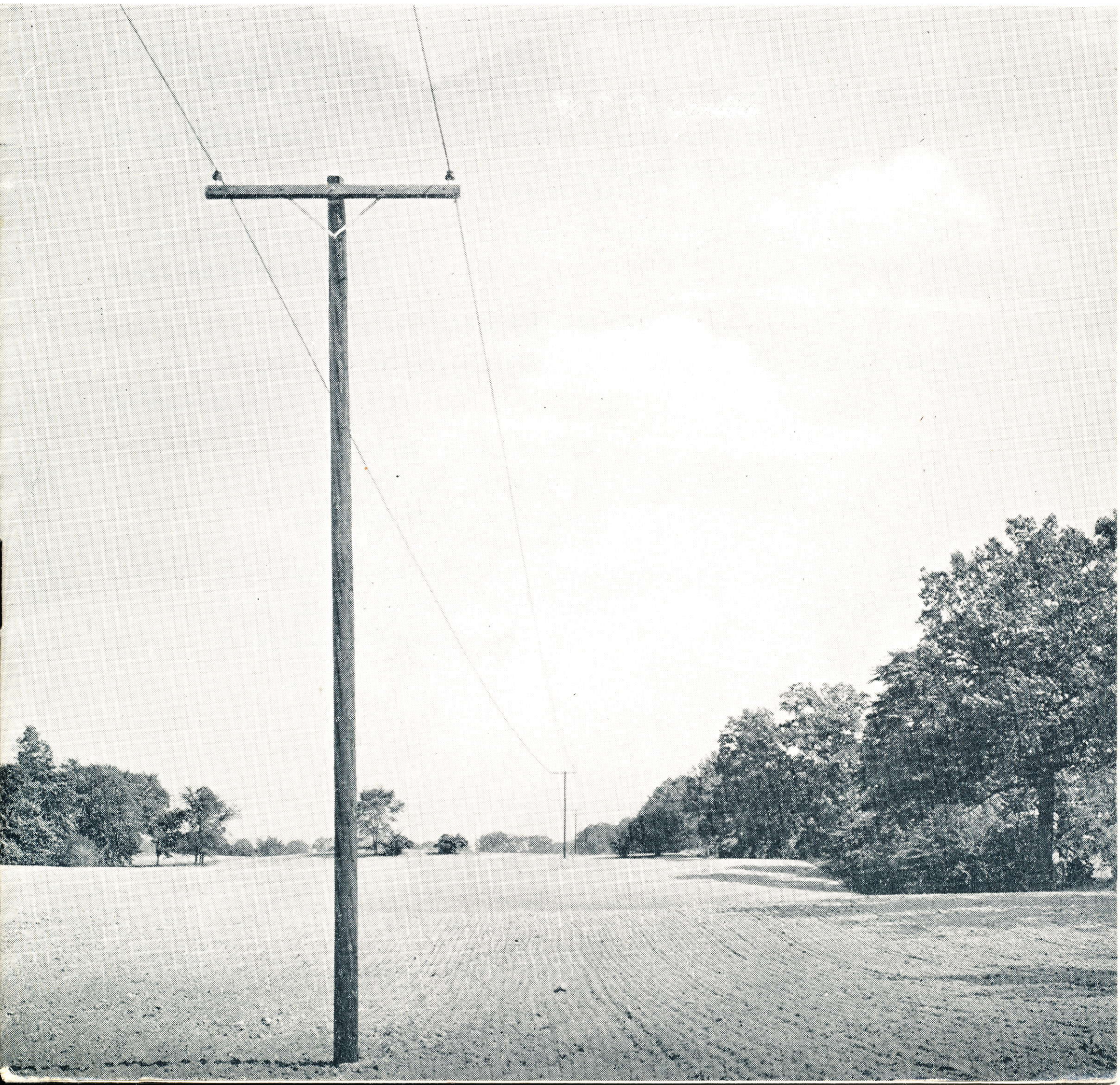
Electrical Projects for 4H Clubs
Michigan State University Cooperative Extension Service
4-H Club Bulletin
P.G. Lundin, Fred W. Roth, Dennis E. Wiant
Issued N.D.
75 pages

CLUB BULLETIN 53

# ELECTRICAL PROJECTS *for* 4-H CLUBS

By P. G. LUNDIN, FRED W. ROTH and DENNIS E. WIANT

MICHIGAN STATE COLLEGE :: COOPERATIVE EXTENSION SERVICE
EAST LANSING



## FOREWORD

This revised copy combines the previous bulletins, "Electrical Projects for 4-H Clubs" and "Farm Electricity for 4-H Clubs".

The 4-H Club Department wishes to express appreciation to all those that helped in its preparation.

## REQUIREMENTS FOR ELECTRICAL CLUB WORK

Electrical club members must be between the ages of 10 and 20 years. First-year members must be at least 10 years old by January 1.

### FIRST YEAR

Members enrolling for the first year must complete Exercise 1, and two others in addition. Also the club must complete the required group Exercise, No. 2.

### SECOND YEAR

Members enrolling for the second year must complete Exercise 13 and two others in addition. The club must complete the required group Exercise, No. 14.

### ADVANCED

Members enrolling for the advanced years must complete two exercises not previously done.

### BASIS OF AWARD

The work of the Electrical Club members will be judged on the following basis:

Quality of workmanship
Interest and attitude as a club member
Completeness and correctness of report

*NOTE: The club member is not limited to making only the articles listed in this bulletin. Changes in the plans may be made to fit individual needs.*

## EXERCISES IN THIS BULLETIN

### A. First Year Exercises

Toy Electric Motor (required group exercise)
Extension Cord or Trouble Lamp (required)
Care of Electric Motors
Making a Motor Portable
Alarm Clock Time Switch
Repairing Appliance Cords
Pig Brooder
Poultry Water Heater
Electric Chick Brooder
Mounting a Motor on a Seed Cleaner or Corn Sheller
Making a Lamp Shade
Miniature Model of a Room

### B. Second Year Exercises

Wiring Panel (required group exercise)
Reading the Electric Meter and Computing Monthly Bill (required)
Care of Electric Motors
Making a Motor Portable
Alarm Clock Time Switch
Pig Brooder
Poultry Water Heater
Electric Chick Brooder
Making a Lamp Shade
Miniature Model of a Room
Movable Work Bench Light
Home Lighting Survey
Making a Table Lamp
Installing a Door Bell or Chime
Installing Convenience Outlets
Call Bell in the Barn
Belt Sander
Switch Panel

Cost of Electricity for Operating Certain Equipment
Electric Egg Candler
Ice Cream Freezer Power Unit

## C. Advanced Exercises

Making a Table Lamp
Movable Work Bench Light
Installing Convenience Outlets
Installing a Door Bell or Chime
Cost of Electricity for Operating Certain Equipment
Ice Cream Freezer Power Unit
Home Lighting Survey
Switch Panel
Electric Egg Candler
Belt Sander
Call Bell in the Barn
Installation of a Permanent Motor
Installing a Yard or Additional Switch on Yard Light
Wiring a Small Building
House Wiring Plan
Farmstead Wiring Plan
Poultry House Light Dimmer
Electric Fence Unit
Motor-Driven Grindstone
Electric Lawn Mower
Drill Press
Circular Saw
Elevators for Handling Farm Products

# Electrical Projects for 4-H Clubs

*By P. G. LUNDIN, FRED W. ROTH and DENNIS E. WIANT*

Electricity is a servant of the farm family. Electricity is ready, at all times, to lighten the load and make it possible for the farmer and his family to have more of the comforts and luxuries of life.

Savings in time, labor, and money are made on thousands of farms where the farmer lets electric power do work that he would otherwise have to do manually.

One kilowatt-hour, which is purchased for 3 cents or less, will do as much work as a man working all day. One can readily see that it is not economical to permit the hired man to do any chores that can be done by electricity.

The usefulness of electricity can be greatly extended. On the majority of farms now using electricity, the installation of additional lights, convenience outlets, switches and circuits would add greatly to the convenience of the users. This is just as true in our city homes.

Approximately 165,000 or 94 percent of Michigan farms are supplied with electricity. The farm home is using more than 85 percent of the farm electrical consumption for labor saving and convenience in the home. More electrical energy should be used for farm production, for it will increase production and lower the cost of production, thereby increasing profits for the Michigan farmer. At the same time, it will reduce labor requirements and add to the convenience of farm operation.

This bulletin shows some of the equipment, reasonable in cost, and simple to construct, which can be used profitably on the farm and in the home.

## ELECTRICAL TERMS DEFINED

AMPERE—The unit of measure of the rate of flow of an electric current.

VOLT—The unit of measure of the electrical pressure or "push" which causes a current to flow. A dry cell is approximately 1½ volts; a 3-cell storage battery about 6 volts. The power supplier furnishes 120 or 240 volts to the house or farmstead.

WATT—The unit of measure of the rate at which electric power is being used or developed. (watts = amperes × volts)

KILOWATT—1,000 watts = 1 kilowatt. (Kw = $\frac{\text{amp.} \times \text{volts}}{1{,}000}$)

WATT-HOUR—The work done when one watt of electric power is used for 1 hour.

KILOWATT-HOUR—1,000 watt-hours = 1 kilowatt hour. (Kw-hr = $\frac{\text{amp.} \times \text{volts} \times \text{hrs.}}{1{,}000}$)

WATT-HOUR METER—Usually spoken of as the meter. An electrical instrument, using no current itself, which records the electricity used in terms of kilowatt-hours. Each electrified house or farmstead is equipped with at least one watt-hour meter.

CIRCUIT—The path of an electric current. It must be complete to permit the flow of a steady current. A complete circuit includes a device for production of electricity; that is, power source, connecting wires, and the device being supplied with power. In the home the wires coming from the transformer are spoken of as the source of power.

*Branch Circuit*—A circuit which is only one of a system made up of two or more circuits. The wiring in a building is usually made up of a system of circuits branching off from a main circuit, and each circuit supplies one part of the building or one particular piece of equipment.

*Closed Circuit*—A continuous metal path through which electricity flows, as when an iron is plugged into the circuit. It is sometimes referred to as a "live" or "hot" circuit.

*Open Circuit*—An intended or accidental opening of the metal pathway or circuit, as when a switch is opened or when a fuse has burned out or a circuit breaker has opened the circuit. Also referred to as a "dead" or "cold" circuit.

*Short Circuit*—Often caused by two wires touching, so that current does not flow through lamp or appliance, but takes an improper short cut to the ground. When a short circuit occurs, a fuse "blows" and "opens" the circuit, which is one of the important reasons why all wiring should be carefully protected by fuses or circuit breakers.

INSULATION—A material that conducts electricity so poorly that the amount passing through it is negligible. Mica, glass, porcelain, and rubber are examples of insulating materials.

CONDUCTOR—A material through which electricity is readily transmitted. Metals such as silver, copper and aluminum are good conductors.

GROUND OR GROUNDING—A safety device which is an electrically tight connection to the earth, to dispose of surplus or overflow electricity by allowing it to leak to the ground. This is usually a wire, with soldered joints, connected to either a city water system or to a pipe or metal rod driven four to eight feet into permanently moist ground.

RESISTANCE—The characteristics of metal which tend to prevent, retard, or restrict electrical current flow. The property of resistance is desirable when used the right way as in electrical heating and lighting devices.

FUSE—The part of an electrical system designed to melt and open the circuit when a specified current is exceeded.

CIRCUIT BREAKER—An automatic switch for opening a circuit, usually when a specified current is exceeded. Circuit breakers need only to be reset, while fuses must be replaced when "blown".

OUTLET—A point at which current is to be used or controlled. At this point a box, usually metal, is installed. The wires are permanently fastened to the box. All necessary connections are made within the box, and the convenience outlet, switch or lamp receptacle is attached to the box.

SAFETY-SWITCH—A switch, usually of 30 amperes or more capacity, enclosed in a grounded metal box, and so arranged that door of box cannot be opened unless switch is off.

TRANSFORMER—A simple electrical device which changes the pressure or voltage. For example, a transformer serving a farm might "step-down" the voltage from 4,800 volts to 120 volts.

HORSEPOWER—A measurement of power. One horsepower = 746 watts. A one-horsepower motor requires approximately 1,000 watts to operate it at rated load, because it is only about 75 percent efficient. Thus, the "input" to the motor would be 1,000 watts, but the "output" would be 746 watts or the equivalent of 1 horsepower. Motors are rated on the output, not the input.

## NECESSARY TOOLS

To do satisfactory work in electrical projects, a good set of tools is necessary. The following list is a minimum to begin your project work. As you complete more projects new tools will be needed.

1. Hammer
2. Screwdriver
3. Side-cutter pliers
4. Jack knife
5. Soldering iron (either electric or non-electric with blow torch)
6. Resin-core wire solder
7. Test lamp
8. Rubber tape
9. Friction tape.

It is also necessary to have available a copy of "Wiring Simplified" by H. P. Richter.

**Fig. 1. Tools required to begin project work.**

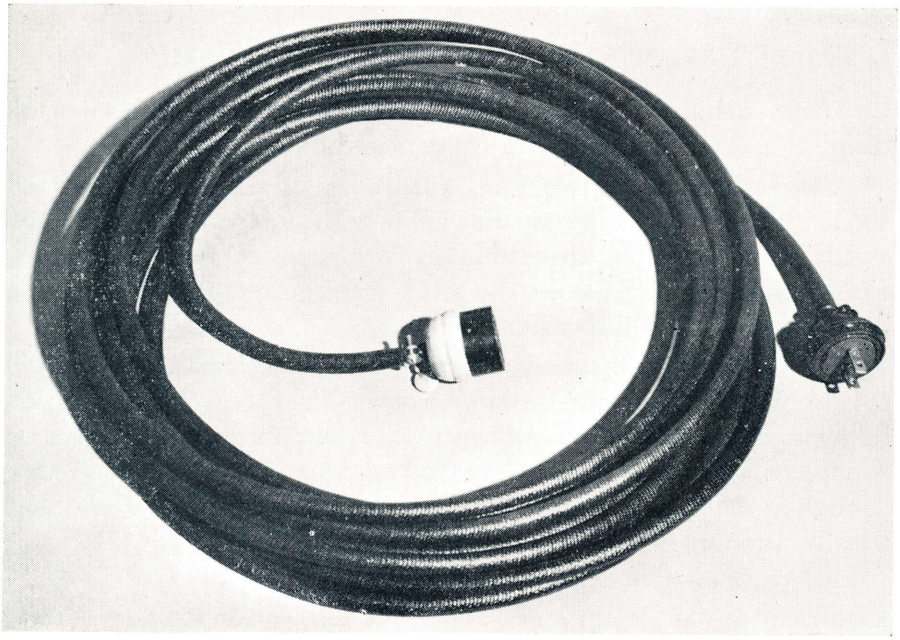


Fig. 2. A portable extension cord.

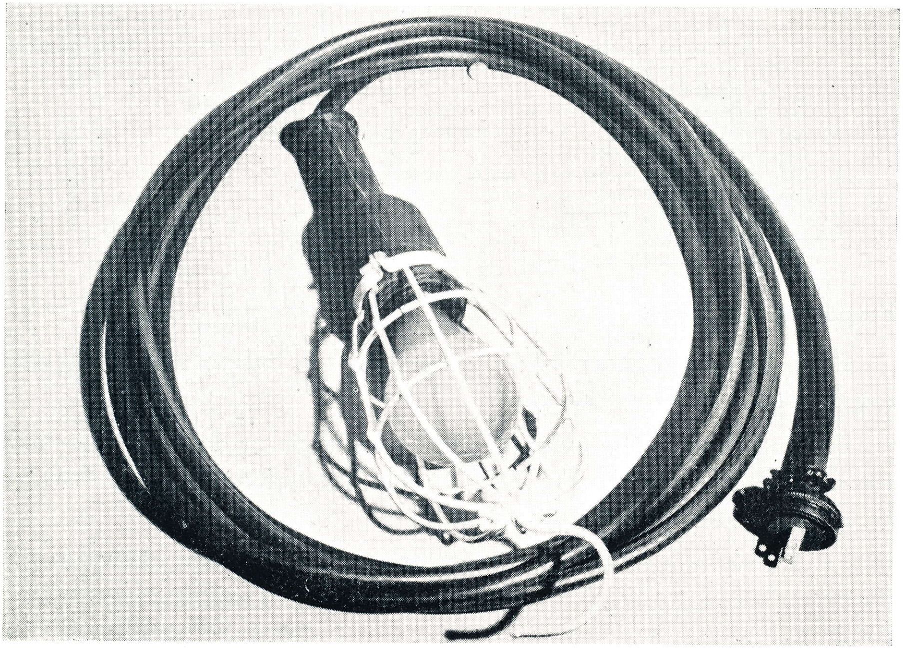


Fig. 3. A trouble lamp.

EXERCISE 1

## EXTENSION CORD OR TROUBLE LAMP

There are many uses for both an extension cord and a trouble lamp on every electrified farm (Figs. 2 and 3).

The cord should be two-wire, No. 16, heavy duty, rubber-covered, about 20 feet long. The trouble lamp will require a rubber handle and lamp guard, while the extension cord requires a connector body with a clamp grip. A good connector cap, preferably with a clamp grip, is required for either cord.

The cord should be connected in such a way that the tension will not be transmitted to the terminal screws. This may be done in the following ways: 1) by using a cap with a clamp grip, 2) if such a cap is not available, by tying an Underwriters knot, 3) if there is not room enough in the cap for a knot, the wire may be looped around the posts before fastening it under the terminal screws.

EXERCISE 2

## TOY ELECTRIC MOTOR

### Materials Required

1—Wood block 2⅛″ x 4½″
1—Wood block 4½″ x 6″
(both should be cut from soft pine wood preferably ¾″ thick. Grain of wood should run with the longest dimension of each piece)
1—11½″ length of ⅛″ thick x ¾″ wide soft iron (strip steel)
1—(or more as required) 1¾″ length of same iron as above.
1—(or more as required) 16-penny common spike nails (iron)
2—4-penny common nails (iron)
2—No. 8–1¼″ long, round-head wood screws (iron)
1—½-lb. coil No. 18 bell wire (75 ft.)
1—Roll friction tape ¾″ x 6′
1—dry cell 1½-volt
1—Wrapping string 6 feet long.

### Preparing the Parts

*Base*—The large wood block is used for the base of the motor and requires no further work.

*Bearing Block*—The bearing block should be made from the small wood block as shown in Fig. 4. The notch in the bottom, ¾″ wide by ⅛″ deep, should fit the iron.

*Field Poles*—Bend the long piece of iron to the shape shown in the diagram, keeping the dimensions as close as you can to those in the diagram. (Variations in the bending are permissible as long as the space between the pole ends is 2 inches and as long as each pole is

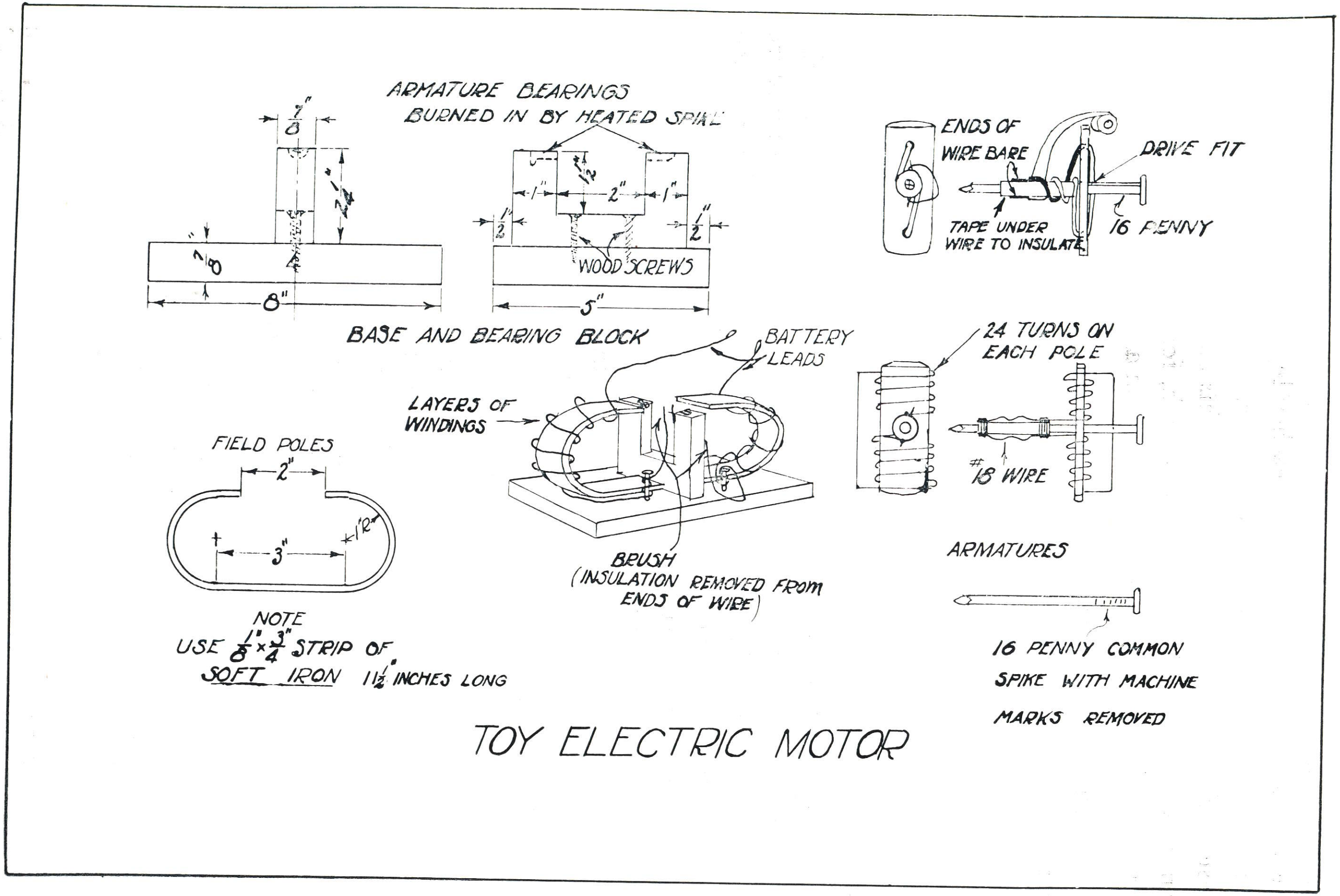

ARMATURE BEARINGS
BURNED IN BY HEATED SPIKE
7/8"
2 1/4"
1/8"
8"
1/2"
1"
2"
1"
1/2"
1/2"
WOOD SCREWS
5"
BASE AND BEARING BLOCK
ENDS OF
WIRE BARE
DRIVE FIT
TAPE UNDER
WIRE TO INSULATE
16 PENNY
BATTERY
LEADS
24 TURNS ON
EACH POLE
LAYERS OF
WINDINGS
FIELD POLES
2"
3"
1"R
#18 WIRE
ARMATURES
BRUSH
(INSULATION REMOVED FROM
ENDS OF WIRE)
NOTE
USE 1/8" × 3/4" STRIP OF
SOFT IRON 11 1/2" INCHES LONG
16 PENNY COMMON
SPIKE WITH MACHINE
MARKS REMOVED
TOY ELECTRIC MOTOR

Fig. 4.

