

# Century

## Single Phase Motors

### INSTALLATION AND CARE

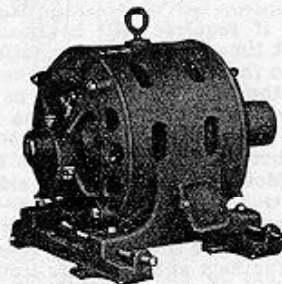


Figure No. 1

**FOUNDATION.**—A solid substantial FOUNDATION should be provided for the installation of any Motor. When the Motor is mounted upon the foundation, it should be bolted down securely, and when so fastened the armature shaft should be level.

**CEILING SUSPENSION.**—If it is desired that the Motor be INVERTED and attached to the ceiling, this can be accomplished by turning the end brackets 180° so that the oil wells will be in a vertical position. Care should be taken to see that no dirt is allowed to get between the end-bracket and the shoulder on the frame of the Motor, which would result in throwing the bearings out of alignment.

**SIDE-WALL SUSPENSION.**—If the Motor is to be mounted directly on the SIDE-WALL, this can be accomplished by turning the end-brackets 90° so that the oil wells will be in a vertical position, providing

the Motor is wound for four or eight poles, such as:

60 cycle, 1750 RPM  
60 cycle, 870 RPM  
50 cycle, 1460 RPM  
50 cycle, 730 RPM  
25 cycle, 730 RPM

Other Motors wound for two, six and ten poles such as:

60 cycle, 1165 RPM  
50 cycle, 970 RPM  
25 cycle, 1460 RPM  
133 cycle, 1540 RPM  
75 cycle, 1460 RPM

should be provided with a special brush-holder in order to locate the brushes in their proper relation to the field poles. The end-brackets will be turned to the proper position at the factory, and the special brush holder if required will be furnished without charge at that time, provided information is given on the order as to the position in which the motor will be installed. If the end-brackets are to be turned at the factory, please specify clearly how the Motor will be installed, and if it is to be mounted upon the side-wall indicate whether the pulley is to be on the left or the right of the Motor when facing the side-wall.

**REVERSING ARMATURE.**—When shipped this Motor was assembled with its armature in proper position. The armature must not be reversed, end for end, because the field and armature iron will not line up, and the Motor will not pull its load properly if this is done.

**BELTING.**—If belted to the apparatus to be driven, the armature shaft should be parallel with the shaft which it is driving so as to prevent the shoulder on the armature shaft from crowding over against one bearing. A pulley of the size regularly listed with the Motor should be used, as that size has been selected to secure continued satisfaction from the belt and the bearings. There should be a reasonable distance between the center of the armature shaft and the center of the shaft being driven so as to eliminate the necessity of having to run the belt very tight, which would produce unnecessary friction loads. Whenever possible, the direction of rotation should be such as to cause the pull to be on the bottom side of the belt. The installation of a Motor directly under the shaft being driven should be avoided, as this tends to prevent an even and satisfactory belt tension and belt contact with the Motor pulley.

**GEAR CONNECTION.**—If the Motor is geared to the apparatus to be driven, the gear and pinion should not mesh so tight as to prevent a thin piece of paper from being pulled from between the teeth without tearing.

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## GENERAL DATA

**ALLOWABLE VARIATION FROM RATED VOLTAGE.**—All Motors will operate successfully at rated load and frequency with voltage not more than 10 per cent above or below name-plate rating, but not necessarily in accordance with the standards established for operation at normal rating.

**ALLOWABLE VARIATION FROM RATED FREQUENCY.**—All Motors will operate successfully at rated load and voltage, with frequencies not more than 5 per cent above or below the name-plate rating, but not necessarily in accordance with the standards established for operation at normal rating.

**ALLOWABLE COMBINED VARIATION OF VOLTAGE AND FREQUENCY.**—All motors will operate successfully at rated load with combined variation in voltage and frequency not more than 10 per cent above or below the name-plate rating, provided the limits of variations given above are not exceeded, but not necessarily in accordance with the standards established for operation at normal rating.

At a lower than normal voltage the efficiency and power-factor will be increased at light loads; the full load constants, however, are usually somewhat lower.

The speed of induction Motors depends chiefly upon the frequency of the supply circuit. When the frequency and voltage are normal, the speed of the Motor will only vary 4 per cent or 5 per cent, according to percentage of rated capacity it is developing.

