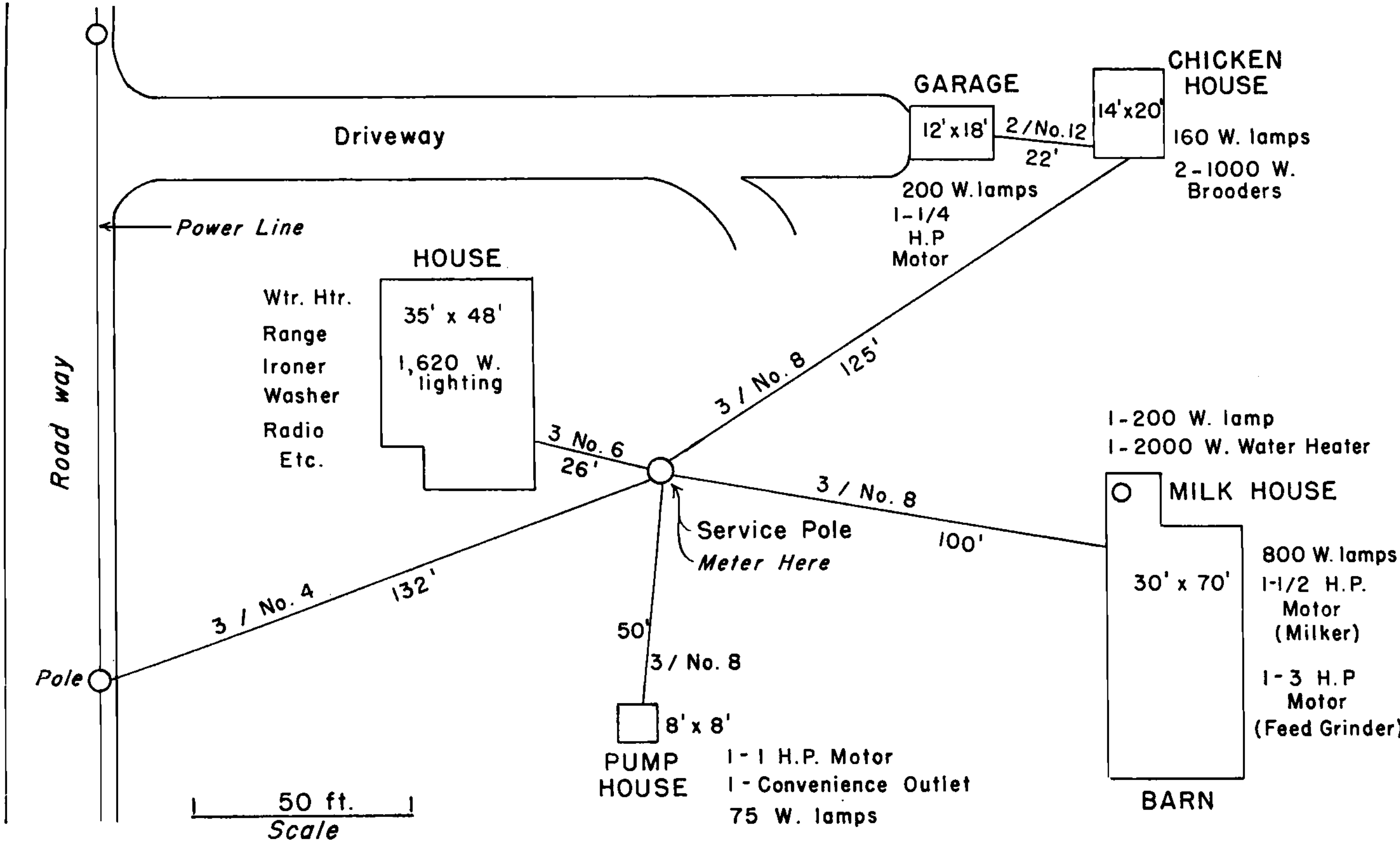


Figure 6. Farm distribution diagram.

Your drawing should include the following information:

▶ The over-all dimensions of the house.

▶ The size of each room.

▶ The purpose of each room (living room, dining room, kitchen, etc.)

▶ Windows and doors should be shown for each room.

