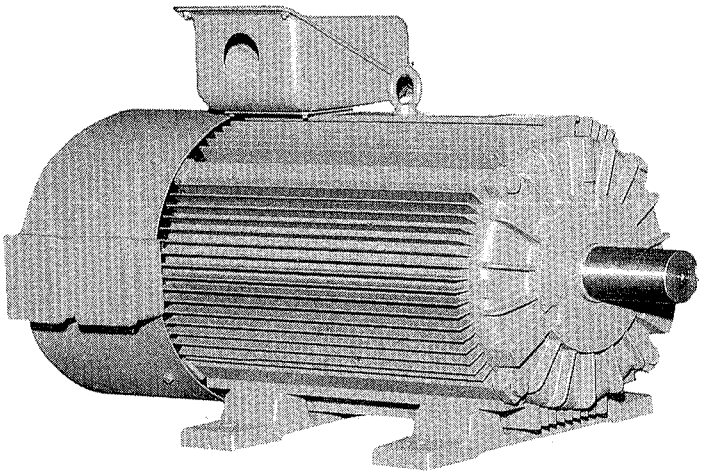
TOYODENKI

# UF Series
# Induction Motor for Inverter

## INSTRUCTION MANUAL

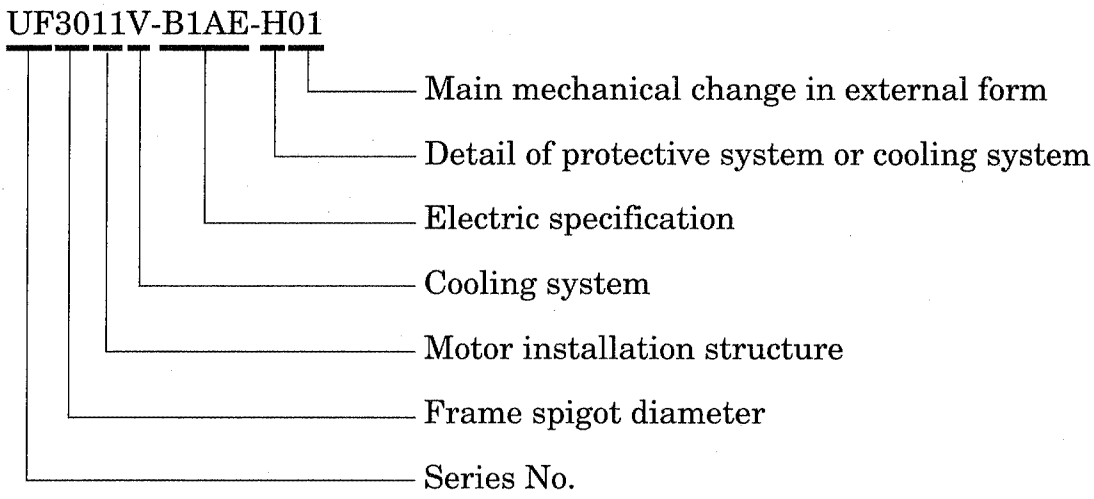


# *FORWARD*

Thank you very much for your adopting UF series induction motor inverter.
This instruction manual describes about UF series three-phase induction motor for inverter.
In using it, you are requested to refer to the inverter related instruction manual as well as this instruction manual.

The UF series induction motor is a optimum-designed for inverter driving by Toyo Denki which has the combination of rotating machine technology and control technology.

**Explanation of Type**



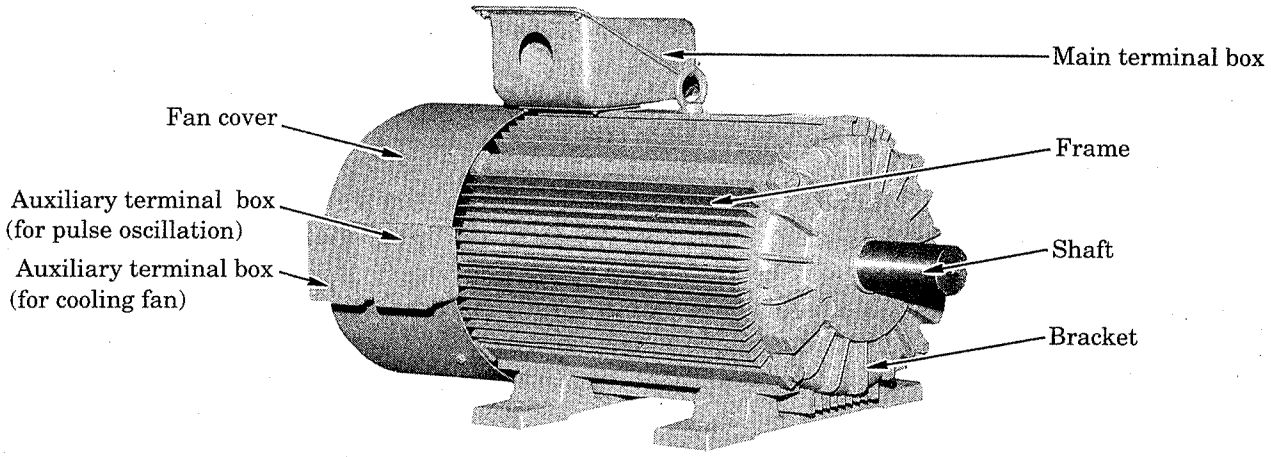
# CONTENTS

# I. Preparation for Operation

## 1. Checking at Arrival of Equipment

When you received the motor, please check paying attention to the following points.

(1) Check with the invoice separately sent.
(2) Check for damage, rusting, dropping of accessories, etc.
(3) In some cases, the rotor may be fixed to prevent the bearings from being damaged during transportation. Check for it and remove it.
(4) Manually turn the shaft end to confirm smooth rotating.
(5) Check the motor output, voltage, current, frequency, revolutions, etc. shown on the name plate.




## 2. Storage

(1) If the motor is stored for 3 months or longer to the initial operation after receiving it or its operation is stopped for 3 month or longer, take the following steps.

1) Storage : The motor should be placed in the normal installation position, covered with waterproofing sheet, and kept at a dry place.

2) Exposed machined surfaces : Apply rust-preventive agent every 6 month. If it is export-packed, unpack it after the elapse of one year and apply the rust preventive agent.

3) Shaft turning : Operate the motor for a few minutes every 3 months (and before long storage) or manually turn the shaft about 10 times. When it is export-packed, follow Item 4) below.

