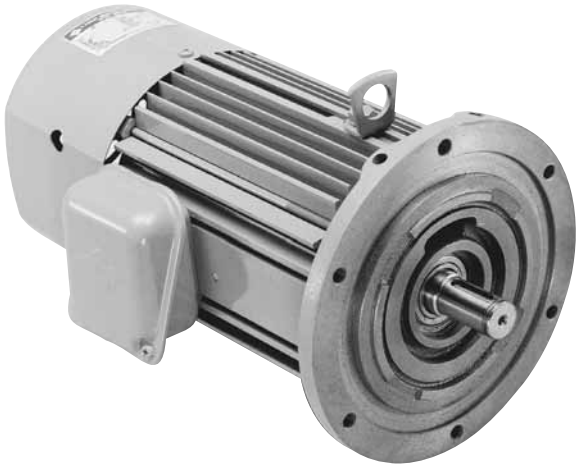
Sumitomo Drive Technologies

Always on the Move

3-PHASE MOTOR BRAKE

(FB-01A1～FB-30, CMB-20)



- 3-phase motor brake should be handled, installed and maintained by trained technicians.
  Carefully read the maintenance manual before use.
- A copy of this maintenance manual should be sent to the actual user of 3-phase motor brake.
- This maintenance manual should be maintained by the user.

Operating and Maintenance Manual | MM0202E-8

Safety and Other Precautions

- Carefully read this maintenace manual and all accompanying documents before use (installation, operation, maintenance, inspection, etc.) Thoroughly understand the machine, information about safety, and all precautions for correct operation. Maintain this manual for future reference.
- Pay particular attention to the "DANGER" and "CAUTION" warnings regarding safety and proper use.

DANGER :Improper handling may cause danger, resulting in death or serious injury.

CAUTION :Improper handling may cause danger, resulting in medium -degree injury, slight injury, or physical damage only.

Matters described in **CAUTION** may lead to serious danger depending on the situation. Be sure to observe important matters described herein.

DANGER

(General)

- Transport, installation, plumbing, operation, maintenance, and inspections should be handled by properly trained technicians; otherwise, electric shock, injury, fire, or damage to the equipment may result.
- When the unit is to be used in a system for transport of human beings, a secondary safety device should be installed to minimize chances of accidents resulting in injury, death, or damage to the equipment.
- When the unit is to be used for an elevator, install a safety device on the elevator side to prevent it from falling; otherwise, personal injury, death, or damage to the equipment may result.

(Transport)

- Do not stand directly under the unit suspended by a crane or other lifting mechanism; otherwise, personal injury or death may result.

(Installation)

- Do not use the unit in an explosive atmosphere; otherwise, explosion, ignition, electric shock, fire, or damage to the equipment may result.

(Wiring)

- Do not handle the unit when cables are live. Be sure to turn off the power; otherwise, electric shock may result.
- Connect a power cable to the unit according to the connectin diagram shown inside the terminal box or in the maintenance manual; otherwise, electric shock or fire may result.
- Do not forcibly curve, pull, or clamp the power cable and lead wires; otherwise, electric shock or fire may result.
- Correctly ground the grounding bolt; otherwise, electric shock may result.

(Operation)

- Do not approach or touch rotating parts (motor shaft, etc.) during operation; otherwise, loose clothing caught in these rotating parts may result in serious injury and/or death.
- When the power supply is interrupted, be sure to turn off the power swich; otherwise, unexpected resumption of power supply may cause electric shock, injury, or damage to the equipment.
- Do not operate the unit with the brake released by the brake release bolt; otherwise, the unit may fall, be damaged, or go out of control.
- Do not operate the brake motor with the cover of the conduit box removed, after inspecting or adjusting otherwise electric shock may result.

(Maintenance and inspection)

- Do not handle the unit when cables are live. Be sure to turn off the power; otherwise, electric shock may result.
- Do not approach or touch any rotating parts (motor shaft, etc.) during maintenance or inspection of the unit; otherwise, loose clothing caught in these rotating parts may result in serious injury and/or death.
- When the unit is to be used for an elevator, do not release the brake of the unit during lifting the unit; otherwise, the unit may fall.
- Do not operate the unit with the brake released by the brake release bolt; otherwise, the unit may fall or go out of control.
- Inspect the function of brakes before operation; otherwise, the unit may fall or go out of control.
- Avoid adhesion of water, oil, or fat to the brake; otherwise, the unit may fall or go out of control due to the drop in the braking torque.

⚠ CAUTION

(Inspection upon delivery)

- Unpack the unit after verifying that it is positioned right side up; otherwise, injury may result.
- Verify that the unit received is in fact the one that is ordered. When a different unit is installed, injury or damage to the equipment may result.
- Do not remove the rating plate.

(Transport)

- Exercise ample care so as not to drop the unit during ransport. When a hanging bolt or hole is provided, be sure to use it. After mounting the unit on the equipment, do not hoist the entire equipment using the hanging bolt or hole; otherwise, injury or damage to the equipment and/or lifting device may result.
- Before hoisting, check the weight with a rating plate, crate, outline drawing, catalog, etc. Never hoist the unit that exceeds the rating of the crane or other mechanisms being used for lifing; otherwise, injury or damage to the equipment and/or lifiting device may result.

(Installation)

- Strictly observe the brake specifications; otherwise, electric shock, injury, or damage to the equipment may result.
- Do not place inflammables around the motor with the brake; otherwise, fire may result.
- Do not place any object that will hinder ventilation around the motor with the brake; otherwise, cooling effect will be reduced, leading to a possible fire hazard due to excessive heat built-up.
- Do not step on or hang from the motor with the brake; otherwise, injury may result.
- Do not use the unit besides the usage as a nameplate or following production specifications.
- Do not touch the keyway at the end of shaft in the motor with brake and the edge of cooling fan; otherwise, injury may result.

(Wiring)

- When wiring, follow technical standards for electric facilities and extension regulations; otherwise, burning, electric shock, injury, or fire may result.
- The motor with the brake is not equipped with a protective device. However, it is compulsory to install an overload protector according to technical standards for electric facilities. It is recommended to install other protective devices (earth leakage breaker, etc.), in addition to an overload protector, in order to prevent burning, electric shock, injury, and fire.
- Never touch the terminals when measuring insulation resistance; otherwise, electric shock may result.
- When star-delta starter is adopted for the motor with the brake, select one with an electromagnetic switch on the primary side (3-contactor type); otherwise, fire may result.
- When a 400V-class inverter is used for driving the motor with the brake, mount a suppresser filter or reactor on the inverter side, or provide reinforced insulation on the motor side; otherwise, fire or damage to the equipment due to dielectric breakdown may result.
- When an ambient temperature is over 60 °C, relocate the rectifier so that the temperature will be below 60 °C, relocate the rectifier so that the temperature will be below 60°C. Besure to cover the rectifier for protection.

(Operation)

- Do not put fingers into the opening of the motor with the brake; otherwise, electric shock, injury, fire, or damage to the equipment may result.
- The motor with the brake will become very hot during operation. Do not touch or come in contact in any way with the unit; otherwise, burns may result.
- If the unit is operating in an abnormal way, stop it immediately; otherwise, electric shock, injury fire may result.
- In the case of the motor with standard brake, install it to a place where the ambient temperature is 40 °C or lower.

(Maintenance and inspection)

- Do not put fingers into the opening of the motor with the brake; otherwise, electric shock, injury, fire, or damage to the equipment may result.
- The motor with the brake will become very hot during operation. Do not touch the unit with bare hands; otherwise, burns may result.
- Do not touch the terminal when measuring insulation resistance; otherwise, electric shock may result.
- Identify and provide appropriat corrective action in a timely fashion for any abnormal operation characteristics according to the maintenance manual. Do not operate the unit until corrective action has been taken.
- Do not use damaged brakes; otherwise, injury, fire, or damage to the equipment may result.
- We will not take responsibility for any trouble due to remodeling by customers.
- Dispose of the motor with the brake as general industrial waste.
- Do not operate the motor with the brake without the fan cover after inspection and adjustment of gaps; otherwise, loose clothing caught in the motor with the brake may result in injury.
- Experience and skill is neccessary for replacement of brake lining, so be sure to ask our specialized factory for replacement
- At the beginning of the usage, prescribed brake torque might not outputted due to the friction surface. When this happens, rub the friction surfaces by turning on/off under the lightest loading as possible.

• For **handling of motors and gear motors**, refer to the respective maintenance manuals.

CONTENTS

1. Type of brake

The types of brake and the relationship between the motor capacity and brake delay time are as follows:

Table 1 Type of brake

Type of brake	Motor capacity		J (kg·m²)	Brake delay time (sec)		
	3-phase motor (4-pole)	3-phase inverter motor (4-pole)		Normal braking action (3-phase motor)	Normal braking action (3-phase inverter motor)	Frast braking action
FB-01A1, FB-01A *1)	0.1kW		0.00035	0.15~0.2		0.015~0.02
FB-02A1, FB-02A *1)	0.2kW	0.1kW	0.00055		0.08~0.12	
FB-05A1, FB-05A *1)	0.4kW	0.2kW	0.00068	0.1~0.15	0.03~0.07	0.01~0.015
FB-1B	0.75kW	0.4kW	0.0013	0.2~0.3	0.1~0.15	0.01~0.02
FB-2B1	1.5kW	0.75kW	0.0024			
FB-3B	2.2kW	1.5kW	0.0037	0.3~0.4	0.15~0.2	
FB-5B	3.7kW	2.2kW	0.0096	0.4~0.5	0.2~0.25	
FB-8B	5.5kW	3.7kW	0.0125	0.3~0.4	0.1~0.15	
FB-10B	7.5kW	5.5kW	0.0303	0.7~0.8	0.25~0.3	0.03~0.04
FB-15B	11kW	7.5kW	0.041	0.5~0.6	0.15~0.2	
FB-20	15kW	11kW	0.107	1.7~1.8	0.65~0.75	0.03~0.06
CMB-20	15kW	11kW	0.133	200V class 0.6~0.8 400V class 0.4~0.5	200V class 0.3~0.35 400V class 0.1~0.15	0.1~0.15
FB-30	18.5kW		0.243	1.4~1.5	0.45~0.55	0.03~0.06
	22kW	15kW				
	30kW	22kW	0.262			

*1) The standard brakes for **0.1, 0.2, and 0.4 kW 3-phase motors** and **0.2kW 3-phase inverter motors** are FB-01A1, 02A, and 05A1, but FB-01A, 02A, or 05A may be used for special motors. Check the name plate.

*2) The type of brake may be different from those shown in Table 1 depending on the specification. Check the name plate.

