FANUC AC SPINDLE MOTOR series

OPERATOR'S MANUAL

B-53424E/07

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In this manual, we endeavor to include all pertinent matters.
There are, however, a very large number of operations that must not or cannot be performed, and if the manual contained them all, it would be enormous in volume.
It is, therefore, requested to assume that any operations that are not explicitly described as being possible are "not possible".

CONTENTS

I FANUC AC SPINDLE MOTOR

1. GENERAL

This chapter describes the operating procedure on FANUC AC SPINDLE MOTOR used for driving the spindle of NC machine tool.
To prolong the life of the spindle motor and to prevent an unexpected accident, build a practical maintenance plan according to the operating environments and conditions by making reference to this chapter, and carry out the maintenance and inspection.

2. INSTALLATION AND STORAGE

2.1 Installation Place

Install the AC spindle motor in places meeting the following conditions.

1) The installing surface is flat and rigid, and considered to minimize the influence of machine's vibration.
2) Sufficient air can be supplied to the cooling fan motor. Accessible to the cooling unit for inspection and maintenance.
3) Minimum dust and low humidity.
4) Places not exposed to the splash of the cutting fluid and oil.
5) The ambient temperature is 0 ~ 40 C.

2.2 Connection

For the details of the connection between the AC spindle motor and the AC spindle servo unit, refer to the general connection diagram attached to each machine.

Note) A three-phase fan motor is used for cooling the AC spindle motor 18 22 30 40. Make the connection according to the order of phases indicated at the terminal.

2.3 Storage

Don't leave the motor outdoor. Store it indoor free from extreme change in temperature and high humidity.

2.4 Power Supply

2.4.1 Installing an earth leakage circuit breaker

Be sure to use an earth leakage circuit breaker or a leak alarm in the power supply of factory or the machine for prevention of fire and operator's safety.
As the AC spindle servo unit employs the transistor pulse width modulation control system, a high frequency leakage current flows through the stray capacity of cable and motor, but the 50/60Hz component is less than the non-operating current (15mA) of ordinary high-sensitivity high-speed earth leakage circuit breaker.
In some types of the earth leakage circuit breaker and alarm, a mal-function by high frequency current is likely to occur or some are operated by the rush current (impulsive wave) when the power is turned on. Select the earth leakage circuit breaker or alarm unit having the following performance, by consulting with the manufacturer.

1) Not sensitive to a high frequency component for avoiding an unnecessary operation for a high frequency leakage current without spoiling the protective characteristic.
2) Not operated by a impulsive wave.

2.4.2 Installing power capacitors

The power-factor of input power supply at driving the AC spindle motor is 0.9 or higher. Don't install power capacitors in the input power supply of the AC spindle servo unit.

2.5 Allowable Radial Load

Set the radial load of the motor output shaft to the radial load specified in the table below.

Motor	1	2	3	6	8/12/15	18.22	30/40
Allowable radial load	40kg	90kg	150kg	200kg	300kg	450kg	500kg

Note) The radial loads are the values obtained when the point of application is taken at the output axis end.

3. TEST RUN

Check the following points when the motor is initially operated after the installation or after the change of installation place.

3.1 Check Items before Starting Operation

1) Connection is made correctly.
2) The joints are completely tightened or insulated.
3) The motor fixing screws are firmly tightened.
4) The motor is grounded.

3.2 Check Items after Starting Operation

1) The speed command value coincides with the motor speed.
2) The load meter (output meter) indicates reasonable value.
3) The motor operates without abnormal noise or vibration.
4) The bearing temperature or the exhaust temperature is not suddenly increased.

3.3 Check after Stored for a Long Period

Make trial running when operating the motor after it has been stored for a long period (over several months).

4. MAINTENANCE

4.1 Periodical Maintenance Items

The periodical maintenance items are as shown below.

Inspection period	Inspection item
Routine maintenance and inspection (daily) (Verify during operation)	① Rotation speed ② Abnormal vibration ③ Abnormal noise ④ Ventilation (Rotation of fan motor) ⑤ Bearing temperature ⑥ Case temperature ⑦ Abnormal smell
Maintenance and inspection at every 6 months (1 year at least)	① Bearing check ② Fan motor cleaning ③ Ventilation port cleaning ④ Insulation resistance measurement

The inspection interval is for the usual operation.
Set an appropriate interval according to the operating conditions.

4.2 Checking the Bearing

For FANUC AC Spindle Motors, a grease sealed bearing is used and it is unnecessary to replenish grease. Check the following points periodically. The standard interval is 6 months.

1) Temperature increase in the bearing
   The maximum allowable temperature is 80°C. The allowable temperature increase at a room temperature of 40°C is 40°C.

2) Noise and vibration
   A defect in the bearing is detected by an abnormal noise or vibration. Pay attention to these points during operation.

4.3 Cleaning the Fan Motor

If the finger guard or ventilation port of the fan motor is dusty, the cooling performance of the fan motor is lowered spoiling the ratings and causing a defect by heating. The recommended inspection period is 6 months.
If the finger guard or the ventilation port is clogged with dust, clean it immediately.

5. TROUBLESHOOTING (TROUBLE CHECK LIST)

Item	Symptom	Possible cause	Remedy
1	Abnormal vibration	(1) Influence of mounting and load (2) Defective speed detector (3) Defective AC spindle servo unit	(1) Check the load condition. (2) Contact with FANUC service. (3) Contact with FANUC service.
2	Motor temperature is abnormally high.	(1) Defective cooling (2) Abnormally loaded	(1) Check and clean the fan motor. (Contact with FANUC service.) (2) Check the load condition. (Contact with FANUC service.)
3	Abnormal noise	(1) Defective speed detector (2) Defective bearing (3) Motor trouble (4) Irregular mounting or load	(1) Contact with FANUC service. (2) Contact with FANUC service. (3) Contact with FANUC service. (4) Check the load condition.
4	No output	(1) Lowered input supply voltage (2) Motor trouble	(1) Check the input supply voltage. Check the transformer setting. (Contact with FANUC service.) (2) Check the motor temperature. (Contact with FANUC service.)
5	Blown fuse	(1) Defective insulation (2) Defective AC spindle servo unit	(1) Contact with FANUC service. (2) Contact with FANUC service.
6	Acceleration/ deceleration time is too long. Orientation fails. Rotation speed is different from the command. Rotation fails. Others	(1) Defective AC spindle servo unit	(1) Contact with FANUC service.

Item	Symptom	Possible cause	Remedy
7	Earth leakage circuit breaker operates.	(1) Defective insulation of the motor. (2) Malfunction of the circuit breaker	(1) Contact with FANUC service. (2) Replace the circuit breaker.