▶ The location of the entrance switch should be shown. A notation should be made showing capacity of this switch in amperes, the number of circuits provided and the size of fuse used in each location within the switch.

▶ Location of permanent lighting fixtures should be shown in each room. It would also be desirable for you to show the location of each main piece of furniture, portable lamp, and/or electrical appliances, used in each room.

▶ Each convenience outlet and switch should be shown on the plan. A line should be drawn from each switch to the lighting fixture it controls.

Each of the above electrical outlets should be indicated by the proper symbol. Figure 7 will give you an idea of what the finished drawing should look like and page 14 will give you a complete listing of the symbols commonly used by architects in indicating the various types of outlets. If you will take some pains to make your drawings neat and accurate, they will be a source of considerable pride to you. They will also be very fine exhibits for you to use in showing what your club is doing at any 4-H exhibit or fair in which you wish to take part. These drawings should be preserved for use in one of the later jobs of the second year's work.

Job No. 4. Principles of Good Wiring Practice

Job 4 will center around a study of the following paragraphs on principles of good wiring. Once you have studied and learned these principles, your leader should arrange for several short group discussion periods. Picking one of the wiring plans for Job 3, each member will spend a few moments studying it. Then the group members will make suggestions and enter into a discussion as to how the wiring job shown by the drawing can be improved upon. Try to keep your suggestions practical, and always keep in mind future electric equipment which may be added. A second group should discuss another wiring plan and so on.