4) Bearings and lubrication

- Schielded bearing : After the storage of 2 years or longer, pay attention to abnormal sound of the bearing during trial operation. If any abnormality is recognized, the bearing should be replaced.
- Grease replenishment type: Replenish the quantity described on the nameplate while manually turning the shaft or operating the machine, every year. (If it is export-packed, unpack it temporarily and replenish the grease.)

| | |
|---|---|
| 5) Insulation resistance of winding : | Measure the insulation resistance of the winding every 6 months during long stoppage of the motor and before the operation is started. If it is lower than 1MΩ at ordinary temperature and the cause is not the adsorption within the terminal box, dry the winding. |
| 6) Space heater (when provided) : | When the motor is stopped for 1 day or longer, energize the heater. |
| 7) Surface painting : | Re-paint, as required, every 2 years. |
| 8) Drain plug (when provided) : | Open the drain plug periodically (at least every 6 months) and before the operation is started. |

# 3. Installation

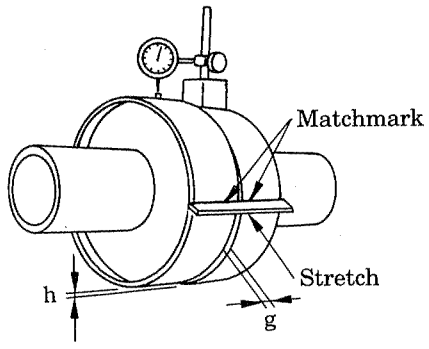
## 3.1 Installation Place

(1) Install the motor at a well-ventilated place and prevent the heat coming out of the motor from returning to the intake side. At a place where the ambient temperature is high or when subjected to heat conduction/radiation, take such steps as heat insulation, reduction of load, etc.
(2) The distance between the inlet of the cooling fan of the motor and the wall should be 20cm or more for UF27 type or lower or 30cm or more for UF30 type or higher.
(3) Place with less humidity
(4) Place with less dust. If dust is accumulated on the fins of the frame, the cooling effect will be reduced causing overheating, and so periodical cleaning should be done at a dusty place.
(5) Place not subjected to the effects of noxious gas and acid/alkaline chemicals, etc. When it is used at a place where flammable gas exists, recheck if the explosionproof structure selected is in agreement with the ordinances of Ministry of International Trade & Industry and the Labor Ministry.
(6) Place where such works as disassembling, checking, maintenance, and cleaning can be easily done.
(7) Install the motor on a strong foundation and rigid common base so that external vibration will not be conveyed to the motor. If the vibration during operation is large, the bearing life may be shortened leading to the vibration fatigue failure of the fan, rotor, etc.
(8) Place with less fluctuation of supply voltage and voltage drop.

## 3.2 Connection with Counterpart Machine

(1) Foundation work

In order to minimize the vibration and misalignment during operation, a strong foundation is required. If the foundation is incomplete, the machine will vibrate and the bearing life will be shortened. To prevent vibration, the most ideal foundation is a strong concrete foundation, but if the concrete foundation cannot be used because of the place and counterpart machine, securely install the motor to a steel frame with bolts and be sure to set the motor shaft level (or perpendicular for a vertical motor). For the base, accurately




h : Parallelism

g : Eccentricity

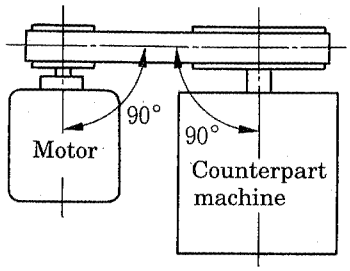
Fig. 1

achieve the levelness 0.2/1000mm or less. The mounting leg surfaces to the motor should be cleaned.

(2) In case of flexible coupling

1) Mark matchmarks on the outer surfaces.
2) To turn the couplings together, connect the couplings of the counterpart machine and the motor with one bolt.
3) Firmly secure a dial gauge to the outer surface of one coupling. (Fig. 1)
4) Bring the matchmark of the coupling to the top and measure the dimension g with the clearance gauge and dimension h with the dial gauge.
5) Turn the coupling and conduct the same measurements as in 4) above at four places every 90°.
6) Adjust with shim plates so that the difference between maximum and minimum of measured values will be 0.03mm for both g and h. Every time the measurement for adjustment is made, sufficiently tighten the installation with the bolt.

When the dial gauge cannot be attached for a small motor, apply the stretch to the outer surface of one coupling and measure the clearance between the other coupling and the stretch.




(3) Belt drive

Set the counterpart machine shaft and motor shaft accurately parallel and apply the belt in such a way that the pulley centers are in agreement.

There is a tendency to tense the belt too much, but excessive tensing will damage the bearing or result in unexpected accidents such as breakage of the motor shaft.

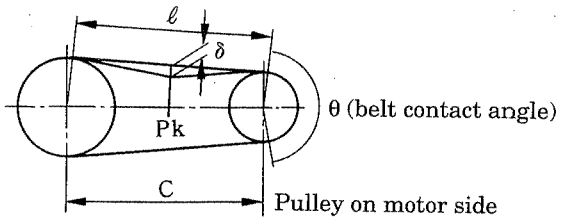



Fig. 2 Belt Stretching Method

1) Belt stretching method

Step 1 : Firstly, obtain the belt span ($l$).
The belt span is the length of the portion between contacts with pulleys

Step 2 : Apply a load (Pk) at the center of the belt span. The load should be calculated by the following formula 5 and should be within the range of Pk 1 to 2.

Step 3 : Stretch the belt in such a way that the deflection ($\delta$) when normal load is applied will be the value obtained by the following formula.
$\delta = 0.016 \times l$

2) Calculating formula

Step 1 : How to seek belt contact angle (small pulley side) θ . . . . . Formula 1

Formula 1 $\theta = 180 - 57/C\ (Do - do)$ . . . . . (deg)

Step 2 : How to seek initial tension (To) . . . . . Formula 2

Formula 2 $$To = 0.9 \left\{ 367 \times \frac{25 - F\theta}{F_\theta} \times \frac{Prd}{N.V} + WV^2 \right\}$$

To : initial tension (N)
Fθ : correction factor by contact angle
Prd : design horsepower (ps) . . . . Note
N : number of belts
V : belt speed (m/sec)
W : belt unit weight (kg/m)

| Contact angle (θ) | 140° | 150° | 160° | 170° | 180° |
|---|---|---|---|---|---|
| Correction factor (Fθ) | 0.89 | 0.92 | 0.95 | 0.98 | 1 |

Note : The design horsepower (Prd) should be calculated by the following formula.
Prd = motor output (kW) × 1.743 (coefficient of machine = 1.3)

Step 3 : How to seek span ($l$) . . . . . Formula 3

Formula 3 $$l = \sqrt{C^2 - \frac{(Do - do)^2}{4}}$$

$l$ : span (mm)
C : distance between shafts (mm)
Do : large pulley outside diameter (mm)
do : small pulley outside diameter (mm)

Step 4 : How to seek deflection (δ) . . . . . Formula 4

Formula 4 $\delta = 0.016 \times l$

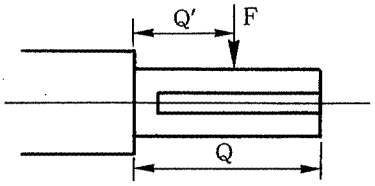
δ : deflection (mm)
$l$ : span (mm)

Step 5 : How to seek deflection load (Pk1, Pk2) . . . . . Formula 5

Formula 5

Pk1 (minimum value) = $\frac{(To + Y)}{16}$

Pk2 (maximum value) = $\frac{(1.25 \times To + Y)}{16}$




| | Belt type | Y(kg) | W(kg/m) |
|---|---|---|---|
| Standard belt | A type | 1.5 | 0.12 |
| | B type | 2.0 | 0.20 |
| | C type | 3.0 | 0.37 |
| | D type | 6.0 | 0.67 |
| Heavy duty belt | 3V type | 2.0 | 0.08 |
| | 5V type | 4.0 | 0.20 |
| | 8V typ | 10.0 | 0.50 |

| Motor type | UF17 Type | UF19 Type | UF22 Type | UF27 Type | UF30 Type | UF38 Type | UF 40 Type | UF48 Type | UF51 Type | UF62 Type |
|---|---|---|---|---|---|---|---|---|---|---|
| Allowable shaft load F (N) | 1080 | 1650 | 3050 | 5550 | 8700 | 13100 | 10000 | 22500 | 15000 | 25000 |
| Q (mm) | 60 | 80 | 110 | 110 | 140 | 140 | 140 | 170 | 170 | 210 |
| Q' (mm) | 30 | 31.5 | 50.5 | 68 | 70 | 70 | 70 | 110 | 85 | 110 |

The peripheral speed of belt recommended by our company is as follows.
Standard belt (A, B, C, D type) . . . . . 25m/sec or lower
Heavy duty belt (3V, 5V, 8V type) . . . . 33m/sec or lower
This should be taken into consideration when the pulley diameter is decided.

