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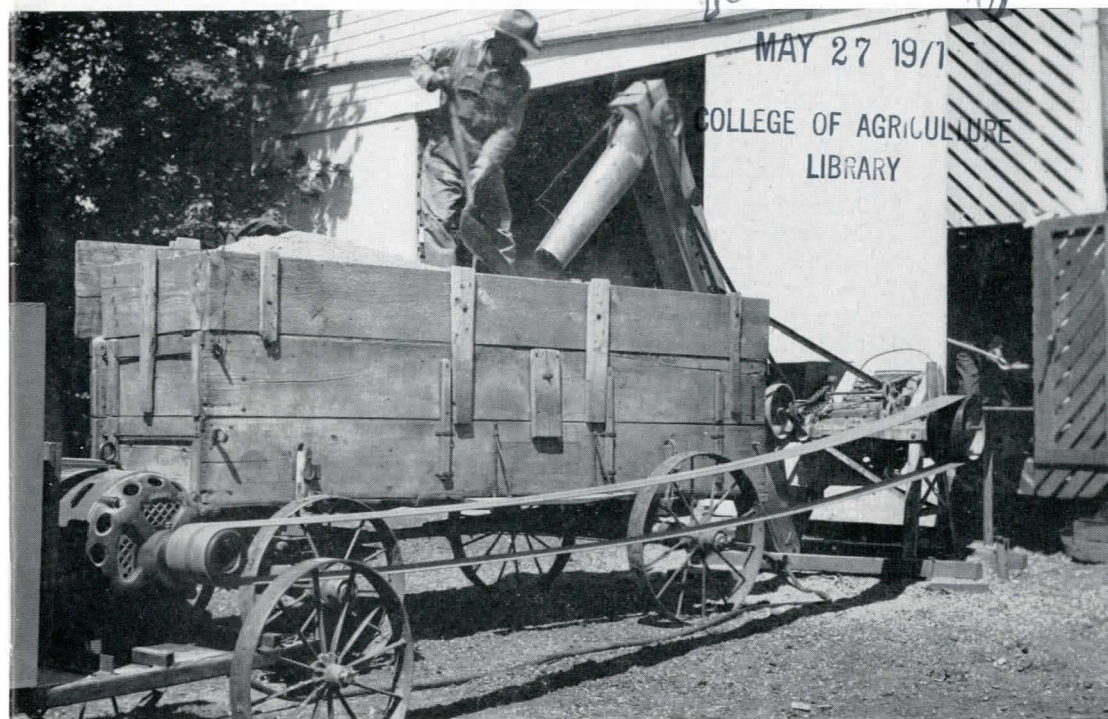
EC 786

ELECTRIC MOTORS FOR NEBRASKA FARMS

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THE UNIVERSITY OF NEBRASKA
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LINCOLN, NEBRASKA

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EXTENSION CIRCULAR 786

MAY, 1941

The writer wishes to express his appreciation to O. J. Ferguson, Dean of the Engineering College, Prof. E. E. Brackett, Chairman of the Agricultural Engineering Department, and F. D. Yung, Research Engineer of the Agricultural Engineering Department, for helpful suggestions in preparing this circular.

Extension Service of the University of Nebraska College of Agriculture
United States Department of Agriculture Cooperating

W. H. Brokaw, Director, Agricultural Extension Service, Lincoln, Nebraska

Electric Motors for Nebraska Farms

E. A. OLSON

AS A SOURCE OF FARM POWER, the electric motor offers many advantages. It is reliable, quiet running, easy to start or stop, has a large overload capacity for a short time, and is free from poisonous fumes. It is economical because of its reasonable first cost, low operating cost, and low depreciation. The electric motor requires very little attention and upkeep and, if properly cared for, will last for many years.

A definite increase in the number of electric motors will result, no doubt, from the steadily increasing mileage of rural power lines. The selection, care, and operation of motors suitable for farm use can well be studied by most farmers. A study of these problems will enable farmers to reduce trouble and expense, and thus insure more satisfactory service. Material in this circular deals with electric motors of $7\frac{1}{2}$ horsepower and smaller for operation on 110-220-volt, single-phase, 60-cycle alternating current.

TYPES OF ELECTRIC MOTORS

Motor type, size, and speed must be considered in the selection of an electric motor for a given job. The prospective purchaser of an electric motor should have available enough information to enable him to make the proper choice.

The type of motor to be selected depends upon the rural service available and the conditions under which the motor is to be operated. Service on most farms is 110-220-volt, three-wire, single-phase, 60-cycle, alternating current. This three-wire rural service is sometimes mistaken for three-phase, which is available on only a small portion of farms at present.

The types of electric motors commonly used on single-phase, 110-220-volt farm service are split-phase, capacitor, and repulsion-induction. Universal motors are also used on some appliances. Starting torque, starting current, and overload capacity are motor characteristics which vary to some extent in different types of motors. These characteristics for the various motors are explained below.

Split-Phase Motor

The split-phase motor is probably the simplest for use on single-phase alternating current. It is usually available in sizes of $\frac{1}{3}$ horsepower and smaller. It has low starting torque, and is not suitable for use on loads that are hard to start. Full power is not developed until the motor reaches full speed. It can be used on any machine that is easy to start or one where the load is thrown on after the motor has reached full speed. The common applications for this motor are washing machines, tool grinders, and bench saws.

The direction of rotation can be reversed by interchanging motor connections as specified by the manufacturer.

Capacitor Motor

The capacitor motor has come into use within the last few years. It has a condenser or capacitor which enables it to start loads $1\frac{1}{2}$ to 2 times heavier than will the split-phase motor of the same horsepower rating. The starting current of the capacitor motor is about half that of the split-phase. Efficiency of the capacitor is higher than that of the split-phase. Common sizes are up

to $\frac{3}{4}$ horsepower, but larger sizes can be obtained. By interchanging motor connections as specified by the manufacturer, the direction of rotation can be reversed. This motor can easily be identified by a container, either on top or underneath the motor. This container houses the condenser.