### IN CASE OF TROUBLE WITH THE MOTOR, OBSERVE THE FOLLOWING:

1st. See that the COMMUTATOR is in good condition. It may be that starting frequently with brushes not bearing properly, or attempting to carry a heavy overload, or for some other reason, the Motor has been allowed to run as a repulsion Motor with the brushes bearing on the commutator. This produces sparking sufficient to roughen the commutator and cause the brushes to make poor contact. In that event sandpaper the commutator with coarse sandpaper (No. 1½ or No. 2) so as to clean it and keep the insulation level with the commutator bars. Use a block of wood to hold the sandpaper so that the high spots may be cut down to a level with the low ones. (Do not use emery cloth or emery paper to clean the commutator.) Where commutator is badly burnt, the armature should be removed and placed in a lathe, where a slight cut should be taken off the commutator.

2nd. The BRUSHES should fit well in the brush-holders, but still be free enough to allow the springs to press them firmly against the commutator. Also see that they have a good bearing fit against the commutator.

3rd. Be certain that the BRUSHES are long enough. It may be that they have worn down so that the springs cannot force them to make good contact with the commutator.

4th. Examine setting of the BRUSH-HOLDERS. They should be set exactly at the point indicated on the index plate on the commutator end of the Motor for right (clockwise) or left-hand (counter-clockwise) rotation facing commutator, as the case may be.

After the governor has acted and the Motor is carrying its load, the spring barrel ring should enter the bore of the brush-holder sufficiently so that the parallel motion fingers which are fastened to the brush-holder rest on the outside of that ring. The brush-holder should not be closer to the commutator than ¼ inch.

Examine the brush-holder and spring barrel to see that the spring barrel ring does not stick in the brush-holder. This would prevent the brushes from dropping back on the commutator when the Motor stops.

5th. Note how the Motor is CONNECTED, whether for 110 or 220 volts, and see that it corresponds to the voltage of the circuit to which the Motor is connected. (See diagrams, page 5.) Be certain the voltage is up to normal at the Motor terminals all the time the Motor is starting and carrying its load.

6th. Examine the GOVERNOR MECHANISM. It may not operate satisfactorily, due to the mechanism becoming clogged with dirt. An occasional drop of oil on the governor mechanism bearing points will do no harm. A hand-bellows or compressed air should be used occasionally to blow the accumulation of dirt out of the Motor. Storage in a damp place for some time may cause a sufficient amount of rust to accumulate as to prevent its satisfactory operation. However, such troubles are very infrequent.

7th. Examine the SHORT CIRCUITING DEVICE. If the segments do not make good contact with the commutator bars, there will be sparking between the segments and commutator bars after the governor has acted. A good cleaning, using coarse sandpaper or a half-round file, will usually eliminate this trouble. There will be no occasion for trouble at this point except for an abnormal accumulation of dirt or frequent imposition of loads in excess of the maximum capacity of the Motor.

8th. Test short circuits in armature. This may be done as follows:

(A) Disconnect the Motor from the apparatus it is driving.

(B) Raise the brushes off the commutator.

(C) Close the switch which is used to start the Motor.

(D) Turn the armature slowly by hand. If there are any short circuits in the armature, it will apparently stick opposite each pole. The tendency to stick will be quite pronounced, and the armature will turn with a decided jump as the defective coils pass the center of the pole. If the armature turns freely, then the winding is all right.

9th. Test for short circuits in the field winding. This may be done as follows:

(A) Raise the brushes off the commutator.

(B) Close the switch, thus throwing the field winding across the line. Leave the switch closed for a few minutes.

(C) If there is a defective coil there will be an unusual heating in the defective coil or coils.

10th. Examine the bearings to see if they are worn. If the armature is striking the iron of the field, this is a sure indication that the bearings are worn out and must be replaced. As the clearance between the armature and field varies from .015" to .030", dependent upon the size of the Motor, a bearing should be replaced which shows any appreciable sign of wear. A

spring in it to prevent it from turning until the lock spring is removed.

2nd. CHANGE OF FREQUENCY (may be caused by change of generators, or by poor regulation of engine or water wheel). It is not infrequent that the current is supposed to be exactly 60 cycles, or some other particular frequency, when on investigation it is found that the speed of the generator is sufficiently higher or lower than what it should be to give that frequency, to make a variation of as much as 5% to 10%.