The belt tension differs depending on the belt type, but the radial load imposed on the motor shaft should not exceed the values in the following table.

(4) Installation of coupling and belt pulley

The coupling and belt pulley must be carefully installed not to damage the motor bearing. Press-fit it by lightly hitting it with a wooden or plastic hammer. When heating, the temperature should be uniformly about 100°C. When press-fitting, remove the rust preventive agent on the shaft end with petroleum solvent or alkali solvent and apply molybdenum disulfide.

(Caution)
When the pulse oscillator for speed detection is provided on the non-transmission side shaft end, be careful not to give impact when the coupling/belt pulley is inserted because the pulse oscillator may be damaged. (See Structural Drawing Fig. 8 — fig. 12)

(5) Flange type motor
The flange engagement surface is accurately machined. If contaminant, paint or rusting is found on the engagement surface, remove it.

# 4. Electric Wiring

## 4.1 Terminal Box

There are main terminal box for equipment terminals and thermistor and auxiliary terminal boxes for pulse oscillator and fan. The external wirings must be correctly connected.

## 4.2 Connection Diagram

Fig. 3 shows the standard connection diagrams. For the application which does not take the speed feedback, the oscillator is not provided.
When the temperature sensing element (pt100Ω), temperature element (bimetal type), and electromagnetic brake are provided, all these terminals are housed in the main terminal box and the terminal symbols are shown in Fig. 4.

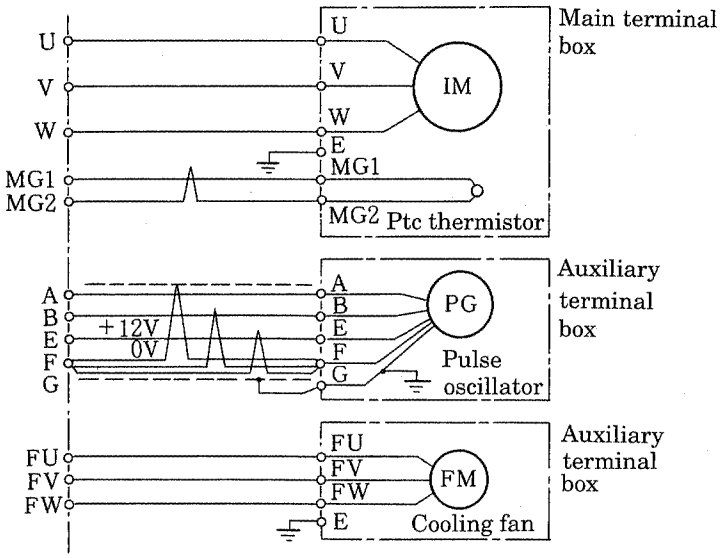
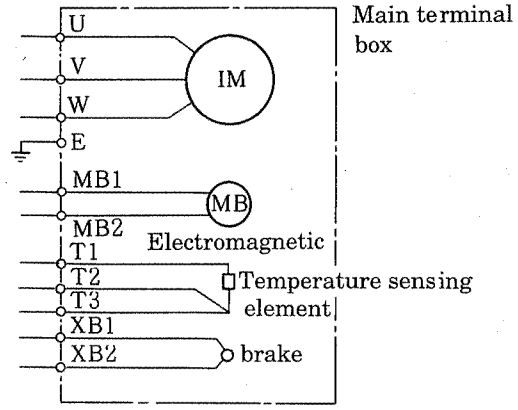



Fig. 3




Note : The cooling fan is single phase for UF17 to UF27 types. Therefore, it has two terminals FU and FV.

Fig. 4

(Caution)

1. If the electromagnetic brake and main power supply circuits are connected mistakenly to the terminals of the ptc thermistor (terminals MG1, MG2), temperature sensing element (terminals T1, T2, T3) and temperature element (XB1, XB2), the elements will be damaged and the motor coil will be damaged, and so due care must be taken. Also the insulation resistance measurement with the insulation resistance tester (megger) must be avoided. If the power was turned on with wrong connection, disassembling/checking must be done.
2. The pulse oscillator must be correctly connected. If wrong connection of the terminals is made, the IC circuit of the pulse oscillator will be damaged as well as no normal operation will occur. If power was turned on with wrong connection, the pulse oscillator must be replaced with a new one even when no abnormality is found with the output signal.

## 4.3 Rotating Direction

(1) The rotating direction must be correct.

(2) The rotating direction of the motor is expressed as seen from the shaft end on the drive side. The standard rotating direction of the motor is counterclockwise (CCW), if the phase sequence on the power supply side is R,S,T, and when the R,S,T are connected to the motor terminal symbols U,V,W.

## 4.4 Wiring Checking

(1) The terminals must be correctly connected in accordance with the connection diagrams (Figs. 3, 4). Due attention should be paid to the following points.

1) For the signal cable between the pulse oscillator (PG) and controller, the twisted pair, shielded cable should be used for noise protection. The length should not exceed 100m.
2) All the cables on one side of the twisted pair should be connected to the 0V terminal (symbol F) of the PG.
3) For the shielded cable, only the one on the motor side is to be grounded. Connect it to the terminal symbol G of the auxiliary terminal box.
4) The insulation resistance measurement (megger test) of the pulse oscillator must never be made. For the insulation resistance measurement, use the tester.
5) For the ptc thermistor wiring cable, use the twisted pair cable.
6) The earthing terminal is provided within the main terminal box (terminal mark E) and must be grounded. The earthing terminal is also provided within the auxiliary terminal box for cooling fan (terminal mark E) and must be grounded.

(2) Checking rotating direction of electric fan

After the wiring is completed, check that the cooling fan rotates in the right direction (the rotating direction and cooling air flow are indicated on the fan cover), before normal operation is started.

## 4.5 Detail Drawings of Terminal Boxes

For the main terminal box (Fig. 5) of standard specification, the lug type terminal box is adopted, and so the conductive portions must be insulated with the insulating tape after the terminals are connected. For the pulse oscillator (PG) terminal box (Fig. 6) and cooling fan terminal box (Fig. 7), the terminal block type is adopted.

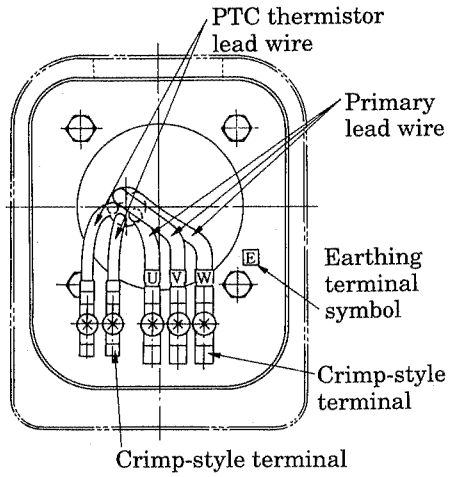



Fig. 5 Main Terminal Box 6.