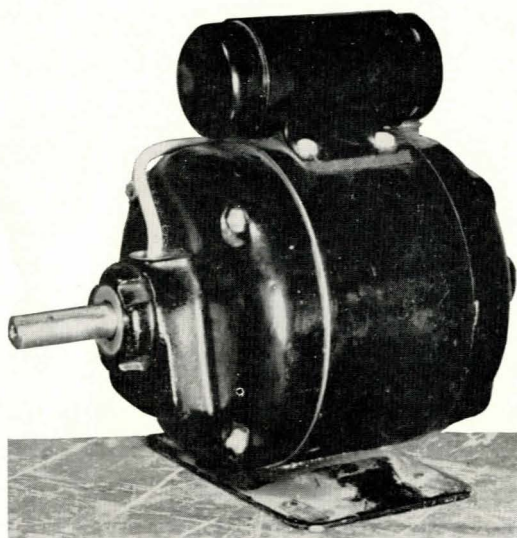


FIG. 1.—A capacitor motor identified by the cylindrical container mounted on top of the motor.

Repulsion-Induction Motor

The repulsion-induction motor has the lowest starting current and highest starting torque of all single-phase motors. It will start almost any load it can carry within its horsepower rating. It is commonly used on cream separators,

milking machines, feed grinders, and ensilage cutters. Most of these motors are so designed that by changing the motor connections as specified by the manufacturer, it is possible to operate it on either 110- or 220-volt current. The direction of rotation can be reversed by changing the position of the brush-holding yoke. Repulsion-induction motors are available for loads up to 10 horsepower, provided local power facilities permit their use.

The repulsion-induction motors are of two types, the "brush-riding" and the "brush-lifting." Electrically these motors are about the same. Mechanically, the brush-lifting types lift the brushes from the commutator while the brush-riding do not. The brush-lifting type of motor saves wear on the brushes except where frequent starts are made.

Universal Motor

This type of motor will operate on either direct or single-phase alternating current. The speed of the motor may be varied over a wide range. While idling, the motor may attain a speed of 15,000 rpm. but when loaded it may slow down to 500 rpm., making the motor unsuitable for most jobs. This motor is commonly used on such machines as vacuum cleaners and fans where the load is constant, also on sewing machines and food mixers where speed control is essential. The universal motor usually is made in small sizes for operating such appliances as are mentioned above.

MOTOR SIZES, STYLES, TYPES, AND CONSUMPTION FOR VARIOUS FARM USES

Farm Machine To Be Driven	Motor Size (horsepower)	Motor Style	Type of Motor	Approximate Kilowatt-Hour Consumption
Churn	$\frac{1}{4}$	Portable or stationary	Split-phase	1 to 2 per 100 lbs. butter
Corn sheller (1 or 2 hole)	$\frac{1}{4}$ — $\frac{1}{2}$	Portable	Repulsion-induction	0.1—0.2 per bushel
Cream separator	$\frac{1}{4}$ — $\frac{1}{3}$	Stationary	Capacitor or repulsion-induction	0.5 per 1,000 lbs. milk
Emery wheel	$\frac{1}{4}$	Portable or stationary	Split-phase	0.33 per hour
Ensilage cutter	3—7 $\frac{1}{2}$	Portable	Repulsion-induction	0.8 to 1.5 per ton
Fanning mill	$\frac{1}{4}$ —1	Portable	Split-phase	1.5 per 100 bushels
Feed grinder	1—7 $\frac{1}{2}$	Portable or stationary	Repulsion-induction	5 to 10 per ton
Feed mixer	3—5	Portable	Repulsion-induction	1—4 per ton
Grain elevator	3—7 $\frac{1}{2}$	Portable or stationary	Repulsion-induction	0.13 to 0.42 per 1,000 bu. per ft. of lift
Hay hoist	3—5	Portable or stationary	Repulsion-induction	0.4 per ton
Milking machine	$\frac{1}{4}$ —1	Stationary	Repulsion-induction	2—3 per cow per month
Sausage grinder	$\frac{1}{4}$	Portable	Repulsion-induction	4 per 100 lbs. of meat
Small concrete mixer	$\frac{1}{2}$	Portable	Capacitor	0.5 per cu. yard
Water system	$\frac{1}{4}$ —2	Stationary	Repulsion-induction	1—3 per 1,000 gals. water
Washing machine	$\frac{1}{4}$	Stationary	Split-phase	2—4 per family per month
Wood saw	3—7 $\frac{1}{2}$	Portable	Repulsion-induction	1—3 per cord

MOTOR SIZE

Electric motors for operation on single-phase service are available in fractional and integral horsepower sizes. The size, stamped on the name plate, indicates the horsepower which the motor will develop continuously under proper operating conditions as explained under "Motor Temperature Rise."

MOTOR SELECTION GUIDE

Single-phase motors commonly used on farms. Other types of motors are manufactured for many purposes.

Motor Type	Motor Characteristics		Common Uses	Sizes Commonly Available (horsepower)
	Starting ability (torque)	Starting current		
Split-phase	Fair	High	Washing machines Bench saws Churns Emery wheels Grindstones Fanning mills Sheep shearers	1/20 to 1/3
Capacitor	Good	Medium	Refrigerators Concrete mixers (small) Corn shellers (single hole)	1/20 to 3/4
Repulsion-induction	Excellent	Low	Cream separators Feed grinders Ensilage machines Milking machines Grain elevators Hay hoists Water systems (automatic pressure)	¼ to 7½

OVERLOAD CAPACITY

An electric motor is capable of developing more than its rated horsepower, and will carry a large overload for a very short time; however, a very small overload can be carried for a longer time. *No motor can be excessively overloaded continuously without "burning out."*

The ability of an electric motor to develop more than its rated horsepower is very convenient. For example, a $\frac{3}{4}$ horsepower motor on a water system may not be overloaded except for the last few minutes when the pressure builds up from 30 to 40 pounds, and perhaps 1 horsepower is needed. The electric motor will take care of this overload automatically because of its ability to develop more than rated horsepower.