3) Since only 200V-class for FB-20, & 30 is produced, please use transformer when you use 400V-class power supply. (Transformer capacity : 250 through 300VA, Secondary voltage : 200 Through 220VA)

4) At the beginning of the usage, prescribed brake torque might not outputted due to the friction surface. When this happens, rub the friction surfaces by turning on/off under the lightest loading as possible.

5) The brake delay time of the braking action varies with the connection for brake. Please select the optimal one depending on the situration.

2. Wiring

⚠ DANGER

- Do not handle the unit when cables are live. Be sure to turn off the power; otherwise, electric shock may result.
- Connect a power cable to unit according to the connection diagram shown inside the terminal box or in the maintenance manual; otherwise, electric shock or fire may result.
- Do not forcibly curve, pull, or clamp the power cable and lead wires; otherwise, electric shock or fire may result.
- Correctly ground the grounding bolt; otherwise, electric shock may result.

⚠ CAUTION

- When wiring, follow technical standards for electric facilities and extension regulations; otherwise, burning, electric shock, injury, or fire may result.
- The motor with the brake is not equipped with a protetive device. However, it is compulsory to install an overload protector according to technical standards for electric facilities. It is recommended to install other protective devices (earth leakage breaker, etc.), in addition to an overload protector, in order to prevent burning, electric shock, injury, and fire.
- Never touch the terminals when measuring insulation resistance; otherwise, electric shock may result.
- When star-delta starter is adopted for the motor with the brake, select one with an electromagnetic switch on the primary side (3-contactor type); otherwise, fire may result.
- When a 400V-class inverter is used for driving the motor with the brake, mount a suppresser filter or reactor on the inverter side, or provide reinforced insulation on the motor side; otherwise, fire or damage to the eqipment due to dielectric breakdown may result.
- When an ambient temperature is over 60°C, relocate the rectifier so that the temperature will be below 60°C. Be sure to cover the rectifier for protection.

2-1) Connection with power cable

Connect power cables with motor lead wires with facing each solderless terminal as shown in Fig. 1.

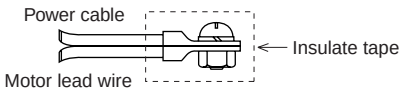
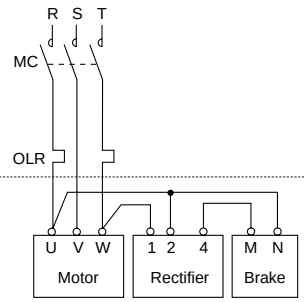
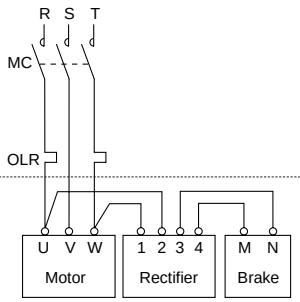
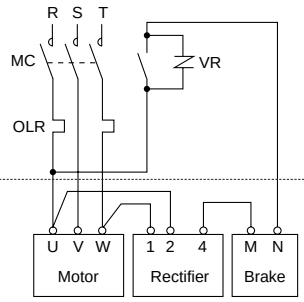
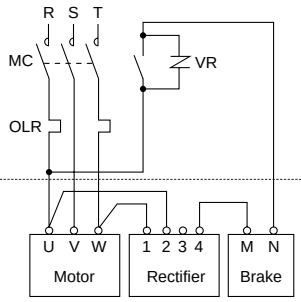
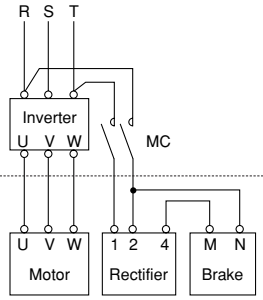
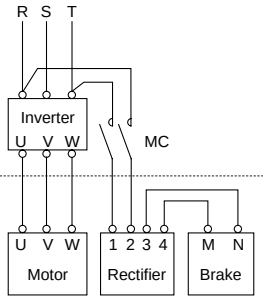
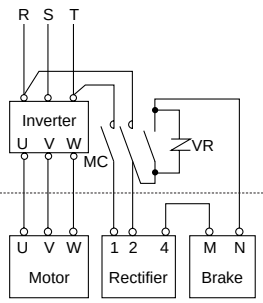
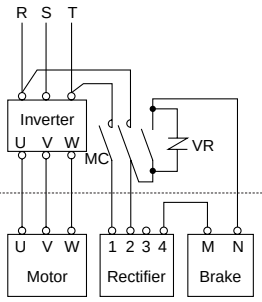


Fig. 1

2-2) Connection for **motor with FB brake**

Fig. 2 shows the standard connection for **3-phase motors with FB-01A1~FB-15B brake** and terminal codes.

Fig. 2 Connection for motor with FB brake and terminal code

Type of brake		FB-01A1~FB-05A1	FB-01A~FB-15B
Standard motor	Normal braking action		
	Fast braking action		
Inverter motor	Normal braking action		
	Fast braking action		

MC : Electromagnetic contactor
OLR : Overload prevention device
VR : Varistor (protector element)

To be furnished by customers.

Table 2 Capacity of the varistor (VR)

Motor power			AC200V–230V	AC380V~460V
Rated voltage of varistor			AC260V–AC300V	AC510V
Varistor voltage			430V–470V	820V
Rated power of varistor	Type of brake	FB-01A1, 02A1, 05A1 01A, 02A, 05A	0.2Watt or more	0.4Watt or more
		FB-1B	0.4Watt or more	0.6Watt or more
		FB-2B1, 3B, 5B, 8B	0.6Watt or more	1.5Watt or more
		FB-10B, 15B	1.0Watt or more	1.5Watt or more

- The brake delay time of the normal braking action is diffierent from that of the fast braking action. Table 1 on page 4 shows the delay time. Use a circuit that meets your requirements.
- DC braking capacity (for DC coil loading) exceeding 5 times the braking current shown on the name plate is recommended for the fast braking action.

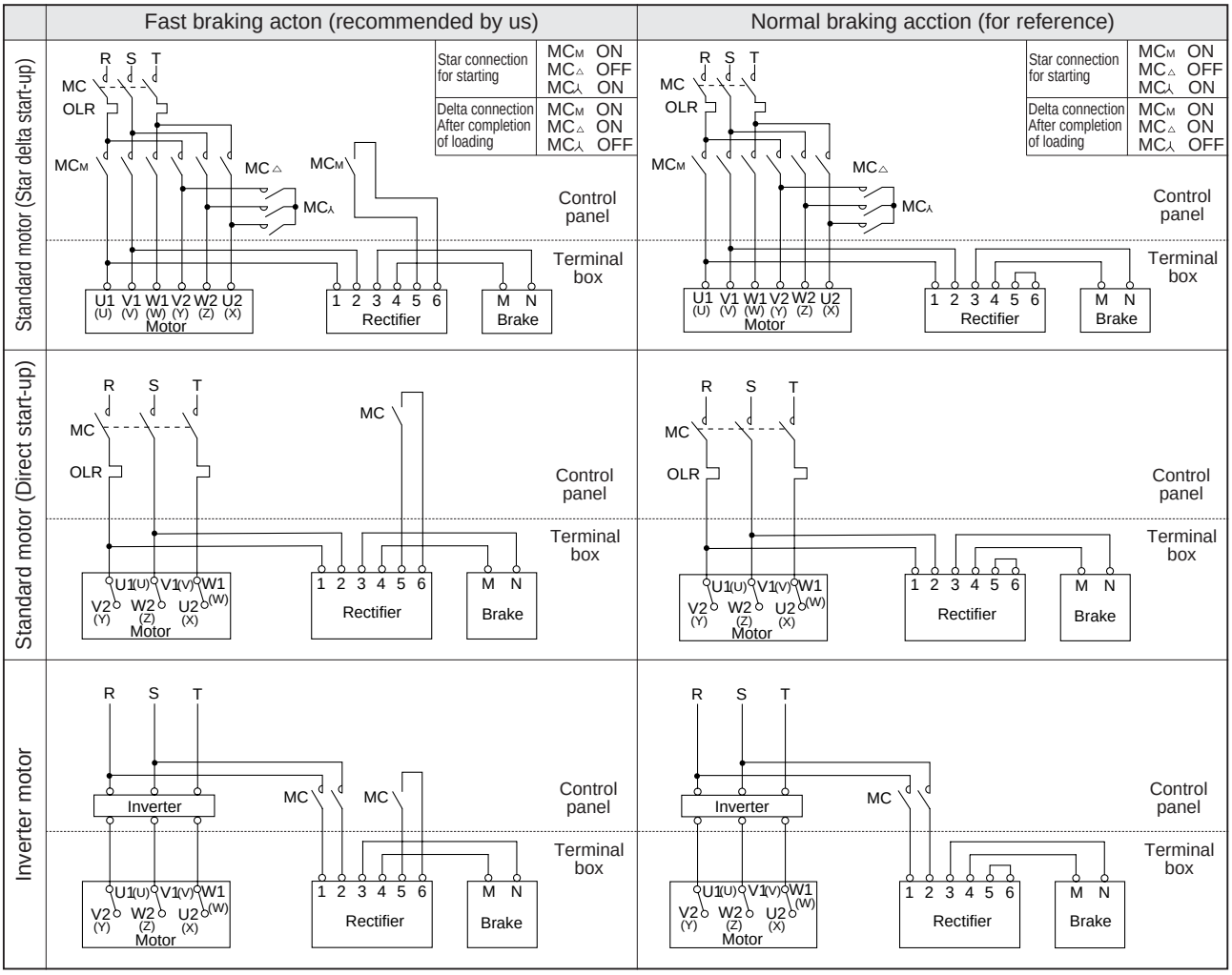
- Use a fast braking action for lifting devices or for better stopping accuracy.
- Use a fast braking action when a leading capacitor is used.

- Pay attention to the following items **when driving an inverter**.

- For inverter-driving the motor with a brake, use the primary-side power supply for braking as shown in Fig. 1, and synchronize the braking operation with the ON/OFF operation of the unit.
- For inverter-driving the motor with brake, interlocking with the inverter is necessary to engage/release the MC. Refer to the inverter maintenance manual or guide manual.

Fig. 3 shows the standard connection for **FB-20, FB-30 (AC200V class)** and terminal codes.

Fig. 3 Connection for motor with FB brake and terminal code



Note: Alphabet inside the bracket indicates the previous terminal code of the motor.

MC : Electromagnetic contactor
OLR : Overload prevention device
To be furnished by customers.

- The brake delay time of the normal braking action is diffierent from that of the fast braking action. Table 1 on page 4 shows the delay time. Use a circuit that meets your requirements. (We recommend the fast braking action)
- DC braking capacity (for DC coil loading) exceeding 5 times the braking current shown on the name plate is recommended for the fast braking action.