2 inches from the bottom.) Find the center of the iron and mark a line with a pencil 1½ inches from each side of the center, for the flat 3 inches straight section at the bottom. Then bend iron between these marks and the ends of the iron. This can be done by putting the iron in a vise and using a monkey wrench, forming iron around a rod or pipe, or bending iron with a hammer on a block of wood.

*Armature Iron*—Armature iron should be made as shown in diagram. The number required will depend on the number of armatures made. Two are shown.

*Armature Shafts*—The spikes to be used for armature shafts should be alike and should be straight, with uniform heads. Remove tool marks from the heads with a file or emery cloth, and also any irregularities or enlargements near the points of the spikes.

*Assembly*—Fasten the field poles to the center of the base with the bearing block, held by the two wood screws. To make the armature bearings, center a spike. (Note: The field pole iron is closer to one bearing than the other. The head of the spike must be on this "closer" bearing.) Heat the spike and "burn in" the head into the block. Do the same for the point end, repeating the process until the spike has burned a bearing as deep as the diameter of the spike. Rotate the spike while burning. After burning, add a few drops of light oil.

*Winding the Field Coils*—With the field pole iron still in place, wrap the places where coils are to be located with friction tape. An 18-inch length, lapping half of the width of the tape at each turn, is required for each pole. Allow 12 inches for battery "lead". Starting at the base on either pole, wrap the wire in a clockwise direction. Lay each turn as close as possible, continuing to within ½ inch of the top. This should take approximately 40 turns. Before the last three turns are applied at top, put a one-inch length of tape under the wire, folding the tape over the windings when the return layer is started. Add the second layer, laying the turn as closely as possible until you reach the base again. This should take approximately 36 turns. Repeat by laying on the third layer up, and the fourth layer down. Each will take approximately 30 turns, making a total of about 136 turns. A few turns more or less, depending on accuracy of applying and length of wire, will do no harm. The finish wire should be wrapped around the 4-penny nail which is driven into the base, ½ inch from both the iron and the bearing block. This nail serves as a "brush" holder, and the end of the wire with the insulation removed, forms the "brush". The other winding is applied in a similar manner (in a clockwise direction), allowing a 12-inch battery "lead". The "finish" wires in each case should be 12 inches long, and each should go to one of the 4-penny nails. The "start" wires go to the battery terminals. "Brush" wires are spaced about ⅜-inch apart at the top.

*Two-pole Armature*—With the point of the spike reduced in size to eliminate the "swell" due to manufacture, it can easily be driven through the hole in the armature iron. The head of the spike should extend 1⅝ inches. At 2⅜ inches from the head, wrap 4 layers of ¾-inch wide friction tape on the spike, for the commutator. Remove the insulation from a three-inch piece of No. 18 wire and make the "bars" for the commutator. This is really only a short-circuiting device. *Important:* These bars must be located on the spike so that they are in line with the "leading" edge of the armature iron. They should also be opposite each other on the commutator and extend the same distance out from the spike. Long-nose pliers will make the work easier. Several strands of string will hold the bars in place. Overall diameter of the bars should be 7/16 inch.

*Two-pole Armature with Winding*—This is the two-pole armature with some No. 18 wire wound on the armature iron.

To wind the armature, first cover the armature iron where the winding is to be applied with at least one thickness of friction tape. This insulates the iron as well as holds the windings in place. Starting at the center of the armature, allow 2 inches for making a commutator bar, then apply the windings in the direction shown. The first layer will take 7 or 8 turns. A one-inch length of friction tape applied under the last two turns and folded back over the first layer will be helpful in holding the start of the second layer of windings.

The second layer will require 8 turns. This winding should continue past the spike to the other pole of the armature. The same direction of winding and the same number of turns and layers will thus be applied on each side. Repeat the process, applying the third and fourth layers. Thus a total of 24 turns per pole can be made from the 11 feet of wire required. More or fewer turns per pole are permissible, but each should have the same number to maintain a proper balance. The "start" and "finish" wires will come automatically at about the correct position to be used for commutator bars.

However, the motor is not designed for high-speed operation. Being a series type motor, it will operate on alternating current from a toy transformer as well as on direct current (dry cells). On alternating current, there is danger of overheating the windings in the motor and toy transformer, as a toy transformer is not designed for too high voltage. Using a rubber band for a belt, this motor can be made to operate small toys.

Many of the fundamental principles of the electric motor are found in this toy motor. These can be explained by removing the armature and closing the circuit by pushing the "brushes" together. The presence of the electric current is shown by the spark, which occurs when the brushes part. If the point of an iron nail about 1½ inches long is touched to the end of one of the field poles and the electric circuit closed by touching the brushes together, the nail will be held suspended between the two poles. When the electric circuit is broken, the nail will fall. If the circuit is again made, with the nail across its original position, it will jump back in line across the gap between the two poles.

Thus we see the presence of two fundamental circuits in all electric motors—namely, the electric circuit where the electricity flows, and the magnetic circuit where the magnetism flows. Without the electric circuit, we would not have the magnetic circuit, and without the magnetic circuit, no motor would be possible.

If the nail were fastened to a shaft and held between the poles, slightly out of line, when the electric circuit was made, the nail would rotate into line. Opening the electric circuit at the right time would allow the armature to roll like a flywheel. Repeating this process at the right time is difficult by hand, so an automatic device to "make" and "break" the electric circuit at the correct time is fastened on the rotating shaft. This is what we call a commutator.

The motor operates because the electric circuit makes the magnetic circuit, and the magnetic circuit has a movable section which is out of line and tends to rotate into line.

**EXERCISE 3**

## CARE OF ELECTRIC MOTORS

Electric motors require a certain amount of regular care to assure trouble-free operation and long life. Occasional cleaning and oiling are necessary as well as checking on the wearing parts, such as brushes and bearings.

Electric motors should be cleaned regularly to prevent overheating due to the insulating effect of the dirt and dust. Wipe the dirt off the outside with a rag. The dirt on the inside can usually be blown out with a tire pump. If grease and dirt have accumulated on the inside of a motor, it may be necessary to take it apart and wash the inside with carbon-tetrachloride in order to clean it thoroughly. However, this should usually be done only by an electric motor serviceman. Motors operated in a dusty or dirty location should be kept covered, and care should be taken to keep them from getting wet.

A little oil goes a long way on electric motors. The amount needed, depends on the type of bearings and how much the motor is used. The manufacturer's recommendations should always be followed, but in the absence of their instructions, the general rule for the common fractional horsepower motor is 3 or 4 *drops* of oil every 3 or 4 months. Remember, there is a lot of difference between a *drop* and a *squirt* of oil, and that one of the common causes of motor failure is over-

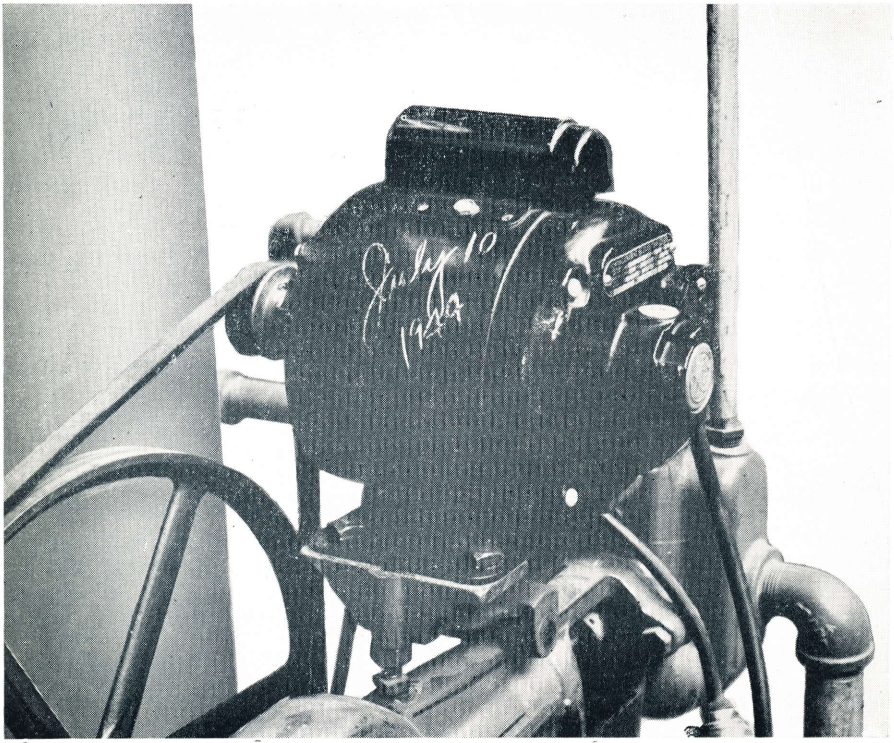


**Fig. 5. A good clean motor, with a record of the oiling date written on the motor.**

oiling. Motors with ball bearings require special lubrication about every two years by an electric motor serviceman.

The brushes will wear out in time and should be replaced before they become so short that the brush spring no longer holds the brush on the commutator firmly. New brushes should have a curve on the end which fits the curve on the commutator. This curve can be ground on by wrapping a strip of fine sandpaper around the commutator and turning it a few turns by hand with the brush held firmly against the sandpaper.

Bearings should be checked for looseness and endplay each time the motor is oiled. Replacing bearings is a job that should be done by an electric motor serviceman.

Overloading the motor will cause it to overheat and possibly burn out. A simple test for determining whether a motor is overloaded is to place the palm of your hand on the motor. If you can hold it there while you slowly count to 10 (10 seconds) it is probably not overloaded. On machines where a certain speed is not required, the load can be decreased by using a smaller pulley on the motor or a larger pulley on the machine.

The belt tension should be just tight enough to prevent slipping. If the belt is too tight the bearings will wear faster. On the other hand, if the belt is too loose, it will slip and wear faster. Belts should be replaced when they become frayed or worn, and should be kept free of oil. It is important that the pulleys be properly lined up, and that the motor be fastened securely to prevent vibration.

This exercise consists of caring for the motors on your farm (minimum of three motors) and reporting the oiling and cleaning dates, and all necessary repairs for one year.

**EXERCISE 4**

## MAKING A MOTOR PORTABLE

There are many machines on a farm which can be driven profitably with an electric motor. Some of these machines are elevators, pump jacks, seed cleaners, corn shellers, grinding wheels, egg cleaners, sausage grinders, onion, potato and apple graders. Many of these machines are not used often enough to justify a separate motor for each machine. So it is desirable to use the same motor for several different purposes.

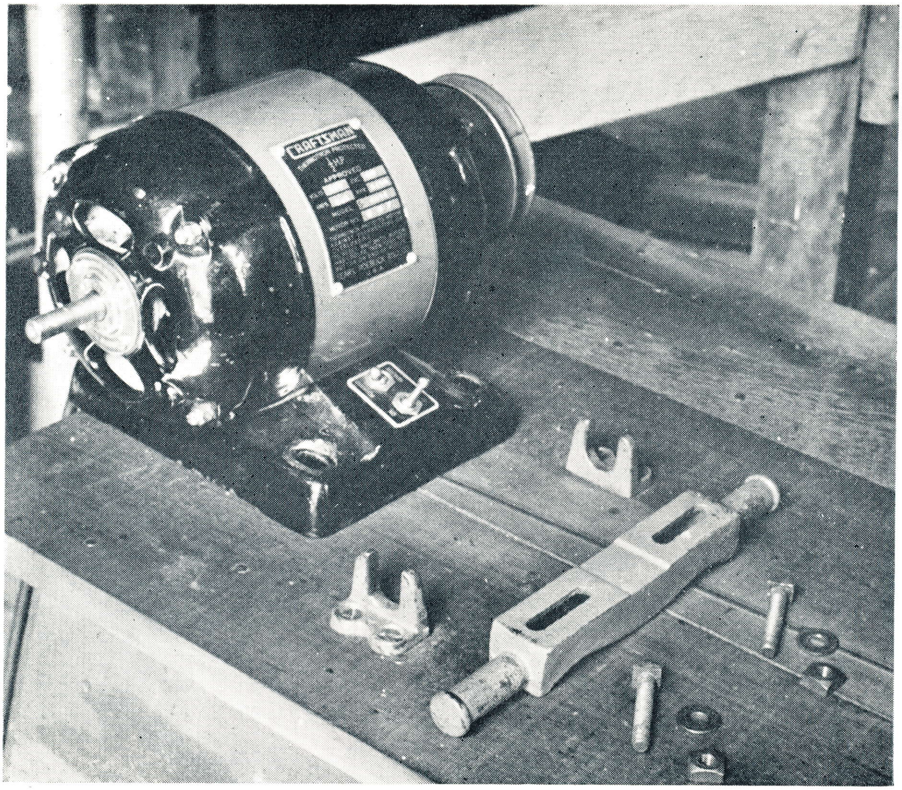



**Fig. 6. A commercially made motor mount.**

Figures 6, 7 and 8 show three common methods of making a motor portable so that it will be convenient to change it from one job to another.

Figure 6 shows a commercial type of iron rail with brackets that support the rail. Extra brackets may be purchased so they do not have to be moved for each job.

Figure 7 shows the "C" clamp method. Mount the motor on a board slightly larger than the motor. The motor can then be clamped to almost any piece of equipment with two 5-inch "C" clamps. An advantage of this type of mounting is that the motor can be mounted in any position necessary for the job, provided the motor is of a type designed for such mounting.

Figure 8 shows the broom handle method of making a motor portable. Cut a large broom handle or hoe handle of approximately the same length as the motor shaft. Bolt the broom handle to the motor as shown, counter sinking the heads of the bolts. The slot in the wood mounting block is made by drilling two holes (the distance between the centers of these two holes should be equal to the length of the broom handle) in a board and removing the wood between the holes with a keyhole saw.

The mounting in all cases should be installed so that the pulleys are properly lined up. Motors up to and including ⅓ h.p., may hang in the belt to keep it tight. Larger motors should be supported so that the entire weight does not hang in the belt. The direction of rotation can be changed on most motors and this may be necessary when changing the motor from one machine to another.

This exercise consists of making a motor portable, using these or

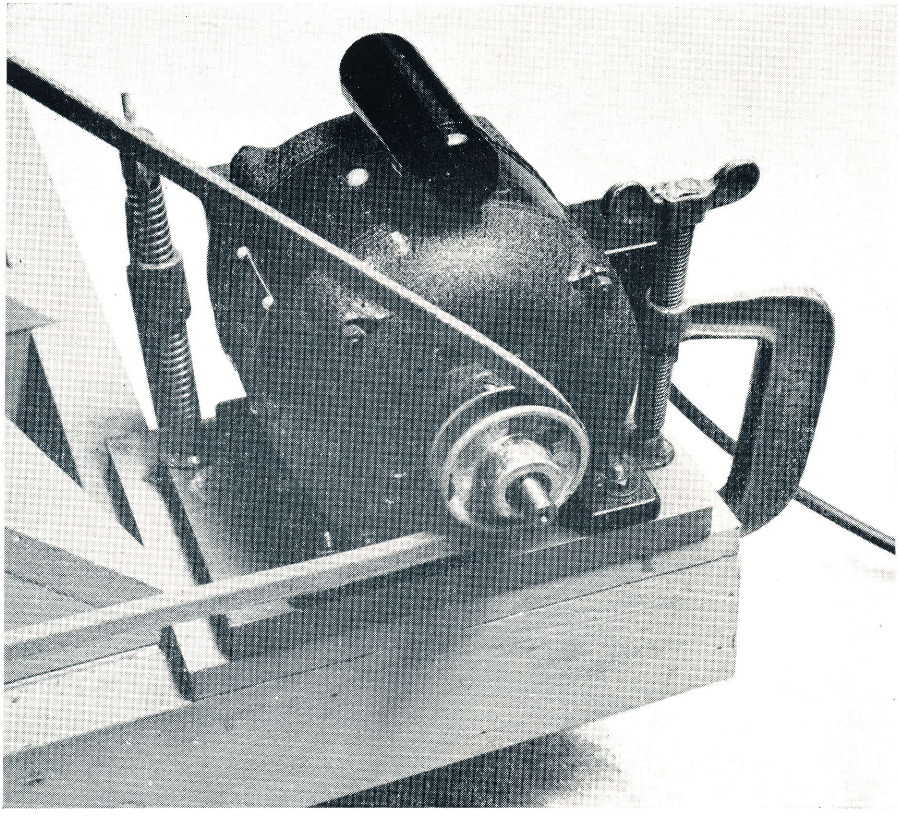


Fig. 7. The use of C-clamps in making a motor portable.

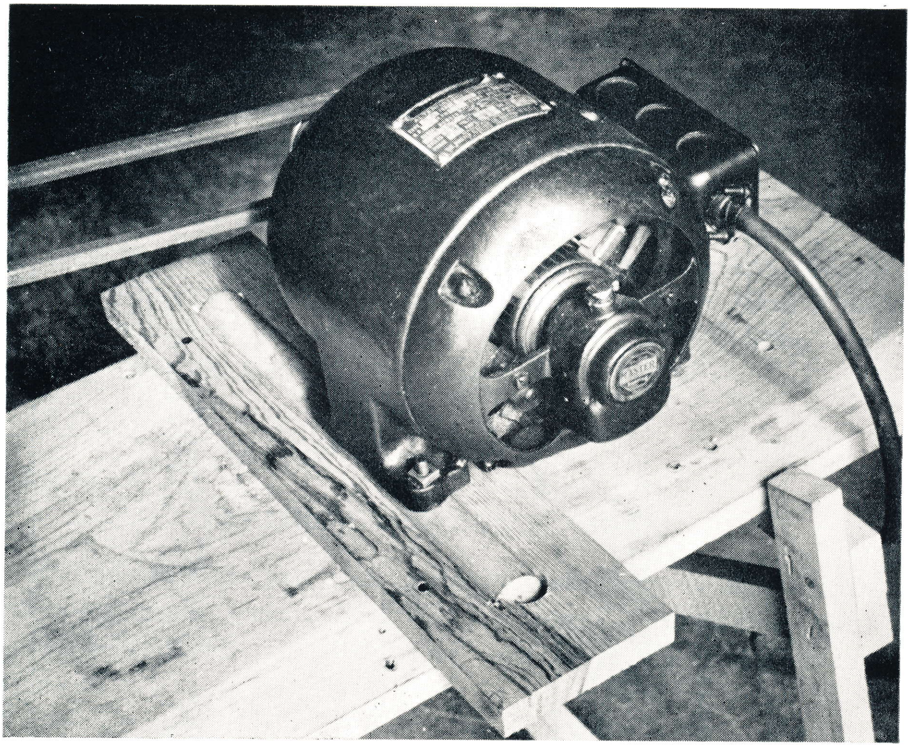


**Fig. 8. The broom handle portable motor in operating position.**

similar methods so that the motor can be used on at least two different pieces of equipment. Report the machines on which the motor is to be used, and the method by which the motor was made portable.