II. FANUC AC SPINDLE SERVO UNIT

1. GENERAL

This chapter describes the handling of the FANUC AC SPINDLE SERVO UNIT that controls the FANUC AC SPINDLE MOTOR used for driving the spindle of NC machine tool.
Handle the unit correctly according to the operating environment and conditions by making reference to this chapter.

2. INSTALLATION AND STORAGE

2.1 Installation of the AC Spindle Servo Unit

The primary installation conditions are as follows.

Ambient temperature: 0 ~ 55°C
Relative humidity : 95% max. (no dewing)
Vibration : 0.5G max.

2.2 Installation of the Machine/System Containing the AC Spindle Servo Unit

Unit

1) Take sufficient space for maintenance in front of the door of the machine/system.
2) Don't block the air flow of the cooling unit.

2.3 Connection

2.3.1 Check of power supply voltage

Before connecting the power supply, check the power supply voltage and make the following setting according to the supply voltage value.

Supply voltage	Measure
170 ~ 220 V	Set the toggle switch to the 200V position.
221 ~ 253 V	Set the toggle switch to the 220V position.
Over 254 V	Use an insulation transformer, and set the input voltage to 200V and set the toggle switch to the 200V position.

2.3.2 Connection of protective earth

Before connecting the power supply, ground the connection terminal "G".

2.3.3 Connection of power supply

Connect the power lines to the unit after grounding the terminal "G".
Phase rotation of the power supply is not specified for the AC spindle servo unit.

2.4 Storage

When the NC machine tool is not immediately used after installing the AC spindle servo unit or motor, cover it with a vinyl sheet for dust protection and store it in a dry place.

2.5 Power Supply

For the precautions on the power supply, refer to "Chapter I AC Spindle Servo Motor, 2.4".

3. TEST RUN

Check the following items when operating the machine initally after the installation or the change of installation place.

3.1 Check before Starting Operation

1) The signal line connector and power cables are correctly and tightly connected.

2) The magnetics cabinet is securely grounded.

3.2 Precautions before Operation

1) The door of the magnetics cabinet containing the AC spindle servo unit must be closed during operation.

2) When the door of the magnetics cabinet needs to be opened, a personnel who is trained in the maintenance of the system must open after the input breaker and the power source switch to the magnetics cabinet turning off.

3) A high voltage is applied to the PCB or the cables during operation. Take suffient care not to touch the tool or hand when it is inevitable to open the cabinet door during operation. Also in this case, the person trained in the maintenance of the system must do so.

4. MAINTENANCE

1) When a filter is used in the magnetics cabinet, clean it once a month.

2) A cooling fan is used in the upper part of the servo unit. If extreme dust is adhered to the fan, the cooling efficiency is lowered and the rated performance is not obtained, causing a defect in the unit. Clean the fan periodically. The standard cleaning interval is 6 months.

5. TROUBLESHOOTING

The trouble contents are indicated by the LED on the PCB in the AC spindle servo unit. The LED mounting position and indicating style are different by PCB. Refer to "8. Mounting Diagram" of this chapter.

5.1 Alarm Display

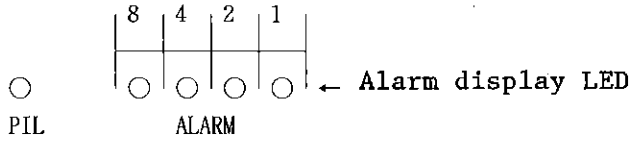
There are two methods of alarm display. Although the method is different by PCB, the contents indicated by the alarm No. are the same. Typical alarms and countermeasures are shown below.

5.1.1 When AL-□□ is displayed (Applicable Fig. No. A20B-1001, 0120)

Display	Meaning of display	Corrective action
Al-01	Motor overheat.	(1) Check the cutting condition and the tool for wear. (2) Check the fan motor for cooling the motor.
AL-02	Excessive speed deviation	(1) Check the cutting condition and the tool for wear. (2) Check the fuse for continuity.
AL-03	Blown DC link fuse	(1) Check the fuse (F7) of the DC link for continuity, and replace it if necessary.
AL-04	Blown input fuse	(1) Check the fuses (F1,2,3) of the AC input section for continuity, and replace them if necessary.
AL-08	Overvoltage	(1) Check the toggle switch setting. (2) Check the input supply voltage.
AL-09	Radiator is over-heated.	(1) Check the cutting condition to see whether the operation is overloaded.
AL-10	Lowered input supply voltage	(1) Check the input supply voltage (low voltage).
AL-11	Overvoltage of DC link	(1) Check the input supply voltage.

When the other alarms occur, contact to FANUC service.
In such cases, verify the operating status before occurrence of defect and the LED display status.

5.1.2 When the alarm lamp on the PCB is lighted
(PCB drawing No. A20B-0009-0531 ~ 9, A20B-1000-0690 ~ 9, A20B-1000-0700 ~ 1, A16B-1100-0080)



Alarm display				Meaning of display	Countermeasure
8	4	2	1		
			○	Motor overheat.	(1) Check the cutting condition and the tool for wear. (2) Check the fan motor for cooling the motor.
		○		Excessive velocity deviation	(1) Check the cutting condition and the tool for wear. (2) Check the fuse for continuity.
		○	○	Blown DC link fuse	(1) Check the fuse (F7) of the DC link for continuity and replace it if necessary.
	○			Blown input fuse	(1) Check the fuses (F1,2,3) of the AC input section for continuity, and replace them if necessary.
○				Overvoltage	(1) Set the toggle switch setting. (2) Check the input supply voltage.
○			○	Radiator is over-heated.	(1) Check the condition to see if the operation is overloaded.
○		○		Lowered input supply voltage	(1) Check the input supply voltage (low voltage).
○		○	○	Overvoltage of DC link	(1) Check the input supply voltage. (2) Check the DC link voltage.

When the other alarms occur, contact to FANUC service.
In such cases, verify the operating status before occurrence of defect and the LED display status on PCB.

5.2 Power ON Lamp PIL (Green) Is Not Lit

For the fuse mounting position, refer to "8. Mounting diagram" of this chapter.

① PCB No.
A20B-1001-0120, A20B-0009-0530 ~ 9, A208-10000690 ~ 9, A20B-1000-0700 ~ 1

Item	Cause of defect	Check method	Countermeasure
1	AC power is not supplied.	Check the supply voltage at the power input terminals R, S and T.	
2	The fuses F4a and b are blown.		Replace the fuses F4a and b5A.
3	The fuse AF1 or the fuse resistor FR1/2 is blown. (Note 1)	Check if the alarm LED is lit for the fuse AF1. Check if the fuse resistor FR1 or FR2 is blown.	Check if the pulse generator cable is shorted and the position coder cable for operation is shorted. Replace the fuse AF1 or the fuse resistor FR1/2 if necessary.