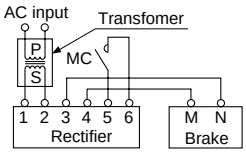
- Use a fast braking action for lifting devices or for better stopping accuracy.
- Use a fast braking action when a leading capacitor is used.
- Models FB-20 and FB-30 are shipped with short circuit plate between rectifier terminal 5 and 6. Remove the short circuit plate when using them as quick braking circuit.

• Pay attention to the following items **when driving a inverter**

- For inverter-driving the motor with a brake, use the primary-side power supply for braking as shown in Fig.2, and synchronize the braking operation with the ON/OFF operation of the unit.
- For inverter-driving the motor with a brake, interlocking with the inverter is necessary to engage/release the MC. Refer to the inverter maintenance manual or guide manual.

- When input voltage P of rectifier is other than AC 200/220V, set transformer (transformation capacity: 250VA-300VA, secondary voltage 200-220V) separately as in Fig. 4.

Fig. 4 Example

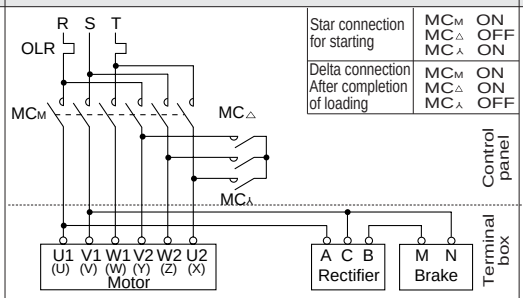
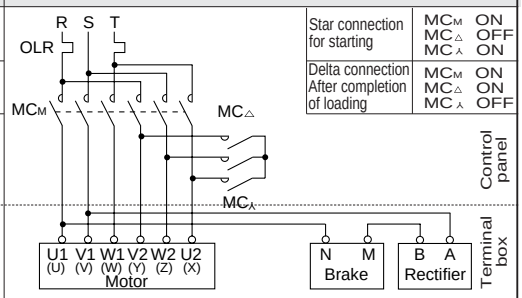
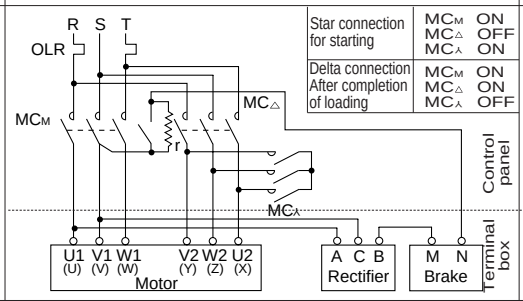
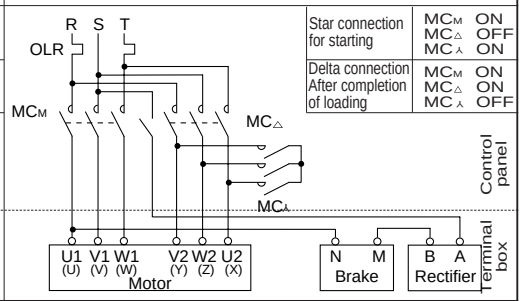
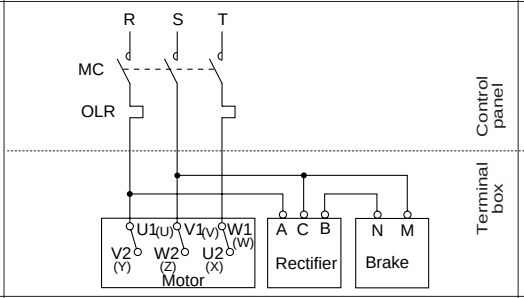
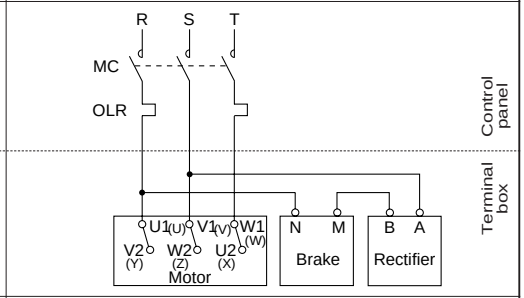
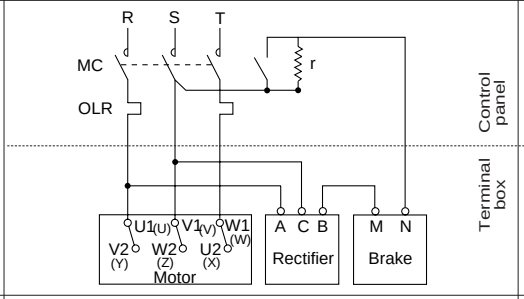
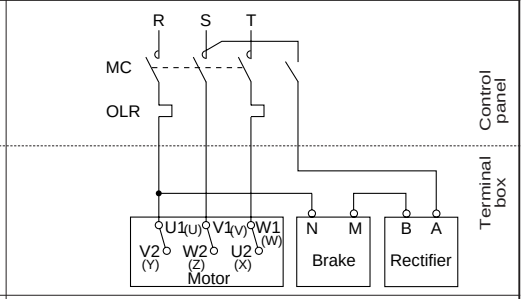
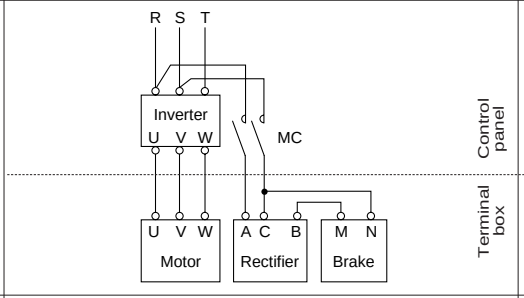
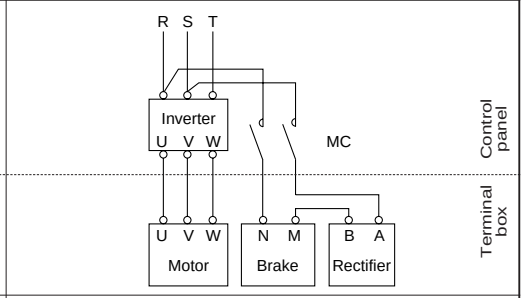
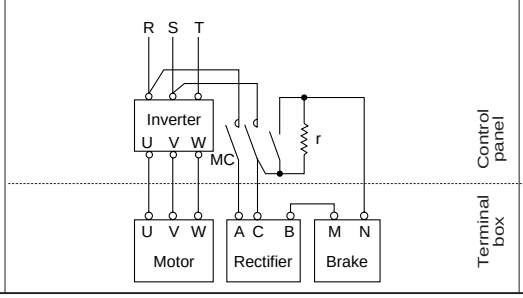
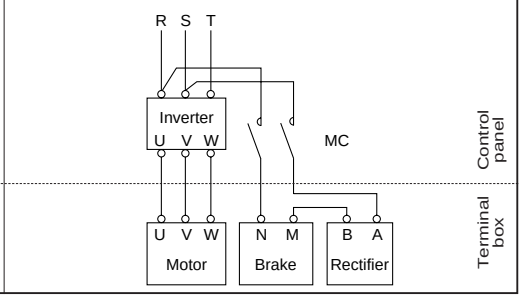


P: AC input voltage
S: 200V~220V

2-3) Connection for motor with CMB motor

Figure 5 shows the standard connection for **3-phase motors with CMB-20 brake** and terminal codes.

Fig. 5 Connection for motor with CMB brake and terminal code

Type of brake		CMB-20	
		200V-class	400V-class
Standard motor (Star delta start-up)	Normal braking acton		
	Fast braking action		
Standard motor (Direct start-up)	Normal braking acton		
	Fast braking action		
Inverter motor	Normal braking acton		
	Fast braking action		

Refer to notes on the following page.

Note: Alphabet inside the bracket indicates the previous terminal code of the motor.

MC : Electromagnetic contactor
OLR : Overload prevention device
r : Discharging resistor (for protection of contact)

To be furnished customers.

- Use a 5~10 Watt, 200~300Ω resistor as r (discharging resistor).

- The brake delay time of the normal braking action is different from that of the fast braking action. Table 1 on page 3 shows the delay time. Use a circuit that meets your requirements.
- DC braking capacity (for DC coil loading) exceeding 3 times the braking current shown on the name plate is recommended for the 200V-class fast braking action, and about twice for the 400V-class.

- Use a fast braking action for lifting devices or for better stopping accuracy.
- Use a fast braking action when a leading capacitor is used.

- Pay attention to the following items **when driving a inverter**

- For inverter-driving the motor with a brake, use the primary-side power supply for braking as shown in Fig.5, and synchronize the braking operation with the ON/OFF operation of the unit.
- For inverter-driving the motor with a brake, interlocking with the inverter is necessary to engage/release the MC. Refer to the inverter maintenance manual or guide manual.

3. Maintenance and Inspection of FB brake

⚠ DANGER

- Do not handle the unit when cables are live. Be sure to turn off the power, otherwise, electric shock may result.
- When the unit is to be used for an elevator, do not release the brake of the unit during lifting the unit; otherwise, the unit may fall.
- Do not operate the unit with the brake released by the brake release bolt; otherwise, the unit may fall or go out of control.
- Inspect the function of brakes before operation; otherwise, the unit may fall or go our of control.
- Avoid adhesion of water, oil, or fat to the brake; otherwise, the unit may fall or go out of control due to the drop in the braking torque.

⚠ CAUTION

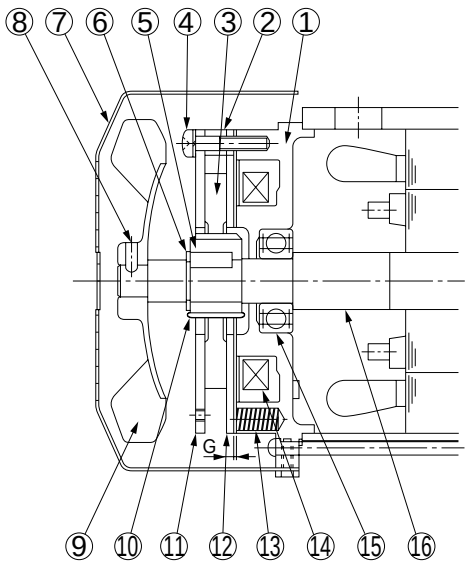
- Do not operate the motor with the brake without the fan cover after inspection and adjustment of gaps; otherwise, loose clothing caught in the motor with the brake may result in injury.
- Experience and skill is neccessary for replacement of brake lining, so be sure to ask our specialized factory for replacement.

The mechanical life of the FB brake is 2,000,000 times (1,000,000 times: in the case of FB-30). Periodically check the brake gap G. Long-time operation will cause abrasion of the brake lining, not allowing brake release. Operation exceeding 2,000,000 times (1,000,000 times: in the case of FB-30) may casue abrasion and/or breakage of mechanical parts, allowing the unit to tall or go out of control.