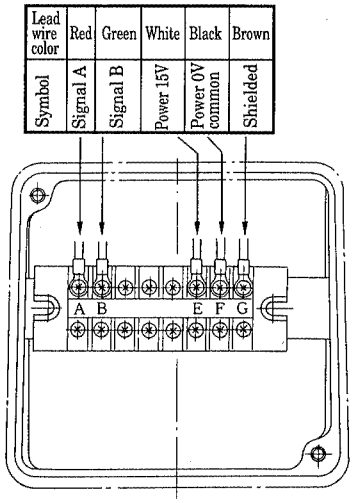
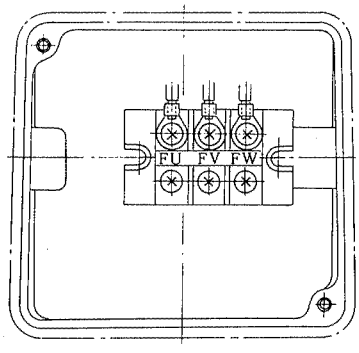



Fig. 6 Pulse Oscillator (PG) Terminal Box




In case of single phase, the terminal symbols are FU and FV.

Fig. 7 Cooling Fan Terminal Box

# II. Trial Operation and Operation

## 1. Before Power ON

All the motors purchased passed severe tests at the factory, but they may be damaged during transportation or adversely affected due to long storage, and so the following checking/confirming must be done before the operation is started.

(1) Precautions in working before trial operation
   1) Check that the shaft fixer and cover for storage are removed.
   2) Check that the electric wiring is correctly done and terminal box covers are installed.
   3) Check the tightening bolts for looseness.
   4) Check that the ventilation is not impeded and that no dust is accumulated inside the open type motor.
   5) Check there is no contact between rotating portion and fixed portion when the shaft is manually turned.
   6) Measurement of insulation resistance to earth of stator coil
      Disconnect the motor main circuit at the terminal block on the controller side and measure the insulation resistance using a 500V megger between the motor terminal and earth. Although it is difficult to generally indicate the insulation resistance value, it should be 1MΩ or higher as a yardstick.
   7) Check that all the earthing terminals are completely connected.

(2) Lubrication
   For the grease lubrication type motors, the bearing portion was filled with grease prior to shipping, but if they are left to stand without operation for more than 6 months after the delivery at the site, the grease must be replenished immediately after the operation is started. This does not apply when the bearing of grease-sealed type is used.

(3) Others
   Check direct-connected condition, belt tension, and tightening of bolts and nuts.

## 2. After Power On

(1) In the initial operation, the motor should be operated at a low speed independently without load to confirm no abnormality. Subsequently it should be directly connected to the counterpart machine.

(2) After starting, check the following points.
   1) Rotating direction (the standard rotation is clockwise as seen from the non-load side)
   2) Any abnormal noise from the bearing portion?
   3) Any abnormal noise inside the motor?
   4) Any burning smell of insulator, etc?
   5) Any abnormal vibration? If the total amplitude 30μm is exceeded, investigate the cause and take necessary action.
   6) Are the supply voltage and phase current balanced?
   7) Isn't the starting time abnormally long?

While checking the above points, sequentially proceed with independent operation, no-load operation, and full load operation. If no abnormality is found, full-fledged operation can be started.

# III. Maintenance/Checking

In order to prevent accidents in machine operation, daily monitoring or checking is required.

## 1. Daily Checking

Check vibration and sound at start and during operation by touching and hearing to confirm that there is no abnormality. You are recommended to take operation records.
Records of daily checking

(1) Measurement date, time, and weather
(2) Voltage, load current, frequency, rotating speed
(3) Ambient temperature
(4) Stator winding or frame temperature
(5) Bearing temperature/sound
(6) Abnormal vibration
(7) Cooling air condition of cooling fan

## 2. Periodical Checking

(1) Measurement of insulation resistance
(2) Bearing related checking
(3) Ventilated condition
(4) Measurement of vibration
(5) Looseness of tightening nuts
(6) Direct-connected condition of coupling, belt tension
(7) Cleaning of various portions
(8) Power supply condition
(9) Pulse oscillator, cooling fan checking

The insulation resistance should be measured every 6 months and other items should be checked every year. To measure and monitor the machine vibration periodically is very important for maintenance/checking of the machine. Big vibration will adversely affect the bearing, winding, and direct-coupled condition. Investigate the cause and correct it.

## 3. Bearings and Lubrication

### 3.1 Shielded Bearing

For the UF17 — UF27 types and UF30 type (non-load side) motors, the shielded type (non-contact grease seal) bearing is used. Generally, the bearing should be replaced at the time of periodical checking. No grease maintenance is required. For the bearing grease when replacing, specify Kyodo Yushi's Multemp SRL or equivalent.

### 3.2 Grease Replenish Type Bearing

The grease type, replenishing quantity, and interval are indicated on the nameplate.

(1) At the replenishment interval (operation time) shown on the nameplate, the grease should be replenished during operation. If the net operation time is short due to short-time or duty-cycle operation, the replenishment should be made in such a way that the elapsed time including stoppage will not become twice or more the interval shown on the nameplate, or at least every 6 months.
(2) When the grease is replenished, be sure to run the motor(300r/min or higher),clean the

grease nipple, and replenish a required quantity through the nipple using a grease gun. Every time the grease replenishment is made, the old grease should be scraped out from the grease drain port. (on the non-load side of UF38 and UF48 type, it is not necessary to scrape out the old grease)

(3) When the grease is replenished, the bearing sound will become temporarily louder a little or the bearing temperature will rise 5 — 10°C higher than normal because of excess grease, but it will return to normal in several hours to 1 day.

(4) Table 1 shows approximate values for grease replenishment and replenishing timing.

Table 1 Replenishment Quantities of Grease

| Totally enclosed type | | Replenishment quantity (g) | Replenishing timing (cumulative operation time) Hr at specified speed | | | |
|---|---|---|---|---|---|---|
| | | | 1750r/min | 1450r/min | 1150r/min | 950r/min |
| UF30 type | NU313 | 33 | 3400 | 4200 | 5000 | 5000 |
| | 6213ZZ | — | — | — | — | — |
| UF38 type | NU316 | 47 | 3000 | 3700 | 4800 | 5000 |
| | 6315 | 20 | 3000 | 3700 | 4800 | 5000 |
| UF48 type | NU320 | 72 | 2600 | 3200 | 4200 | 5000 |
| | 6318 | 27 | 2600 | 3200 | 4200 | 5000 |

| Open type | | Replenishment quantity (g) | Replenishing timing (cumulative operation time) Hr at specified speed | | | |
|---|---|---|---|---|---|---|
| | | | 1750r/min | 1450r/min | 1150r/min | 950r/min |
| UF40 type | NU316 | 47 | 3000 | 3000 | 4800 | 5000 |
| | 6213ZZ | — | — | — | — | — |
| UF51 type | NU318 | 58 | 2800 | 2800 | 4400 | 5000 |
| | 5315 | 20 | 2800 | 2800 | 4400 | 5000 |
| UF62 type | NU324 | 102 | 2300 | 2300 | 3700 | 4600 |
| | 6316 | 37 | 2300 | 2300 | 3700 | 4600 |

At the shipment from our factory, they are filled with Multemp SRL (by Kyodo Yushi), unless otherwise specified, (or specified brand). For replenishing, this brand of grease should be used. If this brand is not available, the equivalent greases shown in the right table can be used.

| Maker name | Grease brand |
|---|---|
| Kyodo Oil | Multemp SRL |
| Nippon Oil | Multi Knock Wide 2 |
| MOBIL | Mobil Temp SHC100 |
| SHELL | Variant M2 |
| ESSO | Templex N2 |

### 3.3 Use of Different Types of Grease for Grease Replenish Type Bearing

(1) Avoid mixed use of different brands of grease. The combination may greatly change the properties.