Note 1) In the PCB drawing No. A20B-0009-0530 ~ 9, A20B-1000-0690 ~ 9 and A20B-1000-0700 ~ 1, use the alarm fuses AF2/3 instead of the fuse resistor FR1/2.

② PCB drawing No. A16B-1100-0080, A16B-1100-0090 * 2

Item	Cause of defect	Check method	Countermeasure
1	AC power is not supplied.	Check the supply voltage at the power input terminals R, S and T.	
2	The fuse F1 is blown.		Replace the fuse F1 (5A).
3	The fuse AF1 or the fuse resistor FR1/2 is blown.	Check if the alarm LED is lit for the fuse AF1.	Replace the fuse AF1 or the fuse resistor FR1/2.

6. PRECAUTIONS ON REPLACEMENT OF FUSE

If the fuse is blown immediately after being replaced, the other cause must be expected.
Verify the alarm No. and the operating status before the fuse is blowing, and contact with FANUC service.
Before replacing the fuse, please read the following precautions. For the fuse mounting position, refer to "8. Mounting diagram" of this chapter.

1) Before touching to the fuse, turn off the main switch of the magnetics cabinet and the switch of the power source to the cabinet.
2) When loosening the screws, take care not to loss the washers.
3) After replacing the fuse, mount the fuse cover.
4) Be sure to close the door of the magnetics cabinet when re-starting operation.

7. SPARE PARTS

Reserve the spare parts (fuses) of the AC spindle servo unit under operation.

7.1 AC Spindle Servo Unit Model 1/2/Compact 3 (fuse specifications A06B-6052-K010)

Fuse	Specification / Drawing No.	1/2/compact 3
		K010
Fuse (0.3A)	A60L-0001-0175/03.A	2
Fuse (5.0A)	A60L-0001-0031/5A	1
Alarm fuse (3.2A)	A60L-0001-0046/3.2	1
Surge absorber	A50L-2001-0155/20D220	2
Surge absorber	A50L-2001-0155/20D431	1

7.2 AC Spindle Servo Unit Model 3 ~ 22 (fuse specifications A06B-6055-KXXX)

Fuse	Specification / Drawing No.	3/6 K003	8 K004	12 K005	3/6 K006	8 K008	12 K012	15 K015	18 K018	22 K022
Fuse (50A)	A60L-0001-0147 (25FH50)	1			3					
Fuse (75A)	A60L-0001-0127/ 15FH75	3			1					
Fuse (100A)	A60L-0001-0145 (25SH100)		4	1		4	3			
Fuse (140A)	A60L-0001-0149 (25SH140B)			3			1	4	4	
Fuse (150A)	A60L-0001-0163 (25SH150)									4
Fuse (20A)	A60L-0001-0197/ PC1F-20	2			2					
Fuse (30A)	A60L-0001-0197/ PC1F-30		2	2		2	2	2		
Fuse (40A)	A60L-0001-0197/ PC2F-40								2	
Fuse (50A)	A60L-0001-0197/ PC2F-50						2			2
Alarm fuse (3.2A)	A60L-0001-0046/3.2	1	1	1	1	1	1	1	1	1
Fuse (0.3A)	A60L-0001/0175/0.3A	2	2	2	2	2	2	2	2	2
Fuse (1.0A)	A60L-0001/0175/1.0A	1	1	1	1	1	1	1	1	1
Fuse (5.0A)	A60L-0001/0031/5A	2	2	2	2	2	2	2	2	2
Surge absorber	A50-2001/0155/ 20D431				4	4	4		4	4
Surge absorber	A50L-2001-0062/ 441-12	4	4	4				4		
Unit specification No.	A06B-6055-HXXX (internal connection)	H003/ H006	H008	H012	H103/ H106	H108	H112	H115	H118	H122
	A06B6055-HXXX (external connection)	H004/ H007	H009	H013	H203/ H206	H208	H212	H215	H218	H222

Note) The fuses specified in the unit specification A068-6044-HXXX are the same as those specified in A068-6055-HXXX.

7.3 AC Spindle Servo Unit Model 30/40 (fuse specifications A06B-6044-KXXX)

Fuse	Specification / Drawing No.	30	40
		K028	K029
Fuse (225A)	A60L-0001-0183/225A (CR2L-225)	4	
Fuse (260A)	A60L-0001-0183/260A (CR2L-260)		4
Fuse (0.3A)	A60L-0001-0175/0.3A	4	4
Fuse (5.0A)	A60L-0001-0031/5A	5	5
Alarm fuse (3.2AS)	A60L-0001-0075/3.2	2	2
Alarm fuse (3.2A)	A60L-0001-0046/3.2	1	1
Surge absorber	A50L-2001-0155/20D431	3	3
Surge absorber	A50L-2001-0062/441-12	1	1

8. MOUNTING DRAWING

8.1 Location of PCB Parts

8.1.1 Model 1/2/compact 3

8.1.1(a) A16B-1100-0080 (the upper one of two-stage PCB)

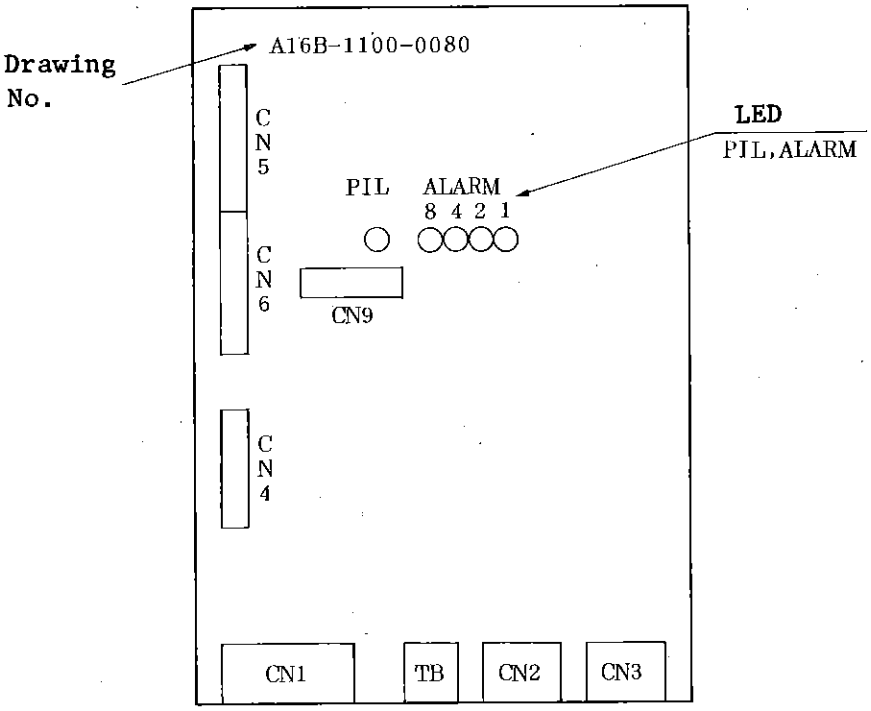


Fig. 8.1(a)