**EXERCISE 5**

## ALARM CLOCK TIME SWITCH

### Materials Required

Wall shelf
Alarm clock
Wooden arm 1″ x 2″ x 4″ to 8″ (for use with snap switch)
Stove bolt ¼″ x 2¼″
Small pulley and cord (for use with toggle switch)

An ordinary spring-wound alarm clock makes a simple time switch for automatically turning lights and small motors on or off at a certain time. For example, poultry house lights can be turned on automatically in the morning to stimulate winter egg production. Motors

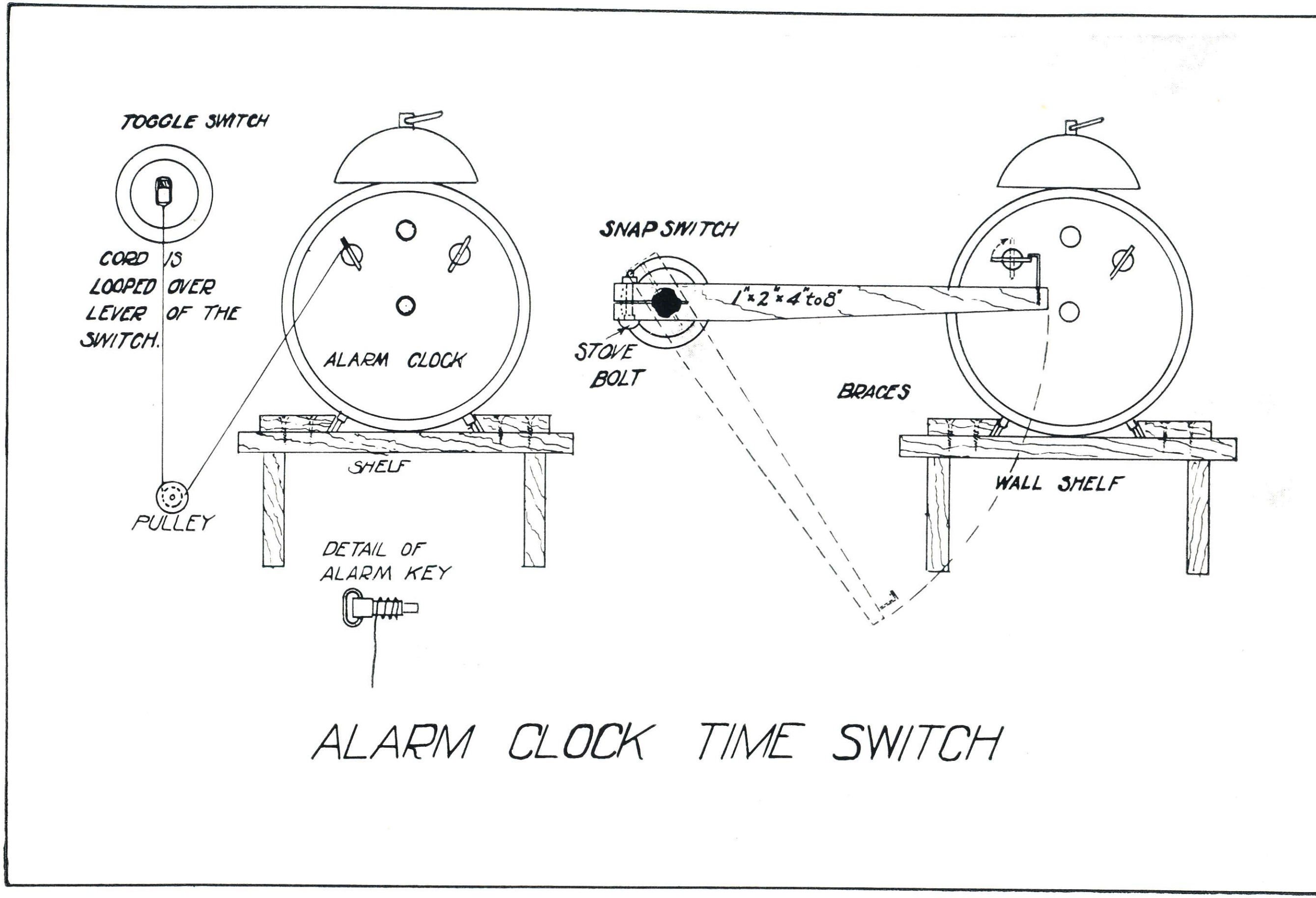

TOGGLE SWITCH
CORD IS LOOPED OVER LEVER OF THE SWITCH.
PULLEY
ALARM CLOCK
SHELF
DETAIL OF ALARM KEY
SNAP SWITCH
1"×2"×4"to8"
STOVE BOLT
BRACES
WALL SHELF
ALARM CLOCK TIME SWITCH

Fig. 9.

on pump jacks, feed grinders, and other appliances can also be started or stopped with this device.

Figure 9 shows the arrangement for use with either a snap switch or a toggle switch. A lever arm is used with the snap switch and it must have enough weight so that it will drop and snap the switch when released from the alarm key.

A length of cord and a small pulley is needed to operate a toggle switch. The cord must be wound on the alarm key so that it will wind up and pull the switch when the alarm goes off. The clock should be securely fastened to the shelf.

**EXERCISE 6**

## REPAIRING APPLIANCE CORDS

Frayed and worn places on appliance cords, lamp cord and extension cords can be serious shock and fire hazards. All of these cords should be repaired immediately, or replaced if the damage is too extensive.

**To Repair a Cord Frayed Near the Plug: (Steps 1 - 6; Fig. 10)**

1. Release cord by loosening the screws inside plug.

2. Cut off frayed end of cord.

3. Strip 2″ of outer fabric covering from cord. Moulded rubber cord can be split back 2″ from the end. Be sure that when the cords are split no wires are exposed through the insulation.

4. Strip insulation from ends of cords to expose about ¾″ of bare wire. Twist strands together.

5. Slip cord through plug and tie cord ends in Underwriters knot. This keeps wires from being pulled away from under the screw posts. Pull knot down inside plug.

6. Wrap wires around prongs to form an S. Loop bare copper ends around the screw posts in clockwise direction. Hold in place and tighten screws firmly.

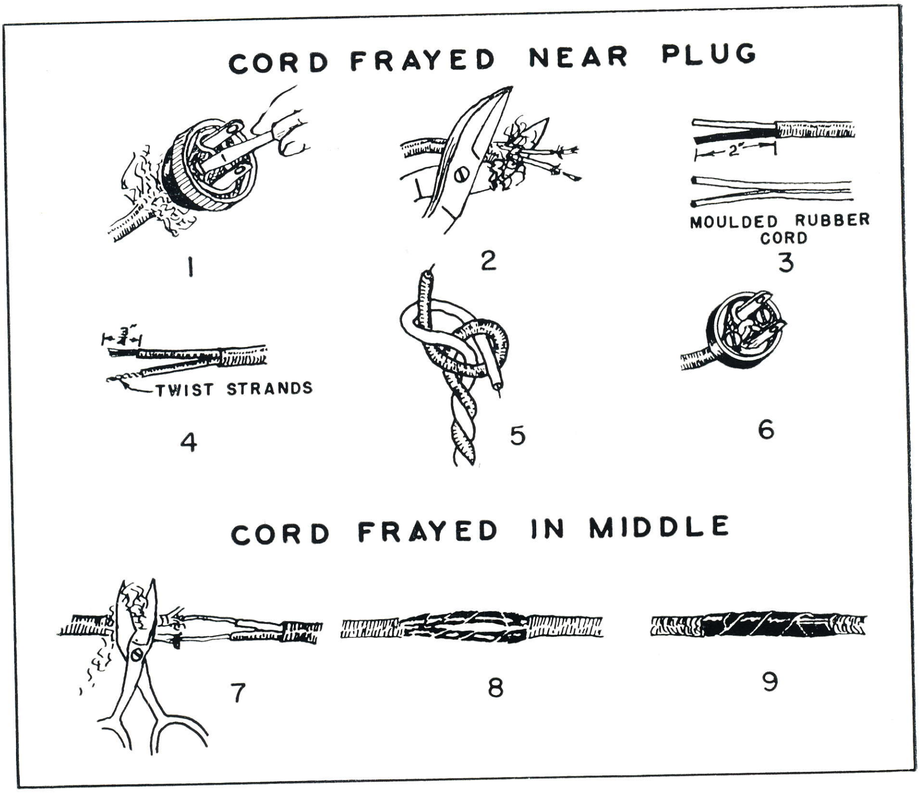



Fig. 10.

**To Repair a Cord Frayed in the Middle: (Steps 7 - 9; Fig. 10)**

7. Cut frayed edge clean.

8. With electrician's rubber tape, wrap each wire *separately* from end to end.

9. With friction tape (tire tape) bind the 2 wires together.

This exercise consists of inspecting and repairing all of the cords around your home and farm. Replace all broken plugs with new ones of a type which will not break when dropped or stepped on. Report the number and types of cords you repaired.

EXERCISE 7

## PIG BROODER

The electrical pig brooder is a simple piece of equipment which helps to save more pigs per litter during early spring farrowing, by providing a warm area in one corner of the pen to prevent loss by chilling after farrowing and to protect the little pigs from injury. They should be placed under the brooder immediately after farrowing and once they learn to stay there, little attention is needed to reduce the danger of their being laid on or stepped on by the old sow.

The brooder should be used during farrowing and for 7 to 10 days afterwards. It may be used in any farrowing pen where electric current is available. Fasten the brooder securely in one corner of the house or pen and place a gate, heavy boards, or 2 x 4's across the corner above the brooder to protect the reflector and cord.

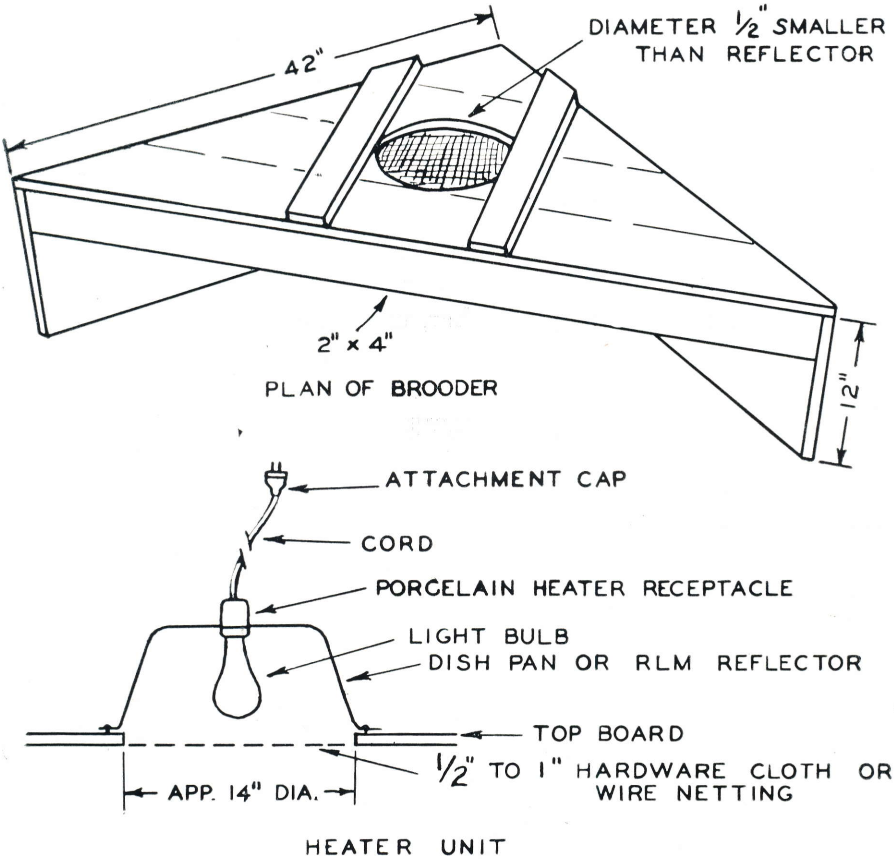



Fig. 11. Pig brooder.

**Construction of the Brooder**

Construct the brooder as shown in the plan. The two sides may be either planks or boards 12 inches wide and 36 to 42 inches long. Use 36-inch sides in a 6- by 6-foot farrowing house and 42-inch sides in larger houses. The top is made of boards or one-fourth or three-eighths inch plywood, if available. A 2 x 4 is placed along the front edge to give the brooder strength and to hold the heat under the brooder.

If an RLM reflector is not readily available, a dish pan with a bright inside surface may be used. The pan should be 6 or 7 inches deep and approximately 14 inches in diameter. A hole, large enough for a porcelain heater receptacle, may be made in the bottom with a hammer and chisel. Rubber covered cord should be used. (Note: To facilitate the use of the brooder, a convenience receptacle should be mounted on the wall of the individual house or near the farrowing pen in the central house. The wires from the receptacle in the individual house should extend to the outside through an approved weatherhead.) Fasten the reflector with screws to permit replacement of the light bulbs. Nail a piece of hardware cloth or fine chicken wire below the hole in the hover to prevent straw or litter from coming in contact with the bulb and causing a fire.

Change the bulb to meet weather conditions. During normal winter weather, use a 100-watt bulb; during severe weather, use a 150-watt bulb; and during mild weather, use a 60-watt bulb.

**EXERCISE 8**

## POULTRY WATER HEATER

Water available at all times is essential for a flock of producing hens. Electric lights can be used to arouse the birds early in the morning, but unless water is available for them, much of the value of the lights may be lost.

An inexpensive poultry water heater to keep the water from freezing can be constructed from the accompanying diagram. The hole in which the porcelain heater receptacle is mounted may be cut with a hammer and chisel and should be just large enough to admit the receptacle. A round, or half-round file is handy for smoothing the edge to make a good fit. A hole should also be punched in the bottom of the pan near one corner, to drain any water which might spill into the pan.

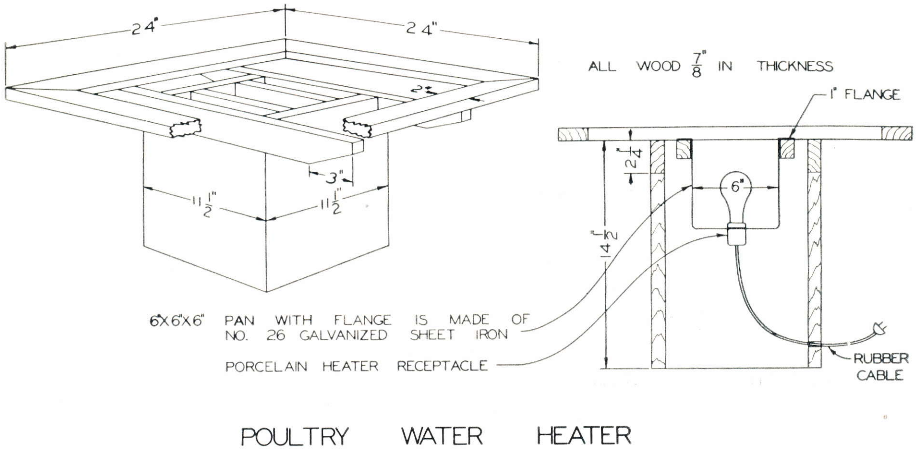



**Fig. 12. Poultry water heater.**

The poultry waterer is placed on the stand over the lamp which raises it about 14½ inches above the floor. Thus it is necessary for the hen to jump up on the framework of the stand to obtain water. This helps keep dirt out of the water and reduces spillage.

The size of lamp used for heating should be 25 watts or larger, depending on the amount of water to be warmed, and the air temperature. During cold weather the lamp should be left on continuously. For this reason a separate circuit, which does not turn off with the lights, should be provided. It is not necessary to heat the water appreciably; it needs only to be kept from freezing.

**EXERCISE 9**

## ELECTRIC CHICK BROODER

This 4- by 4-foot brooder, equipped with eight low-wattage lamps will care for 250 chicks during normal brooding conditions. Three hundred and fifty chicks may be brooded in a 4- by 6-foot brooder of similar construction, using 12 low-wattage lamps. The cost of materials for building this brooder should be about $10 and will have a life comparable to that of a good commercial brooder.

### Construction

The frame is 1- by 4-inch material. The top and sides are ¼-inch building board of the hard type, such as plywood, fiber board, or studio board. The four inches of space on top of the brooder should be filled with litter similar to that used on the floor.

## Bill of Materials

3—1″ x 4″ x 12′ white pine recommended
1—$\frac{1}{4}$″ x 4′ x 8′ building board of hard type
8—two-piece porcelain standard receptacle sockets with concealed terminals—such as Paulding 50721
20′—rubber-covered cord, No. 16
12—2″ No. 8 screws (fasten mounting strips to brooder)
$\frac{1}{2}$ pound—6d cement-coated nails
16—$\frac{3}{4}$″ No. 6 screws (fasten receptacle to mounting strip)
1—handy utility box with cover for duplex outlet
2—$\frac{1}{2}$″ connectors
1—duplex receptacle—flush
3—connector caps (plugs)
8—60-watt electric lamps

Cut building materials into the following pieces:

| Part No. | Req. No. | Size | Piece |
|---|---|---|---|
| A | 4 | 1″ x 4″ x 16″ | legs |
| B | 2 | 1″ x 4″ x 48″ | side supports |
| C | 2 | 1″ x 4″ x 45$\frac{1}{2}$″ | side supports (cut length to fit) |
| D | 3 | 1″ x 4″ x 47″ | mounting strips |
| E | 1 | $\frac{1}{4}$″ x 47″ x 48″ | top board |
| F | 2 | $\frac{1}{4}$″ x 12″ x 48″ | sides |
| G | 2 | $\frac{1}{4}$″ x 12″ x 49″ | sides |

## Wiring the Brooder

Two-piece porcelain standard receptacle sockets with concealed terminals are satisfactory. The eight sockets are arranged as shown in Fig. 13. A duplex outlet on the side of the hover aids in making connections and provides a simple way of turning lights on and off to control the temperature. The center circuit of two lamps is attached directly to one pair of terminal screws on the duplex unit and will remain "on" as long as the cord from the brooder is plugged in. The two outside circuits of three lamps each are provided with attachment plugs, and are "on" only when plugged into the duplex outlet. Rubber-covered No. 16 cord is satisfactory.

An alternate method of wiring is to connect all the lights in one circuit. This method eliminates the duplex outlet, but it is necessary to loosen or tighten in the socket any lamp which is to be turned off or on.

## Controlling the Temperature

Use eight 60-watt standard lamps when starting the chicks. As the chicks grow older, their bodies will furnish more heat, and the temperature may be lowered by using fewer or smaller lamps. No thermostat or thermometers are necessary for this brooder. Watch the chicks. They will huddle in a bunch if too cold, and if it is too warm none of them will stay under the brooder.

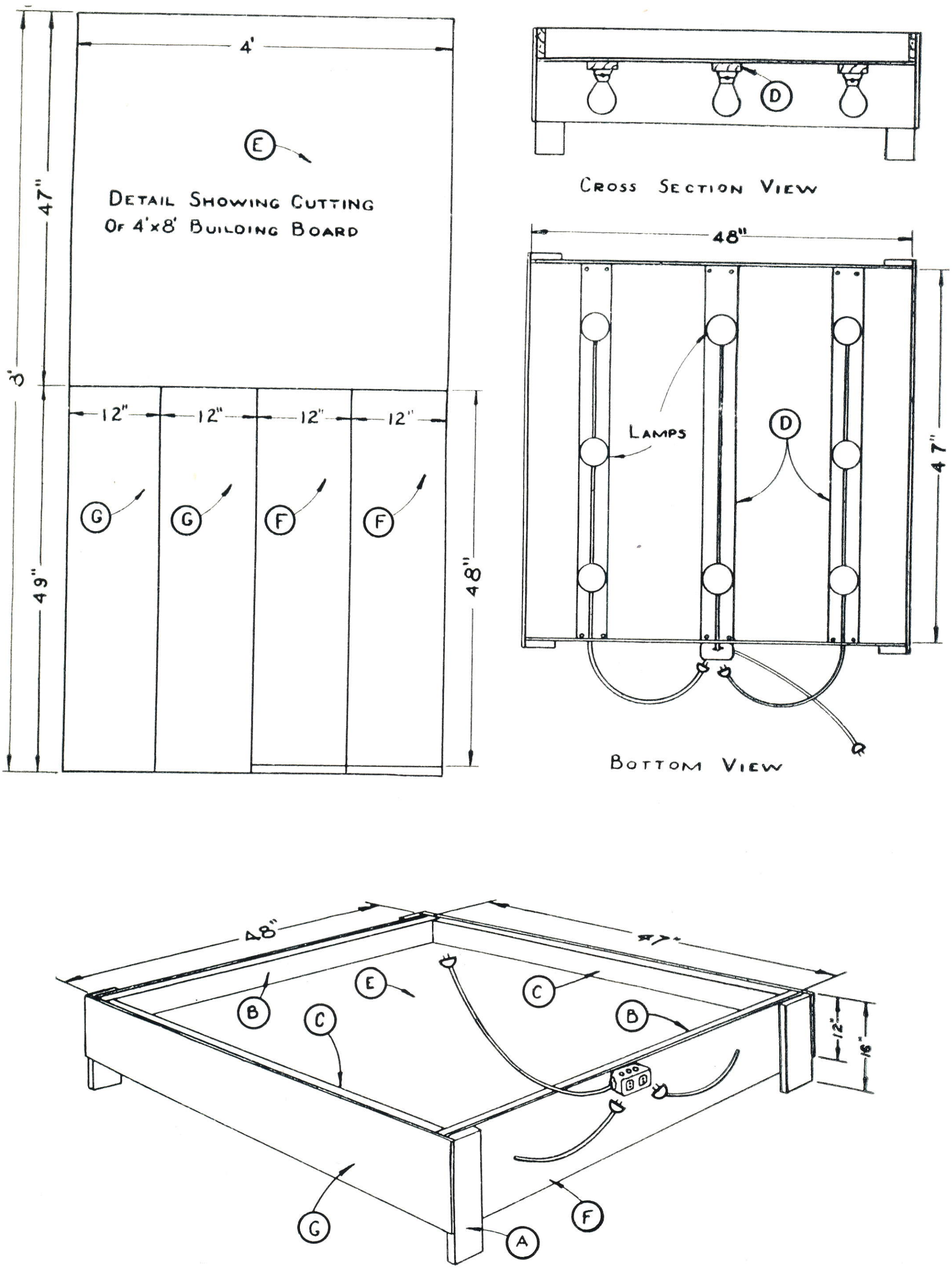



Fig. 13. Home-built brooder.