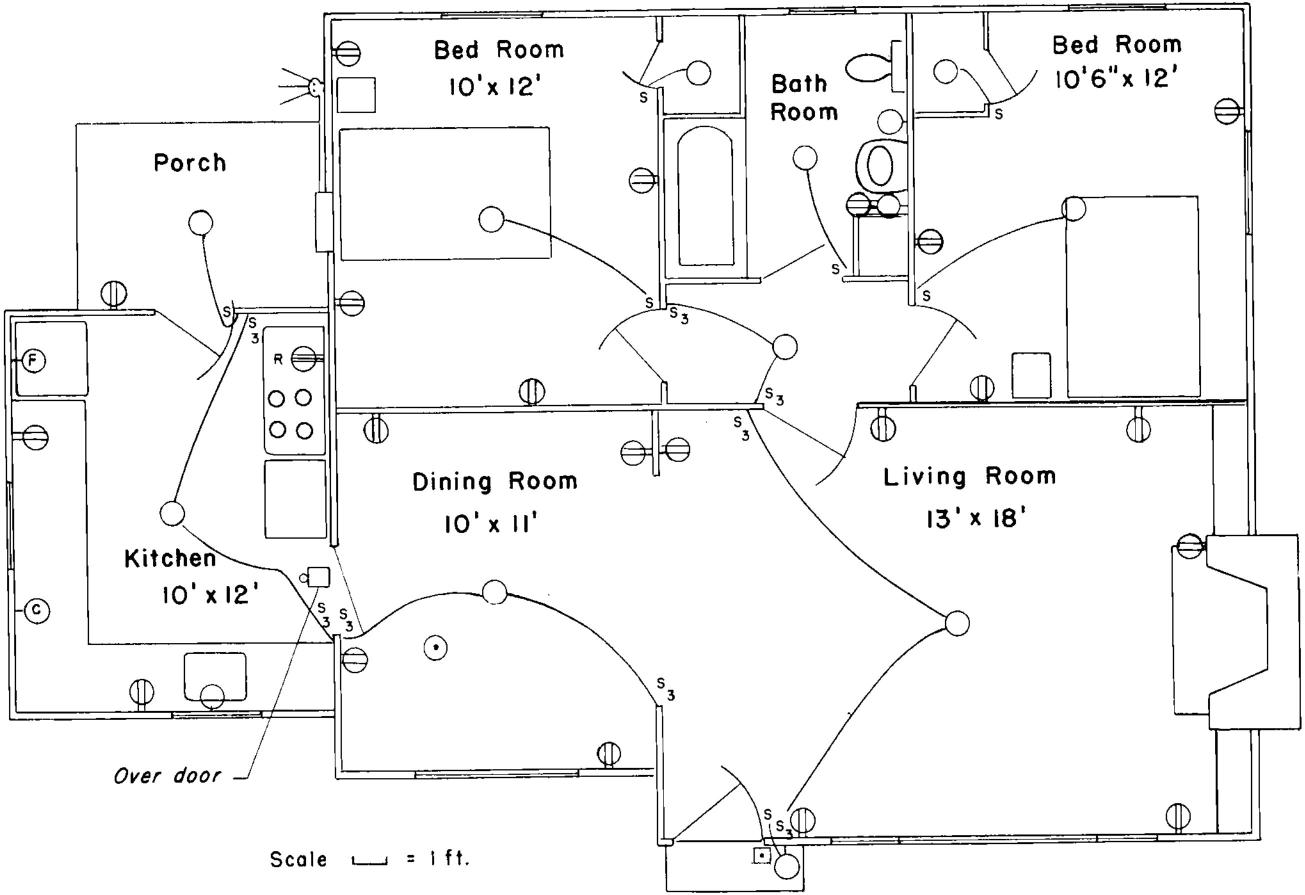


Figure 7. Typical small home wiring plan.

GRAPHICAL ELECTRICAL SYMBOLS
For Architectural Plans

GENERAL OUTLETS

Ceiling	*Wall*		*Ceiling*	*Wall*	
		Outlet	J	J	Junction Box
F	F	Fan Outlet	C	C	Clock Outlet

CONVENIENCE OUTLETS

Duplex Convenience Outlet

R Range Outlet

WP Weather-proof Convenience Outlet

Floor Outlet

Special Purpose Outlet
(Described on plans or in specifications)

SWITCH OUTLETS

S Single Pole Switch

S_2 Double Pole Switch

S_3 Three Way Switch

S_4 Four Way Switch

S_{WP} Weather-proof Switch

MISCELLANEOUS SYMBOLS

M Motor

Buzzer

Bell

Push Button

Figure 8.

In good wiring practice there are definite rules and precautions. Some of them are listed here:

▶ The entrance switch should be protected from the weather but should be easily available for the renewing of burned-out fuses.

▶ For a small three- or four-room house utilizing electricity for lights, washing machine, ironer, toaster, and radio only, the switch should be not less than 30 ampere capacity.

▶ If additional equipment (such as range, hot plate, water heater, or water pump) is served through this switch, it should have a capacity of at least 60 amperes and possibly up to 100 amperes.

▶ Each branch circuit should be separately fused and should be limited to not more than 10 outlets.

▶ At least one separately fused circuit should be provided for each building served through this switch. The pump, if served through this switch, should be on a separate circuit.

▶ All wire in the entire system should be No. 14 AWG or larger. No. 12 wire is often preferred, particularly for circuits supplying convenience outlets. Even larger sizes are needed for electric range and water heater outlets.

▶ Wire sizes to outlying buildings will depend upon the distance to the building and the amount of load to be served at the building.

▶ If several buildings are to be served from one point, it is often better to set a service pole at a point convenient to all buildings, at which location the entire service will be metered. From here separate services can be run to each building with an adequate entrance switch being provided at each building.

▶ Within the home at least one convenience outlet should be provided on each continuous wall space between each pair of doorways. The reason for this is obvious in that it is very difficult and not at all safe to carry an extension cord over, around, or across a doorway.

▶ Convenience outlets should be so placed that they may be easily reached without having to move a sofa, davenport, piano, bed, or other piece of heavy furniture.

▶ Convenience outlets should be placed with the thought in mind that a reading or portable lamp will probably be desired at each end of the davenport, that a reading lamp may be desired beside the bed, that decorative lamps will probably be placed on the vanity, the chest of drawers, the fireplace mantle and other places which will come to mind. In the kitchen, in placing convenience outlets, it will be well to remember the large number of appliances (such as mixer, electric iron, refrigerator, washing machine, dish washer, disposal unit, electric clock, and other devices) which may be used there. In the dining room you will, of course, wish to have a convenient place for plugging in the toaster and the percolator as well perhaps as some portable lamps and a fan.