3rd. CHANGE OF VOLTAGE at the motor terminals.

(B) Frequent starting of large Motors on the transmission line.

(A) Sudden change of load on generator.

(C) Heavy varying load on Motors on same circuit.

4th. LOW VOLTAGE. Causes:

(A) Wire which is too small.

(B) Transformer which is too small or has poor regulation with an induction load.

(C) Loose connections, either at the motor terminals or at the switch or in the line.

5th. Overload.

6th. Poor contact between short-circuiting segments and commutator bars, resulting from an unusual accumulation of dirt.

TEMPERATURE. The permissible temperature rise of electric Motors generally considered as standard by all engineering bodies is 40° Centigrade or 72° Fahrenheit above the temperature of the surrounding atmosphere. ~~Centigrade~~ Motors will carry a full load continuously with a rise of temperature well inside of those limits if located in a room having good ventilation and a temperature not above 40° Centigrade or 104° Fahrenheit.

If further information is desired, communicate with Century Electric Company, St. Louis, Mo., or with our nearest District Sales Office.

Close the switch and note whether the speed of the Motor decreases after the governor has acted; if it does, then loosen the spring barrel nut one, two or more turns, as necessary. When that is regulated, and if during the time the Motor is starting the voltage is maintained at 110 or 220 volts at the Motor terminals (according to the connections), its failure to act is probably an overload; however, as a trial the spring barrel nut may be loosened one or two turns, returning it to its original position if it does not produce the desired result. This nut can be reached by removing the end bracket from the commutator end of the Motor, when the nut will be found on the armature shaft. It has a lock spring (in the later types a steel spring is used) in it to prevent it from turning until the lock spring is removed.

Failure of the governor to act, under a load within the rated capacity of the Motor, with proper voltage at the terminals all the time the Motor is being started, indicates that the frequency of the circuit is lower than that which will allow the Motor, when under load, to reach such a speed as to enable the governor weights to overcome the tension of the governor spring and take the tension off the brushes, and it is therefore necessary to loosen the spring barrel nut. Providing the frequency was such that under proper voltage the governor would act, then if the Motor has a full load or an overload to start, it may not be able to develop sufficient power with a low voltage to carry this load at such a speed (above its full load speed) as will enable the governor to act.

In some small motors, adjustment is not necessary; so on these a non-adjustable spring collar is used instead of our adjustable spring barrel nut.

**FREQUENT ACTING OF THE GOVERNOR** This would indicate one of the following causes:

1st. The most probable cause is that the **TENSION OF THE GOVERNOR SPRING** is **NOT CORRECT FOR THE FREQUENCY** of the circuit on which the Motor is installed, hence the Motor is unable to reach such a speed before the governor acts as will allow it to bring its load up to full speed (which is governed by the frequency of the circuit) after the governor has acted. The trouble may or may not be accompanied by blowing of the fuses. Providing the proper voltage is maintained at the motor terminals all the time the Motor is starting, the remedy is to tighten the spring barrel nut one or more turns, as may be necessary. This nut can be reached by removing the end bracket from the commutator end of the Motor, when the nut will be found on the armature shaft. It has a lock

heavy rumbling sound at the time of starting usually indicates the bearing is badly worn, although the armature does not quite touch the field.

11th. **HOT BEARINGS.** The bearing on the commutator end of all Motors will show a normal temperature rise in excess of the bearing on the pulley end, because of a lesser forced circulation of air around it. However, the temperature rise should not exceed 40° Cent. or 72° F. above the surrounding atmosphere. Any one of the following causes may result in a hot bearing:

- (A) Oil which is too heavy.
- (B) Oil which is too thin. (Select a good grade of mineral lubricating oil which is not affected by a change in temperature.)
- (C) Dirt or grit in the oil.
- (D) The belt may be too tight.
- (E) Gears meshing too tight.
- (F) The pulley hub may be rubbing against the bearing.
- (G) The Motor may not be properly lined up, causing the armature shaft shoulder to pull or be pushed against one bearing.
- (H) The shaft may be sprung.