3-1) Construction and operation

The construction of the FB brake is shown in Figs.3~6 (indoor type) and Figs.7~10) outdoor type). A spring is used for braking operation (nonexcitation operation type).

A. Indoor type



No.	Part name
1	Stationary
2	Spacer
3	Brake lining
4	Assembling bolt
5	Boss
6	Shaft retaining C-ring
7	Cover
8	Fan set bolt
9	Fan(Not provided for FB-01A1 and FB-01A)
10	Leaf spring
11	Fixed plate
12	Armature plate
13	Spring
14	Electromagnetic coil
15	Ball bearing
16	Motor shaft

Fig. 6 **FB-01A1, 02A1, 05A1, 01A, 02A and 05A** (Indoor type)

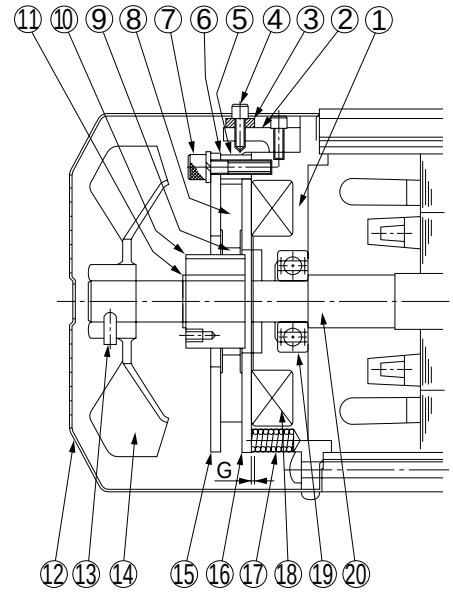


Fig. 7 **FB-1B, 2B1, and 3B** (Inddor type)

No.	Part name
1	Stationary
2	Rlease fitting
3	Manual release prevention spacer
4	Brake release bolt
5	Spacer
6	Gap adjusting shim
7	Assembling bolt
8	Brake lining
9	Leaf spring
10	Boss
11	Shaft retaining C-ring
12	Cover
13	Fan setting bolt
14	Fan
15	Fixed plate
16	Armature plate
17	Spring
18	Electromagnetic coil
19	Ball bearing
20	Motor shaft

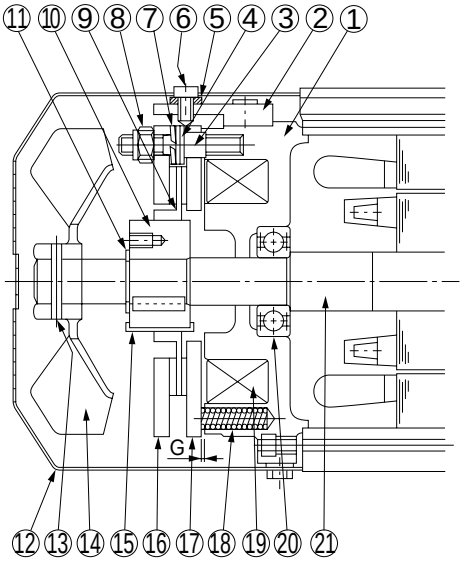


Fig. 8 **FB-5B and 8B** (Indoor type)

No.	Part name
1	Stationary
2	Release fitting
3	Stud bolt
4	Adjusting washer
5	Manual release prevention spacer
6	Brake release bolt
7	Spring washer
8	Gap adjusting nut
9	Brake lining
10	Boss
11	Shaft retaining C-ring
12	Cover
13	Spring pin
14	Fan
15	Leaf spring
16	Fixed plate
17	Armature core
18	Spring
19	Electromagnetic coil
20	Ball bearing
21	Motor shaft

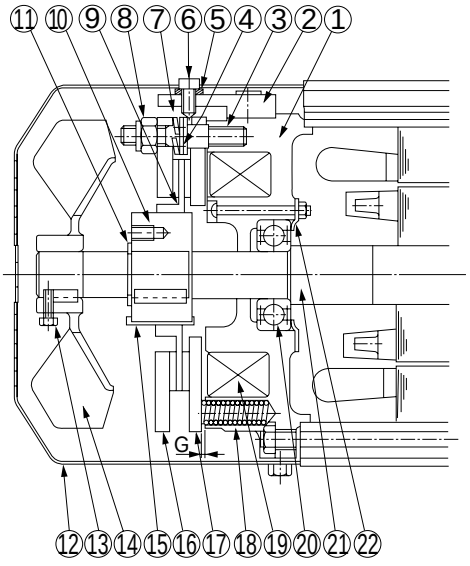


Fig. 9 **FB-10B and 15B** (Indoor type)

No.	Part name
1	Stationary
2	Release fitting
3	Stud bolt
4	Adjusting washer
5	Manual release prevention spacer
6	Brake release bolt
7	Spring washer
8	Gap adjusting nut
9	Brake lining
10	Boss
11	Shaft retaining C-ring
12	Cover
13	Fan Setting bolt
14	Fan
15	Leaf spring
16	Fixed plate
17	Armature core
18	Spring
19	Electromagnetic coil
20	Ball bearing
21	Motor shaft
22	Bearing cover

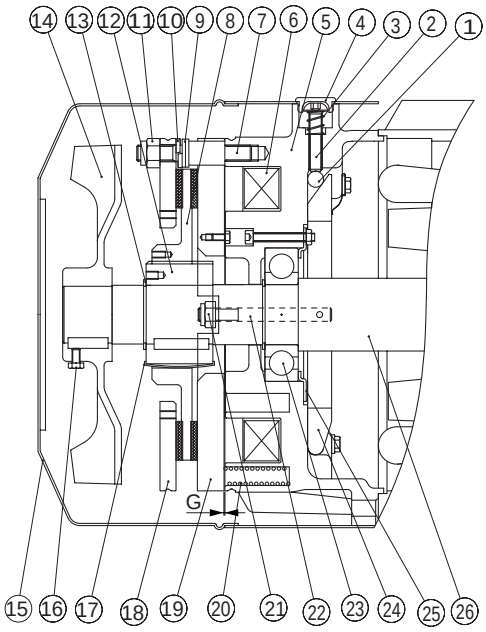


Fig. 10 **FB-20** (Indoor type)

No.	Part name
1	Roller
2	Brake release bolt
3	Auxiliary spring
4	Plug
5	Stationary core
6	Electromagnetic coil
7	Stud bolt
8	brake lining
9	Adjusting washer
10	Spring washer
11	Gap adjusting nut
12	Boss
13	Shaft retainig
14	Fan
15	Cover
16	Fan setting bolt
17	Leaf spring
18	Fixed plate
19	Armature core
20	Spring
21	Nut
22	Stud bolt
23	Ball bearing
24	Release lever
25	Bearing cover
26	Motor shaft

Note 1: The shape of the outdoor cover ⑰ for the vertical outdoor type is different.

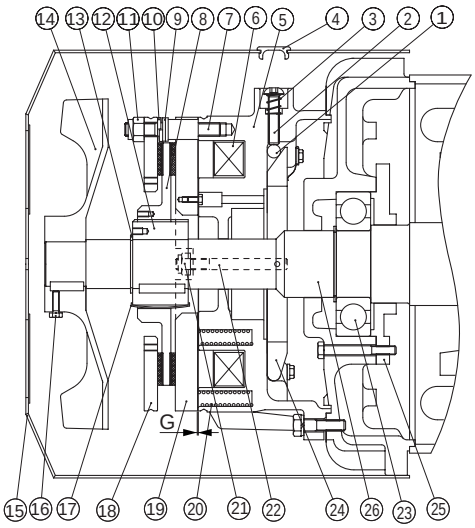


Fig. 11 **FB-30** (Indoor type)

No.	Part name
1	Roller
2	Brake release bolt
3	Auxiliary spring
4	Plug
5	Stationary core
6	Electromagnetic coil
7	Stud bolt
8	brake lining
9	Adjusting washer
10	Spring washer
11	Gap adjusting nut
12	Boss
13	Shaft retainig
14	Fan
15	Cover
16	Fan setting bolt
17	Leaf spring
18	Fixed plate
19	Armature core
20	Spring
21	Nut
22	Stud bolt
23	Ball bearing
24	Release lever
25	Bearing cover
26	Motor shaft

Note 1: The shape of the outdoor cover ⑰ for the vertical outdoor type is different.

B. Outdoor type

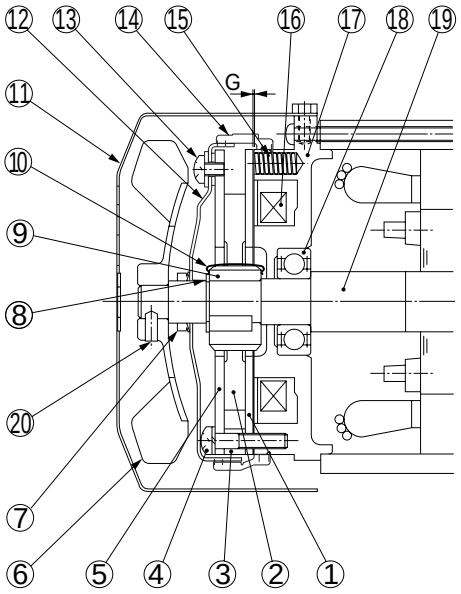


Fig. 12 **FB-01A1, 02A1, 05A1, 01A, 02A, and 05A** (Outdoor type)

No.	Part name
1	Armature plate
2	Brake linig
3	Spacer
4	Assembling bolt
5	Fixed plate
6	Fan
7	V-ring
8	Shaft retaining C-ring
9	Boss
10	Leaf spring
11	Cover
12	Waterproof cover
13	Waterproof cover mounting bolt
14	Waterproof seal
15	Spring
16	Electromagnetic coil
17	Stationary core
18	Ball bearing
19	Motor shaft
20	Fan setting bolt

Note 1: ⑥⑦, and ⑳ are not provided for FB-01A1 and 01A.

