

CNC TAPPING CENTER

TC-215, TC-225

MAINTENANCE MANUAL

BROTHER INDUSTRIES, LTD.

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1. TROUBLESHOOTING

1.1 ABNORMALITIES AFTER TURNING ON THE MAIN POWER SUPPLY

1.1.1 Power Supply Cannot Be Turned On

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	No power supply when POWER ON main button pressed (LED for power supply does not light.)	No-fuse circuit breaker is OFF.	Turn no-fuse circuit breaker ON.		
		Circuit protector in the control unit is OFF.	Turn the circuit protector ON.		
		Connector CNMC disconnected from the POWER SUPPLY PCB	Connect the CNMC connector.		
		Connector CNPOW1, CNPOW2 or CNPOW3 disconnected from the POWER SUPPLY PCB	Connect the CNPOW 1, 2, 3 connectors.		
		Fuse F1 on the POWER SUPPLY PCB blown	Replace the 0.1A fuse.		
		No DC 24 V voltage across C1 on the POWER SUPPLY PCB	Replace the POWER SUPPLY PCB.		
		Relay CR1 and/or CR2 on the POWER SUPPLY PCB will not turn ON.	Replace relays CR1 and/or CR2.		
		Relay MC1 in the control unit will not turn ON.	Replace the relay MC1.		
		RELAY I/O PCB's 57 and 58 (external power supply) being used	Check external wiring. Short-circuit if 57 and 58 not used.		
		POWER ABNORMAL LED lights. Supply voltage is or was 15% or more.	Supply rated voltage: 200 V \pm 10%		

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
2	The operation panel LED's do not light when power supply is turned ON, or another LED lights during machine operation.	Defective contact or clamping of connector CNKEY on OPERATION PCB	Check connector CNKEY pins and clamp firmly.		
3	The operation panel LED's do not light when power supply is turned ON.	5V is not detected on the PCB (defective 5V switching regulator).	Replace the 5V switching regulator.		

1.1.2 No Display when Main Power Supply Turned ON

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	CRT screen turns black or green, or display is irregular after power supply is turned ON.	Defective CRT	Refer to 1.9.1, "Abnormal CRT Display".		

1.1.3 Defective Axis Movement when Main Power Supply Turned ON

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	All axes begin moving on their own when power supply is turned ON.	Slave circuit on the NC PCB not operating	Replace the NC PCB.	700100 700200	760100 760300
2	The X-axis begins moving on its own when power supply is turned ON.	Defective X-axis servo driver	Replace the X-axis servo driver.	700700 700800	760100 760300
3	The Y-axis begins moving on its own when power supply is turned ON.	Defective Y-axis servo driver	Replace the Y-axis servo driver.	700700 700800	760100 760300
4	The Z-axis begins moving on its own when power supply is turned ON.	Defective Z-axis servo driver	Replace the Z-axis servo driver.	700700 700800	760100 760300

1.1.4 Error Displayed Immediately after Main Power Supply Turned ON

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	"DEVIATION ERROR" is displayed.	Deviation error occurred for an axis	Refer to 1.6.2, "X- and Y-axis Deviation Errors", and 1.7.2, "Z-axis Deviation Errors".		
2	"SERVO ERROR" is displayed.	Servo error occurred for an axis	Refer to 1.6.1, "X- and Y-axis Servo Errors", and 1.7.1, "Z-axis Servo Errors".		
3	"ATC ERROR" is displayed.	ATC error	Refer to 1.5.1, "ATC Errors".		
4	"ATC ERROR" is displayed when the RESET key is pressed after "EM SWITCH ON" is displayed.	The OUTPUT PCB brake circuit is short-circuited.	Replace the OUTPUT PCB.		
5	"EM SWITCH ON" is displayed and cannot be reset.	The OUTPUT PCB 24 V circuit is short-circuited. Pattern discontinuity on the OPERATION PCB	Replace the RELAY PCB. Replace the OPERATION PCB.	800200	
6	"SPINDLE OVERHEAT" is displayed and cannot be reset.	Low 24 V power supply voltage due to cutting oil on the OUTPUT PCB causing shorting	Clean the OUTPUT PCB (and INPUT PCB) and connectors.		
7	OVERRUN (+)(-) X, Y, Z and EMERGENCY STOP are displayed on the ALARM DISPLAY.	Defective contact of the CNIOM and/or CNIOS connectors on the RELAY I/O PCB Incorrect adjustment of the P24V switching regulator in the power supply unit	Clamp the connectors firmly. Adjust the switching regulator AVR2 voltage to +24 V \pm 5%.		

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
8	"POWER SUPPLY ERROR" displayed on the ALARM DISPLAY	Low DC supply voltage in the power supply unit	Adjust the switching regulator AVR1 (in the power supply unit) voltage to +5 V +3%.		
		Defective contact of the CNPWS con- nector on the NC PCB	Clamp the connector firmly.		
		Power supply voltage is less than -15% lower.	Supply rated voltage: 200 V <u>+10%</u>		
9	"BATTERY ALARM" displayed on the ALARM DISPLAY	Batteries low voltage	Replace the bat- teries.	700500	
		Defective battery connection	Clamp the connector firmly.		

1.1.5 Other Problems after Turning on the Main Power Supply

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	All LED's on the operation panel light when the power supply is turned ON.	Abnormal power supply unit voltage	Adjust the switching regulator AVR1 (in the power supply unit) voltage to +5 V +3%.		
		Defective power connection to NC PCB (defective contact or wiring discontinuity)	Check contact and wiring. Replace if necessary.	700100 700200	760100 760300
		Abnormal ROM mounting (wrong pin order)	Replace or remount the ROM.	700100 700400 700600	
		Defective NC PCB	Replace the NC PCB.	700100 700200	760100 760300
2	White smoke issuing from top of control box	The spindle driver UHT is too high, causing overheating of the regenerative resistance.	Set to driver UHT to "7" on the scale (TC-225).		760300
3	Servo power supply will not turn ON.	Error type needs for release OFF ON.	Turn the power supply OFF and back ON.		
		Circuit protector in the common power supply unit is OFF.	Turn the circuit protector ON.		
		Defective contact of the motor power cable connector	Clamp the connector firmly.		
		Fuse FU1 has blown in each axis driver.	Replace the 1A fuse.		
		Defective NC PCB	Replace the NC PCB.	700100 700200	760100 760300

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
3	Servo power supply will not turn ON.	Relay RY7 (TC-215) or RY (TC-225) does not turn ON.	Replace the relay.		
		Defective common power supply unit	Replace the common power supply unit.		
		Defective driver	Replace the driver.	700700 700800	760100 760300

1.2 ABNORMALITIES DURING MANUAL OPERATION

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	Table and headstock do not move when the MANUAL mode keys are pressed. "DEVIATION ERROR" displayed.	Chips jammed in the ball screw (X- or Y-axis)	Replace the ball screw assembly.	300600 300700 400600 400700	360100 660100
		High Belleville spring sliding resistance (in Z-axis ATC operation area)	Replace the Belleville spring or spindle assembly.	100900	160100
		No movement when a command is given due to driver failure	Replace the driver of the axis which does not move.	700700 700800	760100 760300
		No driver control power supply	Replace the relay MC2.		
2	Table and headstock do not move when the MANUAL mode keys are pressed. "DEVIATION ERROR" is not displayed.	Defective contact of the motor connector	Insert the connector correctly.		
		Cutting oil seeped into motor. (X-axis or Y-axis deviation amount of 30 - 50)	Replace the motor.	300100 300200 300300 400100 400200 400300	360100 660100 760100
		Large deviation amount (100 - 1000) due to driver failure	Replace the driver.	700700 700800	760100 760300

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
3	"OVERRUN" error display cannot be reset.	Defective operation of one of the axis limit switches due to jammed chips	Clean the limit switch.		
		Discontinuity in one of the axis limit switch leads	Replace the limit switch leads.		
		(+) (-) overrun error occurs for one of the axes. (24 V power supply cut off.)	Check connector CN10M connection or repair the 24 V power supply.		
		No Z-axis servo power	Replace the Z-axis driver.	700700 700800	760100 760300
		Loose connector CNKEY in operation box	Connect the connector firmly.		
4	"POSITION ERROR" displayed. (X-, Y- and Z-axis)	Incorrect driver SPD adjustment (deviation error too large)	Adjust driver SPD.		760100 760300
		Incorrect zero-point limit switch position	Adjust the limit switch position.		360100 360300 660100
5	"POSITION ERROR" displayed. (Z-axis)	The [+Z] or [-Z] key was pressed while the Z-axis (spindle) was in the ATC operation area.	Instruct the operator (how to operate).		
		The [M.Z.RT] key was pressed while the Z-axis was in the ATC operation area.	Instruct the operator (how to operate).		
		Defective limit switch position in the ATC operation area	Adjust the limit switch position.		660400

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
6	"DEVIATION ERROR" is displayed when the table or headstock moves.	Incorrect driver SPD adjustment (deviation error too large)	Adjust driver SPD.		760100 760300
		Power supply voltage is more than 10% lower.	Correct the power supply.		
		Cutting oil seeped into motor	Replace the motor.	300100 300200 300300 400100 400200 400300	360100 660100 760100
		Chips jammed in the ball screw (X-, Y- or Z-axis)	Replace the ball screw assembly.	300600 300700 400600 400700 500600 500700	360100 660100 760100
		Incorrect parameter (time constant) setting	Set the parameter.		
7	"SERVO ERROR" is displayed when axes move. Servo "ON" lights.	Preload on bearing too high	Replace the ball screw assembly.	300600 300700 400600 400700 500700 500800	360100 660100 760100
		Defective driver	Replace the driver.	700700 700800	760100 760300
8	"DEVIATION ERROR" is displayed during rapid traverse.	Deviation is too large during rapid traverse.	Adjust driver SPD.		760100 760300
		Power supply voltage is more than 10% lower.	Correct the power supply.		
9	Table movement shudders at 10% of rapid traverse rate.	Incorrect adjustment or abnormality of servo driver	Adjust or replace the servo driver.	700700 700800	760100 760300

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
9	Table movement shudders at 10% of rapid traverse rate.	Defective servo motor	Replace the servo motor.	300100 300200 300300 400100 400200 400300	360100 360300 660100 760100 760300
10	Z-axis motor vibrates.	Incorrect deviation amount adjustment	Re-input the deviation amount from the I/O display.		760100 760300
		Incorrect maximum deviation amount setting	Check and re-input the deviation amount.		760100 760300
		Defective driver	Replace the driver.	700700 700800	760100 760300
		Defective contact of the switching AG power supply terminals	Check the terminal contact.		
11	Table and headstock begin moving on their own when the RESET key is pressed.	NC PCB slave circuit not operating	Replace the NC PCB.	700100 700200	760100 760300
12		Oil on the OPERATION PCB	Replace the OPERATION PCB.	800200	
13	Axis movement occurs during work set-up.	Oil on the START switch causing shorting	Clean, or replace the OPERATION PCB.	800200	
14	When one key is pressed, nearby keys operate simultaneously.	Defective operation panel	Replace the operation panel.	800200	

1.3 ABNORMALITIES ON ZERO POINT RETURN

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	Zero point return cannot be carried out.	An axis not in position	Check and re-input the in-position width parameters.		
		Large deviation amount due to defective NC PCB	Replace the NC PCB.	700100 700200	760100 760300
		Large deviation amount due to cutting oil seeped into motor	Replace the motor.	100100 100200 100300 100400 300100 300200 300300 400100 400200 400300 500100 500200	160100 360100 360300 660100 760100 760200 760300
		Servo will not turn ON.	Check FU1 in each axis driver.		
		NC PCB slave circuit not operating	Check the voltages of the AVR1 and AVR2 switching regulators in the control unit. Replace the NC PCB.	700100 700200	760100 760300
		Defective contact or discontinuity of the motor power cable connection	Check and replace the motor power cable connection.		
		Incorrect position of limit switch dog (5 mm displacement)	Adjust the position of the limit switch dog.	*	360100 360300 660100
2	"POSITION ERROR" displayed for X-, Y- and Z-axis on zero point return.	Incorrect driver SPD adjustment (deviation error too large)	Adjust driver SPD.		760100 760300

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
2	"POSITION ERROR" displayed for X-, Y- and Z- axis on zero point return.	Large disparity driver deviations (2.5 mm displace- ment of zero point)	Replace the drivers (TC-215).	700700	760100
3	"POSITION ERROR (Z)" displayed.	The [+Z] or [-Z] key was pressed while the Z-axis (spindle) was in the ATC operation area.	Instruct the operator (how to operate).		
		The [M.Z.RT] and [ATC] keys were pressed while the Z-axis was in the ATC operation area.	Instruct the operator (how to operate).		
		Incorrect ATC operation area limit switch posi- tion	Adjust the limit switch position.		660400
4	"OVERRUN" displayed during axis movement.	The zero point return start posi- tion is too close to the zero point (X- and Y-axis).	Instruct the operator. (Move at least 60 mm from the zero point.)		
		Large disparity of driver deviations (2.5 mm displace- ment of zero point)	Replace the drivers (TC-215).	700700	760100
5	Axis movement stops during zero point return. No error displayed.	Deviation amount and D/A offset values do not match.	Turn the power supply OFF and back ON again.		

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
6	X- and Y-axis can be manually moved but the [M.Z.RT] switch does not operate (LED does not light).	An external reset signal (from counter or program selector switch) is causing a halt signal.	Correct the external device. (Reset the counter.)		
7	Low X- and Y-axes speed after the zero point return start point and an "OVERRUN" is displayed.	Defective operation of a zero-point limit switch due to jammed chips	Clean the limit switch.		
		Discontinuity in a zero-point limit switch leads	Replace the limit switch leads.		
		Loose connector CNKEY in operation box	Connect the connector firmly.		
8	During Z-axis zero point return, axis ascends then rapidly descends to cause an OVERRUN (-Z) error.	Defective operation of the Z-axis zero-point limit switch	Clean the limit switch.		
9	2.5 mm displacement from zero point	Weak zero point pulse signal due to large disparity of driver deviation	Replace the drivers (TC-215).	700700	760100
10	5 mm displacement from zero point	Incorrect position of limit switch dog	Adjust the position of the limit switch dog.		360100 360300 660100
		Zero-point offset value not suitable	Correct the zero-point offset value.		360100 360200 360300

1.4 PROBLEMS WITH THE SPINDLE

1.4.1 Spindle Servo Errors

(1) TC-215

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	"SPINDLE SRVO ERR" is displayed. O.C LED lights.	Shorting of motor power cables	Connect the motor power cables correctly.		
		Defective transistor in main circuit (resistance across driver terminals drops below 10 kΩ.)	Replace the spindle driver.	700700	760100
2	"SPINDLE SRVO ERR" is displayed. UV LED lights.	Circuit breaker in the driver is OFF.	Turn the circuit breaker ON.		
		Fuse in the driver is blown.	Replace the 2A fuse.		
		Low power supply voltage is supplied to driver.	Ensure that the correct voltage is supplied to the driver.		
		Defective transistor in main circuit (resistance across driver terminals drops below 10 kΩ.)	Replace the spindle driver.	700700	760100
3	"SPINDLE SRVO ERR" is displayed. UV LED flashes.	Input voltage deviates more than $\pm 10\%$ from the specified value.	Adjust the input voltage within $\pm 10\%$ of the specified value.		
		Operation under conditions causing repeated, frequent acceleration and decelerations	Change the operation conditions.		

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
3	"SPINDLE SRVO ERR" is displayed. UV LED flashes.	Large tool of load GD ² mounted on the spindle	Instruct the operator not to mount large tool of load GD ² .		
		Defective spindle driver	Replace the spindle driver.	700700	760100
4	"SPINDLE SRVO ERR" is displayed. UV and OH LED'S flash alternately.	Discontinuity in a resolver cord	Replace the resolver cord.		
		Incorrect setting of jumper pin J-COS	Match the jumper phase setting to the motor resolver phase.		
		Defective spindle driver	Replace the spindle driver.	700700	760100
5	"SPINDLE SRVO ERR" is displayed. OH LED flashes.	High spindle loading	Set suitable cutting conditions.		
6	"SPINDLE SRVO ERR" is displayed. OH LED lights.	Defective contact of the motor power cables or signal lines	Check the cables and lines. Clamp the connectors firmly.		
		High spindle loading	Set suitable cutting conditions.		
		Defective motor (spindle easy to turn)	Replace the motor.	100100 100200 100300	160100 760100 760200
		Seized bearings or damaged Belleville spring (spindle hard to turn)	Replace the spindle.	100900	160100

(2) TC-225

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	"SPINDLE SRVO ERR" is displayed. "1 (O.C)" LED lights.	Defective transistor in main circuit (resistance across driver terminals drops below 10 kΩ.)	Replace the spindle driver.	700800	760300
		Shorting of motor power cables	Connect the motor power cables correctly.		
2	"SPINDLE SRVO ERR" is displayed. "2 (O.C)" LED lights.	High spindle loading	Set suitable cutting conditions.		
		Defective motor (spindle easy to turn)	Replace the motor.	100400	160100 760300
		Seized bearings or damaged Belleville spring (spindle hard to turn)	Replace the spindle.	100900	160100
3	"SPINDLE SRVO ERR" is displayed. "3 (O.H)" LED lights.	Extremely high ambient temperature	Bring the ambient temperature to within the specified range.		
		Defective driver cooling fan or driver operation	Replace the spindle driver.	700800	760300
5	"SPINDLE SRVO ERR" is displayed. "4 (M.P.E)" LED lights.	Circuit breaker in the driver is OFF.	Turn the circuit breaker ON.		
		Defective spindle driver (will not rotate, even at low speed.)	Replace the spindle driver.	700800	760300
		Incorrect input voltage (will rotate at low speed.)	Ensure that the correct voltage is supplied to the driver.		

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
6	"SPINDLE SRVO ERR" is displayed. "5 (P.E)" LED lights.	The voltage across R-S is not in the range AC 210 V <u>±15%</u> .	Supply voltage in the range AC 210 V <u>±15%</u> .		
		Defective spindle driver	Replace the spindle driver.	700800	760300
7	"SPINDLE SRVO ERR" is displayed. "6 (S.E)" LED lights.	The command voltage is not in the range <u>+10 V at 6000 rpm.</u>	Adjust the SPD.		760300
8	"SPINDLE SRVO ERR" is displayed. "7 (V.E)" LED lights.	The voltage across R-S is not in the range AC 210 V <u>±15%</u> .	Supply voltage in the range AC 210 V <u>±15%</u> .		
		Defective connection of motor power cables	Connect the motor power cables correctly.		
		Defective spindle driver	Replace the spindle driver.	700800	760300
9	"SPINDLE SRVO ERR" is displayed. "8 (C.E)" LED lights.	Defective connection of motor signal lines	Connect the motor signal lines correctly.		
		Defective motor	Replace the motor.	100400	160100 760300

1.4.2 Spindle Deviation Error

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	"DEVIATION ERROR" displayed when power supply turned ON.	Incorrect setting of the parameter position deviation value	Correct the deviation value.		760100 760300
		Defective spindle servo driver (Too large motor deviation value) (Remains traveling deviation value)	Replace the servo driver.	700700 700800	760100 760300
		Defective connector contact	Insert the connector correctly.		
2	"DEVIATION ERROR" displayed when spindle started.	Circuit breaker in the driver is OFF.	Turn the circuit breaker ON.		
		Defective contact of the MC1 relay	Replace the MC1 relay.		
		Incorrect power supply voltage for driver input	Ensure that the correct voltage is supplied to the driver.		
		Bearing seized or jammed with foreign matter	Replace the bearing.	100900	160100
		Defective Belleville spring	Replace the Belleville spring.	100900	160100
		I/O PCB shorted by oil	Replace the I/O PCB.		
3	"DEVIATION ERROR" displayed when spindle is rotating.	High spindle loading	Set suitable cutting conditions.		
		Discontinuity of the motor power cables or signal lines or defective contact connector	Check the connectors. Replace the cables or lines.		

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
3	"DEVIATION ERROR SP" displayed when spindle is rotating.	Power supply voltage is too low (at least -10%).	Ensure that the correct voltage is supplied.		
		Defective spindle servo driver	Replace the spindle servo driver.	700700 700800	760100 760300
		Defective spindle motor	Replace the spindle motor.	100100 100200 100300 100400	160100 760100 760200 760300
4	"DEVIATION ERROR" displayed when a maximum speed command is given.	The deviation value is too large at maximum speed.	Adjust the driver SPD.		760100 760300
		No negative output from the NC PCB D/A	Replace the NC PCB.	700100 700200	760100 760300

1.4.3 Spindle Overheating

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	"SPINDLE OVERHEAT" displayed when spindle is rotating.	The temperature of the spindle motor exceeds the rated value.	Stop operation for 10 - 20 minutes to allow motor to cool.		
2	"SPINDLE OVERHEAT" displayed when spindle is stationary. (Bit 1 of IN 3 on the I/O display is "0".)	Defect or discontinuity in the temperature sensor	Check wiring in temperature sensor circuit. Replace wiring if necessary.		
	(Bit 1 of IN 3 on the I/O display is "1".)	Defective NC PCB	Replace the NC PCB.	700100 700200	760100 760300

1.4.4 Abnormality during Tool Clamping

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	Tool falls out when clamped by ATC. (incorrect orientation position)	Incorrect spindle grid shift value	Re-input the spindle grid shift value.		360300
		Broken spindle coupling	Replace the coupling.	100500 100600 100700 100800	160100 760200
		Defective contact or discontinuity of the motor power cables or signal lines	Check the cables, lines and connectors. Clamp the connector firmly. Replace the cables and lines if necessary.		
		Defective COUNTER PCB operation	Replace the COUNTER PCB.	700100 700300	
		Defective spindle servo amplifier	Replace the spindle motor.	700700 700800	760100 760300
		Defective spindle motor encoder	Replace the spindle motor.	100100 100200 100300 100400	160100 760100 760200 760300
		Defective NC PCB	Replace the NC PCB.	700100 700200	760100 760300
2	Tool will not come out of the spindle.	Cutting oil on the spindle taper	Clean the spindle taper and tool.		
		Displacement of the spindle motor encoder position	Replace the spindle motor.	100100 100200 100300 100400	160100 760100 760200 760300
		Deformation of the clamp shaft ball	Replace the clamp shaft.	100900	160100
3	Loud noise when tool is changed.	Incorrect orientation	Adjust the orientation.		160100

1.4.5 Other Problems with the Spindle

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	"COMMAND ERROR" displayed when a spindle- rotation command is given.	Spindle-rotation command was given while the Z-axis was in the ATC operation area.	Move the Z-axis outside the ATC operation area and command.		
2	Spindle has play in direction of rotation.	Cracked disk	Replace the coupling.	100500 100600 100700 100800	160100 760200
3	Loud spindle noise	Looseness of the periphery of the disk	Replace the coupling.	100500 100600 100700 100800	160100 760200
		Spindle scrapes when rotated by hand (scratching).	Replace the spindle.	100900	160100
		Spindle hums with large disparity of deviation value when stationary.	Adjust or replace the spindle driver.	700700 700800	760100 760300
4	The tool holder detaches from the spindle during machining.	When tapping, the tap is seized by workpiece and the tool holder detaches from the spindle at reversing.	Instruct the operator. (Carry out machining within capability of machine.)		
		Cracked spindle Belleville spring	Replace the spindle Belleville spring.	100900	160100
		Loose pull stud	Tighten the pull stud.		

1.5 PROBLEMS WITH THE MAGAZINE

1.5.1 ATC Errors

(1) Before Magazine Rotation

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	"ATC ERROR" displayed when power supply turned ON.	Magazine stopped during rotation.	Rotate the magazine by hand to the reference position and press the RESET switch.		
		Defective address sensor	Replace the address sensor.	200300	260200
2	"ATC ERROR" is displayed when the RESET key is pressed after "EM SWITCH ON" is displayed.	The OUTPUT PCB brake circuit is short-circuited.	Replace the OUTPUT PCB.		
3	"ATC ERROR" is displayed when Z-axis ascends into ATC operation area.	Incorrect Z-axis grid shift value	Re-input the Z-axis grid shift value.		360300
		The ZATC zero-point limit switch does not operate when the Z-axis moves into the ATC operation area.	Adjust the position of the ZATC zero-point limit switch.		660500
		5 mm displacement of the Z-axis zero point	Adjust the Z-axis zero limit switch.		660100
		2.5 mm displacement of the Z-axis zero point	Replace the Z-axis driver (TC-215).	700700	760100
		Defective Z-axis ATC zero limit switch	Replace the Z-axis ATC zero limit switch	600900	660500

(2) During Magazine Rotation

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	"ATC ERROR" displayed during magazine rotation.	Looseness in the ATC drive system	Tighten all connection components or replace the barrel cam.	200400	260100 260200 260300
		Displacement of the address sensor	Adjust the position of the address sensor.		260200
		Defective address sensor	Replace the address sensor	200300	260200
2	Magazine rotates continuously without stopping.	Defective address sensor	Replace the address sensor	200300	260200
3	Magazine rotates and then reciprocates about the specified position.	Discontinuity in the address sensor encoder cable	Correct the wiring.		
4	Magazine stops during rotation.	Chips jammed in barrel cam	Clean the barrel cam.		260100 260200 260300
		Loose relay MC1 terminal screws	Tighten the terminal screws.		
		Slit plate and photosensor rubbing	Replace the address sensor.	200300	260200
		Discontinuity in the flat cable CNIOM connecting the NC PCB to the RELAY I/O PCB.	Replace the flat cable.		
5	Specified magazine tool number cannot be selected.	Defective address sensor	Replace the address sensor.	200300	260200

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
6	"ATC ERROR" displayed after magazine rotation.	Defective address sensor	Replace the address sensor.	200300	260200
		ATC RUN relay on the RELAY I/O PCB does not operate.	Replace the ATC RUN relay or replace the NC PCB.	700100 700200	760100 760300
		Defective barrel cam	Replace the barrel cam.	200400	260100 260200 260300
		Incorrect ATC motor	Replace the ATC motor.	200500 200600	
		Defective brake pack in the control unit	Replace the brake pack.		
7	"ATC ERROR" displayed. Magazine does not rotate.	Defective contact of relay CW/CCW	Replace the relay.		
		Burned at thermal relay MC1 or dipped contacts	Reset or replace the thermal relay MC1.		
		Defective coupling	Replace the coupling.	200600	

1.5.2 Other Problems with the Magazine

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	Machine opera- tion stops in ATC operation area with no error displayed.	The Z-axis is not in position.	Check and re-input the Z-axis deviation value.		760100 760300
		Circuit protector CP2 in the control unit tripped.	Turn CP2 ON.		
		Defective ATC RUN relay on the RELAY I/O PCB	Replace the relay.		
		Defective CW/CCW relay on the RELAY I/O PCB	Replace the relay.		
		Defective NC PCB	Replace the NC PCB.	700100 700200	760100 760300
		Defective brake pack in the control unit	Replace the brake pack.		
		Defective ATC motor	Replace the ATC motor.	200500	
		Defective connec- tion of connector cable CNATC between the RELAY UNIT PCB and the ATC motor brake pack	Check the connector cable and ensure a good connection (TC-215).		
2	Tool falls out during ATC rotation.	Uneven tool weight distribution	Change positions of tools in magazine.		
		Tool is too heavy.	Instruct the opera- tor.		
		Tool is too long. The center of gra- vity is to high. side.	Instruct the opera- tor.		
		Defective grip pin	Replace the grip pin.	200200	260100 260200 260300
		Defective grip key	Replace the grip.	200200	260100 260200 260300

1.6 PROBLEMS WITH X- AND Y-AXIS

1.6.1 X- and Y-axis Servo Errors

(1) TC-215

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	"X SERVO ERROR", "Y SERVO ERROR" displayed. O.C LED lights.	Resistance across driver terminals drops below 10 kΩ.	Replace the driver.	700700	760100
2	"X SERVO ERROR", "Y SERVO ERROR" displayed. UV LED lights.	Circuit protector in the common power supply unit is OFF.	Turn the circuit protector ON.		
		Fuse FU2 in driver blown	Replace the 10A fuse.		
		Power supply voltage is more than 10% lower.	Ensure that the correct voltage is supplied.		
		Resistance across driver terminals drops below 10 kΩ.	Replace the driver.	700700	760100
3	"X SERVO ERROR", "Y SERVO ERROR" displayed. OH LED lights.	Discontinuity or defective connec- tion of motor power cable	Check the motor power cable. Replace if necessary.		
		Discontinuity or defective connec- tion of motor signal lines	Check the motor signal lines. Replace if necessary.		
		High spindle loading due to cutting conditions	Set suitable cutting conditions.		
		Total weight on the table too heavy	Instruct the opera- tor.		
		Foreign matter jammed in ball screw	Replace the ball screw assembly.	300600 400600	360100 660100

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
3	"X SERVO ERROR", "Y SERVO ERROR" displayed. OH LED lights.	Bearing seized	Replace the ball screw assembly.	300600 400600	360100 660100
		Defective motor	Replace the motor.	300100 300200 400100 400200	360100 660100 760100

(2) TC-225

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	"X SERVO ERROR", "Y SERVO ERROR" displayed. PL1 LED lights.	Fuse F1 blown	Replace the 3A fuse.		
		Defective connec- tion of cables X1, X2	Correctly connect the cables.		
2	"X SERVO ERROR", "Y SERVO ERROR" displayed. PL2 LED lights.	Circuit breaker in driver OFF	Turn on the circuit breaker on the driver.		
		Defective connec- tion of cables L1, L2	Correctly connect the cables.		
		Tripped circuit breaker	Replace the driver.	700800	760300
3	"X SERVO ERROR", "Y SERVO ERROR" displayed. P.E LED lights.	Voltage across X1 and X2 below 85 V.	Ensure a voltage of 100 V <u>+10%</u> .		
4	"X SERVO ERROR", "Y SERVO ERROR" displayed. D.E LED lights.	Defective connec- tion of motor signal lines	Correctly connect motor signal lines.		
					-
5	"X SERVO ERROR", "Y SERVO ERROR" displayed. O.S LED lights.	Defective connec- tion of motor signal lines	Correctly connect motor signal lines.		

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
6	"X SERVO ERROR", "Y SERVO ERROR" displayed. O.C LED lights.	Shorted motor power cables	Correctly connect the cables.		
		Resistance across driver terminals drops below 10 kΩ.	Replace the driver.	700800	760300
		Defective motor insulation	Replace the motor.	300300 400300	360100 660100 760300
7	"X SERVO ERROR", "Y SERVO ERROR" displayed. O.C LED lights.	Discontinuity or defective contact of motor power cables	Check the motor power cables. Replace if necessary.		
		Discontinuity or defective contact of motor signal lines	Check the motor signal lines. Replace if necessary.		
		High spindle loading due to cutting conditions	Set suitable cutting conditions.		
		Total weight on the table too heavy	Instruct the opera- tor.		
		Foreign matter jammed in ball screw	Replace the ball screw assembly.	300700 400700	360100 660100
		Bearing seized	Replace the ball screw assembly.	300700 400700	360100 660100
		Defective motor	Replace the motor.	300300 400300	360100 660100 760300

1.6.2 X- and Y-axis Deviation Errors

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	"DEVIATION ERROR" displayed immediately after the power supply is turned on.	Deviation parameter data limited values destroyed	Re-input the data.		
		Deviation value exceeds 20000 immediately after power supply is turned on.	Replace the feed motor.	300100 300200 300300 400100 400200 400300	360100 660100 760100
		Defective connector contact or discontinuity of the motor power cables or signal lines	Check the cables, lines and connectors. Replace the cables or lines if necessary.		
2	No axis movement when manual (+) and (-) keys are pressed. "DEVIATION ERROR" is displayed.	Defective driver	Replace the driver.	700700 700800	760100 760300
		Incomplete connection of the connectors CNX and CNY	Connect the connectors firmly.		
3	"DEVIATION ERROR" displayed during axis movement.	Deviation value is too large during axis movement.	Adjust the driver SPD		760100 760300
		Power supply voltage is more than 10% lower.	Ensure that the stable voltage is supplied.		
		Cutting oil seeped into motor	Replace the motor.	300100 300200 300300 400100 400200 400300	360100 660100 760100
		Foreign matter jammed in the ball screw	Replace the ball screw assembly.	300600 300700 400600 400700	360100 660100

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
3	"DEVIATION ERROR" displayed during axis movement.	High spindle loading due to cutting conditions	Set suitable cutting conditions.		
		Total weight on the table too heavy	Instruct the opera- tor.		
		Bearing seized	Replace the ball screw assembly.	300600 300700 400600 400700	360100 660100

1.6.3 Other Problems with the X- and Y-axis

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	"OVERRUN" displayed during axis movement.	The zero point return start position is too close to the zero point.	Instruct the operator. (Move start position at least 60 mm away from the zero point.)		660200 660300
		Large disparity of driver deviation value (2.5 mm)	Replace the drivers (TC-215).	700700	760100
2	"ABNORMAL TEMP." displayed.	The temperature of the axis feed motor regenerative resistance too high	Stop operation for 10 - 20 minutes to cool the motor. Turn the power supply off and then back on again.		
3	"POSITION ERROR" displayed.	Incorrect position of limit switch dog (5 mm)	Adjust the position of the limit switch dog.		360100 660100
		Incorrect driver SPD adjustment (deviation value too small)	Adjust driver SPD.		760100 760300
		Large disparity of driver deviation value (2.5 mm)	Replace the drivers (TC-215).	700700	760100
4	Axes do not move when the manual keys are pressed. No error displayed.	Defective contact of a motor connector	Check the connector and connect firmly.		

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
4	Axes do not move when the manual keys are pressed. No error displayed.	Cutting oil seeped into motor (deviation value: 30 - 50)	Replace the motor.	300100 300200 300300 400100 400200 400300	360100 660100 760100
		Defective driver (deviation value: 100 - 1000)	Replace the driver.	700700 700800	760100 760300
5	Table feedrate is too low during to returning the zero point	Chips jammed in the zero-point limit switch	Clean the zero-point limit switch.		
		Discontinuity of the limit switch leads	Repair or replace the limit switch leads.		
6	Table vibrates	Discontinuity in motor signal lines	Repair or replace the motor signal lines.		
		Defective connector connection	Check and firmly connect the connector.		
		Defective motor	Replace the motor.	300100 300200 300300 400100 400200 400300	360100 660100 760100
		Defective driver	Replace the driver.	700700 700800	760100 760300
		Defective NC PCB	Replace the NC PCB.	700100 700200	760100 760300
7	Zero point error of feed axes (5 mm)	Serring error of the zero-point offset value.	Reset the zero-point offset value.		360100

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
8	Positioning error	Defective counter circuit. RAM cannot be read.	Replace the NC PCB. Replace the COUNTER PCB.	700100 700200 700300	760100 760300
		Defective contact of the connector	Check the connector and connect firmly.		
		Defective servo amplifier	Replace the servo amplifier.	700700 700800	760100 760300
		Cutting oil seeped into the motor	Replace the motor.	300100 300200 300300 400100 400200 400300	360100 660100 760100
		Cracked coupling or loose screws	Replace the coupling or tighten the screws.	300400 300500 400400 400500	360100 660100
		Work not clamped tightly to table			
		Defective NC PCB operation	Replace the NC PCB.	700100 700200	760100 760300

1.7 PROBLEMS WITH Z-AXIS

1.7.1 Z-axis Servo Errors

(1) TC-215

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	"Z SERVO ERROR" displayed. O.C LED lights.	Resistance across driver terminals drops below 10 kΩ.	Replace the driver.	700700	760100
2	"Z SERVO ERROR" displayed. UV LED lights.	The circuit protec- tor in the power supply unit is OFF.	Turn the circuit protector ON.		
		Fuse in the driver blown	Replace the 2A fuse.		
		Power supply voltage is at least 10% lower.	Ensure that the correct voltage is supplied.		
		Resistance across driver terminals drops below 10 kΩ.	Replace the driver.	700700	760100
3	"Z SERVO ERROR" displayed. OH LED lights.	Discontinuity or defective connec- tion of the motor power cables	Check the cables. Replace if necessary.		
		Discontinuity or defective connec- tion of the motor signal lines	Check the signal lines. Replace if necessary.		
		Spindle loading is too high due to cutting conditions	Set suitable cutting conditions.		
		High sliding resistance of the Belleville spring	Replace the Belleville spring or the spindle assembly.	100900	160100
		Foreign matter jammed in the ball screw	Replace the ball screw assembly.	500700	360300 660100

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
3	"Z SERVO ERROR" displayed. OH LED lights.	Bearing seized	Replace the ball screw assembly.	500700	360300 660100
		Defective motor	Replace the motor.	500100	360100 660100 760100
		Defective brake operation	Replace the brake. Check the connector connections.	500500	360300 660100
4	"Z SERVO ERROR" displayed. UV LED lights.	Power supply voltage exceeds 10%.	Ensure that the voltage must be supplied within $\pm 10\%$.		
		Cutting conditions frequent accelera- tions decelerations.	Change the cut- ting conditions.		
		Large tool or load GD^2 mounted on the spindle	Change the tool.		
5	"Z SERVO ERROR" displayed. UV and OH LED'S flash alternately.	Discontinuity in a resolver cord	Replace the resolver cord.		
		Incorrect setting of jumper pin J-COS	Match the jumper switch phase setting to the motor resolver cord phase.		

(2) TC-225

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	"Z SERVO ERROR" displayed. PL1 LED lights.	Fuse F1 blown	Replace the 3A fuse.		
		Defective connec- tions of the cables X1, X2	Correctly connect the cables.		
2	"Z SERVO ERROR" displayed. PL2 LED lights.	The circuit breaker in the driver is OFF.	Turn the circuit breaker ON.		
		Defective connec- tions of the cables L1, L2	Correctly connect the cables.		
		Tripped circuit breaker	Replace the driver.	700800	760300
3	"Z SERVO ERROR" displayed. P.E LED lights.	Voltage between X1 and X2 is under 85 V	Ensure a voltage of 100 V <u>+10%</u> .		
4	"Z SERVO ERROR" displayed. D.E LED lights.	Defective connec- tion of motor signal lines	Correctly connect motor signal lines.		
5	"Z SERVO ERROR" displayed. O.S LED lights.	Defective connec- tion of motor signal lines	Correctly connect motor signal lines.		
6	"Z SERVO ERROR" displayed. M.P.E LED lights.	Tripped circuit breaker	Turn the circuit breaker ON.		
		200V AC power is not supplied across L1 and L2.	Supply voltage of 200V AC.		
		Defective driver	Replace the driver.	700800	760300

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
7	"Z SERVO ERROR" displayed. O.C LED lights.	Shorted motor cables	Connect the motor cables.		
		Resistance across driver terminals drops below 10 kΩ.	Replace the driver.	700800	760300
8	"Z SERVO ERROR" displayed. O.L LED lights.	Discontinuity or defective connec- tion of the motor power cables	Check the cables. Replace if necessary.		
		Discontinuity or defective connec- tion of the motor signal lines	Check the signal lines. Replace if necessary.		
		Spindle loading is too high due to cutting conditions	Set suitable cutting conditions.		
		High sliding resistance of the Belleville spring	Replace the Belleville spring or the spindle assembly.	100900	160100
		Foreign matter jammed in the ball screw	Replace the ball screw assembly.	500800	360300 660100
		Bearing seized	Replace the ball screw assembly.	500800	360300 660100
		Defective motor	Replace the motor.	500200	360300 660100 760300
		Defective brake operation	Replace the brake. Check the connector connections.	500600	360300 660100

1.7.2 Z-axis Deviation Errors

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	"DEVIATION ERROR" displayed on turning on the power supply.	MAXIMUM DEVIATION on parameter was damaged	Re-input the data.		
		Deviation amount exceeds 20000 turning on the power supply.	Replace the feed motor.	500100 500200	360300 660100 760300
		Defective connector contact or discontinuity of the motor power cables or signal lines	Check the cables, lines and connectors. Replace the cables or lines if necessary.		
2	No axis movement when manual (+), (-) keys are pressed. "DEVIATION ERROR" is displayed.	Defective driver	Replace the driver.	700700 700800	760100 760300
3	"DEVIATION ERROR" displayed during axis movement.	Deviation value is too large during axis movement.	Adjust the driver SPD.		760100 760300
		Power supply voltage is at least 10% lower.	Connect to stable power supply.		
		Cutting oil seeped into motor	Replace the motor.	500100 500200	360300 660100 760300
		Foreign matter jammed in the ball screw	Replace the ball screw assembly.	500700 500800	360300 660100
		Spindle loading is too high due to cutting conditions	Set suitable cutting conditions.		
		The delay relay has not turned ON.	Replace the relay.		

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
3	"DEVIATION ERROR" displayed during axis movement.	Bearing seized	Replace the ball screw assembly.	500700 500800	360300 660100
		High sliding resistance of the Belleville spring	Replace the Belleville spring or the spindle assembly.	100900	160100
		Defective contact or discontinuity of the motor power cables or signal lines	Check the cables, lines and connec- tors, and replace if necessary.		
		Defective driver (dispersion of deviation value)	Replace the driver.	700700 700800	760100 760300
		Defective NC PCB	Replace the NC PCB.	700100 700200	760100 760300

1.7.3 Other Problems with the Z-axis

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	"OVERRUN" displayed during axis movement.	The zero point return start position is too close to the zero point.	Instruct the operator. (Move start position at least 60 mm away from the zero point.)		
		Large disparity of driver deviation value (2.5 mm)	Replace the driver. (TC-215)	700700	760100
2	"ABNORMAL TEMP." displayed.	The temperature of the axis feed motor regenerative resistance is too high	Stop operation for 10 - 20 minutes to cool the motor. Turn the power supply off and then back on again.		
3	"POSITION ERROR" displayed.	Incorrect position of zero-point limit switch dog (5 mm displacement)	Adjust the position of the limit switch dog.		660100
		Incorrect driver SPD adjustment (derection too small)	Adjust driver SPD.		760100 760300
		Large disparity of driver deviation value (2.5 mm displacement of zero point)	Replace the driver. (TC-215)	700700	760100
		The [+Z] or [-Z] key pressed while the Z-axis was in the ATC operation area.	Instruct the operator.		
		The [M.Z.RT] button was pressed while the Z-axis was in the ATC operation area.	Instruct the operator.		

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
3	"POSITION ERROR" displayed.	Incorrect position of the ATC opera- tion area limit switch	Adjust the limit switch position.		660400
		Defective LS	Replace the LS.		600700 600800 600900
4	Axes do not move when the manual keys are pressed. No error displayed.	Deviation value and zero-point offset values do not match.	Re-input the data.		
		Defective contact of a motor connec- tor	Check the connector and clamp firmly.		
		Cutting oil seeped into motor (deviation value: 30 - 50)	Replace the motor.	500100 500200	360300 660100 760100 760300
		Defective driver (deviation value: 100 - 1000)	Replace the driver.	700700 700800	760100 760300
5	Feedrate is too low on returning to the zero point.	Foreign matter jammed in the zero- point limit switch	Clean the zero- point limit switch.		
		Discontinuity of the limit switch leads	Repair or replace the limit switch leads.		
6	Z-axis motor vibrates in manual opera- tion mode.	Discontinuity in motor signal lines	Repair or replace the motor signal lines.		
		Defective connector connection	Check and firmly clamp the connec- tor.		
		Defective motor	Replace the motor.	500100 500200	360300 660100 760100 760300

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
6	Z-axis motor vibrates in manual operation mode.	Defective driver	Replace the driver.	700700 700800	760100 760300
		Defective NC PCB	Replace the NC PCB.	700100 700200	760100 760300
7	Feed axis zero point displaced 5 mm	Incorrect zero-point limit switch adjustment value	Reset the zero-point offset value.		660100
8	Positioning error	Defective counter circuit. RAM cannot be read.	Replace the NC PCB. Replace the COUNTER PCB.	700100 700200 700300	760100 760300
		Defective contact of a motor connector	Check the connector and clamp firmly.		
		Defective servo amplifier	Replace the servo amplifier.	700700 700800	760100 760300
		Cutting oil seeped into motor	Replace the motor.	500100 500200	360300 660100 760100 760300
		Foreign matter jammed in taper	Clean the taper.		
		Defective NC PCB operation	Replace the NC PCB.	700100 700200	760100 760300
9	Z-axis descends on its own to cause an OVERRUN (-Z) error.	Work not clamped correctly to table			
		Oil seeped into brake unit	Replace the brake unit.	500500 500600	360300 660100
		Defective zero-point limit switch (during zero-point return)	Replace the zero-point limit switch.	600700	360300 660100
		Low servo lock force	Replace the driver.	700700 700800	760100 760300

1.8 PROBLEMS WITH NC CONTROL

1.8.1 Errors Related to NC Control

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	Machine goes out of control during a memory run.	Poor connection of P5V circuit. (AVR1)	Tighten the terminals of the AVR1 terminal block.		
2	Parity error occurs after power is cut off.	Data is destroyed.	Re-input the data.		
3	When any key is pressed a specific number is displayed and the table moves.	Defective NC PCB	Replace the NC PCB.	700100 700200	760100 760300
4	When a numeric key is pressed, a row of the same digit is displayed.				
5	A "CPU 2" error is displayed. The X- and Y-axis move on their own when the RESET key is pressed.				
6	External signals are not output.				

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
7	When the spindle is stopped during a memory run: - Spindle continues to rotate under its own inertia and does not stop immediately. - Spindle rotates in reverse direction and makes abnormal noises.	Defective NC PCB	Replace the NC PCB.	700100 700200	760100 760300
8	Delay of the output signal timing. Index table is miss indexing.	Defective contact of relay M12	Replace the RELAY I/O PCB (TC-215). Replace the RELAY I/O PCB (TC-225).		
9	"EM SWITCH ON" error displayed continuously.	Discontinuity on the OPERATION PCB	Replace the OPERATION PCB.	800200	
		Shorting of the brake circuit on the OUTPUT PCB (24 V circuit shorted)	Replace the OUTPUT PCB (TC-225).		
10	ABNORMAL TEMP. error	High temperature of a regenerative resistance	Replace the spindle driver.	700700 700800	760100 760300
		Input voltage is too high (within 10%).	Instruct the operator.		