**FAILURE OF GOVERNOR TO ACT AND TAKE THE TENSION OFF THE BRUSHES.** This would indicate that one of the following is the cause:

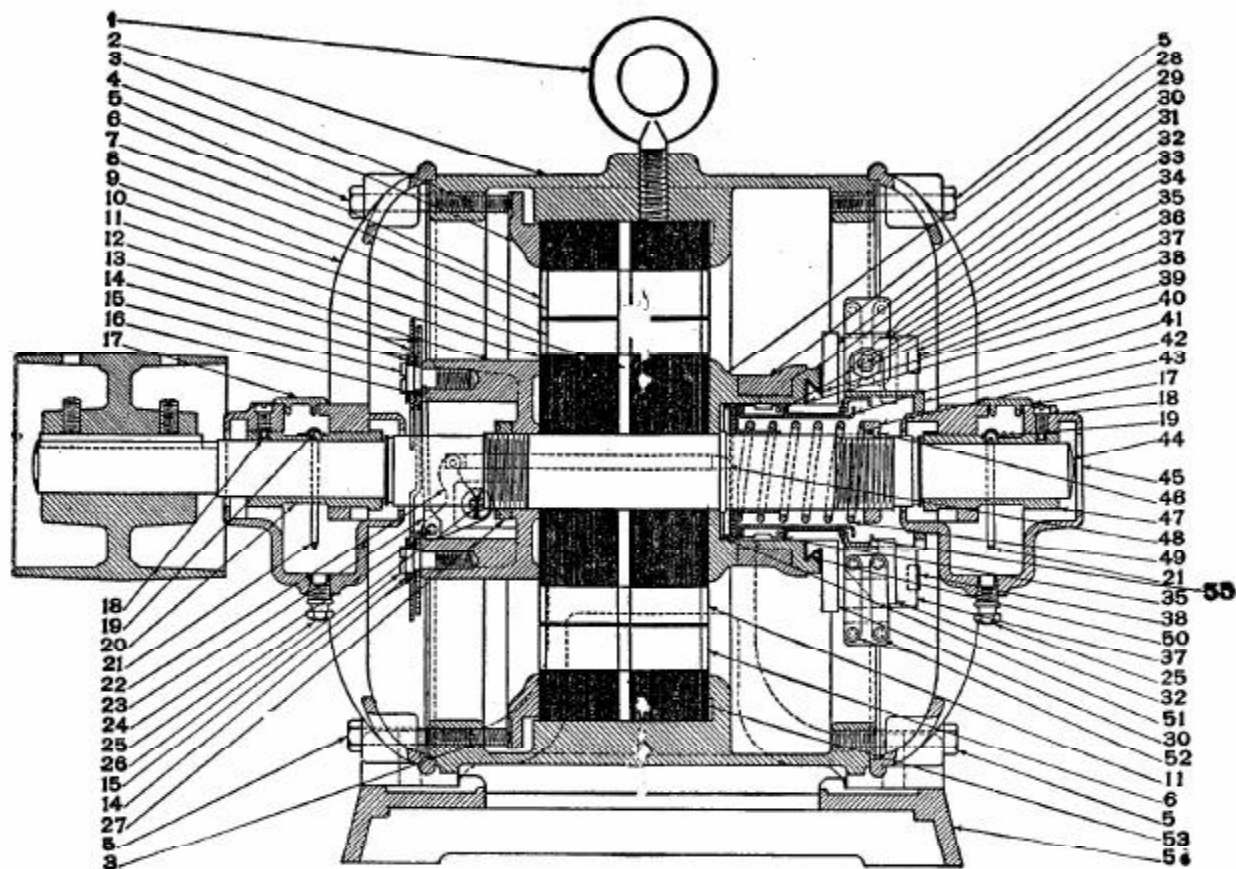
1st. **LOW VOLTAGE.** The voltage at the Motor terminals must not be lower at any time than that for which the Motor is wound, if the Motor is expected to develop its rated capacity. (The power an alternating current Motor will develop varies directly as the square of the impressed voltage.)

2nd. **OVERLOAD.** Frequently in cold weather poor oil will be so nearly frozen in line shaft or other bearings as to cause a heavy friction load.

3rd. **FREQUENCY** different than that for which the governor spring tension is adjusted. (Remember the frequency of the circuit governs the speed of any A. C. induction Motor.) It is not infrequent that the current is supposed to be exactly 60 cycles, or some other particular frequency, when on investigation it is found that the speed of the generator is sufficiently higher or lower than what it should be to give that frequency, to make a variation of as much as 5% to 10%.