► For maximum fire protection, the electric pump should not be wired on a circuit with any other appliance or outlets. It should be connected as close to the source of power as possible. Sometimes it is found desirable to run electric pump wiring underground. It is not well to run the circuit to the electric pump through any buildings.

► Electric pump, electric range, electric water heater and utility motor circuits for motors of 1/3 horsepower or larger should generally be wired for 240 volts.

Job No. 5. Improved House Wiring Plan

By now you have undoubtedly come to know there is a "right" and a "wrong" way of doing things electrically. This principle applies very much to any home or farm wiring layout. If your home wiring plans have been thoroughly planned or "engineered" you will find that your electric service is far more convenient to you than it would have been if your wiring had been done in a more or less haphazard fashion.

Take your original drawing from Job 3 and use it to trace the outlines of your home. Then, making use of the new ideas you have gathered concerning good wiring, draw in on this tracing your conception of a modern up-to-date wiring layout.

This finished drawing in conjunction with the one you made in Job 3 should make a very interesting display. It will show the "old" and the "new" ideas, as it were.

Job No. 6. Appliance Maintenance

Undoubtedly each of you Electricity Club members has a number of small motor-driven appliances in your home. Occasionally these appliances need some routine maintenance or care which can be rendered right at home that will prolong the life of the device and yet which will not require servicing by a regular appliance store service department. One of the devices occasionally requiring this type of service is the vacuum cleaner.

A vacuum cleaner, being a typical electric-motor-driven appliance, provides an interesting source of experimentation of the type of service mentioned. The leader of the Electricity Club, or one of the members, may volunteer the use of a vacuum cleaner for an interesting study by the entire class.

While working on this job you will attempt to learn how best to service a vacuum cleaner in the following respects:

▶ To check the cord for any undue wear and to repair or replace it as required.

▶ To replace either a broken switch, or a broken plug on the end of a cord.

▶ To clean the vacuum cleaner of excess oil, dirt and dust.

▶ To clean the commutator. Never oil the surface of a commutator. The brushes are made with the lubricant in them.

▶ How to lubricate the vacuum cleaner.

▶ To remove, empty, and replace the dust bag.

▶ How to adjust the cleaner for the most effective work on various types of rugs, taking their thickness and weave into consideration.

▶ How to use the attachments.

Because of the nature of this job, you will expect your leader to supervise the work very carefully, and you will perhaps not have the opportunity of doing much of the taking apart or reassembling of the vacuum cleaner yourself. You will want to give very close attention to his demonstration and to any additional hints he may give with respect to the care, use, and safe storage of the vacuum cleaner. It is also recommended that neither you nor your leader ever work on a vacuum cleaner while it is plugged in. Be sure that the plug has been pulled out of the outlet before attempting to make even the most simple repairs to either the cord or the machine.

Job No. 7. Building an Electrical Device

You should now determine for yourself which of the electric devices listed in the back of this manual would be most useful to you at your home and which one you would most like to make. The building of this device will then become the concluding accomplishment of your second 4-H Electricity Club year.

In building the device, whether it be a chick brooder, pig brooder, egg cleaner, electric table lamp, or whatever other device you choose to build, you will study the complete plans thoroughly before starting the building so that you know you have, or can get, all materials necessary. You will investigate to be sure that you have access to the tools necessary for the construction.

Having checked on these facts and having decided to go ahead with the building of the device, you should let nothing stand in the way of its completion. You will take great pride in doing a workmanlike job and in building a device that will satisfactorily perform the job for which it is designed.

The completion of this job should provide you with an appliance which will have practical use on your farm or in your home and which you can also exhibit with pride at any local 4-H or County Fair in which you may wish to make an entry.

Electricity Club Experiments

In the first year Electricity Club booklet, Club Series V-1, members discovered that an electric current generated heat and that this phenomenon, when properly controlled, could be put to very good use. The electric range is one example and the incandescent light bulb is another.

It was also learned that an electric current surrounds itself with a magnetic field. This characteristic is utilized in making electric motors turn, in operating magnetic circuit breakers, in electrical measuring instruments and in countless other ways.

Still another way in which an electric current may be utilized is in the field of electrochemistry. The following three experiments will open up a whole new vista of uses of electricity to experimenting Electricity Club members.