8.1.1(b) A16B-1100-0090～92 (the lower one of two-stage PCB)

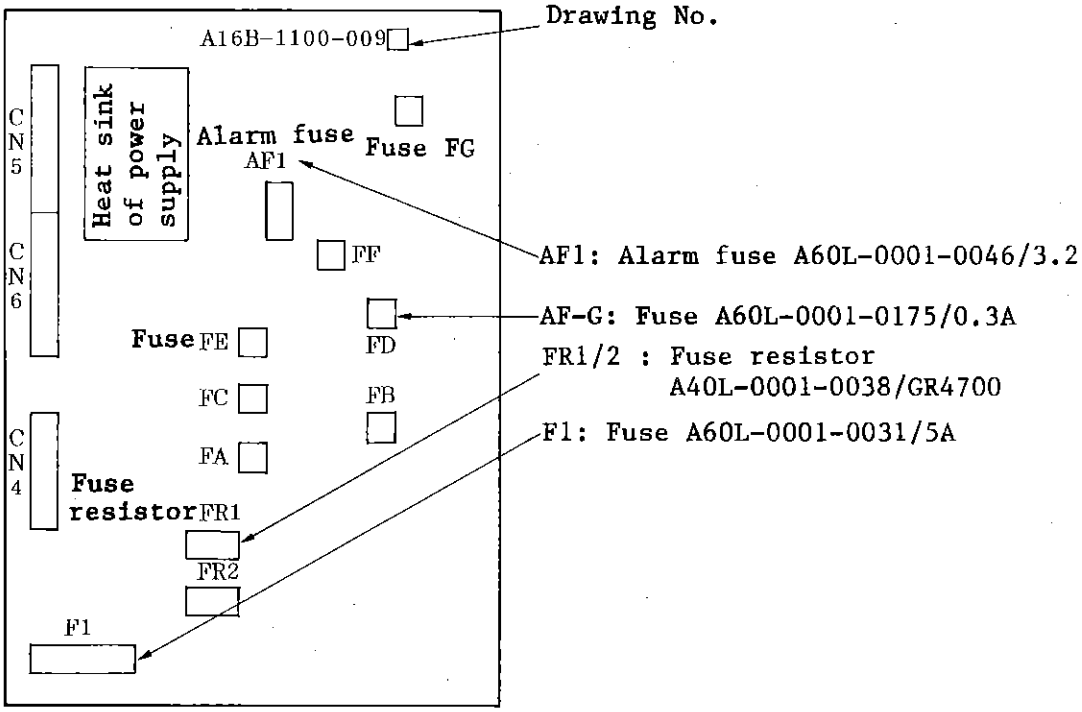


Fig. 8.1(b)

8.1.2 Model 3～22 A20B-0009-0530～9, A20B-1000-0690～9

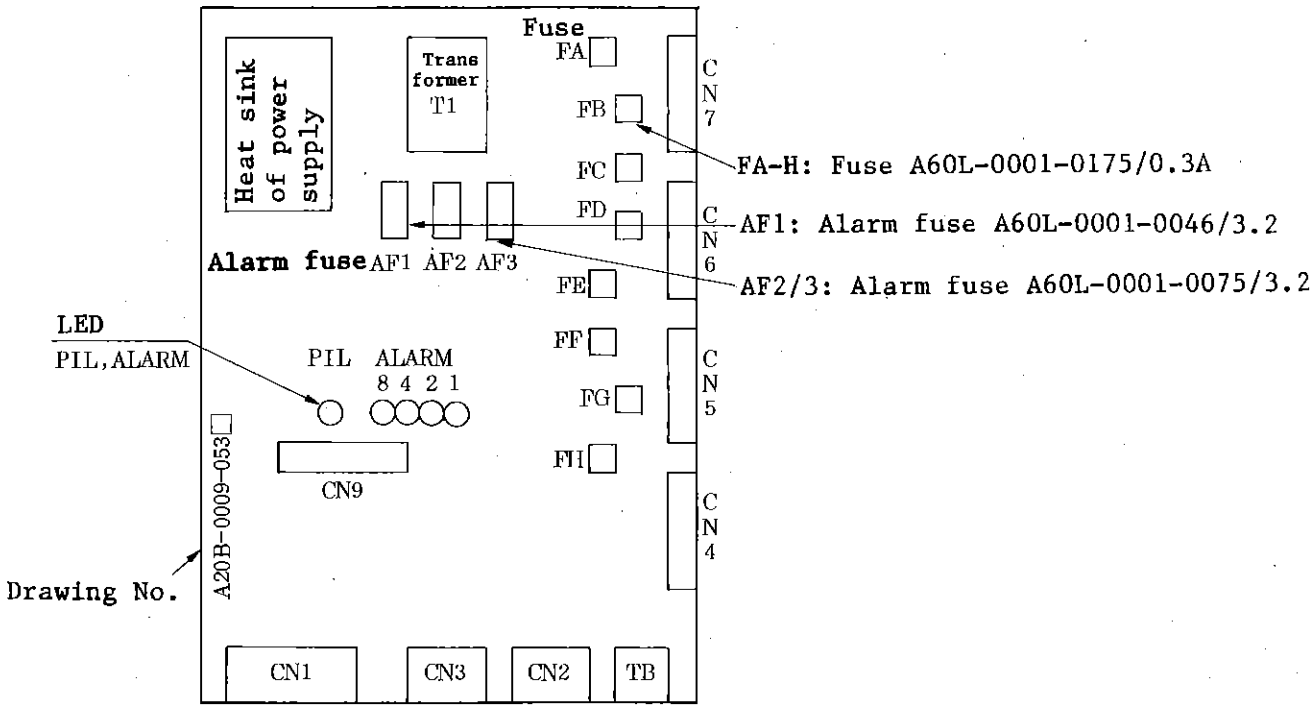


Fig. 8.1(c)