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
11	POWER FAILURE	+5V and +15V voltages is low.	Adjust the voltages.		
		Defective contact of the connector CNPWS on the NC PCB	Check and clamp the connector firmly.		
		Loose terminal block of AVR1	Tighten the terminals.		
12	PARITY error		Re-input the data that caused the parity error.		
13	Positional displacement of the X-, Y- and Z-axis	P5V voltage is low.	Adjust AVR1 (to within P5V $\pm 3\%$).		
14	COMMAND ERROR	The spindle was rotated in the ATC operation area.	Instruct the operator (how to operate).		
15	ROM ERROR	P5V voltage is low.	Adjust AVR1 (to within P5V $\pm 3\%$).		
		ROM is not connected firmly to the MEMORY PCB.	Press the ROM firmly into place.		
		ROM pins are bent or broken.	Insert the ROM correctly or replace.	700100 700400 700600	

1.9 PROBLEMS WITH THE OPERATION BOX

1.9.1 Abnormal CRT Display

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	No display on the CRT (dark)	Power supply is not turned ON.			
		Fuse blow in the CRT.	Replace the 1.5V fuse.		
		Display has been cleared.	Select another display.		
		CRT brightness not adjusted	Adjust the brightness.		860100
		Poor connection of the coaxial cable	Connect the coaxial cable correctly. Check the connections at the NC PCB and the CRT unit.		
		Shorting of the coaxial cable	Repair the coaxial cable.		
		No video signal output from the NC PCB	Replace the NC PCB.	700100 700200	760100 760300
		Broken CRT unit heater or defective cathode-ray tube socket contact	Replace the CRT unit.	800100	860100
		Defective contact of the CRT unit power supply	Repair the electrical contact.		
		Cracked focus and brightness adjustment PCB	Replace the CRT unit.	800100	860100
		Defective cathode-ray tube	Replace the CRT unit.	800100	860100

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
2	The screen becomes green only.	Poor connection of the coaxial cable	Connect the coaxial cable correctly. Check the connections at the NC PCB and the CRT unit.		
		Discontinuity in the coaxial cable	Repair the coaxial cable.		
		P5V not applied to NC PCB	Check the AVR1 P5V voltage and tighten the terminals.		
3	Green becomes abnormally bright.	The green contrast cannot be adjusted over the entire screen. (20 white horizontal lines)	Replace the CRT unit.	800100	860100
		The right side of the screen is bright and the left side dark.	Replace the CRT unit.	800100	860100
4	Characters displayed magnified and cannot be adjusted.	Defective capacitor on the PCB in the CRT unit	Replace the CRT unit.	800100	860100
5	The characters at the top of the CRT move horizontally.	Horizontal synchronization partially ineffective	Adjust VR501 in the CRT unit.		860100
6	CRT display is tilted horizontally.	Rotary deviation of the deflecting coil (DY)	Cut the silicon rubber fixing and turn the coil handles.		860100
7	Image moves vertically.	Vertical synchronization displacement	Adjust VR401 in the CRT unit.		860100
8	Entire CRT display off-center	Rotary displacement of the positioning adjusting plates	Turn the two rotating circular plates at the rear of the deflecting coil.		860100

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
9	Characters appear double.	Vertical synchronization displacement	Adjust VR401 in the CRT unit.		860100
10	Characters not clear	Focus adjustment displacement	Adjust VR203 on the PCB at the rear of the cathode-ray tube.		860100
		Positional displacement of the interlace lines (Characters are very bright.)	Adjust VR401 in the CRT unit.		860100
11	Characters are sometimes bright, sometimes dark.	Defective cathode-ray tube socket contact in the CRT unit	Fix the socket with silicon rubber or replace the CRT unit.	800100	860100
		Defective connection of the coaxial cable	Replace the coaxial cable.		
12	Entire CRT display is dark.	Defective brightness or contrast adjustment	Adjust VR271 or VR272 in the CRT unit.		860100
		Disconnection in the coaxial cable	Repair the coaxial cable.		
13	Unaligned characters appear on the CRT.	The terminals of the switching power supply N15 are loose.	Tighten the terminals.		
		The OPERATION PCB connector is not locked.	Firmly clamp the connector.		

1.9.2 Abnormalities with the Operation Panel

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	No data can be input by pressing operation panel switches.	Mode select is incorrectly. Poor connection or clamping of the flat cable connector CNKEY on the OPERATION PCB	Instruct the operator. Replace the cable or clamp it firmly.		

1.10 MACHINE STOPS DURING A MEMORY RUN

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	Machine stops with the START switch LED lit.	Machine stops because the Y-axis deviation value is large and Y-axis is not in position.	Replace the Y-axis motor.	400100 400200 400300	360100 660100 760100 760300
		Due to accumulated of deviation, Machine stops at return position.	Slave circuit inoperative. Replace the NC PCB.	700100 700200	760100 760300
2	LIMIT OVER error during memory run	The program specified a movement which was out of range	Correct the program.		
		The working zero position have been changed (-) to (+).	Correct the program.		
3	The DRY RUN LED lamp flashes during a memory run.	Shorting due to oil	Replace the OPERATION PCB.	800200	

1.11 DEFECTIVE TAPPING

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	No-go gage enters tapped hole.	Defective operation of the NC PCB due to low P5V voltage	Adjust AVR1 to within 5 V (bring P5V to within <u>+3%</u>).		
		Incorrect adjustment of the spindle driver servo gain	Adjust the GAIN UHT (for TC-215 with old type driver). Adjust the P, I (for TC-215 with new type driver).		760100 760200 760300
		Tap drill hole too big. Misalignment of tool.	Instruct the operator.		
2	Go-gage does not enter tapped hole.	Deterioration of the spindle driver servo	Replace the spindle driver.	700700 700800	760100 760300
		The burr of the through tap drill hole is too large.	Instruct the operator on selection of taps.		
3	Abnormal noise during tapping	Play developed in the coupling	Replace the coupling.	100500 100600 100700 100800	160100 760100
4	Poor accuracy of the tapped hole position	Poor accuracy of the cored tap drill hole position on casting	Instruct the operator.		
5	SERVO ERROR occurs during tapping.	Tool and tap pitches differ due to a programming error	Instruct the operator.		
		Tapping process beyond capabilities of the machine	Instruct the operator.		
6	Tap breaks.	Tap hitting one side of the tap drill hole	Instruct the operator.		

1.12 POOR MACHINING ACCURACY

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	5 mm displacement of the X-, Y- and Z-axis	Zero-point limit switch and motor zero-point signals too close	Adjust the position of the zero-point limit switch dog.	600100 600300 600700	360100 360300 660100
2	2.5 mm displacement of the X-, Y- and Z-axis	Large discrepancies in X-, Y- and Z-axis deviation disrupt the zero-point signal pulses, resulting in displacement of the zero point	Replace the driver for each axis (TC-215).	700700	760100
		Coolant seeped into X- and Y-axis motors causing displacement of the zero point	Replace the X- and Y-axis motors.	300100 300200 300300 400100 400200 400300	360100 660100 760100
3	Z-axis depth gradually increases.	Depth increases by 5/100 mm due to thermal expansion of the spindle.	Instruct the operator (to change the program).		
		Chips jammed inside spindle causing a 0.05 - 0.2 mm increase in depth.	Clean the tool holder and inside the spindle.		
4	Occasional positional displacement of X-, Y- and Z-axis	Low P5V voltage (below 4.5 V)	Adjust the P5V voltage (to within 5V <u>+3%</u>).		
5	Dimensional displacement of X- or Y-axis	X-axis slipping due to cracked X-axis coupling	Replace the coupling.	300400 300500 400400 400500	360100 660100
		Worn X-axis bearing giving about 1 mm play	Replace the bearing or the ball screw assembly.	300600 300700 400600 400700	360100 660100

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
5	Dimensional displacement of X- or Y-axis	Loose fixing to X- or Y-axis motor bracket	Tighten the bracket bolts.		
		At a Y-axis feedrate of 10 mm/min, the axis gradually slips in the (+) direction.	Replace the Y-axis driver.	700700 700800	760100 760300
		Operator using an unsuitable jig	Correct the jig.		
		Tool slide due to lack of center drilling	Include a center drilling process in the program.		
6	Chattering on the milled face	Low tool clamping force due to cracked Belleville spring	Replace the Belleville spring or spindle assembly.	100900	160100
		Coupling gap too large	Adjust the coupling gap to approximately 0.5 mm.		

1.13 PROBLEMS WITH PERIPHERALS

1.13.1 Problems with the Coolant System

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	Coolant motor does not operate.	The COOLANT MOTOR switch is OFF.	Turn the switch ON.		
		Circuit protector CP3 in the control unit is OFF. (TC-215)	Turn CP3 ON (TC-215).		
		Discontinuity in the power supply unit thermal relay MC2 (TC-225)	Replace the MC2 thermal relay (TC-225).		
		Poor connection or incorrect wiring of the motor terminal block TB5 (TC-215)	Confirm the wiring (TC-215).		
		Poor connection or incorrect wiring of the power unit terminal block TB3 or the motor terminal block TBC (TC-225)	Confirm the wiring (TC-225).		
		Relay MC2 in the control unit is not ON (TC-215).	Replace the relay MC2 (TC-215)		
		Relay MC2 in the power supply unit is not ON (TC-225).	Replace the relay MC2 (TC-225).		
		Fuse FUS1 (3A) on the RELAY I/O PCB is blown (TC-215).	Replace the 3A fuses (TC-215).		
		Fuse F1 or F2 (3A) at the rear of the coolant motor terminal block is blown (TC-225).	Replace the 3A fuses (TC-225).		

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
2	Coolant valve is not ON.	Fuse FUS1 (3A) on the RELAY I/O PCB is blown (TC-215).	Replace the fuse 3A (TC-215).		
		Fuse FUS (2A) in the power supply unit is blown (TC-225).	Replace the fuse 2A (TC-225).		
		Defective relay RY2 on the RELAY I/O PCB (TC-215)	Replace the relay.		
		Defective relay RY26 on the RELAY PCB (TC-225)	Replace the relay.		
		Defective connection or incorrect wiring of the RELAY I/O PCB (TC-215) or OUTPUT PCB (TC-225) terminal block	Confirm the wiring (TC-215) (TC-225).		
3	Low coolant flow	Valve is closed.	Open the valve.		
		Coolant motor is rotating in reverse direction.	Change the phase of the terminal block connections.		

1.13.2 Problems with the Air Blaster

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	Air valve will not turn ON.	Fuse FUS1 (3A) on the RELAY I/O PCB is blown (TC-215).	Replace the fuse 3A (TC-215).		
		Fuse FUS (2A) in the power supply unit is blown (TC-225).	Replace the fuse 2A (TC-225).		
		Defective relay RY1 on the RELAY I/O PCB (TC-215)	Replace the relay.		
		Defective relay RY23 on the RELAY PCB (TC-225)	Replace the relay.		
		Defective connection or incorrect wiring of the RELAY I/O PCB (TC-215) or OUTPUT PCB (TC-225) terminal block	Confirm the wiring (TC-215) (TC-225).		

1.13.3 Problems with the Handy Sequence Controller

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1	Problems with the display lamps				
1.1	Display lamp does not light.	Lamp blown	Replace the lamp.		
1.2	Blown fuse in the display lamp power supply circuit	Fuse rated less than 1A	Replace with a 1A fuse.		
1.3	No DC 24 V power supply to the PCB (LED's 12 and 13 do not light when the terminals 4 and 5 are shorted together.)	Defective cable CNPOW Defective PCB	Replace the cable CNPOW. Replace the PCB.		
1.4	The display lamp to indicate that machining has ended does not light.				
	Does not light when 35 and 23 on the PCB and terminal block are shorted together.	Defective display lamp	Replace the display lamp.		
	LED6 lights but the display lamp does not light when tapping center output terminals 133 and 134 are shorted together.	Defective relay RY6 on the PCB or defective PCB	Replace the relay or PCB.		

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1.4	LED6 and the display lamp light when tapping center output terminals 133 and 134 are shorted together.	Defective relay unit or OUTPUT PCB	Replace the relay unit or OUTPUT PCB.		
1.5	LED6 does not light when tapping center output terminals 133 and 134 are shorted together.	Defective cable CNRYB1 or PCB	Replace the cable CNRYB1 or PCB.		
1.5	Alarm display lamp does not light.				
	Does not light when terminals 35 and 24 on the PCB are shorted together.	Defective display lamp	Replace the display lamp.		
1.5	LED5 lights but the display lamp does not light when tapping center output terminals 135 and 136 are shorted together.	Defective relay RY5 on the PCB or defective PCB	Replace the relay or PCB.		
1.5	LED5 and the display lamp light when tapping center output terminals 135 and 136 are shorted together.	Defective relay unit or OUTPUT PCB	Replace the relay unit or OUTPUT PCB.		

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
1.5	LED5 does not light when tapping center output terminals 135 and 136 are shorted together.	Defective cable CNRYB1 or PCB	Replace the cable CNRYB1 or PCB.		
1.6	Display lamp does not light during operation.				
	Does not light when terminals 35 and 25 on the PCB are shorted together.	Defective display lamp	Replace the display lamp.		
	LED7 lights but the display lamp does not light when tapping center output terminals 129 and 130 are shorted together.	Defective relay RY7 on the PCB or defective PCB	Replace the relay or PCB.		
	LED7 and the display lamp light when tapping center output terminals 129 and 130 are shorted together.	Defective relay unit or OUTPUT PCB	Replace the relay unit or OUTPUT PCB.		
2	Defective pre-set counter				
2.1	Counter does not count up when machining is complete.				

No.	Problem	Cause	Measures	Replace- ment Proc.	Adjust- ment Proc.
2.1	LED6 does not light when machining is complete.	PROGRAM STOP is set at the end of the program.	Delete the PROGRAM STOP.		
	The HOLD switch LED or RESET switch LED on the operation panel lights after machining ends, or immediately before.	An external hold or reset signal has been received.	Investigate and correct the peripheral device sending the external hold or reset signal.		
	The timer TM1 on the PCB is set to 0.2 seconds, or less.	Time is too short.	Set the timer to 0.5 seconds.		
	Counter does not count up when terminals 1 and 12 on the PCB are shorted together.	Defective counter	Replace the counter.		
	Counter counts up when PCB terminals 1 and 12 on the PCB are shorted together.	Defective relay RY6 on the PCB.	Replace the relay.		

2. PARTS REPLACEMENT PROCEDURES

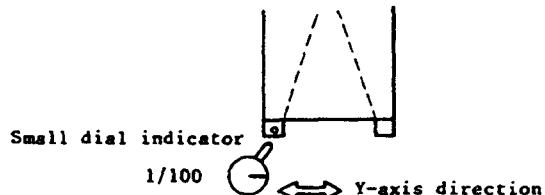
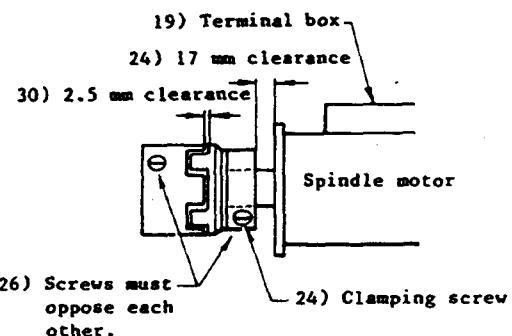
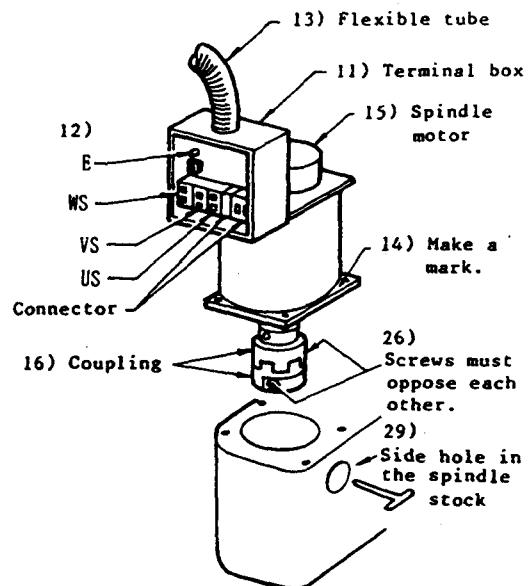
2.1 SPINDLE PARTS

- 100100 Replacing the Spindle Motor TC-215 6000 min⁻¹ A
- 100200 Replacing the Spindle Motor TC-215 6000 min⁻¹ B
- 100300 Replacing the Spindle Motor TC-215 10000 min⁻¹
- 100400 Replacing the Spindle Motor TC-225
- 100500 Replacing the Spindle Coupling TC-215 6000 min⁻¹ A
- 100600 Replacing the Spindle Coupling TC-215 6000 min⁻¹ B
- 100700 Replacing the Spindle Coupling TC-215 10000 min⁻¹
- 100800 Replacing the Spindle Coupling TC-225
- 100900 Replacing the Spindle and Clamp Shaft

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TC-215

- 1) POWER [ON]
- 2) [MDI]
- 3) [PARAM]
- 4) [2] [ENTER]
- 5) [\downarrow PAGE]
- 6) Set the GRID SHIFT VALUE SPINDLE to 0.
 - 6)-1 PROGRAM PROTECT [OFF]
 - 6)-2 Move cursor with the [\uparrow CURSOR] [\downarrow CURSOR] key to the GRID SHIFT VALUE SPINDLE row.
 - 6)-3 [0] [ENTER]
 - 6)-4 PROGRAM PROTECT [ON]
 - 6)-5 POWER [OFF]
 - 6)-6 POWER [ON]
- 7) [MANU]
- 8) [ATC] (Z-axis zero point)
- 9) [ATC] (Z-axis upper limit)
- 10) POWER [OFF]
- 11) Open the spindle motor terminal box.
- 12) Disconnect the US, VS, WS and E motor cables, and the connector.
- 13) Disconnect the flexible tube.
- 14) Make a mark on the motor base and the spindle stock.
- 15) Remove the spindle motor.
(CAUTION: The motor weighs about 15 kg.)
- 16) Disconnect the coupling from the motor and the spindle.
- 17) Connect the flexible tube to the new motor.
- 18) Connect the motor cables and the connector.
- 19) Place the motor terminal box upward on top of the control box.
- 20) POWER [ON]
- 21) [RESET]
- 22) [RELEASE] [-Z] (Move the Z-axis at least 60 mm below the zero point.)
- 23) [ATC] (Spindle orientation)
- 24) Push the coupling onto the motor shaft to leave a 17 mm gap with the motor. Align the clamping screws horizontally and tighten the clamping screws.



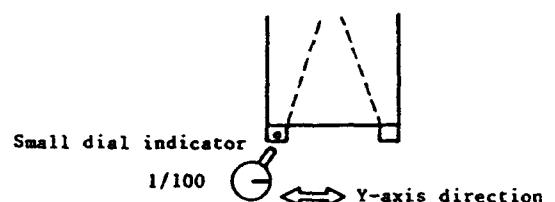
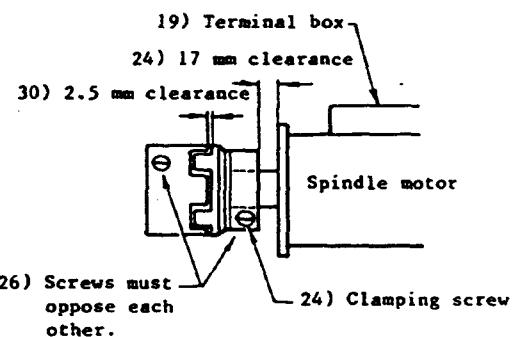
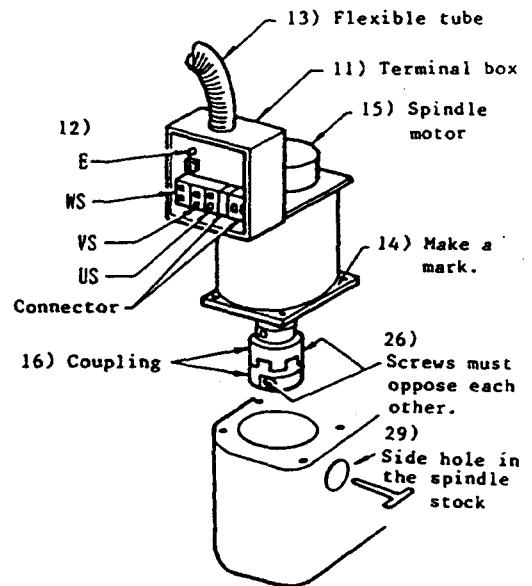
34) Parallelism at least ± 0.02
35) Parallelism at least 0.1 after tightening coupling

Replacement Parts	Part Name	Part Code	Jigs and Tools Required	
	AC motor 1.5K-6 Note: Export ... Nos. 111149 and below	620572003		Small dial indicator 1/100 Allen wrench (set) Straight-headed screwdriver Phillips screwdriver

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TC-215

- 25) [ATC] (Z-axis upper limit)
 26) Check that the coupling clamping screws oppose each other.
 27) Mount the spindle motor (with the motor terminal box on the control box side). Make sure that the marks are aligned.
 28) [RESET]
 29) [RELEASE] [-Z] (Move the Z-axis until the coupling becomes visible through the side hole in the spindle stock.)
 30) Open the coupling to give a 2.5 mm clearance.
 31) [RELEASE] [-Z] (Move the Z-axis at least 60 mm below the zero point.)
 32) [ATC] (Spindle orientation)
 33) [-Z] (Move the Z-axis until the coupling becomes visible through the side hole in the spindle stock.)
 34) Turn the spindle manually until the parallelism with the Y-axis of the key side faces at the end of the spindle is within ± 0.02 .
 35) Tighten the coupling through the side hole in the spindle stock. (Attach the rubber cap.) Check that the spindle parallelism is within 0.1 after tightening.
 36) Adjust the spindle orientation. (Adjustment No. 160100)
 37) Adjust the TC-215 spindle driver. (Adjustment No. 760100)



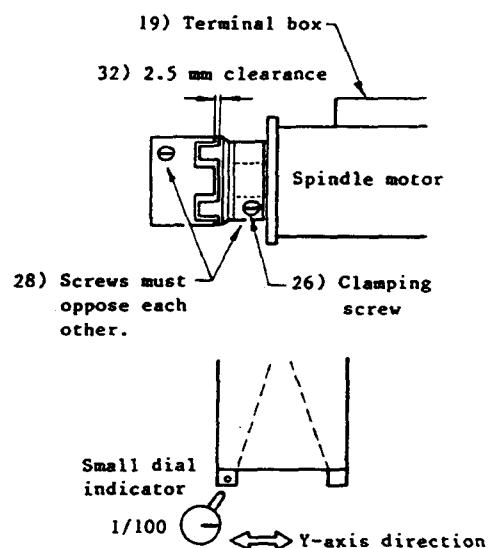
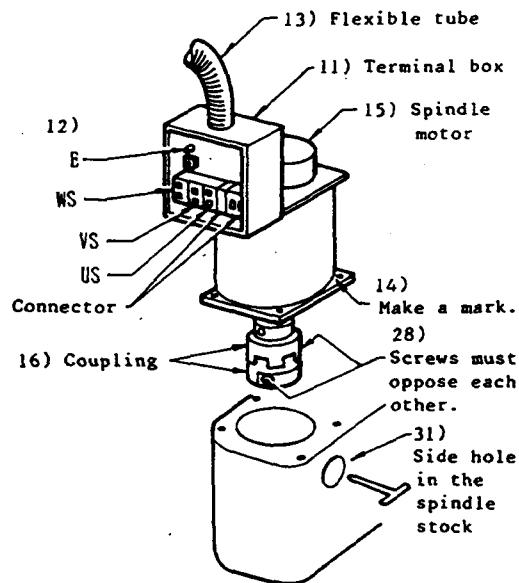
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 35) Parallelism at least 0.1 after tightening coupling

Replacement Parts	Part Name	Part Code	Jigs and Tools Required	
	AC motor 1.5K-6 Note: Export ... Nos. 111149 and below	620572003		Small dial indicator 1/100 Allen wrench (set) Straight-headed screwdriver Phillips screwdriver

Issued: / /

TC-215

- 1) POWER [ON]
- 2) [MDI]
- 3) [PARAM]
- 4) [2] [ENTER]
- 5) [↓ PAGE]
- 6) Set the GRID SHIFT VALUE SPINDLE to 0.
 - 6)-1 PROGRAM PROTECT [OFF]
 - 6)-2 Move cursor with the [↑ CURSOR] [↓ CURSOR] keys to the GRID SHIFT VALUE SPINDLE row.
 - 6)-3 [0] [ENTER]
 - 6)-4 PROGRAM PROTECT [ON]
 - 6)-5 POWER [OFF]
 - 6)-6 POWER [ON]
- 7) [MANU]
- 8) [ATC] (Z-axis zero point)
- 9) [ATC] (Z-axis upper limit)
- 10) POWER [OFF]
- 11) Open the spindle motor terminal box.
- 12) Disconnect the US, VS, WS and E motor cables, and the connector.
- 13) Disconnect the flexible tube.
- 14) Make a mark on the motor base and the spindle stock.
- 15) Remove the spindle motor.
(CAUTION: The motor weighs about 15 kg.)
- 16) Disconnect the coupling from the motor and the spindle.
- 17) Connect the flexible tube to the new motor.
- 18) Connect the motor cables and the connector.
- 19) Place the motor terminal box upward on top of the control box.
- 20) Set the spindle driver P gain and I gain to 0/10 N.
- 21) POWER [ON]
- 22) [RESET]
- 23) [RELSE] [-Z] (Move the Z-axis at least 60 mm below the zero point.)
- 24) [ATC] (Spindle orientation)



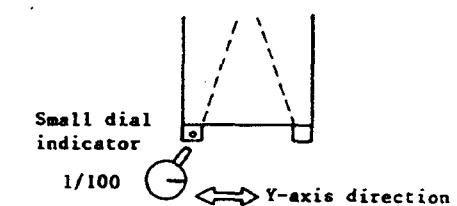
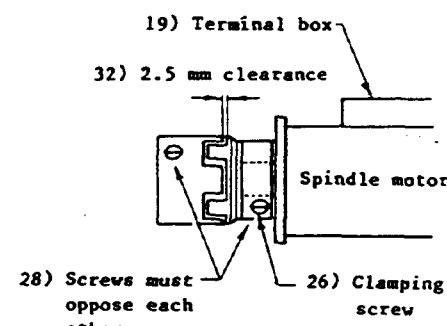
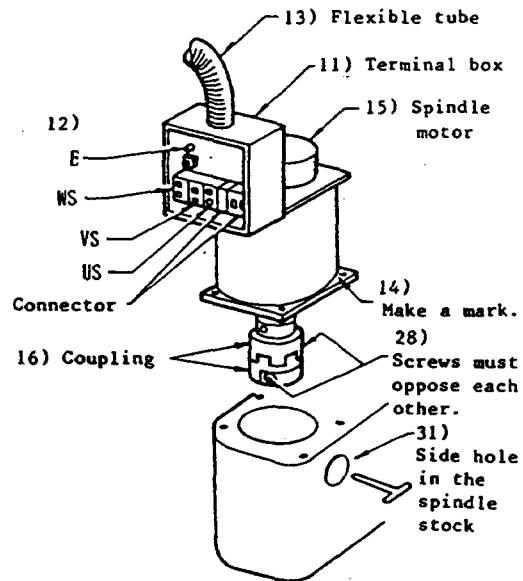
36) Parallelism at least ± 0.02
37) Parallelism at least 0.1 after tightening coupling

Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Small dial indicator 1/100 Allen wrench (set) Straight-headed screwdriver Phillips screwdriver
	Motor 12M 1.5K-6 Note: Export ... Nos. 111150 and above	628264000		

Issued: / /

TC-215

- 25) [I/O] [↓ PAGE]
Adjust SZ on the spindle driver to set the spindle deviation amount in the range ± 1 .
- 26) Push the coupling up to the motor end of the motor shaft. Align the clamping screws horizontally and tighten the clamping screws.
- 27) [ATC] (Z-axis upper limit)
- 28) Check that the coupling clamping screws oppose each other.
- 29) Mount the spindle motor (with the motor terminal box on the control box side.) Make sure that the marks are aligned.
- 30) [RESET]
- 31) [RELEASE] [-Z] (Move the Z-axis until the coupling becomes visible through the side hole in the spindle stock.)
- 32) Open the coupling to give a 2.5 mm clearance.
- 33) [RELEASE] [-Z] (Move the Z-axis at least 60 mm below the zero point.)
- 34) [ATC] (Spindle orientation)
- 35) [-Z] (Move the Z-axis until the coupling becomes visible through the side hole in the spindle stock.)
- 36) Turn the spindle manually until the parallelism with the Y-axis of the key side faces at the end of the spindle is within ± 0.02 .
- 37) Tighten the coupling through the side hole in the spindle stock. (Attach the rubber cap.) Check that the spindle parallelism is within 0.1 after tightening.
- 38) Adjust the spindle orientation.
(Adjustment No. 160100)
- 39) Adjust the TC-215 spindle driver.
(Adjustment No. 760200)



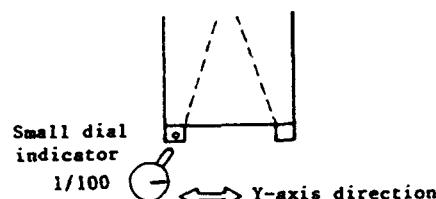
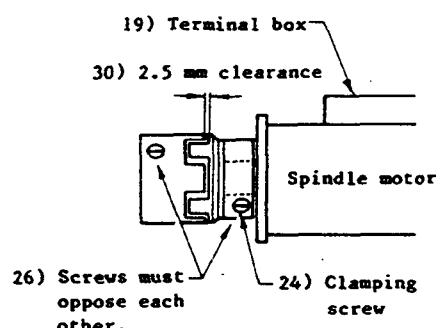
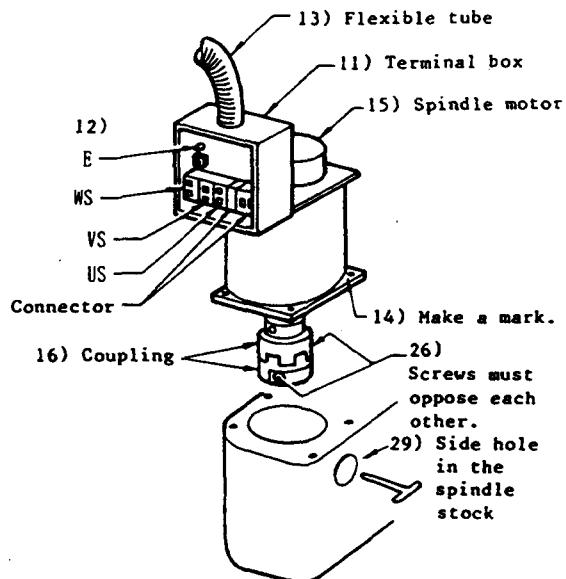
36) Parallelism at least ± 0.02
37) Parallelism at least 0.1 after
tightening coupling

Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Motor 12M 1.5K-6 Note: Export ... Nos. 111150 and above	628264000	Small dial indicator 1/100 Allen wrench (set) Straight-headed screwdriver Phillips screwdriver

Issued: / /

TC-215

- 1) POWER [ON]
- 2) [MDI]
- 3) [PARAM]
- 4) [2] [ENTER]
- 5) [↓ PAGE]
- 6) Set the GRID SHIFT VALUE SPINDLE to 0.
 - 6)-1 PROGRAM PROTECT [OFF]
 - 6)-2 Move cursor with the [↑ CURSOR] [↓ CURSOR] keys to the GRID SHIFT VALUE SPINDLE row.
 - 6)-3 [0] [ENTER]
 - 6)-4 PROGRAM PROTECT [ON]
 - 6)-5 POWER [OFF]
 - 6)-6 POWER [ON]
- 7) [MANU]
- 8) [ATC] (Z-axis zero point)
- 9) [ATC] (Z-axis upper limit)
- 10) POWER [OFF]
- 11) Open the spindle motor terminal box.
- 12) Disconnect the US, VS, WS and E motor cables, and the connector.
- 13) Disconnect the flexible tube.
- 14) Make a mark on the motor base and the spindle stock.
- 15) Remove the spindle motor.
(CAUTION: The motor weighs about 15 kg.)
- 16) Disconnect the coupling from the motor and the spindle.
- 17) Connect the flexible tube to the new motor.
- 18) Connect the motor cables and the connector.
- 19) Place the motor terminal box upward on top of the control box.
- 20) POWER [ON]
- 21) [RESET]
- 22) [RELEASE] [-Z] (Move the Z-axis at least 60 mm below the zero point.)
- 23) [ATC] (Spindle orientation)
- 24) Push the coupling up to the motor end of the motor shaft. Align the clamping screws horizontally and tighten the clamping screws.



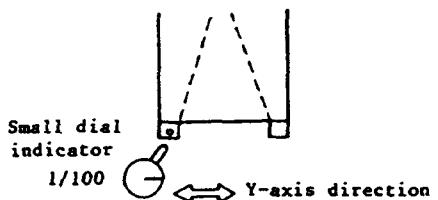
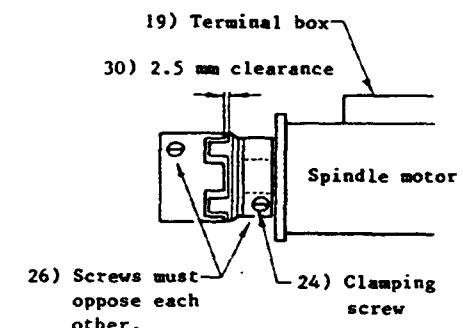
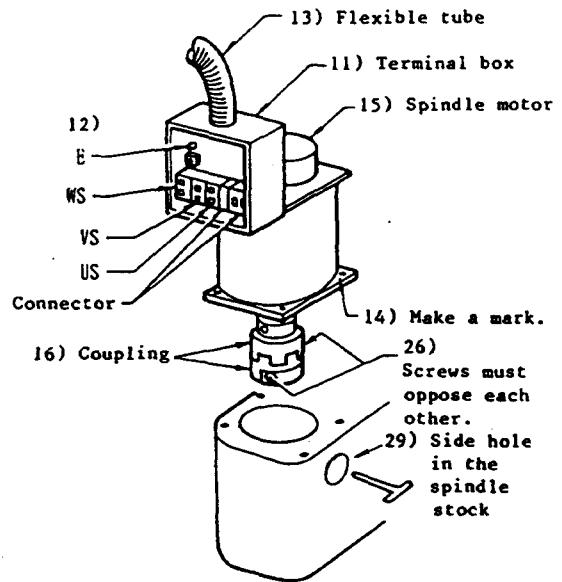
34) Parallelism at least ± 0.02
35) Parallelism at least 0.1 after tightening coupling

Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Notes
	AC motor 12M 1.5K assembly 10000	628041000		Small dial indicator 1/100 Allen wrench (set) Straight-headed screwdriver Phillips screwdriver

Issued: / /

TC-215

- 25) [ATC] (Z-axis upper limit)
 26) Check that the coupling clamping screws oppose each other.
 27) Mount the spindle motor (with the motor terminal box on the control box side.) Make sure that the marks are aligned.
 28) [RESET]
 29) [RELEASE] [-Z] (Move the Z-axis until the coupling becomes visible through the side hole in the spindle stock.)
 30) Open the coupling to give a 2.5 mm clearance.
 31) [RELEASE] [-Z] (Move the Z-axis at least 60 mm below the zero point.)
 32) [ATC] (Spindle orientation)
 33) [-Z] (Move the Z-axis until the coupling becomes visible through the side hole in the spindle stock.)
 34) Turn the spindle manually until the parallelism with the Y-axis of the key side faces at the end of the spindle is within ± 0.02 .
 35) Tighten the coupling through the side hole in the spindle stock. (Attach the rubber cap.) Check that the spindle parallelism is within 0.1 after tightening.
 36) Adjust the spindle orientation. (Adjustment No. 160100)
 37) Adjust the TC-215 spindle driver. (Adjustment No. 760100)



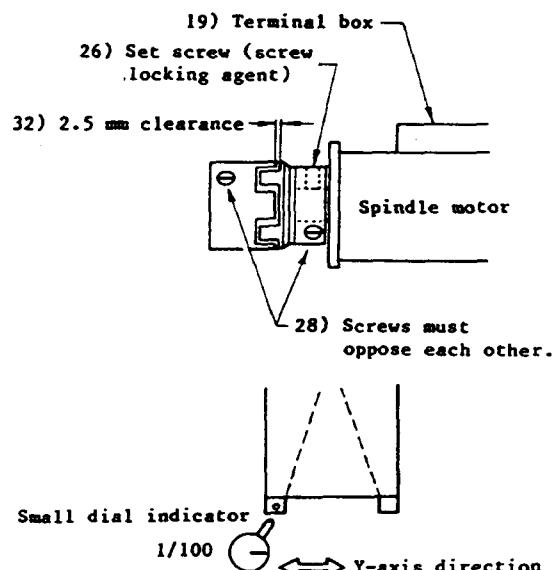
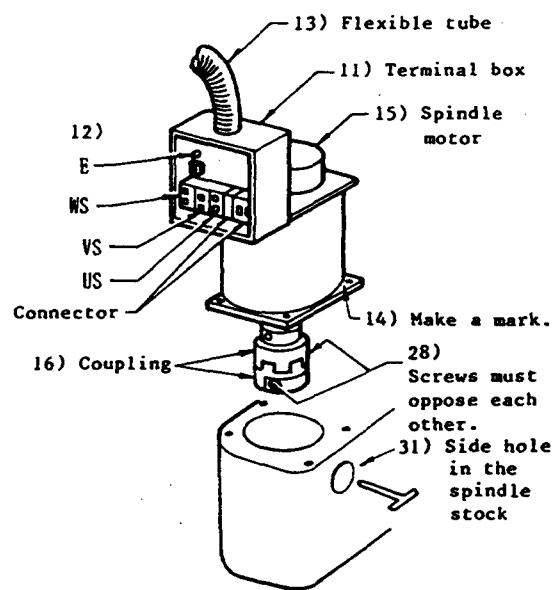
34) Parallelism at least ± 0.02
 35) Parallelism at least 0.1 after tightening coupling

Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	AC motor 12M 1.5K assembly 10000	628041000	Small dial indicator 1/100 Allen wrench (set) Straight-headed screwdriver Phillips screwdriver

Issued: / /

TC-225

- 1) POWER [ON]
- 2) [MDI]
- 3) [PARAM]
- 4) [2] [ENTER]
- 5) [↓ PAGE]
- 6) Set the GRID SHIFT VALUE SPINDLE to 0.
 - 6)-1 PROGRAM PROTECT [OFF]
 - 6)-2 Move cursor with the [↑ CURSOR] [↓ CURSOR] keys to the GRID SHIFT VALUE SPINDLE row.
 - 6)-3 [0] [ENTER]
 - 6)-4 PROGRAM PROTECT [ON]
 - 6)-5 POWER [OFF]
 - 6)-6 POWER [ON]
- 7) [MANU]
- 8) [ATC] (Z-axis zero point)
- 9) [ATC] (Z-axis upper limit)
- 10) POWER [OFF]
- 11) Open the spindle motor terminal box.
- 12) Disconnect the US, VS, WS and E motor cables, and the two connectors.
- 13) Disconnect the flexible tube.
- 14) Make a mark on the motor base and the spindle stock.
- 15) Remove the spindle motor.
(CAUTION: The motor weighs about 15 kg.)
- 16) Disconnect the coupling from the motor and the spindle.
- 17) Connect the flexible tube to the new motor.
- 18) Connect the motor cables and the connectors.
- 19) Place the motor terminal box upward on top of the control box.
- 20) POWER [ON]
- 21) [RESET]
- 22) [RELEASE] [-Z] (Move the Z-axis at least 60 mm below the zero point.)
- 23) [ATC] (Spindle orientation)
- 24) Push the coupling up to the motor end of the motor shaft. Align the set screw vertically and lightly tighten it to mark the motor shaft.



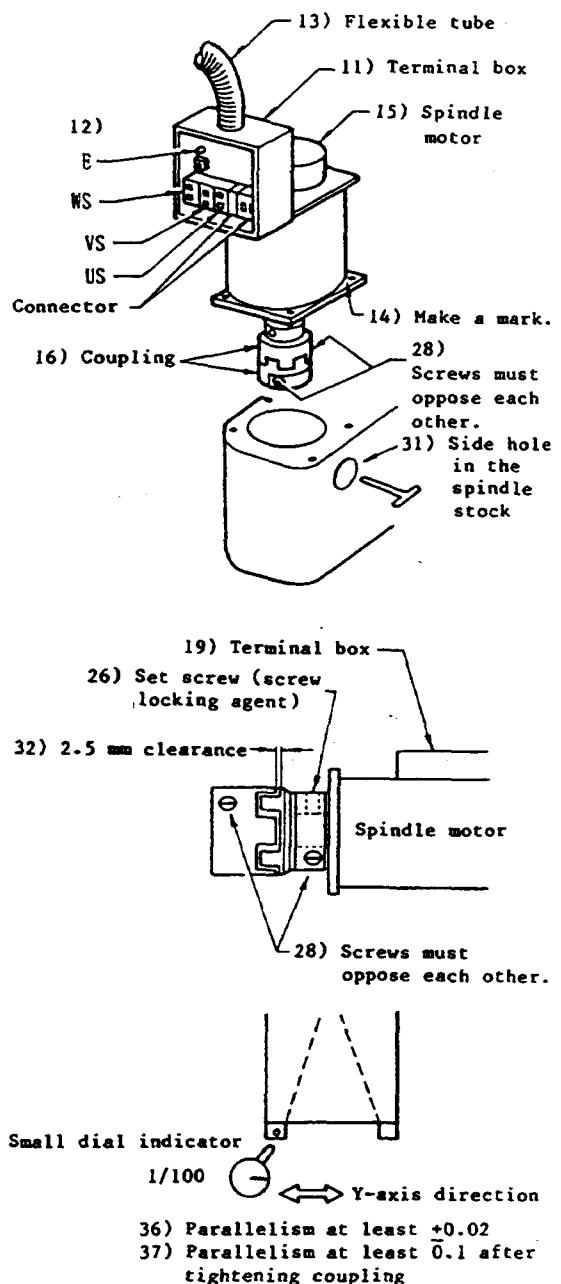
36) Parallelism at least ±0.02
37) Parallelism at least 0.1 after tightening coupling

Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Servo motor 3.1 kw	626170001	Small dial indicator 1/100 Allen wrench (set) Flat file Screw locking agent Straight-headed screwdriver Phillips screwdriver

Issued: / /

TC-225

- 25) Take the coupling off the shaft and file a flat where the set screw mark is.
- 26) Replace the coupling. Apply locking agent to the set screw and tighten the screw.
- 27) [ATC] (Z-axis upper limit)
- 28) Check that the coupling clamping screws oppose each other.
- 29) Mount the spindle motor (with the motor terminal box on the control box side.)
- 30) [RESET]
- 31) [RELEASE] [-Z] (Move the Z-axis until the coupling becomes visible through the side hole in the spindle stock.)
- 32) Open the coupling to give a 2.5 mm clearance.
- 33) [RELEASE] [-Z] (Move the Z-axis at least 60 mm below the zero point.)
- 34) [ATC] (Spindle orientation)
- 35) [-Z] (Move the Z-axis until the coupling becomes visible through the side hole in the spindle stock.)
- 36) Turn the spindle manually until the parallelism with the Y-axis of the key side faces at the end of the spindle is within ± 0.02 .
- 37) Tighten the coupling through the side hole in the spindle stock. (Attach the rubber cap.) Check that the spindle parallelism is within 0.1 after tightening.
- 38) Adjust the spindle orientation.
(Adjustment No. 160100)
- 39) Adjust the TC-225 spindle driver.
(Adjustment No. 760300)

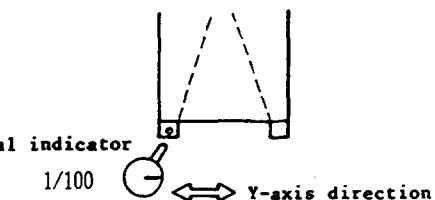
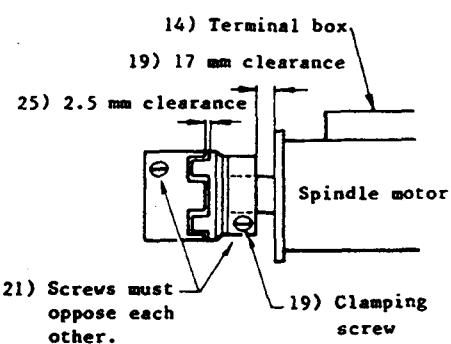
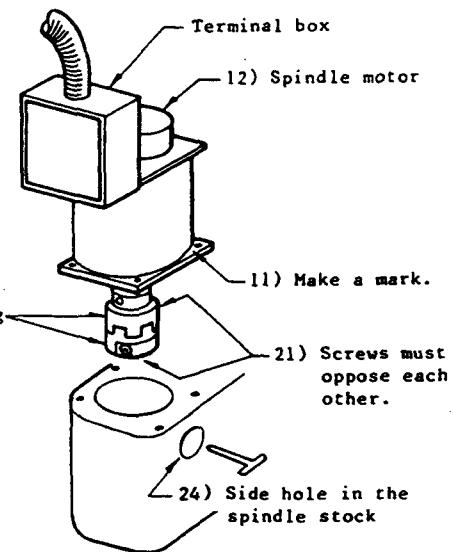


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Servo motor 3.1 kW	626170001	Small dial indicator 1/100 Allen wrench (set) Flat file Screw locking agent Straight-headed screwdriver Phillips screwdriver

Issued: / /

TC-215

- 1) POWER [ON]
- 2) [MDI]
- 3) [PARAM]
- 4) [2] [ENTER]
- 5) [\downarrow PAGE]
- 6) Set the GRID SHIFT VALUE SPINDLE to 0.
 - 6)-1 PROGRAM PROTECT [OFF]
 - 6)-2 Move cursor with the [\uparrow CURSOR] [\downarrow CURSOR] keys to the GRID SHIFT VALUE SPINDLE row.
 - 6)-3 [0] [ENTER]
 - 6)-4 PROGRAM PROTECT [ON]
 - 6)-5 POWER [OFF]
 - 6)-6 POWER [ON]
- 7) [MANU]
- 8) [ATC] (Z-axis zero point)
- 9) [ATC] (Z-axis upper limit)
- 10) POWER [OFF]
- 11) Make a mark on the motor base and the spindle stock.
- 12) Remove the spindle motor.
(CAUTION: The motor weighs about 15 kg.)
- 13) Disconnect the coupling from the motor and the spindle.
- 14) Place the motor terminal box upward on top of the control box.
- 15) POWER [ON]
- 16) [RESET]
- 17) [RELSE] [-Z] (Move the Z-axis at least 60 mm below the zero point.)
- 18) [ATC] (Spindle orientation)
- 19) Push the coupling onto the motor shaft to leave a 17 mm gap with the motor. Align the clamping screws horizontally and tighten the clamping screws.
- 20) [ATC] (Z-axis upper limit)
- 21) Check that the coupling clamping screws oppose each other.
- 22) Mount the spindle motor (with the motor terminal box on the control box side.) Make sure that the marks are aligned.
- 23) [RESET]