POWER CONSUMED BY A MOTOR

The amount of power (watts) consumed by a motor depends upon the power (horsepower) it is delivering. The following table shows this very clearly:

Motor Size (horsepower)	Delivering (horsepower)	Watts Drawn (approximate)
1	$\frac{1}{4}$	400
1	$\frac{1}{2}$	540
1	$\frac{3}{4}$	760
1	1	975
1	$1\frac{1}{2}$	1140

Electric motors can develop more than their rated horsepower when starting. This added torque is often necessary since most machines require more power while starting than while running. "Starting torque" is a term used to designate the turning or rotating ability of a motor while starting and coming up to speed. This varies with the type of motor; some are able to deliver four or five times normal torque while starting.

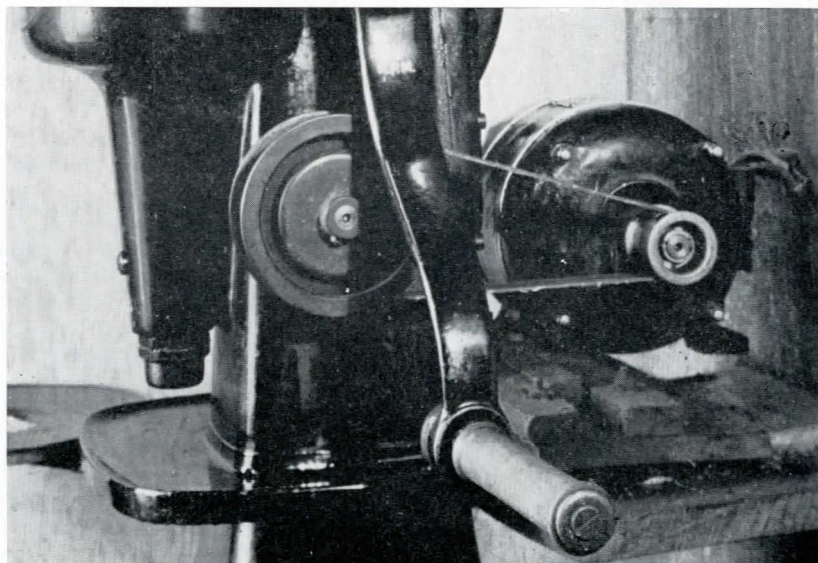


FIG. 2.—A home-made motor mounting on a cream separator. The "rocking mounting" keeps the belt tight at all times.

The following method of determining the number of watts (or kilowatts) drawn by a motor or other device may be useful in checking the consumption of various appliances:

1. Turn off all lights and devices.
2. See that the disk in your electric meter is not running. (The disk is a thin piece of aluminum which revolves horizontally and is usually below the dials or numbers on the meter.)
3. Turn on a new 100-watt light bulb.
4. Record the time in seconds required for the aluminum disk to make one revolution. It may be more accurate to take two or three readings, using the average of these readings.



FIG. 3.—A $\frac{1}{4}$ -horsepower motor operating a water pump. A pressure switch will provide automatic operation on a water system.

5. Turn the 100-watt bulb off.

6. Turn on the motor or other device to be tested for wattage.

7. Record the time in seconds required for the aluminum disk to make one revolution. It may be difficult to obtain this time if the disk is turning rather rapidly. If that is the situation, time the disk for several revolutions, counting the revolutions. Divide this time by the number of revolutions, thereby obtaining the time for one revolution.

8. Now use the following method of determining the wattage of the device you are testing: Divide the number of seconds per revolution of the disk when the 100-watt bulb was connected by the number of seconds per revolution when the motor was connected. Multiply the answer by 100. Suppose, for example, that 66 seconds was the time required with the 100-watt bulb. The time for the disk to make two revolutions with the motor attached was 22 seconds. Dividing 22 by 2 gives 11 seconds per revolution. As shown below the motor draws:

$$66 \div 11 \times 100 = 600 \text{ watts (6/10 kilowatt)}$$

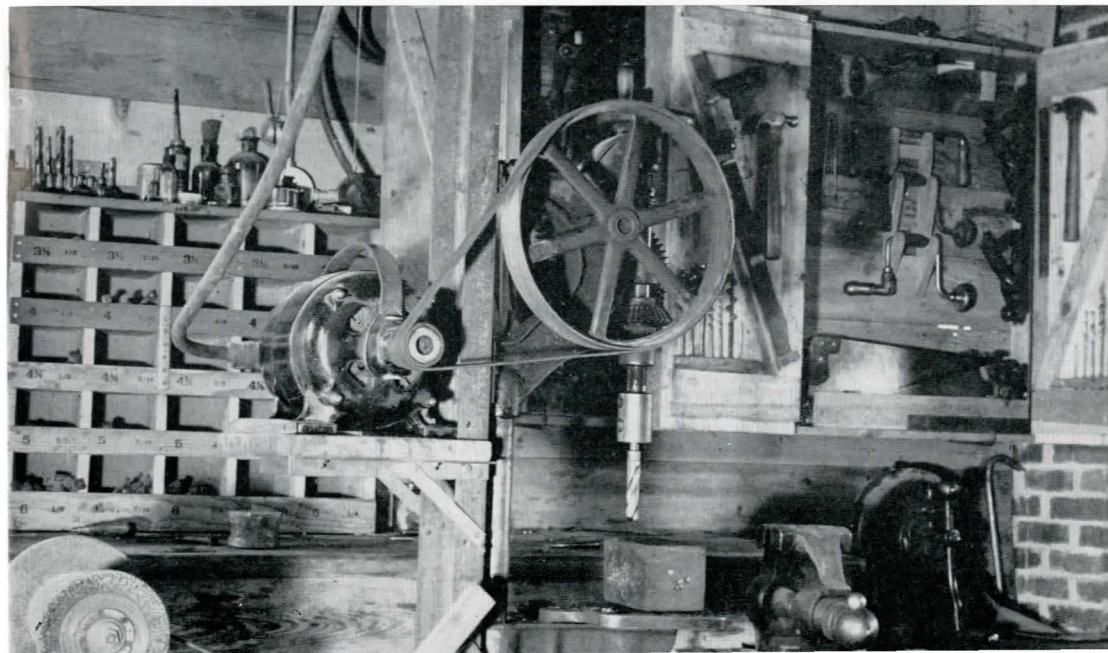
ELECTRIC MOTORS vs. INTERNAL-COMBUSTION ENGINES