If the Motor is disconnected from the apparatus it is driving, and the governor acts properly after closing the switch, then "1," "2" or "3" is the probable cause of its failure to act when connected to its load.





1. Eye Bolt.
2. Field Frame.
3. Field Ring Locking Screws.
4. Field Ring.
5. End Bracket Cap Screws.
6. Field Frame.
7. Field Core.
8. Armature Core.
9. Back End Bracket.
10. Armature Ventilating Grid.
11. Armature Fibres.
12. Back Flange.
13. Governor Weights.
14. Governor Weight Stud Washers.

15. Governor Weight Studs.
16. Governor Weight Rivet.
17. Oil Wall Covers.
18. Dog Point Bearing Screws.
19. Oilring Guards.
20. Back Bearing.
21. Oil Rings.
22. Bell Crank.
23. Governor Weight Link.
24. Governor Weight Link Rivet.
25. Oil Plugs.
26. Bell Crank Stud.
27. Back Flange Nut.
28. Front Flange.
29. Commutator Head.

30. Commutator Segments.
31. Commutator V. Ring.
32. Parallel Motion Fingers.
33. Brush Holder Gib.
34. Gib Screw Lock Nut.
35. Short Circuiting Segments.
36. Gib Screw.
37. Carbon Brushes.
38. Brush Springs.
39. Paper Commutator Insulating Ring.
40. Mica Commutator Insulating Ring.
41. Spring Barrel.
42. Brush Holder.
43. Spring Barrel Nut.

44. Armature Shaft.
45. Front End Bracket.
46. Spring Barrel Nut Locking Screw.
47. Front Bearing.
48. Governor Weight Pins.
49. Spring.
50. Paper Commutator Insulating Ring (Taper).
51. Governor Weight Pin Guide Washer.
52. Parallel Motion Links.
53. Field Ventilating Grid.
54. Subbase.
55. Spring Barrel Ring (Steel).

*Caterpillar* Single Phase Motors do not require the use of any external device other than an ordinary knife switch to start them. This illustration shows the method of connecting through the switch to the line wires.

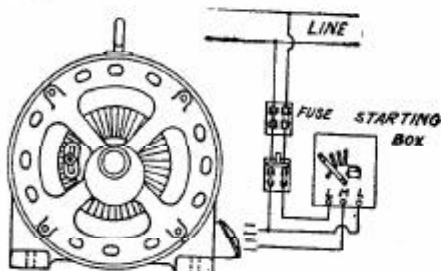


Figure No. 7

This illustration shows the method of connecting the Motor through a starter to the line. We recommend for the benefit of all interested in the installation that a starter be used with all Motors of 7½ horsepower and larger.

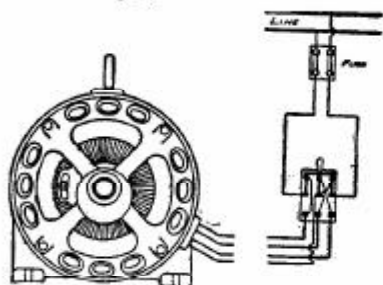


Figure No. 8

Figure No. 8 shows the method of connecting Motors wound for reversing the direction of rotation with a double throw switch. To reverse the direction of rotation, it is necessary that it be allowed to slow down sufficient for the governor to return to its starting position and press the brushes against the commutator before the switch is closed to reverse its direction of rotation.

**FUSES.**—Where a Motor is started and stopped automatically and is installed in an out-of-the-way place or controlled from a distance, we do not recommend the use of a fuse having a rated capacity of more than 100% to 110% of the rated ampere capacity.