### Safety Precautions

Always leave a lamp in every socket to prevent danger from electrical shocks. Lamps should not be closer to the floor than shown in the drawing. All wiring to the brooder house and within the house and in the brooder itself, should be installed according to approved methods. It is important that the wires leading to the house be of proper size since wires which are too small will greatly reduce the heat output of the lamps.

**EXERCISE 10**

## MOUNTING A MOTOR ON A SEED CLEANER OR CORN SHELLER

These are two machines which are easy to electrify. An electric motor will drive them all day for a few cents worth of electricity. This

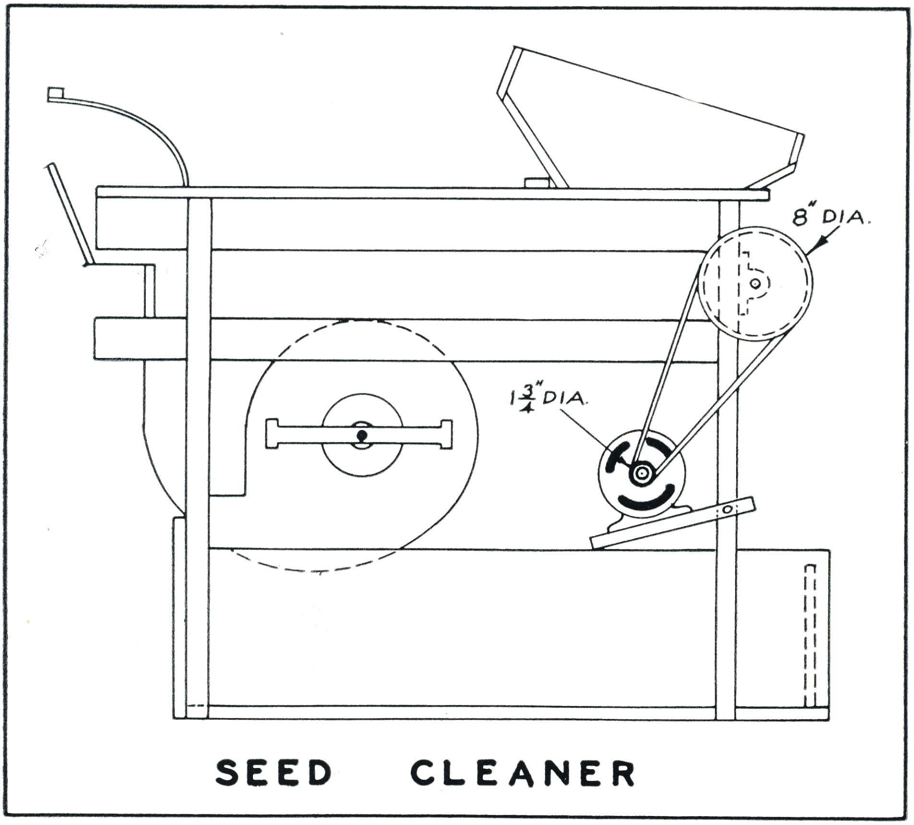



Fig. 14.

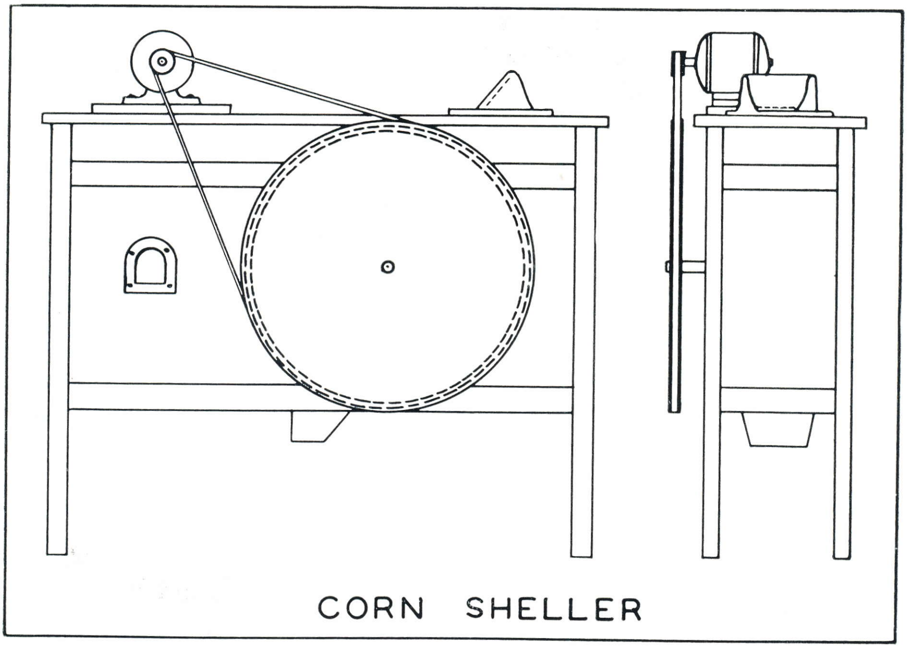



Fig. 15.

exercise requires that you mount a motor on a seed cleaner or corn sheller, and report which you did.

**Attachment to Seed Cleaner**

Attach the motor to a 9″ x 12″ board, 1″ thick, which is notched to fit the post of a fanning mill as indicated in Fig. 14. Drill a 3/8″ hole lengthwise through the board or attach 1″ x 2″ strips to the board and drill holes for the bolt through the strips. Also drill a 3/8″ hole through the post at a point 16 inches below the rack power shaft. A 3/8″ machine bolt, 13″ long is necessary to reach through the board. Use an 8″ pulley on the rack power shaft with a 1¾″ pulley on the motor to get a speed of 400 r.p.m. If necessary, reverse the motor to obtain the proper direction of rotation.

**Attachment to Corn Sheller**

To transfer the motor to a corn sheller simply mount the board on top of the sheller as indicated in Fig. 15 and reverse the direction of rotation of the motor if necessary. A capacitor or repulsion induction (RI) motor should be used.

If the flywheel does not have a flat face on which to run the belt, a pulley can be made from ¾″ or 1″ plywood cut to size, and bolted to the flywheel. As a safety precaution replace the handle with a collar fitted with a flush set-screw.

EXERCISE 11

## MAKING A LAMP SHADE

Lamp shades are not mere accessories in a room, but are as important a part of the furnishings as the chairs, tables, and other furniture. They should be of the proper size, shape, color and material to provide good lighting and harmonize with the rest of the room. You can easily make a new shade when it becomes necessary to replace an old one, or when you wish to give an old lamp a new look.

### Shade Size and Shape

Shades are always measured by the diameter across the bottom. On vanity lamps or dresser lamps the diameter should be 8 to 10

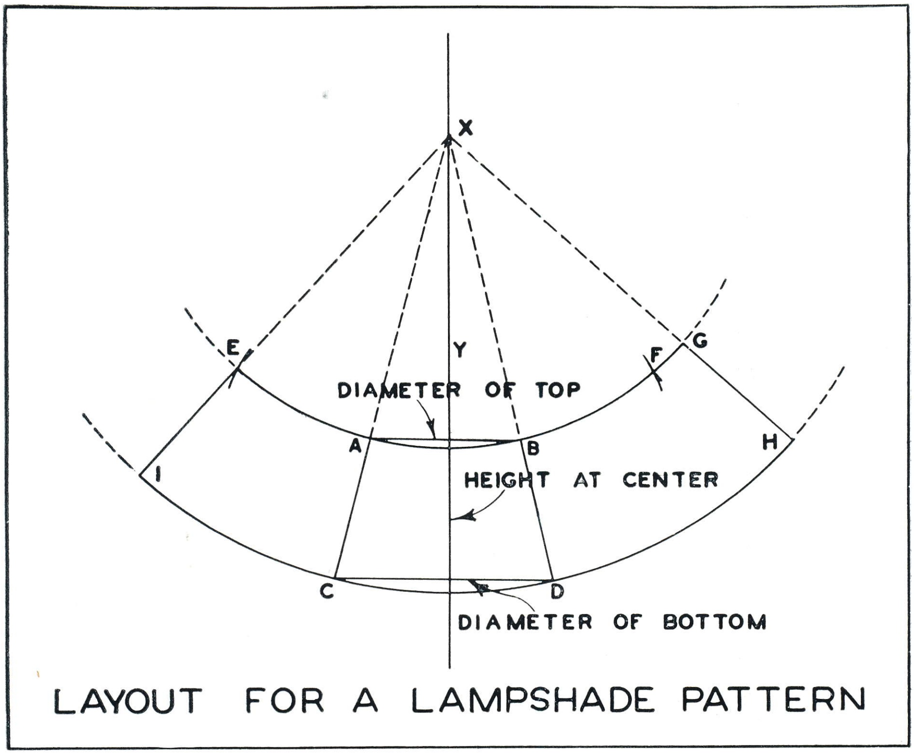



Fig. 16.

inches. Table lamps such as are used for reading, studying, and sewing should have shades with a bottom diameter of 14 inches to 18 inches. The flared shades permit a wider circle of light than the drum or square types and are generally best except when the design of the room calls for modern straight lines.

**Shade-color**

Shades should generally be a light color, at least on the inside, because dark colors soak up or absorb the light instead of reflecting it. White, off white, very light grey, yellow, or shell pink are good. The outside of the shade may be decorated with oil or water color paints.

**Shade-materials**

Paper shades are more common and are usually cheaper and easier to make than those covered with fabrics. The paper should be heavy enough to hold its shape and hide the imprint of the bare bulb, yet thin enough to let light come through. You can test the material, before cutting the pattern, by holding it over a lighted bulb.

## Materials Needed

1. Old lamp shade or wire frame from one
2. Paper for lamp shade (one of the following)
    a. parchment paper
    b. drawing paper
    c. cover paper
    d. manila paper
    e. poly plastex
3. Household cement (transparent)
4. Scotch tape, clothes pins—pincer type (6 or 8)
5. Shears, pins, pencil, ruler
6. Oil or water color paints (optional)

NOTE: Heavy papers, such as manila can be made translucent (so that part of the light comes through) by oiling both sides with a mixture of equal parts of turpentine and linseed oil. When this is dry, a coat of clear shellac may be applied. This makes an imitation parchment.

**Making the Shade**

1. Remove cover from wire frame and save for a pattern if suitable.
2. Clean wire frame using steel wool if necessary.
3. Paint or enamel frame white and dry 48 hours.
4. Cut out new shade using old covering as a pattern or follow directions under "How to Make a Pattern for a Paper Shade".
5. Attach shade to frame by lacing or using gummed tape around the rims. To attach by lacing it is necessary to punch holes about ½-inch apart along top and bottom rim of paper. Leave a ½-inch margin from outside edges and be sure to space evenly. Lace the paper onto the frame with an overhand stitch using heavy yarn, ribbon, colored twine, heavy cord, shoelaces, etc. The edge seam where the two ends meet may also be laced together or glued.

**How to Make a Pattern for a Paper Shade**

1. Measure diameter at top of wire frame.
2. Measure diameter at bottom.
3. Measure height through center of frame.
4. Draw diagram, full size, on wrapping paper.
5. Draw a line through center of pattern, extending well through top. Call this line "Y".
6. Extend line BD to meet line Y.
7. Extend line AC to meet line Y.
8. Mark X at point where all three lines meet.
9. Attach string and pencil to sturdy common pin.
10. Stick pin firmly into X.

11. With pencil swing an arc well around the AB line.

12. Swing another arc well around CD line.

13. With string measure from A to B.

14. Put pin on A. Swing slight arc to E.

15. Put pin on B. Swing slight arc to F.

16. Measure about 2 inches beyond F to G.

17. Draw line from X through G to H.

18. Draw line from X through E to I.

19. Cut out pattern. E I G H.

**EXERCISE 12**

## MINIATURE MODEL OF A ROOM

Two miniature models should be made of either the living room or your bedroom of your present home. The first model should show the room as it is now, the second should show the same room after improvements have been made in furniture arrangement, lighting, and electrical outlets. You may wish to make some changes in decoration too in the way of color and design. Label one "present" and the other "future".

Rearranging furniture, changing color schemes and thereby making a room more cheerful and livable is fun and it's not hard. You may not be able to *actually* make all the changes you find necessary in your home but you will have set a goal for yourself towards which you can work.

### General Suggestions for a Living Room

1. Never place large pieces of furniture cater-corner.

2. In average sized and small rooms place large pieces of furniture against a wall.

3. Chairs with high backs should not be used in the middle of the room.

4. If there is a lovely view out of the window, arrange the chairs to take advantage of it.

5. Place a lamp close to every comfortable chair.

6. Lamps are more noticeable at night when lighted so it is decoratively necessary to have enough floor and table lamps to light the whole room. At least four lamps are needed in the average living room. When all are turned on the room looks cheerful and comfortable.

7. Arrange furniture so it will be easy to converse with other people. Don't have a comfortable chair too far from the conversational center.

8. Do not use all large pieces on one side of room. Balance furniture as to size and height.

9. There should be enough electrical outlets in the walls or floor to connect lamps without the use of extension cords.

### General Suggestions for a Bedroom

1. A double bed should be placed in the center of a wall.

2. Single beds may be placed with either headboards or sides against the wall.

3. Low modern beds may be placed at right angles to each other in a corner, forming an "L".

4. Place a bed so that there is plenty of ventilation for the sleeper.

5. Night tables may be used between twin beds or on the outside of each bed.

6. One comfortable arm chair with a good reading lamp is desirable.

7. Place bureau or dresser against a wall opposite the bed if possible—this gives good balance to the room.

8. A dressing table or vanity should have plenty of light.

9. Dressing tables are attractive when placed in a bay window or on a small wall space between two windows.

10. A desk is handy if you study in your bedroom. Place it flat against a wall or if space is limited, place it at right angles.

11. Remember—never place furniture cater-corner. Furniture at odd angles upsets the design and balance of the room.

12. There should be enough electrical outlets in the wall or floor to connect lamps without the use of extension cords.

## Necessary Working Tools

| | |
|---|---|
| Crayons | Two pasteboard boxes |
| Ruler | Toy furniture or furniture made from paper |
| Paste | |
| Scissors | |

## How to Make a Miniature Room

1. Select either your living room or your bedroom with which to work.

2. Measure the room from end to end and from side to side.

3. Measure windows and doors—height and width. (Jot down these measurements.)

4. Use pasteboard boxes for walls and floor. Use scale one inch equals one foot. (1″ = 1 ft.)

5. Mark off floor dimensions.

6. Make three walls only. The fourth wall will not be used, enabling you to work more easily in the room. If the room you select has a solid wall, unbroken by windows and doors, use that as the "open" wall.

7. With crayons, color the walls and floor to match your own room as closely as possible.

8. Study the suggestions on furniture arrangements and color as listed in the previous paragraphs.

9. Arrange the furniture exactly as it is in your own room at present. Mark electrical outlets with (X).

10. Prepare and assemble the second or "Future" room. Using the identical number of furniture pieces, rearrange the room until the new placement is entirely comfortable. You may then add any further chairs, tables, etc., you feel are necessary to completely outfit the room.

11. Refer to household magazines, for good color schemes. Colored pictures of bedrooms and living rooms in such magazines are excellent guides for you to follow. Discuss your favorite colors with your leader and follow her advice.

12. Exhibit the "Present" and "Future" rooms.

EXERCISE 13

## READING THE ELECTRIC METER AND COMPUTING MONTHLY BILL

The electric meter measures the amount of electricity used. It is actually a small motor which turns the dial pointers through a train of gears when electricity is being used.

The dials register in kilowatt-hours (KWH) the amount of electricity used. This is the unit of measure by which electricity is paid for in the same way that gasoline is paid for by the gallon and sugar by the pound. A kilowatt-hour is 1,000 watts used for an hour, 500 watts used for 2 hours, 100 watts used for 10 hours, or any other such combination.

Two meter dials are shown in Fig. 17. One shows the reading at the beginning of the month, and the other shows the reading at the end of the month. Note that two of the hands turn in one direction and the other two in the opposite direction. To read a meter, write down the number each pointer has passed starting with the right hand dial. The reading at the beginning of the month in Fig. 17 is 3,851 and the reading a month later is 4,087. Thus the number of kilowatt-hours used during the month is the difference between the two readings: 4,087 — 3,851 = 236 KWH.

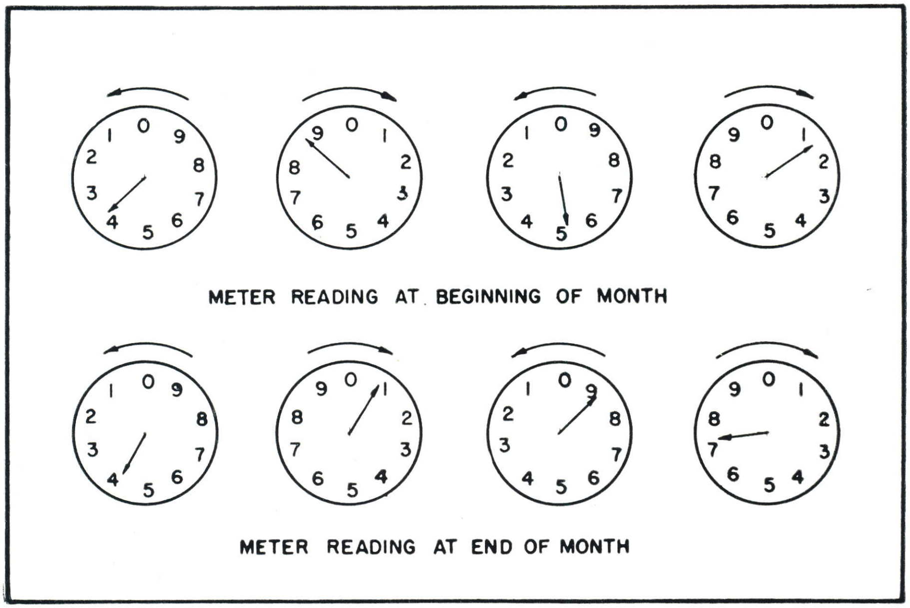



Fig. 17.

From this you can figure the monthly bill if you know the electric rate. Most electrical rates are on a step-basis similar to the sample rate shown here so that the more electricity you use per month, the lower the average cost per KWH.

| | | | |
|---|---|---|---|
| First | 15 KWH | — | 5.0¢ per KWH |
| Next | 15 KWH | — | 4.0¢ per KWH |
| Next | 35 KWH | — | 3.0¢ per KWH |
| Next | 155 KWH | — | 2.0¢ per KWH |
| | 220 KWH | | |
| Over | 220 KWH | — | 1.5¢ per KWH |
| Minimum bill | | — | $1.00 |

Sales tax, 3%. 10% discount for prompt payment. Using the sample rate for 236 KWH, the bill for the month is figured as follows:

| | | | | |
|---|---|---|---|---|
| First | 15 KWH | @ 5.0¢ | = | $0.75 |
| Next | 15 KWH | @ 4.0¢ | = | .60 |
| Next | 35 KWH | @ 3.0¢ | = | 1.05 |
| Next | 155 KWH | @ 2.0¢ | = | 3.10 |
| Last | 16 KWH | @ 1.5¢ | = | .24 |
| Total 236 KWH | | | | $5.74 |
| Less 10% for prompt payment | | | | .57 |
| | | | | $5.17 |
| Plus 3% sales tax | | | | .16 |
| NET BILL | | | | $5.33 |

The average cost per KWH, is obtained by dividing the total monthly bill by the total KWH, used during the month. For example— $5.33 ÷ 236 = 2.258¢ per KWH.

**Requirements**

1. Obtain your local electrical rate schedule and list on a sheet of paper.

2. Read your electrical meter and write down the reading and the date.

3. One month later, read your electrical meter. Again write down the reading, and the date.

4. Determine the total number of kilowatt-hours used during the month.

5. Determine the amount of your monthly electrical bill using your local rate.

6. Find the average cost per KWH, for the period covered by the bill.

This report should be attached to your electrical club report.