Electric motors differ from internal combustion engines in the ability to carry momentary overloads equal to several times their rated horsepower. In selecting an electric motor to replace an internal combustion engine, it is essential to determine accurately the horsepower requirements for the given job. Helpful suggestions can often be obtained from company representatives or salesmen. If competent advice is not locally available, the county agent may be consulted or a letter stating your problem sent to the Extension Service, College of Agriculture, Lincoln, Nebraska.

PROBLEMS ENCOUNTERED WITH LARGE MOTORS

The maximum size of motor that can be used on a rural line depends on a number of limiting factors. Often a farmer feels the need for a 10 horsepower motor. Upon investigating, he finds that single-phase motors larger than 5 horsepower are quite expensive. He also finds that his transformer cannot handle a motor larger than 3 or 5 horsepower. The power company objects to the installation of a larger transformer unless a higher fixed monthly charge is made for the added investment in a larger transformer.

FIG. 4.—An electric motor can be used for operating a number of tools in the farm shop.



The use of a small machine requiring a smaller motor would do the same job as a large machine in a longer period of time. While the smaller machine requires more hours to do the job, a small crew can be used and a much smaller sum of money would be invested. Before investing in electric motors larger than 3 horsepower, it is a very good plan to check with your power company to determine the maximum size motor that is permitted. The size of motor is definitely limited by the size of transformer being used. It is always advisable to check with your power company before buying additional power units.

MOTOR SPEEDS

Motors operating at approximately 1,800 rpm. are commonly used for farm power. The actual full-load speed of these motors varies from 1,725 to 1,760 rpm. Low voltage and motor overload tend to cause further reduction in speed.

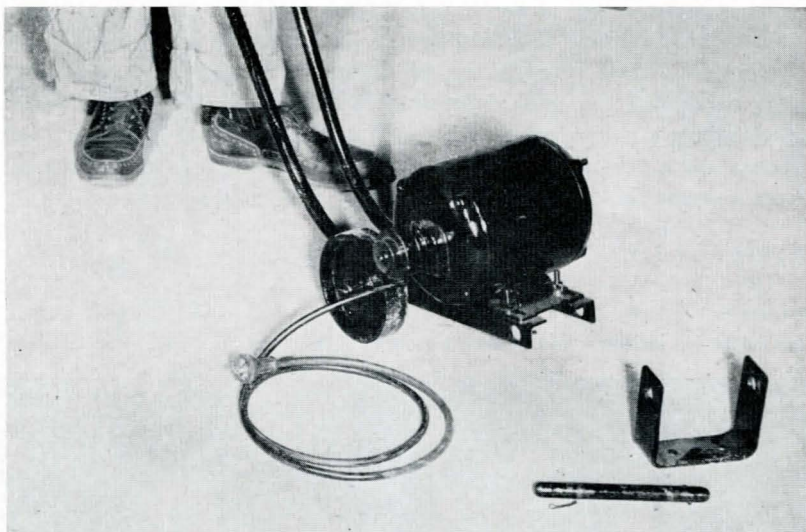


FIG. 5.—A motor truck for motors up to 5 horsepower can be made in the farm shop. The "U" bar shown at the right of the motor is attached to the machine which the motor is to operate. The short rod serves as the connecting means.

Motors are also manufactured for operating at speeds of approximately 900, 1,200, and 3,600 rpm. These are more costly and more difficult to secure for replacement in case of failure. For this reason, it is advisable to use an 1,800 rpm. motor whenever possible. When a very low speed is desired, it is advisable to obtain a gear motor. These are comparatively high in first cost, but this is offset by high operating efficiency, dependability, and compactness. These are usually 1,800 rpm. motors with a gear reduction unit built into the motor. Speeds as slow as 15 rpm. and slower are obtainable.

Single-phase alternating current motors are not designed for speed control by rheostats or other similar devices. Universal motors, however, which

operate on either direct or alternating current, lend themselves readily to speed control.

Motors designed to operate at a specific voltage will drop noticeably in speed if a lower voltage is supplied. This will be discussed under wiring for motor.

PORTABLE AND STATIONARY MOTORS

Portable motors are of two kinds, those that are hand-portable or those which are mounted on trucks. Motors of the larger sizes are mounted on trucks and are used for operating such equipment as corn shellers, ensilage cutters, and feed grinders. Where conditions make it possible, considerable saving in investment can be made by the use of a portable motor for different jobs on the farm. It is not probable that all the machines to be operated with one motor should run at the same speed but with the use of a 3 or 4 step pulley or by changing pulleys the motor can be adapted to many machines.