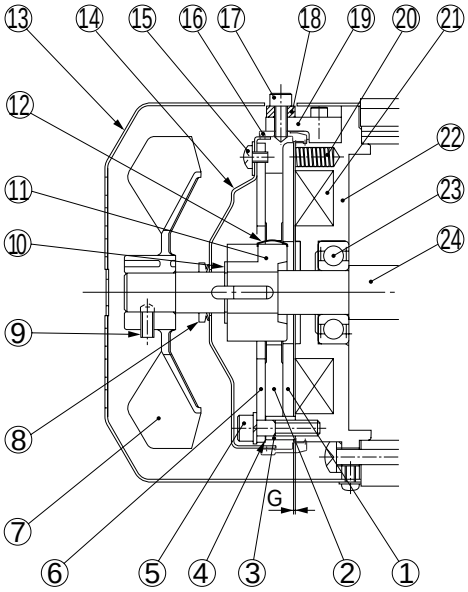


Fig. 13 **FB-1B, 2B1, and 3B** (Outdoor type)

No.	Part name
1	Armature plate
2	Brake lining
3	Spacer
4	Gap adjusting shim
5	Assembling bolt
6	Fixed plate
7	Fan
8	V-ring
9	Fan setting bolt
10	Shaft retaining C-ring
11	Boss
12	Leaf spring
13	Cover
14	Waterproof cover
15	Waterproof cover mounting bolt
16	Waterproof seal
17	Brake release
18	Manual release prevention spacer
19	Release fitting
20	Spring
21	Electromagnetic coil
22	Stationary core
23	Ball bearing
24	Motor shaft

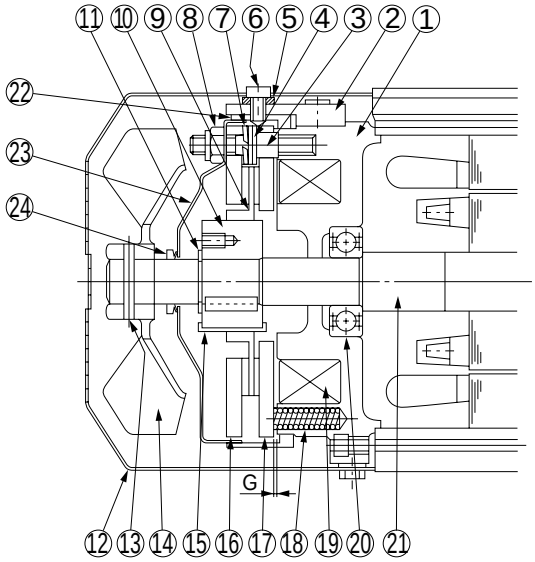


Fig. 14 **FB-5B and 8B** (Outdoor type)

No.	Part name
1	Stationary core
2	Release fitting
3	Stud bolt
4	Adjusting washer
5	Manual release prevention spacer
6	Brake release bolt
7	Spring washer
8	Gap adjusting nut
9	Brake lining
10	Boss
11	Shaft retaining C-ring
12	Cover
13	Spring pin
14	Fan
15	Leaf spring
16	Fixed Plate
17	Armature core
18	Spring
19	Electromagnetic coil
20	Ball bearing
21	Motor shaft
22	Waterproof seal
23	Waterproof cover
24	V-ring

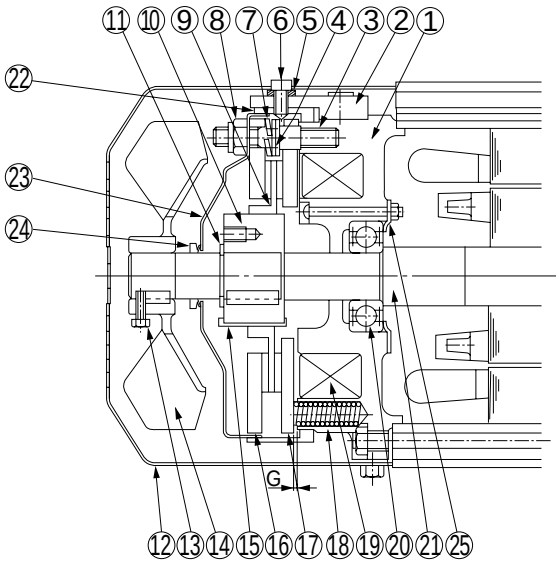


Fig. 15 **FB-10 and 15B** (Outdoor type)

No.	Part name
1	Stationary core
2	Release fitting
3	Stud bolt
4	Adjusting washer
5	Manual release prevention spacer
6	Brake release bolt
7	Spring washer
8	Gap adjusting nut
9	Brake lining
10	Boss
11	Shaft retaining
12	Cover
13	Fan setting bolt
14	Fan
15	Leaf spring
16	Fixed plate
17	Armature core
18	Spring
19	Electromagnetic coil
20	Ball bearing
21	Motor shaft
22	Waterproof seal
23	Waterproof cover
24	V-ring
25	Bearing cover

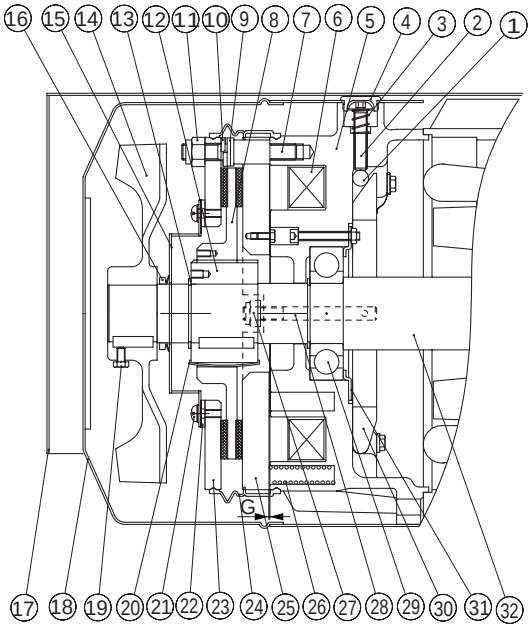


Fig. 16 **FB-20** (Outdoor type)

No.	Part name
1	Roller
2	Brake release bolt
3	Auxiliary spring
4	Plug
5	Stationary core
6	Electromagnetic coil
7	Stud bolt
8	Brake lining
9	Adjusting washer
10	Spring washer
11	Gap adjusting nut
12	Boss
13	Shaft retaining
14	Fan
15	Waterproof cover
16	V-ring
17	Outdoor cover
18	Cover
19	Fan setting bolt
20	Leaf spring
21	Waterproof cover mounting bolt
22	Packing
23	Fixed plate
24	Waterproof seal
25	Armature core
26	Spring
27	Nut
28	Stud bolt
29	Ball bearing
30	Release lever
31	Bearing cover
32	Motor shaft

Note 1: The shape of the outdoor cover ⑰ for the vertical outdoor type is different.

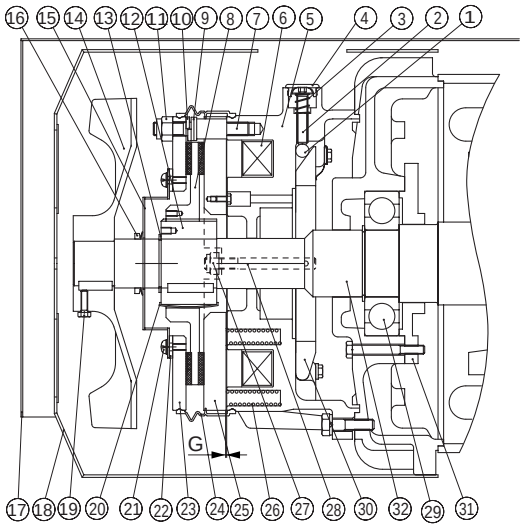


Fig. 17 **FB-30** (Outdoor type)

No.	Part name
1	Roller
2	Brake release bolt
3	Auxiliary spring
4	Plug
5	Stationary core
6	Electromagnetic coil
7	Stud bolt
8	Brake lining
9	Adjusting washer
10	Spring washer
11	Gap adjusting nut
12	Boss
13	Shaft retaining
14	Fan
15	Waterproof cover
16	V-ring
17	Outdoor cover
18	Cover
19	Fan setting bolt
20	Leaf spring
21	Waterproof cover mounting bolt
22	Packing
23	Fixed plate
24	Waterproof seal
25	Armature core
26	Spring
27	Nut
28	Stud bolt
29	Ball bearing
30	Release lever
31	Bearing cover
32	Motor shaft

Note 1: The shape of the outdoor cover ⑰ for the vertical outdoor type is different.

3-2) Manual release operation of FB brake

(FB-01A1~05A1 Optional : FB01A~05A)

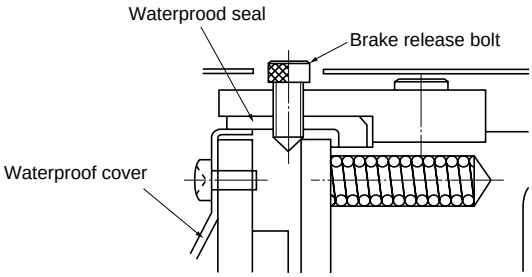
To manually release the brake without turning on the power, operate the brake release device in the following manner:

(1) Remove the brake release bolts arranged diagonal to each other, and remove the spacer. Then screw in the bolts with a hexagon wrench, and the brake will be released. Be careful not to turn the brake release bolts excessively. (Check to see if the brake is released, while turning the brake release bolts.) (See Fig.11.)

(2) To return to the original state after releasing the bolts, install the spacer, which was removed in operation (1), back to the original position for safety. See Fig.12.)

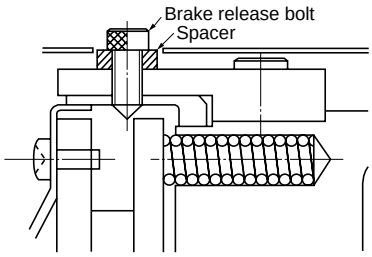
(3) See the following table for the size of brake release bolt.

Brake type	Bolt size
FB-01A1~05A1 FB-01A~05A FB-1B	M5
FB-2B1~3B	M6
FB-5B~15B	M8



During releasing

Fig. 18



During operation

Fig. 19

Note: The indoor type is not equipped with the waterproof seal and waterproof cover.

(FB-20, FB-30)

To manually release the brake without turning on the power, operate the brake release device in the following manner (Fig.00):

(1) Remove plug ④ and turn release bolt ② in the loosening direction (clockwise) with a hexagon wrench (for M8 bolt with a hole). Then the brake will be released. (Remove the lid in the window section of outdoor cover ⑰ of the outdoor type.)

(2) In order to return to the original state after releasing the brake, turn (approx. 5~7 turns) release bolt ② with a hexagon wrench in the braking direction (counterclockwise) to the extent that the bolt head will not project from stationary cover ⑤. Then install plug ④ in the original position.(Install the lid in the window section of the outdoor cover of the outdoor type.)

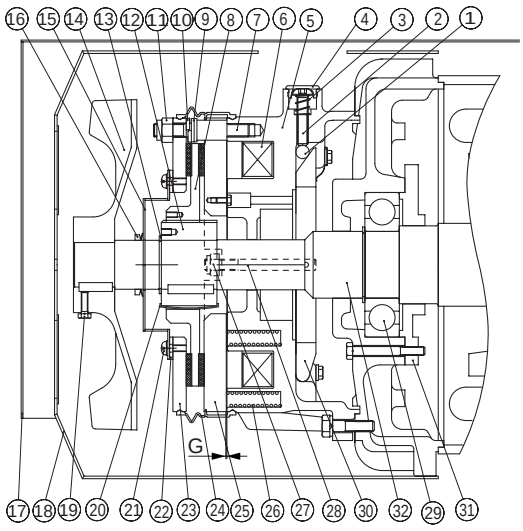


Fig. 20

Negligence of the installation of plug ④ or the lid in the window section of the outdoor cover will result in loss of the dustproofing or waterproofing effect. Do not turn on or off the power while the brake is manually released; otherwise, release lever ㉚ may be broken.