(2) If it is necessary to use a grease brand different from the grease used at the time of delivery, use the following method.

1) Open the grease drain port and inject the new grease while scraping out the old grease during operation or manually turning the shaft.

2) Repeat this work until the new grease comes out of the grease drain port.

(3) When the grease is injected, the bearing temperature may rise. In such a case, wait until the bearing temperature decreases and then repeat the grease injection.

### 3.4 Sound of Bearing (Grease Replenish type)

The bearing sound during operation is classified as follows.

(1) Normal sound

The normal sound is continuous. The race sound, jarring sound and cage sound are considered normal. The jarring sound may be mistaken as abnormal noise, but it does not indicate abnormality of the bearing. The jarring sound disappears temporarity when the grease is injected. The jarring sound may be produced in the following cases.

1) Clearance C3 or C4 for high-speed machine
2) Cylindrical roller bearing
3) Winter with low ambient temperature or beginning of operation after long stoppage

(2) Abnormal sound

1) Flaw noise or dust noise is abnormal.
2) Abnormal noise discontinuous, in some cases accompanied by vibration.
3) When abnormal noise exists, inject new grease and observe changes in sound and temperature for a while. If the abnormal noise does not stop, it may be necessary to replace the bearing.

## 4. Checking Accessories

For checking such accessories as electromagnetic brake and speed reducer, see the separate instruction manuals for accessories.

## 5. Service Life of Main Accessory Parts

Some motor parts have their service life. It depends on the service environment/service conditions, but checking or replacement should be done using the following life periods as a yardstick.

### 5.1 Motor Related Parts

(1) Motor bearing (at ambient temperature 40°C or lower and at 1800r/min)

a) Grease replenish type bearing about 30,000 hours
b) shielded bearing about 25,000 to 27,000 hours
(or about 3 – 4 years if the operation time is short)

- Grease to be used: Koyodo Yushi's Multemp SRL or equivalent
- The life of the shielded bearing depends on the grease life. The grease life is affected by the ambient temperature and shortened about 1/1.5 every time the ambient temperature rises 10°C from 40°C.

(2) Fan motor About 3 or 4 years (ambient temperature 40°C or lower)

(3) Pulse oscillator About 4 or 5 years (at ambient temperature 40°C or lower, at 1800r/min)
(The shielded bearings of the fan motor and pulse oscillator will reach their service life and come to an end. This affected by the ambient temperature.)

### 5.2 Helical Speed Reducer (at ambient temperature 40°C or lower)

(1) Bearings About 25,000 hours

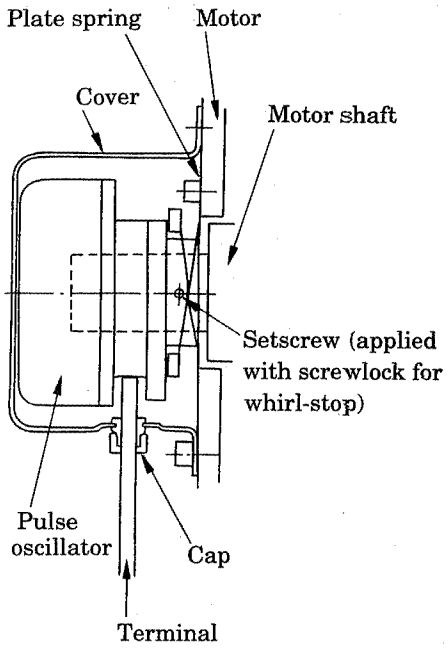
(2) Oil seal About 10,000 to 15,000 hours as a yardstick (Life greatly differs depending on the environmental conditions)

(3) Replacement cycle of lubrication oil
First 500 to 1,000 hours after start of operation
Subsequently every 25,000 hours

# IV. Disassembling/Assembling

## 1. Disassembling Procedure (see structural drawing Figs. 8-12)

(1) Power OFF
(2) Remove the connection with the load.
(3) Remove all the external wirings connected to the terminals in the terminal box.
(4) Remove all the internal/external wirings connected to the terminal block in the terminal box for pulse oscillator.
(5) Remove the terminal block and terminal box for pulse oscillator.
(6) Remove the fan cover mounting bolts and remove the fan cover. At that time, the cooling fan installed to the fan cover is also removed together with the fan cover.
(7) Remove the pulse oscillator cover mounting screws.
(8) Manually loosen the cap of the output cable outlet of the pulse oscillator, move it toward the terminal side, then pull the cover this way while pushing the cable into the cover.
(9) Remove the screws fixing the plate spring of the pulse oscillator stator to the motor.
(10) Loosen about 3 turns the two setscrews fixing the pulse oscillator rotor to the motor shaft and remove the pulse oscillator ( do not remove the screws). Remove the electromagnetic brake, if provided.



Pulse oscillator

(11) Remove the bearing outer cover on the non-load side ( for UF17 — UF30 types, it is integral with the bracket, and so the bolts fixing the bearing inner cover should be removed). Mark the matchmarks. For UF38 type or higher, it is not necessary to remove from the bearing outer cover of the pulse oscillator mount. When it is removed, mark the matchmarks.
(12) Remove the ventilation cover on the load side ( some types are not provided with this cover).
(13) Remove the bearing outer cover on the load side. (For UF17 - UF 27 types, it is integral with the bracket.)
(14) Remove the main terminal box. (It is not necessary to remove it for UF17 — UF27 types)
(15) Remove the bracket on the load side. For UF30 - UF62 types, it should be removed while pushing the lead wires into the bracket. Since the clearance between the coil and bracket is small, due care must be taken not to flaw the coil. It should be noted that the bearing outer ring will come out simultaneously.
(16) Pull the rotor toward the load side and remove the bearing on non-load side from the bracket on non-load side.
(17) Remove the bracket on the non-load side.
(18) Slowly remove the rotor keeping parallelism. Due care must be taken not to flaw the stator coil.
(19) Remove the bearing fixing parts (bearing collar and slinger) (they are not provided for UF17 — UF27 types).
(20) Remove the bearing from the shaft using the puller (for the work details of the bearing, see IV-4).
(21) After the disassembling is completed, remove the grease on the bearings, bearing covers, etc. with clean washing oil (this work is not required for the shielded bearing).

## 2. Assembling Procedure

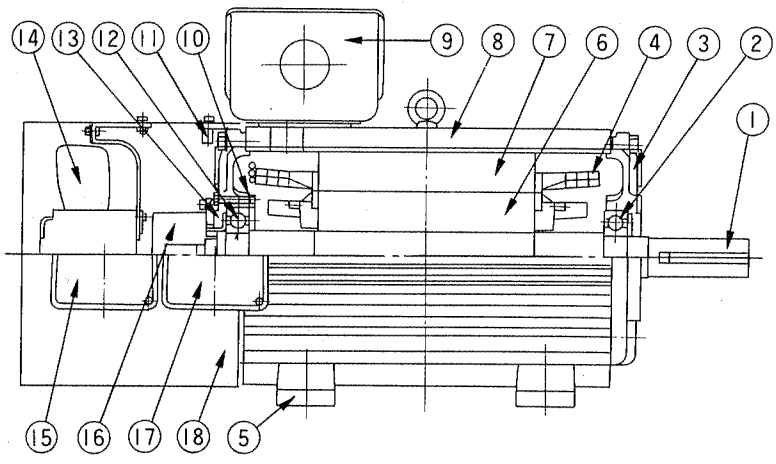
(1) The cleaned bearing or new bearing should be filled with grease while turning the outer ring. The bearing cover should be filled to about 1/2 to 1/3 of the content volume. (This work is no required for the shielded bearing)

(2) For assembling, reverse the disassembling procedure. Align the matchmarks marked when disassembled and avoid uneven tightening by alternately tightening the bolts diagonally.