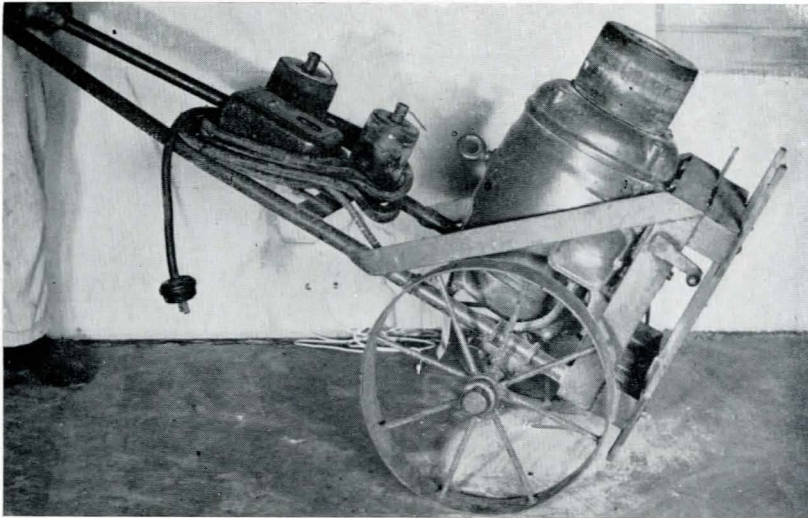


FIG. 6.—A 5-horsepower farm motor mounted on a truck. Note that two extra pulleys are provided for operating machines at different speeds.

Hand-portable motors are generally $\frac{1}{4}$ horsepower. They are used for operating such machines as emery wheels, small corn shellers, grindstones, and small fanning mills. This size of motor can be moved about from one job to another and can be used on many machines designed for hand operation.

Stationary motors are left in one location for continued use. The motor is mounted in position and belted or connected directly to the machine. Horizontal motors can be mounted on floors, walls, or ceilings. Vertical motors are also available.

When a motor is to be selected for driving feed grinders under dusty conditions, consideration should be given to the merits of a dustproof motor

case. The use of the dustproof motor will help eliminate the chances of spontaneous combustion, should extremely dusty conditions be encountered.

CARE OF ELECTRIC MOTORS

Electric motors require little care and attention, provided they have been correctly selected and installed. There are a few important points which must be observed to obtain long life and greatest satisfaction from a motor.

Motor Temperature Rise

Electric motors normally heat when in use. Well-designed motors are so built that they will run continuously under normal conditions and develop their rated load without overheating. Most motors are designed to operate so that their temperature does not increase more than 40° Centigrade or 72° Fahrenheit above the surrounding air temperature, which does not exceed 50° Centigrade or 122° Fahrenheit.

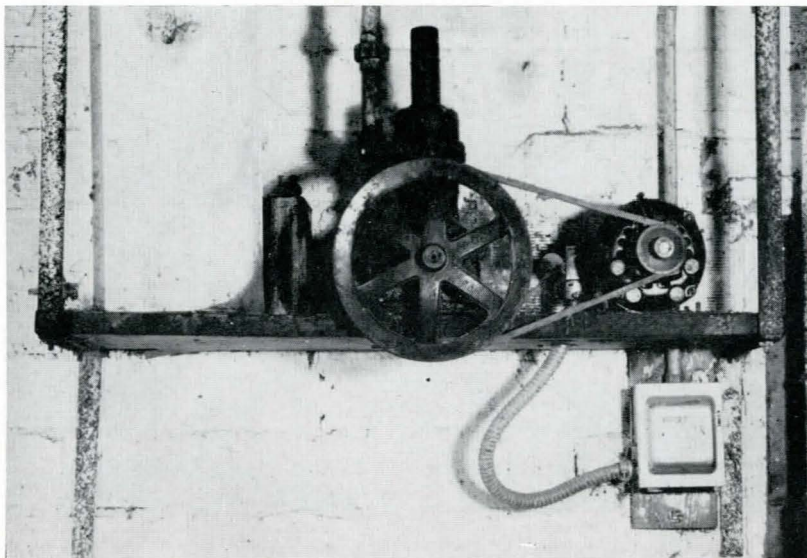


FIG. 7.—A ½-horsepower repulsion-induction motor for operating a milking machine unit.

On days with a temperature of 110° F., the temperature of the fully-loaded motor may rise to 182° F. (110° F.+72° F.). This may feel very hot to the hand but should cause no alarm as the motor is entirely safe. On the other hand, should the temperature of the motor rise above 194° F. (122° F.+72° F.) the motor is *not* entirely safe and is in danger of overheating and burning out. A thermal overload protection built into the motor as explained under the next heading will afford protection under such conditions. Its use is recommended in *all* motor installations. The temperature of a motor may also rise above the danger point if the motor is continually overloaded or located in such a position that the air cannot circulate freely around it or is

located in the direct rays of the sun. It is important to select a motor location that will permit plenty of air circulation.

Motor Protection

Most machines require more power for starting than under normal running conditions. Electric motors are designed to develop more than normal torque for starting and for momentary overloads. When a motor delivers more than its rated horsepower it draws more than normal current. Above-normal current is harmful as it causes excessive heating in the motor and tends to damage the insulation on the motor windings.

The simplest kind of protective device is the ordinary fuse. However, this protects only the wiring to the motor and does not protect the motor windings since it will carry the large starting current and would allow a continuous flow of high current to the motor. An ordinary fuse alone is *not* proper motor protection. No motor should be installed without *overload protection* in addition to fusing. Some motors have built-in protective devices.

There are now available on the market a number of protective devices. One of these devices permits the high starting current to flow to the motor for a short period of time but opens the circuit if the high current continues to flow in case of excessive overload. Another device, known as a circuit breaker, operates in a similar manner and can be reset once the heating coil within the breaker has cooled down to normal temperature.