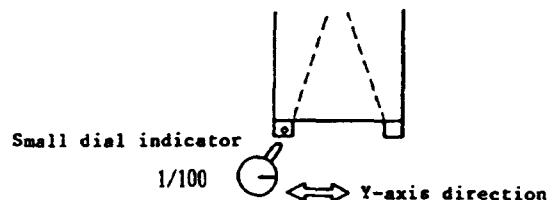
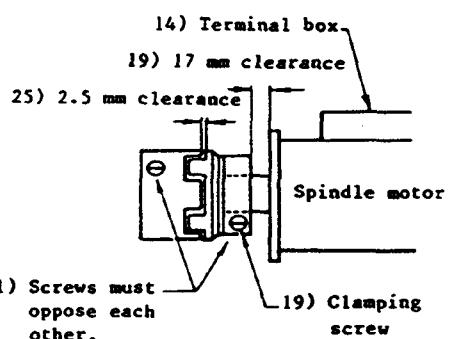
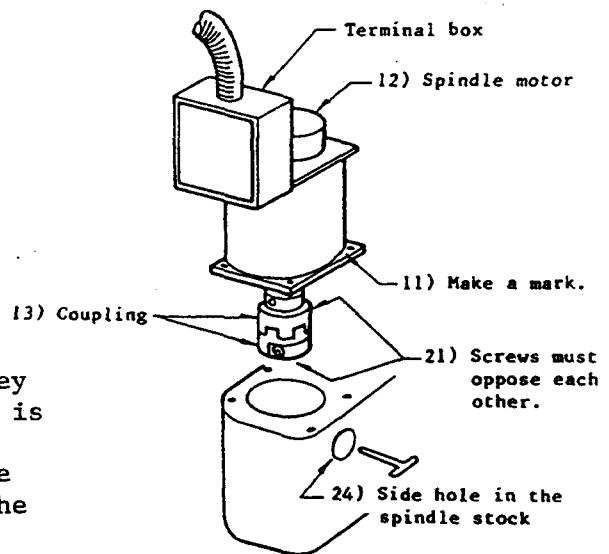
29) Parallelism at least ± 0.02
30) Parallelism at least 0.1 after tightening coupling

Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Notes
	Coupling assembly B215 Note: Export ... Nos. 111149 and below	628151000		Small dial indicator 1/100 Allen wrench (set) Straight-headed screwdriver Phillips screwdriver

Issued: / /

TC-215

- 24) [RELEASE] [-Z] (Move the Z-axis until the coupling becomes visible through the side hole in the spindle stock.)
- 25) Open the coupling to give a 2.5 mm clearance.
- 26) [RELEASE] [-Z] (Move the Z-axis at least 60 mm below the zero point.)
- 27) [ATC] (Spindle orientation)
- 28) [-Z] (Move the Z-axis until the coupling becomes visible through the side hole in the spindle stock.)
- 29) Turn the spindle manually until the parallelism with the Y-axis of the key side faces at the end of the spindle is within ± 0.02 .
- 30) Tighten the coupling through the side hole in the spindle stock. (Attach the rubber cap.) Check that the spindle parallelism is within 0.1 after tightening.
- 31) Adjust the spindle orientation. (Adjustment No. 160100)



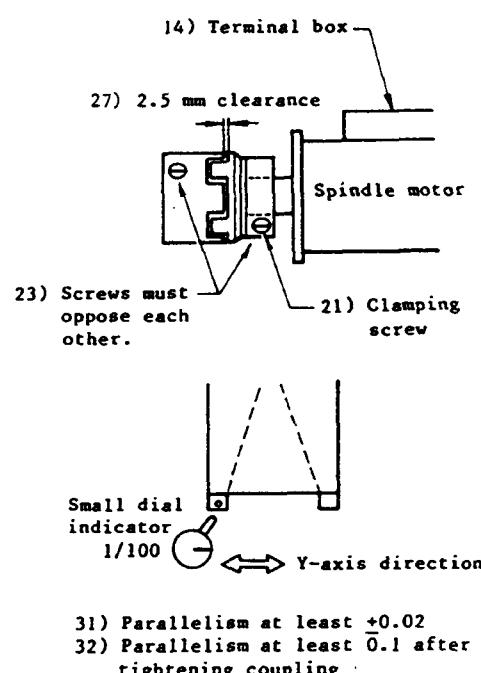
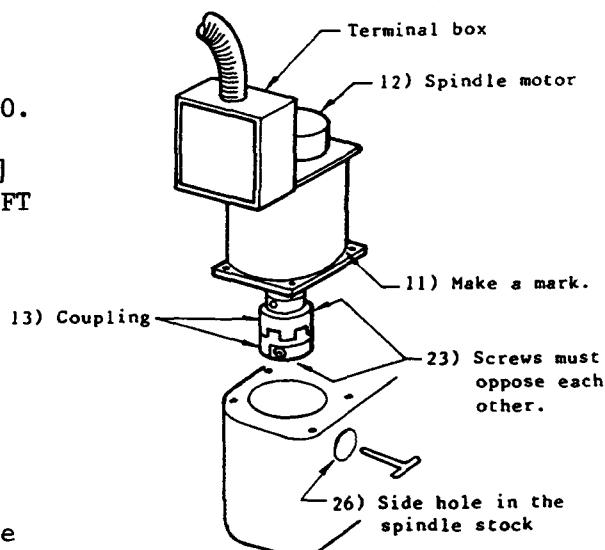
- 29) Parallelism at least ± 0.02
30) Parallelism at least 0.1 after tightening coupling

Replacement Parts	Part Name Coupling assembly B215 Note: Export ... Nos. 111149 and below	Part Code 628151000	Jigs and Tools Required	Small dial indicator 1/100 Allen wrench (set) Straight-headed screwdriver Phillips screwdriver

Issued: / /

TC-215

- 1) POWER [ON]
- 2) [MDI]
- 3) [PARAM]
- 4) [2] [ENTER]
- 5) [↓ PAGE]
- 6) Set the GRID SHIFT VALUE SPINDLE to 0.
 - 6)-1 PROGRAM PROTECT [OFF]
 - 6)-2 Move cursor with the [↑ CURSOR]
[↓ CURSOR] keys to the GRID SHIFT
VALUE SPINDLE row.
 - 6)-3 [0] [ENTER]
 - 6)-4 PROGRAM PROTECT [ON]
 - 6)-5 POWER [OFF]
 - 6)-6 POWER [ON]
- 7) [MANU]
- 8) [ATC] (Z-axis zero point)
- 9) [ATC] (Z-axis upper limit)
- 10) POWER [OFF]
- 11) Make a mark on the motor base and the spindle stock.
- 12) Remove the spindle motor.
(CAUTION: The motor weighs about 15 kg.)
- 13) Disconnect the coupling from the motor and the spindle.
- 14) Place the motor terminal box upward on top of the control box.
- 15) Set the spindle driver P gain and I gain to 0/10 N.
- 16) POWER [ON]
- 17) [RESET]
- 18) [RELEASE] [-Z] (Move the Z-axis at least 60 mm below the zero point.)
- 19) [ATC] (Spindle orientation)
- 20) [I/O] [↓ PAGE]
Adjust SZ on the spindle driver to set the spindle deviation amount in the range ±1.
- 21) Push the coupling up to the motor end of the motor shaft. Align the clamping screws horizontally and tighten the clamping screws.



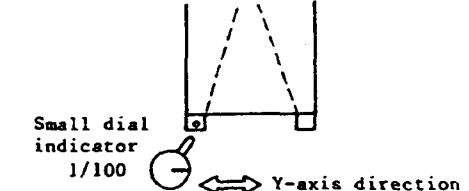
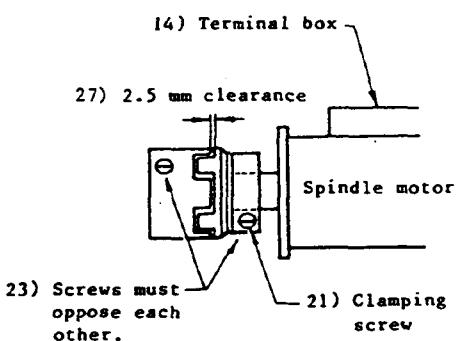
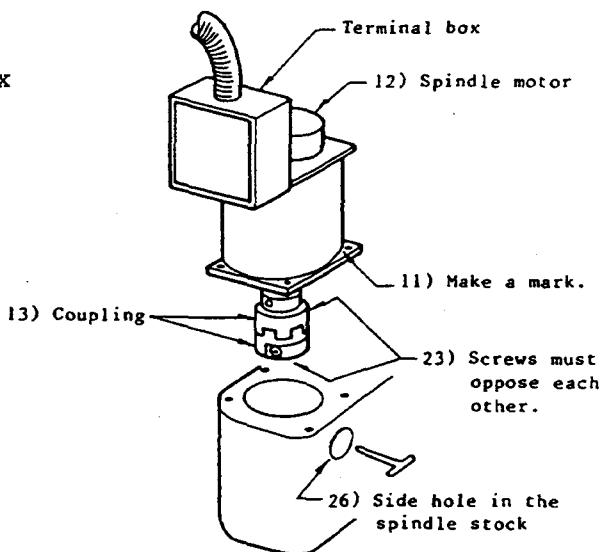
31) Parallelism at least +0.02
32) Parallelism at least 0.1 after
tightening coupling

Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Small dial indicator 1/100 Allen wrench (set) Straight-headed screwdriver Phillips screwdriver
	Coupling assembly A215 Note: Export ... Nos. 111150 and above	628062000		

Issued: / /

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- 22) [ATC] (Z-axis upper limit)
 23) Check that the coupling clamping screws oppose each other.
 24) Mount the spindle motor (with the motor terminal box on the control box side.)
 25) [RESET]
 26) [RELEASE] [-Z] (Move the Z-axis until the coupling becomes visible through the side hole in the spindle stock.)
 27) Open the coupling to give a 2.5 mm clearance.
 28) [RELEASE] [-Z] (Move the Z-axis at least 60 mm below the zero point.)
 29) [ATC] (Spindle orientation)
 30) [-Z] (Move the Z-axis until the coupling becomes visible through the side hole in the spindle stock.)
 31) Turn the spindle manually until the parallelism with the Y-axis of the key side faces at the end of the spindle is within ± 0.02 .
 32) Tighten the coupling through the side hole in the spindle stock. (Attach the rubber cap.) Check that the spindle parallelism is within 0.1 after tightening.
 33) Adjust the spindle orientation.
 (Adjustment No. 160100)
 34) Adjust the TC-215 driver at changing spindle motor. (Adjustment No. 760200)



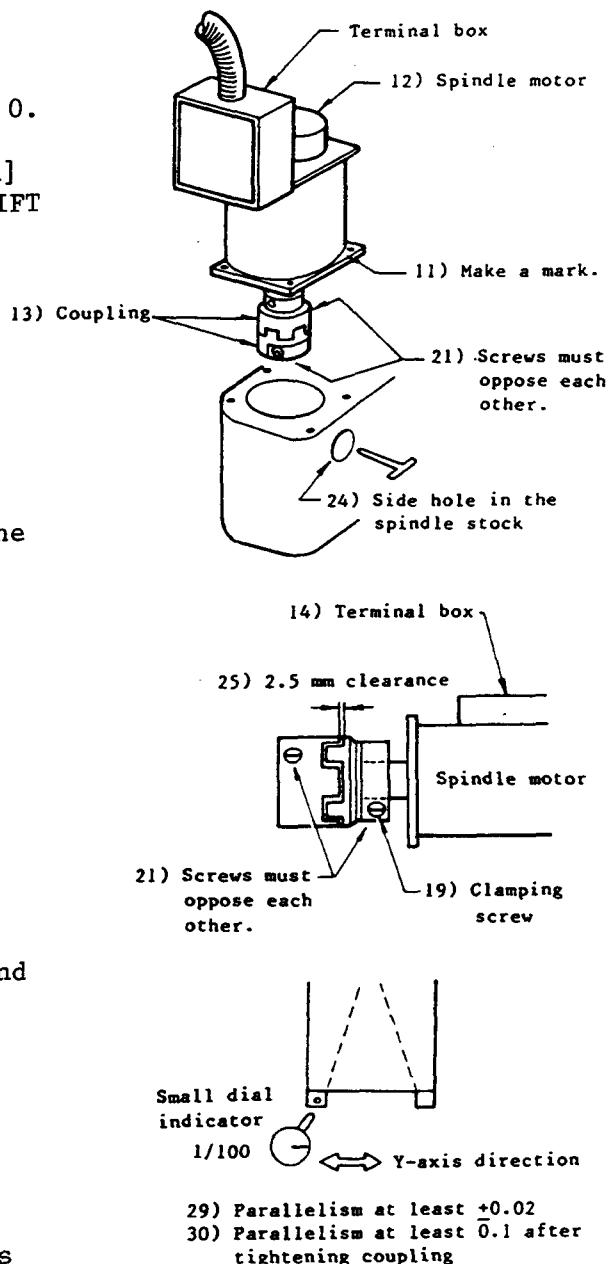
31) Parallelism at least ± 0.02
 32) Parallelism at least 0.1 after
 tightening coupling

Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Coupling assembly A215 Note: Export ... Nos. 111150 and above	628062000	Small dial indicator 1/100 Allen wrench (set) Straight-headed screwdriver Phillips screwdriver

Issued: / /

TC-215

- 1) POWER [ON]
- 2) [MDI]
- 3) [PARAM]
- 4) [2] [ENTER]
- 5) [↓ PAGE]
- 6) Set the GRID SHIFT VALUE SPINDLE to 0.
 - 6)-1 PROGRAM PROTECT [OFF]
 - 6)-2 Move cursor with the [↑ CURSOR] [↓ CURSOR] keys to the GRID SHIFT VALUE SPINDLE row.
 - 6)-3 [0] [ENTER]
 - 6)-4 PROGRAM PROTECT [ON]
 - 6)-5 POWER [OFF]
 - 6)-6 POWER [ON]
- 7) [MANU]
- 8) [ATC] (Z-axis zero point)
- 9) [ATC] (Z-axis upper limit)
- 10) POWER [OFF]
- 11) Make a mark on the motor base and the spindle stock.
- 12) Remove the spindle motor.
(CAUTION: The motor weighs about 15 kg.)
- 13) Disconnect the coupling from the motor and the spindle.
- 14) Place the motor terminal box upward on top of the control box.
- 15) POWER [ON]
- 16) [RESET]
- 17) [RELEASE] [-Z] (Move the Z-axis at least 60 mm below the zero point.)
- 18) [ATC] (Spindle orientation)
- 19) Push the coupling up to the motor end of the motor shaft. Align the clamping screws horizontally and tighten the clamping screws.
- 20) [ATC] (Z-axis upper limit)
- 21) Check that the coupling clamping screws oppose each other.
- 22) Mount the spindle motor (with the motor terminal box on the control box side.) Make sure that the marks are aligned.
- 23) [RESET]

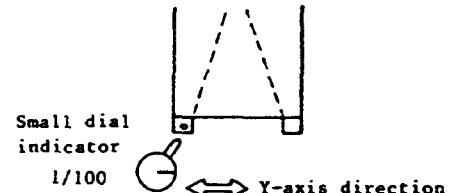
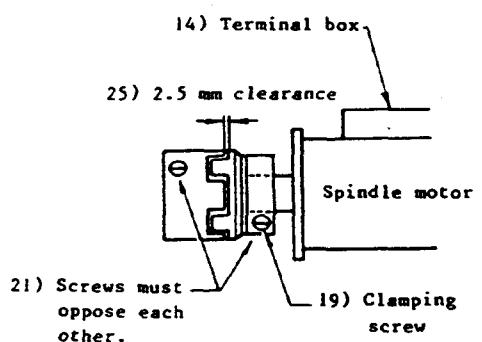
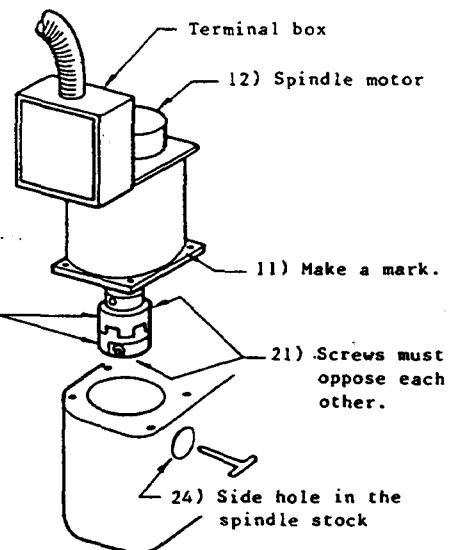


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Coupling assembly A215	628062000	Small dial indicator 1/100 Allen wrench (set) Straight-headed screwdriver Phillips screwdriver

Issued: / /

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- 24) [RELEASE] [-Z] (Move the Z-axis until the coupling becomes visible through the side hole in the spindle stock.)
- 25) Open the coupling to give a 2.5 mm clearance.
- 26) [RELEASE] [-Z] (Move the Z-axis at least 60 mm below the zero point.)
- 27) [ATC] (Spindle orientation)
- 28) [-Z] (Move the Z-axis until the coupling becomes visible through the side hole in the spindle stock.)
- 29) Turn the spindle manually until the 13) Coupling parallelism with the Y-axis of the key side faces at the end of the spindle is within ± 0.02 .
- 30) Tighten the coupling through the side hole in the spindle stock. (Attach the rubber cap.) Check that the spindle parallelism is within 0.1 after tightening.
- 31) Adjust the spindle orientation. (Adjustment No. 160100)



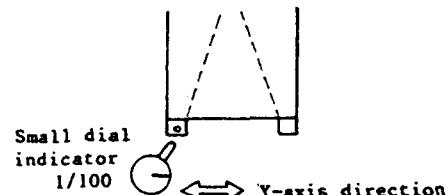
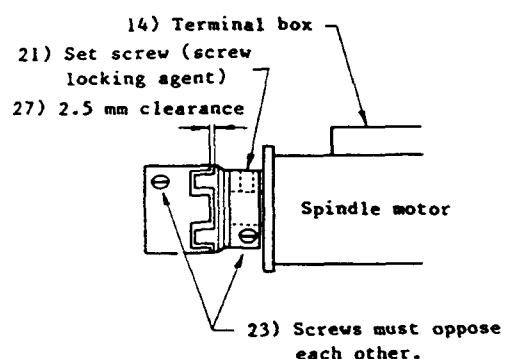
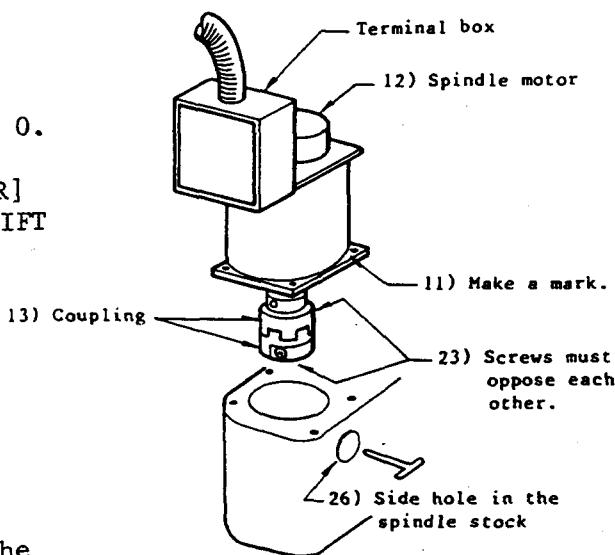
29) Parallelism at least ± 0.02
 30) Parallelism at least 0.1 after
 tightening coupling

Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Small dial indicator 1/100 Allen wrench (set) Straight-headed screwdriver Phillips screwdriver
	Coupling assembly A215	628062000		

Issued: / /

TC-225

- 1) POWER [ON]
- 2) [MDI]
- 3) [PARAM]
- 4) [2] [ENTER]
- 5) [\downarrow PAGE]
- 6) Set the GRID SHIFT VALUE SPINDLE to 0.
 - 6)-1 PROGRAM PROTECT [OFF]
 - 6)-2 Move cursor with the [\uparrow CURSOR]
[\downarrow CURSOR] keys to the GRID SHIFT
VALUE SPINDLE row.
 - 6)-3 [0] [ENTER]
 - 6)-4 PROGRAM PROTECT [ON]
 - 6)-5 POWER [OFF]
 - 6)-6 POWER [ON]
- 7) [MANU]
- 8) [ATC] (Z-axis zero point)
- 9) [ATC] (Z-axis upper limit)
- 10) POWER [OFF]
- 11) Make a mark on the motor base and the spindle block.
- 12) Remove the spindle motor.
(CAUTION: The motor weighs about 15 kg.)
- 13) Disconnect the coupling from the motor and the spindle.
- 14) Place the motor terminal box upward on top of the control box.
- 15) POWER [ON]
- 16) [RESET]
- 17) [RELEASE] [-Z] (Move the Z-axis at least 60 mm below the zero point.)
- 18) [ATC] (Spindle orientation)
- 19) Push the coupling up to the motor end of the motor shaft. Align the set screw vertically and lightly tighten it to mark the motor shaft.
- 20) Take the coupling off the shaft and file a flat where the set screw mark is.
- 21) Replace the coupling. Apply locking agent to the set screw and tighten the screw.



31) Parallelism at least ± 0.02
32) Parallelism at least 0.1 after
tightening coupling

Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Joint assembly 28/38-1	626380001	Small dial indicator 1/100 Screw locking agent Flat file Allen wrench (set) Straight-headed screwdriver Phillips screwdriver

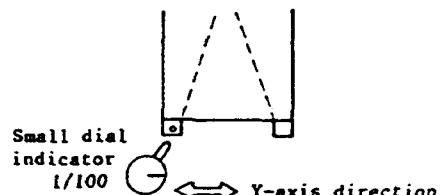
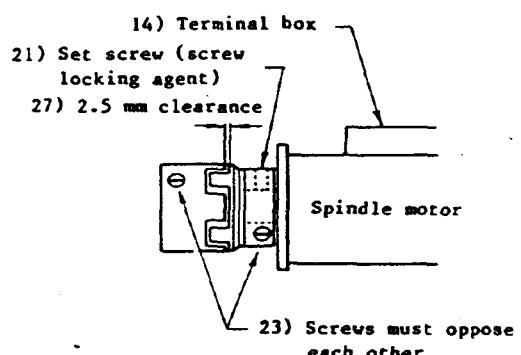
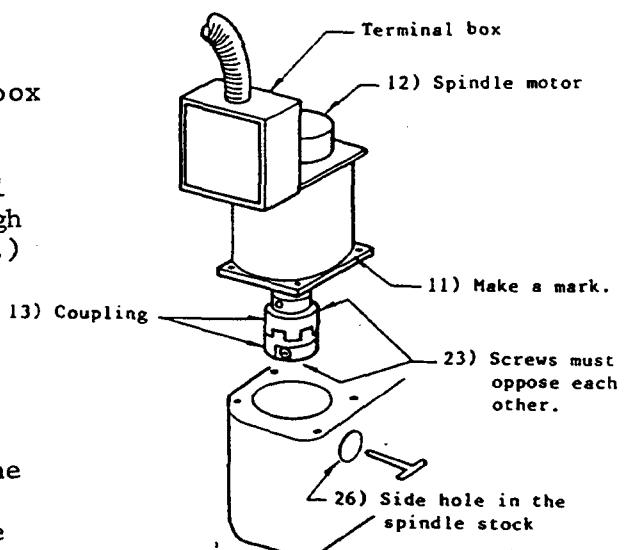
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- 22) [ATC] (Z-axis upper limit)
- 23) Check that the coupling clamping screws oppose each other.
- 24) Mount the spindle motor (with the motor terminal box on the control box side.)
- 25) [RESET]
- 26) [RELEASE] [-Z] (Move the Z-axis until the coupling becomes visible through the side hole in the spindle stock.)
- 27) Open the coupling to give a 2.5 mm clearance.
- 28) [RELEASE] [-Z] (Move the Z-axis at least 60 mm below the zero point.)
- 29) [ATC] (Spindle orientation)
- 30) [-Z] (Move the Z-axis until the coupling becomes visible through the side hole in the spindle stock.)
- 31) Turn the spindle manually until the parallelism with the Y-axis of the key side faces at the end of the spindle is within ± 0.02 .

Tighten the coupling through the side hole in the spindle stock.
(Attach the rubber cap.)

- 32) Check that the spindle parallelism is within 0.1 after tightening.
- 33) Adjust the spindle orientation.
(Adjustment No. 160100)

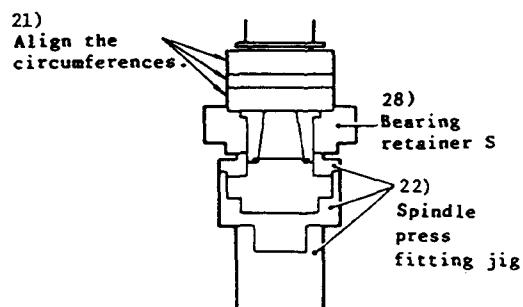
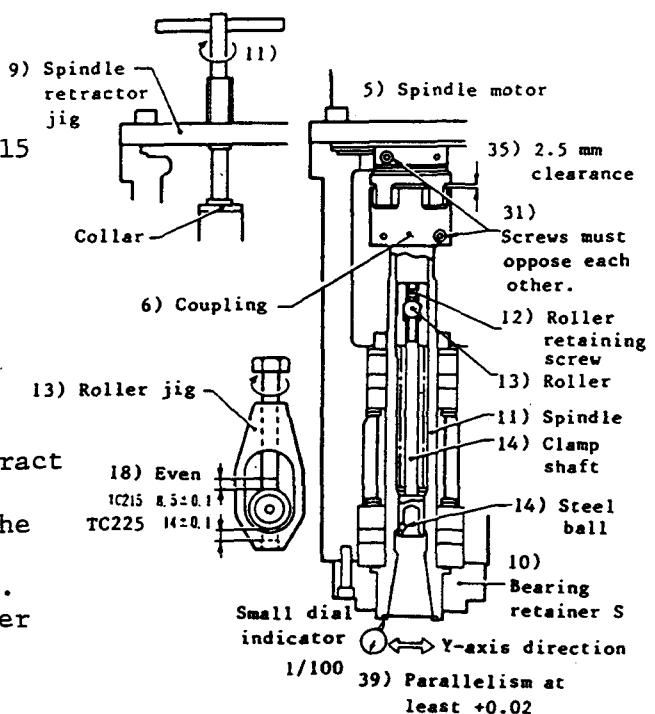


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Joint assembly 28/38-1	626380001	Small dial indicator 1/100 Screw locking agent Flat file Allen wrench (set) Straight-headed screwdriver Phillips screwdriver

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- 1) POWER [ON]
- 2) [MDI]
- 3) [ATC]
- 4) [ATC] (Z-axis upper limit)
- 5) Remove the spindle motor.
(CAUTION: The motor weighs about 15 kg.)
- 6) Disconnect the coupling from the spindle.
- 7) [RESET]
- 8) [RELEASE] [-Z] (Until the gripper opens.)
- 9) Attach the spindle retractor jig onto the motor mounting flange.
- 10) Remove the bearing retainer S.
- 11) Turn the retractor jig bar to retract the spindle.
(CAUTION: Support the bottom of the spindle.)
- 12) Remove the roller retaining screw.
- 13) Take off the roller with the roller jig.
- 14) Remove the clamp shaft and three steel balls.
- 15) Stick the balls to the new clamp shaft with grease.
- 16) Insert the new clamp shaft in the spindle.
- 17) Press fit the roller with the roller jig.
- 18) Make the roller end dimensions even.
(TC-215: 8.5 ± 0.1 , TC-225: 14 ± 0.1)
- 19) Apply locking agent to the roller retaining screw and tighten the screw.
- 20) Check by hand that all bearings rotate freely.
- 21) Align the bearing and the collar circumferences.
- 22) Insert the spindle from underneath and attach the spindle press fitting jig.
- 23) [MANU]
- 24) [JOG]



Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Notes
	Spindle assembly 215-6	628153001		Allen wrench (set)
	Spindle assembly 215-10	628042001		Spindle retractor jig
	Spindle assembly 225	628508001		Roller jig
	Clamp shaft assembly 215	628047001		Screw locking agent
	Clamp shaft assembly 4(225)	626404001		Spindle press fitting jigs
				Small dial indicator 1/100

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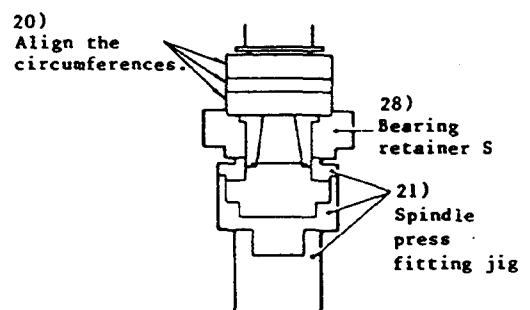
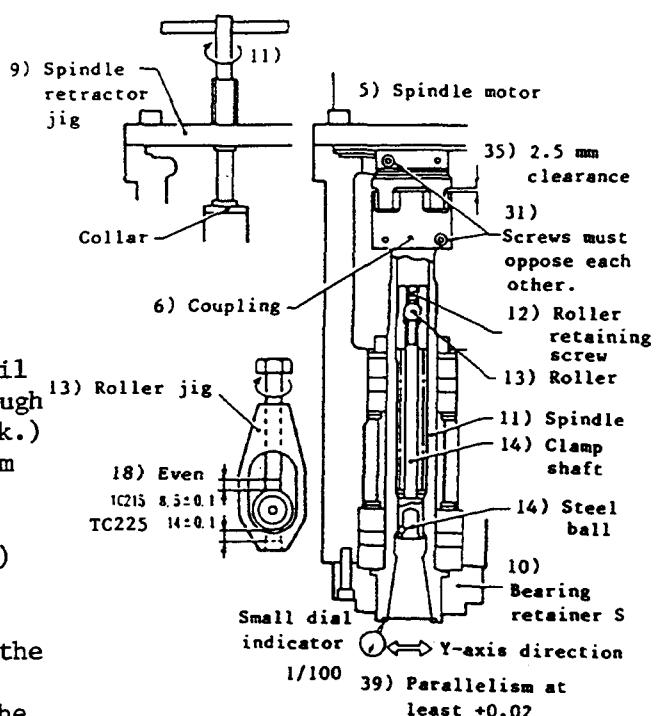
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- 25) [I/O]
- 26) [↓ PAGE]
- 27) [-Z] (Press fit the spindle.)
- 28) Mount the bearing retainer S.
- 29) [ATC]
- 30) [ATC] (Z-axis upper limit)
- 31) Check that the coupling clamping screws oppose each other.
- 32) Mount the spindle motor (with the motor terminal box on the control box side.)
- 33) [RESET]
- 34) [RELEASE] [-Z] (Move the Z-axis until the coupling becomes visible through the side hole in the spindle stock.)
- 35) Open the coupling to give a 2.5 mm clearance.
- 36) [RELEASE] [-Z] (Move the Z-axis at least 60 mm below the zero point.)
- 37) [ATC] (Spindle orientation)
- 38) [-Z] (Move the Z-axis until the coupling becomes visible through the side hole in the spindle stock.)
- 39) Turn the spindle manually until the parallelism with the Y-axis of the key side faces at the end of the spindle is within ± 0.02 .
- 40) Tighten the coupling through the side hole in the spindle stock.
(Attach the rubber cap.)
- 41) Adjust the spindle orientation.
(Adjustment No. 160100)

Note 1: Stop press-fitting when the Z-axis deviation reaches 100 or more.

Note 2: If SERVO ERROR occurs, turn the POWER OFF and insert the jig with striking by hammer on it.



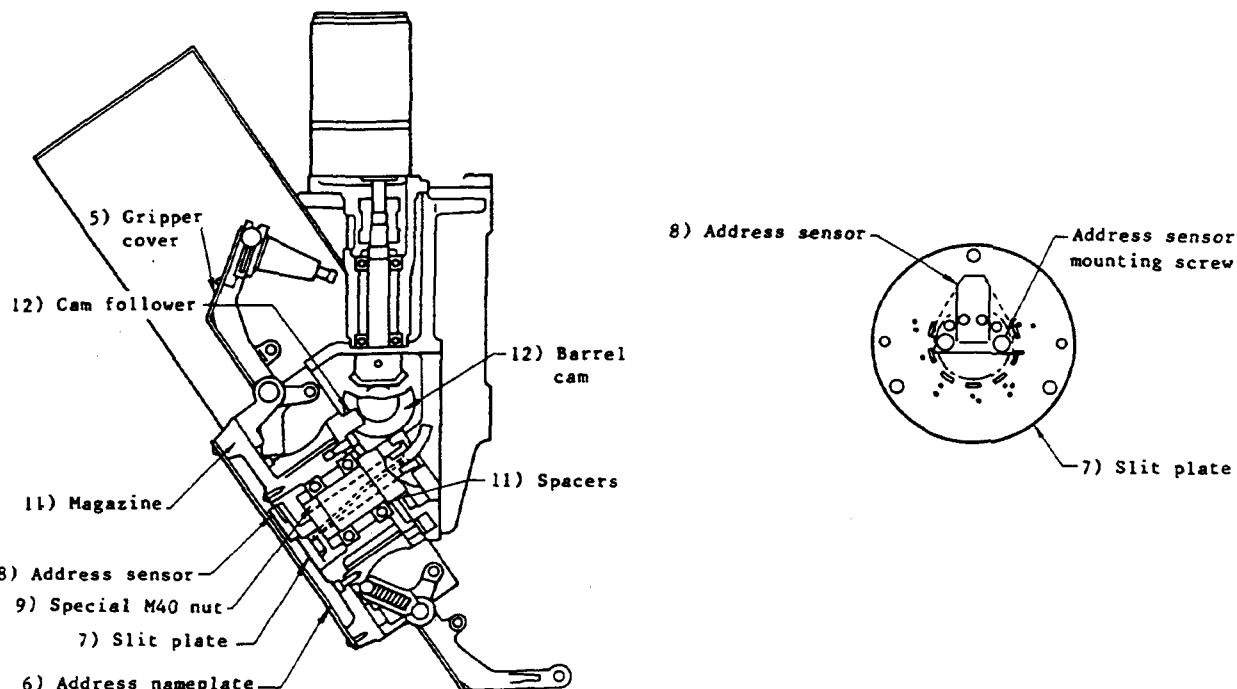
Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Allen wrench (set) Spindle retractor jig Roller jig Screw locking agent Spindle press fitting jigs Small dial indicator 1/100
	Spindle assembly 215-6	628153001		
	Spindle assembly 215-10	628042001		
	Spindle assembly 225	628508001		
	Clamp shaft assembly 215	628047001		
	Clamp shaft assembly 4(225)	626404001		

2.2 MAGAZINE PARTS

- 200100 Replacing the Magazine
- 200200 Replacing the Gripper
- 200300 Replacing the Address Sensor
- 200400 Replacing the Barrel Cam
- 200500 Replacing the ATC Motor
- 200600 Replacing the Gear Head

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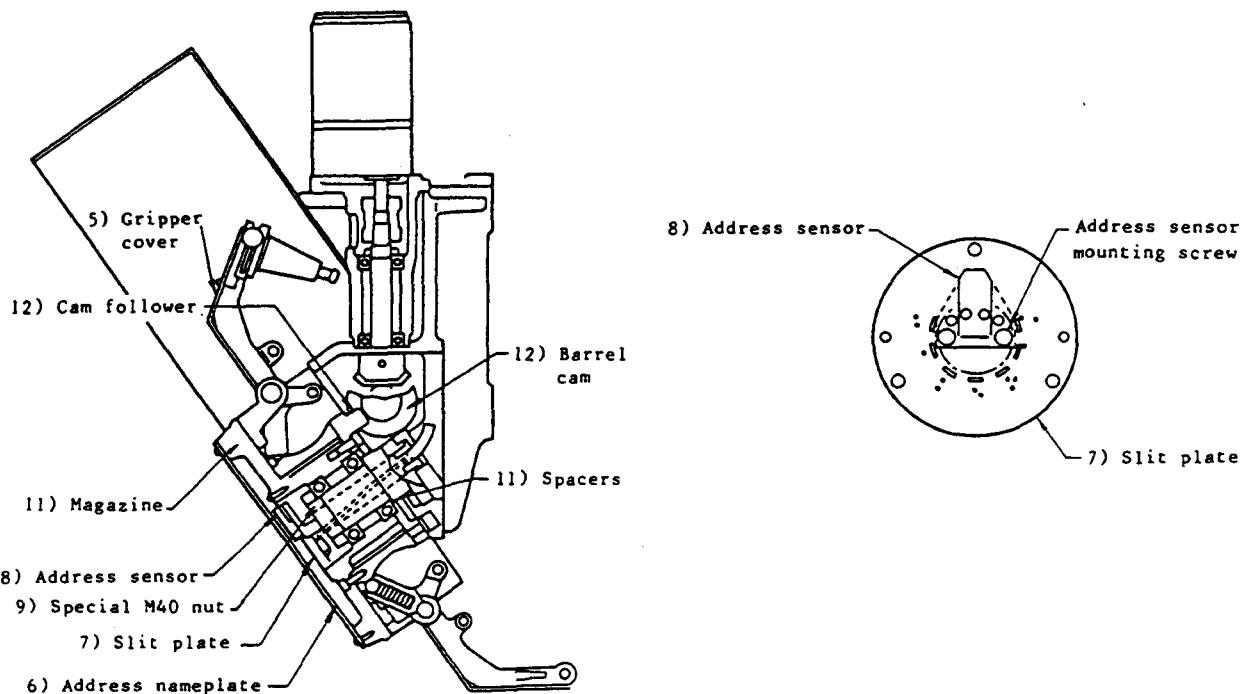
- 1) [MANU]
- 2) Press [ATC] twice to raise the Z-axis to the upper limit position.
- 3) POWER [OFF]
- 4) Remove all the tools from the magazine, labelling each one with the magazine number.
- 5) Remove the gripper cover.
- 6) Remove the address nameplate.
- 7) Remove the slit plate.
- 8) Remove the address sensor. (Insert the connector inside the shaft.)
- 9) Loosen the hexagon socket head set screw in the special M40 nut.
- 10) Support the magazine so that it cannot fall and remove the special M40 nut.
- 11) Remove the magazine. (Take care of the spacers at the rear of the center shaft.)
- 12) Mount the magazine such that barrel cam fits under the cam follower.
- 13) Tighten the special M40 nut.



Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Description
	Tool magazine assembly	628172001		Straight-headed screwdriver
	Shift cam spacer 0.1	628149001		Phillips screwdriver
	Center shaft spacers	628098000		Allen wrench (set)
				Wrench for the special M40 nut
				Tool centering jig assembly
				Small dial indicator 1/100
				13 mm hexagonal wrench

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- 14) Tighten the hexagon socket head set screw in the special M40 nut.
- 15) Mount the address sensor.
- 16) Adjust the magazine. (No. 260100)
- 17) Attach the slit plate with the cut-out "2" on the surface.
- 18) Adjust the address sensor. (No. 260200)
- 19) POWER [ON]
- 20) [MDI] [PRGRM]
Use the [\uparrow CURSOR] [\downarrow CURSOR] keys to move the cursor to "TOOL".
- 21) [1] [ENTER] [START]
Magazine 1 is selected.
- 22) Attach the address nameplate with "1" downwards.
- 23) Attach the gripper cover.
- 24) Insert the tools in their original magazines.
- 25) [MANU]
- 26) Repeatedly press [ATC] to check the tool change status.



Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Description
	Tool magazine assembly	628172001		Straight-headed screwdriver
	Shift cam spacer 0.1	628149001		Phillips screwdriver
	Center shaft spacers	628098000		Allen wrench (set)
				Wrench for the special M40 nut
				Tool centering jig assembly
				Small dial indicator 1/100
				13 mm hexagonal wrench

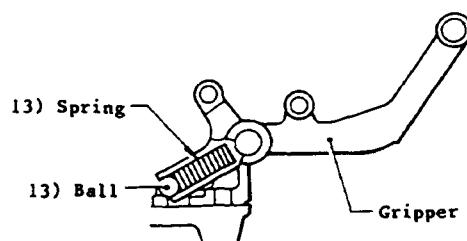
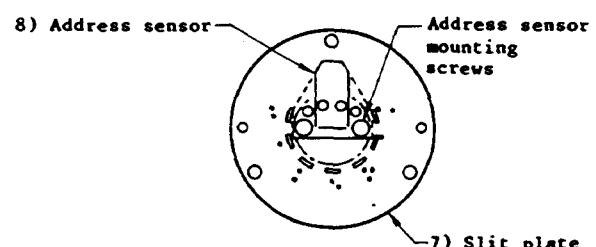
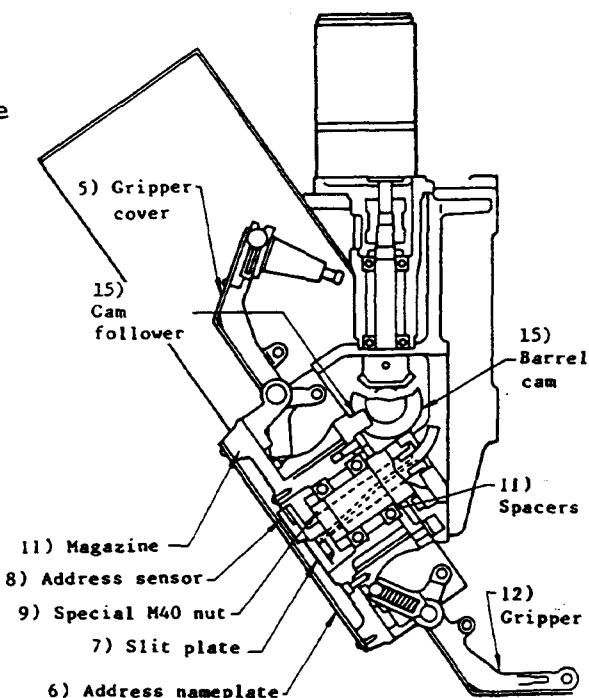
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- 1) [MANU]
- 2) Press [ATC] twice to raise the Z-axis to the upper limit position.
- 3) POWER [OFF]
- 4) Remove all the tools from the magazine, labelling each one with the magazine number.
- 5) Remove the gripper cover.
- 6) Remove the address nameplate.
- 7) Remove the slit plate.
- 8) Remove the address sensor.
(Insert the connector inside the shaft.)
- 9) Loosen the hexagon socket head set screw in the special M40 nut.
- 10) Support the magazine so that it cannot fall and remove the special M40 nut.
- 11) Remove the magazine. (Take care of the spacers at the rear of the center shaft.)
- 12) Remove the damaged gripper.
- 13) Insert the spring and ball into the new gripper and mount the magazine.
- 14) Attach a tool to the gripper and check that the tool parallelism is within 0.3 mm.

Replace the gripper if the tool parallelism does not meet this value.
- 15) Replace the magazine such that barrel cam fits under the cam follower.
- 16) Tighten the special M40 nut.
- 17) Tighten the hexagon socket head set screw in the special M40 nut.
- 18) Mount the address sensor.
- 19) Adjust the magazine. (No. 260100)

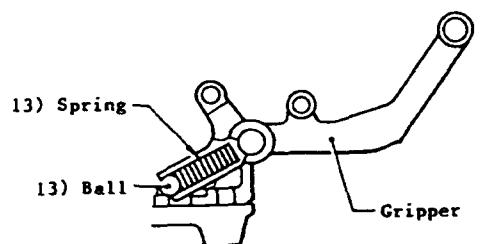
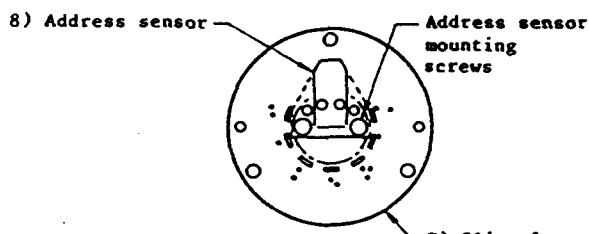
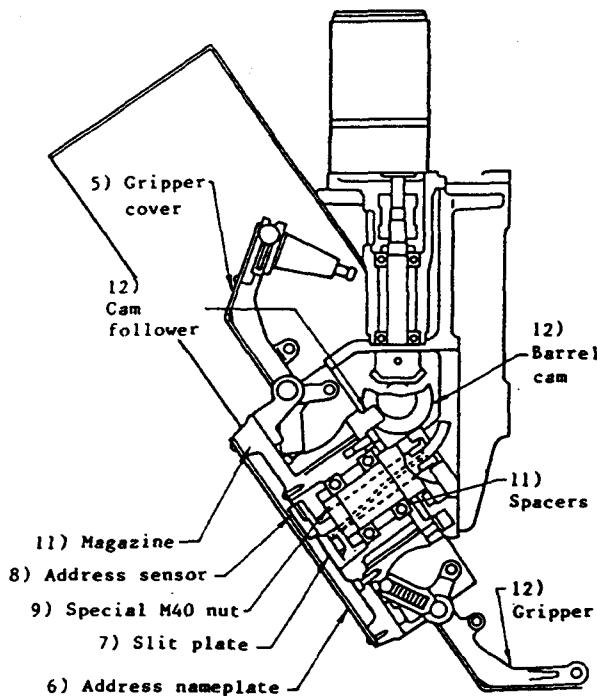


Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Description
	Gripper assembly	628120001		Straight-headed screwdriver Phillips screwdriver Allen wrench (set) Socket for the special M40 nut Center jig Small dial indicator 1/100 Magnetic stand 13 mm hexagonal wrench Tool centering jig assembly

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- 20) Attach the slit plate with the cut-out "2" on the surface.
- 21) Adjust the address sensor.
(No. 260200)
- 22) POWER [ON]
- 23) [MDI] [PRGRM]
Use the [\uparrow CURSOR] [\downarrow CURSOR] keys
to move the cursor to "TOOL".
- 24) [1] [ENTER] [START]
Select magazine 1.
- 25) Attach the address nameplate with "1" downwards.
- 26) Attach the gripper cover.
- 27) Insert the tools in their original magazines.
- 28) [MANU]
- 29) Repeatedly press [ATC] to check the tool change status.