EXERCISE 14

## WIRING PANEL

The purpose of this exercise is to teach some of the principles of wiring. You are required to do this exercise before attempting others which involve wiring.

The exercise consists of making the panel as shown in Fig. 19. The same panel, partly completed, is shown in Fig. 18. The wire which leads in from the right feeds the current to this group of outlets and can be considered the *source*. The switch at the left controls the outlet next to it while the pull chain cover has a switch in the base. The outlet at the top is connected to the source in the junction box.

Study Chapters 4 and 5 in "Wiring Simplified" when you do this exercise.

The upper left hand-corner of the panel shows the five steps in making a "Western Union" splice:

1. Twisting the wires
2. Completed splice

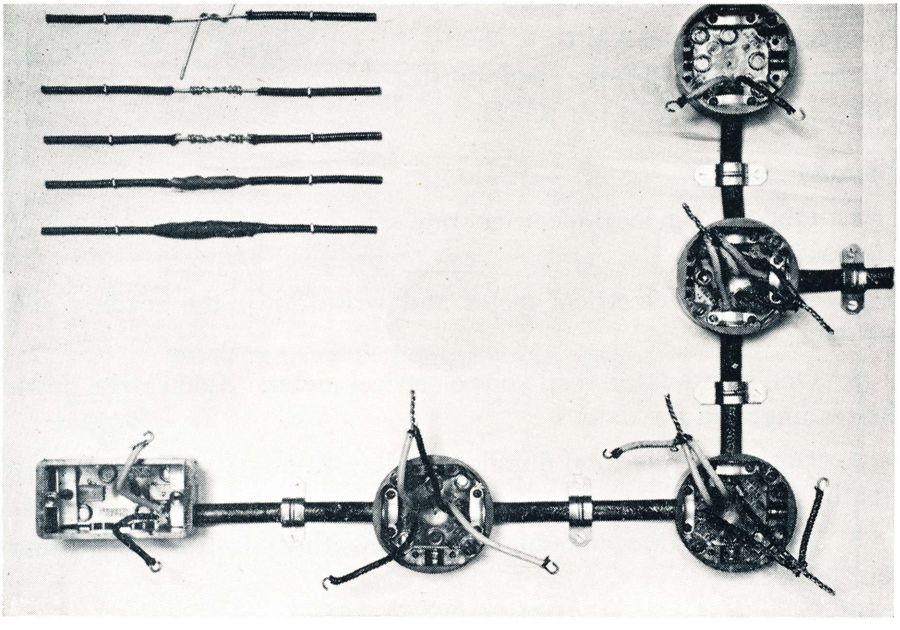


**Fig. 18. Panel partly completed to show wiring connections. The twisted connections on the indoor wiring should be bent, soldered, and taped before installing receptables as shown in Fig. 19.**

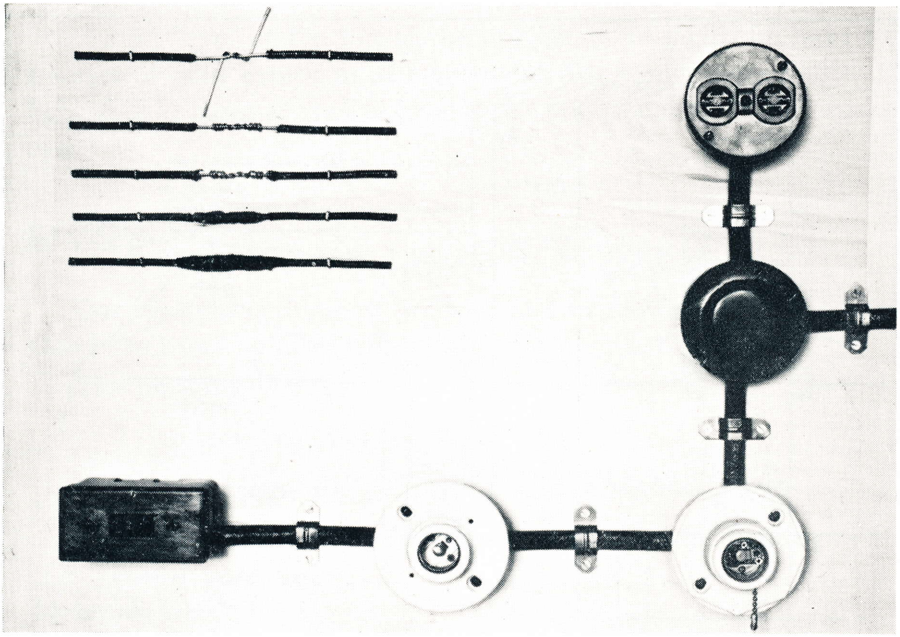


**Fig. 19. The complete panel.**

3. Soldered
4. Rubber tape
5. Friction tape

This splice is used only for outdoor wiring.

### Materials Required for Panel

7 feet—No. 14 rubber covered wire
7 feet—2 wire No. 14 non-metallic cable
1—Rectangular or utility outlet box with clamps
1—Switch cover for rectangular outlet box
3—3¼″ outlet boxes
1—Duplex outlet for 3¼″ outlet box
1—Cover for 3¼″ outlet box
1—3¼″ lamp receptacle with pull chain
1—3¼″ lamp receptacle without pull chain
5—Cleats for 2 wire No. 14 non-metallic cable
20—⅝″ No. 8 round head screws

**EXERCISE 15**

## MOVABLE WORK BENCH LIGHT

A movable lamp which can be used to provide ample light for any area of the work bench is a great convenience. The materials necessary for constructing this lamp are easily available.

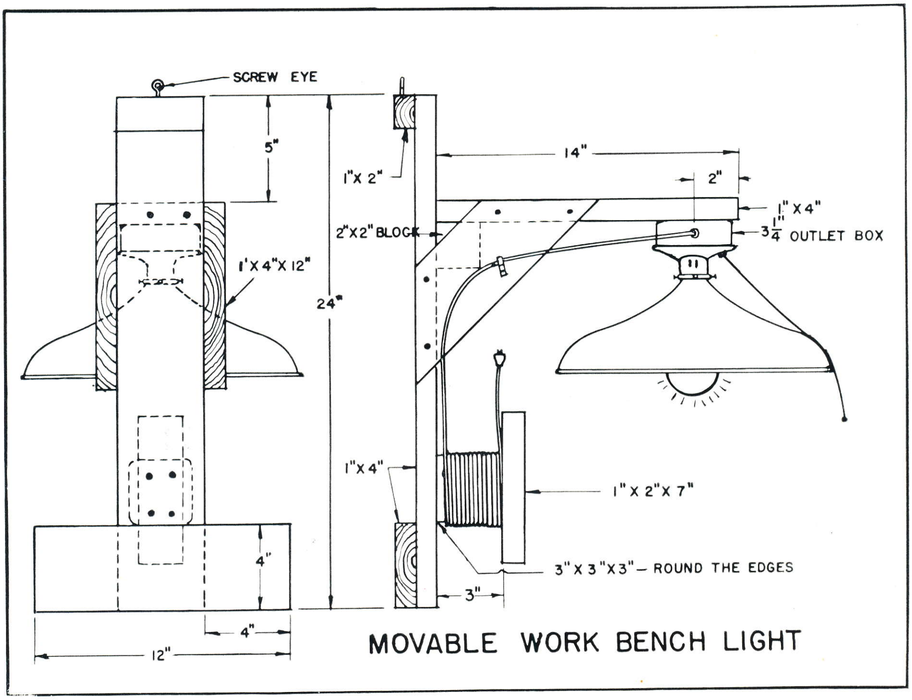



Fig. 20.

## Bill of Material

1 piece—1″ x 4″ x 24″
1 piece—1″ x 4″ x 14″
3 pieces—1″ x 4″ x 12″
1 piece—1″ x 2″ x 4″
1 piece—2″ x 2″ x 4″
1 piece—3″ x 3″ x 3″
1 piece—1″ x 2″ x 7″
1—3¼″ octagonal outlet box
1—3¼″ porcelain receptacle with appliance outlet (pull-chain type if available)
1—No. 14 two wire rubber covered cable of length required
1—connector cap plug
1—½″ connector
1—14″ porcelain reflector
1—100 or 150 watt lamp

## Procedure

Attach the 14″ piece of 1″ x 4″ to the 24″. Attach the heel piece and brace boards as indicated. Fasten the outlet box to the board and attach cable (using connector). Connect wires to receptacle and mount. Attach reflector.

An added feature would be a spool for extra wire on the upright as indicated.

Use an "eye" at the top of the upright to suspend the light from a series of nails driven in at convenient places along the wall. The light should hang at such a level as to prevent glare in the worker's eyes.

EXERCISE 16

## HOME LIGHTING SURVEY

Our eyesight is the most precious and important of the five senses. Good electrical lighting will help to preserve our vision.

The purpose of this exercise is threefold:

1. to learn what adequate lighting is
2. to measure the amount of light in various places
3. to improve the effectiveness of the present lighting system.

### Materials Needed

Light meter (may be borrowed from power company)
Rule or tape measure

The amount of light is measured in foot candles (f.c.). One foot candle is the amount of light a candle will cast on a surface placed one foot away. On a clear June day, there may be 10,000 f.c., of light available in the open. There may be 1,000 f.c., under a shade tree and even 500 f.c., under a porch roof. Inside a room on a clear day, 200 f.c., may be available near the window, but 12 feet back from the window, there may be only 10 f.c., of light available. The average living room has less than 5 f.c., of artificial light supplied, which is considerably less than the eyes are accustomed to.

The following table gives the amount of light recommended for certain household tasks:

**5 to 10 f.c.:** for general lighting
**10 to 20 f.c.:** work areas in kitchen, laundry and ironing
**20 to 50 f.c.:** reading, sewing on light goods, shaving and make-up
**50 to 100 f.c.:** reading fine print, sewing on dark goods.

"General lighting" refers to the light level throughout the room. This should be at least 1/10 the brightness of local lighting to avoid unpleasant and tiring contrasts of light and dark areas.

"Local lighting" is the light directly on your book or other work.

The color of walls, ceilings, and floors has a marked effect on the amount of light available in a room. A light-colored room not only looks brighter, but, actually is brighter because light colors reflect more light. This should be kept in mind when selecting the color scheme for a room.

**Amount of Light Reflected by Different Colors**

| | | | |
|---|---|---|---|
| White (new) | 82 – 89% | Blue | 34 – 61% |
| Cream | 62 – 80% | Pink | 36 – 61% |
| Ivory | 73 – 78% | Gray | 17 – 63% |
| Green | 48 – 75% | Tan (dark) | 30 – 56% |
| Yellow | 61 – 75% | Red (dark) | 13 – 30% |
| Buff | 49 – 66% | Green (dark) | 11 – 25% |

In addition to color, the following factors, which depend mostly on the types of lamps and their placement, should be considered.

1. *Direct Glare:* Proper shading of all bulbs will correct this serious lighting defect. Light is made to see by, not to be looked at.

2. *Reflected Glare:* Reflections from bright surfaces, such as a book page, desk top, etc., are annoying and may be eliminated by changing the position of the lamp or the work.

3. *Quality:* Light is of good quality when it is evenly distributed and shadows are absent. The glass diffusing bowls on the better portable lamps distribute the light better and soften the shadows.

4. *Intensity:* The foot candle readings at each visual task should be in accordance with the recommendations.

5. *Contrast:* Unless the foot candle reading throughout the room is at least 1/10 of the reading at the brightest spot in the room there will be tiresome, unpleasant contrasts, and a spotty lighting effect. The light meter readings are necessary to determine this important point.

6. *Adaptability:* There should be good lamps for every seeing purpose in the room and enough of them so that all activities may go on simultaneously without having to move lamps about.

7. *Decorative Harmony:* This means that the lamp is pleasing to the eye from any location in the room and is in keeping with sound decorative principles. There is a correct lamp for each table, desk, or furniture grouping.

ROOM____________________

NOTE: Let each dot represent 1 foot or 2 feet

ACTIVITIES DONE HERE:

ROOM COLOR:

WALLS CEILING FLOOR

| PLACE OF ACTIVITY | DISTANCE TO LIGHT | WATTAGE | MIN. F.C. RECOM-MENDED | READING IN F.C. | IMPROVEMENTS NEEDED (OR MADE) |
|---|---|---|---|---|---|
| | | | | | |

**Fig. 21.**

**Requirements**

1. Select one room, preferably the kitchen or living room and on a chart similar to Fig. 21, make a drawing, showing the size and shape, location of furniture, equipment and lights.

2. List the places where activities are carried on, giving the distance to lights and wattages of the lights.

3. Using the light meter, determine the amount of light available at each point listed under "2" above.

4. List all improvements needed.

5. Prepare another drawing and chart, showing the new arrangement of lights, furniture, equipment, color scheme and any other changes which were made.

6. Write a short summary outlining the improvements in lighting made in your home and elsewhere due to your interest in lighting.

**References**

"SEEING"—General Electric Company

"SEEING BEGINS WITH MEASURED LIGHT"—General Electric Company

"LIGHT UP AND LIVE ON THE FARM"—Westinghouse Electric Corporation.

**EXERCISE 17**

## MAKING A TABLE LAMP

A properly designed table lamp makes reading, studying and sewing easier, more comfortable and conserves eyesight. In order to provide good lighting, a table lamp should have several important features. It should have an overall height of 26″ - 28″ and a flared shade with a bottom diameter of 16″ - 18″ to permit a good spread of light. The shade should be light enough to permit considerable of the light to pass through it. The lamp should have a diffusing bowl to soften the light and reflect some of it upward for general lighting. You can make such a lamp cheaply and easily with materials readily available.

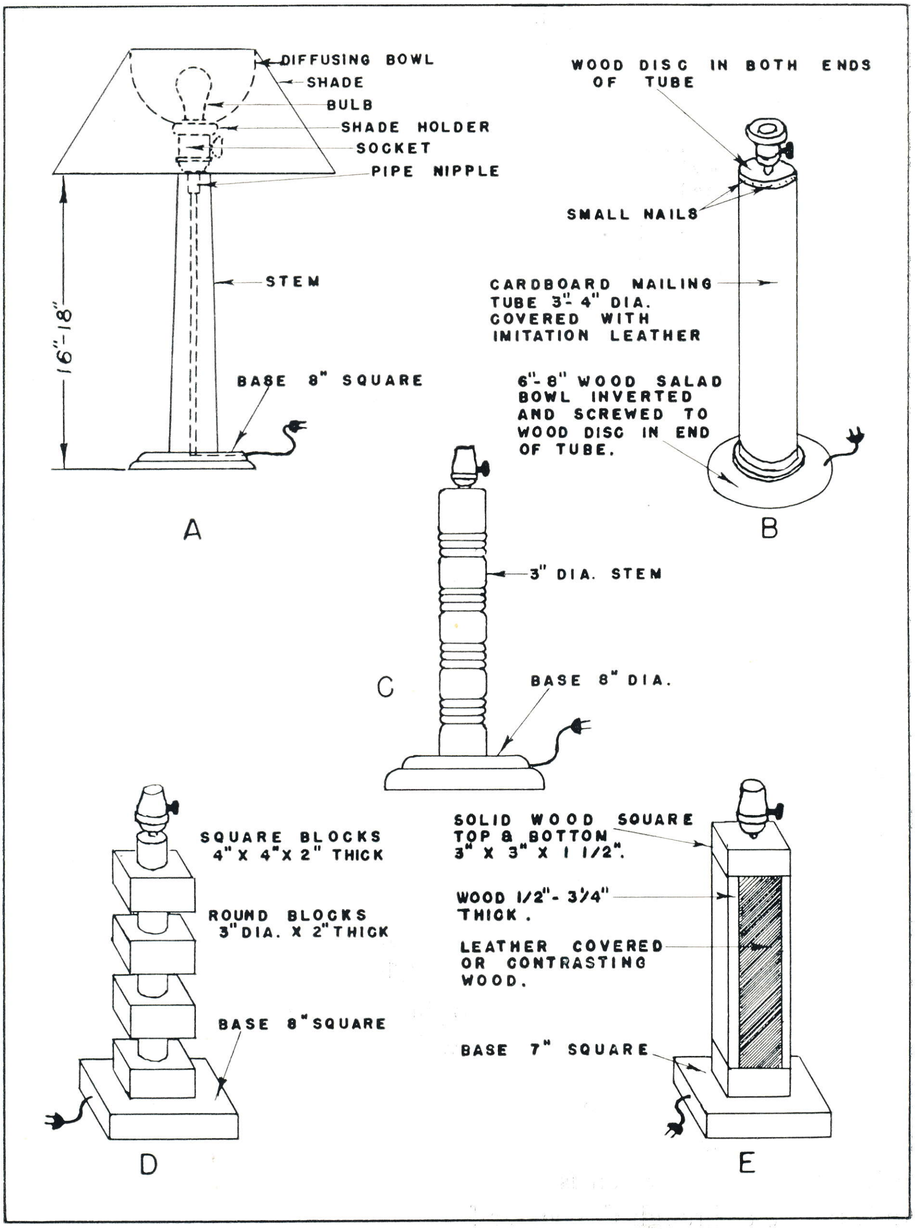



**Fig. 22. Suggested table lamp designs.**

In addition to the stem and base, which you will make, you will need the following materials:

1—lamp socket with switch (threaded for ⅛″ pipe)
1—⅛″ pipe nipple 1″ or 1½″ long (to fit socket)
1—shade holder to fit socket (supports diffusing bowl)
1—diffusing bowl (8″ for 100 watt bulb)
1—shade (white lined with bottom diameter 16″ to 18″)
1—100 watt bulb
1—lamp cord, 10-feet with rubber plug (U.L. approved) wood working tools, sandpaper, glue, etc.

Make one of the lamps shown in Fig. 22, or use any other plan which your leader thinks is suitable. The stem and base may be round, square, or octagonal and no definite measurements are required except that the distance from the base to the socket should be 16″ - 18″.

**Lamp "A":** The stem is made by gluing together 2 pieces of wood 1″ x 2″ x 17″ and shaping as shown in the sketch. Before gluing the pieces together, cut a "V" groove ¼″ deep lengthwise in each piece so that when they are fitted together the grooves match to form a hole through the center for the cord. The base is made of 2 pieces of wood 1″ thick. The lower piece is 8″ square and the upper one, 7½″ square. Make a groove on the under side of the top piece and drill a hole through the center of it to provide a place for the cord. Thread the cord through the hole and through the stem before gluing the base pieces together and fastening them to the stem.

**Lamp "B":** A cardboard mailing tube is used to make the stem for this lamp. A wood disk, 1″ thick, is fitted snugly in both ends and held in place with a few small nails. The base is a 6″ or 8″ wooden salad bowl inverted and fastened to the bottom end with screws. The mailing tube may be covered with wallpaper or imitation leather.

**Lamp "C":** The stem and base for this lamp are to be turned on a lathe and a variety of turning patterns may be used. You will need a ⅜″ ships auger (which is longer than the ordinary wood auger) to drill the hole through the center for the cord.

**Lamp "D":** This stem is made by gluing together the required number of square and round blocks as shown in the sketch and fastening them on the base. A hole should be drilled through the center of each block before assembling them.

**Lamp "E":** This stem is a hollow square tube with a solid square piece glued to both ends. Two or three different kinds of wood can be used in combination to make an attractive lamp.

The socket is fastened to each of the lamps by screwing it on the pipe nipple which in turn is screwed into a ⅜″ hole in the top of the stem.

Rub the wood parts with fine sandpaper to make them smooth, and apply the desired finish to the wood. The shade holder is screwed on the socket and the diffusing bowl fastened in place. With the addition of the bulb and shade, you have a good lamp which is worth far more than it cost.

**EXERCISE 18**

## INSTALLING A DOORBELL OR CHIME

Doorbells or chimes are convenient devices, simple to install, which make it easier for visitors to announce their arrival. A bell is usually installed for the front door and a buzzer for the back door in order to tell at which door the visitor is calling.

Musical chimes have a much more pleasant tone and are gradually replacing the doorbell. They are usually so arranged that when the front door button is pushed a different signal is sounded than when the back door button is pushed. Also an advantage is that no matter how long the button is held down, the chime does not repeat, or ring continuously.

The exercise consists of installing a doorbell or chimes. Refer to Chapter 12 of "Wiring Simplified" for instructions. The following materials are required:

1—bell transformer or 2 dry cells (1½ volt each)
1—chime or doorbell and buzzer
2—push button switches
bell wire as needed.

**EXERCISE 19**

## INSTALLING CONVENIENCE OUTLETS

Plenty of outlets and switches, located in the proper places, is the key to making the best use of the servant, electricity. Good lighting not only adds convenience and safety, but a barn is actually a more cheerful place to work in when it is well lighted. Switches should be so located that you can light the way ahead of you, and turn the lights off when you leave without having to walk through a dark area.

Outlets for plugging in motors, toasters, electric irons, etc., should be provided wherever needed to get the most satisfactory operation out of these appliances. They should not be plugged in a light socket, because the wire is usually not heavy enough to carry the amount of current needed.