(3) After assembling, manually turn the shaft to confirm smooth rotating.
(Precautions)

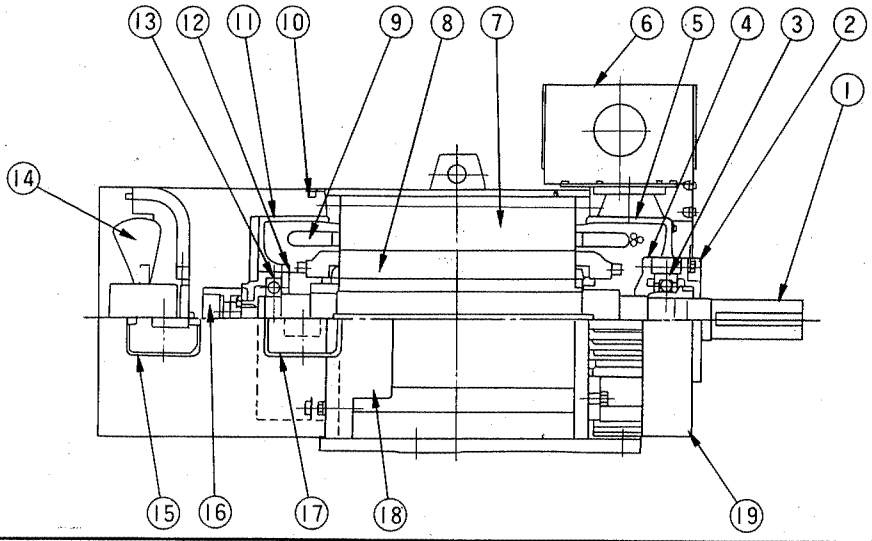
1. To give impact to the pulse oscillator will cause failure.
   Never hit it with a hammer, etc. For engaging the pulse oscillator rotor and shaft, the clearance fit is adopted, and so manual removal can be made.
2. The tightening torque of the load-side ventilation cover and fan cover mounting bolts is 70 to 90 N·cm.
   Be careful not to tighten them too much.

## 3. Structural Drawing of Motor



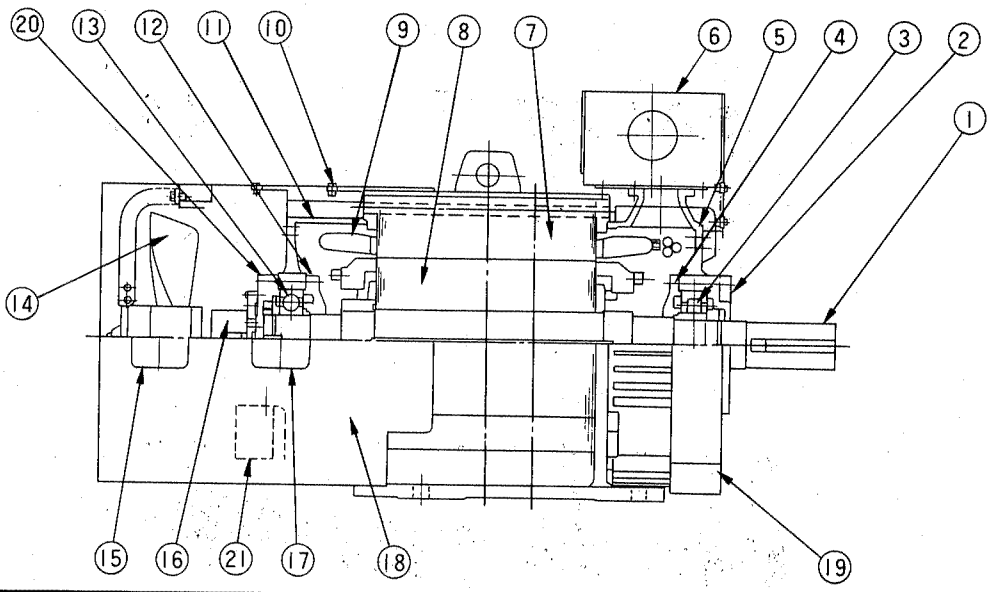

| Item No. | Name |
|---|---|
| ① | Shaft |
| ② | Load-side doulble shielded ball bearing |
| ③ | Load-side bracket |
| ④ | Rotor coil |
| ⑤ | Mounting leg |
| ⑥ | Rotor |
| ⑦ | Stator |
| ⑧ | Frame |
| ⑨ | Main terminal box |
| ⑩ | Non-load-side bearing inner cover |
| ⑪ | Vibrationproof rubber |
| ⑫ | Non-load-side double shielded ball bearing |
| ⑬ | Non-load-side bracket |
| ⑭ | Electric cooling fan |
| ⑮ | Terminal box for cooling fan |
| ⑯ | Pulse oscillator |
| ⑰ | Terminal box for pulse oscillator |
| ⑱ | Fan cover |

Fig. 8 Structural Drawing of Motor



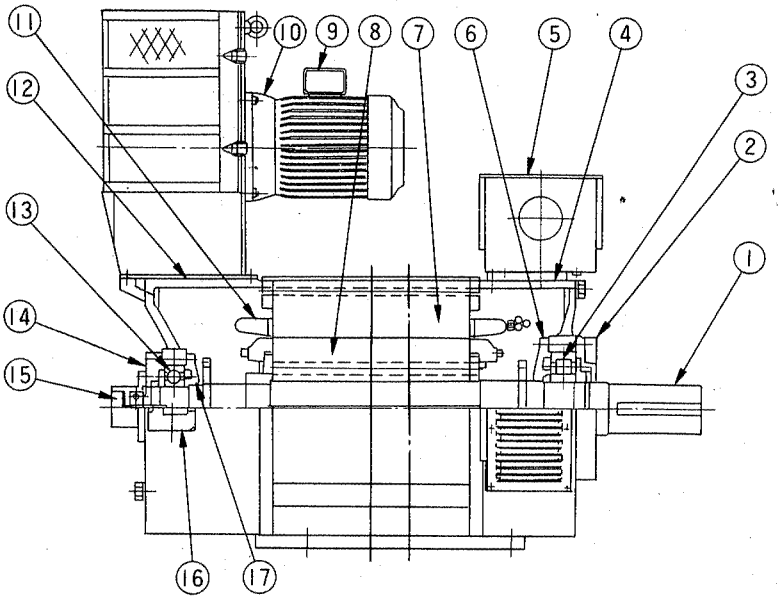

| Item No. | Name | Item No. | Name | Item No. | Name |
|---|---|---|---|---|---|
| ① | Shaft | ⑧ | Rotor | ⑮ | Terminal box for cooling fan |
| ② | Load-side bearing outer cover | ⑨ | Stator coil | ⑯ | Pulse oscillator |
| ③ | Load-side roller bearing | ⑩ | Vibrationproof rubber | ⑰ | Terminal box for pulse oscillator |
| ④ | Load-side bearing inner cover | ⑪ | Non-load-side bracket | ⑱ | Fan cover |
| ⑤ | Load-side bracket | ⑫ | Non-load-side bearing inner cover | ⑲ | Load-side ventilation cover |
| ⑥ | Main terminal box | ⑬ | Non-load-side double shielded ball bearing | | |
| ⑦ | Stator (frame) | ⑭ | Electric cooling fan | | |