8.1.3 Model 30/40 A20B-1000-0700～1

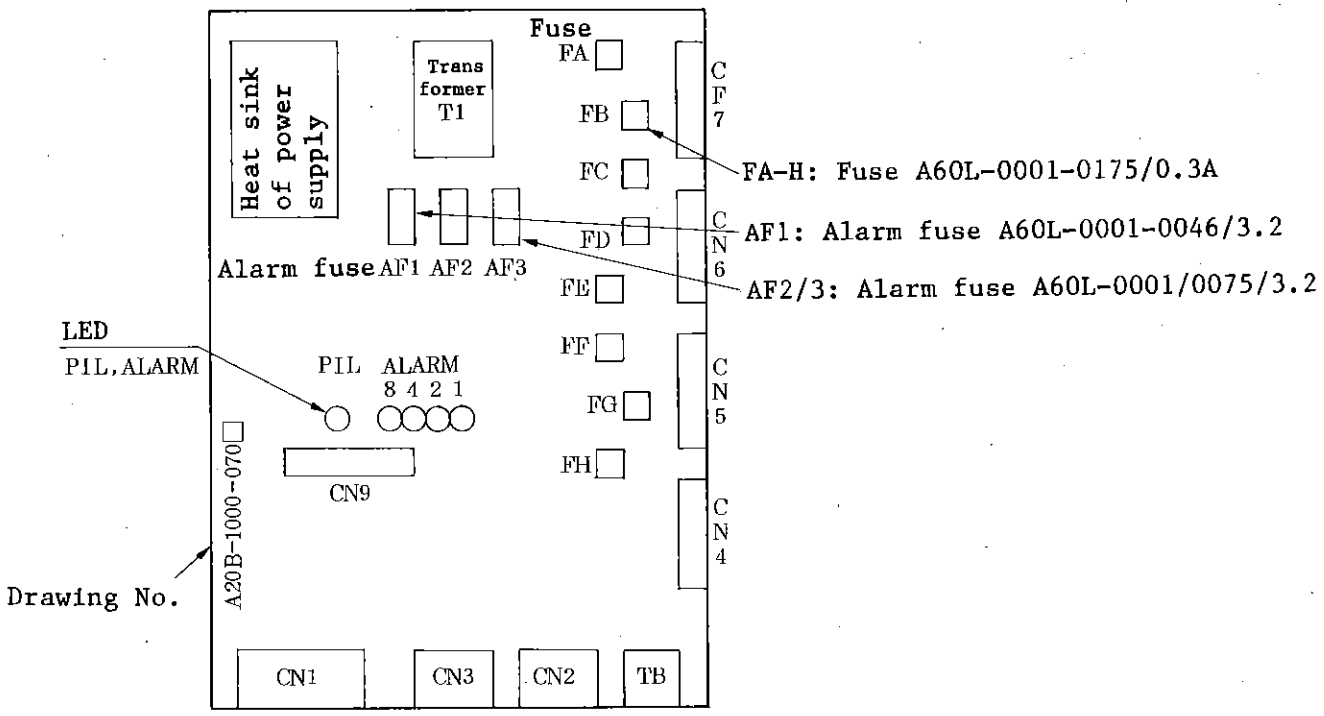


Fig. 8.1(d)

8.1.4 Model 3～22 (digital) A20B-1001-0120

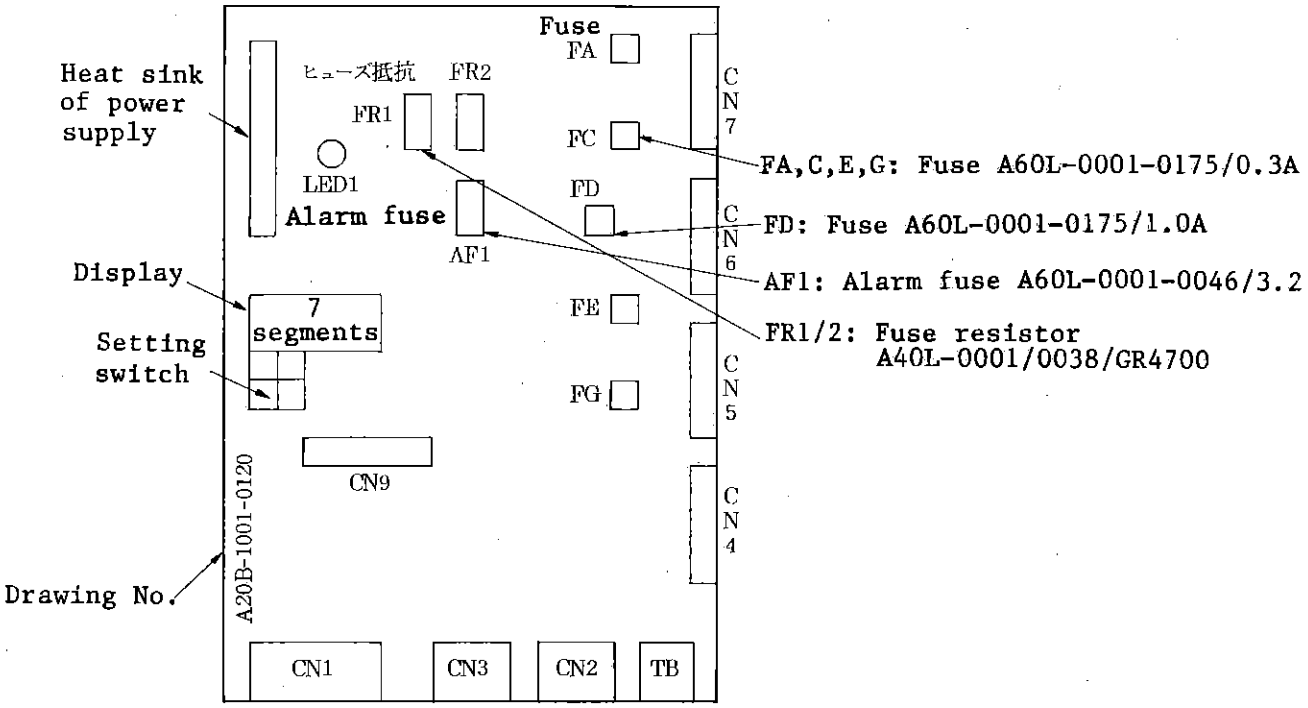


Fig. 8.1(e)

8.2 Location of Unit Parts

8.2.1 AC spindle servo unit model 1/2/compact 3 A06B-6052-1001/002/003

The input fuse of the control power supply transformer of the AC spindle servo unit model 1/2/compact 3 is mounted on the two-stage PCB A16B-1100- 0090 ~ 92.

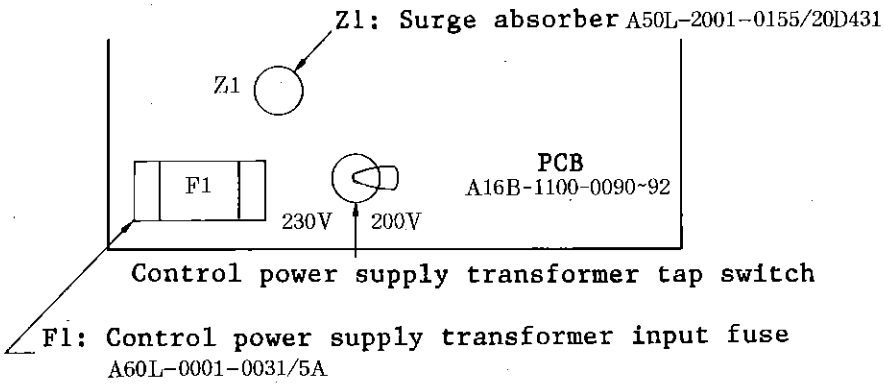


Fig. 8.2(a)

8.2.2 AC spindle servo unit model 3/6 A06B-6055-H103/203/106/206

The fuses of the AC spindle servo unit model 3/6 are mounted on the terminal block with fuse holder.