This exercise consists of installing two or more outlets in your home, or some other building on your farm—either a light receptacle or a duplex outlet. Use No. 12 non-metallic cable.

Study chapters 5, 8 and 13 in "Wiring Simplified". Before attempting this exercise, you should have completed the Wiring Panel. Exercise 13.

**EXERCISE 20**

## CALL BELL IN BARN

For convenience or emergency use a call bell may be installed in the barn. Various signals may be prepared to summon each member of the family to the telephone, or to meals, or to call anyone in case of emergency.

A bell may be installed in the barn only, or one may be installed in the barn and one in the house, making it possible to signal from either place.

### Materials Needed

1—push button switch—2 needed if bell is used in house and barn
1—call bell—2 needed if bell is used in house and barn
1—bell transformer or 2 dry cells
inside wire as needed (bell wire)
outside wire as needed (weatherproof)

### Procedure

Install the call bell in the barn at a point where it can be heard in any part of the barn. The bell in the house is usually installed in the kitchen. The transformer or dry cells may be located either in the house or barn. Complete the installation to the source of either the bell transformer or two dry cells hooked in series, that is, center post of one battery to the outside post of the other battery. Connect the switches and mount them in a convenient location.

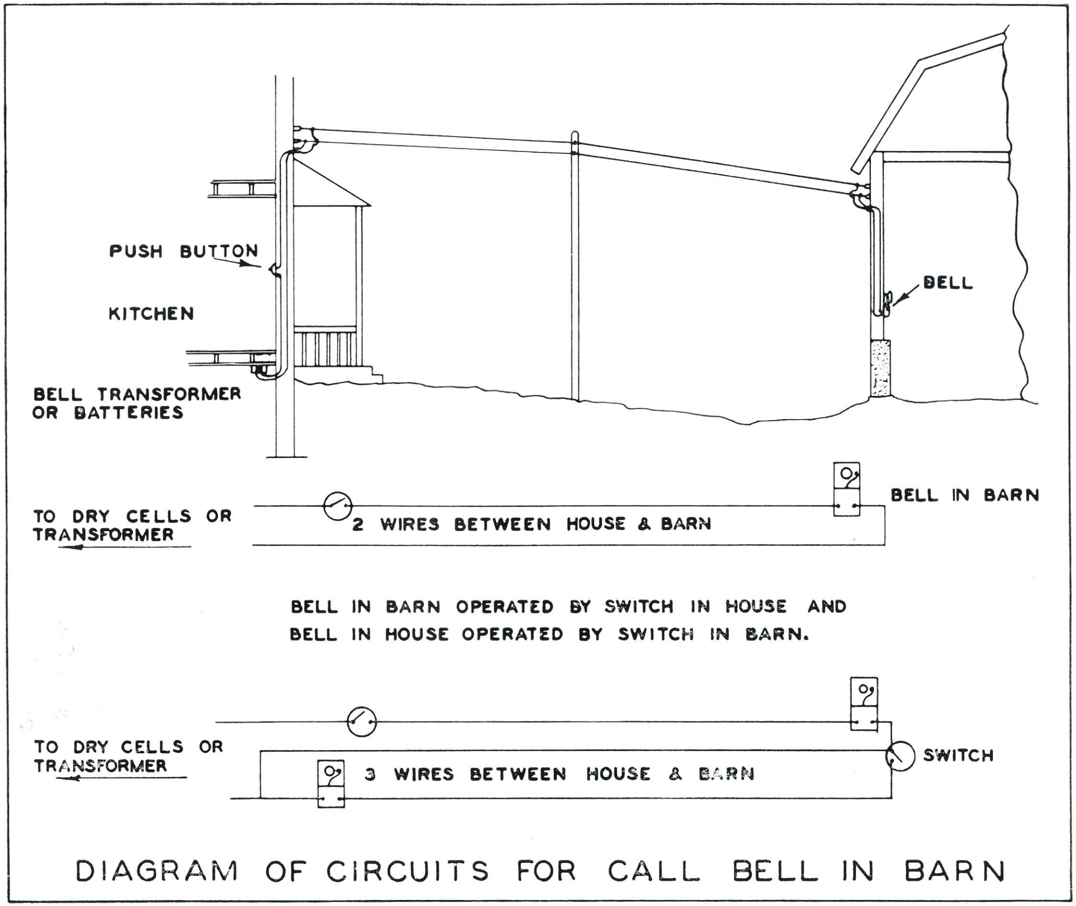

PUSH BUTTON
KITCHEN
BELL TRANSFORMER
OR BATTERIES
BELL
TO DRY CELLS OR
TRANSFORMER
2 WIRES BETWEEN HOUSE & BARN
BELL IN BARN
BELL IN BARN OPERATED BY SWITCH IN HOUSE AND
BELL IN HOUSE OPERATED BY SWITCH IN BARN.
TO DRY CELLS OR
TRANSFORMER
3 WIRES BETWEEN HOUSE & BARN
SWITCH
DIAGRAM OF CIRCUITS FOR CALL BELL IN BARN

Fig. 23.

The bell wire should be kept at least 6 inches from the power wires inside the building. The wiring system for this project is similar to that used in wiring a doorbell as outlined in Chapter 12 of "Wiring Simplified". The main difference is that outside wire is needed between the house and barn to complete the circuit. The outside wiring should be installed in the same way as ordinary electrical wiring using proper size as indicated in the following table:

Spans up to 25 feet—No. 12 wire (Weatherproof)
Spans 25-50 feet—No. 10 wire
Spans 50 feet and over—No. 8 or larger

Wire smaller than recommended may be used, but breakage must be expected in case ice forms on the wire.

When the outside wires are mounted on the light pole, they should be below the light wires, preferably at least a foot. All outside wires should be placed at sufficient height to clear traffic. The diagram shows how the circuits are connected. Consult "Wiring Simplified".

**EXERCISE 21**

## SWITCH PANEL

This is a good exercise to do before attempting the actual installation of a yard light or an additional switch. It will help you understand how the circuits are wired for controlling a light from several points, and the switches can be used later in actual rewiring work.

The exercise consists of making a panel showing one or all of the three typical yard light installations as shown in Fig. 28. The type of wiring is the same as in the "Wiring Panel" exercise.

Mount the switch boxes and an outlet box for a lamp receptacle on a panel. Use a 3-wire cable between the boxes and connect the switches as shown in the diagram. Install a lamp receptacle on the outlet box. Attach a cord at one end of the system to supply current for the light. Before putting on the switch covers, operate the switches and trace the path of the current each time a switch is turned on.

**EXERCISE 22**

## BELT SANDER

A belt sander is a useful piece of equipment for the shop which you can easily make by following the plan in Fig. 24.

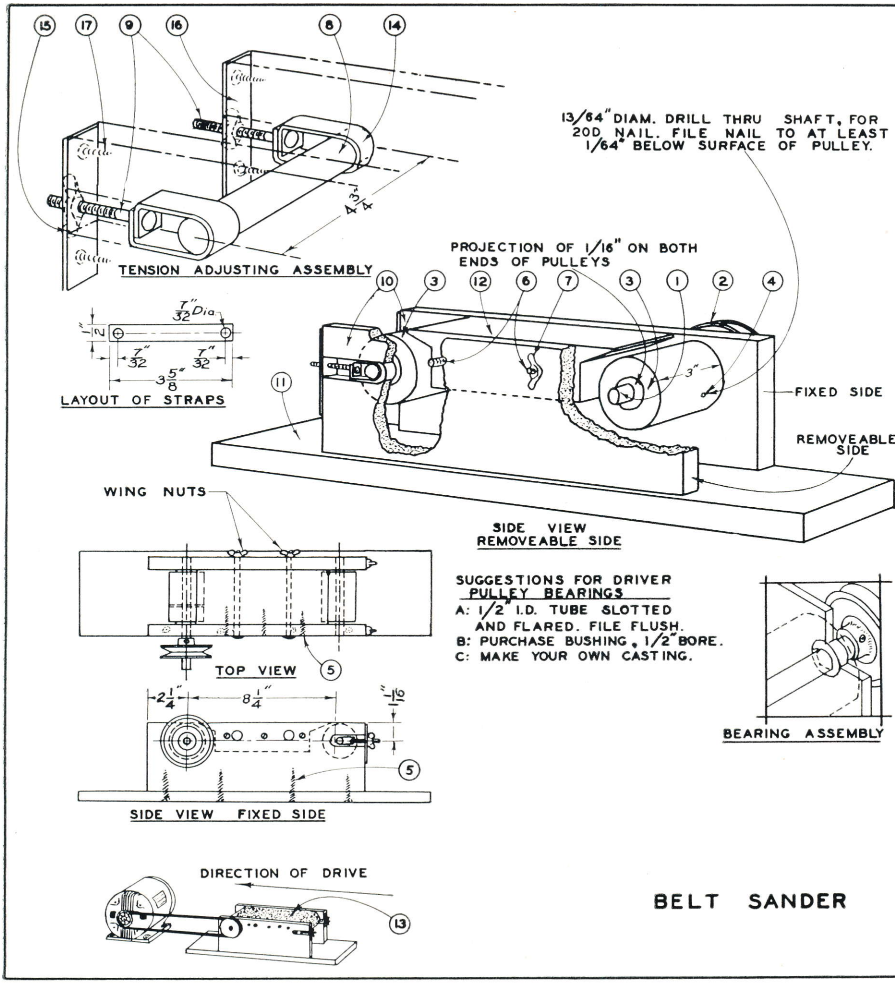

13/64" DIAM. DRILL THRU SHAFT, FOR 20D NAIL. FILE NAIL TO AT LEAST 1/64" BELOW SURFACE OF PULLEY.
TENSION ADJUSTING ASSEMBLY
PROJECTION OF 1/16" ON BOTH ENDS OF PULLEYS
FIXED SIDE
REMOVEABLE SIDE
LAYOUT OF STRAPS
WING NUTS
SIDE VIEW REMOVEABLE SIDE
SUGGESTIONS FOR DRIVER PULLEY BEARINGS
A: 1/2" I.D. TUBE SLOTTED AND FLARED. FILE FLUSH.
B: PURCHASE BUSHING, 1/2" BORE.
C: MAKE YOUR OWN CASTING.
TOP VIEW
BEARING ASSEMBLY
SIDE VIEW FIXED SIDE
DIRECTION OF DRIVE
BELT SANDER

Fig. 24.

**Materials Needed**

| PIECE | DESCRIPTION | SIZE | QUAN. | MATERIAL |
|---|---|---|---|---|
| 1 | Driver pulley shaft | ½″ diam. x 6⅝″ long | 1 | Steel or iron |
| 2 | Single groove "V" type pulley, with set screw. | 2″ diam. ½″ bore. For ½″ or ⅜″ wide belt. | 1 | Metal |
| 3 | Belt driver pulley and idler pulley. | 2⅛″ diam. x 3⅛″ long | 2 | Hard wood |
| 4 | Common nail for key on driver pulley and shaft. | 20d, approx. 3/16″ diam. by 4″ long. | 1 | Steel or iron |
| 5 | Flat head, wood screws | No. 9 x 1½″ long | 7 | Steel, brass or iron |
| 6 | Carriage bolts | ¼″–20 N.C. x 5″ long | 2 | Iron or steel |
| 7 | Wing nuts | ¼″–20 N.C. | 2 | Iron or steel |
| 8 | Idler pulley shaft | ½″ diam. x 4¾″ long | 1 | Steel |
| 9 | Belt tension adjustment screws. | No. 10–24 N.C. machine screws 2½″ long. | 2 | Steel |
| 10 | Side plates | ¾″ x 4″ x 12⅝″ | 2 | Hard wood |
| 11 | Bottom plate | ¾″ x 5″ x 20½″ | 1 | Hard wood |
| 12 | Working top and spacer block | 1¾″ x 3½″ x 7½″ | 1 | Hard wood |
| 13 | Sandpaper belt | 3″ wide x 24″ grit to suit | 1 | |
| 14 | Tension adjustment straps | ½″ x 3⅝″ x No. 16 Ga. | 2 | Iron or brass |
| 15 | Wing nuts | No. 10–24 thread | 2 | |
| 16 | Thrust plates | ½″ x 2″ x No. 16 Ga. | 2 | Iron or steel |
| 17 | Wood screws | No. 8 x 1¼″, flat head | 4 | Iron or brass |

**Procedure**

1. Prepare the wood parts by cutting to proper size and drilling the necessary holes as shown in the plan. The pulleys will need to be turned out on a lathe.

2. Assemble the wooden pulleys on the shafts and fasten the driver pulley to the shaft with a nail as indicated.

3. Make the tension adjusting straps by bending as shown in the diagram (the holes should be drilled before bending).

4. Assemble the sander placing the pulley on the shaft last. Note that one side is removable so that the sanding belt can easily be changed.

5. The sanding belt must run in the direction indicated on the plan.

**EXERCISE 23**

## COST OF ELECTRICITY FOR OPERATING CERTAIN EQUIPMENT

**Materials Needed**

Local electrical rate
Electric meter
} obtain from power company

The purpose of this exercise is to make each club member realize the economy of electricity as a source of power. Power companies have agreed to furnish an electric meter, if they are available, so that accurate results can be obtained on your farm.

If the meter is available, attach it to the electrical equipment for 15 or 30 days. A representative of the power company will show you how to attach it. Where this is not possible, the operating cost can be estimated as outlined below. Compute the cost on a monthly basis.

Each motor on the farm has a name plate giving its rated horsepower. Because motors are not 100 percent efficient, a one-horsepower (1 H.P.) motor will use approximately 1 KWH of electricity or a ½ H.P. motor will use about ½ KWH, for each hour of operation. So by multiplying the H.P., of the motor by the hours of operation during the month, you will have a close estimate of the number of KWH used. This multiplied by the average cost per KWH gives the approximate cost of the electricity used by the motor.

The current requirement of heating equipment is given on the name plate. The cost of operation is figured by converting the watts to kilowatts and multiplying this by the hours of operation and the average cost per KWH.

At least two pieces of equipment should be checked with the meter and accurate costs determined. If a meter is not available, estimate the costs. A report similar to the following should be attached to your electrical club report.

| COLUMN NO. | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| ITEM<br>EXAMPLES: | H.P. OR KW. RATING OF AP-PLIANCE | HOURS USE PER MONTH | KWH USED PER MONTH—COL. 1 x COL. 2 | COST PER MONTH COL. 3 x AVERAGE COST PER KWH | REMARKS |
| Water pump | ½ | 80 | 40 | $0.96 | Used meter 15 days |
| Washing machine | ¼ | 12 | 3 | 0.07 | |
| Water heater | 2 | 60 | 120 | 2.89 | |
| Milking machine | ½ | 76 | 38 | 0.92 | Used meter 10 days |
| Total | | | 301 | $4.84 | |

Monthly bill—net . . . . . . . . $4.84
KWH used . . . . . . . . . . . . . . 201
Average cost per KWH . . . . 2.41 cents.

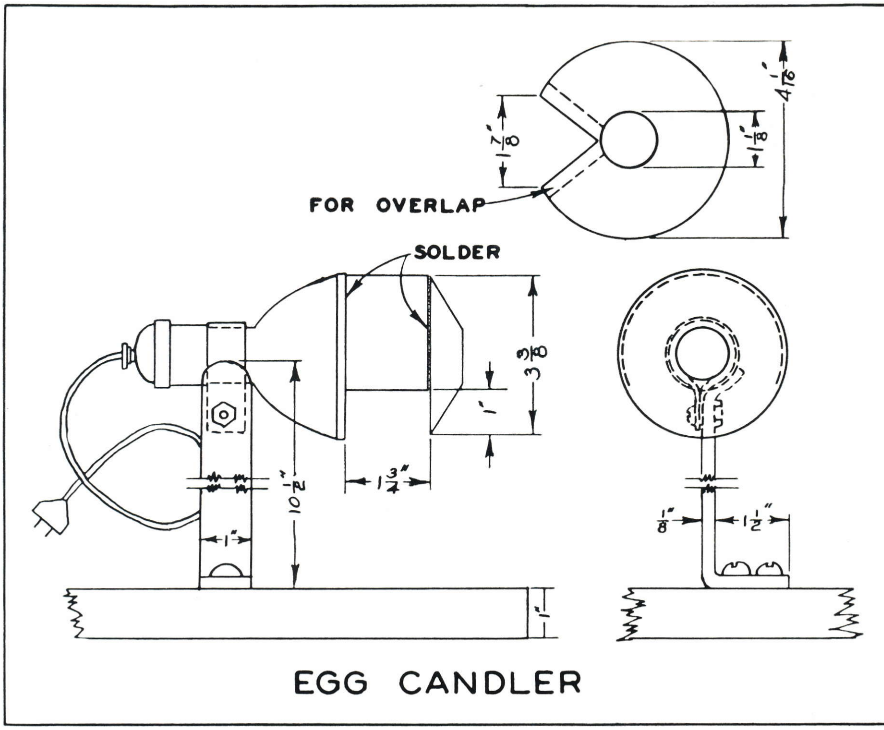



Fig. 25.

EXERCISE 24

## ELECTRIC EGG CANDLER

By using an egg candler the farmer can determine the quality of his eggs before he markets them. The candler can be used also to demonstrate the necessity for frequent collection and prompt cooling of eggs in order to maintain a high quality product.

### Materials Needed

1 – Extension cord with lamp outlet
1 – small dome-shaped oil can (base approx. 3⅜″ in diameter)
1 – No. 2 tin can, 1¾″ long
1 – 1″ x ⅛″ x 12″ strap iron
1 – ¼″ x 1½″ machine bolt
1 – flat piece of sheet metal 6″ x 8″
1 – small can of aluminum paint
1 – S11 Mazda 10-watt lamp

**Procedure**

Remove the bottom from the oil can with a can opener and attach the short No. 2 can with solder. Flatten the threads of the oil can and split the thread area on opposite sides with a hack saw to permit the socket to be forced into the opening. Secure with a pressure band as indicated.

Cut and shape the cone from the 6″ x 8″ sheet metal (another can will provide this material). Paint all inside surfaces with aluminum paint. When the paint is dry solder the cone to the barrel of the candler as shown. Mount on a 1″ x 12″ x 12″ block using the strap iron bent to form a foot, and drilled for screws. Leave an opening large enough to allow a lamp to be placed in the socket. This opening provides illumination below the candler and keeps the candler cooler. Caution—All sharp edges should be turned to avoid cutting fingers.

EXERCISE 25

## ICE CREAM FREEZER POWER UNIT

A simple power unit to turn an ice cream freezer with a motor is shown in Figs. 26 and 27. Other hand-operated machines, such as

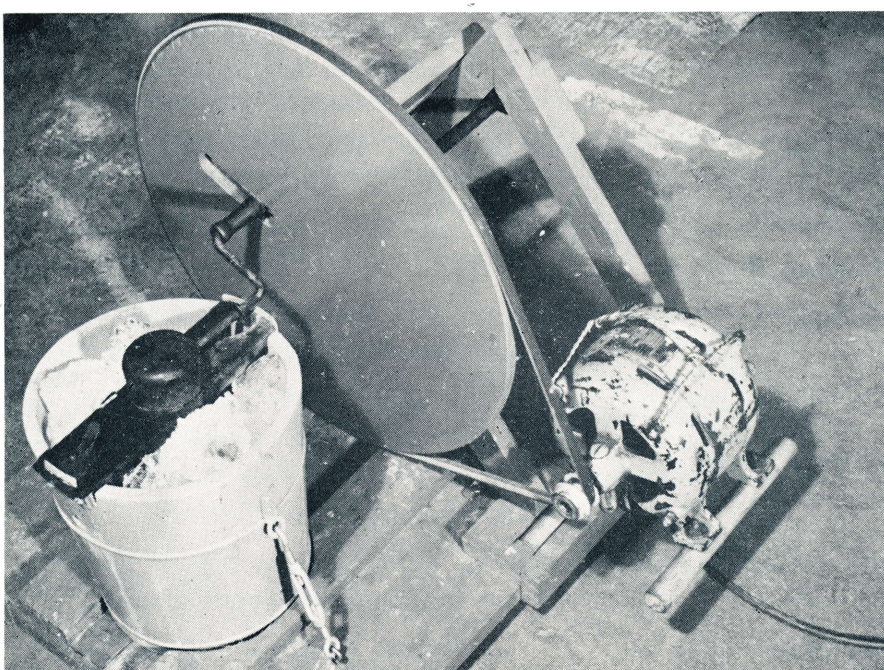


Fig. 26. View of an ice cream freezer, showing the construction. No dimensions are given since they will vary with different sizes of freezers.