Probably the best protective unit is a thermal overload device that carries the starting current and is built into the motor housing so that the heat from the motor windings is added to the heat due to the flow of current. This device disconnects the motor when *excessive motor temperature* is reached.

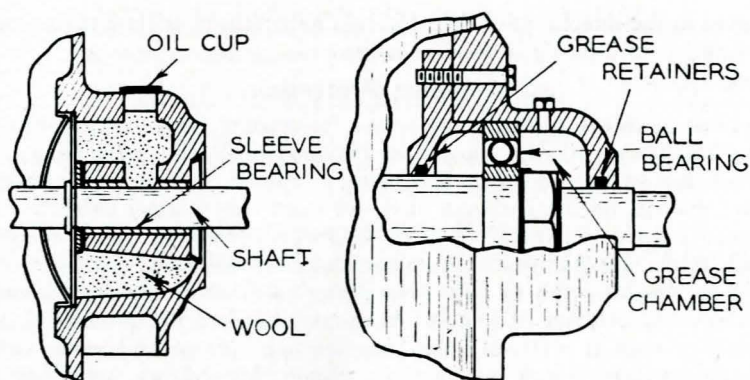
The size of protective device selected should not be more than 125 per cent of the normal running current of the motor. If an amperage greater than this is used, little protection for the motor can be expected.

Motor Bearings

There are two common types of bearings available for motors. They are sleeve bearings and ball bearings. Sleeve bearings are most commonly used for motors that are mounted horizontally. Ball bearings can be used but the cost is greater. For vertical mounting, ball bearings are preferred since they carry the weight of the motor and also tend to retain oil better than do the sleeve bearings.

Ball-bearing housings are often filled with grease and permanently sealed, thus doing away with the job of greasing. Only double bearings should be used because the single-sealed type allows the grease to work out. Double-sealed bearings packed with grease require no lubrication until the grease gets dirty. Then the bearings should be cleaned and repacked.

Sleeve bearings are generally wool-packed and require small applications of a light grade of oil at regular intervals. Care must be taken that only small applications of oil are made, as there is danger of excess oil saturating the winding insulation and causing motor trouble. *Always follow oiling instructions as given with the motor* regarding the kind and amount of oil used for lubrication.



- SLEEVE BEARING ASSEMBLY- - BALL BEARING ASSEMBLY-

FIG. 8.—Sectional views of two common types of electric motor bearings.

SELECTION OF MOTOR SWITCHES AND CONTROLS

Choice of electric motor controls should be governed by the motor installation and the recommendations of the manufacturer. Farm motors are generally controlled by two types of switches. These are manually or magnetically operated. Selection of a switch for a given motor will depend on motor size, type, and conditions under which the motor is being used.

Manually operated switches are operated by levers that move the switch blades. These are used when the switch can be located to give the operator convenient access to it.

Magnetic switches make it possible to control motors from some remote point by means of push-button switches. This feature is very convenient as it is possible to control a motor from more than one place.

All motor switches should be located in places where they are protected from the weather unless weatherproof switch boxes are used. It must be remembered that all motor switches must be totally enclosed, as open switches are a source of danger and a fire hazard.

WIRING FOR MOTOR

For efficient operation, it is just as important to select the correct size of wire between the motor and meter as it is to choose the right type of motor. Excessive "voltage drop" or a loss in voltage occurs if too small wire is used. When a motor is operated at a voltage lower than that shown on the name-plate, reduced motor efficiency and overheating are likely to occur.

Reference to the table on motor wiring shows that the larger the motor or the greater the distance from motor to meter, the larger the size of wire required. For example, a 1-horsepower motor operated on 110-volt service requires No. 10 A. W. G.¹ copper wire at 100 feet but at 400 feet No. 4 is

¹ American Wire Gauge.

WIRE SIZES FOR USE BETWEEN MOTOR AND METER ¹

Motor Horsepower	One-way Distance from Motor to Meter (ft.)										
	25	50	75	100	150	200	250	300	400	500	1000
110 Volts											
$\frac{1}{2}$	14	14	14	14	12	10	10	10	8	8	4
$\frac{1}{2}$	14	14	14	12	10	10	8	8	6	6	2
$\frac{3}{4}$	14	14	12	12	10	8	8	6	6	4	2
1	14	14	12	10	8	8	6	6	4	4	0
$1\frac{1}{2}$	12	12	10	8	8	6	6	4	2	2	0
2	12	10	10	8	6	4	4	4	2	0	0
220 Volts											
$\frac{1}{4}$	14	14	14	14	14	14	14	14	14	12	10
$\frac{1}{2}$	14	14	14	14	14	14	14	14	12	12	8
$\frac{3}{4}$	14	14	14	14	14	14	14	12	12	10	8
1	14	14	14	14	14	14	12	12	10	10	6
$1\frac{1}{2}$	14	14	14	14	14	12	10	10	10	8	6
2	14	14	14	12	10	10	10	10	8	6	4
3	14	14	12	12	10	10	8	8	6	6	2
5	12	12	10	10	8	8	6	6	4	4	0
$7\frac{1}{2}$	10	10	8	8	6	6	4	4	2	2	0

¹ Based on a maximum of 3 per cent voltage drop and 110 per cent motor load.



FIG. 9.—Hay hoist operated by a 3-horsepower repulsion-induction motor. This makes a very convenient arrangement for handling large amounts of hay.

required. It can also be seen from the table that the same 1-horsepower motor operating at 110 volts requires No. 6 wire at 300 feet, while if the same motor were operated at 220 volts at the same distance No. 12 wire would be satisfactory. This would mean that a considerable saving in cost of wire would result, provided the motor was operated on 220-volt service.