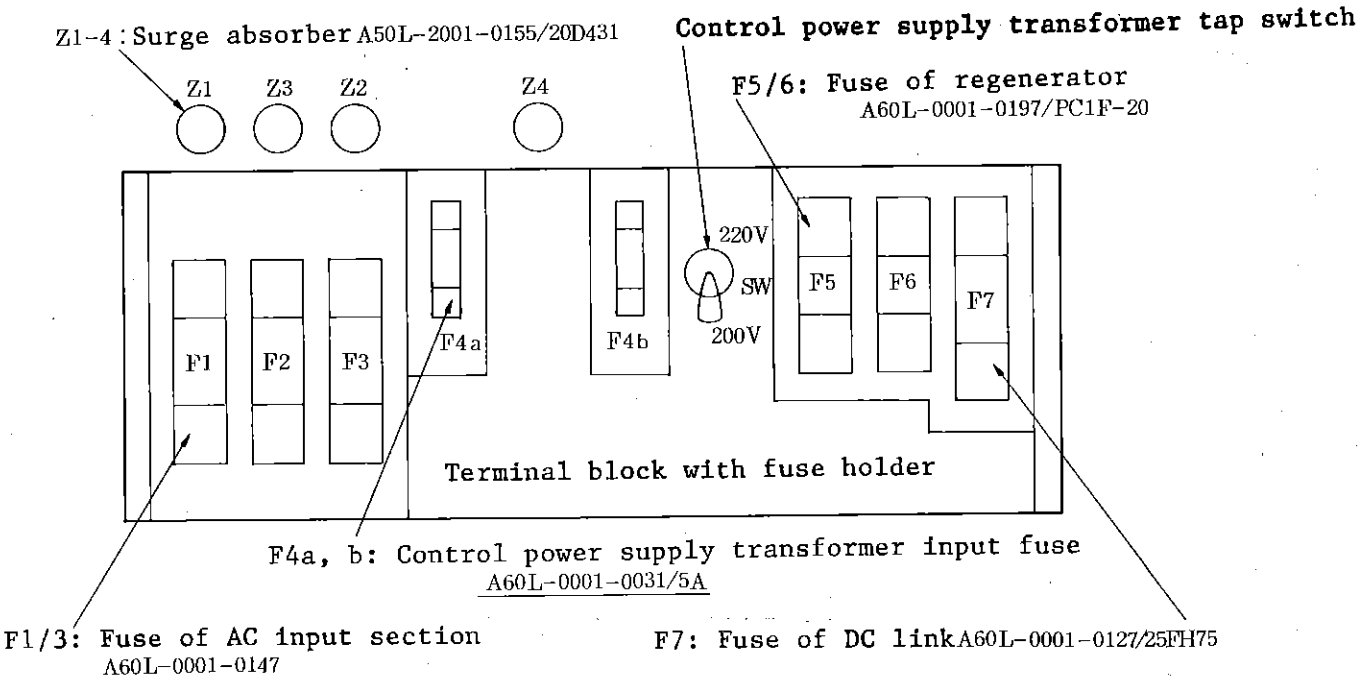


Fig. 8.2(b)

8.2.3 AC spindle servo unit model 8/12 A06B-6055-H108/208/112/212

The fuses of the AC spindle servo unit model 8/12 are mounted on the terminal block with huse holder.

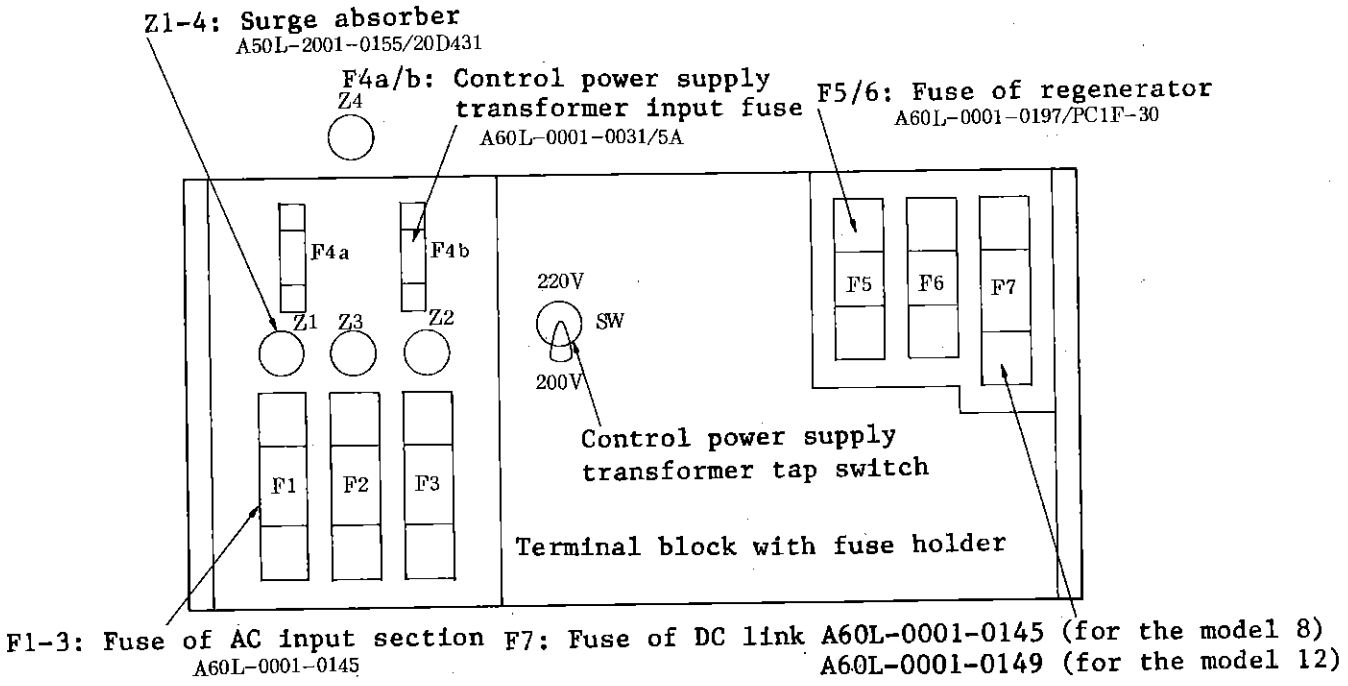


Fig. 8.2(c)

8.2.4 AC spindle servo unit model 15 A06B-6055-H115/215

The fuses of the AC spindle servo unit model 15 are mounted on the terminal block with fuse holder and within the unit.