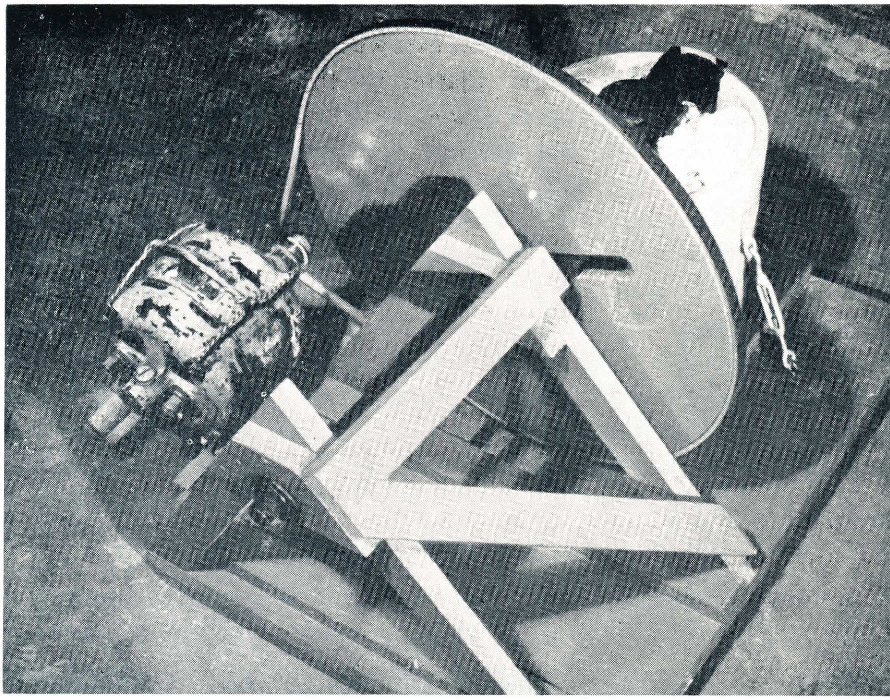


**Fig. 27. Another view of ice cream freezer showing construction.**

meat grinders and churns can be power-driven in the same way. This device is easy to construct, and it is not necessary to make any changes on the machine which is to be driven.

## Materials Required

1—1″ x 6″ x 12′ for platform
1—2″ x 4″ x 10′ for frame
2—1″ x 4″ x 8′ for braces and cross pieces
1—¾″ x 17″ (or larger) plywood pulley
1—V-belt
1—¼″ x 18″ pipe threaded both ends
1—¼″ pipe flange
1—¼″ pipe cap
1—washer to fit over pipe
1—1½″ V-pulley to fit motor shaft
2—turn buckles of suitable size
1—portable motor and mounting
necessary nails and screws

NOTE: ⅜″ or ½″ pipe may be used if ¼″ fittings are not available.

## Procedure

Make the platform about 2′ x 3′ in size by nailing the 6-inch boards on 3 cross pieces placed underneath. Assemble the frame out of

2″ x 4″ material braced with 1″ x 4″ pieces and nail to the platform. The pipe shaft passes through the short 2″ x 4″ pieces near the top, and must be mounted at exactly the same height as the crank shaft on the ice cream freezer. Cut a slot about 4-inches long in the pulley to admit the crank handle. Mount the pipe flange over the center of the plywood pulley and screw the pipe into the flange. The pipe cap and washer on the other end holds the pipe in place. The turnbuckles are used to fasten the freezer to the platform.

A 1½″ pulley should be used on the motor, which will give a freezer speed of about 160 r.p.m., when used with a 17″ pulley.

EXERCISE 26

## INSTALLATION OF A PERMANENT MOTOR

Three possible types of installation exercises are:

A. Installation of a motor and equipment where the motor is not part of, or attached to, the driven equipment.

B. Installation of a motor to drive equipment already in place.

C. Installation of a piece of electrically driven equipment where the motor is already mounted on the equipment.

The following steps are essential in making a type A installation. Type B and C installations will not require all of these steps. List the steps required according to your type of installation and execute them. Study Chapter 16 in "Wiring Simplified".

1. Determine a suitable location for the motor and equipment. Some factors which determine location are:
    - a) place where equipment can be used most efficiently
    - b) accessibility to electrical outlet
    - c) convenience to install, service and maintain
    - d) conditions, such as dampness
2. Determine correct size of pulleys and belt, or inspect those already installed.
3. Line up the pulleys properly.
4. Set motor level. Ball-bearing motors are the only ones which may be mounted in any position.

5. Fasten securely, making sure there is provision for adjusting belt tension.

6. Complete the electrical connections after determining the following facts:

   a) Is a separate circuit required? (Motors of ½ h.p., and larger should be connected to 240-volt circuits when possible.)

   b) Is present outlet convenient, satisfactory and safe? See Chapter 4 in "Wiring Simplified".

7. Operate equipment to see if it functions properly.

Install at least one motor as outlined above. Prepare a report telling which type of installation was made, whether 120 or 240 volt was connected, and how the motor is protected from overloading. List all of the steps which you did.

EXERCISE 27

## INSTALLING A YARD LIGHT OR ADDITIONAL SWITCH ON A YARD LIGHT

The value of yard lights from the viewpoint of convenience and safety is immeasurable. An additional switch in the garage or granary can often pay for itself in a year or less by reducing trips to the switch.

This exercise may be either the installation of the yard light with two switches or the installation of an additional switch. In Fig. 28, diagrams A, B, and C, show the "hook-up" when two, three or four switches are used. The letters H and G denote "hot" and "grounded" wires.

Inside wires should be non-metallic cable and may be either No. 14 or No. 12 wire. Outside, use weatherproof wire, either No. 12, 10, or 8 depending on the distance between supports. All wiring must be done according to instructions given in "Wiring Simplified". Study chapters 4 and 15 before doing this project. The "Wiring Panel" should be completed before attempting this exercise.

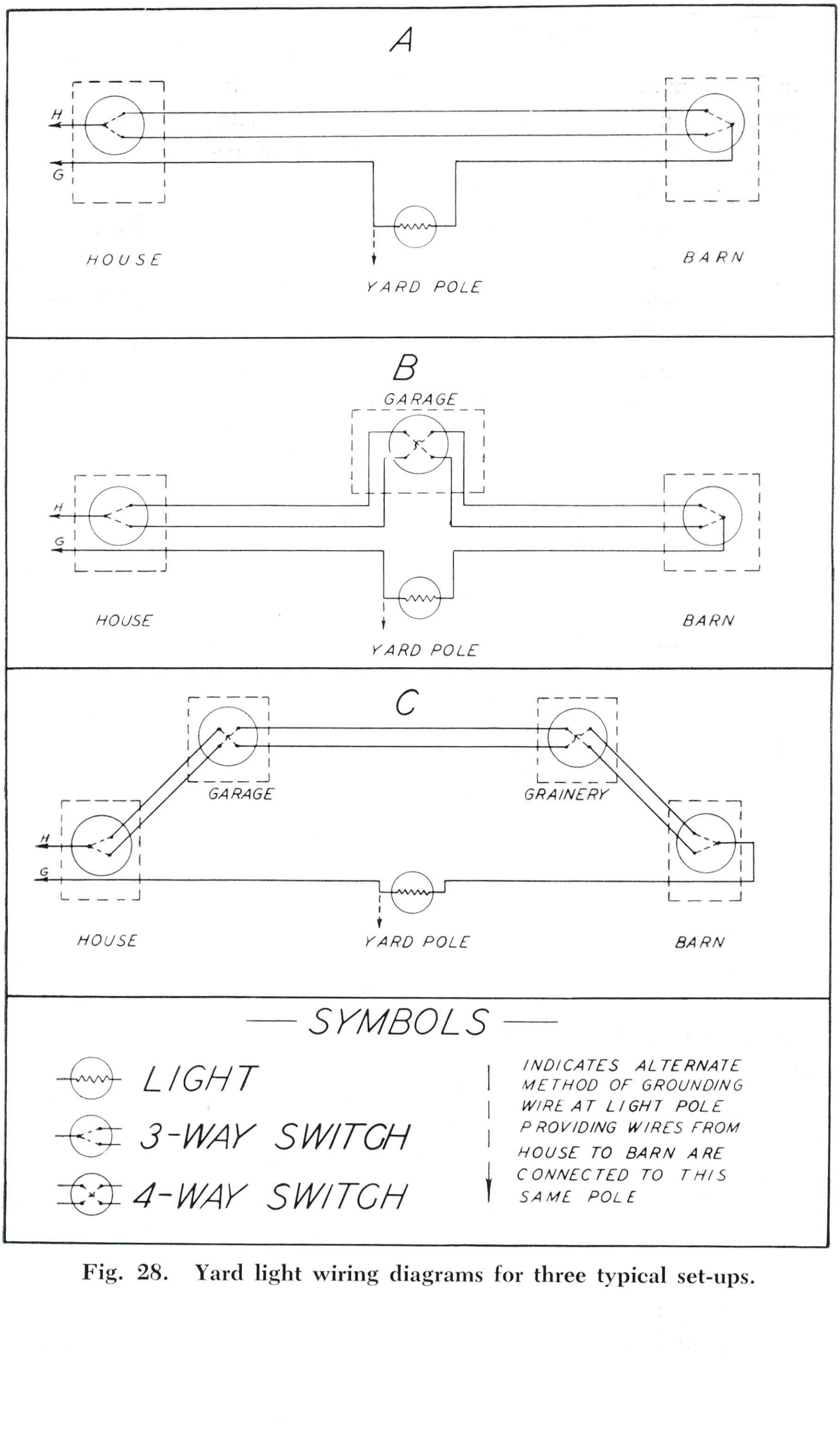



**Fig. 28. Yard light wiring diagrams for three typical set-ups.**

EXERCISE 28

## ELECTRIC FENCE UNIT

No home-made unit is safe to use on 110 volts, and no such unit will be credited toward a 4-H project. Even with the battery type, it is better to buy rather than build because of greater assurance of effective operation.

This exercise consists of the installation of an electric fence, either the 110-volt or battery type, which must be a unit approved by the Underwriters Laboratory. Follow manufacturers' recommendations in the installation.

Report the length of electric fence installed, and for what purpose it was erected.

EXERCISE 29

## WIRING A SMALL BUILDING

This exercise consists of furnishing electricity to some small building on the farm. At least one light receptacle and one duplex outlet should be installed. Follow instructions given in "Wiring Simplified". Exercise 13 should be completed before attempting this exercise.

Before starting work, make a bill of material, listing each item needed, the number or amount required and the approximate cost of each item. From this you can figure the total cost. Submit the bill of material with your report.

EXERCISE 30

## POULTRY HOUSE LIGHT DIMMER

Extending the day in the poultry house during the fall and winter to approximately 13 hours by night lighting is recommended for increased egg production. A light intensity of one watt for each 5 square feet of floor area will provide the illumination desired. Thus, a poultry house, 30 x 50, (1,500 square feet) would require 300 watts of light. This can be supplied by using eight 40-watt lamps, or five 60-watt lamps. Better distribution of light may be obtained by using more lamps of smaller wattage rather than fewer lamps of greater wattage. Do not use lamps larger than 60 watts, unless you find it necessary to have more light than is recommended.

Lights may be turned on either in the morning or in the evening. When evening lights are used, it is necessary that they be dimmed

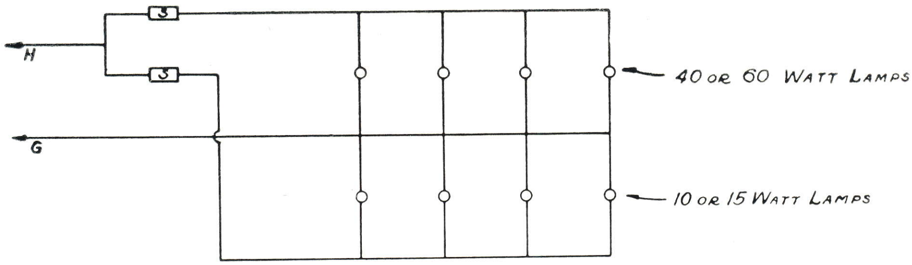



**Fig. 29. Common ground system of dimming poultry lights.**

before turning them off completely to allow the birds to get up on the perches. This is easily done without any special dimming device, by using the *common ground system* as shown in Fig. 29. This system consists of two circuits using the same ground wire. The large wattage lamps in one circuit provide the necessary light. When the lights are to be turned off, the low wattage lamps are turned on and the high wattage ones turned off. When the birds have gone to roost, the low wattage lamps are turned off.

Follow wiring instructions as given in "Wiring Simplified". Draw up a wiring diagram and make a bill of materials covering all of the equipment needed. Include this with your report.

**EXERCISE 31**

## FARMSTEAD WIRING PLAN

This exercise is designed to help you understand what a good farmstead wiring system is and how it is designed. It will be necessary to make a drawing of your farmstead to scale and show the following things:

1. Location of all buildings
2. Location of large trees
3. Driveway and part of road that goes past your farm
4. Location of pole and transformer that serves your farm
5. Location of meter
6. Location of entrance switch or main fuse box
7. Show where wires go between buildings
8. Indicate number and size of outside wires

9. List electrical equipment and lights in each building
10. Show yard light location

First, determine the length and width of each building and the distances between them. If you do not have a long measuring tape, you can pace the distances and multiply the number of paces by the average length of your step. Also determine the over-all length and width of the farmstead which you are going to draw.

When you have all of the measurements, select a suitable scale so the drawing will go on the size paper which you want to use. You might let 1/8″ on the paper equal 1 foot or 2 feet. Draw the farmstead plan, showing the things listed above in their correct location. Show which direction is north on your plan. A large drawing, 1½ to 2 feet in size is easier to work on.

Obtain a copy of the "Handbook of Farmstead Wiring Design" from your County Club Agent and study it to determine what changes if any, would be desirable.

Make another drawing of your farmstead identical with the first except do not show the wiring system. On this drawing, show how you would rewire your farmstead to give you safety and good service in each building. For each building, indicate the correct wire size, either 120- or 240-volt service, and size of entrance switch. Show possible location of power pole if this would give better service to your farm.

Write a short report, telling what changes you made in the second plan and why you made them.

EXERCISE 32

## HOUSE WIRING PLAN

The purpose of this exercise is to make a plan of the present wiring system and study it to see how it might be improved. Three important features of a good wiring plan are: 1) a sufficient number of lights properly located so as to provide good lighting wherever needed, 2) switches conveniently located so that all lights can be turned on and off without going back, or walking through a dark area, and 3) a sufficient number of convenience outlets properly located so that

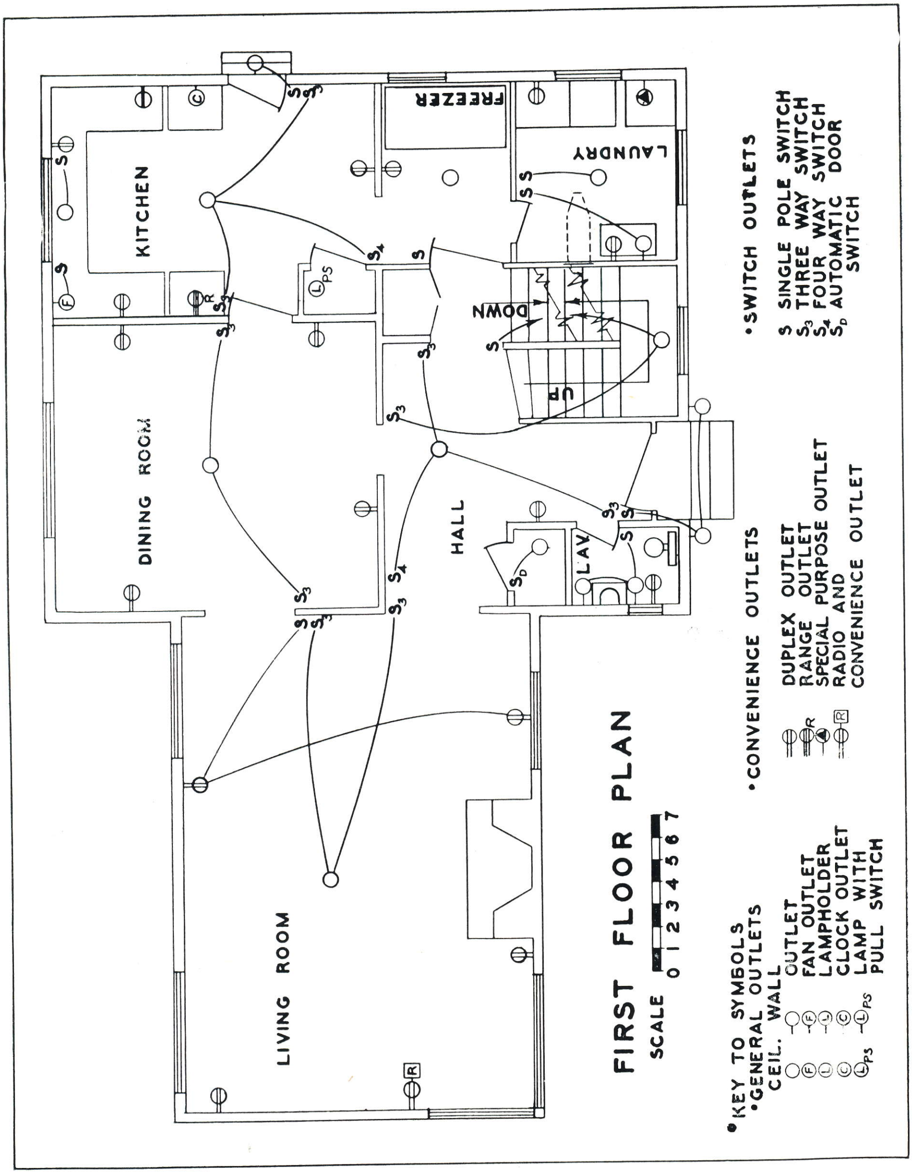



Fig. 30.

unsightly extension cords are not needed to plug in lamps, radios, and other appliances.

Measure the rooms in your home and make a floor plan using a suitable scale. Show the location of convenience outlets, lights, switches, fuse box, and any special outlets such as for the electric range or water heater. Indicate whether lights are pull-chain, or controlled by wall switches. Use symbols as shown in Fig. 30 to denote the type of outlet and its location.

Study some good wiring booklets to determine how your present plan might be improved with respect to the features outlined above. Your leader or Club Agent can get a copy of the "Handbook of Residential Wiring Design" from the Industry Committee on Interior Wiring Design, 420 Lexington Ave., New York, N. Y.

Make a second plan, showing the location of convenience outlets, lights, switches and other outlets as you would place them. Use the electrical symbols. Write a short report telling which outlets, switches, and lights you added or changed in your second plan.

EXERCISE 33

## MOTOR-DRIVEN GRINDSTONE

Faster and easier work can be done when a grindstone is driven by a motor. This exercise consists of mounting a grindstone as shown in Figs. 31 and 32, or installing a jack shaft on your present stone to permit the use of an electric motor. Using pulleys of the sizes indicated will give a speed of about 45 r.p.m., on the grindstone.

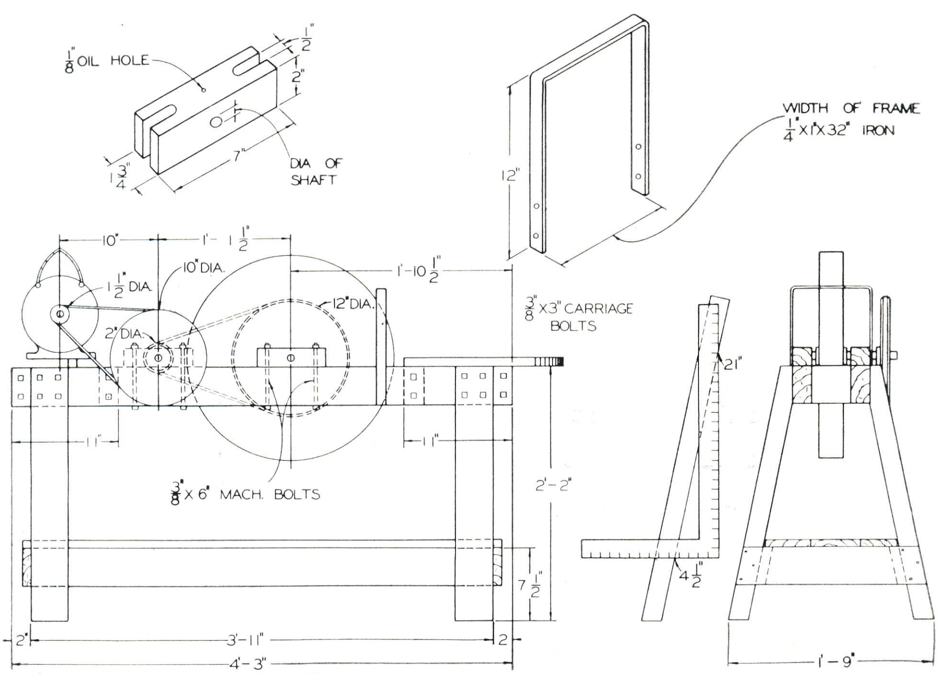
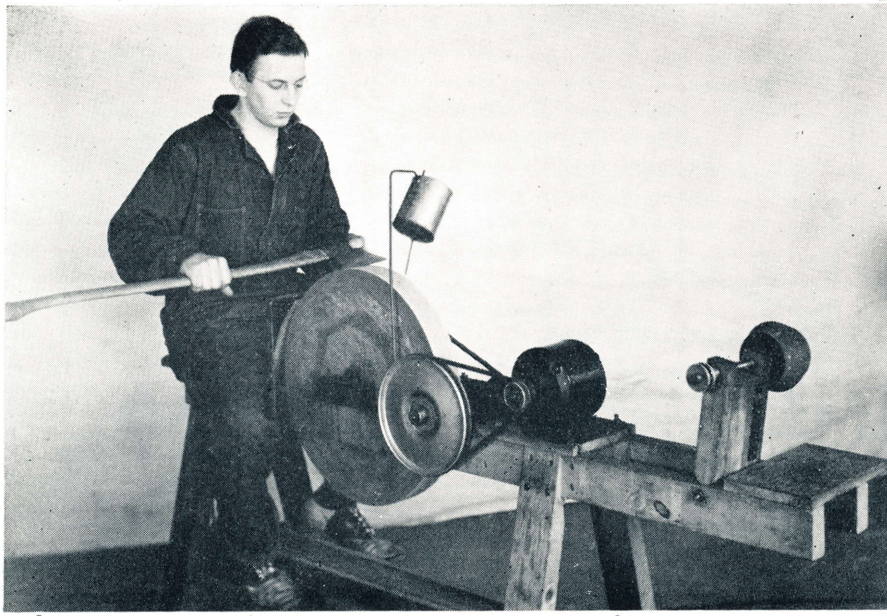



Fig. 31. Grindstone plan.