3-3) Inspection of gap

When the brake is used for a long time, the brake lining is abraded, and the brake cannot be released. Periodically check the gap G in the following manner:

(1) Remove the cover.

(2) Insert the feeler gauge between the stationary and armature cores to measure the gap. (Shift the position of the waterproof seaf of the outdoor type.) When the gap is near the limit shown in Table 3, adjustment is necesary. Measure three points along the circumference. (The minimum thickness of the gap adjusting shim for FB-1B ~3B is 0.2~0.25 mm.)

Note: Refer to 3-4) Adjustment of gap for the details of disassembly.

Table 3 Brake gap

Type of brake	Gap G (mm)	
	Specification	Limit
FB-01A1, FB-01A FB-02A1, FB-02A FB-05A1, FB-05A	0.2~0.35	0.5
FB-1B FB-2B1	0.3~0.4	0.6
FB-3B		0.7
FB-5B FB-8B	0.4~0.5	1.0
FB-10B FB-15B	0.4~0.5	1.2
FB-20 FB-30	0.6~0.7	1.5

3-4) Adjustment of gap

When the gap nears the limit shown in Table 3 during inspection, adjust the gap in the following manner:

A. Indoor type

<FB-01A1, 02A1, 05A1, 01A, 02A, and 05A>

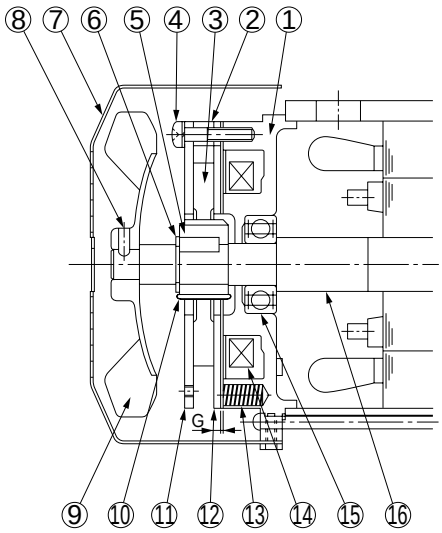
(See Fig.6 on page 9.)

(1) Remove cover ⑦.

(2) Slightly loosen assembling bolt ④, and turn fixed plate ⑪ counterclockwise to the maximum. Then tighten the assembling bolt. After tightening, measure the gap G and confirm that the gap is between the specification and limit. (After this operation, the gap will decrease by approx. 0.3 mm.)

(3) Turn on and off the power and check the braking operation.

(4) Install cover ⑦.



<FB-1B, 2B1 and 3B>

(See Fig.7 on page 10.)

(1) Remove brake release bolt ④, and manual release prevention spacer ③.

(2) Remove cover ⑫.

(3) Remove fan setting bolt ⑬, and remove fan ⑭.

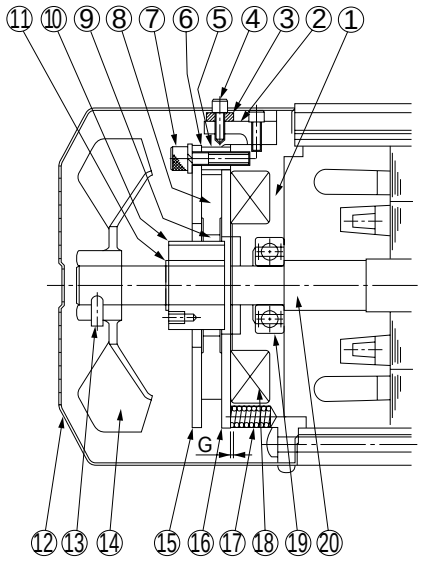
(4) Loosen assembling bolt ⑦, and remove spacer ⑤, gap adjusting shim ⑥, assembling bolt ⑦, and fixed plate ⑮ all together as a set. Be careful not to remove assembling bolt ⑦ alone; otherwise, gap adjusting shim ⑥ will drop.

(5) Gap adjusting shim ⑥ is approx. about 0.2~0.25 mm thick. Reduce the number of shims according to the condition of abrasion and reassemble spacer ⑤, gap adjusting shim ⑥, assembling bolt ⑦ and fixed plate ⑮ all together as a set.

(6) Check the gap G, and if it is substantially different from the specification, readjust the shim.

(7) Turn on and off the power and check the braking operation.

(8) Install fan ⑭, fan setting bolt ⑬ and cover ⑫. Apply a locking agent to the fan setting bolt at that time Finally, install release bolt ④ and spacer ⑤.



<FB-5B, 8B, 10B and 15B>

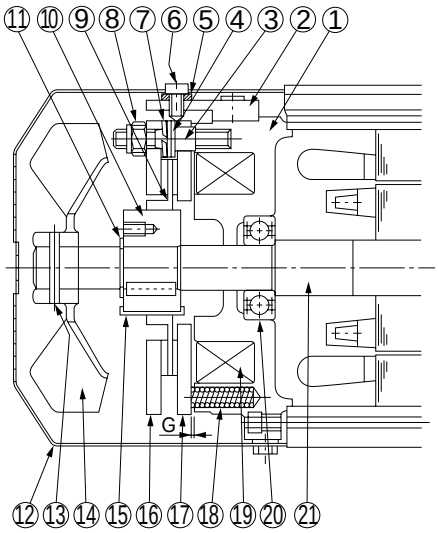
(See Fig.8 and 9 on page 10.)

(1) Remove cover ⑫.

(2) Insert the feeler gauge between stationary core ① and armature core ⑰, and turn clockwise gap adjusting nut ⑧ attached to the end of stud bolt ③. When adjustment is impossible due to excessively large gap, reduce the number of adjusting washers ④. Alternately adjust the adjustiong nuts arranged at three locations so that the gaps at three locations around the circumference will be as specified in Table 3.

(3) Turn on and off the power check the braking operation.

(4) Install cover ⑫. Finally, install release bolt ⑥ and spacer ⑤.



<FB-20 and 30>

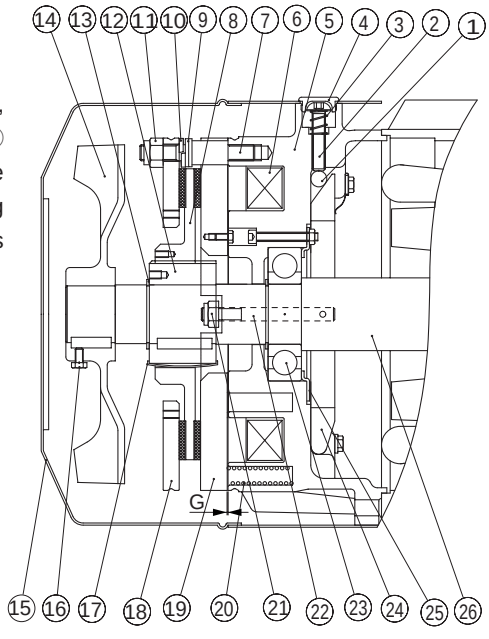
(c.f.p.11 fig. 10 & 11)

(1) Remove Plug ④ (in the case of FB-20), and cover ⑮.

(2) Insert feeler gauge between stationary core ⑤ and armature core ⑲, and turn gap adjusting nut ⑪ attached to the end of stud bolt ⑦ clockwise. When it is impossible to adjust it due to excessively large gap, reduce adjusting washer ⑨. Alternately adjust the adjusting nuts arranged at three locations so that the gaps at three locations on the circumference may be regulated values in Table 3.

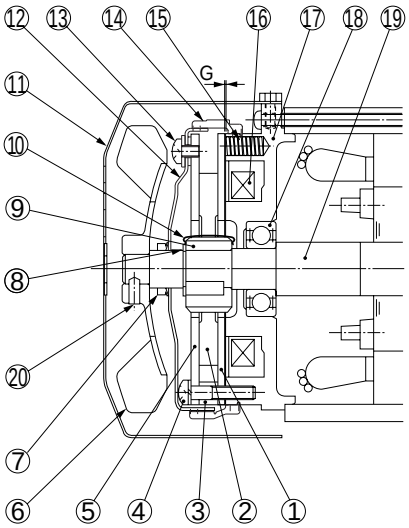
(3) Turn on and off the power and check the braking operation.

(4) Install cover ⑮, plug ④. (in the case of FB-20)



B. Outdoor type

<FB-01A1, 02A1, 05A1, 01A, and 05A> (See Fig.12 on page 13.)



(1) Remove cover ⑪.
(2) Loosen fan setting bolt ⑳ and remove fan ⑥.
(3) Pull out V-ring ⑦.
(4) Remove waterproof cover mounting bolt ⑬, and remove waterprof covrer ⑫.
(5) Slightly loosen assembling bolt ④ and turn fixed plate ⑤ counterclockwise to the maximum. Then tighten the assembling bolt. Measure the gap G after tightening, and confirm that the gap is between the specification and limit. (The gap will decrease by approx. 0.3 mm by this operation.)
(6) Install the waterproof cover with the mounting bolt. Exercise care so that the gap (dimension A in Fig.13) between the hole of waterproof cover and motor shaft will be almost equal all around the circumference.
(7) Clean the surface of the waterproof seal.
(8) Install the waterproof seal between the stationary core and waterproof cover as shown in the construction drawing.
With an arrow in the waterproof seal facing to the loaded side, insert the waterproof seal. Align the release bolt hole of the waterproof seal with the position of the release bolt. Then, install the waterproof seal so that the projection from the waterproof seal may go in the groove of stationary core. Otherwise, water may enter.
(9) Turn on and off the power and check the braking operation.
(10) Install the V-ring. Clean the lip of the V-ring and the contact surface of the lip, and apply a small quantity of grease to the lip surface, Strictly observe the mounting dimensions (B=4.5 mm). (See Fig. 21)
(11) Install fan 6 and cover ⑪. Apply a small quantity of locking agent (Three Bond 1102) to fan set bolt ⑳.
Note: The manual release bolt is optional for these models. When the release bolt is installed, remove it first before disassembling the unit.