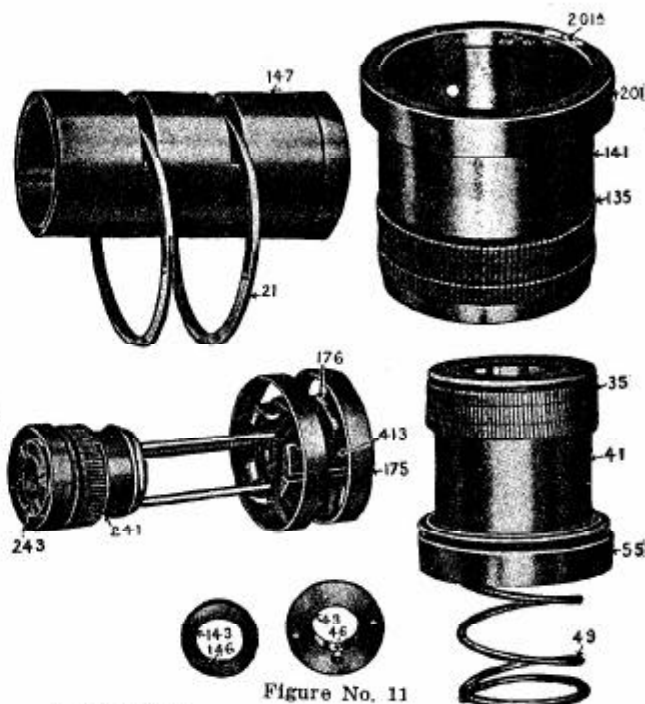


Figure No. 11

- |                                      |                                      |
|--------------------------------------|--------------------------------------|
| 21. Oil Rings.                       | Locking Spring.                      |
| 35. Short Circuiting Segment.        | 147. Phosphor Bronze Bearing Sleeve. |
| 41. Spring Barrel.                   | 175. Governor Weight Thrust Washer.  |
| 43. Spring Barrel Nut.               | 176. Governor Weight Ball Bearing.   |
| 46. Spring Barrel Nut Locking Screw. | 201. Spring Barrel Ring (Brass).     |
| 49. Governor Spring.                 | 201A. Spring Barrel Ring (Iron).     |
| 55. Spring Barrel Ring (Steel).      | 241. Spring Barrel.                  |
| 135. Short Circuiting Segments.      | 243. Spring Barrel Nut.              |
| 141. Spring Barrel.                  | 413. Governor Weights.               |
| 143. Spring Barrel Nut.              |                                      |
| 146. Spring Barrel Nut.              |                                      |

*Caterpillar* There has been a constant development of Motors ever since the motor has been on the market, with the result that various types of governor mechanisms have been used for the various conditions. The object of showing these illustrations is to establish the proper nomenclature, which will be of assistance in corresponding or ordering repair parts.

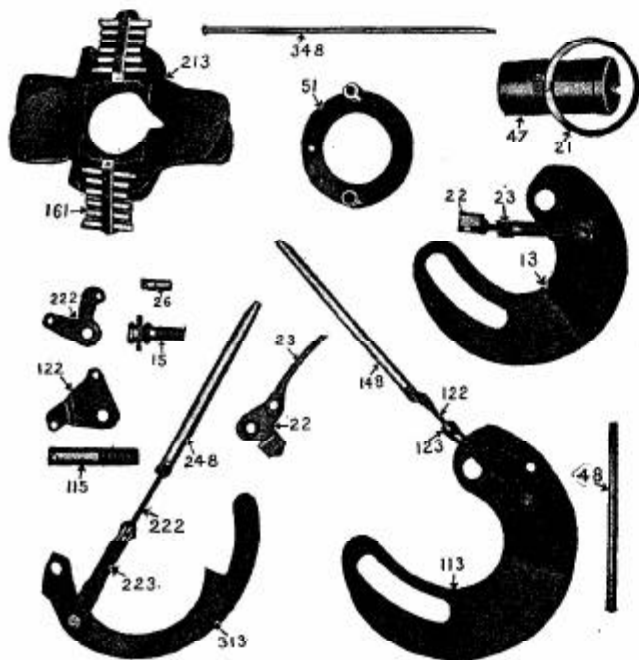


Figure No. 12

- |                          |                           |
|--------------------------|---------------------------|
| 18. Governor Weight.     | Stud.                     |
| 16. Governor Weight      | 122. Bell Crank.          |
| Stud.                    | 123. Governor Weight      |
| 21. Oil Ring.            | Link.                     |
| 22. Bell Crank.          | 148. Governor Weight Pin  |
| 23. Governor Weight      | 161. Governor Weight      |
| Link.                    | Roller Bearing.           |
| 26. Bell Crank Stud.     | 213. Governor Weight.     |
| 47. Bearing Sleeve.      | 222. Bell Crank.          |
| 48. Governor Weight Pin. | 223. Governor Weight      |
| 51. Governor Weight      | Link.                     |
| Pin Guide Washer.        | 248. Governor Weight Pin. |
| 113. Governor Weight.    | 313. Governor Weight.     |
| 115. Governor Weight     | 348. Governor Weight Pin. |

the connections to the line through an ordinary two-pole knife switch and the fuse block, while Figure 7 will indicate how the non-inductive resistance starting box should be installed if any is used with the installation.