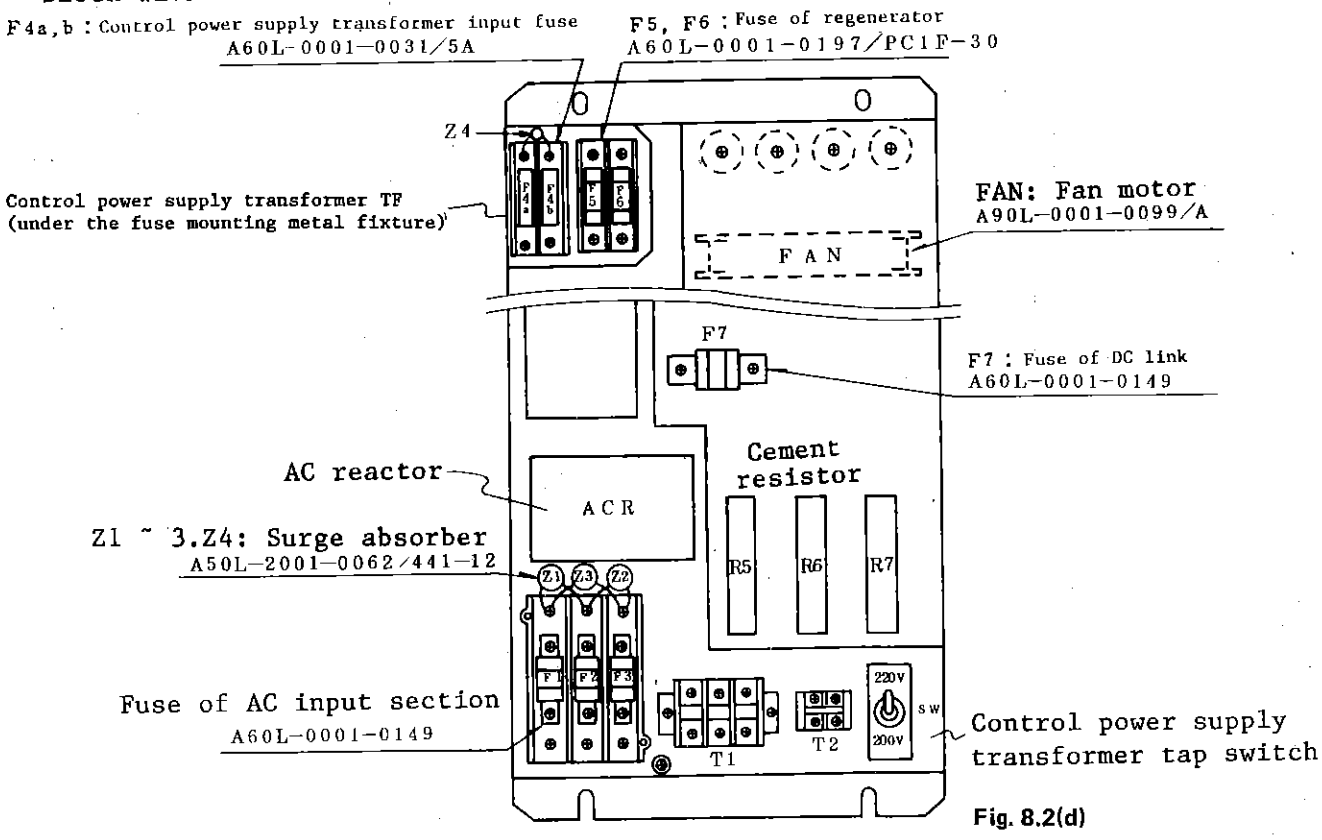


Fig. 8.2(d)

8.2.5 AC spindle servo unit model 18/22 A06B-6055-H118/218/122/222

The fuses of the AC spindle servo unit model 18/22 are mounted on the terminal block with fuse holder and within the unit.

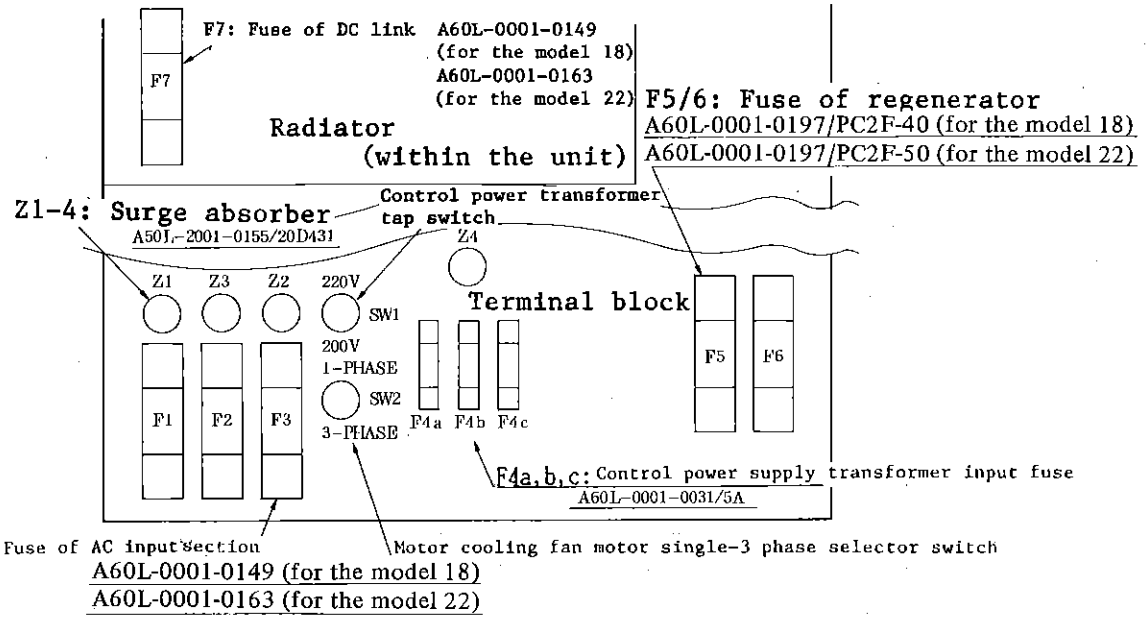


Fig. 8.2(e)