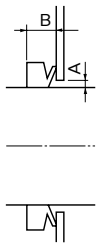
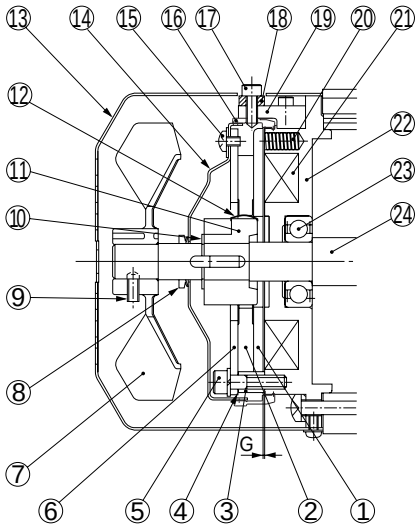
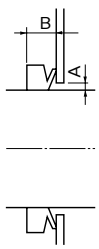


Fig. 21

<FB-1B, 2B1 and 3B> (See Fig.13 on page 13.)



(1) Remove release bolt ⑰ and manual release prevention spacer ⑱.
(2) Remove cover ⑬.
(3) Loosen fan set bolt ⑨ and remove fan ⑦.
(4) Pull out V-ring ⑧.
(5) Remove release brackets. (2 places)
(6) Remove waterproof cover mounting bolt ⑮, and remove waterproof cover ⑭.
(7) Slightly loosen assembling bolt ⑤ and remove spacer ③, gap adjusting shim ④, assembling bolt ⑤, and fixed plate ⑥ all together as a set. Exercise care so as not to remove assembling bolt alone; otherwise, the gap adjusting shim will drop.
(8) Install the waterproof seal between the stationary core and waterproof cover as shown in the construction drawing.
With an arrow in the waterproof seal facing to the loaded side, insert the waterproof seal. Align the release bolt hole of the waterproof seal with the position of the release bolt. Then, install the waterproof seal so that the projection from the waterproof seal may go in the groove of stationary core. Otherwise, water may enter.
(9) Check the gap G, and if it is substantially different from the specification, readjust the shim.
(10) Install the waterproof cover with the mounting bolt. Exercise care so that the gap (dimension A in Fig.14) between the hole of waterproof cover and motor shaft will be almost equal all around the circumference.
(11) Clean the surface of the waterproof seal.
(12) Install the waterproof seal between the stationary core and waterproof cover as shownin the construction drawing, and install the release fitting. Align the release bolt hole of the waterproof seal with the position of the release bolt, and install the waterproof seal along the edge of the waterproof cover or along the machined surface around the circumference of the stationary core. (Exercise care so that the waterproof seal will not snake; otherwise, water may enter.)
(13) Turn on and off the power and check the braking operation.
(14) Install the V-ring. Clean the lip of the V-ring and the contact surface of the lip, and apply a small quantity of grease to the lip surface. Strictly observe the mounting dimensions (dimension B). (See Fig.14.)
(15) Install fan ⑦ and cover ⑬. Apply a small quantiry of locking agent (Three Bond 1102) to fan set bolt ⑨. Finally, install release bolt ⑰ and spacer ⑱.

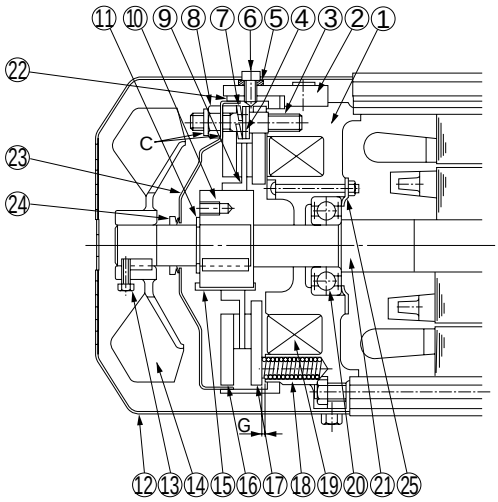


	FB-1B	FB-2B1	FB-3B
Dimension B	4.5mm	6mm	6mm

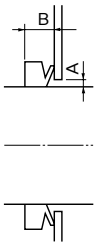
Fig. 22

<FB-5B, 8B, 10B, and 15B> (See Fig.13 and 14 on page 13.)

(1) Remove release bolt ⑥ and manual release prevention spacer ⑤.
(2) Remove cover ⑫.
(3) Remove spring pin ⑬ from FB-8B and FB-5B, and remove fan ⑭. Remove fan setting bolt ⑬ from FB-10B and FB-15B, and remove fan ⑭.
(4) Pull out V-rng ㉔.
(5) Loosen release fitting ② (2 places) and remove waterproof seal ㉒.
(6) Insert the feeler gauge between stationary core ① and armature core ⑰, and turn clockwise gap adjusting nut ⑧ attached to the end of stud bolt ③. When adjustment is impossible due to excessively large gap, reduce the number of adjusting washers ④. Alternately adjust the adjusting nuts arranged at three locations so that the gaps at three locations around the circumference will be as specified in Table 3.
(7) Install the waterproof cover so that the gap (dimension A in Fig.23) between the waterproof cover and motor shaft will be almost the same all around the cirumference. (Only when waterproof cover is removed)



(8) Clean the surface of the waterproof seal.
(9) Install the waterproof seal between the stationary core and waterproof cover as shown in the construction drawing, and install the release backet. Aligh the release bolt hole of the waterproof seal with the position of the release bolt, and install the waterproof seal along the edge of the waterproof cover or along the machined surface around the circumference of the stationary core. (Exercise care so that the waterproof seal will not snake; otherwise, water may enter.)
(10) Turn on and off the power and check the braking operation.
(11) Install the V-ring ㉔. Clean the lip of the V-ring and the contact surface of the lip, and apply a small quantity of grease to the lip surface. Strictly observe the mounting dimensions (dimension B). (See Fig.15.)
(12) Thoroughly apply waterproofing bond (Three Bond 1102) to the gap (section C) between the gap adjusting nut and stud bolt, as well as to that between the stud bolt and waterproof cover.
(13) Install fan ⑭ and cover ⑫. Finally, install release bolt ⑥.

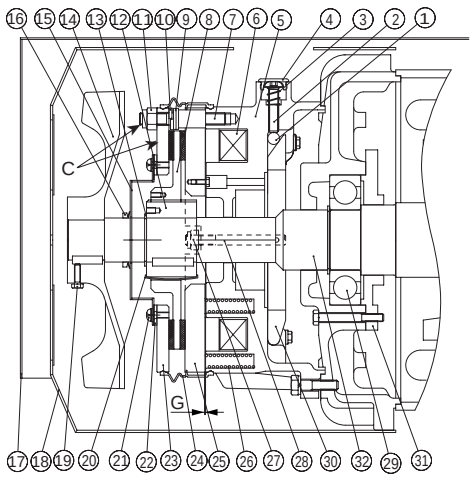


	FB-5B FB-8B	FB-10B FB-15B
Dimension B	6mm	6mm

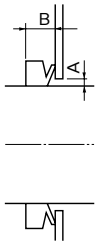
Fig. 23

<FB-20 and 30> (c.f.p.14 fig. 16 & 17)

(1) Romove outdoor cover ⑰, plug ④, and cover ⑪.
(2) Remove fan setting bolt ⑨ and fan ④.
(3) Pull out V-ring ⑥.
(4) Remove waterproof seal 24.
(5) Insert feeler gauge between stationary core ⑤ and armature core 25, and turn gap adjusting nut ⑪ attached to the end of stud bolt ⑦ clockwise. When it is impossible to adjust it due to excessively large gap, reduce adjusting washer ⑨. Alternately adjust the adjusting nuts arranged at three locations so that the gaps at three locations on the circumference may be regulated values in Table 3.
(6) Turn on and off the power and check the braking operation.
(7) Install waterproof cover ⑮ so that the gaps between the waterproof cover and motor shaft (dimension A in Fig. 24) may be almost equal. (Only when waterproof cover is removed.)



(8) Clean the surface of the waterproof seal.
(9) Install the waterproof seal 24 between the stationary core ⑤ and fixed plate 23 as shown in the construction drawing. (Exercise care so that the waterproof seal will not snake; otherwise, water may enter.)
(10) Install V-ring ⑯. Clean the lip of the V-ring and the contact surface of the lip, and apply a small amount of grease to the lip surface. Strictly observe the mounting dimensions (dimension B). (See Fig.24)
(11) Thoroughly apply waterproofing bond (Three Bond 1102) to the gap (section C) between the gap adjusting nut ⑪ and stud bolt ⑦, as well as to that between the gap adjusting not and fixed plate 23.
(12) Install fan ⑭, cover ⑮, plug ④ and outdoor cover ⑰.



	FB-20, 30
Dimension B	7mm

Fig. 24

3-5) Replacement of brake lining

When the thickness of the brake lining has reached the limit shown in Table 4 (when the brake gap has reached the limit shown in Table 3 on page 12 after gap adjustment in the case of FB-01A1, 02A1, 05A1, 01A, 02A, and 05A), ask us to replace the brake lining at our specialized plant.

Table 4 Dimensions of brake lining

Type of brake	Dimensions of brake lining	Initial thickness to (mm)	Limit thickness to (mm)
FB-01A1, FB-01A FB-02A1, FB-02A FB-05A1, FB-05A		7.0	
FB-1B		7.0	6.0
FB-2B1		8.8	7.8
FB-3B		9.0	8.0
FB-5B, 8B		10	6
FB-10B, 15B		11	7
FB-20, 30		16	12

At the beginning of the usage, prescribed brake torque might not outputted due to the friction surface. When this happens, rub the friction surfaces by turning on/off under the lightest loading as possible.

3-6) Replacement of V-ring and rubber seal (Outdoor type)

The waterproofing performance of the V-ring and rubber seal deteriorates as time goes by, so periodically replace them according to the Table 5.

Table 5 Type of parts and replacement term

	Name of part (Type)		
	Waterproofing seal	V-ring	Seal washer
FB-01A1, 02A1, 05A1 FB-01A, 02A, 05A	ET864WW-01	V-14A	For M4 × 3 pcs
FB-1B	ET628WW-01	V-16A	For M4 × 3 pcs
FB-2B1	ET591WW-01	V-20A	For M8 × 3 pcs
FB-3B	ET634WW-01	V-25A	For M8 × 3 pcs
FB-5B, 8B	DU685WW-01	V-28A	–
FB-10B, 15B	DY339WW-01	V-35A	–
FB-20, 30	EU934WW-01	V-45A	–
Recommended replacment term	3year	3year	3year

Note 1: FB-10A1 and 02A does not come with V-ring because totally enclosed non-ventilated type has no fan.

Note 2: We recommend V-ring manufactured by Forsheda (Standard material is nitrile rubber).