Photograph: L. M. Roehl, Cornell University

**Fig. 32. An electric grindstone.**

EXERCISE 34

## ELECTRIC LAWN MOWER

Mowing the lawn can be made an easier task by mounting a motor on a good lawn mower as shown in Fig. 33.

### Materials Required

A good lawn mower with proper size V-pulley
Capacitor or repulsion-induction motor, ⅓ h.p., 1750 r.p.m.
Mounting board, length and width to fit
Strap iron for motor support
V-pulley as large as distance between blade shaft and wheel axle shaft will permit
V-belt, **A** size, length to fit
Two-wire heavy duty rubber-covered extension cord
Snap switch
Reel for extension cord.

### Procedure

Disassemble the mower and install the V-pulley on the blade shaft, cutting off the ends of the blades if necessary to make room for the pulley. (It may be also necessary to remove part of the blade shaft bearing on that end.)

Mount the motor so that it will be located slightly to the rear

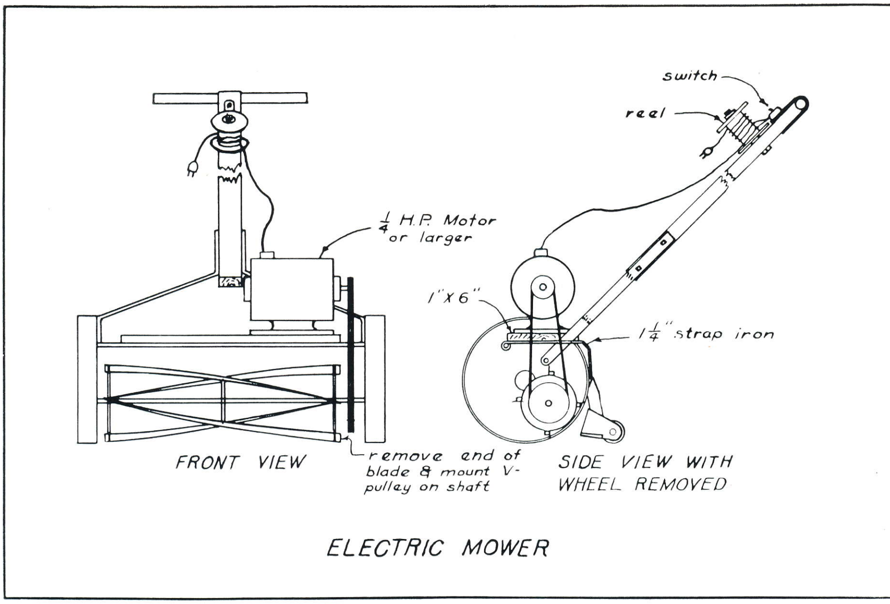



Fig. 33.

of center for good balance. The strap iron support brackets must be fitted to the mower as required.

Install switch and wire reel as indicated. The motor revolves the blade, but the operator pushes the mower at whatever speed he desires. On some mowers it will be desirable to remove the driving "dogs" at the ends of the blade shaft.

The speed of the blade shaft should be approximately 500 r.p.m., for a five-blade mower, and not more than 650 r.p.m., for a four-blade mower. To determine the pulley size for the motor, use the following formulae:

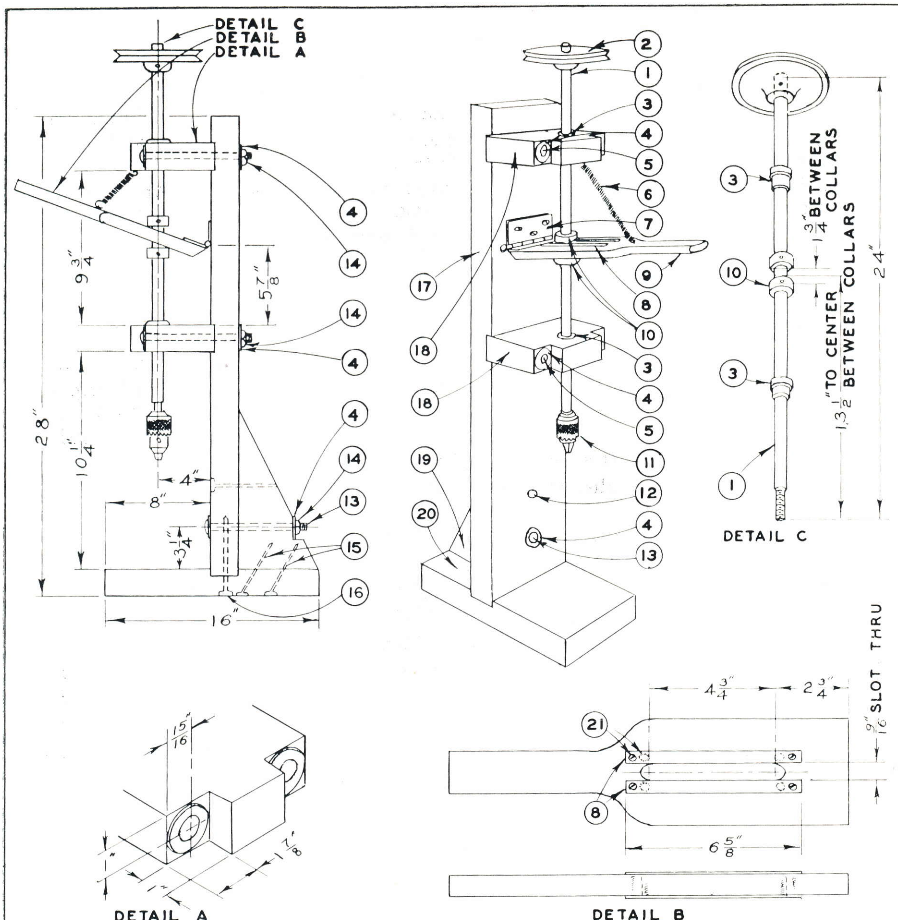
$$\text{For a five-blade mower} — \frac{500 \text{ x pulley dia.}}{1750} = \text{motor pulley size}$$

$$\text{For a four-blade mower} — \frac{650 \text{ x pulley dia.}}{1750} = \text{motor pulley size}$$

**EXERCISE 35**

## DRILL PRESS

An inexpensive drill press which will do good work can be made as shown in Fig. 34. This is a useful piece of equipment for any farm shop which speeds up most drilling jobs.




NOTES

1. THREADS MUST BE CONCENTRIC WITHIN .005" WITH SPINDLE FOR GOOD AND SAFE WORK. USUALLY THREADED SPINDLE CHUCKS 1/4" OR 1/2" CAP. HAVE 1/2"-24NS-2 THREADS. SPINDLE SHOULD BE POLISHED FOR BETTER BEARING PERFORMANCE.

2. BUSHINGS SHOULD BE SEATED WITH SPINDLE AND CONTROL HANDLE ASSEMBLED, THEN ANCHORED SECURELY. SPINDLE MUST SPIN FREELY. PLUMB VERTICALLY. KEEP SPINDLE WELL OILED.

3. TO PREVENT WOOD SPLITTING, DRILL GUIDE HOLES FOR NAILS. DIAMETERS OF DRILLS TO BE GOVERNED BY QUALITY OF WOOD AND SIZE OF NAILS.

DRILL PRESS

Fig. 34.

## Materials Required

| NO. | DESCRIPTION | SIZE | QUAN. | MATERIAL |
|---|---|---|---|---|
| 1 | Spindle, ½″ dia. Steel line shafting | 24″ long | 1 | Cold fin. steel |
| 2 | Single groove "V" pulley with set screw. | 6″ dia. ⅜″ to ½″ V-belt. Bore to suit spindle. | 1 | Metal |
| 3 | Spindle bushings, from a motor bearing or poured from babbitt. | Flanged to permit securing, ½″ bore. | 2 | Any bearing metals. |
| 4 | Round washers | For ½″ carriage bolt—1¾″ O.D. | 10 | |
| 5 | Carriage bolts, oil finished | ½″ dia. x 8″ | 4 | |
| 6 | Pull spring, coiled, with looped ends, and staples. | 10 lb. pull, or greater | 1 | Steel |
| 7 | Butt hinges, with screws | 4″ x 4″ | 1 | (pr.) Metal |
| 8 | Bearing plates | ½″ x 6⅝″, No. 16 U.S. Gage. | 4 | Steel strip stock. |
| 9 | Operating handle | 1″ x 4″ x 15″ | 1 | Hard wood |
| 10 | Line shaft collars with set screws | ½″ bore | 2 | Steel |
| 11 | 3 jaw drill chuck, threaded spindle type. | ¼″ or ½″ capacity | 1 | |
| 12 | Common nail | 40d, 5″ long | 1 | Steel |
| 13 | Carriage bolt, oil finished | ½″ dia. x 7″ | 1 | |
| 14 | Nuts, carriage bolt | For ½″ bolts | 5 | |
| 15 | Common nails | 30d, 4½″ long | 2 | Steel |
| 16 | Common nails | 60d, 6″ long | 2 | Steel |
| 17 | Column | 2″ x 6″ x 26½″ | 1 | Hard wood |
| 18 | Head pieces | 2″ x 6″ x 6½″ | 2 | Hard wood |
| 19 | Column brace | 2″ x 6″ x 12″ | 1 | Hard wood |
| 20 | Table base | 2″ x 6″ x 16″ | 1 | Hard wood |
| 21 | Wood screws for bearing plates | No. 6 x ¾″ flat head | 8 | |

## Procedure

1. Prepare the wood pieces and assemble the stand as shown in the plan.

2. The spindle shaft will need to be threaded to fit the threads in the spindle chuck. Most machine shops which have a metal lathe can do this.

3. Assemble the spindle in the head pieces putting on the shaft collars in the proper order and screwing the drill chuck on last.

4. The motor to drive the drill press can be mounted either on the back of the stand or on a separate shelf. In either case, the drill press needs to be fastened to a work bench. For vertical mounting on the back of the stand, only a ball-bearing motor should be used.

EXERCISE 36

# CIRCULAR SAW

A circular saw such as shown in Fig. 35 is a handy and useful piece of equipment which is not very difficult to make. With it you can quickly rip a board to any desired width as well as cut it off.

## Materials Required

| NO. | DESCRIPTION | SIZE | AM'T | MATERIAL |
|---|---|---|---|---|
| 1 | Table top | 1″ boards | 5½ bd. ft. | Hard wood |
| 2 | Side plates | 1″ x 4″ x 34½″ | 4 | White pine |
| 3 | End plates | 1″ x 4″ x 20″ | 4 | White pine |
| 4 | Legs | 2″ x 4″ x 30½″ | 4 | White pine |
| 5 | Adjustable power shelf | 1″ boards | 3⅞ bd. ft. | White pine |
| 6 | Bottom plates for above | 1″ x 3″ x 16″ | 3 | White pine |
| 7 | Adjusting handle | 1″ x 2½″ x 23″ | 1 | White pine |
| 8 | Adjustment board | 1″ x 2″ x 24″ | 1 | White pine |
| 9 | Fulcrum | 2″ x 4″ x 20″ | 1 | White pine |
| 10 | Butt hinges | 4″ x 4″ | 2 | Iron or steel |
| 11 | Wood screws | Dia. to fit above, 1″ long | 3 | Metal |
| 12 | Hex. head bolts for handle | ½″–13 NC–5½″ long | 2 | Iron or steel |
| 13 | Washers, flat, round | ⅝″ bolt | 6 | Iron or steel |
| 14 | Nuts, hex | ½″–13 NC | 2 | Iron or steel |
| 15 | Hex. head bolt | ½″–13 NC–3″ long | 1 | Iron or steel |
| 16 | Nails | 5d | 55 | Steel |
| 17 | Nails | 6d | 60 | Steel |
| 18 | Nails | 7d | 30 | Steel |
| 19 | Nails | 9d | 30 | Steel |
| 20 | Combination circular saw | 8″ bore to fit mandrel | 1 | Steel |
| 21 | Saw mandrel | | 1 | Steel |
| 22 | "V" type belt | A | 1 | |
| 23 | Wood screws | Dia. same as Part No. 11 2″ long. | 3 | Iron or steel |
| 24 | Reinforcement plates | 6″ x 6″ No. 16 U.S. Ga. | 2 | Iron or steel |
| 25 | Hex. head bolts | To fit mandrel and block | 4 | Iron or steel |

## Procedure

1. Build the saw table and shelf as shown in the plan.

2. Mount the motor and saw mandrel on the shelf. (See Notes on the plan). The saw must be parallel to the table top boards.

3. For sawing lumber more than 1″ thick, the motor should be ½ H.P., or larger, with a 3″ diameter pulley.

## Safe Operation

When sawing short pieces or narrow strips, always use a push stick. Always stand at one side of the saw, never directly behind it.

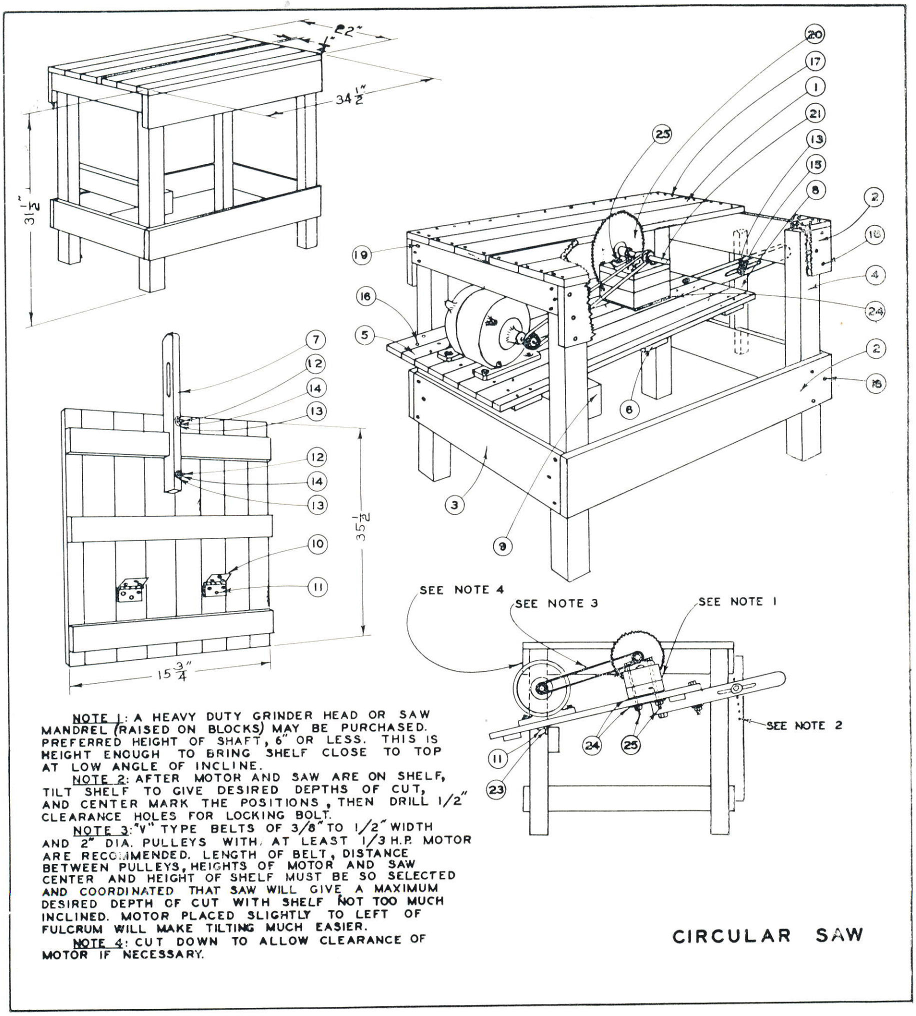



Fig. 35.

EXERCISE 37

## ELEVATORS FOR HANDLING FARM PRODUCTS

Many farm products can be more easily handled with elevating and conveying equipment, thus eliminating one of the hardest jobs on the farm. Farmers cannot afford to handle by hand any products which can be handled mechanically. A 1/3 h.p. electric motor on a small home-built elevator using a few cents worth of electricity will bin more grain in a day than three or four men. Ear corn, potatoes, sugar beets, baled hay and straw, bagged feed, crated produce and many other products can be handled and elevated mechanically.

Building an elevator is an interesting and worthwhile exercise. There are three principal types of elevators for which plans are available at County Extension offices. These are: 1) The Michigan Vertical

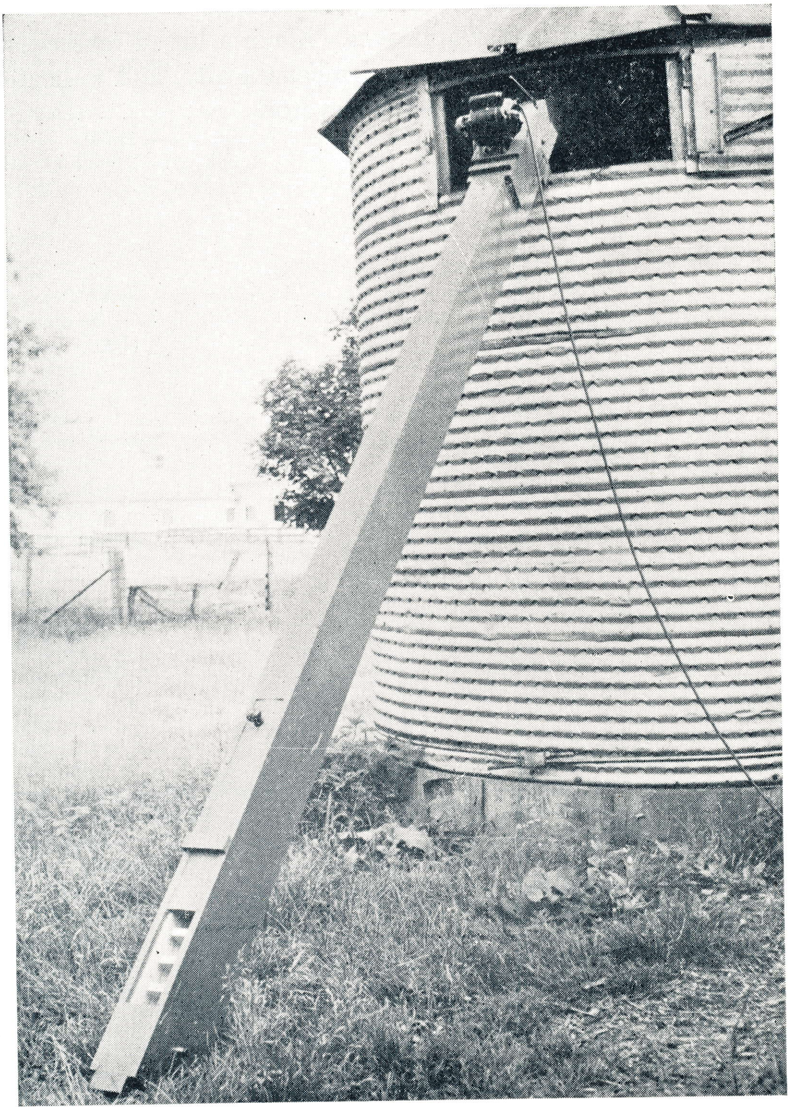


**Fig. 36. The Michigan conveyor elevator for handling small grain, shown with hopper removed.**

Cup-type Elevator for Small Grain, Circular Bulletin 193; 2) The Michigan Conveyor Elevator, Article 26-6, August 1943; 3) An Elevator for Ear Corn, Article 25-45, May 1943.

The first of these is considered a somewhat permanent type of installation while numbers 2 and 3 are portable types which can be moved from one job to another. One type is shown in Fig. 36.

In this exercise, build an elevator using one of these plans, or any other plan which your leader approves. Make a list of materials and farm products which can be elevated mechanically, and indicate the jobs which you plan to do with your elevator.

# INDEX

Cooperative extension work in agriculture and home economics. Michigan State College and U. S. Department of Agriculture cooperating. C. V. Ballard, Director, Cooperative Extension Service, Michigan State College, East Lansing. Printed and distributed under acts of Congress, May 8 and June 30, 1914.

10M