Experiment 1. The primary cell

Everyone is acquainted with the dry cell battery (such as is used in a pocket flashlight). A dry cell is not really "dry," as it contains a certain amount of moisture to permit the activity of its chemical elements. It is, however, a "primary" cell as contrasted with the "storage battery" type.

Figure 9 shows the constructional details for building a wet cell type of battery. The electrolyte may be a solution of sal ammoniac in water. The carbon electrodes can be taken from old, discarded dry cells.

As the battery is used, it will be noted that the carbon electrode will rapidly become covered with gas bubbles which will cut down its power output. For this reason this type of battery is practical for intermittent use only.

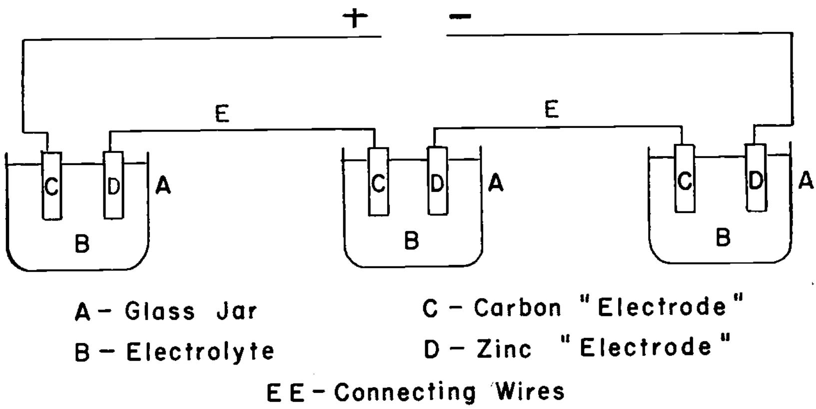


Figure 9. Three wet cells connected in series.

If anyone in the group has a pocket battery tester (volt-ammeter) the experiment can be made more interesting by comparing the voltage and current flow (amperes) as the cells are connected first in series, then in parallel.

Experiment 2. Electroplating

The circuit shown in Figure 10 is not intended for practical work in copper plating, but enough can be accomplished to serve as an interesting experiment in the theory of the process. The electrolyte in this case is copper sulphate and water. (Copper sulphate is also known as blue vitriol and is easily obtained though very poisonous.) The object to be plated should be small and of conducting material.

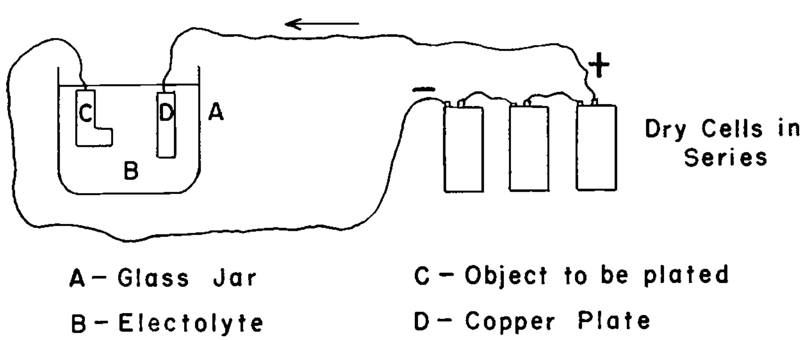


Figure 10. Electroplating.

A wax mold could also be used, such as a mold of a silver dollar. The face of the mold is then brushed with powdered graphite to give it a conducting surface. Electrotype plates for printing are made in this way.

Copper is only one of the substances that can be used in electroplating. Gold, silver and other less precious metals may be chosen to suit the need.