It must be remembered that mechanical strength is a definite requirement that also must be considered for outside spans. To insure sufficient mechanical

strength, No. 10 is the minimum wire size that should be used for outside spans up to 50 feet. Greater spans require at least No. 8 wire or larger.

It should be remembered that adequate size will not give you the highest efficiency and satisfaction unless your transformer is of sufficient size to carry your load. Whenever you plan to make a substantial change in load, you should consult the power company.

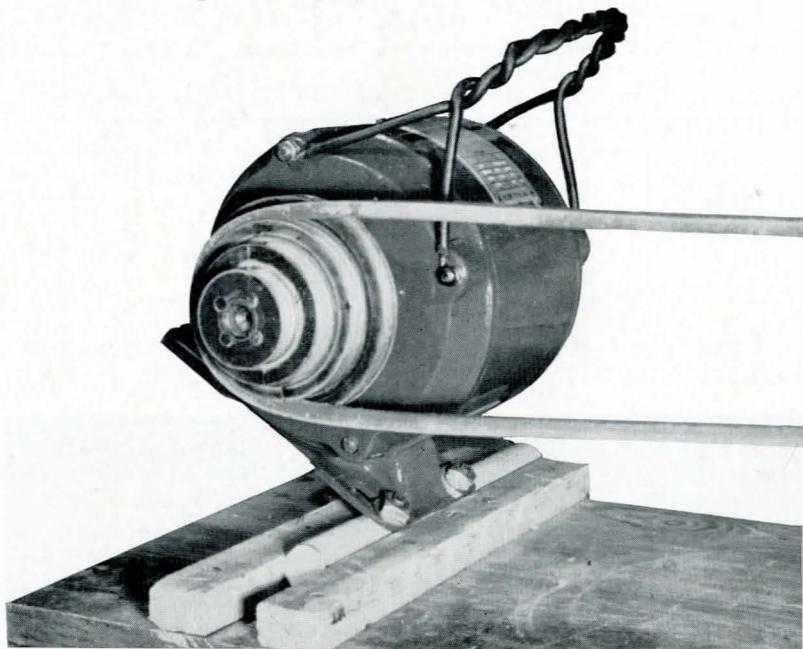


FIG. 10.—A chore motor equipped with the “rocking mounting.” A handle made from heavy insulated wire provides a satisfactory means for carrying the motor from one job to another.

Motor Grounding

For the practical safeguarding of persons and buildings from hazards arising from the use of electricity, the National Electric Code is set up as a standard. Minimum requirements for the safe use of electricity are set up for the installation and safe use of electrical appliances and equipment.

Electric motors that are operated on 220 volts or in a wet place are a source of danger through shock to the operator or other persons coming in contact with the motor. The Code requires that such motors should be grounded. This means that all farm motors, portable or stationary, operating on 220 volts should be grounded. Stationary motors are usually grounded by means of an armored conductor attached to the motor frame and then to an adequate ground. Special three-wire motor cord can be used very conveniently for grounding portable motors.

Adequate ground rods must be used in all cases. They should be made of copper or other corrosion-resisting material and should be long enough to reach moist earth. Motors located in or near wells should also be grounded. This can be done by means of an armored conductor attached to a ground rod or to the well casing.

MOTOR DRIVES

The selection of drives for use with electric motors presents a more difficult problem than does that of internal-combustion engines. Most electric motors

USE THIS CHART FOR SELECTING PULLEY SIZES TO GIVE DESIRED MACHINE SPEEDS WITH 1,750 R. P. M. MOTORS

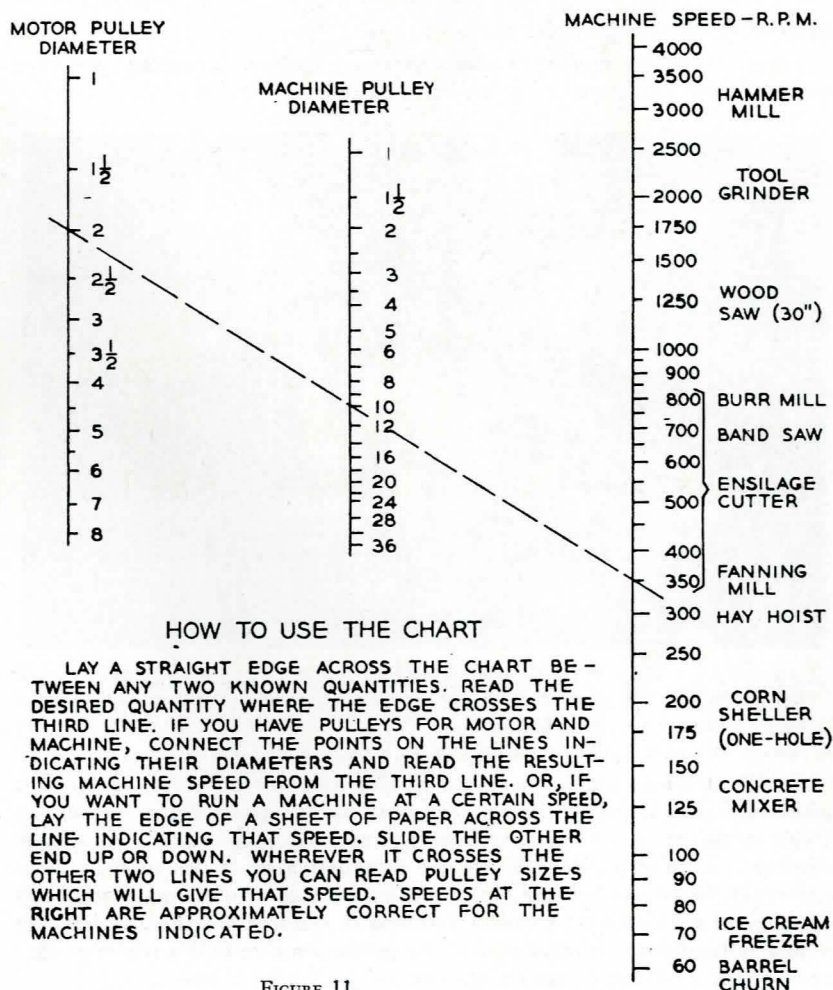


FIGURE 11.

operate at speeds of 1,725 to 1,750 rpm. and, as a result, greater speed reduction is necessary than with an engine.