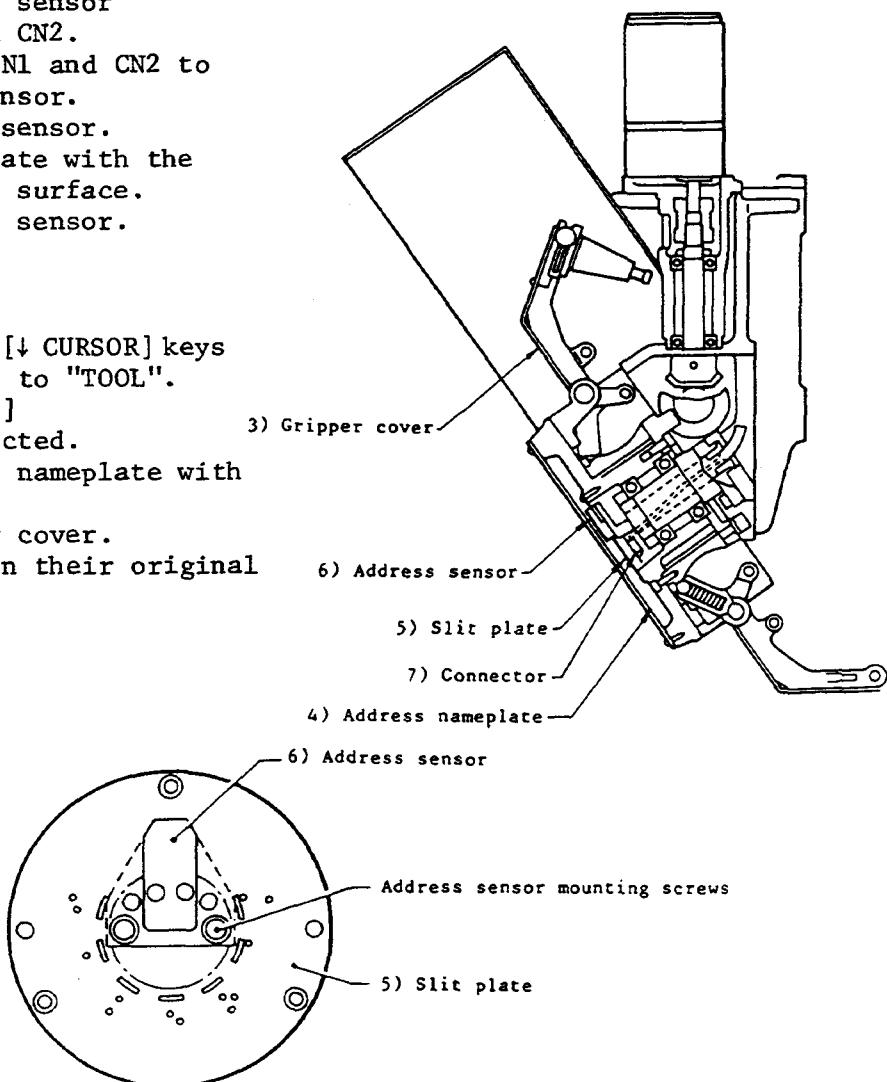
Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Gripper assembly	628120001	Straight-headed screwdriver Phillips screwdriver Allen wrench (set) Socket for the special M40 nut Center jig Small dial indicator 1/100 Magnetic stand 13 mm hexagonal wrench Tool centering jig assembly

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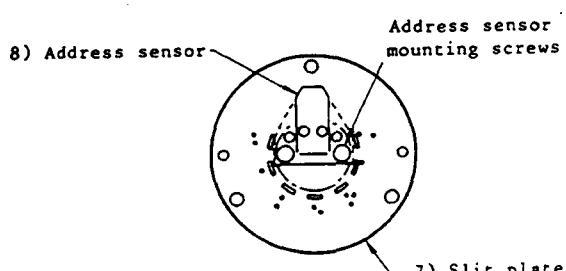
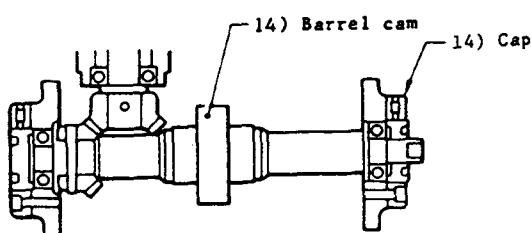
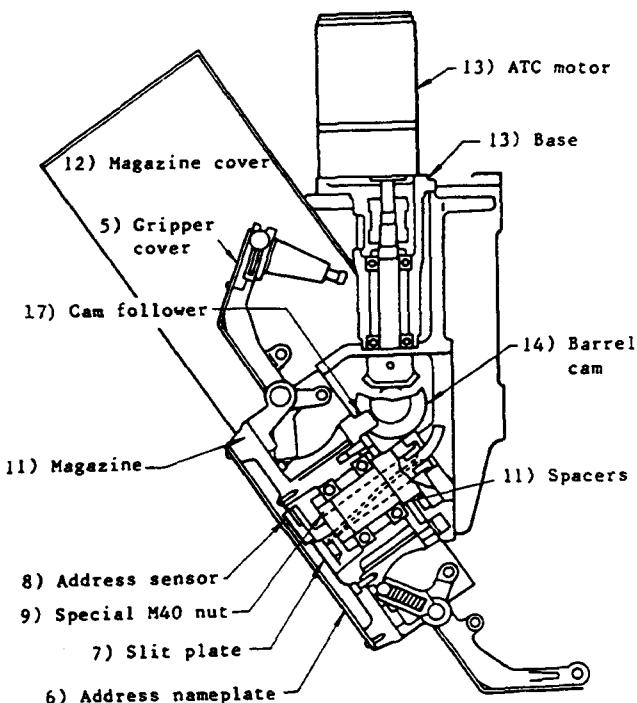
- 1) Remove all the tools from the magazine, labelling each one with the magazine number.
- 2) POWER [OFF]
- 3) Remove the gripper cover.
- 4) Remove the address nameplate.
- 5) Remove the slit plate.
- 6) Remove the address sensor.
- 7) Remove the address sensor connectors CN1 and CN2.
- 8) Mount connectors CN1 and CN2 to the new address sensor.
- 9) Mount the address sensor.
- 10) Attach the slit plate with the cut-out "2" on the surface.
- 11) Adjust the address sensor.
(No. 260200)
- 12) POWER [ON]
- 13) [MDI] [PRGRM]
Use the [\uparrow CURSOR] [\downarrow CURSOR] keys to move the cursor to "TOOL".
- 14) [1] [ENTER] [START]
Magazine 1 is selected.
- 15) Attach the address nameplate with "1" downwards.
- 16) Attach the gripper cover.
- 17) Insert the tools in their original magazines.



Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Address sensor	627606001	Straight-headed screwdriver Phillips screwdriver 13 mm hexagonal wrench

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- 1) [MANU]
- 2) Press [ATC] twice to raise the Z-axis to the upper limit position.
- 3) POWER [OFF]
- 4) Remove all the tools from the magazine, labelling each one with the magazine number.
- 5) Remove the gripper cover.
- 6) Remove the address nameplate.
- 7) Remove the slit plate.
- 8) Remove the address sensor.
(Insert the connector inside the shaft.)
- 9) Loosen the hexagon socket head set screw in the special M40 nut.
- 10) Support the magazine so that it cannot fall and remove the special M40 nut.
- 11) Remove the magazine. (Take care of the spacers at the rear of the center shaft.)
- 12) Remove the magazine cover.
- 13) Remove the ATC motor with base.
- 14) Remove the barrel cam cap on the saddle right side.
- 15) Replace the barrel cam
- 16) Attach the barrel cam cap



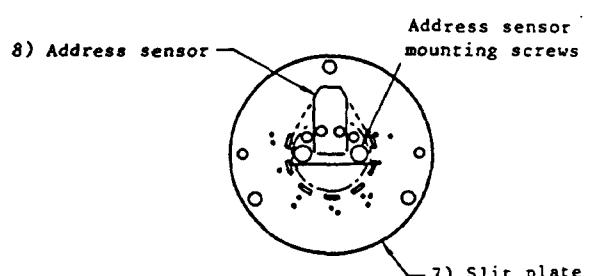
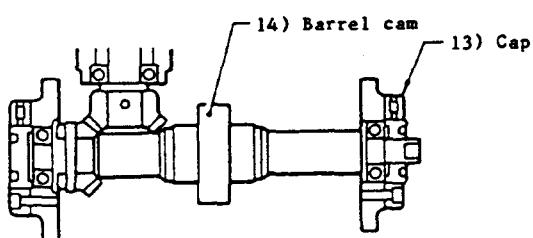
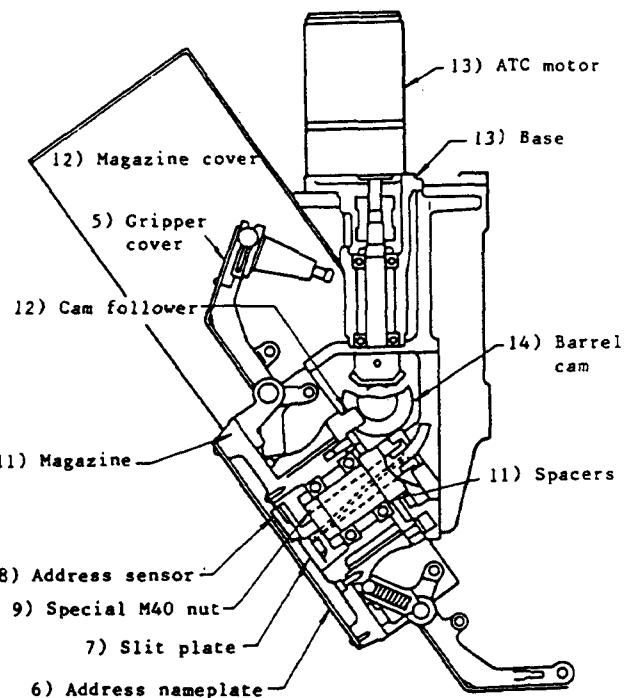
Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Description
	Barrel cam L60	628105001		Straight-headed screwdriver Phillips screwdriver Allen wrench (set) Socket for the special M40 nut 13 mm hexagonal wrench Small dial indicator 1/100 Tool centering jig assembly

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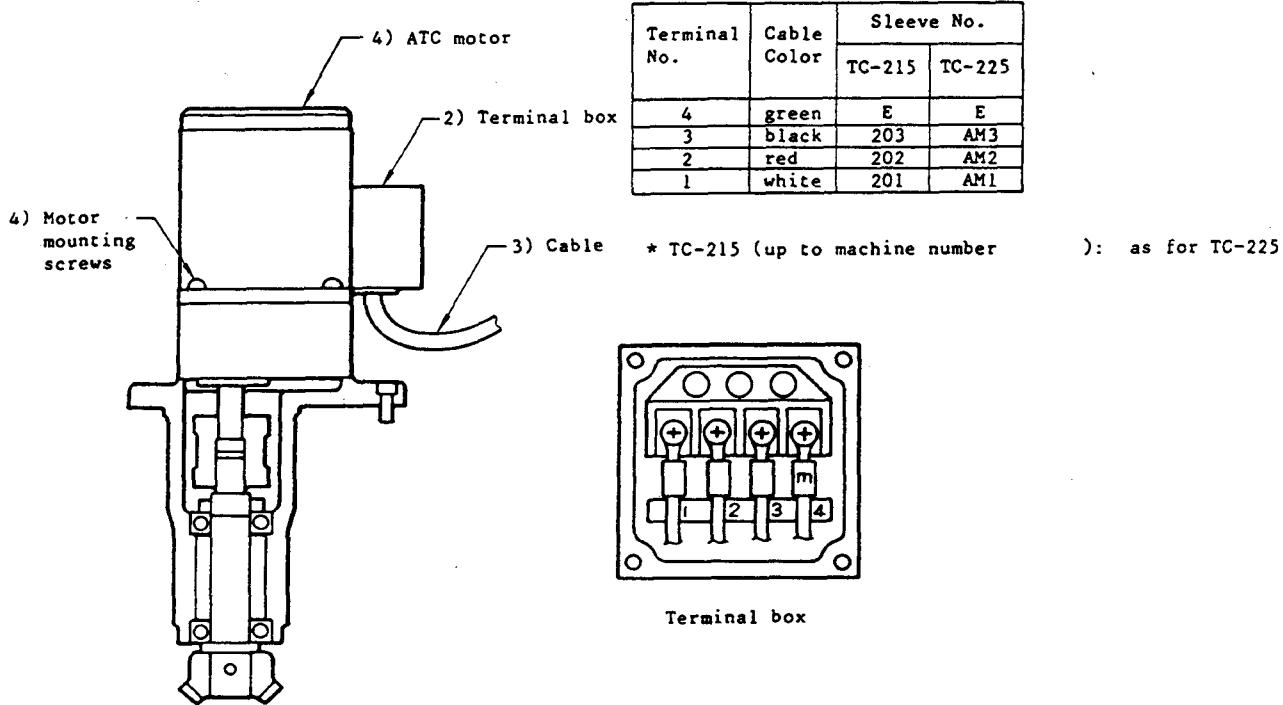
- 17) Replace the magazine such that barrel cam fits under the cam follower.
- 18) Tighten the special M40 nut.
- 19) Mount the ATC motor
- 20) Tighten the hexagon socket head set screw in the special M40 nut.
- 21) Mount the address sensor.
- 22) Adjust the magazine. (No. 260100)
- 23) Attach the slit plate with the cut-out "2" on the surface.
- 24) Adjust the address sensor. (No. 260200)
- 25) POWER [ON]
- 26) [MDI] [PRGRM]
Use the [\uparrow CURSOR] [\downarrow CURSOR] keys to move the cursor to "TOOL".
- 27) [1] [ENTER] [START]
Magazine 1 is selected.
- 28) Attach the address nameplate with "1" downwards.
- 29) Attach the gripper cover.
- 30) Attach the magazine cover.
- 31) Insert the tools in their original magazines.
- 32) [MANU]
- 33) Repeatedly press [ATC] to check the tool change status.



Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Barrel cam L60	628105001	Straight-headed screwdriver Phillips screwdriver Allen wrench (set) Socket for the special M40 nut 13 mm hexagonal wrench Small dial indicator 1/100 Tool centering jig assembly

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- 1) POWER [OFF]
- 2) Remove the ATC motor terminal box.
- 3) Disconnect the cables from the terminal box.
- 4) Remove the ATC motor.
- 5) Mount the new ATC motor, with the terminal box to the right.
- 6) Connect the cables to the terminal box.
- 7) Attach the ATC motor terminal box cover.
- 8) POWER [ON]
- 9) [MANU]
- 10) Repeatedly press [ATC] to check the magazine rotation.

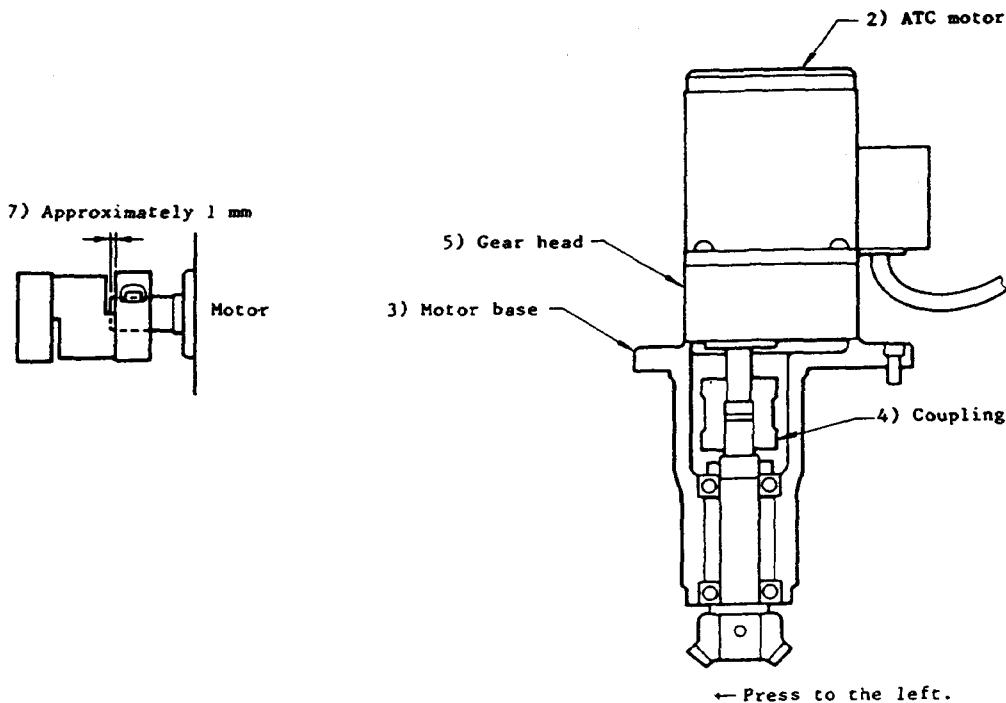


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Motor 5RK40GNCT	628109000	Straight-headed screwdriver Phillips screwdrivers (large, medium)

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- 1) POWER [OFF]
- 2) Remove the ATC motor.
- 3) Remove the ATC motor base assembly.
- 4) Loosen the coupling clamping screw on the bevel gear side.
- 5) Remove the gear head.
- 6) Loosen the coupling clamping screw on the gear head side and remove the coupling.
- 7) Connect the coupling to the new gear head.
- 8) Attach the gear head and the ATC motor to the motor base.
- 9) Tighten the coupling clamping screw on the bevel gear side.
- 10) Mount the ATC motor base assembly, pressing to the left to ensure that there is no backlash in the bevel gears.
- 11) POWER [ON]
- 12) [MANU]
- 13) Repeatedly press [ATC] to check the magazine rotation.



Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Gear head 5GN 7.5K (TC-215)	628110000	Straight-headed screwdriver Phillips screwdriver (large) Allen wrench (set)
	Gear head 5GN 9K (TC-225)		

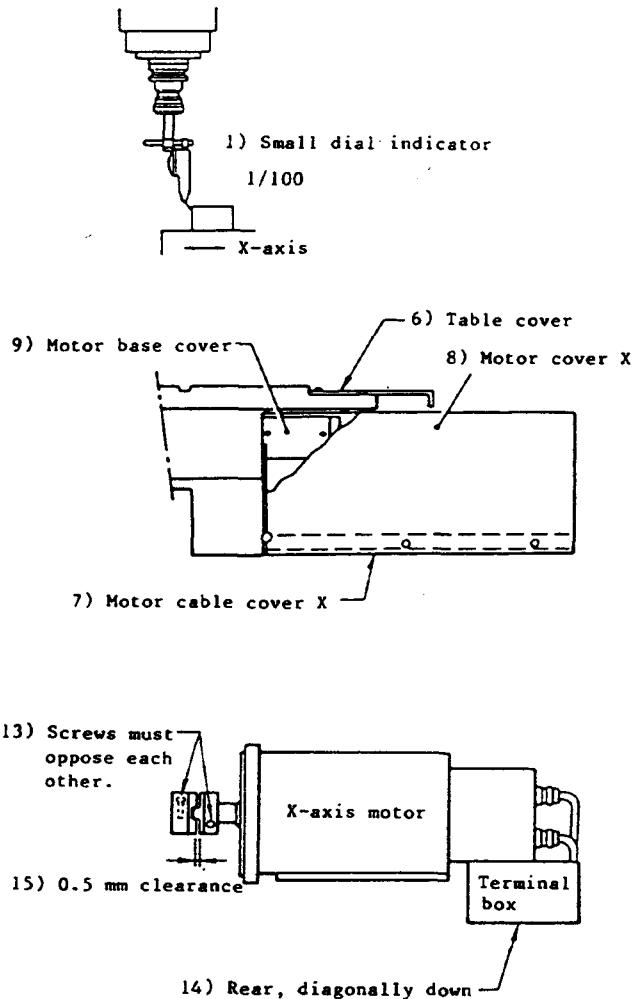
2.3 X-AXIS FEED PARTS

- 300100 Replacing the X-axis Motor TC-215 A
- 300200 Replacing the X-axis Motor TC-215 B
- 300300 Replacing the X-axis Motor TC-225
- 300400 Replacing the X-axis Coupling TC-215
- 300500 Replacing the X-axis Coupling TC-225
- 300600 Replacing the X-axis Ball Screw Assembly TC-215
- 300700 Replacing the X-axis Ball Screw Assembly TC-225

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- 21) [PARAM]
- 22) [2] [ENTER]
- 23) Press [\downarrow PAGE] and make a note of the GRID SHIFT VALUE X.
- 24) Turn the PROGRAM PROTECT switch OFF.
- 25) Use the [\uparrow CURSOR] [\downarrow CURSOR] keys to move the cursor to GRID SHIFT VALUE X.
- 26) [0] [ENTER]
- 27) POWER [OFF] [ON]
- 28) Adjust the X-axis limit switch. (No. 660100)
- 29) Attach the covers that were removed at steps 6) to 9), in the reverse order from that in which they were removed.
- 30) Adjust the X-axis driver. (TC-215) (No. 760100)
- 31) Carry out steps 20) - 27) to set the grid shift value X to the value noted previously.
- 32) Set the grid shift value X. (No. 360100)

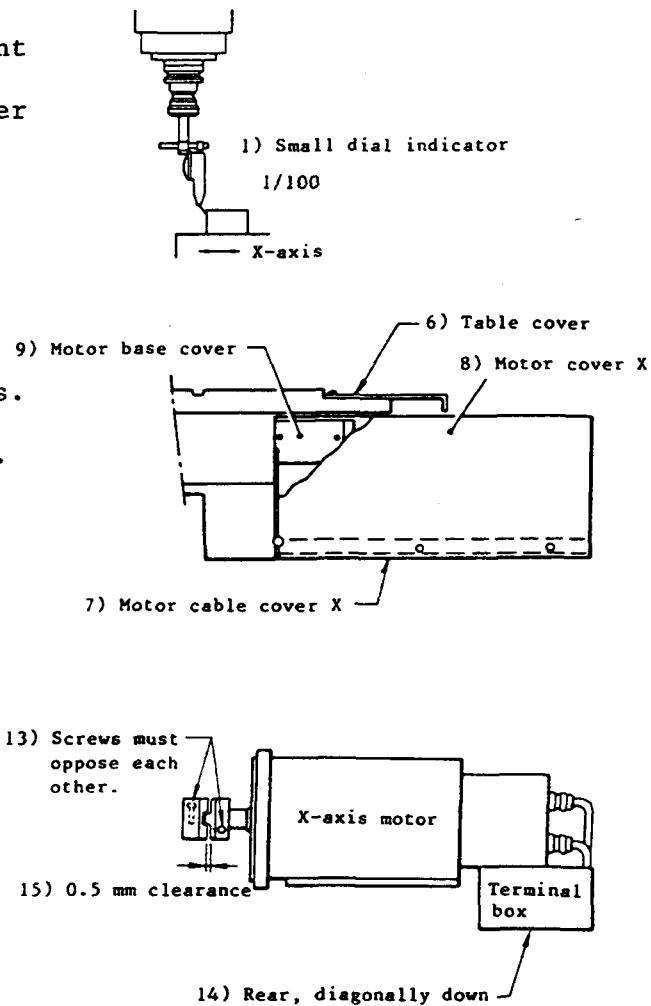


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	AC motor 150W two phase assembly Note: Export ... Nos. 111149 and above	620573003	Small dial indicator 1/100 Phillips screwdriver Allen wrench (set)

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- 1) Mount a small dial indicator in the spindle and measure the current X-axis position.
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current X-axis position.
- 4) Move the X-axis left from the center position. (If the X-axis will not move, turn OFF the power and push it by hand.)
- 5) POWER [OFF]
- 6) Remove the table cover.
- 7) Remove the motor cable cover X.
- 8) Remove the motor cover X.
- 9) Remove the motor base cover.
- 10) Disconnect the two motor connectors.
- 11) Remove the motor.
- 12) Remove the coupling from the motor.
- 13) Mount the coupling on the new motor such that the clamping screw opposes the clamping screw on the ball screw coupling. (Align the circumferences.)
- 14) Mount the new motor such that the terminal box is at the rear, facing diagonally down.
- 15) Set a 0.5 mm clearance in the coupling and tighten the motor coupling clamping screw.
- 16) Connect the two motor connectors.
- 17) POWER [ON]
- 18) [MANU]
- 19) Press [+X] or [-X] to check the operating noise of the motor.
- 20) [MDI]

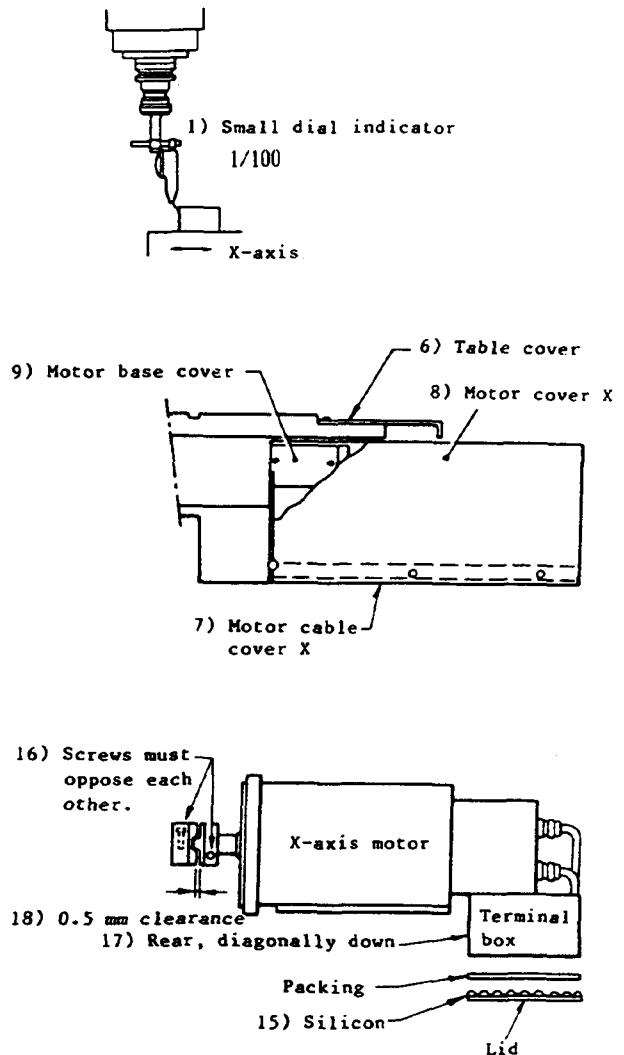


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	AC motor 150W two phase assembly Note: Export ... Nos. 111149 and above	620573003	Small dial indicator 1/100 Phillips screwdriver Allen wrench (set)

Issued: / /

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- 1) Mount a small dial indicator in the spindle and measure the current X-axis position.
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current X-axis position.
- 4) Move the X-axis left from the center position. (If the X-axis will not move, turn OFF the power and push it by hand.)
- 5) POWER [OFF]
- 6) Remove the table cover.
- 7) Remove the motor cable cover X.
- 8) Remove the motor cover X.
- 9) Remove the motor base cover.
- 10) Remove the motor.
- 11) Remove the terminal box lid.
- 12) Disconnect the two sockets and cable plates inside the terminal box.
- 13) Remove the coupling from the motor.
- 14) Connect the two sockets to the new motor.
- 15) Apply silicon to the cable plates and terminal box lid and attach them to the terminal box.
- 16) Mount the coupling on the new motor such that the clamping screw opposes the clamping screw on the ball screw coupling. (Align the circumferences.)
- 17) Mount the new motor such that the terminal box is at the rear, facing diagonally down.
- 18) Set a 0.5 mm clearance in the coupling and tighten the motor coupling clamping screw.
- 19) POWER [ON]

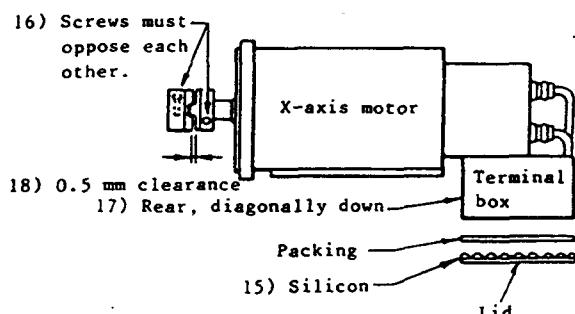
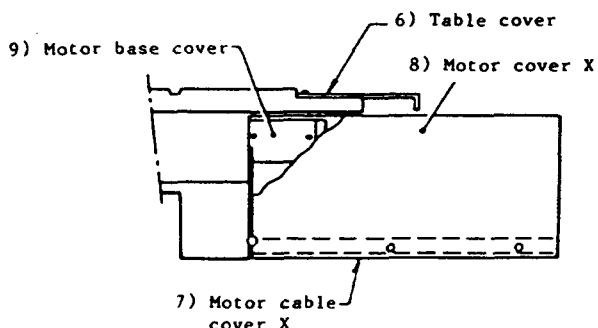
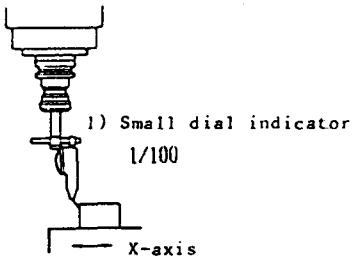


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Motor RA 12M 150W Note: Export ... Nos. 111150 and above	628265000	Small dial indicator 1/100 Phillips screwdriver Allen wrench (set) Silicon

Issued: / /

TC-215

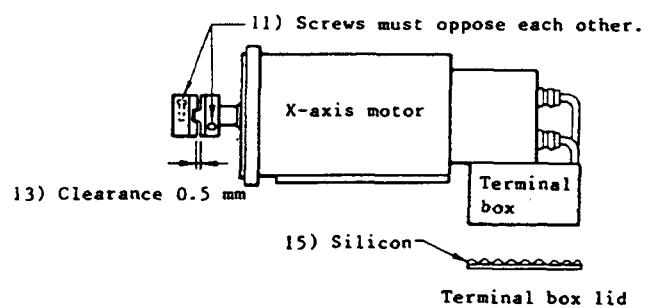
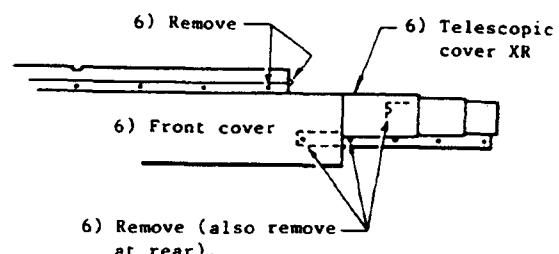
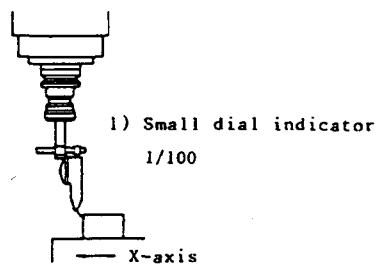
- 20) [MANU]
- 21) Press [+X] or [-X] to check the operating noise of the motor.
- 22) [MDI]
- 23) [PARAM]
- 24) [2] [ENTER]
- 25) Press [\downarrow PAGE] and make a note of the GRID SHIFT VALUE X.
- 26) Turn the PROGRAM PROTECT switch OFF.
- 27) Use the [\uparrow CURSOR] [\downarrow CURSOR] keys to move the cursor to GRID SHIFT VALUE X.
- 28) [0] [ENTER]
- 29) POWER [OFF] [ON]
- 30) Adjust the X-axis limit switch. (No. 660100)
- 31) Attach the covers that were removed at steps 6) to 9), in the reverse order from that in which they were removed.
- 32) Adjust the X-axis driver. (TC-215) (No. 760100)
- 33) Carry out steps 22) - 29) to set the grid shift value X to the value noted previously.
- 34) Set the grid shift value X.A. (No. 360100)



Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Motor RA 12M 150W Note: Export ... Nos. 111150 and above	628265000	Small dial indicator 1/100 Phillips screwdriver Allen wrench (set) Silicon

Issued: / /
TC-225

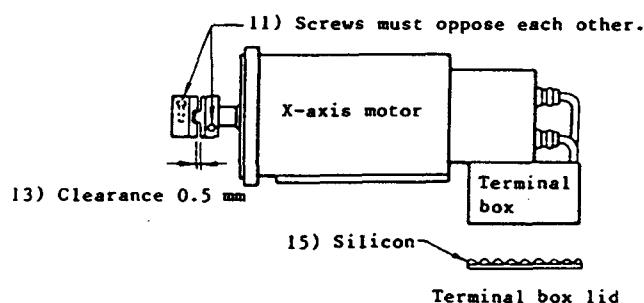
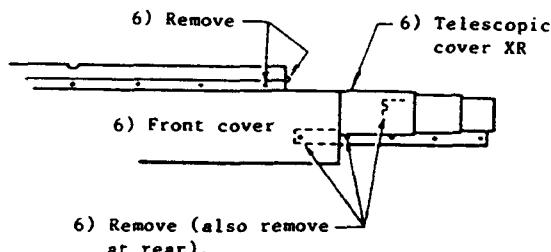
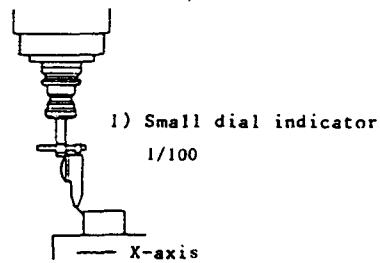
- 1) Mount a small dial indicator in the spindle and measure the current X-axis position.
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current X-axis position.
- 4) Move the X-axis left from the center position. (If the X-axis will not move, turn OFF the power, remove the telescopic cover XL and turn the ball screw by hand.)
- 5) POWER [OFF]
- 6) Remove the table front cover and the telescopic cover XR.
- 7) Open the motor terminal box.
- 8) Disconnect the two sockets inside the terminal box.
- 9) Remove the motor.
- 10) Remove the coupling from the motor.
- 11) Mount the coupling on the new motor such that the clamping screw opposes the clamping screw on the ball screw coupling. (Align the circumferences.)
- 12) Mount the new motor such that the terminal box faces the operator.
- 13) Set a 0.5 mm clearance in the coupling and tighten the motor coupling clamping screw.
- 14) Connect the two sockets to the new motor.
- 15) Apply silicon to the terminal box lid and attach it to the terminal box.
- 16) POWER [ON]
- 17) [MANU]
- 18) Press [+X] or [-X] to check the operating noise of the motor.
- 19) [MDI]



Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	AC servo motor 410 W assembly	626084001	Small dial indicator 1/100 Phillips screwdriver Allen wrench (set) Silicon

Issued: / /
TTC-225

- 20) [PARAM]
 21) [2] [ENTER]
 22) Press [\downarrow PAGE] and make a note of the GRID SHIFT VALUE X.
 23) Turn the PROGRAM PROTECT switch OFF.
 24) Use the [\downarrow CURSOR] [\downarrow CURSOR] keys to move the cursor to GRID SHIFT VALUE X.
 25) [0] [ENTER]
 26) POWER [OFF] [ON]
 27) Adjust the X-axis zero-point limit switch. (No. 660100)
 28) Attach the table front cover and the telescopic cover XR.
 29) Adjust the X-axis driver. (TC-225) (No. 760300)
 30) Carry out steps 19) - 26) to set the grid shift value X to the value noted previously.
 31) Set the grid shift value X.A. (No. 360100)

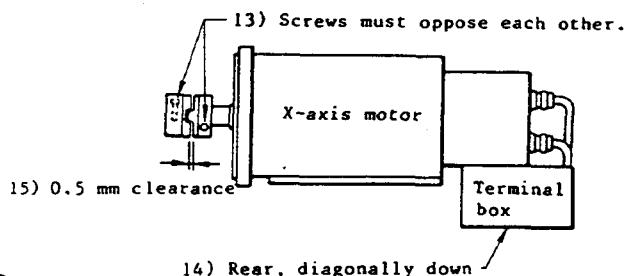
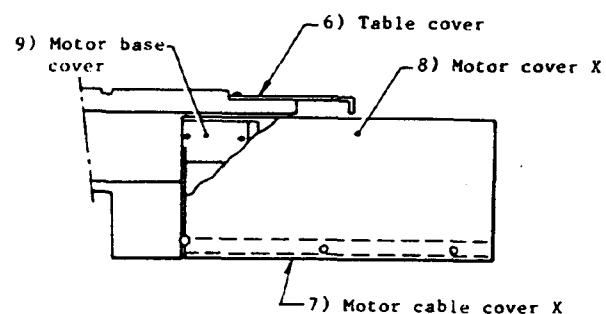
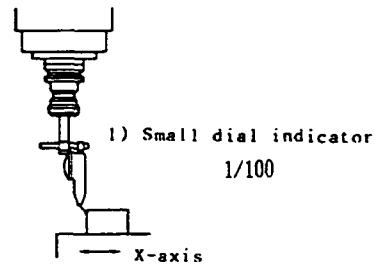


Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Notes
	AC servo motor 410 W assembly	626084001		Small dial indicator 1/100 Phillips screwdriver Allen wrench (set) Silicon

Issued: / /

TC-215

- 1) Mount a small dial indicator in the spindle and measure the current X-axis position.
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current X-axis position.
- 4) Move the X-axis left from the center position. (If the X-axis will not move, turn OFF the power and push it by hand.)
- 5) POWER [OFF]
- 6) Remove the table cover.
- 7) Remove the motor cable cover X.
- 8) Remove the motor cover X.
- 9) Remove the motor base cover.
- 10) Remove the motor.
- 11) Remove the coupling from the motor and the ball screw.
- 12) Push the new coupling onto the ball screw as far as possible and tighten the clamping screw.
- 13) Mount the coupling on the motor such that the clamping screw opposes the clamping screw on the ball screw coupling. (Align the circumferences.)
- 14) Mount the motor such that the terminal box is at the rear, facing diagonally down.
- 15) Set a 0.5 mm clearance in the coupling and tighten the motor coupling clamping screw.
- 16) POWER [ON]
- 17) [MANU]
- 18) Press [+X] or [-X] to check the operating noise of the motor.
- 19) [MDI]
- 20) [PARAM]

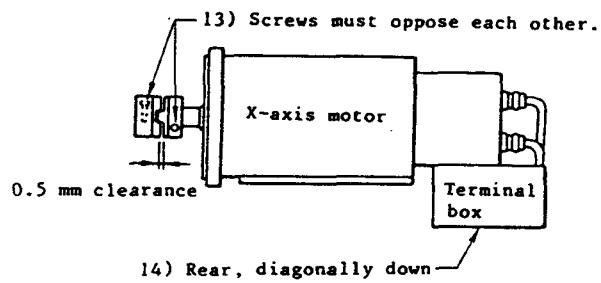
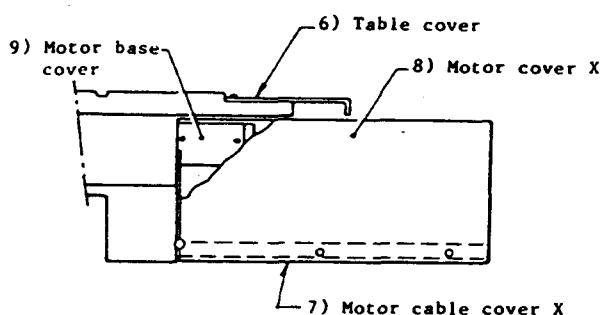
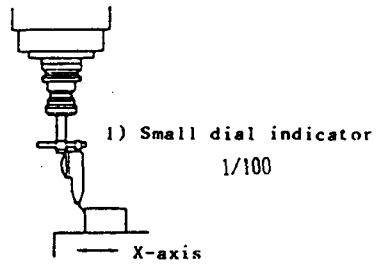


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Joint MJC25-10 assembly Note: Export ... Nos. 111149 and below	620011001	Small dial indicator 1/100 Phillips screwdriver Allen wrench (set)
	Joint MJC-2510x8 assembly Note: Export ... Nos. 111150 and above	628282001	

Issued: / /

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- 21) [2] [ENTER]
- 22) Press [\downarrow PAGE] and make a note of the GRID SHIFT VALUE X.
- 23) Turn the PROGRAM PROTECT switch off.
- 24) Use the [\uparrow CURSOR] [\downarrow CURSOR] keys to move the cursor to GRID SHIFT VALUE X.
- 25) [0] [ENTER]
- 26) POWER [OFF] [ON]
- 27) Adjust the X-axis zero-point limit switch. (No. 660100)
- 28) Attach the covers that were removed at steps 6) to 9), in the reverse order from that in which they were removed.
- 29) Carry out steps 19) - 26) to set the grid shift value X to the value noted previously.
- 30) Set the grid shift value X.A. (No. 360100)

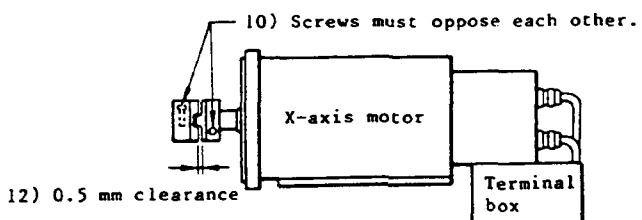
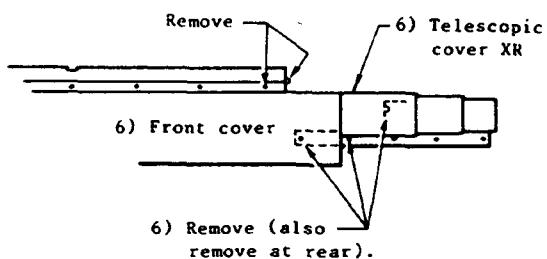
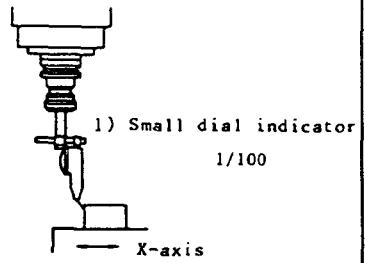


Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Notes
	Joint MJC25-10 assembly Note: Export ... Nos. 111149 and below	620011001		Small dial indicator 1/100 Phillips screwdriver Allen wrench (set)
	Joint MJC-2510x8 assembly Note: Export ... Nos. 111150 and above	628282001		

Issued: / /

TC-225

- 1) Mount a small dial indicator in the spindle and measure the current X-axis position.
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current X-axis position.
- 4) Move the X-axis left from the center position. (If the X-axis will not move, turn OFF the power, remove the telescopic cover XL and turn the ball screw by hand.)
- 5) POWER [OFF]
- 6) Remove the table front cover and the telescopic cover XR.
- 7) Remove the motor.
- 8) Remove the motor and ball screw couplings.
- 9) Push the new coupling onto the ball screw as far as possible and tighten the clamping screw.
- 10) Mount the coupling on the motor such that the clamping screw opposes the clamping screw on the ball screw coupling. (Align the circumferences.)
- 11) Mount the motor such that the terminal box faces the operator.
- 12) Set a 0.5 mm clearance in the coupling and tighten the motor coupling clamping screw.
- 13) POWER [ON]
- 14) [MANU]
- 15) Press [+X] or [-X] to check the operating noise of the motor.

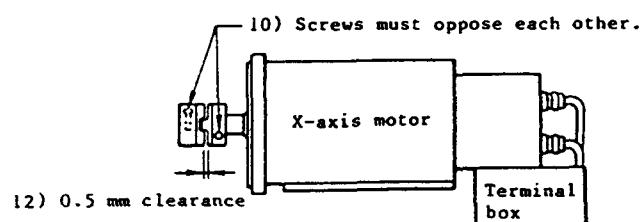
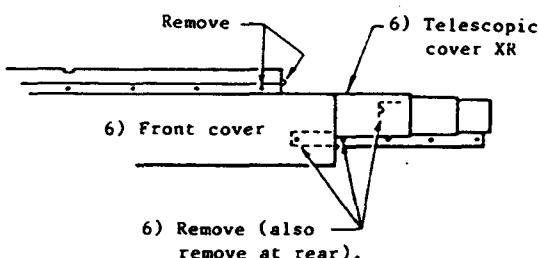
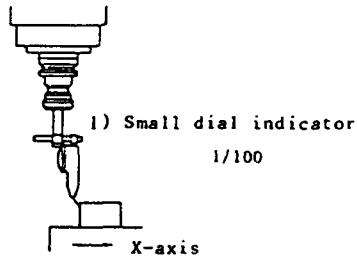


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Joint assembly MJC41-14	626026001	Small dial indicator 1/100 Phillips screwdriver Allen wrench (set)

Issued: / /

TC-225

- 16) [MDI]
- 17) [PARAM]
- 18) [2] [ENTER]
- 19) Press [\downarrow PAGE] and make a note of the GRID SHIFT VALUE X.
- 20) Turn the PROGRAM PROTECT switch OFF.
- 21) Use the [\uparrow CURSOR] [\downarrow CURSOR] keys to move the cursor to GRID SHIFT VALUE X.
- 22) [0] [ENTER]
- 23) POWER [OFF]
- 24) POWER [ON]
- 25) Adjust the X-axis zero-point limit switch. (No. 660100)
- 26) Attach the telescopic cover XR and the table front cover.
- 27) Carry out steps 16) - 24) to set the grid shift value X to the value noted previously.
- 28) Set the grid shift value X.A. (No. 360100)

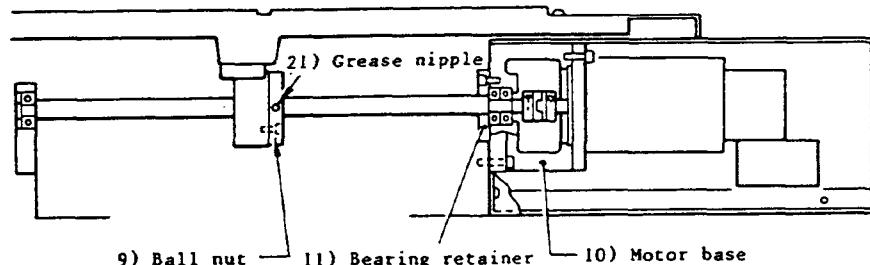
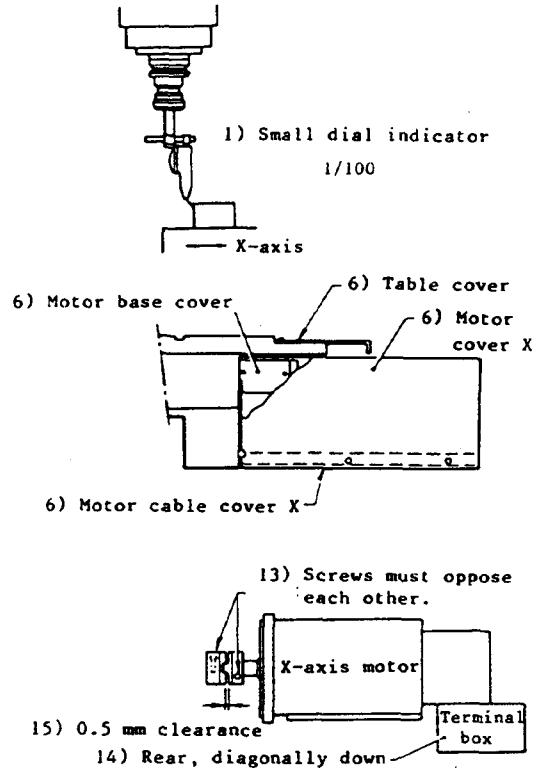


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Joint assembly MJC41-14	626026001	Small dial indicator 1/100 Phillips screwdriver Allen wrench (set)

Issued: / /

TC-215

- 1) Mount a small dial indicator in the spindle and measure the current X-axis position.
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current X-axis position.
- 4) Move the X-axis left from the center position. (If the X-axis will not move, turn OFF the power and push it by hand.)
- 5) POWER [OFF]
- 6) Remove the table cover, cable cover, motor cover and motor base cover.
- 7) Remove the motor.
- 8) Remove the coupling from the ball screw.
- 9) Remove the ball nut clamping screw.
- 10) Remove the motor base mounting screws and remove the motor base and ball screw.
- 11) Remove the bearing retainer and remove the ball screw.
- 12) Mount the new ball screw by reversing the procedure in steps 8) - 11), above.
- 13) Mount the coupling on the ball screw such that the clamping screw opposes the clamping screw on the motor coupling. (Align the circumferences.)
- 14) Mount the motor such that the terminal box is at the rear, facing diagonally down.