Experiment 3. Decomposition of water

Water is composed of oxygen and hydrogen atoms (H_2O) and may be broken down into its component parts by passing an electric current through it. Figure 11 shows the simple apparatus necessary for this experiment. A few drops of sulphuric acid should be added to the water to increase its conductivity. As the test tubes are

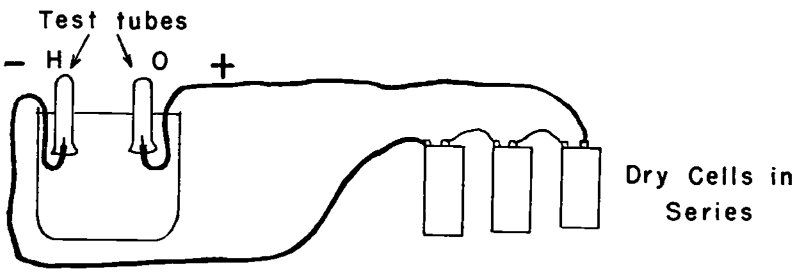


Figure 11. Decomposition of water.

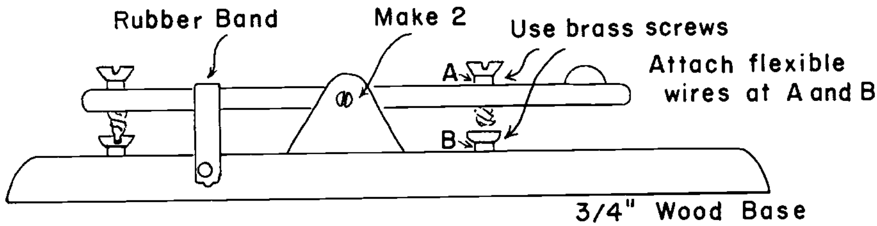
inverted in the jar, they, too, should be kept full of the electrolyte. Then, as the experiment progresses, the liquid will be displaced by the gases formed. The wires leading into the ends of the test tubes should be rubber covered or otherwise water-proofed except for the bare ends.

The hydrogen will collect twice as rapidly as the oxygen. Hydrogen is lighter than air, so to save it, the test tube should be kept upside down if it is removed from the electrolyte. To save the oxygen for a short period, place the thumb over the end of the test tube and turn it right side up. Either gas will soon mix with the air. Oxygen will support combustion. Hydrogen, mixed with air, will explode violently if ignited.

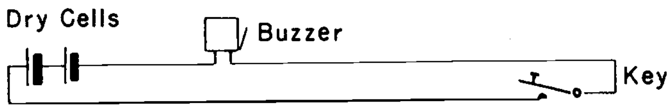
As a precautionary measure, be sure to rinse the hands in clear water after they have been wet in this electrolyte.

The commercial production of some other gases is also accomplished by methods similar to those used in the above experiment.

Home-made Telegraph Key



Schematic Circuit



Morse International Code

A	· —	N	— ·	1	· — — — —
B	— · · ·	O	— — —	2	· · — — —
C	— · — ·	P	· — — ·	3	· · · — —
D	— · ·	Q	— — · —	4	· · · · —
E	·	R	· — ·	5	· · · · ·
F	· · — ·	S	· · ·	6	— · · · ·
G	— — ·	T	—	7	— — · · ·
H	· · · ·	U	· · —	8	— — — · ·
I	· ·	V	· · · —	9	— — — — ·
J	· — — —	W	· — —	0	— — — — —
K	— · —	X	— · · —	.	· — · — · —
L	· — · ·	Y	— · — —	?	· · — — · ·
M	— —	Z	— — · ·	Attention	— · — · — ·

Figure 12.

Experiment 4. Telegraph practice circuit

If some of the members are interested in wireless or radio telegraphy, this experiment will afford them an opportunity of "sending" and "receiving" the code. A key that will be quite practical for slow speed "beginner's" sending is easily made at little or no cost from materials at hand. In choosing a buzzer to use for this purpose, it is best to look for one with a high pitched tone, preferably one with an adjusting screw for regulating the pitch. The home-made buzzer described in the first-year project book also might be used.

A variation of this experiment would be to substitute a flashlight bulb of suitable voltage for the buzzer and practice sending "blinker" signals. This method of signaling is often used between navy ships where it is desired to keep radio silence. The same code is used as when using the buzzer.

Figure 12 shows the details of construction of the key and connections for practicing.

Electrical Terms and Their Meanings

AWG

American Wire Gauge. Indicates that the measure used in describing the size of the wire is in accord with AWG wire measurements. In this system the larger the number, the smaller the wire; for instance, No. 14 wire is larger than No. 19. Each three-number difference in size indicates a wire with twice or one-half the current-carrying capacity as the case may be. This designation was formerly known as B and S Gauge (Brown and Sharp).