Either 110 or 220 volts (or such other corresponding voltages), are equally satisfactory, providing the voltage is maintained at the Motor terminals, and they may be used on circuits having voltage 100-120 or 200-240 volts. Since it is common practice in the installation of small Motors to install wires with a view to mechanical strength, we recommend that as far as possible, all Motors be installed on 220-volt service, for if the wires are of liberal size, it will result in more certainty of good voltage at the Motor terminals and especially when the Motor may be overloaded. The maintenance of proper voltage at the Motor terminals is absolutely necessary. Low voltage results in a rapid dropping off in horsepower capacity of any Motor, since the power that an alternating current Motor will develop varies directly as the square of the voltage impressed at the Motor terminals.

Example.—A 110-volt Motor supplied with current at 95 volts will develop only about 75% as much power as it would if supplied with current at 110 volts.

The following diagrams show the connections as they should be on the board inside the Motor, underneath the binding posts used on old style Motors fitted with a terminal block.

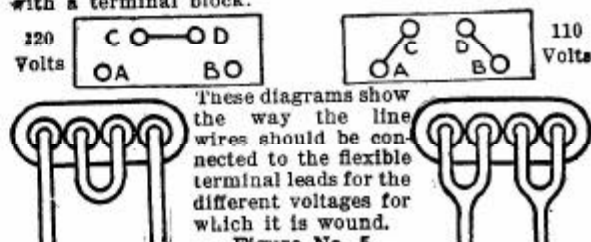


Figure No. 5

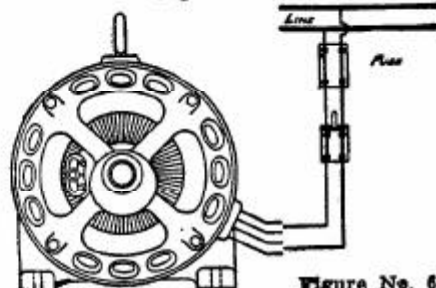


Figure No. 6



If the Motor is installed in a dusty place, the oil should be drawn off at least every two weeks and replaced with clean oil.

If the oil rings rattle, it is a sure indication that there is not sufficient oil in the wells.

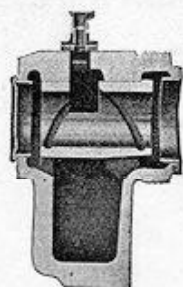


Figure 3

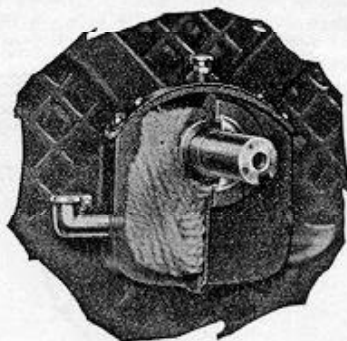


Figure 4

(B) CENTURY WOOL YARN SYSTEM OF LUBRICATION.—Motors equipped with this system of lubrication, when shipped from the works, have the wool yarn saturated with oil. However, before starting the motor fill the oil wells by adding slowly to each oil well, at least the amount of oil designated on the tag attached to the motor.

IF THE BEARING IS REMOVED from the shaft the yarn should be lifted from the bearing before replacing to prevent its being forced between the shaft and the bearing. When replacing the yarn an equal amount should be packed on each side of the bearing and so located over the slot of the bearing that the spring on the oil well cover will press the yarn down on the shaft.

(C) BALL BEARING VERTICAL MOTORS.—To oil vertical motors, remove the plug from the top of the oiler and fill with oil.