8.2.6 AC spindle servo unit model 30 A06B-6044-H130

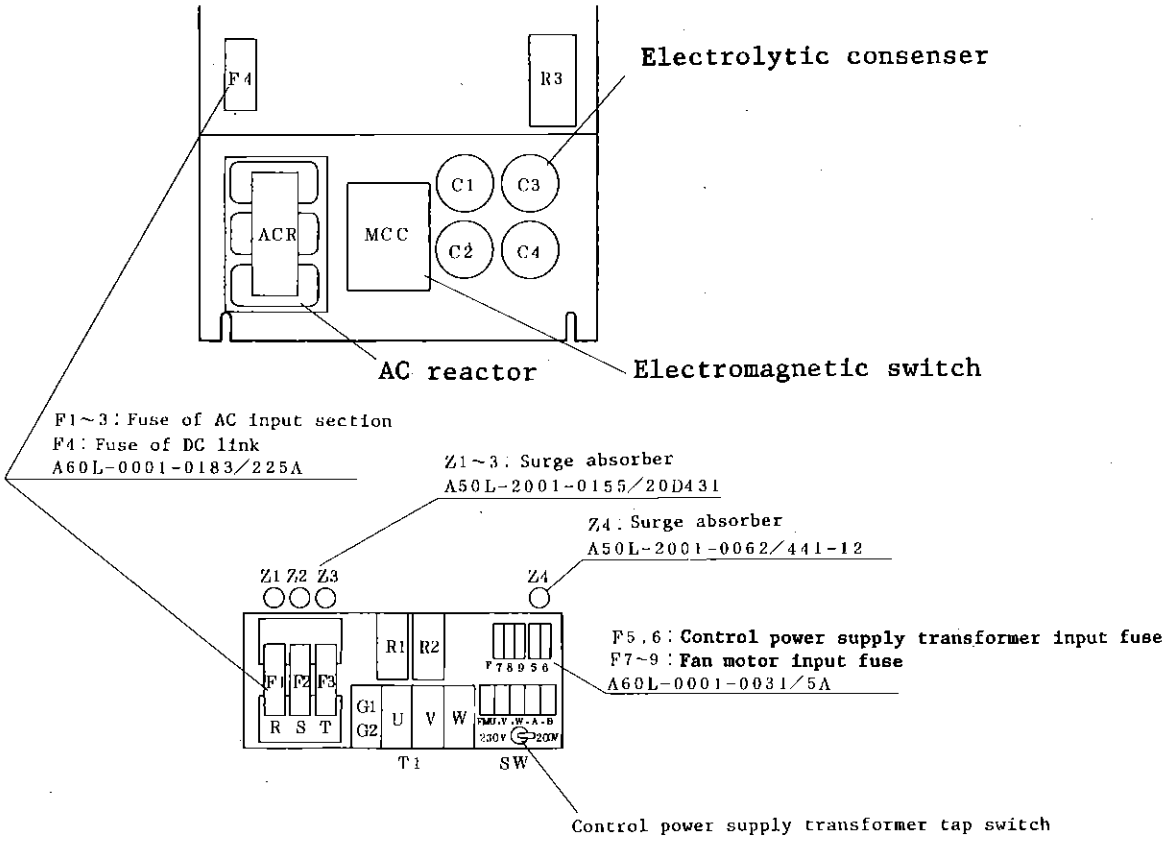


Fig. 8.2(f)

8.2.7 AC spindle servo unit model 40 A06B-6044-H140

The fuses of the AC spindle servo unit model 40 are mounted on the terminal block and within the unit.

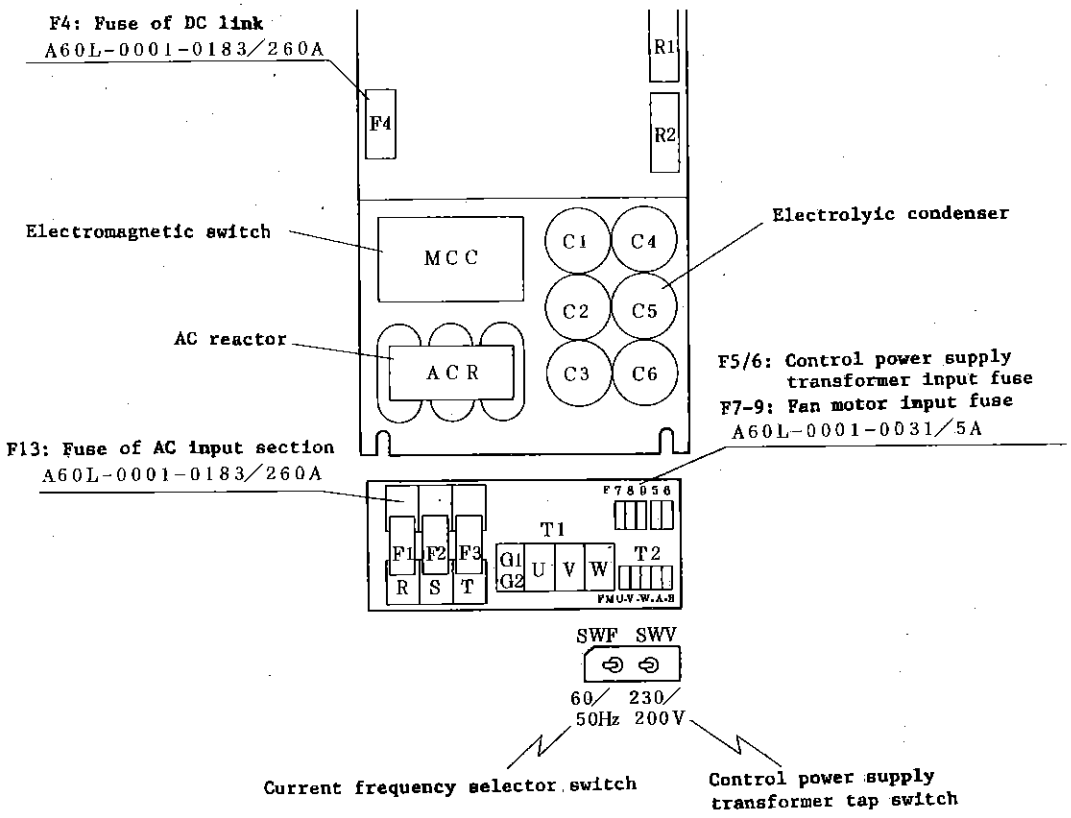


Fig. 8.2(g)

Revision Record

AC SPINDLE MOTOR series OPERATOR'S MANUAL (B-53424E)

Edition	Date	Contents	Edition	Date	Contents
05	'84. 1	Explanations on model 8 & 12 (small type) were added.			
04	'83. 7	Addition of A60L-0001-0036.			
03	'83. 2	PCB parts mounting diagram was updated.			
02	'81. 9	Explanations on model 18 and 22 were added.	07	'88. 7	1. All revised
01	'81. 12	———	06	'85. 6	1. Adding the contents of AC spindle motor model 1, 2, 30, 40. 2. Adding the contents of AC spindle servo unit model 1, 2, small type 3, 30, 40

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* B - 5 3 4 2 4 E / 0 7 *