Branch circuit

Electric feed between the central point of distribution and one or more outlets or appliances. A branch of a main circuit.

BX

Sometimes called armored cable. Two or more wires insulated from each other, and from a metal protective covering wound over them in spirals.

Box

A metal box used to enclose a device which is the terminal or junction point of an electric circuit. It may be either surface or flush mounted.

Cable

Two or more wire conductors insulated from each other and held together by a common, flexible, insulating cover.

Circuit

A complete electric path; that is, a path by means of which electricity may flow from source to load and return to the source.

Conduit

A rigid or flexible pipe or tube through which electric conductors may be run.

Conductor

Any material capable of carrying an electric current.

Capacity

Ability of a conductor to carry safely a flow of electricity, usually indicated in amperes.

Central distributing point

Usually the point of contact with an outside source of electricity from which branch circuits may be run to the various outlets in the home, in the barn, well house, garage, chicken house, etc. Generally the main switch.

Convenience outlet

Place where an extension cord, electric iron, stand or table lamp, toaster, percolator or other electric appliance may be plugged in. A base plug.

Entrance switch

The main switch where the electricity first enters the building. Generally includes the main fuses or circuit breaker for the entire premises and the separate fuses for each branch circuit.

Electrode

One of the elements immersed in the electrolyte in an electro-chemical process by means of which the electricity either enters or leaves the solution.

Electrolyte

The solution used in electro-chemical processes.

Ground

Most types of soil will carry an electric current, particularly when moist or wet. When an electric connection is made to this soil, the circuit so connected is said to be "grounded" and the connection itself is called a "ground." Most grounds are made by driving an iron or copper pipe or rod into the earth or by connecting to water pipes that have considerable contact with the earth.

Hot wire

Usually refers to the ungrounded wire or wires of a grounded circuit.

Insulation

Material that will not carry electricity. Used around wires to prevent a flow of current to some other conductor with which they might come in contact.

Lamp receptacle

A device into which a lamp may be screwed, plugged or fitted which at the same time completes the electrical connection to this lamp.

Loom

A flexible insulating tubing through which wires may be run to help protect them against mechanical injury and electrical losses or short circuits.

Loomex, Romex, Loom-wire, etc.

Nonmetallic sheathed cable. Two or more wires insulated from each other but wrapped together in an outer sheath of flame resistant material.

Neutral

A term often applied to the grounded wire on a two- or three-wire electric circuit.

Nonconductor

A material that will not carry a current of electricity.

Outlet

Generally any terminal point of an electric circuit, such as a convenience outlet, switch (except a main switch), light fixture, etc.

Permanent lighting fixtures

Lighting fixtures that are permanently or semipermanently fastened to the wall or ceiling, as contrasted to portable lamps, stand lamps, etc.

Service pole

A pole on the customer's premises which serves as a central distributing point to the various buildings on his farm. Usually the meter is also mounted on this pole.

Service wires

The wires running from the electric utilities pole to the customer's premises.

Single-pole switch

A switch that opens only one side of an electric circuit, as contrasted with a double-pole switch which opens both sides of a two-wire circuit at one time.

Three-way switch

The type of switch used when it is desired to turn a light off or on from two different locations.

Three-wire service

A service where two voltages are available for use, usually 120 volts and 240 volts. Wires are connected to a proper service to give 240 volts between two of the three wires and 120 volts between the third wire and either of the other two wires.

Suggested Added Activities for Electricity Club Members

Chicken Brooder
Pig Brooder
Making a motor portable
Table lamp
Attach motor to grindstone
Attach motor to sewing machine
Attach motor to cream separator
Food dehydrator
Repair a broken home appliance
Construct an electric hot bed or propagating bed
Electric egg cleaner

Suggestions to Leaders

Job 1.

If the leader has any doubt of his ability to read a meter, it might be worth while to call on his electric utility serving agency before starting this job and ask for instructions on how the reading is done. The utility company usually is very happy to cooperate. Many utilities also have available a set of meter dials which can be changed or set by hand to allow considerable experience in reading different dial indications within a very short period of time.