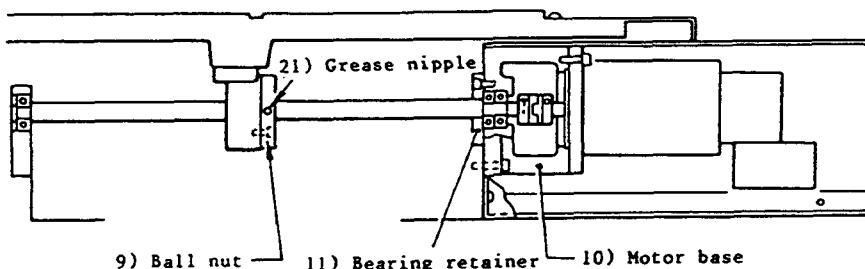
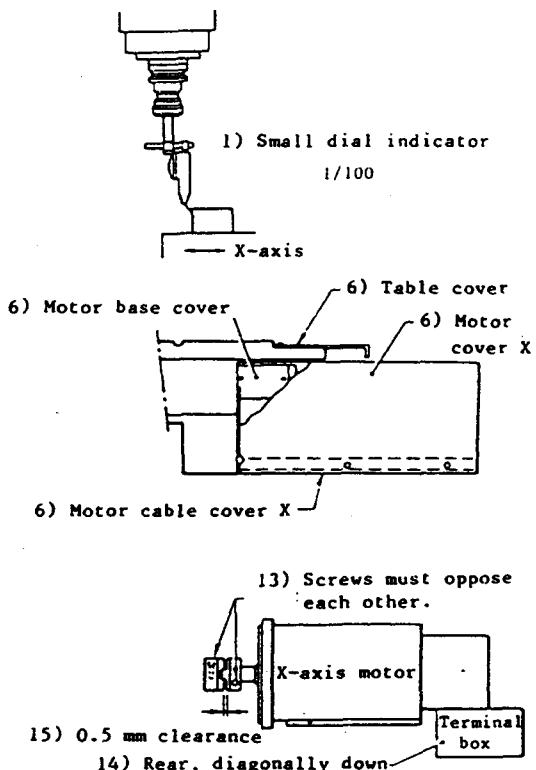


Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Description
	X-axis feed screw assembly	628220001		Small dial indicator 1/100 Phillips screwdriver Allen wrench (set) Wrench for the special M40 nut Grease

Issued: / /

TC-215

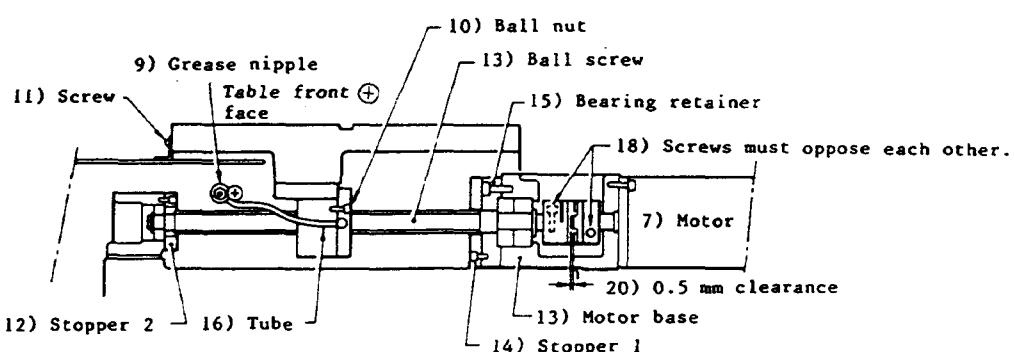
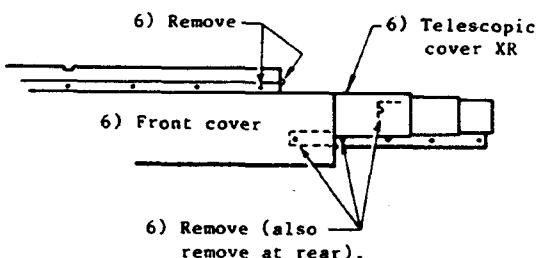
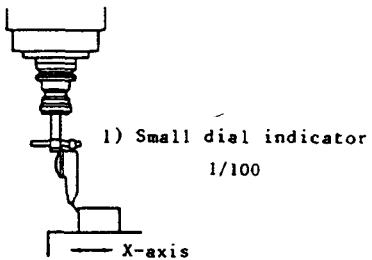
- 15) Set a 0.5 mm clearance in the coupling and tighten the ball screw coupling clamping screw.
- 16) POWER [ON]
- 17) [MANU]
Press [+X] or [-X] to check the operating noise of the motor.
- 18) [MDI] [PARAM] [2] [ENTER] [↓ PAGE]
Make a note of the GRID SHIFT VALUE X.
- 19) Turn the PROGRAM PROTECT switch OFF. Use the [↑ CURSOR] [↓ CURSOR] keys to move the cursor to GRID SHIFT VALUE X.
- 20) [0] [ENTER] POWER [OFF] [ON]
- 21) Apply grease through the grease nipple.
- 22) Adjust the X-axis zero-point limit switch. (No. 660100)
- 23) Attach the motor base cover, motor cover, cable cover and table cover.
- 24) Carry out steps 18) - 20) to set the grid shift value X to the value noted previously.
- 25) Set the grid shift value X.A. (No. 360100)



Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Description
	X-axis feed screw assembly	628220001		Small dial indicator 1/100 Phillips screwdriver Allen wrench (set) Wrench for the special M40 nut Grease

Issued: / /
TC-225

- 1) Mount a small dial indicator in the spindle and measure the current X-axis position.
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current X-axis position.
- 4) Move the X-axis left from the center position. (If the X-axis will not move, turn OFF the power, remove the telescopic cover XL and turn the ball screw by hand.)
- 5) POWER [OFF]
- 6) Remove the table front cover and the telescopic cover XR.
- 7) Remove the motor.
- 8) Remove the ball screw coupling.
- 9) Remove the X-axis ball screw grease nipple.
- 10) Remove the X-axis ball nut clamping screw.
- 11) Remove the screws holding the table and telescopic cover XL and shift the covers.
- 12) Remove the ball screw stopper 2.
- 13) Remove the motor base mounting screws and remove the motor base and ball screw.
- 14) Remove the ball screw stopper 1.
- 15) Remove the bearing retainer and remove the ball screw.
- 16) Attach the grease tube to the new ball screw.

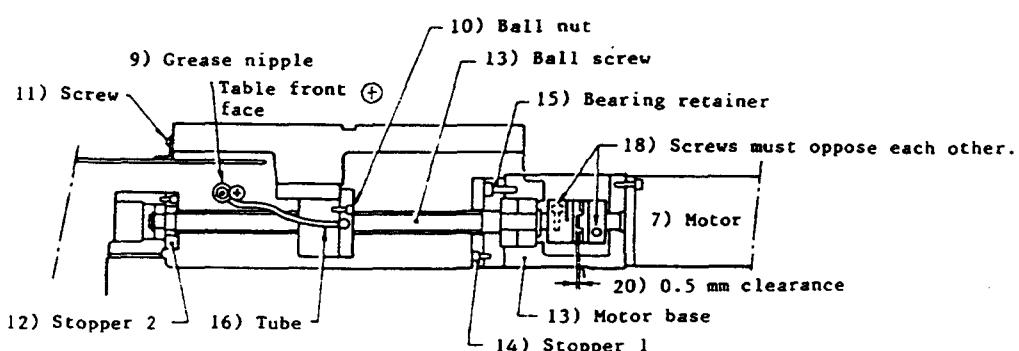
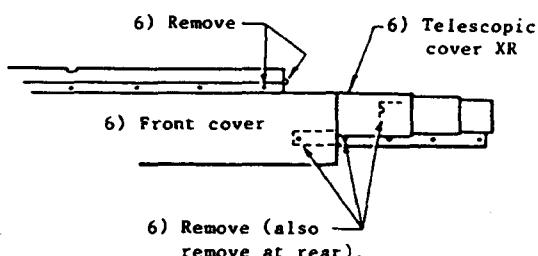
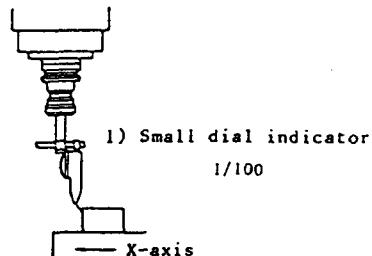


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	X-axis ball screw assembly	626471001	Small dial indicator 1/100 Straight-headed screwdriver Phillips screwdriver Allen wrench (set) Wrench for the special M40 nut Grease

Issued: / /

TC-225

- 17) Mount the new ball screw by reversing the procedure in steps 8) - 15), above.
- 18) Mount the coupling on the ball screw such that the clamping screw opposes the clamping screw on the motor coupling. (Align the circumferences.)
- 19) Mount the motor such that the terminal box faces the operator.
- 20) Set a 0.5 mm clearance in the coupling and tighten the ball screw coupling clamping screw.
- 21) POWER [ON]
- 22) [MANU]
Press [+X] or [-X] to check the operating noise of the motor.
- 23) [MDI] [PARAM] [2] [ENTER] [↓ PAGE]
Make a note of the GRID SHIFT VALUE X.
- 24) Turn the PROGRAM PROTECT switch OFF. Use the [\uparrow CURSOR] [\downarrow CURSOR] keys to move the cursor to GRID SHIFT VALUE X.
- 25) [0] [ENTER] POWER [OFF] [ON]
- 26) Apply grease through the grease nipple.
- 27) Adjust the X-axis zero-point limit switch. (No. 660100)
- 28) Attach the telescopic cover XR and the table front cover.
- 29) Carry out steps 23) - 25) to set the grid shift value X to the value noted previously.
- 30) Set the grid shift value X.A.
(No. 360100)



Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Small dial indicator 1/100 Straight-headed screwdriver Phillips screwdriver Allen wrench (set) Wrench for the special M40 nut Grease
	X-axis ball screw assembly	626471001		

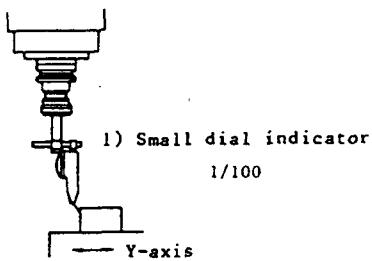
2.4 Y-AXIS FEED PARTS

- 400100 Replacing the Y-axis Motor TC-215 A
- 400200 Replacing the Y-axis Motor TC-215 B
- 400300 Replacing the Y-axis Motor TC-225
- 400400 Replacing the Y-axis Coupling TC-215
- 400500 Replacing the Y-axis Coupling TC-225
- 400600 Replacing the Y-axis Ball Screw Assembly TC-215
- 400700 Replacing the Y-axis Ball Screw Assembly TC-225

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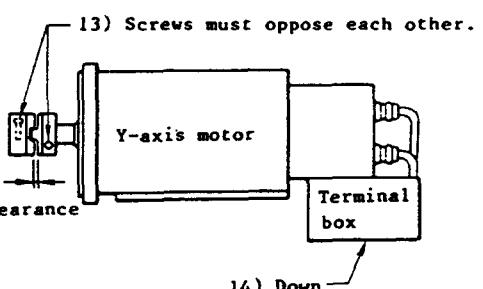
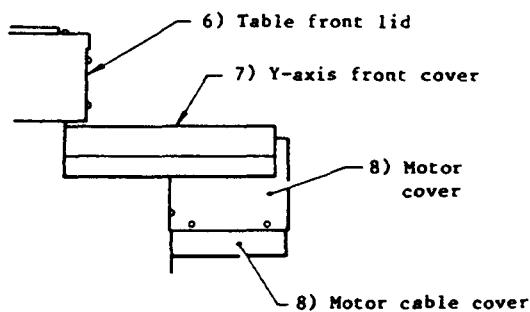
TC-215

- 1) Mount a small dial indicator in the spindle and measure the current Y-axis position.
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current Y-axis position.
- 4) Move the Y-axis towards the column from the center position. (If the Y-axis will not move, turn OFF the power and push it by hand.)
- 5) POWER [OFF]
- 6) Remove the table front lid.
- 7) Remove the Y-axis front cover.
- 8) Remove the motor cable cover and motor cover.
- 9) Remove the motor base cover.
- 10) Disconnect the two motor connectors.
- 11) Remove the motor.
- 12) Remove the coupling from the motor.
- 13) Mount the coupling on the new motor such that the clamping screw opposes the clamping screw on the ball screw coupling. (Align the circumferences.)
- 14) Mount the new motor such that the terminal box faces down.
- 15) Set a 0.5 mm clearance in the coupling and tighten the motor coupling clamping screw.
- 16) Connect the two motor connectors.
- 17) POWER [ON]
- 18) [MANU]
- 19) Press [+Y] or [-Y] to check the operating noise of the motor.



1) Small dial indicator

1/100



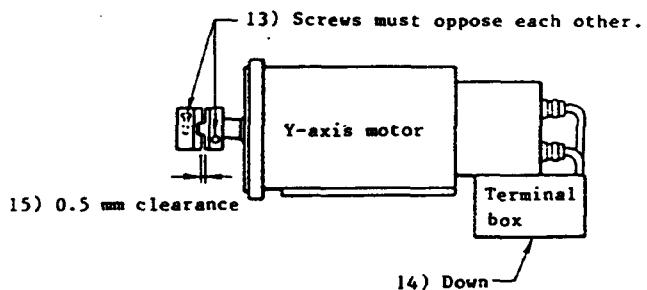
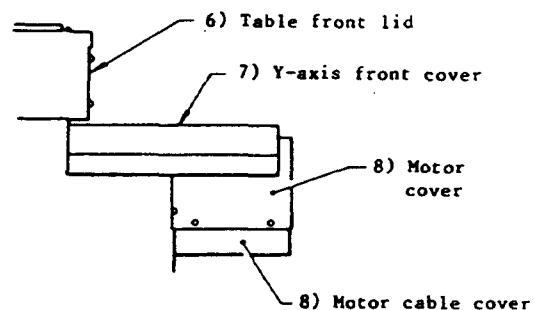
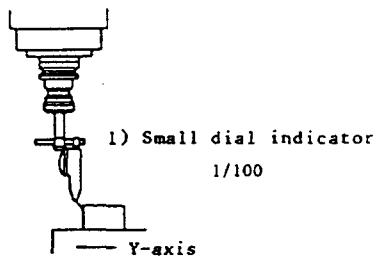
Small dial indicator 1/100
Phillips screwdriver
Allen wrench (set)

Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	AC motor 150W two phase assembly Note: Export ... Nos. 111149 and below	620573003	Small dial indicator 1/100 Phillips screwdriver Allen wrench (set)

Issued: / /

TC-215

- 20) [MDI]
- 21) [PARAM]
- 22) [2] [ENTER]
- 23) Press [\downarrow PAGE] and make a note of the GRID SHIFT VALUE Y.
- 24) Turn the PROGRAM PROTECT switch OFF.
- 25) Use the [\uparrow CURSOR] [\downarrow CURSOR] keys to move the cursor to GRID SHIFT VALUE Y.
- 26) [0] [ENTER]
- 27) POWER [OFF] [ON]
- 28) Adjust the Y-axis zero-point limit switch. (No. 660100)
- 29) Attach the covers that were removed at steps 6) to 9), in the reverse order from that in which they were removed.
- 30) Adjust the Y-axis driver. (TC-215) (No. 760100)
- 31) Carry out steps 20) - 27) to set the grid shift value Y to the value noted previously.
- 32) Set the grid shift value Y.A. (No. 360100)

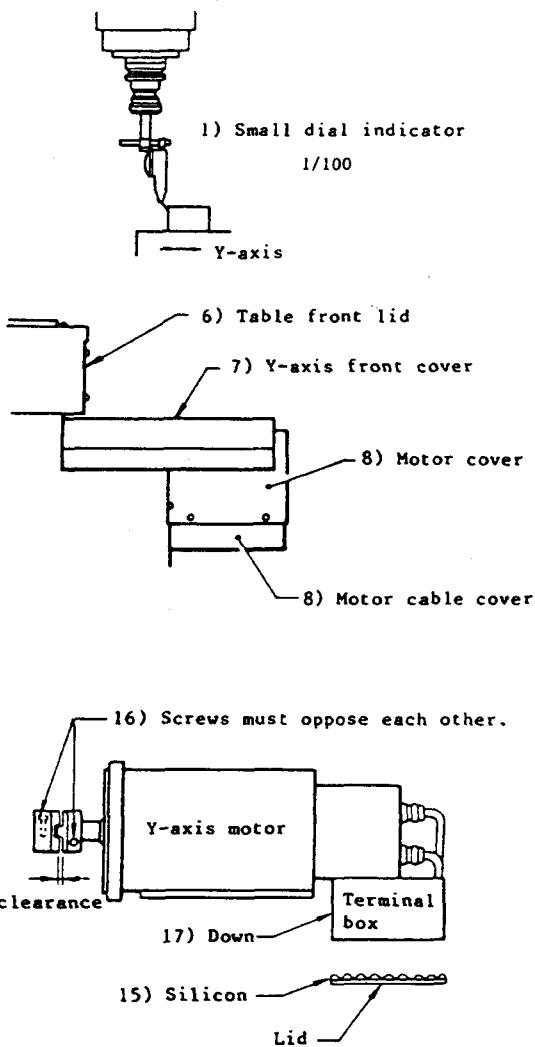


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	AC motor 150W two phase assembly Note: Export ... Nos. 111149 and below	620573003	Small dial indicator 1/100 Phillips screwdriver Allen wrench (set)

Issued: / /

TC-215

- 1) Mount a small dial indicator in the spindle and measure the current Y-axis position.
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current Y-axis position.
- 4) Move the Y-axis towards the column from the center position. (If the Y-axis will not move, turn OFF the power and push it by hand.)
- 5) POWER [OFF]
- 6) Remove the table front lid.
- 7) Remove the Y-axis front cover.
- 8) Remove the motor cable cover and the motor cover.
- 9) Remove the motor base cover.
- 10) Remove the motor.
- 11) Remove the terminal box lid.
- 12) Disconnect the two sockets and cable plates inside the terminal box.
- 13) Remove the coupling from the motor.
- 14) Connect the two sockets to the new motor.
- 15) Apply silicon to the cable plates and terminal box lid and attach them to the terminal box.
- 16) Mount the coupling on the new motor such that the clamping screw opposes the clamping screw on the ball screw coupling. (Align the circumferences.)
- 17) Mount the new motor such that the terminal box faces down.
- 18) Set a 0.5 mm clearance in the coupling and tighten the motor coupling clamping screw.

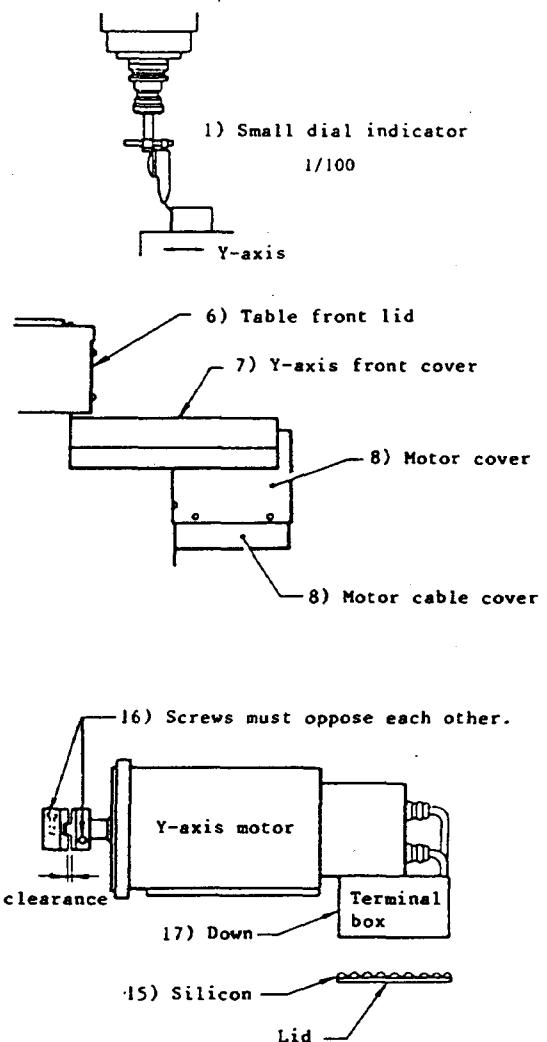


Replacement Parts	Part Name Motor RA 12M 150W Note: Export ... Nos. 111150 and above	Part Code 628265000	Jigs and Tools Required
			Small dial indicator 1/100 Phillips screwdriver Allen wrench (set) Silicon

Issued: / /

TC-215

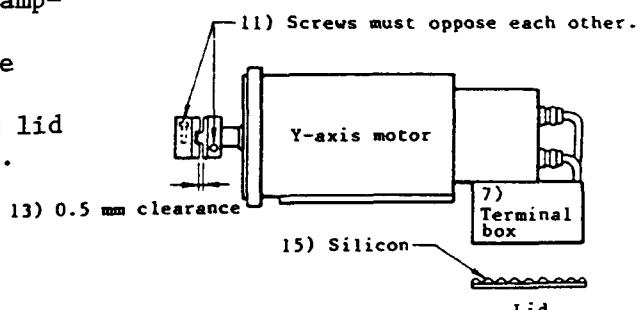
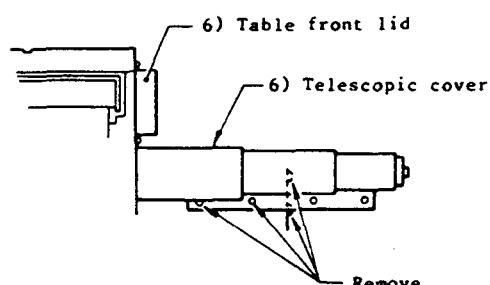
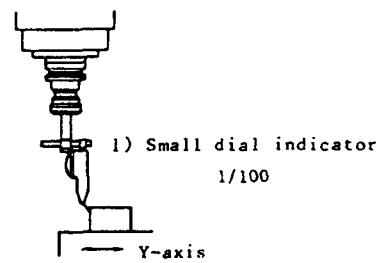
- 19) POWER [ON]
- 20) [MANU]
- 21) Press [+Y] or [-Y] to check the operating noise of the motor.
- 22) [MDI]
- 23) [PARAM]
- 24) [2] [ENTER]
- 25) Press [↓ PAGE] and make a note of the GRID SHIFT VALUE Y.
- 26) Turn the PROGRAM PROTECT switch OFF.
- 27) Use the [↑ CURSOR] [↓ CURSOR] keys to move the cursor to GRID SHIFT VALUE Y.
- 28) [0] [ENTER]
- 29) POWER [OFF] [ON]
- 30) Adjust the Y-axis zero-point limit switch. (No. 660100)
- 31) Attach the covers that were removed at steps 6) to 9), in the reverse order from that in which they were removed.
- 32) Adjust the Y-axis driver. (TC-215) (No. 760100)
- 33) Carry out steps 22) - 29) to set the grid shift value Y to the value noted previously.
- 34) Set the grid shift value Y.A. (No. 360100)



Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Motor RA 12M 150W Note: Export ... Nos. 111150 and above	628265000	Small dial indicator 1/100 Phillips screwdriver Allen wrench (set) Silicon

Issued: / /
TC-225

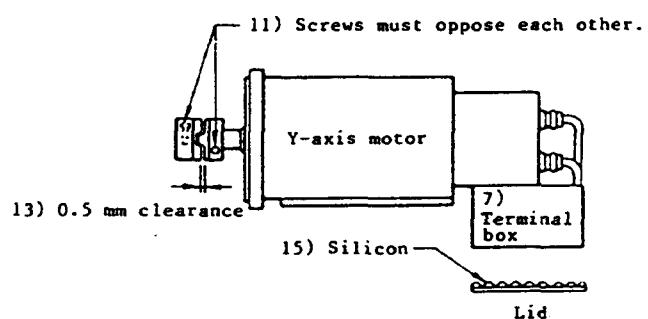
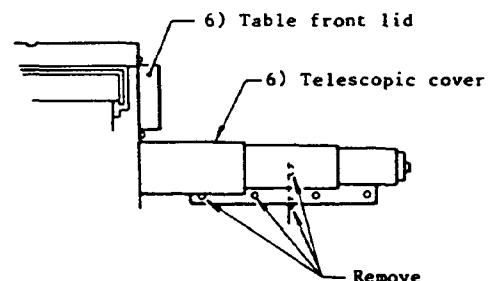
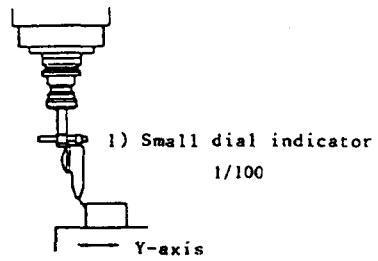
- 1) Mount a small dial indicator in the spindle and measure the current Y-axis position.
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current Y-axis position.
- 4) Move the Y-axis towards the column from the center position. (If the Y-axis will not move, turn OFF the power, remove the Y-axis rear cover and turn the ball screw by hand.)
- 5) POWER [OFF]
- 6) Remove the table front cover and the telescopic cover Y.
- 7) Open the motor terminal box.
- 8) Disconnect the two sockets inside the terminal box.
- 9) Remove the motor.
- 10) Remove the coupling from the motor.
- 11) Mount the coupling on the new motor such that the clamping screw opposes the clamping screw on the ball screw coupling. (Align the circumferences.)
- 12) Mount the new motor such that the terminal box faces left.
- 13) Set a 0.5 mm clearance in the coupling and tighten the motor coupling clamping screw.
- 14) Connect the two sockets inside the terminal box.
- 15) Apply silicon to the terminal box lid and attach it to the terminal box.



Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	AC servomotor 410W assembly	626084001	Small dial indicator 1/100 Phillips screwdriver Allen wrench (set) Silicon

Issued: / /
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- 16) POWER [ON]
 17) [MANU]
 18) Press [+Y] or [-Y] to check the operating noise of the motor.
 19) [MDI]
 20) [PARAM]
 21) [2] [ENTER]
 22) Press [\downarrow PAGE] and make a note of the GRID SHIFT VALUE Y.
 23) Turn the PROGRAM PROTECT switch OFF.
 24) Use the [\uparrow CURSOR] [\downarrow CURSOR] keys to move the cursor to GRID SHIFT VALUE Y.
 25) [0] [ENTER]
 26) POWER [OFF] [ON]
 27) Adjust the Y-axis zero-point limit switch. (No. 660100)
 28) Attach the table front cover and the telescopic cover Y.
 29) Adjust the Y-axis driver. (TC-225) (No. 760300)
 30) Carry out steps 19) - 26) to set the grid shift value Y to the value noted previously.
 31) Set the grid shift value Y.A. (No. 360100)

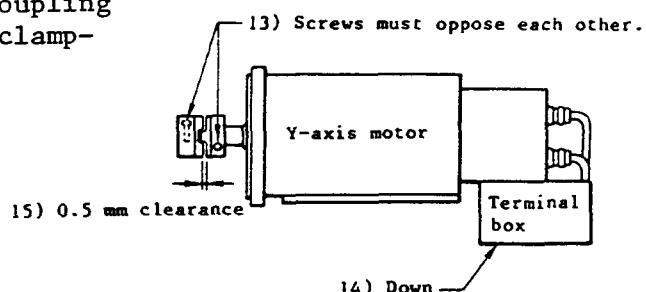
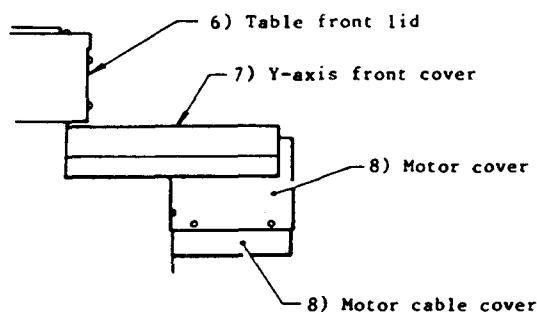
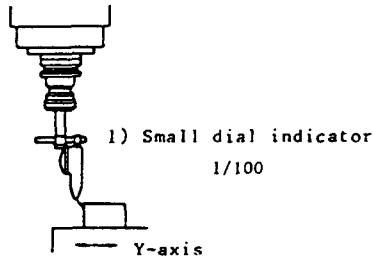


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	AC servomotor 410W assembly	626084001	Small dial indicator 1/100 Phillips screwdriver Allen wrench (set) Silicon

Issued: / /

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- 1) Mount a small dial indicator in the spindle and measure the current Y-axis position.
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current Y-axis position.
- 4) Move the Y-axis towards the column from the center position. (If the Y-axis will not move, turn OFF the power and push it by hand.)
- 5) POWER [OFF]
- 6) Remove the table front lid.
- 7) Remove the Y-axis front cover.
- 8) Remove the motor cable cover and the motor cover.
- 9) Remove the motor base cover.
- 10) Remove the motor.
- 11) Remove the couplings from the motor and the ball screw.
- 12) Push the new coupling onto the ball screw as far as possible and tighten the clamping screw.
- 13) Mount the coupling on the motor such that the clamping screw opposes the clamping screw on the ball screw coupling. (Align the circumferences.)
- 14) Mount the motor such that the terminal box faces down.
- 15) Set a 0.5 mm clearance in the coupling and tighten the motor coupling clamping screw.

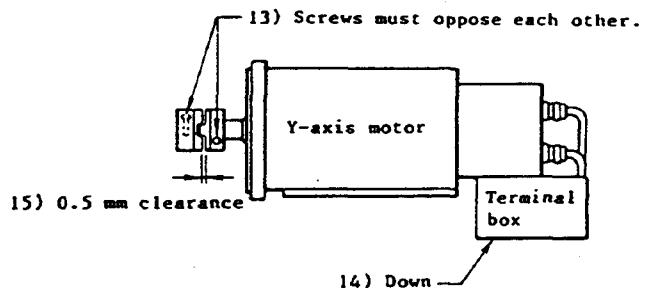
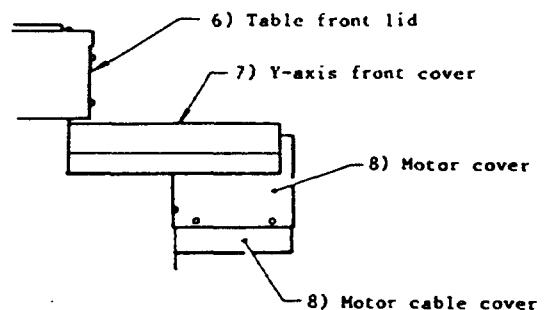
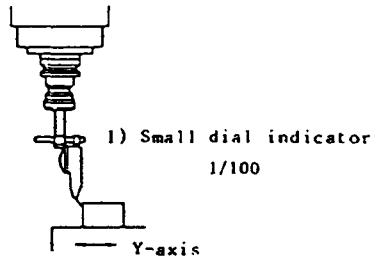


Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Description
	Joint MJC 2510x8 assembly Note: Export ... Nos. 111149 and below	620011001		Small dial indicator 1/100 Phillips screwdriver Allen wrench (set)
	Joint assembly MJC 25-10 Note: Export ... Nos. 111150 and above	628282001		

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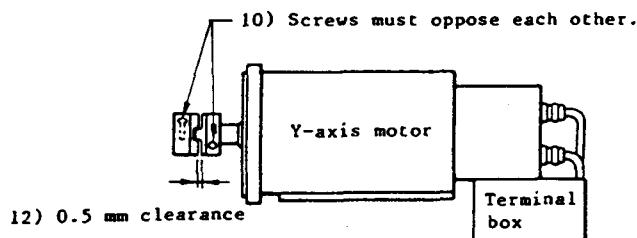
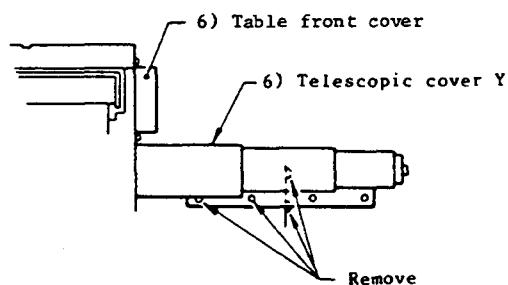
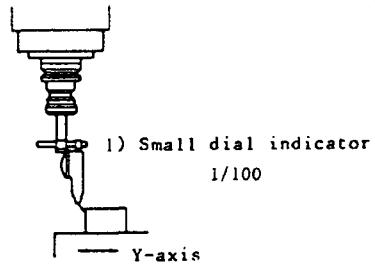
- 16) POWER [ON]
- 17) [MANU]
- 18) Press [+Y] or [-Y] to check the operating noise of the motor.
- 19) [MDI]
- 20) [PARAM]
- 21) [2] [ENTER]
- 22) Press [↓ PAGE] and make a note of the GRID SHIFT VALUE Y.
- 23) Turn the PROGRAM PROTECT switch OFF.
- 24) Use the [↑ CURSOR] [↓ CURSOR] keys to move the cursor to GRID SHIFT VALUE Y.
- 25) [0] [ENTER]
- 26) POWER [OFF] [ON]
- 27) Adjust the Y-axis zero-point limit switch. (No. 660100)
- 28) Attach the covers that were removed at steps 6) to 9), in the reverse order from that in which they were removed.
- 29) Carry out steps 19) - 26) to set the grid shift value Y to the value noted previously.
- 30) Set the grid shift value Y.A. (No. 360100)



Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Joint MJC 2510x8 assembly Note: Export ... Nos. 111149 and below	620011001	Small dial indicator 1/100 Phillips screwdriver Allen wrench (set)
	Joint assembly MJC 25-10 Note: Export ... Nos. 111150 and above	628282001	

Issued: / /
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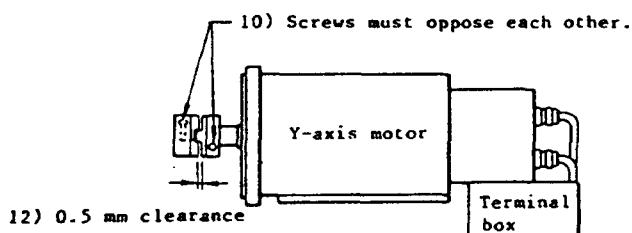
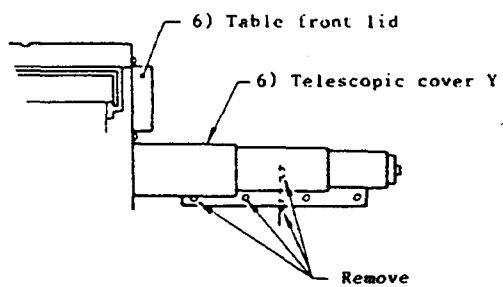
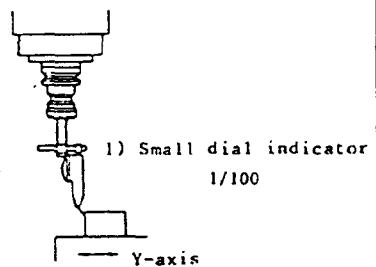
- 1) Mount a small dial indicator in the spindle and measure the current Y-axis position.
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current Y-axis position.
- 4) Move the Y-axis towards the column from the center position. (If the Y-axis will not move, turn OFF the power, remove the Y-axis rear cover and turn the ball screw.)
- 5) POWER [OFF]
- 6) Remove the table front cover and the telescopic cover Y.
- 7) Remove the motor.
- 8) Remove the motor and ball screw couplings.
- 9) Push the new coupling onto the ball screw as far as possible and tighten the clamping screw.
- 10) Mount the coupling on the motor such that the clamping screw opposes the clamping screw on the ball screw coupling. (Align the circumferences.)
- 11) Mount the new motor such that the terminal box faces left.
- 12) Set a 0.5 mm clearance in the coupling and tighten the motor coupling clamping screw.
- 13) POWER [ON]
- 14) [MANU]



Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Joint assembly MJC 41-14	626026001	Small dial indicator 1/100 Phillips screwdriver Allen wrench (set)

Issued: / /
TC-225

- 15) Press [+Y] or [-Y] to check the operating noise of the motor.
 16) [MDI]
 17) [PARAM]
 18) [2] [ENTER]
 19) Press [\downarrow PAGE] and make a note of the GRID SHIFT VALUE Y.
 20) Turn the PROGRAM PROTECT switch OFF.
 21) Use the [\uparrow CURSOR] [\downarrow CURSOR] keys to move the cursor to GRID SHIFT VALUE Y.
 22) [0] [ENTER]
 23) POWER [OFF]
 24) POWER [ON]
 25) Adjust the Y-axis zero-point limit switch. (No. 660100)
 26) Attach the telescopic cover Y and the table front cover.
 27) Carry out steps 16) - 24) to set the grid shift value Y to the value noted previously.
 28) Set the grid shift value Y.A, (No. 360100)

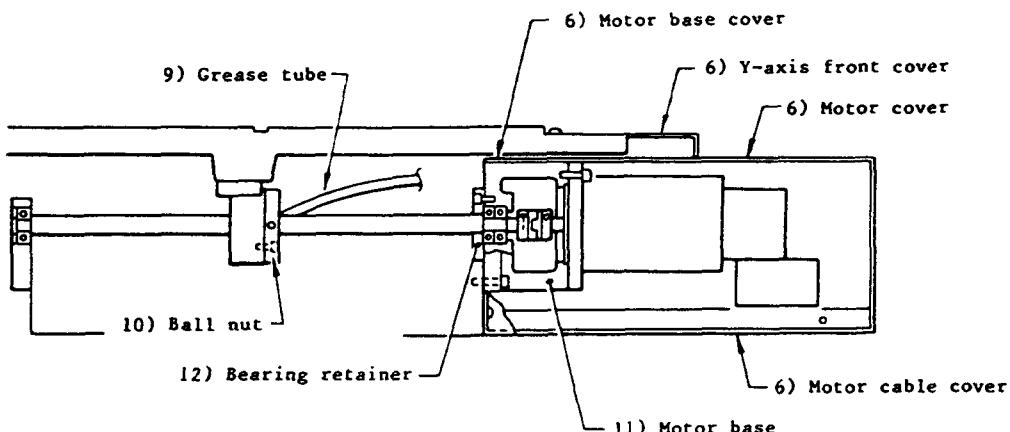
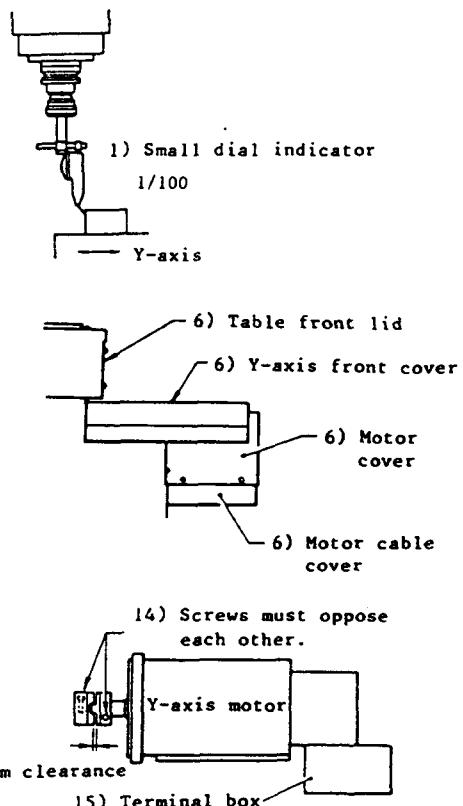


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Joint assembly MJC 41-14	626026001	Small dial indicator 1/100 Phillips screwdriver Allen wrench (set)

Issued: / /

TC-215

- 1) Mount a small dial indicator in the spindle and measure the current Y-axis position.
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current Y-axis position.
- 4) Move the Y-axis towards the column from the center position. (If the Y-axis will not move, turn OFF the power and push it by hand.)
- 5) POWER [OFF]
- 6) Remove the table front lid, Y-axis front cover, motor cable cover, motor cover and motor base cover.
- 7) Remove the motor.
- 8) Remove the coupling from the ball screw.
- 9) Remove the grease tube from the Y-axis ball nut.
- 10) Remove the ball nut mounting screw.
- 11) Remove the motor base mounting screws and remove the motor base and ball screw.
- 12) Remove the bearing retainer and remove the ball screw.
- 13) Mount the new ball screw by reversing the procedure in steps 8) - 12), above.

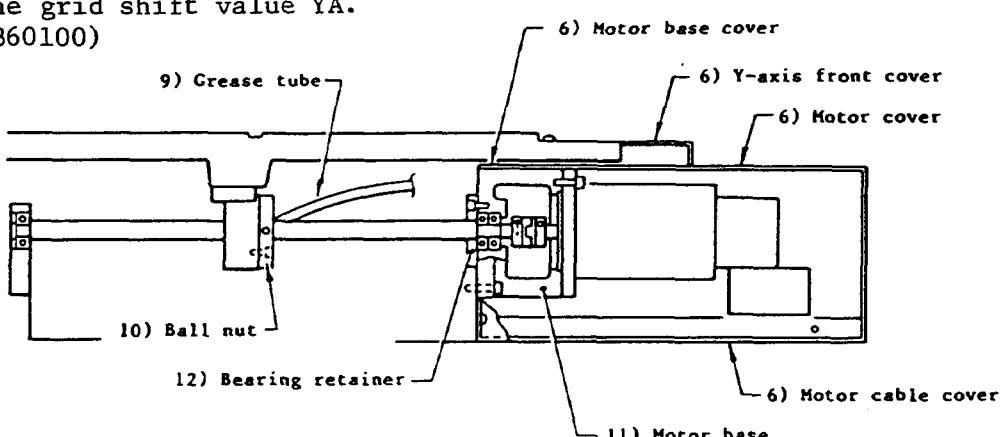
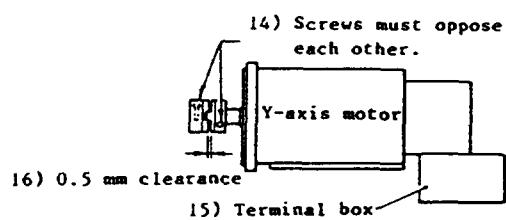
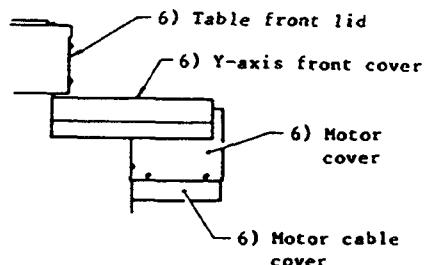
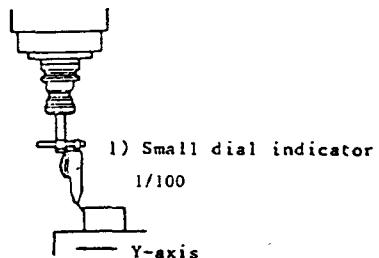


Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Description
	Y feed screw assembly	628222001		Small dial indicator 1/100 Phillips screwdriver Allen wrench (set) Wrench for the special M40 nut Grease

Issued: / /

TC-215

- 14) Mount the coupling on the ball screw such that the clamping screw opposes the clamping screw on the motor coupling. (Align the circumferences.)
- 15) Mount the motor such that the terminal box faces down.
- 16) Set a 0.5 mm clearance in the coupling and tighten the ball screw coupling clamping screw.
- 17) POWER [ON]
- 18) [MANU]
Press [+Y] or [-Y] to check the operating noise of the motor.
- 19) [MDI] [PARAM] [2] [ENTER] [↓ PAGE]
Make a note of the GRID SHIFT VALUE Y.
- 20) Turn the PROGRAM PROTECT switch OFF. Use the [↑ CURSOR] [↓ CURSOR] keys to move the cursor to GRID SHIFT VALUE Y.
- 21) [0] [ENTER] POWER [OFF] [ON]
- 22) Apply grease through the grease nipple.
- 23) Adjust the Y-axis limit switch. (No. 660100)
- 24) Attach the motor base cover, motor cover, cable cover and table cover.
- 25) Carry out steps 18) - 20) to set the grid shift value Y to the value noted previously.
- 26) Set the grid shift value YA. (No. 360100)

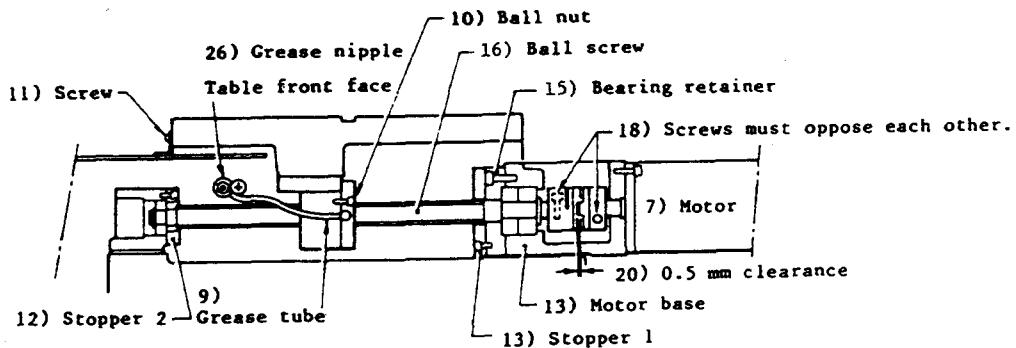
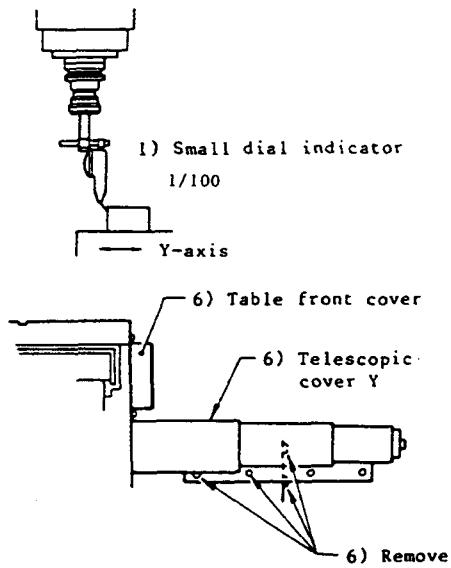


Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Description
	Y feed screw assembly	628222001		Small dial indicator 1/100 Phillips screwdriver Allen wrench (set) Wrench for the special M40 nut Grease

Issued: / /

TC-225

- 1) Mount a small dial indicator in the spindle and measure the current Y-axis position.
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current Y-axis position.
- 4) Move the Y-axis towards the column from the center position. (If the Y-axis will not move, turn OFF the power, remove the Y-axis rear cover and turn the ball screw.)
- 5) POWER [OFF]
- 6) Remove the table front cover and the telescopic cover Y.
- 7) Remove the motor.
- 8) Remove the ball screw coupling.
- 9) Remove the Y-axis ball screw grease tube.
- 10) Remove the Y-axis ball nut mounting screw.
- 11) Attach the screws holding the table cover and Y-axis rear cover and shift the covers.
- 12) Remove ball screw stopper 2.
- 13) Remove the motor base mounting screws and remove the motor base and ball screw.
- 14) Remove ball screw stopper 1.
- 15) Remove the bearing retainer.