Proper belt tension is of primary importance. Care must be taken that belts are not run too tight. Tight belts cause worn bearings and worn belts, and increase the amount of power required to operate a machine. Much better satisfaction will be obtained if belts are run moderately tight. The method of motor support shown in Figure 10 is a convenient method of keeping a belt tight.

V-shaped belts lend themselves readily to use with electric motors. Their use permits shorter belts and smaller pulleys, with considerable reduction in belt slippage. However, pliable canvas and leather belts also can be used. All belts should be run so that they pull on the under side. Vertical belt drives should be avoided if possible.

Direct drives are used with some stationary motors. They are not found very frequently on farms except on irrigation pumps and some water systems.

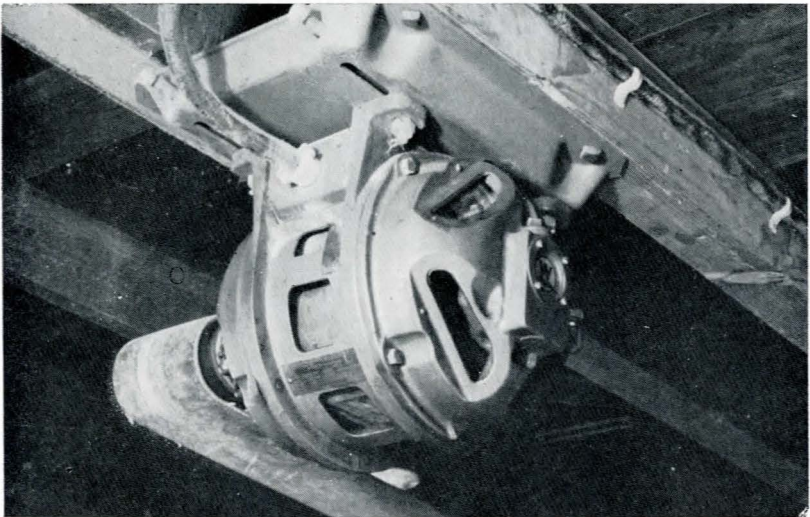


FIG. 12.—A 3-horsepower repulsion-induction motor mounted on the ceiling of a granary and used for operating an elevator and feed grinder. The electric motor lends itself for use in many convenient locations.

Small pulleys should be avoided regardless of the kind of belt used. The smaller the pulley, the sharper the bend and the shorter the life of the belt. A belt can make only a very small contact on a small pulley. This is responsible for considerable belt slippage, which causes a great deal of belt wear. It is generally safe to use the largest pulley possible on the motor to obtain the correct machine speed unless belt speeds greater than 4,000 feet per minute are attained. In other words, the maximum size pulley recommended for use on a 1,750 rpm. motor would be $8\frac{1}{2}$ inches in diameter.

Reference to Figure 11 will give the correct sizes of pulleys to use for a given machine speed. If it is found that correct machine speeds cannot be attained by the use of two pulleys, a jack shaft can be used. This arrangement permits the use of larger pulleys and avoids unnecessary belt slippage.

SUMMARY

The electric motor is an economical dependable power unit which can be adapted readily to many farm jobs.

Correct motor selection is very important for satisfactory operation. Motors are available in a number of sizes and different types for a wide variety of uses.

Electric motors will automatically carry momentary overloads. Some types have the ability to develop a high starting torque.

Motors of $7\frac{1}{2}$ horsepower and smaller are recommended for farm use. Local rural service may not be available for larger sizes. An important advantage of the smaller motor is its lower first cost.

Electric motors can be obtained for safe operation under extreme dusty or wet conditions.

Overload protective devices should be used as a safeguard against motor "burn outs."

Very little attention is required by a properly installed motor other than lubrication as specified by the manufacturer.

Portable electric motors can be used advantageously on the farm for many tasks.

The V-belt can be used efficiently for driving many machines.

Adequate motor wiring and grounding must be used for satisfactory, economical and safe operation.

The flexibility and compactness of the electric motor makes it desirable for use in many locations.

HELPFUL ELECTRIC TERMS

AMERICAN WIRE GAUGE (A. W. G.)—A standard for designating copper wire sizes.

WATT—This is a unit of electric power, similar to “horsepower.” A watt is so small that the term kilowatt is generally used. One thousand watts are equal to one kilowatt. In other words, kilo means one thousand.

KILOWATT-HOUR—A unit for specifying the amount of electric energy used by an appliance. A 100-watt lamp will burn for 10 hours in consuming 1,000 watt-hours or one kilowatt-hour.

EFFICIENCY—The efficiency of a motor definitely affects the cost of operation. High efficiency means low cost, while low efficiency results in a higher cost of operation.

CURRENT—A measure of the flow of electricity. It is similar to gallons per minute used in measuring the flow of water.

STARTING CURRENT—This refers to the current which an electric motor draws at the time of starting or coming up to full speed.

TORQUE—This term denotes the turning ability of a motor.

STARTING TORQUE (starting ability).—Starting torque is the turning effort developed by a motor at the time of starting. Different motor types vary in starting torque.

VOLT—A measure for electric pressure, like “pounds per square inch” used to indicate water pressure. The electric pressures available from power lines are usually 110 and 220 volts.