Fig. 9 Structural Section of UF30 Type



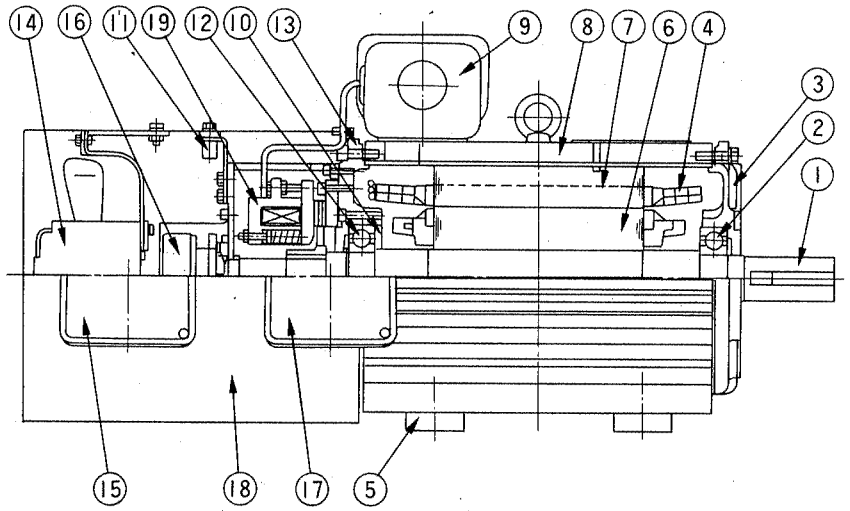

| Item No. | Name | Item No. | Name | Item No. | Name |
|---|---|---|---|---|---|
| ① | Shaft | ⑧ | Rotor | ⑮ | Terminal box for cooling fan |
| ② | Load-side bearing outer cover | ⑨ | Stator coil | ⑯ | Pulse oscillator |
| ③ | Load-side roller bearing | ⑩ | Vibrationproof rubber | ⑰ | Terminal box for pulse oscillator |
| ④ | Load-side bearing inner cover | ⑪ | Non-load-side bracket | ⑱ | Fan cover |
| ⑤ | Load-side bracket | ⑫ | Non-load-side bearing inner cover | ⑲ | Load-side ventilation cover |
| ⑥ | Main terminal box | ⑬ | Non-load-side ball bearing | ⑳ | Non-load-side bearing outer cover |
| ⑦ | Stator (frame) | ⑭ | Electric cooling fan | ㉑ | Grease reservoir |

Fig. 10 Structural Section of UF38/UF48 Types




| Item No. | Name | Item No. | Name | Item No. | Name |
|---|---|---|---|---|---|
| ① | Shaft | ⑦ | Stator (frame) | ⑬ | Non-load-side ball bearing |
| ② | Load-side bearing outer cover | ⑧ | Rotor | ⑭ | Non-load-side bearing outer cover |
| ③ | Load-side roller bearing | ⑨ | Terminal box for cooling fan | ⑮ | Pulse oscillator |
| ④ | Load-side bracket | ⑩ | Electric cooling fan | ⑯ | Terminal box for pulse oscillator |
| ⑤ | Main terminal box | ⑪ | Stator coil | ⑰ | Non-load-side bearing inner cover |
| ⑥ | Load-side bearing inner cover | ⑫ | Non-load-side bracket | | |

Fig. 11 Structural Section of UF51/UF62 Types




| Item No. | Name | Item No. | Name | Item No. | Name |
|---|---|---|---|---|---|
| ① | Shaft | ⑧ | Frame | ⑮ | Terminal box for cooling fan |
| ② | Load-side double shielded ball bearing | ⑨ | Main terminal box | ⑯ | Pulse oscillator |
| ③ | Load-side bracket | ⑩ | Non-load-side bearing inner cover | ⑰ | Terminal box for pulse oscillator |
| ④ | Stator coil | ⑪ | Vibrationproof cover | ⑱ | Fan cover |
| ⑤ | Mounting leg | ⑫ | Non-load-side double shielded ball bearing | ⑲ | Electromagnetic brake |
| ⑥ | Rotor | ⑬ | Non-load-side bracket | | |
| ⑦ | Stator | ⑭ | Electric cooling fan | | |

Fig. 12 Structural Section of UF17 — UF 27 Type with Electromagnetic Brake

# 4. Replacement of Bearing

## 4.1 Removal of Roller Bearing Inner Ring and Ball Bearing

(1) The pliers is used for removing the C-type snap ring and the puller for removing the slinger and bearing.

(2) For the roller bearing, apply a brss or copper plate to the outer ring and alternately hit it at diagonal positions on the circumference with a hammer to remove it from the shield. (Fig. 13)

(3) Pull out the ball bearing (Fig. 14) and roller bearing inner ring with a puller.

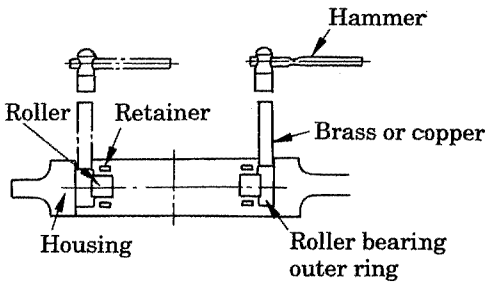



Fig. 13 Removal of Roller Bearing

## 4.2 Bearing Installation

(1) New bearings packed and kept should not be unpacked until they are used.

(2) Thinly apply the grease to the inner surface of the housing in which the bearing is installed.

(3) Before the bearing is inserted, install the inside cover (if provided) to the shaft.

(4) Heat the ball bearing or roller bearing inner ring in oil or thermostatic oven to about 80°C and insert it onto the shaft. Be careful not to overheat it. For the shielded bearing, the heating method in oil must not be used.

(5) For the bearings with shaft diameter 15mm or smaller, the heating method is not used, and the bearing inner ring is press-fit after oil is applied on it. Be careful to keep the parallelism of the shaft and bearing.

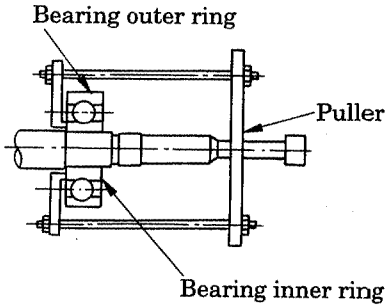



Fig. 14 Removal of Ball Bearing

(6) Quantity of grease filled for grease replenish type

To charge the grease in the void of the bearing itself and further in the grease injection passage, inject the replenishment quantity shown on the nameplate after the rotating machine is assembled.

# V. Troubleshooting of Motor

If the daily checking and periodical checking in III. Maintenance/Checking are correctly done, the motor satisfactorily works. Table 2 shows "Motor Troubleshooting" and Table 3 "Bearing Troubles and Causes". They should be referred to for daily maintenance/checking.