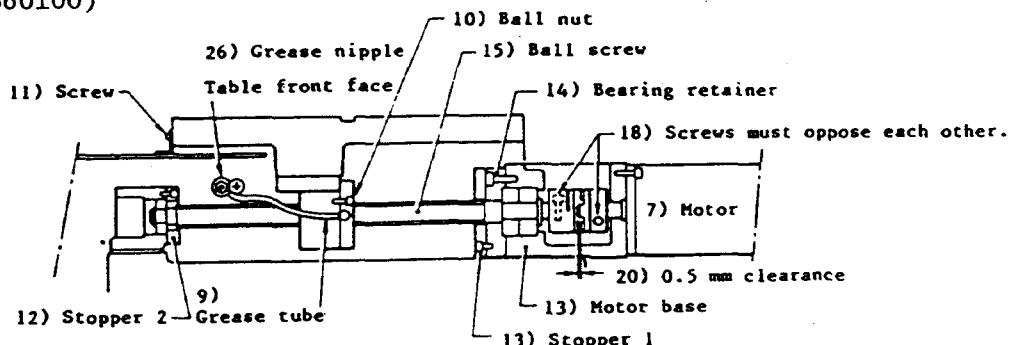
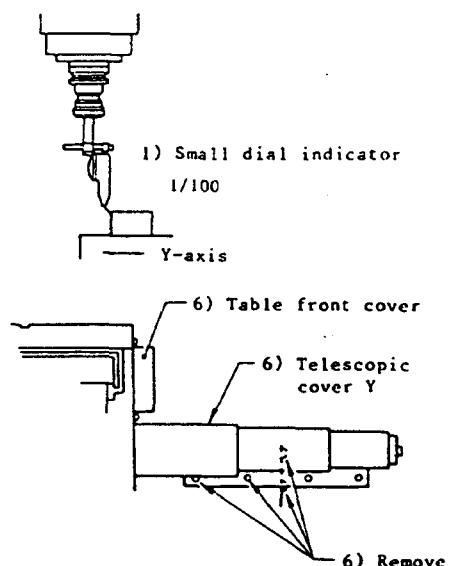


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Y-axis ball screw assembly	626472001	Small dial indicator 1/100 Straight-headed screwdriver Phillips screwdriver Allen wrench (set) Wrench for the special M4 screw Grease

Issued: / /

TC-225

- 16) Remove the ball screw from the motor base.
- 17) Mount the new ball screw by reversing the procedure in steps 8) - 16), above.
- 18) Mount the coupling on the ball screw such that the clamping screw opposes the clamping screw on the motor coupling. (Align the circumferences.)
- 19) Mount the motor such that the terminal box faces left.
- 20) Set a 0.5 mm clearance in the coupling and tighten the ball screw coupling clamping screw.
- 21) POWER [ON]
- 22) [MANU]
Press [+Y] or [-Y] to check the operating noise of the motor.
- 23) [MDI] [PARAM] [2] [ENTER] [↓ PAGE]
Make a note of the GRID SHIFT VALUE Y.
- 24) Turn the PROGRAM PROTECT switch OFF.
Use the [↑ CURSOR] [↓ CURSOR] keys to move the cursor to GRID SHIFT VALUE Y.
- 25) [0] [ENTER] POWER [OFF] [ON]
- 26) Apply grease through the grease nipple.
- 27) Adjust the Y-axis zero-point limit switch. (No. 660100)
- 28) Attach the telescopic cover Y and the table front cover.
- 29) Carry out steps 23) - 25) to set the grid shift value Y to the value noted previously.
- 30) Set the grid shift value Y.A.
(No. 360100)



Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Y-axis ball screw assembly	626472001	Small dial indicator 1/100 Straight-headed screwdriver Phillips screwdriver Allen wrench (set) Wrench for the special M4 screw Grease

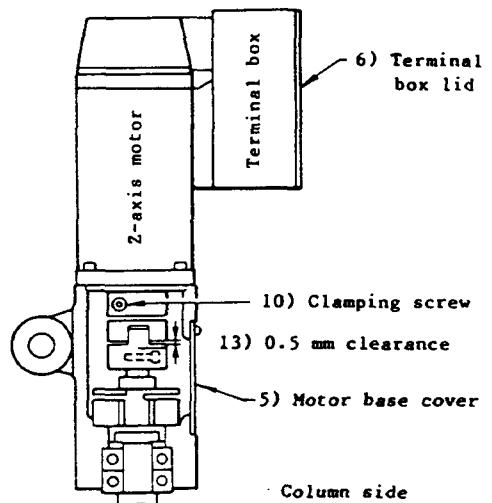
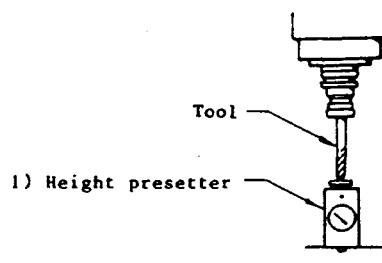
2.5 Z-AXIS FEED PARTS

- 500100 Replacing the Z-axis Motor TC-215
- 500200 Replacing the Z-axis Motor TC-225
- 500300 Replacing the Z-axis Coupling TC-215
- 500400 Replacing the Z-axis Coupling TC-225
- 500500 Replacing the Z-axis Brake TC-215
- 500600 Replacing the Z-axis Brake TC-225
- 500700 Replacing the Z-axis Ball Screw Assembly TC-215
- 500800 Replacing the Z-axis Ball Screw Assembly TC-225

Issued: / /

TC-215

- 1) Mount a tool in the spindle and measure the current Z-axis position with a height presetter. (A small dial indicator can be used if the Z-axis does not move.)
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current Z-axis position.
- 4) POWER [OFF]
- 5) Remove the motor base cover.
- 6) Remove the motor terminal box lid.
- 7) Disconnect the two sockets and cable plates inside the terminal box.
- 8) Remove the motor.
- 9) Remove the couplings from the motor and ball screw.
- 10) Push the coupling onto the new motor as far as possible. Tighten the clamping screw in a position perpendicular to the terminal box.
- 11) Push the coupling onto the ball screw with the clamping screw facing the column. Do not tighten the clamping screw.
- 12) Mount the new motor such that the terminal box faces the column.
- 13) Set a 0.5 mm clearance in the coupling and tighten the ball screw coupling.
- 14) Connect the motor sockets.
- 15) Attach the cable plates and the terminal box lid.
- 16) POWER [ON]
- 17) [MANU]

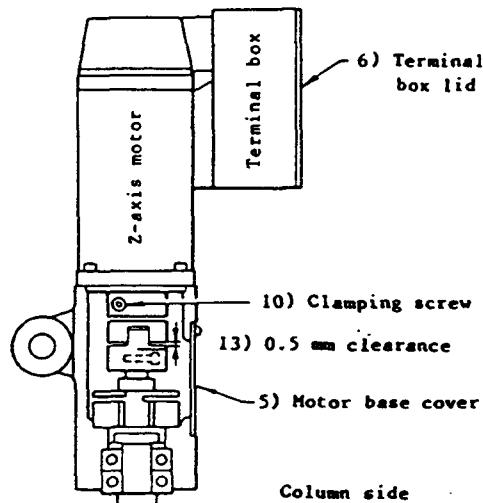
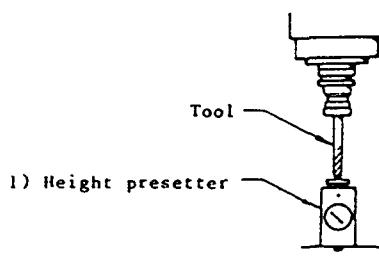


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Motor RA12M 300W	628070000	Height presetter Phillips screwdriver Allen wrench (set)

Issued: / /

TC-215

- 18) Press [+Z] or [-Z] to check the operating noise of the motor.
- 19) [MDI]
- 20) [PARAM]
- 21) [2] [ENTER]
- 22) Press [↓ PAGE] and make a note of the GRID SHIFT VALUE Z.
- 23) Turn the PROGRAM PROTECT switch OFF.
- 24) Use the [↑ CURSOR] [↓ CURSOR] keys to move the cursor to GRID SHIFT VALUE Z.
- 25) [0] [ENTER]
- 26) POWER [OFF] [ON]
- 27) Adjust the Z-axis zero-point limit switch. (No. 660100)
- 28) Attach the motor base cover.
- 29) Adjust the Z-axis driver. (TC-215) (No. 760100)
- 30) Carry out steps 19) - 26) to set the grid shift value Z to the value noted previously.
- 31) Set the grid shift value Z. (No. 360300)

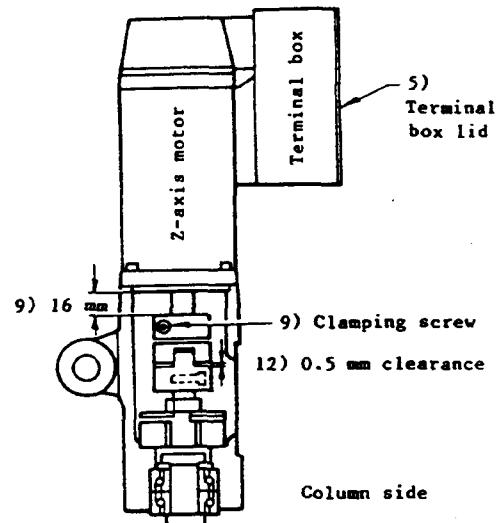
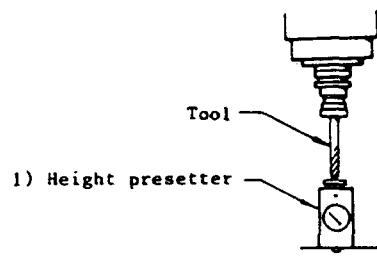


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Motor RA12M 300W	628070000	Height presetter Phillips screwdriver Allen wrench (set)

Issued: / /

TC-225

- 1) Mount a tool in the spindle and measure the current Z-axis position with a height presetter. (A small dial indicator can be used if the Z-axis does not move.)
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current Z-axis position.
- 4) POWER [OFF]
- 5) Remove the motor terminal box lid.
- 6) Disconnect the two sockets and cable plates inside the terminal box.
- 7) Remove the motor.
- 8) Remove the coupling from the motor and ball screw.
- 9) Push the coupling onto the new motor, leaving a 16 mm gap between the coupling and the motor. Tighten the clamping screw in a position perpendicular to the terminal box.
- 10) Push the coupling onto the ball screw with the clamping screw facing the column. Do not tighten the clamping screw.
- 11) Mount the new motor such that the terminal box faces the column.
- 12) Set a 0.5 mm clearance in the coupling and tighten the ball screw coupling.
- 13) Connect the motor sockets.
- 14) Attach the cable plates and the terminal box lid.
- 15) POWER [ON]

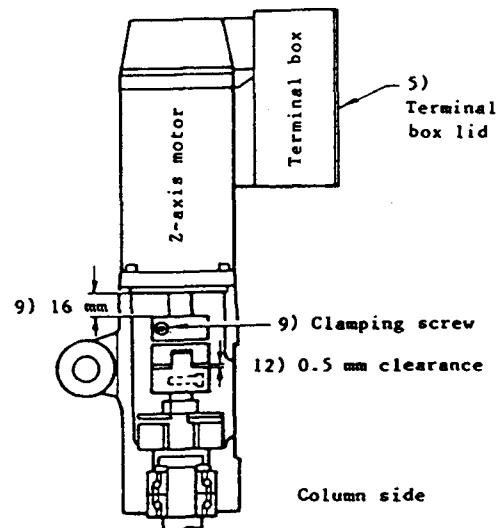
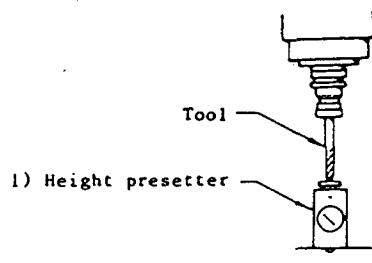


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Servo motor assembly 720W	626143001	Height presetter Phillips screwdriver Allen wrench (set)

Issued: / /

TC-225

- 16) [MANU]
- 17) Press [+Z] or [-Z] to check the operating noise of the motor.
- 18) [MDI]
- 19) [PARAM]
- 20) [2] [ENTER]
- 21) Press [↓ PAGE] and make a note of the GRID SHIFT VALUE Z.
- 22) Turn the PROGRAM PROTECT switch OFF.
- 23) Use the [↑ CURSOR] [↓ CURSOR] keys to move the cursor to GRID SHIFT VALUE Z.
- 24) [0] [ENTER]
- 25) POWER [OFF] [ON]
- 26) Adjust the Z-axis zero-point limit switch. (No. 660100)
- 27) Adjust the Z-axis driver. (TC-225) (No. 760300)
- 28) Carry out steps 18) - 25) to set the grid shift value Z to the value noted previously.
- 29) Set the grid shift value Z. (No. 360300)

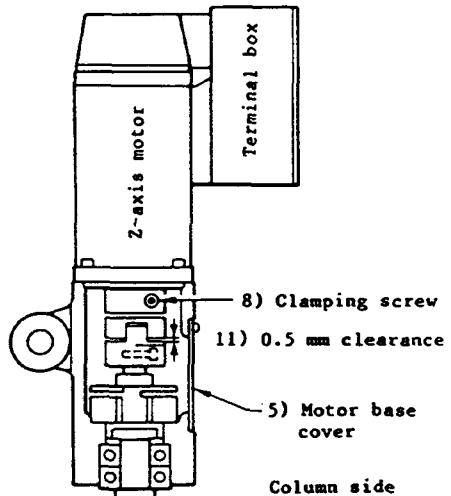
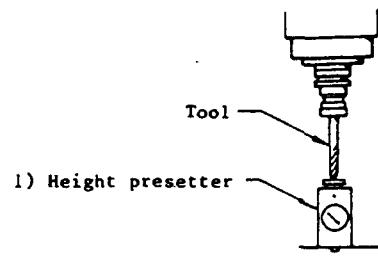


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Servo motor assembly 720W	626143001	Height presetter Phillips screwdriver Allen wrench (set)

Issued: / /

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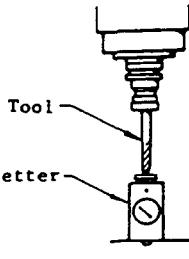
- 1) Mount a tool in the spindle and measure the current Z-axis position with a height presetter. (A small dial indicator can be used if the Z-axis does not move.)
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current Z-axis position.
- 4) POWER [OFF]
- 5) Remove the motor base cover.
- 6) Remove the motor.
- 7) Remove the couplings from the motor and ball screw.
- 8) Push the coupling onto the new motor as far as possible. Tighten the clamping screw in a position perpendicular to the terminal box.
- 9) Push the coupling onto the ball screw with the clamping screw facing the column. Do not tighten the clamping screw.
- 10) Mount the new motor such that the terminal box faces the column.
- 11) Set a 0.5 mm clearance in the coupling and tighten the ball screw coupling.
- 12) POWER [ON]
- 13) [MDI]
- 14) [PARAM]
- 15) [2] [ENTER]
- 16) Press [↓ PAGE] and make a note of the GRID SHIFT VALUE Z.
- 17) Turn the PROGRAM PROTECT switch OFF.
- 18) Use the [↑ CURSOR] [↓ CURSOR] keys to move the cursor to GRID SHIFT VALUE Z.
- 19) [0] [ENTER]
- 20) POWER [OFF] [ON]
- 21) Adjust the Z-axis zero-point limit switch. (No. 660100)
- 22) Attach the motor base cover.
- 23) Carry out steps 13) - 20) to set the grid shift value Z to the value noted previously.
- 24) Set the grid shift value Z. (No. 360300)



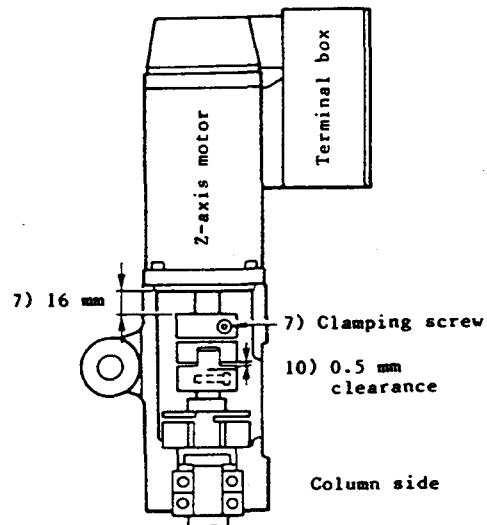
Part Name	Part Code	Jigs and Tools Required
Coupling assembly MJC 41-14	628073000	Height presetter Phillips screwdriver Allen wrench (set)

Issued: / /
TC-225

- 1) Mount a tool in the spindle and measure the current Z-axis position with a height presetter. (A small dial indicator can be used if the Z-axis does not move.)
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current Z-axis position.
- 4) POWER [OFF]
- 5) Remove the motor.
- 6) Remove the couplings from the motor and ball screw.
- 7) Push the coupling onto the new motor, leaving a 16 mm gap between the coupling and the motor. Tighten the clamping screw in a position perpendicular to the terminal box.
- 8) Push the coupling onto the ball screw with the clamping screw facing the column. Do not tighten the clamping screw.
- 9) Mount the new motor such that the terminal box faces the column.
- 10) Set a 0.5 mm clearance in the coupling and tighten the ball screw coupling.
- 11) POWER [ON]
- 12) [MDI]
- 13) [PARAM]
- 14) [2] [ENTER]
- 15) Press [↓ PAGE] and make a note of the GRID SHIFT VALUE Z.
- 16) Turn the PROGRAM PROTECT switch OFF.
- 17) Use the [↑ CURSOR] [↓ CURSOR] keys to move the cursor to GRID SHIFT VALUE Z.
- 18) [0] [ENTER]
- 19) POWER [OFF] [ON]
- 20) Adjust the Z-axis zero-point limit switch. (No. 660100)
- 21) Carry out steps 12) - 19) to set the grid shift value Z to the value noted previously.
- 22) Set the grid shift value Z. (No. 360300)



1) Height presetter

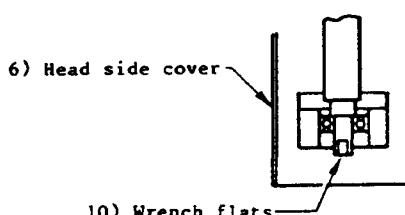
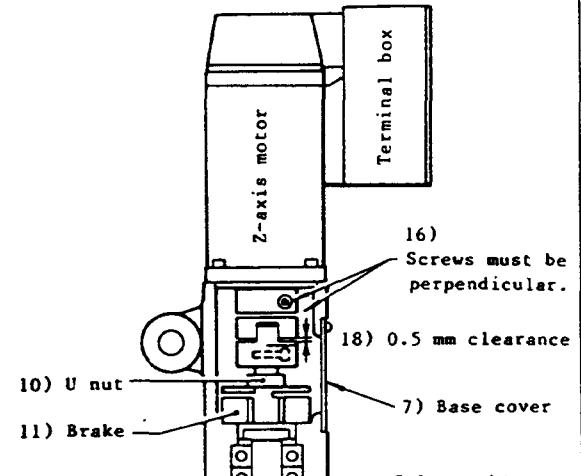
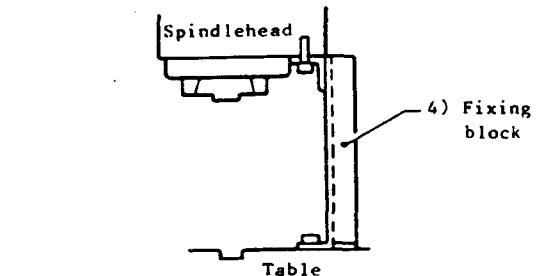
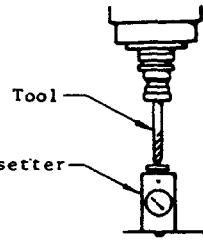


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Joint assembly MJC41-14	626026001	Height presetter Phillips screwdriver Allen wrench (set)

Issued: / /

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- 1) Mount a tool in the spindle and measure the current Z-axis position with a height presetter.
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current Z-axis position.
- 4) Insert a fixing block between the spindlehead and the table so that the spindlehead cannot fall.
- 5) POWER [OFF]
- 6) Remove the head side covers.
- 7) Remove the motor base cover.
- 8) Remove the Z-axis motor.
- 9) Remove the coupling from the ball screw.
- 10) Fasten the bottom end of the ball screw with a wrench to prevent it from rotating and remove the U nut.
- 11) Remove the socket screws holding the brake.
- 12) Disconnect the brake connector and remove the brake.
- 13) Mount the new brake with socket screws.
- 14) Connect the brake connector.
- 15) Fasten the ball screw and tighten the U nut.
- 16) Tighten the ball screw coupling clamping screw in a position perpendicular to the motor coupling.
- 17) Mount the new motor such that the terminal box faces the column.
- 18) Set a 0.5 mm clearance in the coupling and tighten the ball screw coupling.

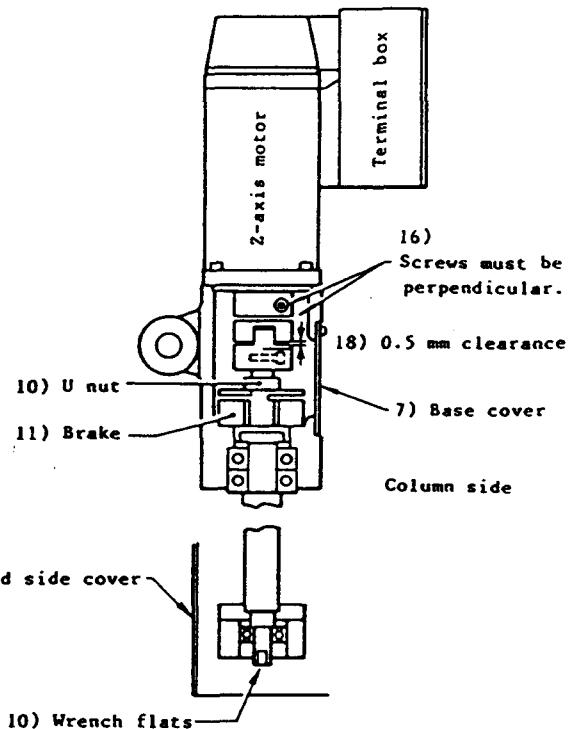
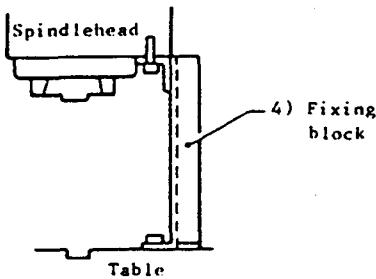
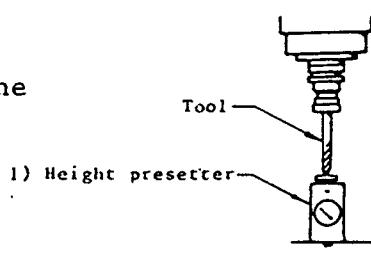


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Brake assembling	628089000	Height presetter Phillips screwdriver Allen wrench (set) 10 mm wrench 22 mm socket wrench Extension bar

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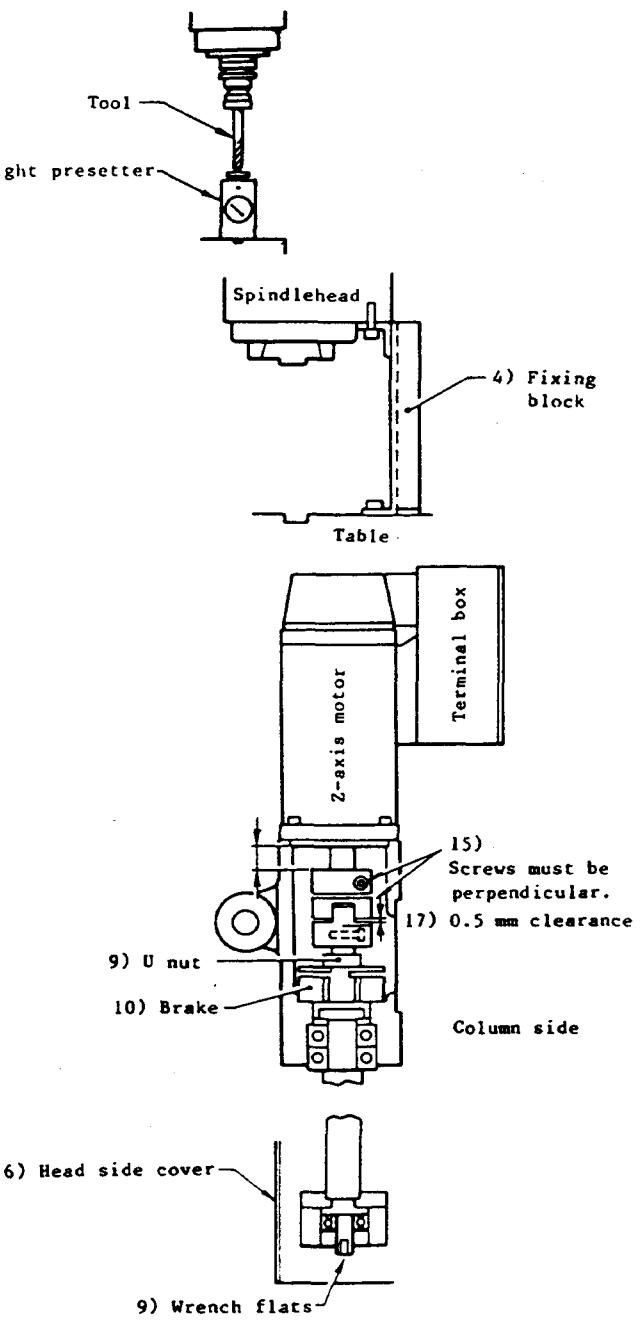
- 19) Attach the motor base cover.
- 20) Attach the head side cover.
- 21) Remove the fixing block for the spindle head.
- 22) POWER [ON]
- 23) [MDI]
- 24) [PARAM]
- 25) [2] [ENTER]
- 26) Press [\downarrow PAGE] and make a note of the GRID SHIFT VALUE Z.
- 27) Turn the PROGRAM PROTECT switch OFF.
- 28) Use the [\uparrow CURSOR] [\downarrow CURSOR] keys to move the cursor to GRID SHIFT VALUE Z.
- 29) [0] [ENTER]
- 30) POWER [OFF] [ON]
- 31) Adjust the Z-axis zero-point limit switch. (No. 660100)
- 32) Carry out steps 23) – 30) to set the grid shift value Z to the value noted previously.
- 33) Set the grid shift value Z. (No. 360300)



Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Brake assembling	628089000	Height presetter Phillips screwdriver Allen wrench (set) 10 mm wrench 22 mm socket wrench Extension bar

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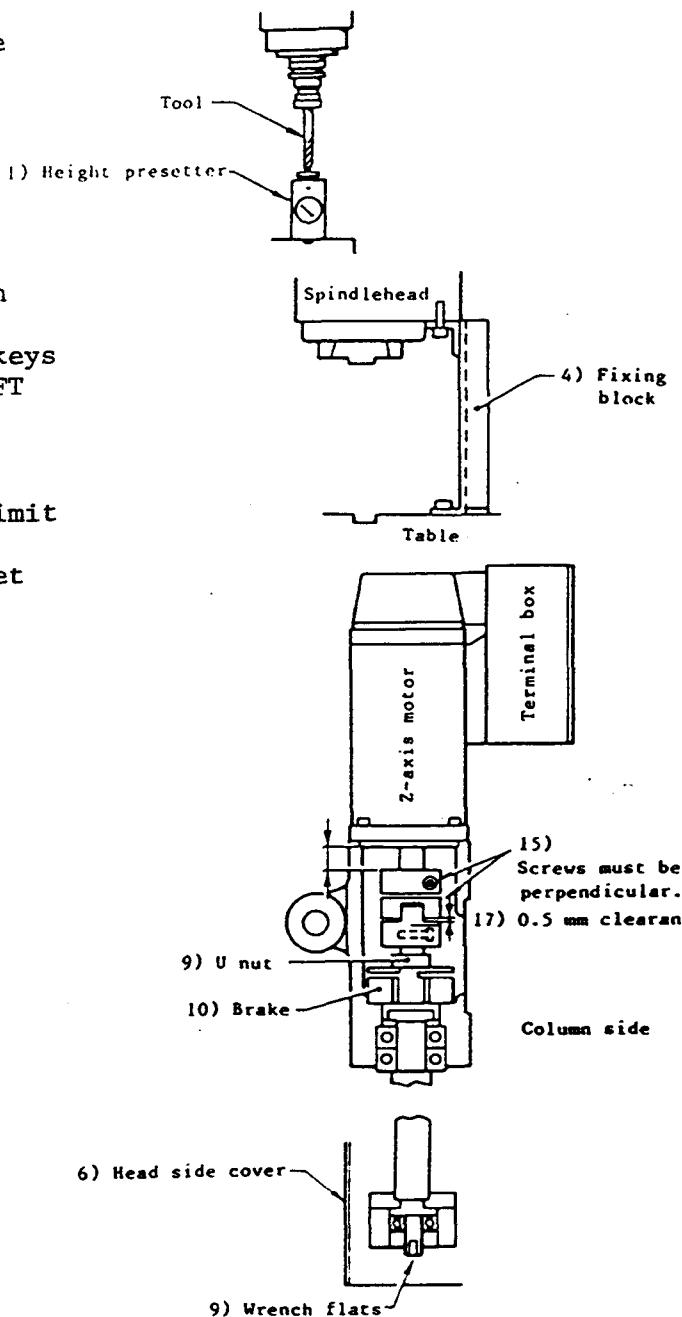
- 1) Mount a tool in the spindle and measure the current Z-axis position with a height presetter.
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current Z-axis position.
- 4) Insert a fixing block between the spindlehead and the table so that the spindlehead cannot fall.
- 5) POWER [OFF].
- 6) Remove the head side cover.
- 7) Remove the Z-axis motor.
- 8) Remove the coupling from the ball screw.
- 9) Fasten the bottom end of the ball screw with a wrench to prevent it from rotating and remove the U nut.
- 10) Remove the socket screws holding the brake.
- 11) Disconnect the brake connector and remove the brake.
- 12) Mount the new brake with socket screws.
- 13) Connect the brake connector.
- 14) Fasten the ball screw and tighten the U nut.
- 15) Tighten the ball screw coupling clamping screw in a position perpendicular to the motor coupling. (Align the circumferences.)
- 16) Mount the new motor such that the terminal box faces the column.
- 17) Set a 0.5 mm clearance in the coupling and tighten the ball screw coupling.



Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Brake assembly SBR 10015	626029001	Height presetter Phillips screwdriver Allen wrench (set) 10 mm wrench U nut socket

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- 18) Attach the head side covers.
- 19) Remove the fixing block for the spindle head.
- 20) POWER [ON]
- 21) [MDI]
- 22) [PARAM]
- 23) [2] [ENTER]
- 24) Press [↓ PAGE] and make a note of the GRID SHIFT VALUE Z.
- 25) Turn the PROGRAM PROTECT switch OFF.
- 26) Use the [↑ CURSOR] [↓ CURSOR] keys to move the cursor to GRID SHIFT VALUE Z.
- 27) [0] [ENTER]
- 28) POWER [OFF] [ON]
- 29) Adjust the Z-axis zero-point limit switch. (No. 660100)
- 30) Carry out steps 21) - 28) to set the grid shift value Z to the value noted previously.
- 31) Set the grid shift value Z. (No. 360300)

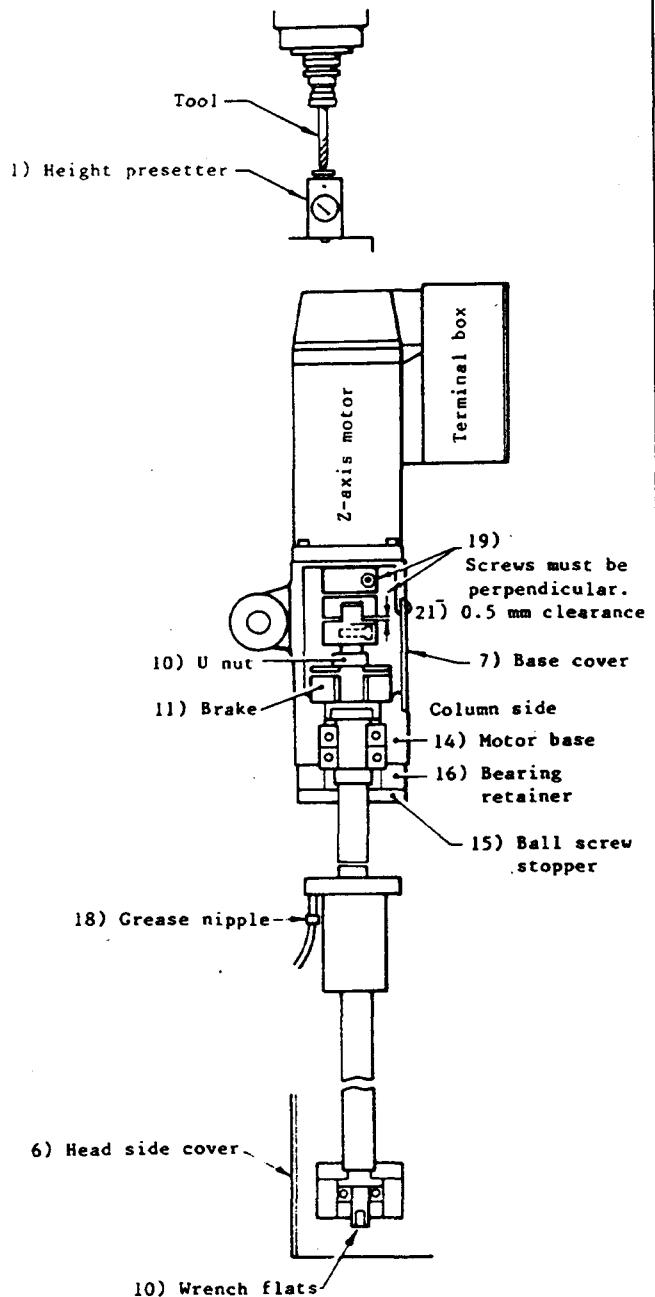


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Brake assembly SBR 10015	626029001	Height presetter Phillips screwdriver Allen wrench (set) 10 mm wrench U nut socket

Issued: / /

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- 1) Mount a tool in the spindle and measure the current Z-axis position with a height presetter. (A small dial indicator can be used if the Z-axis does not move.)
- 2) [POS]
- 3) Make a note of the machine coordinate position and the current Z-axis position.
- 4) Insert a fixing block between the spindlehead and the table so that the spindlehead cannot fall.
- 5) POWER [OFF]
- 6) Remove the head side cover.
- 7) Remove the motor base cover.
- 8) Remove the Z-axis motor.
- 9) Remove the coupling from the ball screw.
- 10) Fasten the bottom end of the ball screw with a wrench to prevent it from rotating and remove the U nut.
- 11) Remove the socket screws holding the brake.
- 12) Disconnect the brake connector and remove the brake.
- 13) Remove the Z-axis ball nut clamping screw.
- 14) Remove the motor base mounting screws and remove the motor base and ball screw.
- 15) Remove the ball screw stopper.
- 16) Remove the bearing retainer.
- 17) Remove the ball screw from the motor base.
- 18) Mount the new ball screw by reversing the procedure in steps 10) - 17), above. (Align the ball nut grease hole and nipple.)

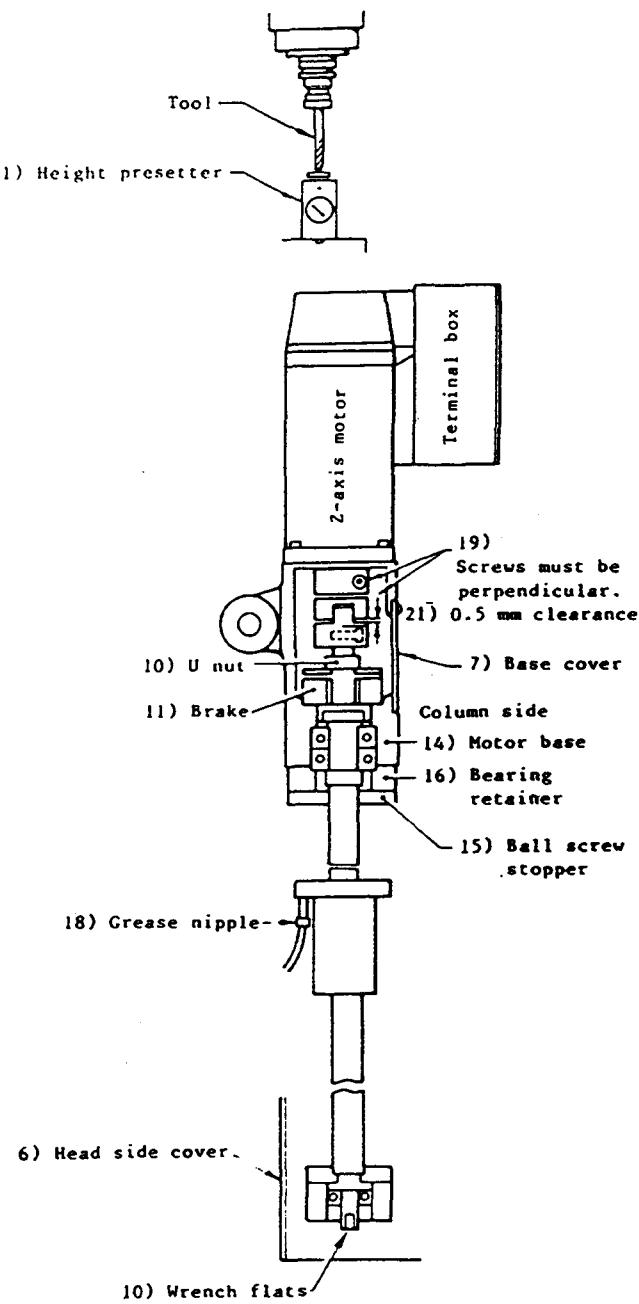


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Z feed screw assembly	628224001	Height presetter Straight-headed screwdriver Phillips screwdriver Allen wrench (set) Wrench for the special M4 screw 10 mm wrench 22 mm socket wrench Extension bar

Issued: / /

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- 19) Tighten the ball screw coupling clamping screw in a position perpendicular to the motor coupling. (Align the circumferences.)
- 20) Mount the motor such that the terminal box faces the column.
- 21) Set a 0.5 mm clearance in the coupling and tighten the ball screw coupling.
- 22) Attach the motor base cover.
- 23) Attach the head side covers.
- 24) Remove the fixing block for the spindle head.
- 25) POWER [ON]
- 26) [MDI]
- 27) [PARAM]
- 28) [2] [ENTER]
- 29) Press [↓ PAGE] and make a note of the GRID SHIFT VALUE Z.
- 30) Turn the PROGRAM PROTECT switch OFF.
- 31) Use the [↑ CURSOR] [↓ CURSOR] keys to move the cursor to GRID SHIFT VALUE Z.
- 32) [0] [ENTER]
- 33) POWER [OFF] [ON]
- 34) Adjust the Z-axis zero-point limit switch. (No. 660100)
- 35) Carry out steps 25) - 32) to set the grid shift value Z to the value noted previously.
- 36) Set the grid shift value Z. (No. 360300)

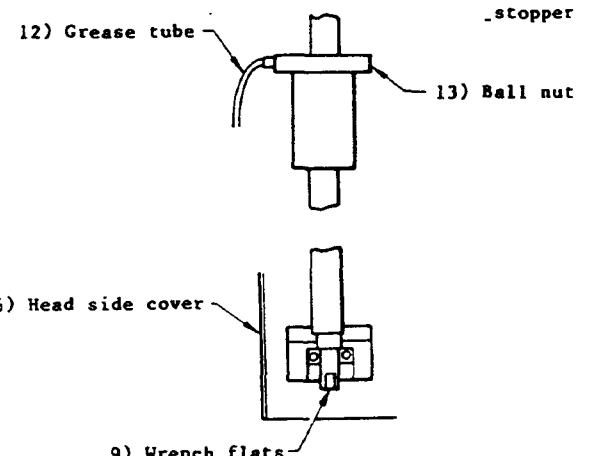
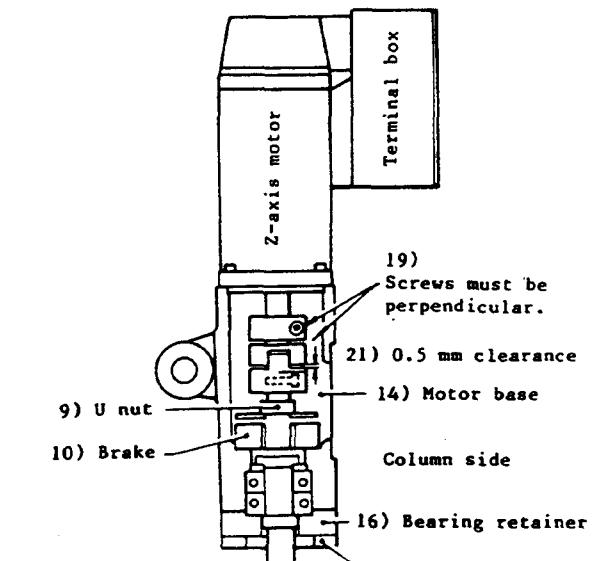
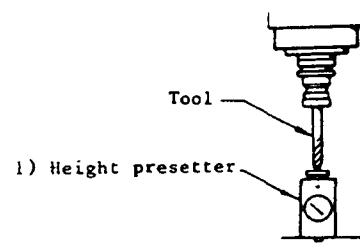


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Z feed screw assembly	628224001	Height presetter Straight-headed screwdriver Phillips screwdriver Allen wrench (set) Wrench for the special M4 screw 10 mm wrench 22 mm socket wrench Extension bar

Issued: / /

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- 1) Mount a tool in the spindle and measure the current Z-axis position with a height presetter. (A small dial indicator can be used if the Z-axis does not move.)
- 2) [POS]
- 3) Make a note of the machine position and the current Z-axis position.
- 4) Insert a fixing block between the spindlehead and the table so that the spindlehead cannot fall.
- 5) POWER [OFF]
- 6) Remove the head side covers.
- 7) Remove the Z-axis motor.
- 8) Remove the coupling from the ball screw.
- 9) Fasten the bottom end of the ball screw with a wrench to prevent it from rotating and remove the U nut.
- 10) Remove the socket screws holding the brake.
- 11) Disconnect the brake connector and remove the brake.
- 12) Remove the Z-axis ball nut grease tube.
- 13) Remove the Z-axis ball nut clamping screw.
- 14) Remove the motor base mounting screws and remove the motor base and ball screw.
- 15) Remove the ball screw stopper.
- 16) Remove the bearing retainer.
- 17) Remove the ball screw from the motor base.
- 18) Mount the new ball screw by reversing the procedure in steps 9) - 17), above.