4. Maintenance and Inspection of CMB Brake

⚠ DANGER

- Do not handle the unit when cables are live. Be sure to turn off the power; otherwise, electric shock may result.
- When the unit is to be used for an elevator, do not release the brake of the unit during lifting the unit; otherwise, the unit may fall.
- Do not operate the unit with the brake released by the brake release bolt; otherwise, the unit may fall or go out of control.
- Inspect the function of brakes before operation; otherwise, the unit may fall or go out of control.
- Avoid adhesion of water, oil, or fat to the brake; otherwise, the unit may fall or go out of control due to the drop in the braking torque.

⚠ CAUTION

- Do not operate the motor with the brake without the fan cover after inspection and adjustment of gaps; otherwise, loose clothing caught in the motor with the brake may result in injury.
- Experience and skill is necessary for replacement of brake lining, so be sure to ask our specialized factory replacement.

The mechanical life of the CMB brake is 1,000,000 times. Periodically check the brake gap G. Long-time operation will cause abrasion of the brake lining, not allowing brake release.
Operation exceeding 1,000,000 times may cause abrasion and/or breakage of mechanical parts, allowing the unit to fall or go out of control.

4-1) Construction and operation

The construction of CMB brake is shown in Fig.16. A spring is used for braking operation (nonexcitation operation type).

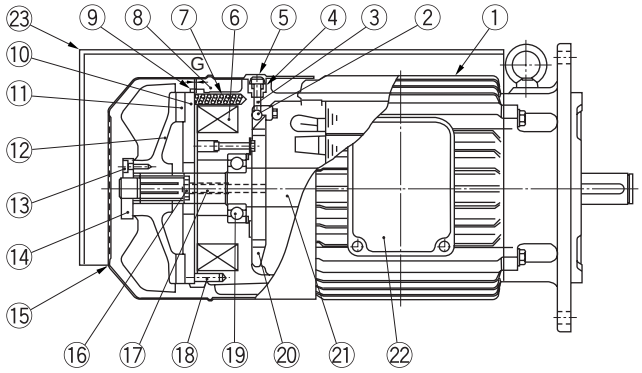


Fig. 16 CMB-20

No.	Part name
1	Motor
2	Roller
3	Brake release bolt
4	Auxiliary spring
5	Plug
6	Magnetic coil
7	Actuating spring
8	Stationary core
9	Dust seal
10	Amature core
11	Brake lining
12	Brake wheel
13	Bolt
14	Retention nut
15	Cover
16	Nut
17	Stud bolt
18	Retention pin
19	Ball bearing
20	Release lever
21	Motor shaft
22	Terminal box
23	Outdoor cover

Note 1: ㉓ is not installed in the indoor type.
Note 2: The shape of the outdoor cover ㉓ for the vertical outdoor type is different.

4-2) Manual releasing operation of CMB brake

To manually release the brake without turning on the power, opetate the brake release device in the following manner (Fig.16 on page 17):

(1) Remove plug ⑤, and turn release bolt ③ in the loosening direction (clockwise with a hexagon wrench (for M8 bolt with a hole). Then the brake will be released. (Remove the lid in the window section of outdoor cover ㉓ of the outdoor type.)

(2) In order to return to the original state after releasing the brake, turn (approx. 5-7 turns) release bolt ③ with a hexagon wrench in the braking direction (counterclockwise) to the extent that the bolt head will not project from cover ⑮. Then install plug ⑤ in the original position. (Install the lid in the window section of the outdoor cover of the outdoor type.)

> Negligence of the installation of plug ⑤ or the lid in the window section of the outdoor cover will result in loss of the dustproofing or waterproofing effect. Do not turn on or off the power while the brake is manually released; otherwise, release lever ⑳ may be broken.

4-3) Adjustment of gap

Braking will be possible more than 1,000,000 times before brake lining ⑪ must be replaced. When the gap G of the brake exceeds 1.2 mm before 1,000,000-time operation, make adjustment in the following manner (Fig.16 on page 17):

(1) Remove plug ⑤ and cover ⑮. (Remove outdoor cover ㉓ first in the case of the outdoor type.)

(2) Remove dustproof seal ⑨.

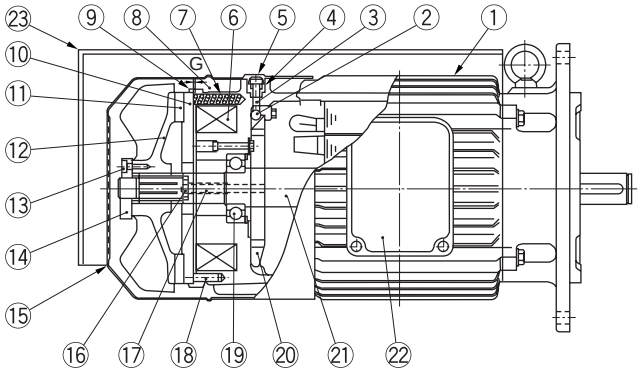
(3) Remove bolt ⑬ with a hexagon wrench. (2 places)

(4) Turn brake release bolt ③ clockwise to completely release the brake, and tighten retention nut ⑭ until brake lining ⑪ is about to be in contact with brake wheel ⑫.

(5) Tighten bolt !3 with a hexagon wrench. (2 plases)

(6) Return brake release bolt to the original position, and check that the gap G is 0.5-0.7 mm.

(7) Install dustproof seal ⑨, cover ⑮, and plug ⑤. (Install outdoor cover ㉓ in the case of the outdoor type.)



5. Troubleshooting

When some trouble occurs the motor with the brake, take appropriate measures without delay according to Table 6.

Table 6 Troubleshooting

Details of trouble			Cause	Correction
The motor does not run without a load.			Power failure	Contact the electric power company.
			Defective electric circuit	Check the circuit.
			Fuse melting	Replace the fuse with a new one.
			Operation of protective device	Remove the cause of operation and reset the device.
			Load locking	Check the load and safety device.
			Poor switch contact	Adjust the contact section.
			Disconnection of motor stator coil	Repair at the specialized factory.
			Breakage of bearing	Repair at the specialized factory.
			3-phase is functioning as single-phase.	Check the power supply with a voltmeter. Check the motor, coil in the transformer, contactor, fuse, etc. and repair or replace then.
			Rusting on break friction surface	Clean the brake (lining) at the specialized factory.
			Poor adjustment of brake gap	Readjust the brake gap. (See pages 11 and 13.)
The motor runs without a load	When a load is applied	The switch is heated.	Insufficient capacity of switch	Replace the switch with a specified one.
			Overload	Lower the load to the specified value.
		Fuse melting	Insufficient capacity fuse	Replace the fuse with a specified one.
			Overload	Lower the load to the specified value.
		The speed will not increase and the motor is overheated.	Voltage drop	Contact the electric power company.
			Overload	Lower the load to the specified value.
			Short-circuited motor stator coil	Repair at the specialized factory.
		The motor stops.	The key missing	Install a key.
			The bearing burned.	Repair at the specialized factory.
			Poor adjustment of protective device	Adjust the protective device.
	The motor runs in the reverse direction		Connection error	Change the connection.
	Fuse melting		The outlet wire is short-circuited.	Repair at the specialized factory.
			Poor contact between motor and starder	Complete the connection.
Excessive temperature rise			Overload	Lower the load to the specified value.
			Voltage drop or voltage rise	Contact the electric power company.
			The ambient temperature is high.	Improve the ventilation method.
The motor produces abnormal sound.			Entry of foreign matter.	Remove foreign matter.
			Damaged bearing	Repair at the specialized factory.
			Poor adjustment of brake gap	Adjust the brake gap. (See pages 16, 17, 18,19 and 22.)
			Abrasion of brake lining	Replace the brake lining with a new one. (See page 20.)
			Burning of magnetic coil in the brake	Replace the magnetic coil with a new one at the specialized factory.
			Broken rectifier	Replace the rectifier with a new one.
			Dislocated or broken leaf spring in the brake boss section	Install a normal leaf spring at the specialized factory.
			In the case of CMB brake, excessive tightening of retention nut during gap adjustment	Make readjustment.
The brake does not work sufficiently.		No braking operation	Missing brake release bolt	Install the brake release bolt.
			Poor adjustment after disassembly	Make readjustment at the specialized factory.
		The brake slips. (braking time becomes longer)	The fast braking action is not adopted.	Change the action to the fast braking action. (See pages 5~7)
			Entry of foreign matter is the brake lining section or adhesion of oil	Remove foreign matter at the specialized factory and prevent entry of foreign matter. Wipe the lining surface with a dry cloth.
			Abrasion of brake lining	Adjust the brake lining. Replace the brake lining with a new one at the specialized factory.
			Irregular brake gap	Adjust the brake gap.
			Overload	Lower the load to the specified value.
			Insufficient tightening of brake release bolt	Tighten the release bolt correctly.

6. Warranty

The scope of our warranty for our products is limited to the range of our manufacture.

Warranty (period and contents)

Warranty Period	The warranty for new Cyclo, units shall be 24 months from date of shipment.
Warranty Condition	In the event that any problem or damage to the Product arises during the "Warranty Period" from defects in the Product whenever the Product is properly installed and combined with the Buyer's equipment or machines, maintained as specified in the maintenance manual, and properly operated under the conditions described in the catalog or as otherwise agree upon in writing between the Seller and the Buyer or its customers; the Seller will provide, at its sole discretion, appropriate repair or replacement of the Product, without charge, at a designted facility, except as stipulated in the "Warranty Exclusions" described below. However, if the Product is installed or integrated into the Buyer's equipment or machines, the Seller shall not reimburse the cost of: removal or re-installation of the Product or other incidental costs related thereto, any lost opportunity, any profit loss or other incidental or consequential losses or damages incurred by the Buyer or its customers.
Warranty Exclusions	Not withstanding the above warranty, the warranty as set forth herein shall not apply to any problem or damage to the Product that is caused by : 1. installation, connection, combination or integration of the Product in or to the other equipment or machine that is rendered by any person or entity other than the Seller ; 2. insufficient maintenance or improper operation by the Buyer or its customers, such that the Product is not maintained in accordance with the maintenance manual provided or designated by the Seller ; 3. improper use or operation of the Product by the Buyer or its customers that is not informed to the Seller, including, without limitation, the Buyer's or its customers' operation of the Product not in conformity with the specifications, or use of lubricating oil in the Product that is not recommended by the Seller ; 4. any problem or damage to any equipment or machine to which the Product is installed, connected or combined, or on any specifications particular to the Buyer or its customers ; 5. any changes, modifications, improvements or alterations to the Product or those functions that are rendered on the Product by any person or entity other than the Seller ; 6. any parts in the Product that are supplied or designated by the Buyer or its customers ; 7. earthquake, fire, flood, sea-breeze, gas, thunder, acts of God or any other reasons beyond the control of the Seller ; 8. normal wear and tear, or deterioration of the Product's parts, such as bearings, oil-seals ; 9. any other troubles, problems or damage to the Product that are not attributable to the Seller.