Table 2 Motor Troubleshooting

| Cause \ Phenomena | | | Shaft breakage | Loud noise/large vibration | Overheat | | Uneven rotation | Protective relay operation | Leakage | Insulation resistance low | Remedy |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Motor | Bearing | | | | | |
| Installation | Place | Ambient temperature is high | | | ◎ | ○ | | ◎ | | | Ventilate well |
| | | Humidity is high | | | | | | | ○ | ◎ | Consult maker |
| | | Splashing of much water/oil | | | | ○ | | | ○ | ◎ | Prevent splashing |
| | | Obstruction close to motor | | | ◎ | ○ | | ○ | | | Secure necessary space |
| | | Large external vibration/impact | | ◎ | | ○ | | | | | Vibrationproofing |
| | Weak foundation | | | ◎ | | | | | | | Strengthen it |
| Coupling with load | Direct coupling | Misalignment | ○ | ◎ | | ○ | | | | | Align correctly |
| | | Large unbalance of coupling | | ◎ | | | | | | | Correct balance of coupling |
| | Belt | Misalignment of center between pulleys | | ◎ | | | ○ | | | | Align the center |
| | | Contact angle is small | ◎ | | | ○ | | | | | Make proper pulley diameter |
| | | Excessive tension of belt | ◎ | | | ◎ | | | | | Make proper belt tension |
| | | Load poing too away from motor | ◎ | | | ○ | | | | | Put load point nearer the motor |
| | | Large pulley impedes cooling air of motor | | | ◎ | | | ○ | | | Provide vent hole for pulley |
| | Others | Dust on rotating portion | | ◎ | | ○ | | | | | Remove dust |
| | | Large thrust load | | | | ◎ | | | | | Review thrust |
| Wiring | Large voltage drop | | | | ◎ | | ○ | ◎ | | | Investigate wiring diameter/length |
| | Loosened terminals | | | | ◎ | | ○ | ○ | | | Retighten terminals |
| | Incomplete earthing | | | | | | | ○ | ◎ | | Complete earthing |
| | Single-phase operation | | | ◎ | ◎ | | | ◎ | | | Investigate connecting circuit |
| | Voltage unbalance | | | ◎ | ○ | | | ○ | | | Investigate control side |
| | Wrong wiring of cooling fan | | | | ◎ | ○ | | | | | Change connecting circuit |
| | Wrong wiring of pulse oscillator | | | | | | | ◎ | | | Change connecting circuit (If trouble occurs with pulse oscillator, replace it) |
| Load | Overload | | | ○ | ◎ | | | ◎ | | | Reduce load |
| | Large number of starts | | ○ | | ◎ | | | ○ | | | Reduce number of starts |
| | Large inertia of load | | | | ◎ | | | ○ | | | Extend acceleration time |
| | Large vibration of counterpart machine | | | ◎ | | | | | | | Investigate counterpart machine |
| | Large unbalance of load | | | ◎ | ○ | | | | | | Correct balance |
| Others | Bearing abnormality (motor) | | | ◎ | | ◎ | | ○ | | | Repair at specialized factory |
| | Disconnection of stator coil (motor) | | | ○ | ○ | | | ◎ | ◎ | ◎ | Repair at specialized factory |
| | Abnormal bearing of cooling fan | | | ○ | ◎ | ○ | ○ | ◎ | | | Replace cooling fan |
| | Disconnection of winding of cooling fan | | | | ◎ | ○ | | ◎ | | | Replace cooling fan |
| | Abnormal bearing of pulse oscillator | | | | | | | ◎ | | | Replace pulse oscillator |
| | Circuit failure of pulse oscillator | | | | | | | ◎ | | | Replace pulse oscillator |

## Table 3 Bearing Troubles and Causes

| Phenomena | Condition | Cause | Remedy |
|---|---|---|---|
| Flaking | ① Flaking of rolling element | ① Excessive interference<br>② Wrong selection of clearance<br>③ Operation clearance minus<br>④ Expansion due to temperature<br>Inclusion of dust, foreign matter or rusting/dent | ① Caution in assembling or making shaft/bearing housing<br>② Review of clearance<br>③ Handling care in assembling<br>④ Investigation of service condition |
| | ② Local flaking of raceway track<br>③ Flaking over entire circumference of raceway track<br>④ Flaking of place opposite to raceway track | ① Elliptic distortion of shaft or bearing housing<br>② Faulty tightening<br>③ Faulty machining accuracy<br>④ Secular change, abnormal thrust load | Investigation of machining accuracy of shaft/bearing housing, investigation of tightening amount |
| | ⑤ Flaking over entire circumference off center of raceway track<br>⑥ Flaking diagonally crossing raceway track<br>⑦ Rolling element pitch-like flaking on raceway track | ① Warp of shaft<br>② Oblique installation of inner/outer rings<br>① Vibration during stoppage<br>② Rusting | Investigation of design of bearing surrounding<br>Investigation of design of bearing surrounding<br>Investigation of service conditions |
| Electrolytic corrosion | Crater-like concave, washboard-like flaw | Current passing | Investigation of design of bearing surrounding |
| Wear | ① Extreme wear of raceway track/ rolling element<br>② Wear of cage | ① Foreign matter in lubricant<br>② Rusting | Investigation of lubricant and lubrication amount |
| Impression | ① Concave (raceway track, etc.)<br>② Ground-like<br>③ Impact during handling<br>④ Flaw caused when assembling | Dust/foreign matter rolled between rolling element and raceway track<br>Careless hadling (dropping, etc.)<br>Careless assembling | Investigation of working conditions when handling or assembling<br>Careful handling<br>Correct assembling |
| Damaged cage | ① Damage<br>② Biased wear<br>③ Wear of pocket portion<br>④ Galling | ① Moment load<br>② High-speed rotation<br>① Lubrication failure<br>② Foreign matter | Careful handling and review of service conditions<br>Investigation of lubrication amount or lubricant |
| Seizure | ① Discoloring/softening of raceway track ring/rolling element<br>② Damage | ① Clearance is too small<br>② Insufficient lubrication<br>③ Improper lubricant<br>Overload | ① Investigation of proper clearance<br>② Investigation of lubrication amount and lubricant<br>③ Review of service conditions<br>④ Investigation of handling |
| Smearing | Galling of raceway track or rolling element surfac | ① Lubrication failure<br>② Inclination of rolling element (skewing)<br>③ Selection of lubricant | Investigation of lubricant/lubricating conditions |
| Creep | Wear, slipping, or discoloring of inside/ outside diameter surface | ① Insufficient interference of engagement<br>② Insufficient tightening of sleeve | ① Investigation of tightening amount<br>② Investigation of machining accuracy of shaft/bearing housing<br>③ Design investigation |
| Cracking/ chipping | ① Cracking<br>② Mis-cutting | ① Progress of impact/strike flaking<br>② Large interference<br>Large R of installation | ① Careful handling<br>② Investigation of tightening amount<br>③ Investigation of machining accuracy of shaft/bearing housing |
| Rusting | ① Rusting over entire surface<br>② Partial rusting<br>③ Contact corrosion of engaged surface | ① Wrong storage condition<br>② Leaving to stand<br>③ Improper cleaning<br>④ Rust preventive agent<br>① Improper packing<br>② Sweat<br>① Insufficient interference<br>② Fluctuating load | ① Investigation of storage place<br>② Caution in handling<br>③ Investigation of rust preventive agent<br>① Review of machining of shaft-bearing housing<br>② Review of service conditions |

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