VOLTAGE CONNECTIONS.—The standard practice of Century Electric Company is to wind *Century* Motors with interchangeable Leads for 110-220 volt connections (excepting reversible motors). Other interchangeable connections of corresponding voltage will be supplied on special orders. Figure 5 will indicate the way the terminal leads should be connected together for these voltages. While *Century* Single Phase Motors do not require other than an approved single throw switch to start them, some power companies require resistance starters for motors  $7\frac{1}{2}$  horsepower and larger, hence, Figure 6 will indicate

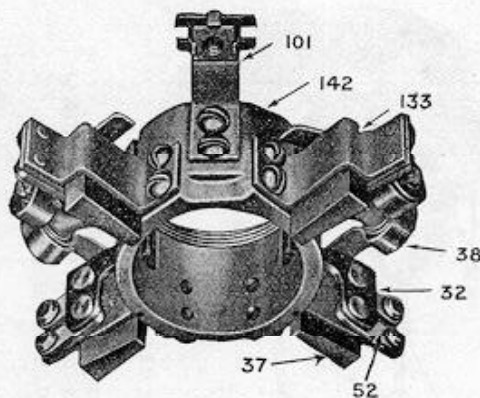


Figure No. 13

For M5 and M6 Frames

- |                              |                            |
|------------------------------|----------------------------|
| 32. Parallel Motion Fingers. | 52. Parallel Motion Links. |
| 37. Brushes.                 | 101. Index Arm.            |
| 38. Brush Springs.           | 133. Brush Retainer.       |
|                              | 142. Brush Holder.         |

Parts 32, 52, 133, while designated separate, are riveted together and must be ordered complete.

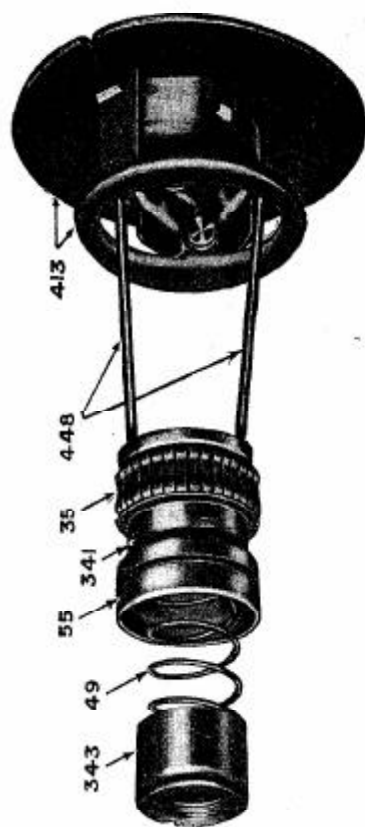


Figure No. 14

- |                                 |                                  |
|---------------------------------|----------------------------------|
| 35. Short Circuiting Segments.  | 343. Spring Barrel Nut.          |
| 49. Governor Spring.            | 413. Governor Weights, Complete. |
| 55. Spring Barrel Ring (Steel). | 448. Governor Weight Pins.       |
| 341. Spring Barrel.             |                                  |

Parts 55 and 341, also 413 and 448, while designated separate, are so assembled that they must be supplied together.

**DIRECT CONNECTION.**—If the Motor is to be direct connected to the shaft of the apparatus to be driven, the two shafts should be in exact alignment. The Coupling should preferably be a flexible coupling, since such a coupling eliminates vibrations from the Motor, prevents undue friction loads upon the bearings due to the shafts being a little out of alignment, or crowding or pulling of the armature shaft against the bearing.



Figure No. 2

**DIRECTION OF ROTATION.**—The direction of rotation of any standard *Century* Single Phase Motor can be changed by shifting the brush-holder (see Fig. 2). On the commutator end of the Motor a brass plate will be found attached to the end-bracket with two lines cut in it, at the side of which are the letters "R" and "L", or there will be equivalent marks on the end-bracket. Loosen the lock screw and move the brush-holder to one of these index marks, either "L" (for left-hand) or "R" (for right-hand or clockwise rotation), to secure the desired direction of rotation.

**OILING.**—(STANDARD HORIZONTAL MOTORS).

(A) **OIL RING LUBRICATION.**—Before starting the Motor wash out the bearings with kerosene or gasoline to remove any dirt or cinders which may have accumulated after the Motor has left the factory; then replace the brass plug in the bottom of each oil well, screwing them up sufficiently tight that the oil will not leak out. Use clean, mineral engine oil (not heavy cylinder oil, animal fat or vegetable oil), and fill the well until the oil flows from the small hole or overflows the bearing housing. Oil should be selected which is not liable to freeze at the ordinary temperatures encountered in the place where the Motor is installed. A light grade of Gasoline Engine Oil will usually be found to be quite satisfactory. Do not use oil so thin that it splatters or is thrown off of the oil ring. Then see that the Armature turns freely before closing the switch.