This job, if properly presented, can be of real practical value to both the leader and members in that it will provide practical experience in the current consumption of various devices used on the farm and in the home. If the testing possibilities of this job are carried out to the ultimate degree, it will be found that some appliances are far more efficient than others even when doing approximately the same work.

Job 2.

The connections suggested under Job 2 are very simple but may prove quite interesting to the members as it enables them to use their hands and exercise some ingenuity in the matter of actual electric connections.

The leader may go as far as seems advisable to him and as his experience will permit in explaining the types of materials and the methods of wiring under actual installation conditions while this work is done.

It will hardly be necessary to repeat for the benefit of the careful leader that no work should be done on any of the circuits as long as they are connected to the source of electric supply.

Job 3.

The material printed for the students under the heading "Job 3" will, for the most part, be self-explanatory.

The leaders will see that if any difficulty arises about securing drawing tools for each separate club member, it will be possible for two or more club members to double up on the use of a compass and triangle. However, the cost is so little and the equipment suggested is so common, both at home and at school, it is thought best that each member have his own tools.

It might be a good idea to review completely the subject matter of Job 3 with the members before embarking upon the actual work, in order to discuss the various terms that may be unknown or strange to the members. Free use should be made of the definitions in the back part of the book.

Job 4.

Job 4 is essentially a "study" project. Additional material concerning the principles of safe and adequate wiring practice probably can be secured through your electrical utility, through the Electrical Inspection Department of a nearby city, the State Labor Commissioner, or by writing to the Adequate Wiring Bureau, 155 E. 44th Street, New York 17, N. Y.

Additional interest in this job can be created by discussing some of the actual wiring problems found in the homes of members or of the leader. As pieces of equipment (such as entrance switch, fused circuit, convenience outlet, etc.) are discussed, these pieces of equipment may be shown to the members in the leader's own home installation.

The discussion groups should be composed of the club members themselves, the leader acting only as the moderator. If the club is large enough, several groups may be set up, rotating the membership for each group so that each individual in the club has an opportunity to participate.

Job 5.

You will note that this job requires additional drawing. In order not to duplicate the work done in Job 3, a good share of this drawing can be done in the form of tracings made from the previous sketches.

The importance of providing sufficient circuits, convenience outlets, large enough wire and entrance switch to care for not only present needs, but for future additions of equipment as well, should be stressed.

Job 6.

This, again, is a job which will give the leader and members of the club an opportunity of actually working with an electrical appliance. If a vacuum cleaner is not readily available for this study, some other electrical appliance, preferably motor driven, might be used. This could be an electric fan, an electric sewing machine motor, a food mixer, a hair dryer or some other appliance. It is recommended that, if possible, the leader secure a complete manual of instruction by the manufacturer of the article with which it is proposed to experiment. He should certainly secure a copy of the Oregon State College Extension Circular 416, "Household Equipment, Its Care and Simple Repair." His electric utility may also have some useful literature on file. Perhaps the help of some local repairman can be secured to assist for one evening on this job.

It is not practical to explain in detail in this bulletin the method of servicing the particular appliance on which you may work because of the considerable difference in mechanical details of machines of different manufacture.

The leader will note that on some of the later devices no provision is made for lubrication, as they are lubricated at the factory for life. However, the subject of lubrication is very important in connection with many electric motors and other appliances and should be part of this discussion.

Job 7.

Job 7 may be carried on concurrently with some of the other jobs by getting the members started on the particular projects that they choose and then encouraging them to do a great deal of their construction at home between club meetings.

The leader should make it a point to see the devices occasionally as construction progresses, in order to assure an adequate and workmanlike job. He should insist that every phase of construction be along safe lines and in accordance with best wiring principles.

He should encourage the members when building chick or pig brooders, when motorizing a grindstone, emery wheel or cream separator or other device, or when carrying out any other project, to build or construct along entirely practical lines so that the device actually will be placed in use in the member's home. Instructions for constructing the different devices that the member may build may be secured from the Agricultural Engineering Department of Oregon State College, from several of the manufacturers or wholesalers of electrical equipment, from the County Extension Agent, or from the public utility serving the area.