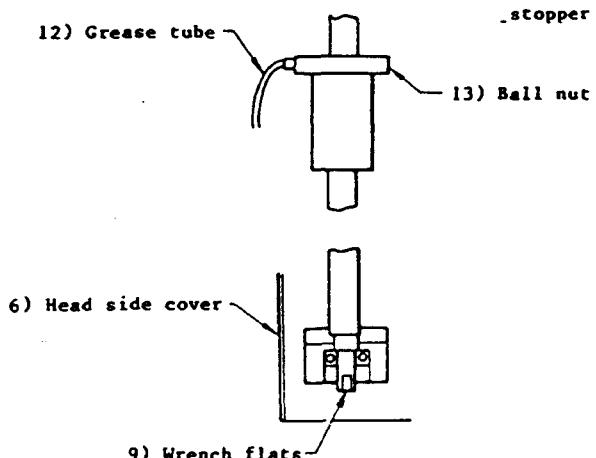
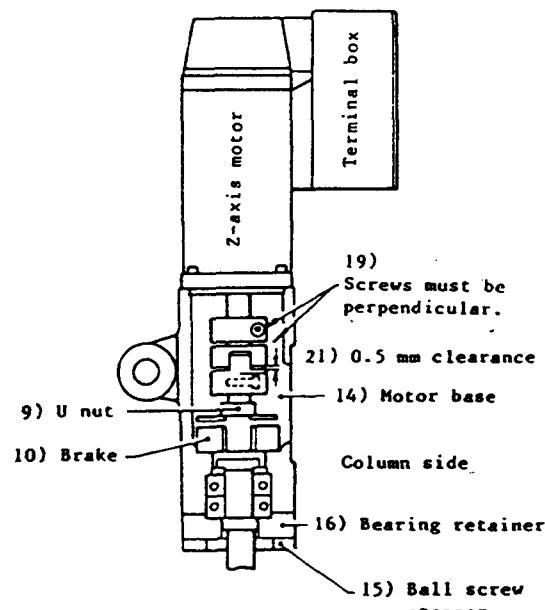
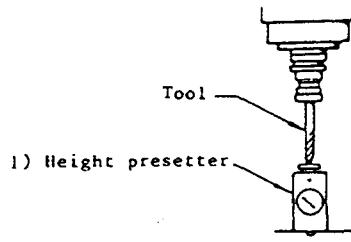


Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Height presetter Straight-headed screwdriver Phillips screwdriver Allen wrench (set) Wrench for the special M4 screw 10 mm wrench U nut socket
	Z-axis ball screw assembly	626473001		

Issued: / /

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- 19) Tighten the ball screw coupling clamping screw in a position perpendicular to the motor coupling. (Align the circumferences.)
- 20) Mount the motor such that the terminal box faces the column.
- 21) Set a 0.5 mm clearance in the coupling and tighten the ball screw coupling.
- 22) Attach the head side covers.
- 23) Remove the fixing block for the spindle head.
- 24) POWER [ON]
- 25) [MDI]
- 26) [PARAM]
- 27) [2] [ENTER]
- 28) Press [↓ PAGE] and make a note of the GRID SHIFT VALUE Z.
- 29) Turn the PROGRAM PROTECT switch OFF.
- 30) Use the [↑ CURSOR] [↓ CURSOR1] keys to move the cursor to GRID SHIFT VALUE Z.
- 31) [0] [ENTER]
- 32) POWER [OFF] [ON]
- 33) Adjust the Z-axis zero-point limit switch. (No. 660100)
- 34) Carry out steps 25) - 32) to set the grid shift value Z to the value noted previously.
- 35) Set the grid shift value Z. (No. 360300)



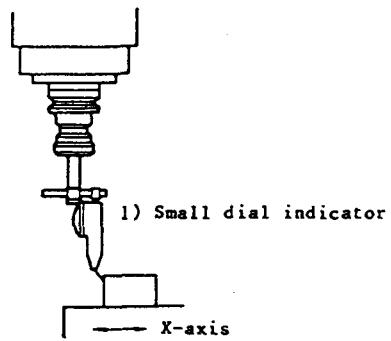
Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Z-axis ball screw assembly	626473001	Height presetter Straight-headed screwdriver Phillips screwdriver Allen wrench (set) Wrench for the special M4 screw 10 mm wrench U nut socket

2.6 LIMIT SWITCH PARTS

- 600100 Replacing the X-axis Zero-Point Limit Switch
- 600200 Replacing the X-axis Overrun Limit Switches
- 600300 Replacing the Y-axis Zero-Point Limit Switch TC-215
- 600400 Replacing the Y-axis Zero-Point Limit Switch TC-225
- 600500 Replacing the Y-axis Overrun Limit Switches TC-215
- 600600 Replacing the Y-axis Overrun Limit Switches TC-225
- 600700 Replacing the Z-axis Zero-Point Limit Switch
- 600800 Replacing the Z-axis Overrun Limit Switches
- 600900 Replacing the Z-axis ATC Zero-point and Operation Area Limit Switches

Issued: / /
TC-215 TC-225

- 1) Mount a small dial indicator in the spindle and measure the current X-axis position.
- 2) [POS]
- 3) Make a note of the machine coordinates positions and the current X-axis position.
- 4) POWER [OFF]
- 5) Remove the table front lid.
- 6) Remove the zero-point limit switch.
- 7) Remove the limit switch protective cover.
- 8) Disconnect the leads from the limit switch.
- 9) Connect the leads to the new limit switch.
- 10) Attach the limit switch protective cover and seal the lead hole with silicon.
- 11) Mount the new limit switch.
- 12) Adjust the X-axis zero-point limit switch. (No. 660100)
- 13) Set the grid shift value X. (No. 360100)
- 14) Attach the table front cover.



Table

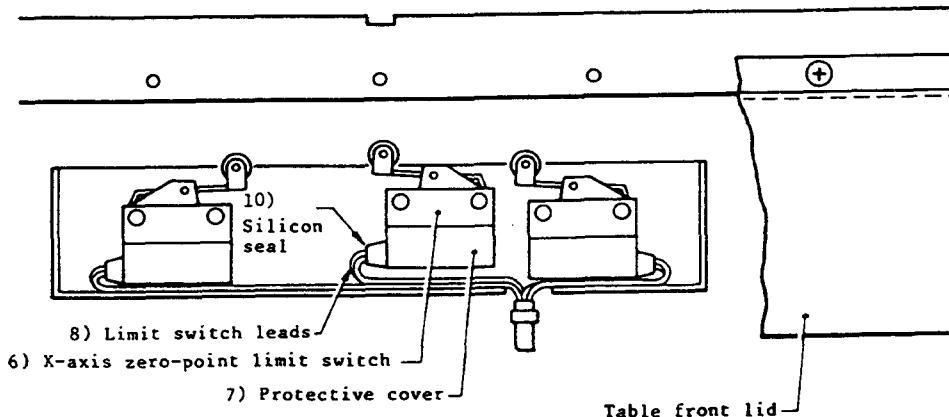
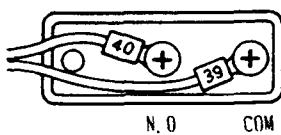


Table front lid



X-axis zero-point limit switch

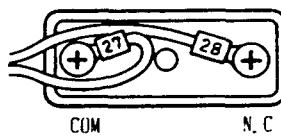
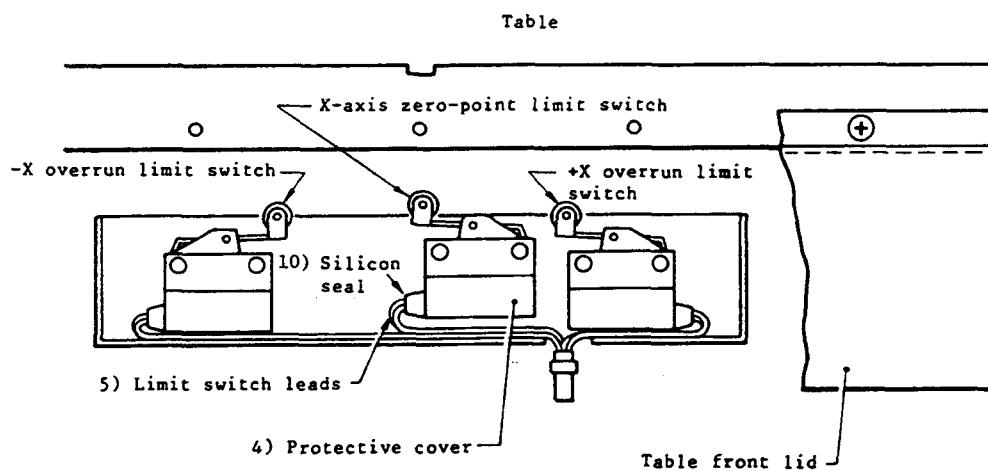
Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Small dial indicator Phillips screwdriver Silicon
	Switch SLL-P	620264000		

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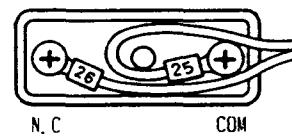
TC-215

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- 1) POWER [OFF]
- 2) Remove the table front lid.
- 3) Remove the overrun limit switch.
- 4) Remove the limit switch protective cover.
- 5) Disconnect the leads from the limit switch.
- 6) Connect the leads to the new limit switch.
- 7) Attach the limit switch protective cover and seal the lead hole with silicon.
- 8) Mount the new limit switch.
- 9) Adjust the X-axis overrun limit switch. (No. 660200)
- 10) Attach the table front cover.



-X overrun limit switch



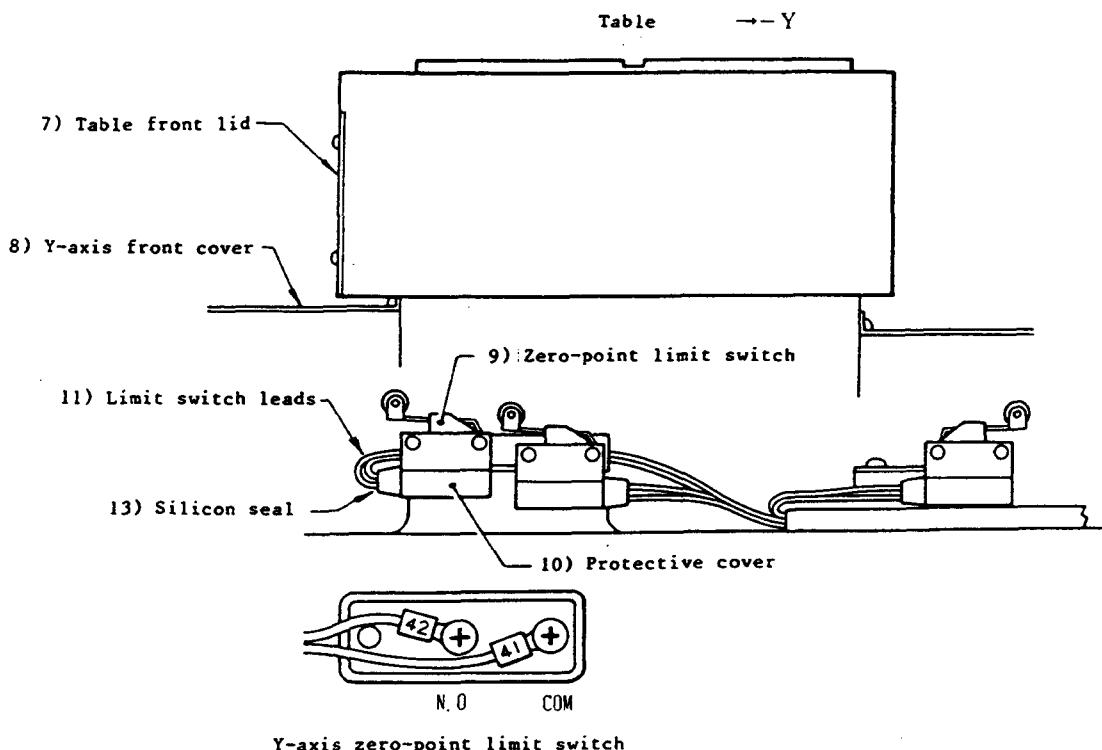
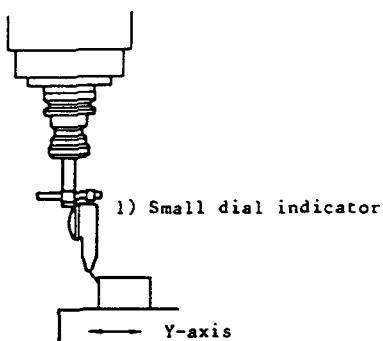
+X overrun limit switch

Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Switch SL1-P	620264000	Phillips screwdriver Silicon

Issued: / /

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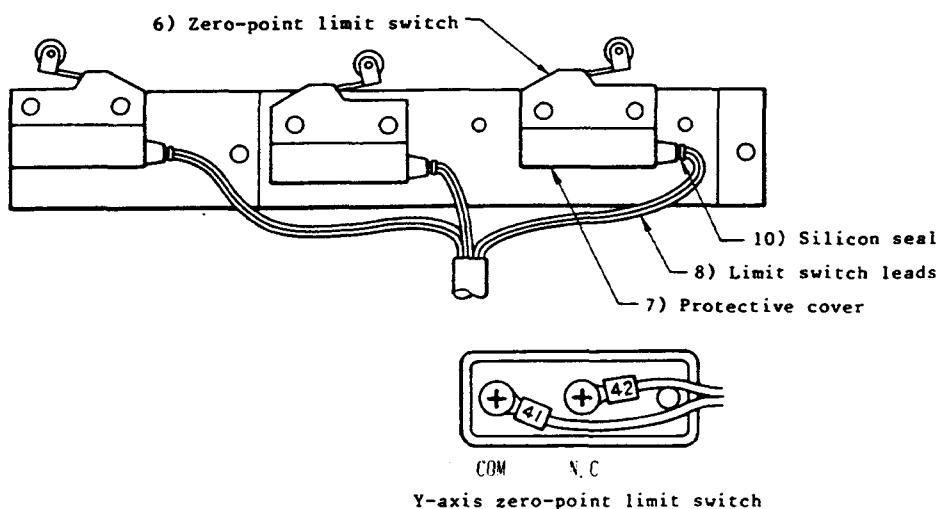
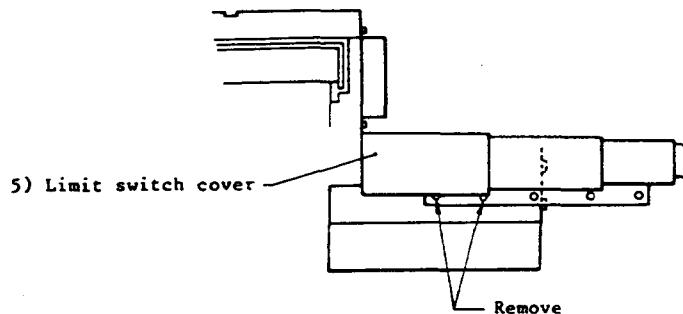
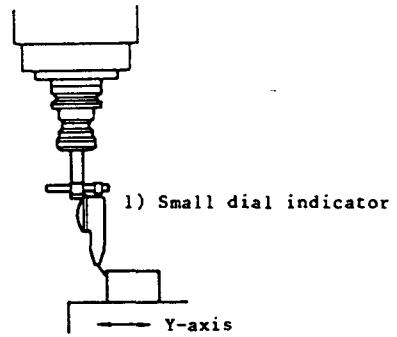
- 1) Mount a small dial indicator in the spindle and measure the current Y-axis position.
- 2) [POS]
- 3) Make a note of the machine coordinate positions and the current Y-axis position.
- 4) [MANU]
- 5) Press the [-Y] switch to move the table towards the column.
- 6) POWER [OFF]
- 7) Remove the table front lid.
- 8) Remove the Y-axis front cover.
- 9) Remove the zero-point limit switch.
- 10) Remove the limit switch protective cover.
- 11) Disconnect the leads from the limit switch.
- 12) Connect the leads to the new limit switch.
- 13) Attach the limit switch protective cover and seal the lead hole with silicon.
- 14) Mount the new limit switch.
- 15) Adjust the Y-axis zero-point limit switch. (No. 660100)
- 16) Set the grid shift value Y. (No. 360100)
- 17) Attach the Y-axis front cover and table front lid.



Part Name	Part Code	Jigs and Tools Required
Switch SLL-P	620264000	Small dial indicator Phillips screwdriver Silicon

Issued: / /
TC-225

- 1) Mount a small dial indicator in the spindle and measure the current Y-axis position.
- 2) [POS]
- 3) Make a note of the machine coordinates positions and the current Y-axis position.
- 4) POWER [OFF]
- 5) Remove the limit switch cover.
- 6) Remove the zero-point limit switch.
- 7) Remove the limit switch protective cover.
- 8) Disconnect the leads from the limit switch.
- 9) Connect the leads to the new limit switch.
- 10) Attach the limit switch protective cover and seal the lead hole with silicon.
- 11) Mount the new limit switch.
- 12) Adjust the Y-axis zero-point limit switch. (No. 660100)
- 13) Set the grid shift value Y.A. (No. 360100)
- 14) Attach the limit switch cover.



Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Small dial indicator Phillips screwdriver Silicon
	Switch SLL-P	620264000		

Issued: / /

TC-215

1) [MANU]

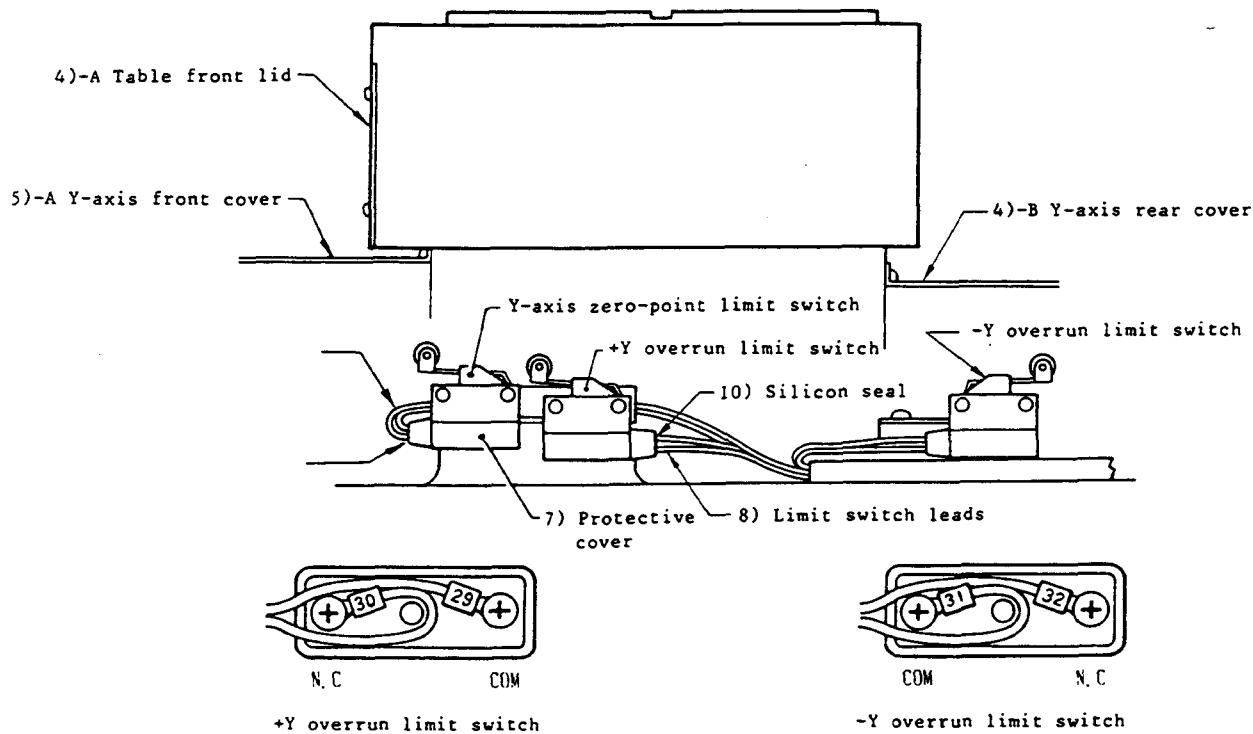
When replacing the +Y overrun limit switch:

- 2)-A Press the [-Y] switch to move the table towards the column.
- 3)-A POWER [OFF]
- 4)-A Remove the table front lid.
- 5)-A Remove the Y-axis front cover.

When replacing the -Y overrun limit switch:

- 2)-B Press the [+Y] switch to move the table towards the zero point.
- 3)-B POWER [OFF]
- 4)-B Remove the Y-axis rear cover.
- 6) Remove the overrun limit switch.
- 7) Remove the limit switch protective cover.
- 8) Disconnect the leads from the limit switch.
- 9) Connect the leads to the new limit switch.
- 10) Attach the limit switch protective cover and seal the lead hole with silicon.
- 11) Mount the new limit switch.
- 12) Adjust the Y-axis overrun limit switch. (No. 660200)
- 13) Attach the limit switch cover.

+ Y ← Table → - Y

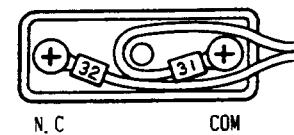
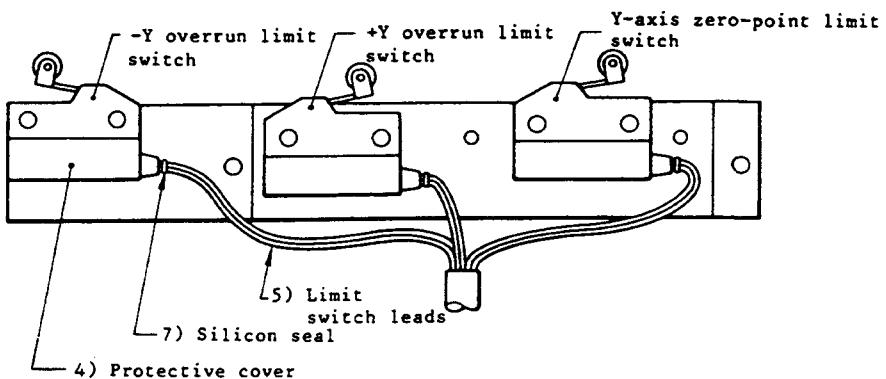
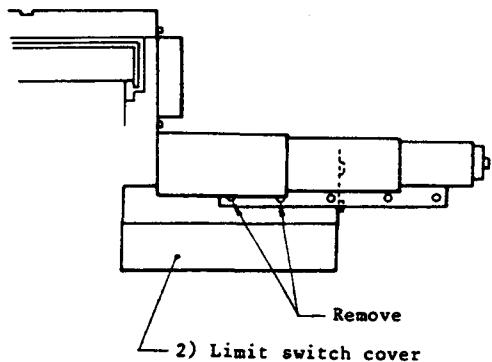


Part Name	Part Code	Jigs and Tools Required	Phillips screwdriver Silicon
Switch SLL-P	620264000		

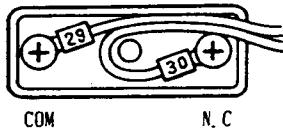
Issued: / /

TC-225

- 1) POWER [OFF]
- 2) Remove the limit switch cover.
- 3) Remove the overrun limit switch.
- 4) Remove the limit switch protective cover.
- 5) Disconnect the leads from the limit switch.
- 6) Connect the leads to the new limit switch.
- 7) Attach the limit switch protective cover and seal the lead hole with silicon.
- 8) Mount the new limit switch.
- 9) Adjust the Y-axis overrun limit switch. (No. 660200)
- 10) Attach the limit switch cover.



-Y overrun limit switch



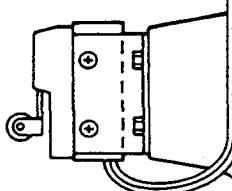
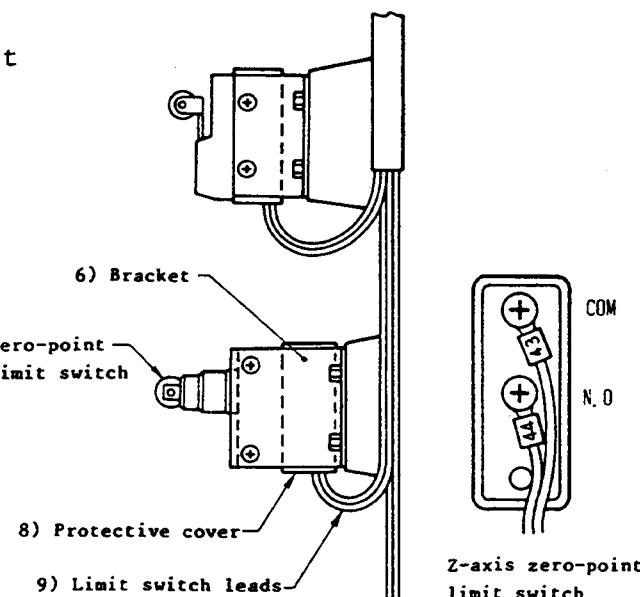
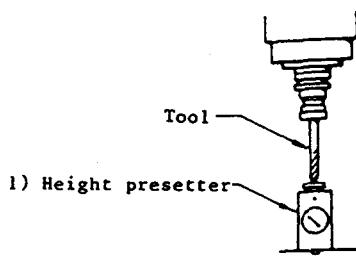
+Y overrun limit switch

Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Switch SL1-P	620264000	Phillips screwdriver Silicon

Issued: / /

TC-215 TC-225

- 1) Mount a tool in the spindle and measure the current Z-axis position with a height presetter.
- 2) [POS]
- 3) Make a note of the machine coordinates positions and the current Z-axis position.
- 4) POWER [OFF]
- 5) Remove the right head side cover.
- 6) Remove the bracket holding the zero-point limit switch. (TC-215 only)
- 7) Remove the zero-point limit switch.
- 8) Remove the limit switch protective cover.
- 9) Disconnect the leads from the limit switch.
- 10) Connect the leads to the new limit switch.
- 11) Attach the limit switch protective cover.
- 12) Mount the new limit switch.
- 13) Mount the bracket to the machine. (TC-215 only)
- 14) Adjust the Z-axis zero-point limit switch. (No. 660100)
- 15) Set the grid shift value Z. (No. 360300)
- 16) Attach the right head side cover.

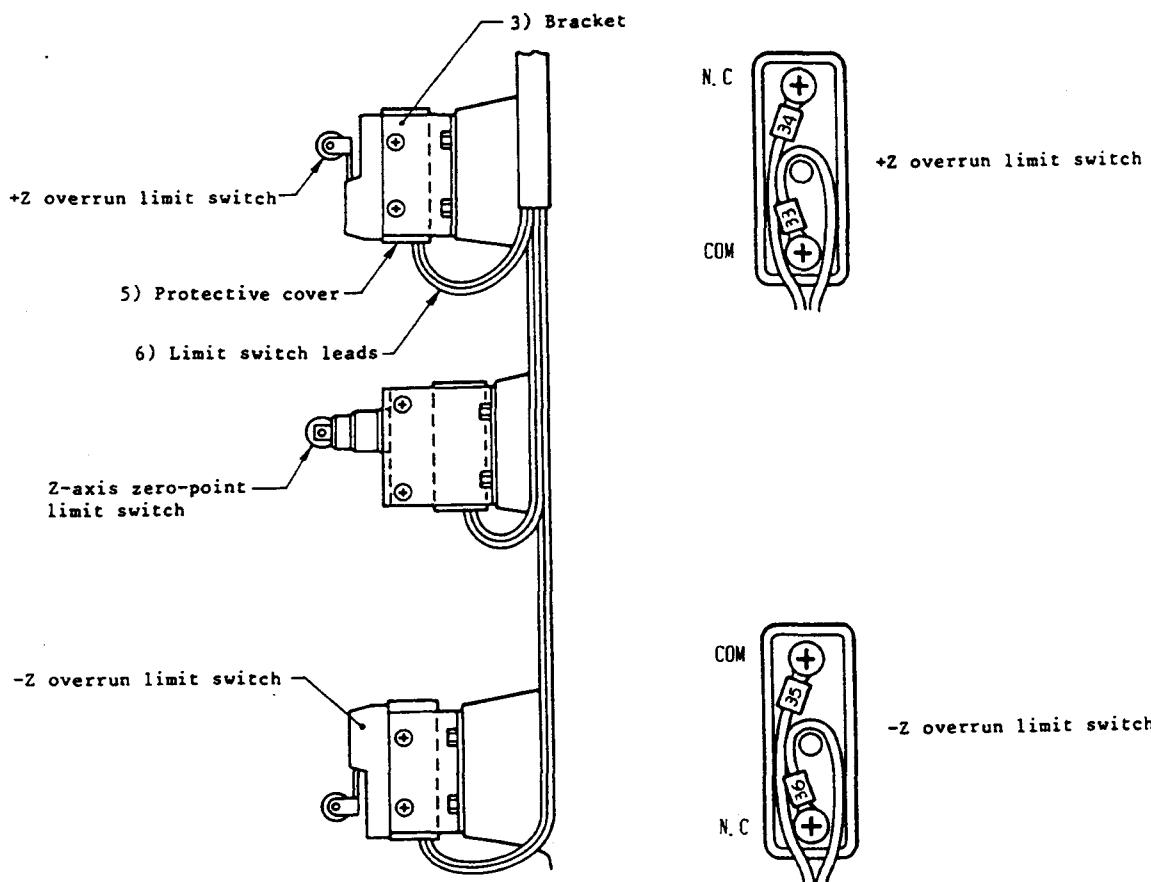


Replacement Parts	Part Name	Part Code	Jigs and Tools Required	
TC-215:	Switch Z-15GQ22-B	626935000		Phillips screwdriver Allen wrench
TC-225:	Switch SLI-AK	626923000		

Issued: / /

TC-215 TC-225

- 1) POWER [OFF]
- 2) Remove the right head side cover.
- 3) Remove the bracket holding the overrun limit switch. (TC-215 only)
- 4) Remove the overrun limit switch.
- 5) Remove the limit switch protective cover.
- 6) Disconnect the leads from the limit switch.
- 7) Connect the leads to the new limit switch.
- 8) Attach the limit switch protective cover.
- 9) Mount the new limit switch.
- 10) Mount the bracket to the machine. (TC-215 only)
- 11) Adjust the Z-axis overrun limit switch. (No. 660300)
- 12) Attach the right head side cover.

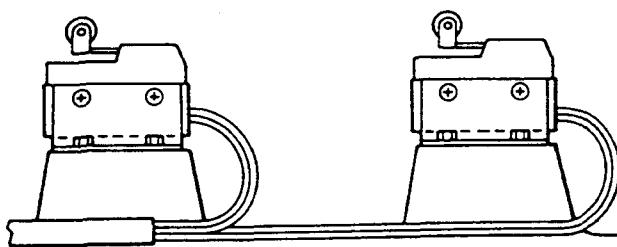


Replacement Parts	Part Name	Part Code	Jigs and Tools Required	
	Switch Z-15GW22-B	626934000	Phillips screwdriver Allen wrench	

Issued:	/	/
TC-215		TC-225

- 1) POWER [OFF]
- 2) Remove the left head side cover.
- 3) Remove the bracket holding the limit switch. (TC-215 only)
- 4) Remove the limit switch.
- 5) Remove the limit switch protective cover.
- 6) Disconnect the leads from the limit switch.
- 7) Connect the leads to the new limit switch.
- 8) Attach the limit switch protective cover.
- 9) Mount the new limit switch.
- 10) Mount the bracket to the machine. (TC-215 only)
- 11) Adjust the ATC zero-point limit switch. (No. 660500)
- 12) Adjust the ATC operation area limit switch. (No. 660400)
- 13) Attach the left head side cover.

ATC zero-point limit switch ATC operation area limit switch



ATC zero-point limit switch ATC operation area limit switch

Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Switch Z15GW22-B	626934000	Straight-headed screwdriver Phillips screwdriver Allen wrench

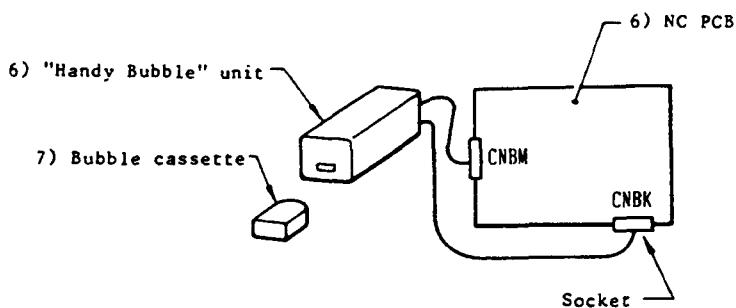
2.7 NC PARTS

- 700100 Program and Data Transfer using the Bubble Cassette
- 700200 Replacing the NC PCB
- 700300 Replacing the COUNTER PCB
- 700400 Replacing the MEMORY PCB
- 700500 Replacing the Batteries
- 700600 Replacing the P-ROMs
- 700700 Replacing the Spindle, X-, Y- and Z-axis Drivers and the Servo Power Supply TC-215
- 700800 Replacing the Spindle, X-, Y- and Z-axis Drivers TC-225

Issued: / /

TC-215 TC-225

- 1) POWER [ON] [MAGAZ]
Make a note of the tool numbers.
- 2) [MEM]
Make a note of the current program number.
- 3) [EDIT] [6] [ENTER] PROGRAM PROTECT [OFF] [START]
Make a note of all the program numbers.
- 4) [MDI] [PARAM] [4] [ENTER]
Make sure that "3" is displayed in the "CONNECT" row to specify the bubble memory unit.
- 5) POWER [OFF]
- 6) Attach the bubble memory unit by following the procedure below.
 - 6)-1 Turn the circuit-breaker OFF.
 - 6)-2 Connect the "Handy Bubble" unit connectors to the sockets on the NC PCB.
 - 6)-3 Turn the circuit-breaker ON.
- 7) Insert the bubble cassette.
- 8) POWER [ON]
- 9) [EDIT] [7] [ENTER] PROGRAM PROTECT [OFF] [4] [ENTER] [-9999] [START].
Delete all the data in the bubble cassette.
- 10) [Fo] [2] [ENTER] [-9999] [START]
Batch write of internal programs to the bubble cassette.
- 11) [Fo] [5] [ENTER] [1] [ENTER] [START]
Transfer tool data to the bubble cassette.
- 12) [2] [ENTER] [START]
Transfer tool patterns to the bubble cassette.
- 13) [3] [ENTER] [START]
Transfer hole sizes before tapping to the bubble cassette.
- 14) [4] [ENTER] [START]
Transfer cutting tool/condition data to the bubble cassette.

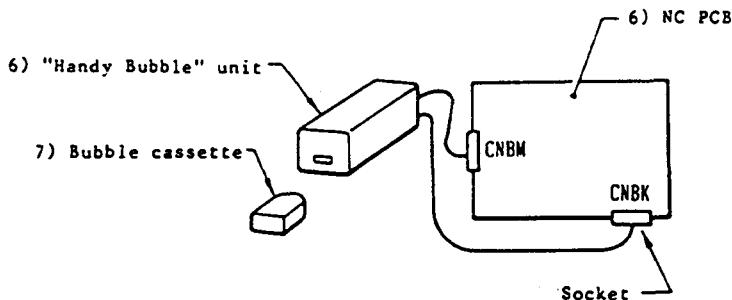


Replacement Parts	Part Name	Part Code	Jigs and Tools Required	"Handy Bubble" unit Bubble cassette

Issued: / /

TC-215 TC-225

- 15) [5] [ENTER] [START]
Transfer parameters to the bubble cassette.
- 16) [Fo] [1] [ENTER] [START]
Check the numbers of the programs listed on the program menu against the numbers listed as step 3.
- 17) POWER [OFF]
Turn the circuit-breaker OFF.
- 18) Replace the PCB.
- 19) Turn the circuit-breaker ON.
POWER [ON]
- 20) [EDIT] [6] [ENTER] PROGRAM PROTECT [OFF] [-9999] [DELET]
Delete all the programs stored in the machine.
- 21) [MDI] [PARAM] [2] [ENTER] [\downarrow PAGE] [\downarrow PAGE] [\downarrow PAGE]
Move the cursor to DATA CLEAR with the [\uparrow CURSOR] [\downarrow CURSOR] keys.
- 22) [9293] [ENTER] [RESET]
Clear all data in the machine.
- 23) [EDIT] [7] [ENTER] [3] [ENTER]
- 24) PROGRAM PROTECT [OFF] [0001] [/] [9999] [START]
Transfer all programs from the bubble cassette to the machine.
- 25) PROGRAM PROTECT [ON] [0001] [/] [9999] [START]
Check the numbers of the programs.
- 26) [Fo] PROGRAM PROTECT [OFF] [6] [ENTER] [1] [ENTER] [START]
Transfer tool data from the bubble cassette.
- 27) [2] [ENTER] [START]
Transfer tool patterns from the bubble cassette.
- 28) [3] [ENTER] [START]
Transfer hole sizes before tapping from the bubble cassette.
- 29) [4] [ENTER] [START]
Transfer cutting tool/condition data from the bubble cassette.

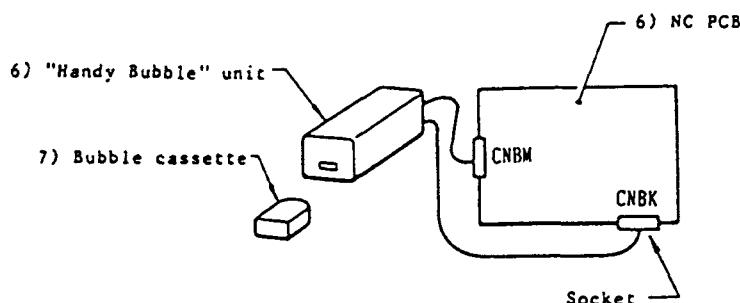


Replacement Parts	Part Name	Part Code	Jigs and Tools Required	"Handy Bubble" unit Bubble cassette

Issued: / /

TC-215 TC-225

- 30) [5] [ENTER] [START]
Transfer parameters from the bubble cassette.
- 31) PROGRAM PROTECT [ON] POWER [OFF] [ON]
- 32) [EDIT] [5]
Enter the program number.
[ENTER] [START]
Assign the tools.
- 33) [MDI] [MAGAZ]
Enter tool numbers.
[ENTER]
- 34) [M.Z.RT] [MEM]
Enter the program number.
[ENTER] [DRY RUN] [START]
Check the operation of the program.
- 35) POWER [OFF]
Turn the circuit-breaker OFF.
- 36) Remove the "Handy Bubble" unit.
- 37) Turn the circuit-breaker ON.
POWER [ON]



Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Description
				"Handy Bubble" unit Bubble cassette

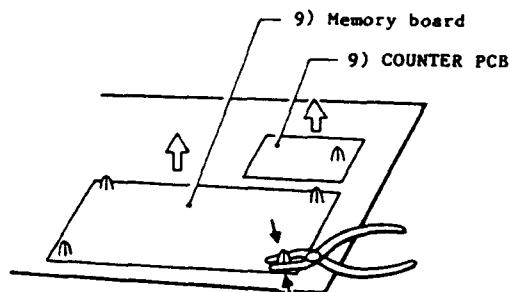
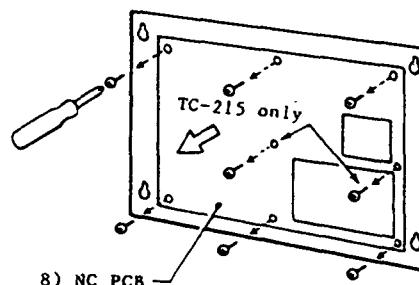
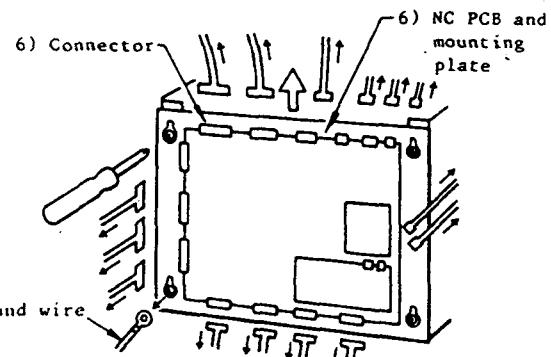
Issued: / /

TC-215

TC-225

- 1) POWER [ON] [MAGAZ]
Make a note of the tool numbers.
- 2) [MEM]
Make a note of the current program number.
- 3) [EDIT] [6] [ENTER] PROGRAM PROTECT [OFF] [START]
Make a note of all the program numbers.
- 4) Attach the bubble cassette and transfer all data from the machine to the bubble cassette. (No. 700100)
- 5) POWER [OFF]
Turn the circuit-breaker OFF.
- 6) Disconnect all connectors and the ground wire from the NC PCB.
- 7) Remove the entire mounting plate holding the NC PCB (and the MEMORY PCB and COUNTER PCB) from the control panel. (Lift the mounting plate upwards and then pull it forwards.)
- 8) Remove the NC PCB (and the MEMORY PCB and COUNTER PCB) from the mounting plate.
- 9) Remove the MEMORY PCB and COUNTER PCB from the NC PCB.

Note: When detaching or mounting the MEMORY PCB to or from the NC PCB, take care not to touch the connector pins or pattern with your hands or any electrically-conductive object.



Can be removed easily using radio pliers.

Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	NC substrate assembly #5	627155005	Phillips screwdriver Radio pliers Bubble cassette "Handy Bubble" unit

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TC-215 TC-225

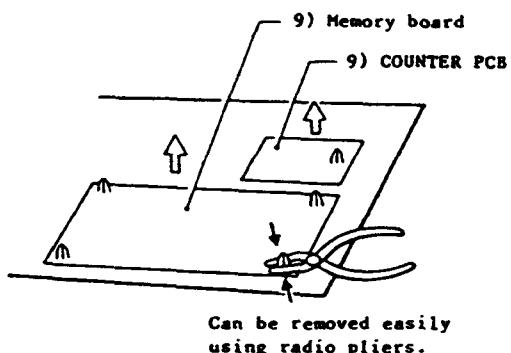
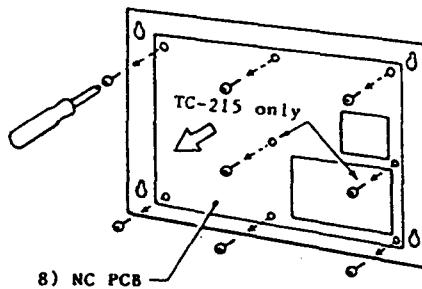
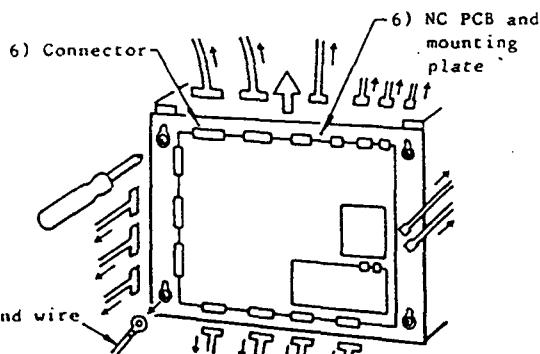
- 10) Correctly set the jumper and DIP switch on the new NC PCB (refer to the next page).
- 11) Install the new NC PCB by reversing the procedure 6) - 9), above.
- 12) Turn the circuit-breaker ON.
POWER [ON]
- 13) Press [MAGAZ] and [MEM] and check the contents of the memory against the data noted in step 3), above.

If the memory contents differ from the previous data:

- 13)-1 Delete the entire contents of the NC PCB.
- 13)-2 Transfer all program and data from the bubble cassette to the MEMORY PCB.
- 13)-3 Enter the tool numbers.
- 13)-4 Enter the program numbers.
(Refer to No. 700100.)
- 14) Check machine operation.
- 15) Adjust the spindle and X-, Y- and Z-axis drivers.

TC-215: No. 760100

TC-225: No. 760300

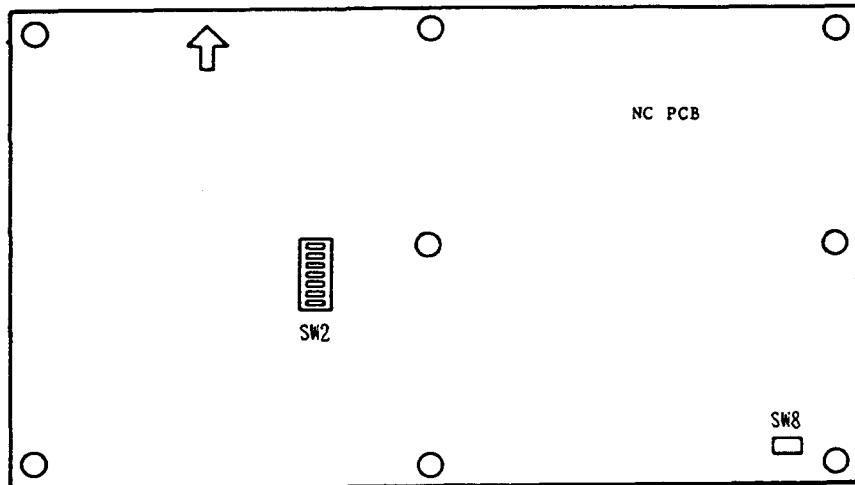


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	NC substrate assembly #5	627155005	Phillips screwdriver Radio pliers Bubble cassette "Handy Bubble" unit

Issued: / /

TC-215 TC-225

Jumper and DIP switch settings when replacing the NC PCB.



SW2 (blue) ... DIP switch

	1	2	3 - 8
TC-215	OFF	ON	OFF
TC-225	OFF	OFF	OFF

SW8 (green) ... Jumper

Japanese	2 - 3
Other language	1 - 2

Make sure that the jumper and DIP switch are set correctly.

Replacement Parts	Part Name	Part Code	Jigs and Tools Required

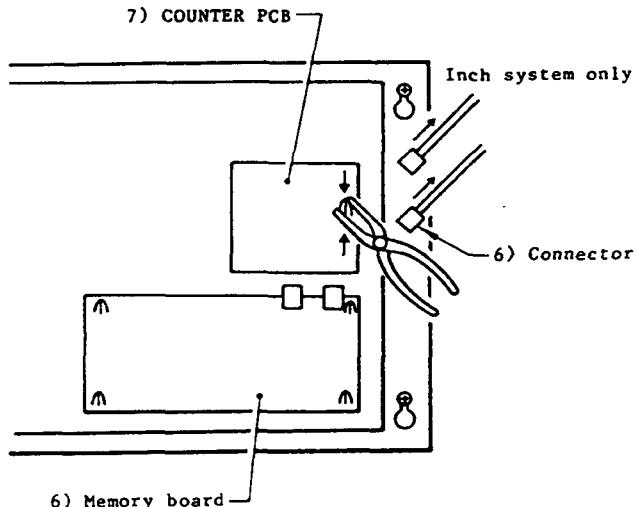
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TC-215 TC-225

- 1) POWER [ON] [MAGAZ]
Make a note of the tool numbers.
- 2) [MEM]
Make a note of the current program number.
- 3) [EDIT] [6] [ENTER] PROGRAM PROTECT [OFF] [START]
Make a note of all the program numbers.
- 4) Attach the bubble cassette and transfer all data from the machine to the bubble cassette. (No. 700100)
- 5) POWER [OFF]
Turn the circuit-breaker OFF.
- 6) Disconnect all connectors from the MEMORY PCB.
- 7) Remove the COUNTER PCB, but leave the NC PCB inside the control panel.
- 8) Mount the new COUNTER PCB.
- 9) Connect the connectors to the new memory board.
- 10) Turn the circuit-breaker ON.
POWER [ON]
- 11) Press [MAGAZ] and [MEM] and check the contents of the memory against the data noted above.

If the memory contents differ from the previous data:

- 11)-1 Delete the entire contents of the NC PCB.
- 11)-2 Transfer all program and data from the bubble cassette.
- 11)-3 Enter the tool numbers.
- 11)-4 Enter the program numbers. (Refer to No. 700100)
- 12) Check machine operation.
- 13) Remove the bubble cassette.



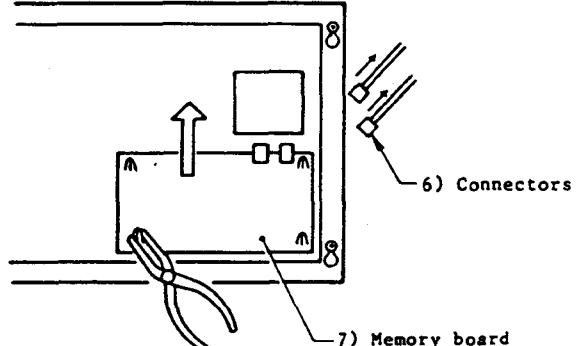
* Can be removed easily using radio pliers.

Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Radio pliers "Handy Bubble" unit Bubble cassette
	Counter substrate assembly	627319001		

Issued: / /

TC-215 TC-225

- 1) POWER [ON] [MAGAZ]
Make a note of the tool numbers.
- 2) [MEM]
Make a note of the current program number.
- 3) [EDIT] [6] [ENTER] PROGRAM PROTECT [OFF] [START]
Make a note of all the program numbers.
- 4) Attach the bubble cassette and transfer all data from the machine to the bubble cassette. (No. 700100)
- 5) POWER [OFF]
Turn the circuit-breaker OFF.
- 6) Disconnect all connectors from the MEMORY PCB.
- 7) Remove the MEMORY PCB from the NC PCB.
- 8) Mount the new MEMORY PCB on the NC PCB. Make sure that all connectors are connected correctly.
- 9) Connect the connectors to the MEMORY PCB.
- 10) Turn the circuit-breaker ON.
POWER [ON]
- 11) [EDIT] [6] [ENTER] PROGRAM PROTECT [OFF] [-9999] [DELETE]
Delete all the programs from memory.
- 12) [MDI] [PARAM] [2] [ENTER] [\downarrow PAGE] [\downarrow PAGE] [\downarrow PAGE]
Move the cursor to DATA CLEAR with the [\uparrow CURSOR] [\downarrow CURSOR] keys.
- 13) [9293] [ENTER] [RESET]
Clear all data in the machine.
- 14) Transfer all programs from the bubble cassette to the machine.
(No. 700100)
- 15) [EDIT] [5]
Enter the program number.
[ENTER] [START]
Assign the tools.
- 16) [MDI] [MAGAZ]
Enter tool numbers.
[ENTER]
- 17) [MANU] [M.Z.RT]
- 18) [MEM]
Enter the program number.
[ENTER] [DRY RUN] [START]
Check the operation of the program.
- 19) PROGRAM PROTECT [ON]
- 20) Remove the bubble cassette.

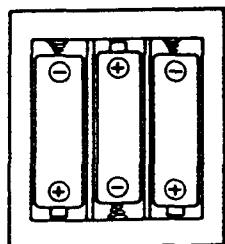
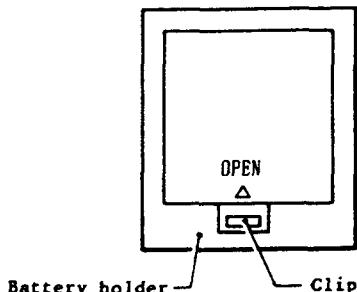


* Can be removed easily using radio pliers.

Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Memory board assembly #5	627149005	"Handy Bubble" unit Bubble cassette Radio pliers

Issued: / /
TC-215 TC-225

- 1) POWER [OFF]
Turn the circuit-breaker OFF.
- 2) Lift the clip on the battery holder and open the lid.
- 3) Replace the batteries, taking care that the polarities are as shown in the diagram.
- 4) Push the battery holder lid firmly closed.
- 5) Turn the circuit-breaker ON.
POWER [ON]
- 6) Make sure that no "BATTERY ERROR" alarm is displayed on the CRT.



Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Battery UM-3	613768000	

Issued: / /

TC-215

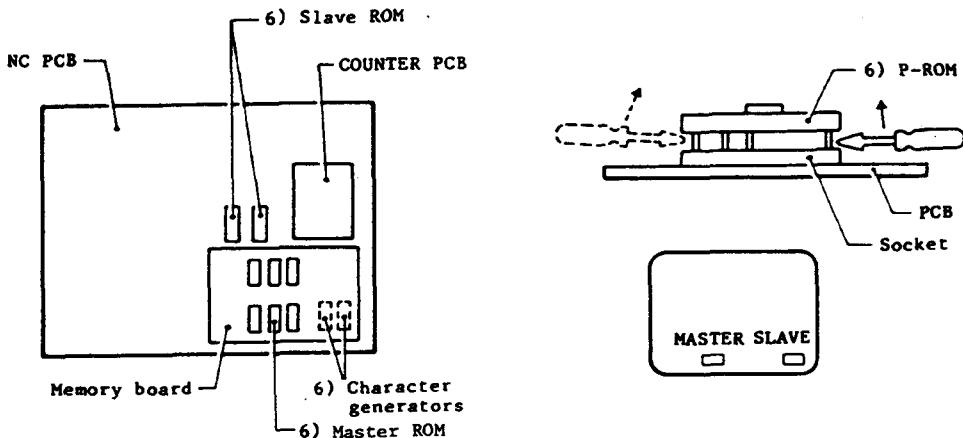
TC-225

- 1) POWER [ON] [MAGAZ]
Make a note of the tool numbers.
- 2) [MEM]
Make a note of the current program number.
- 3) [EDIT] [6] [ENTER] PROGRAM PROTECT [OFF] [START]
Make a note of all the program numbers.
- 4) Attach the bubble cassette and transfer all data from the machine to the bubble cassette. (No. 700100)
- 5) POWER [OFF]
Turn the circuit-breaker OFF.
- 6) a) To replace the master or slave ROMs
Lift softly the ROM from the PCB using a small straight-headed screwdriver.
- b) To replace the character generator
 - 1) Remove the memory board. (No. 700400)
 - 2) Lift softly the ROM from the PCB using a small straight-headed screwdriver.

Note 1: Take care not to damage the PCB pattern with the screwdriver.
 2: Apply the minimum possible force to the ROM.

- 7) Insert the new P-ROMs, making sure that they have the correct number.

Note 1: Make sure that the P-ROMs are inserted in the correct direction.
 2: Make sure that the P-ROM pins do not bend.
 3: Check that the P-ROMs are firmly inserted to the PCB.



Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Refer to the next page.	Refer to the next page.	"Handy Bubble" unit Bubble cassette Small straight-headed screwdriver Radio pliers

Issued: / /

TC-215 TC-225

- 8) Attach the memory board (when replacing the character generators only).

Note 1: Take care not to touch the pins or pattern with your bare hands.

2: Make sure that the connectors are fully inserted.

- 9) Turn the circuit-breaker ON.
POWER [ON]

- 10) Check the version of the P-ROMs (when replacing the master or slave P-ROMs only) by pressing:

[I/O] [\downarrow PAGE]

The P-ROM versions are displayed at the bottom of the CRT screen.

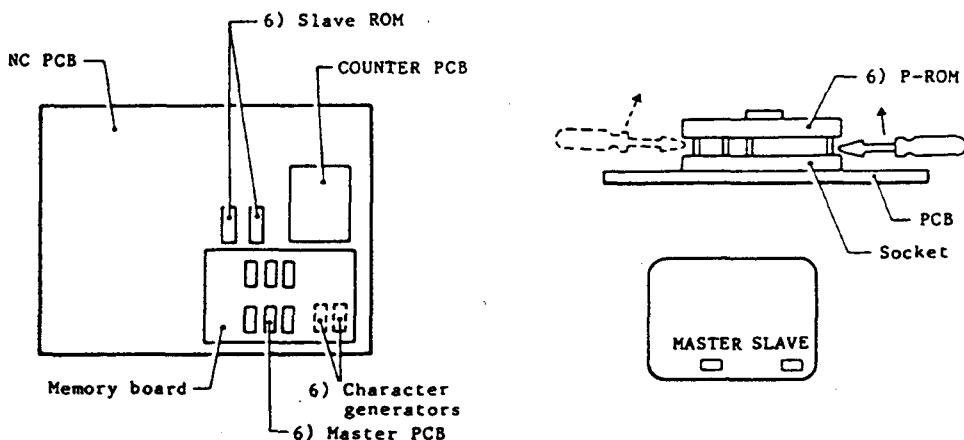
- 11) Press [MAGAZ] and [MEM] and check the contents of the memory against the data noted above.

If the memory contents differ from the previous data:

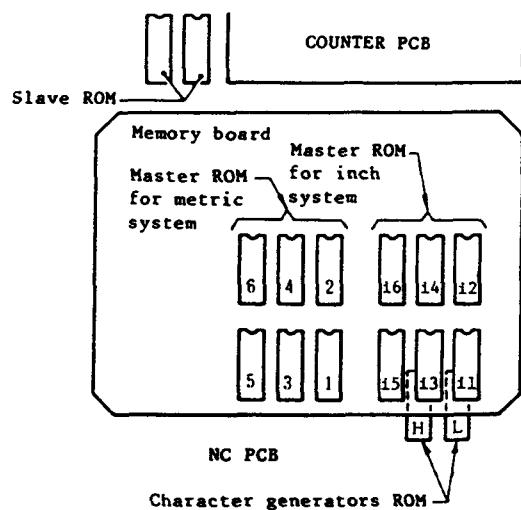
- 11)-1 Delete the entire contents of the PCB.
11)-2 Transfer all program and data from the bubble cassette.
11)-3 Enter the tool numbers.
11)-4 Enter the program numbers. (Refer to No. 700100.)

- 13) Check machine operation.

- 14) Remove the bubble cassette.



Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	Refer to the next page.	Refer to the next page.	"Handy Bubble" unit Bubble cassette Small straight-headed screwdriver Radio pliers

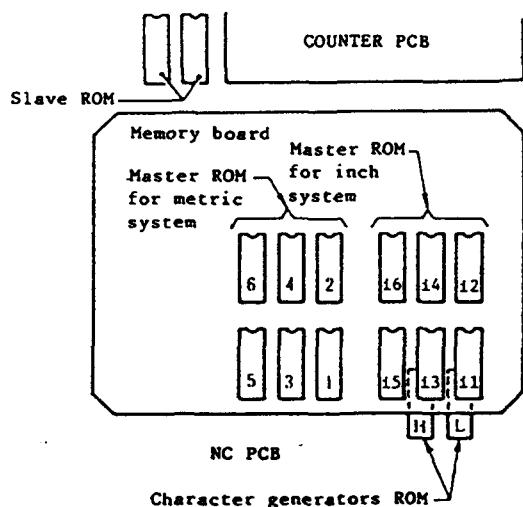
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TC-215 TC-225

Specification	1	2	3	4	5	6	i1	i2	i3	i4	i5	i6	S1	S2	H	L
TC-215:													DS1	DS2	H	L
Japanese	J1	J2	J3	J4	J5	J6										
Metric	K1	K2	K3	K4	K5	K6							DS1	DS2	H	L
Inch							L1	L2	L3	L4	L5	L6	DS1	DS2	H	L
German	M1	M2	M3	M4	M5	M6							DS1	DS2	H	L
TC-225:													ES1	ES2	H	L
Japanese	N1	N2	N3	N4	N5	N6							ES1	ES2	H	L
Metric	O1	O2	O3	O4	O5	O6										
Inch							P1	P2	P3	P4	P5	P6	ES1	ES2	H	L
German	Q1	Q2	Q3	Q4	Q5	Q6							ES1	ES2	H	L

Replacement Parts	Part Name	Part Code	Jigs and Tools Required

Issued: / /

TC-215 TC-225



	Specification	Part Name	Part Code
Replacement Part	MASTER ROM TC-215: Japanese Metric Inch German	P-ROM software assembly J215 P-ROM software assembly M215 P-ROM software assembly I215 P-ROM software assembly G215	627660103 627660202 627660302 627660401
	TC-225: Japanese Metric Inch German	P-ROM software assembly J225 P-ROM software assembly M225 P-ROM software assembly I225 P-ROM software assembly G225	627661103 627661202 627661302 627661402
	SLAVE ROM TC-215: Common	P-ROM software assembly D215	627662106
	TC-225: Common	P-ROM software assembly E225	627663106
	CHARACTER GENERATOR	P-ROM software character generator	627664101

Replacement Parts	Part Name	Part Code	Jigs and Tools Required

Issued: / /

TC-215

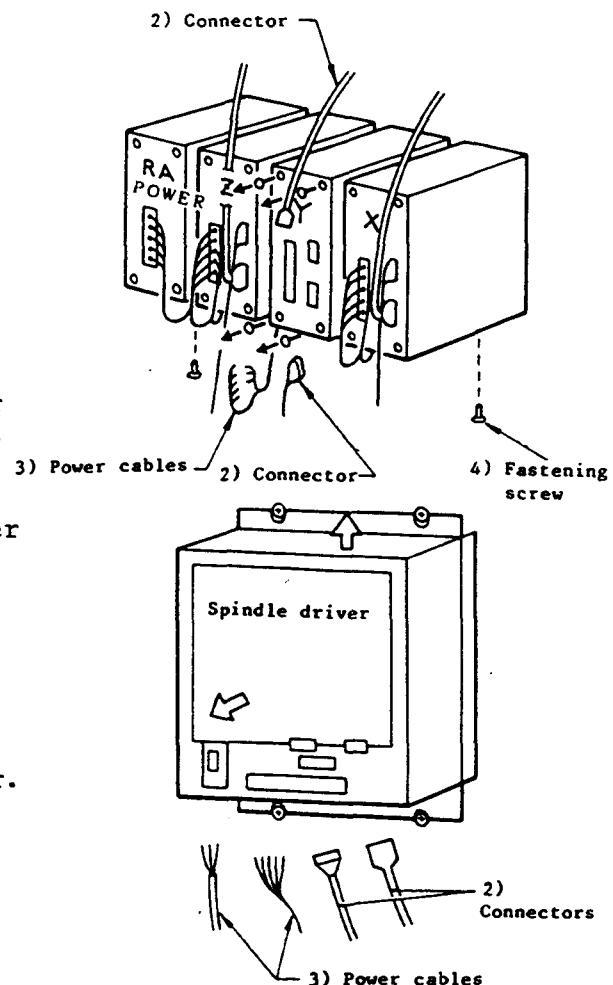
- 1) POWER [OFF]
Turn the circuit-breaker OFF.
- 2) Disconnect all the connectors from the driver to be replaced.
- 3) Disconnect the power cables from the terminal block.
- 4) Loosen or remove the screws fixing the driver.

For each of the drivers and the power supply unit, the four screws in the front panels must be removed. In addition, the screws in the bottom panel must be taken out in order to remove the X-axis driver or the power supply unit. (These screws can be removed by hand.)

The screws holding the spindle driver need only to be loosened.

- 5) X-, Y- and Z-axis servo drivers and the power supply unit can be pulled out. The spindle driver has to be lifted up before it is pulled out. Replace the driver.
- 6) Tighten the screws fixing the driver.
- 7) Connect all the power cables to the terminal block.
- 8) Connect all the connectors.
- 9) Make sure that all cables and connectors are connected firmly.
- 10) Turn the circuit-breaker ON.
POWER [ON]
- 11) Check that the drivers operate normally.
- 12) Adjust the spindle and X-, Y- and Z-axis drivers.

TC-215: No. 760100



Part Name	Part Code	Jigs and Tools Required
Refer to the next page.	Refer to the next page.	Phillips screwdriver

Issued: / /
TC-215

	Part Name	Part Code
Replacement Part	X- AND Y-AXIS DRIVERS	
	AC driver 150W-2 (Export ... Nos. 111149 and below)	620575003
	Driver RAD 12-150 (Export ... Nos. 111150 and above)	627700000
	Z-AXIS DRIVER	
	AC driver 300W	627285000
	SPINDLE DRIVER 6000 min ⁻¹	
	Driver 1.5 kW 6000 4 (Export ... Nos. 111149 and below)	627001000
	Driver RAD02-6000 (Export ... Nos. 111150 and above)	627699000
	SPINDLE DRIVER 10000 min ⁻¹	
	Driver 1.5 kW 10000 4	627296000
	POWER SUPPLY UNIT	
	Power supply unit 008 (Export ... Nos. 111149 and below)	620656000
	Power supply unit 1008 (Export ... Nos. 111150 and above)	627701000

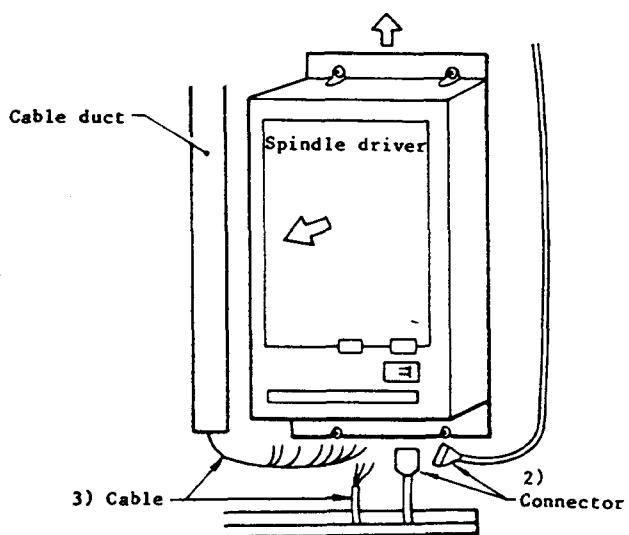
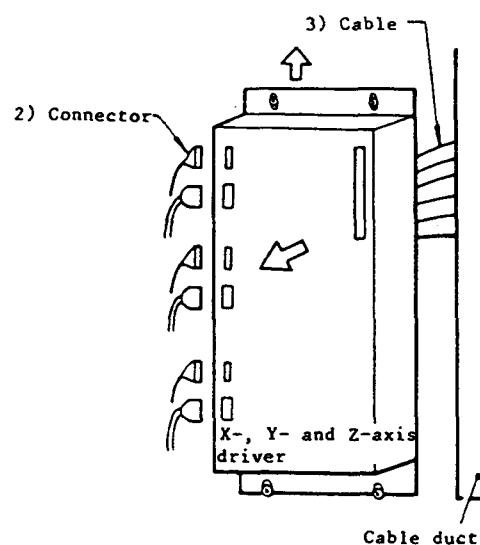
Replacement Parts	Part Name	Part Code	Jigs and Tools Required

Issued: / /

TC-225

- 1) POWER [OFF]
Turn the circuit-breaker OFF.
- 2) Disconnect all the connectors from the driver to be replaced.
- 3) Disconnect the power cables from the terminal block.
- 4) Loosen the screws fixing the driver.
- 5) Lift up the driver and pull it out.
Replace the driver.
- 6) Tighten the screws fixing the driver.
- 7) Connect all the power cables to the terminal block.
- 8) Connect all the connectors.
- 9) Make sure that all cables and connectors are connected firmly.
- 10) Turn the circuit-breaker ON.
POWER [ON]
- 11) Check that the driver operates normally.
- 12) Adjust the spindle, X-, Y- and Z-axis driver.

TC-225: No. 760300



Replacement Parts	Part Name	Part Code	Jigs and Tools Required	
	AC servo amplifier 825 (X-, Y- and Z-axis driver)	626850000		Phillips screwdriver
	AC servo amplifier 820 (Spindle driver)	626851000		

2.8 OPERATION BOX PARTS

800100 Replacing the CRT Unit

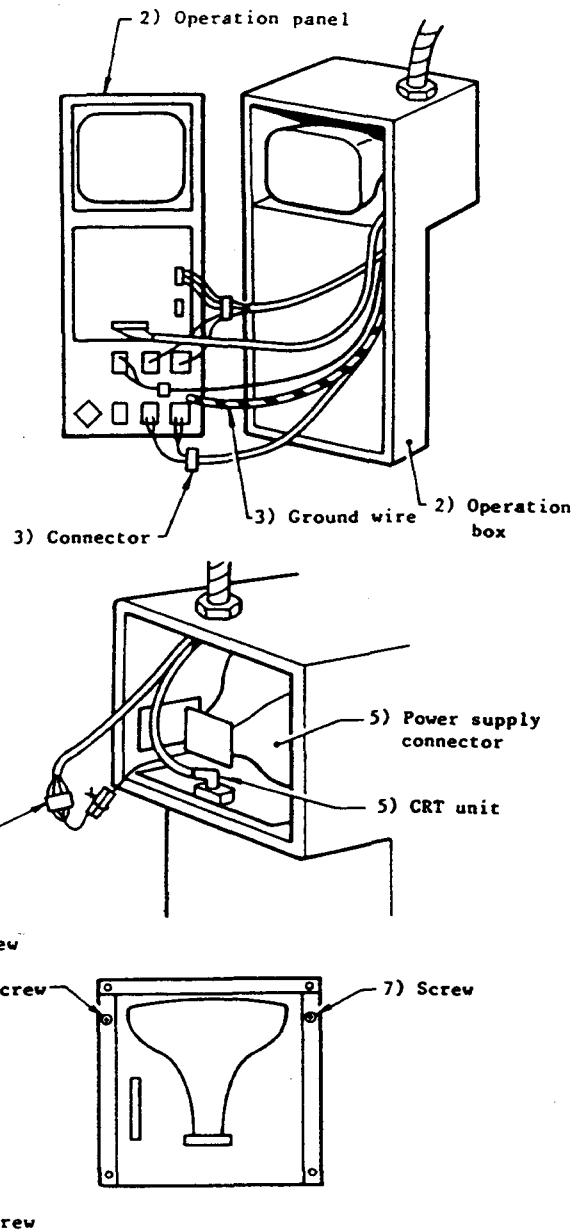
800200 Replacing the OPERATION PCB and Panel Sheet

Issued: / /

TC-215

TC-225

- 1) POWER [OFF]
Turn the circuit-breaker OFF.
- 2) Remove the operation panel from the operation box.
- 3) Some of the cables which come into the operation box from the control box are connected to the operation panel. Disconnect all these connectors (4) and the ground wire (1) from the operation panel.
- 4) Remove the rear panel connected to the splash guard and the rear panel of the operation box.
- 5) Disconnect the coaxial cable connector and the power supply connector from the CRT unit.
- 6) Remove the four screws holding the CRT unit in place.
- 7) Take out the CRT unit, connected to the black plate. Take out the two screws and replace the CRT unit.



Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	CRT assembly 215	627734001	Phillips screwdriver

Issued: / /
TC-215 TC-225

- 8) Reverse the procedure in steps 2) - 6) above (except step 3)), to install the new CRT unit in the operation box.
- 9) Turn the circuit-breaker ON.
POWER [ON]
- 10) Look at the CRT display. If it is normal:

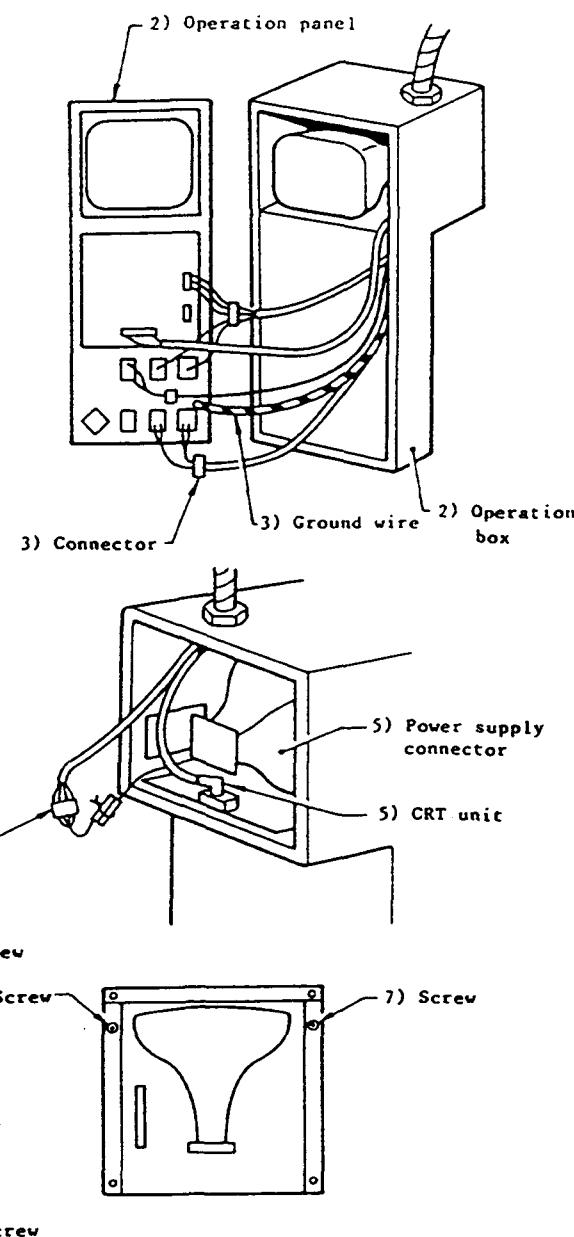
POWER [OFF]

Turn the circuit-breaker OFF.

Attach the rear panel connected to the splash guard and the rear panel of the operation box.

If the display requires adjustment:

Carry out the CRT adjustments (No. 860100) then turn off the power supply and attach the rear panels.



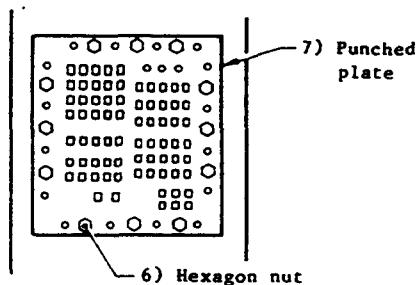
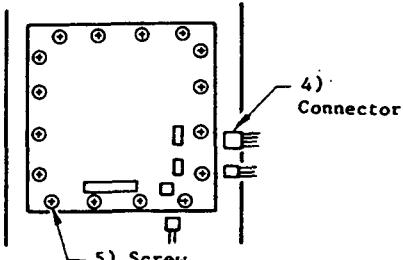
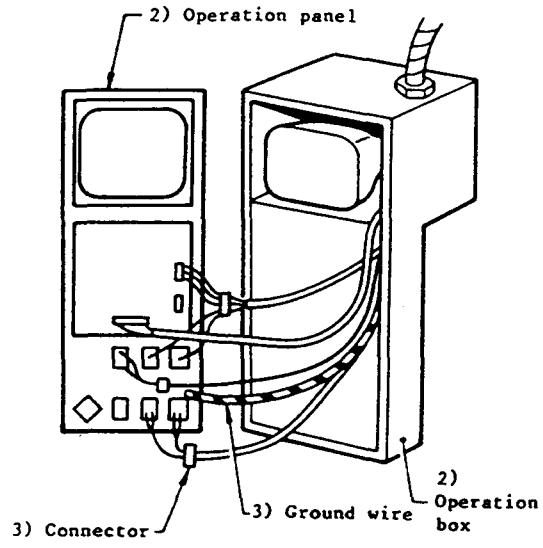
Replacement Parts	Part Name	Part Code	Jigs and Tools Required
	CRT assembly 215	627734001	Phillips screwdriver

Issued: / /
 TC-215 TC-225

- 1) POWER [OFF]
Turn the circuit-breaker OFF.
- 2) Remove the operation panel from the operation box.
- 3) Some of the cables which come into the operation box from the control box are connected to the operation panel. Disconnect all these connectors (4) and the ground wire (1) from the operation panel.
- 4) Disconnect the three connectors from the OPERATION PCB.
- 5) Remove the 16 screws holding the OPERATION PCB in place.

Carry out steps 6) - 9) to replace the panel sheet:

- 6) Remove the 12 hexagon nuts holding the punched plate in position.
- 7) Remove the punched plate and detach the panel sheet from the operation panel.
- 8) Attach the new panel sheet.
- 9) Attach punched plate with the hexagon nuts.
- 10) Replace the OPERATION PCB.
(Not necessary if only the panel sheet is being replaced.)
- 11) Reverse steps 3) - 5) to attach the operation PCB onto the operation panel.
- 12) Check that all connectors are connected firmly to the operation panel.
- 13) Temporarily attach the operation panel to the operation box with about two screws.
- 14) Turn the circuit-breaker ON.
POWER [ON]
- 15) Press all of the switches on the operation panel to check that they operate normally.
- 16) If all switches operate normally, press POWER [OFF], turn the circuit-breaker OFF and insert the tighten all the remaining screws in the operation panel.



Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Phillips screwdriver 5.5 mm box wrench
	Operation substrate assembly (common) 215 #2	627354002		
	Operation panel sheet 215J (Japanese)	627579001		
	Operation panel sheet 215E (English)	627579002		
	Operation panel sheet 215G (German)	627579003		

3. ADJUSTMENT PROCEDURES

3.1 ADJUSTING THE SPINDLE

160100 Adjusting the Spindle Orientation

160200 Static Accuracy Measurements

Issued: / /

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- 1) [MANU]
- 2) [ATC] (Spindle orientation)
- 3) [I/O] [↓ PAGE]
Check if the spindle deviation value is in the range ± 1 .

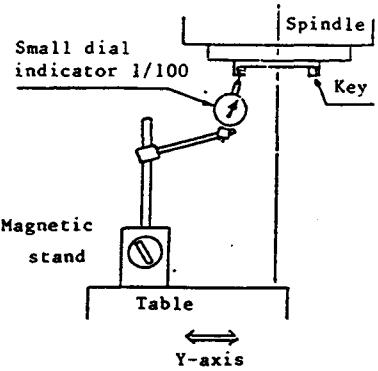
If it does not lie in this range:

- 4)-1 Adjust SZ on the spindle driver to set the spindle deviation value in the range ± 1 .
(TC-215: No. 760100, TC-225:
No. 760300)
- 4)-2 POWER [OFF] [ON]
- 4)-3 Repeat steps 1) - 4) to check that the spindle deviation value is now in the range ± 1 .
- 5) Fix a small dial indicator on the table and measure the key bottom face at the end of the spindle.
- 6) Move the Y-axis and measure the another key bottom face.

Carry out the following adjustment if the difference between the former and latter key measurements exceeds 0.1 mm.

Adjustment by adjusting the coupling:

- 7)-A Press [-Z] to lower the spindle.
- 8)-A Loosen the spindle coupling clamping screw through the hole in the right side of the spindle head.
- 9)-A [ATC] (Spindle orientation)
- 10)-A [-Z]
- 11)-A Turn the spindle manually to adjust the parallelism of the spindle key to within ± 0.02 .
- 12)-A Tighten the spindle coupling.
- 13)-A [ATC]
- 14)-A Check that the spindle parallelism is within ± 0.1 .



Part Name	Part Code	Jigs and Tools Required
Replacement Parts		Small dial indicator 1/100 Magnet stand Allen wrench (set)

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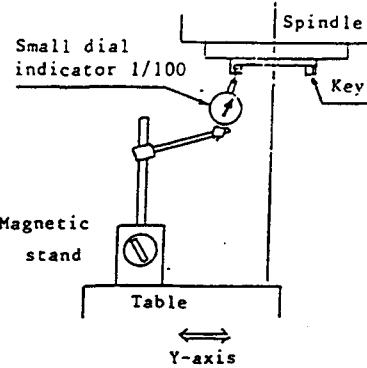
Adjustment by adjusting the grid shift amount setting:

- 7)-B [MDI] [PARAM] [2] [ENTER] [\downarrow PAGE]
Check the displayed spindle grid shift value.
- 8)-B Calculate the new grid shift value for the spindle.
- GRID SHIFT VALUE = (Current setting)
 \pm (Former to latter difference in key measurement (mm))

$$\times 28 \times 1/2$$

- +: If the latter key is to the left of center
-: If the latter key is to the right of center

Note: Round up or down to an integer value.



- 9)-B PROGRAM PROTECT [OFF]
10)-B Move the cursor to the GRID SHIFT VALUE SPINDLE line.
11)-B Input the calculated grid shift value.
[ENTER]
12)-B PROGRAM PROTECT [ON]
13)-B POWER [OFF] [ON]
14)-B [-Z] [ATC]
15)-B Check that the spindle parallelism is within ± 0.1 .
16)-B Make a note of the adjustment in the Inspection Chart.

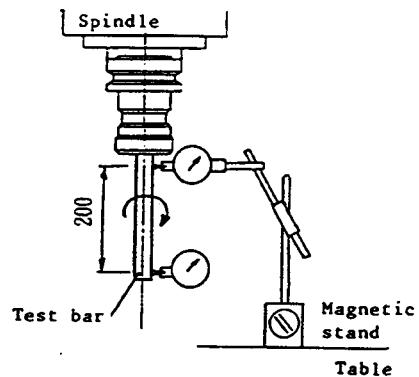
Replacement Parts	Part Name	Part Code	Jigs and Tools Required
			Small dial indicator 1/100 Magnet stand Allen wrench (set)

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Runout of the spindle hole:

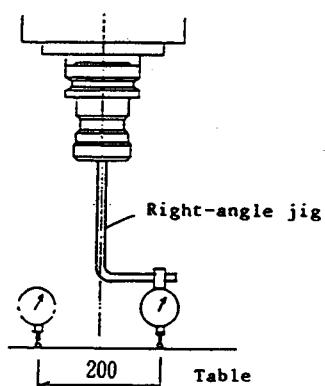
- 1) Mount a test bar in the spindle.
- 2) Mount a magnetic stand on the table.
- 3) Place the small dial indicator in contact with the test bar at the spindle mouth and at a point 200 mm down.
- 4) Turn the spindle and measure the maximum runout values at each point.



Unit: mm		
	At the spindle mouth	200
Permitted values	Within 0.01 (mm)	Within 0.02

Perpendicularity of the spindle center line to the table:

- 1) Mount a right-angle jig in the spindle.
- 2) Place the small dial indicator in contact with the table.
- 3) Turn the spindle and measure the maximum runout value.



Unit: mm	
	200
Permitted values	Within 0.02

Check that the front surface of the table is not lower than the rear surface.

Replacement Parts	Part Name	Part Code	Jigs and Tools Required
			Test bar Small dial indicator 1/100 Magnetic stand Right-angle jig

3.2 ADJUSTING THE MAGAZINE

260100 Adjusting the Magazine

260200 Adjusting the Address Sensor

260300 Adjusting the Barrel Cam Proximity Switch

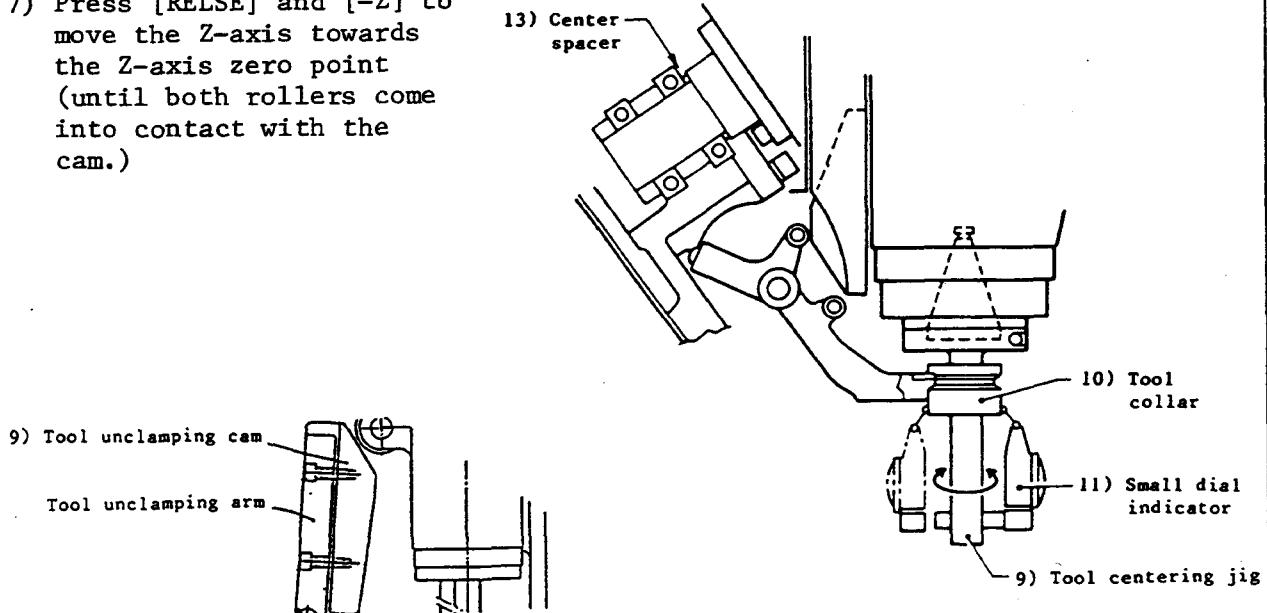
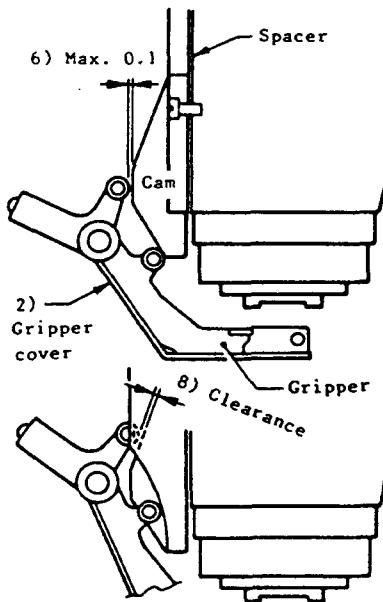
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- 1) Remove all the tools from the magazine, labelling each one with the magazine number.
- 2) Remove the gripper cover.
- 3) [MANU]
- 4) [ATC] Check the spindle orientation. (Refer to No. 160100)
- 5) Press [RELEASE] and [+Z] to bring the gripper roller to the center of the flat on the cam front surface.
- 6) Check that the clearance between the cam and gripper roller does not exceed 0.1 mm when the gripper is horizontal.

If the clearance exceeds 0.1 mm:

- 6)-1 [POS]
- 6)-2 Press [RELEASE] and [-Z] to lower the Z-axis to its lower limit position. (200 + high column)
- 6)-3 Remove the cam mounting screws and insert spacers (0.1, 0.2 or 0.3 mm thickness) as appropriate.
- 6)-4 Repeat steps 3) - 6) to check.
- 7) Press [RELEASE] and [-Z] to move the Z-axis towards the Z-axis zero point (until both rollers come into contact with the cam.)

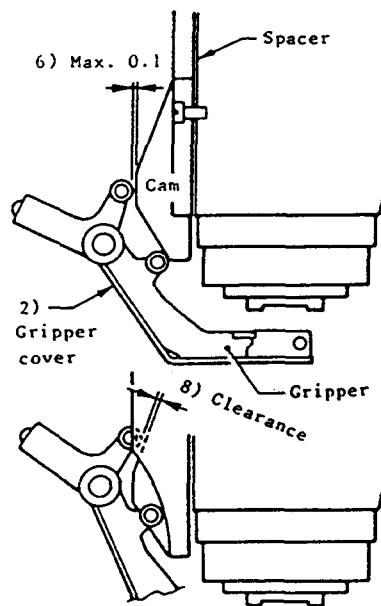


Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Description
	Shift cam spacers Centering spacers	628149000 628098000		Phillips screwdriver Wrench for the cams Allen wrench (set) 7 mm wrench 13 mm wrench (x2) Clearance gauges Tool centering jig Tool collar Small dial indicator 1/100

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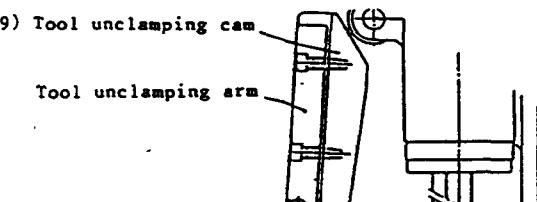
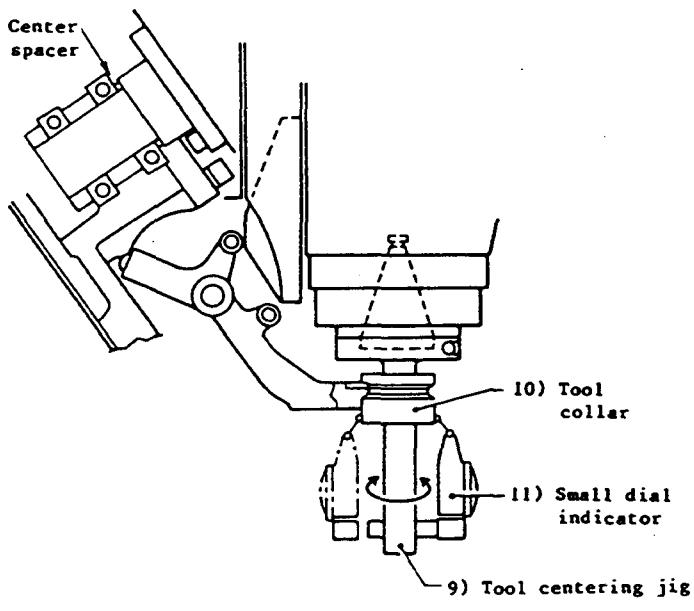
- 8) At the time when one of the rollers only is in contact with the cam, check if there is a clearance between the other roller and the cam. If there is no clearance, carry out the procedures in step 6 to reduce the thickness of spacers.
- 9) Press [RELEASE] and [-Z] to lower the spindle. Mount a tool centering jig in the end of the spindle and remove the tool unclamping cam.
- 10) Press [RELEASE] and [+Z] to raise the spindle. Mount a tool collar in the gripper.
- 11) Press [RELEASE] and [-Z] to lower the spindle. Mount a small dial indicator on the tool centering jig.
- 12) Turn the spindle manually and check that the front/rear runout around the tool collar does not exceed 0.3 mm.



Change the center spacer thickness if the runout exceeds 0.3 mm. Increasing the spacer thickness by 0.2 mm moves the magazine 0.16 mm forwards (the runout changes by 0.33 mm).

0.6, 0.8, 1.0, 1.2 and 1.5 mm centering spacers are available.

Refer to the procedure for replacing the magazine (No. 200100) when changing the spacers.



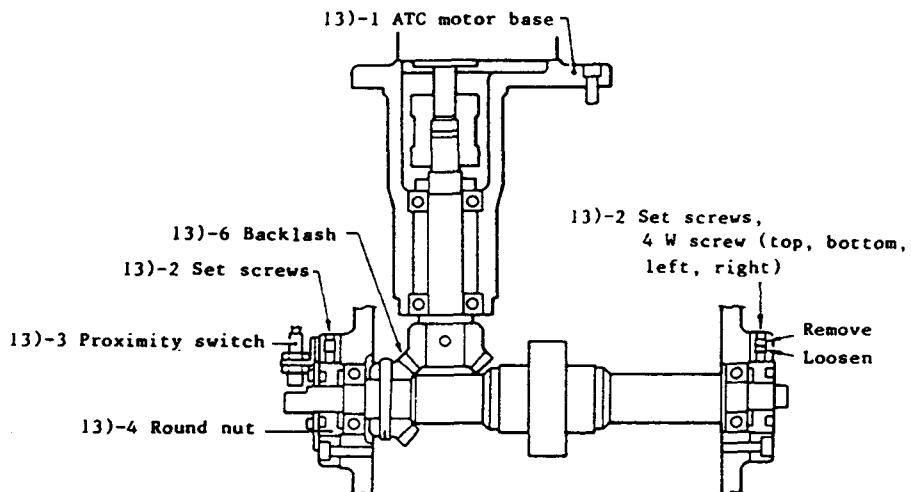
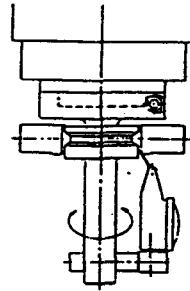
Part Name	Part Code	Jigs and Tools Required
Shift cam spacers	628149000	Phillips screwdriver Wrench for the cams Allen wrench (set) 7 mm wrench 13 mm wrench (x2) Clearance gauges
Centering spacers	628098000	Tool centering jig Tool collar Small dial indicator 1/100

Issued: / /
 TC-215 TC-225

- 13) Turn the spindle manually and check that the left/right runout around the tool collar does not exceed 0.3 mm.

Adjust the barrel cam if the runout exceeds 0.3 mm.

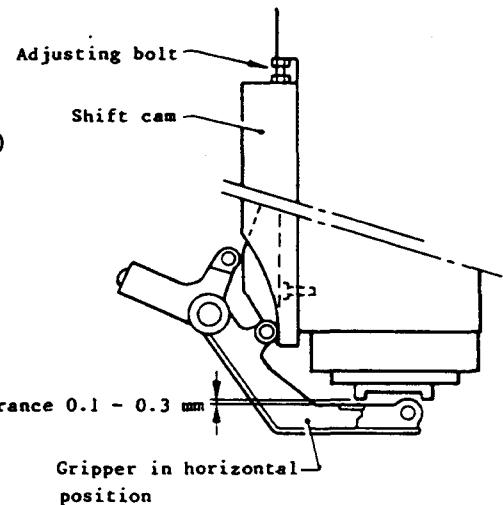
- 13)-1 Loosen the ATC motor base mounting screws.
 13)-2 Loosen the set screws in the round nuts at the left and right ends of the barrel cam. (4W screws)
 13)-3 Remove the barrel cam proximity switch.



- 13)-4 Turn the left and right round nuts to adjust the runout to within 0.3 mm. (Turning the right round nut clockwise by 24 degrees, the gripper moves 0.1 mm rightward.)

Note: The barrel cam rotating torque is 2 kg/cm.

- 13)-5 Make sure that there is not axial play in the barrel cam and tighten the set screws in the round nuts.
 13)-6 Mount the ATC motor, making sure that there is no backlash.
 13)-7 Mount and adjust the barrel cam proximity switch. Refer to procedure No. 260300.

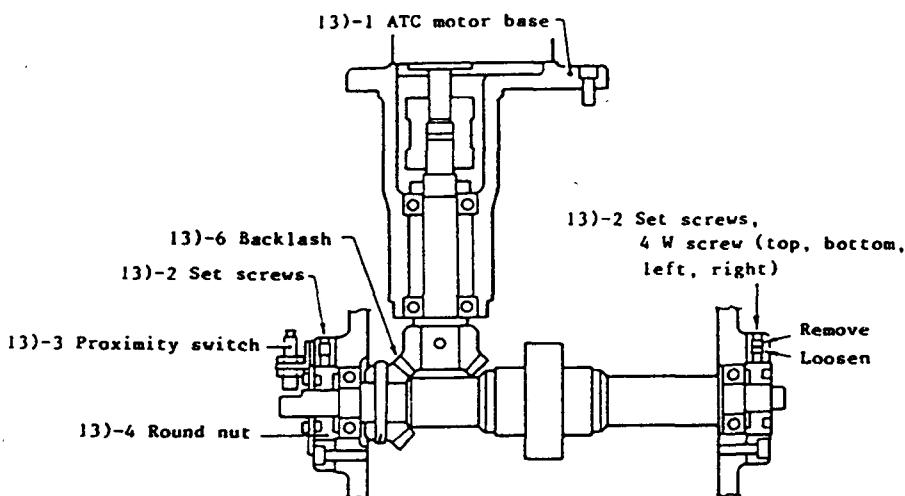
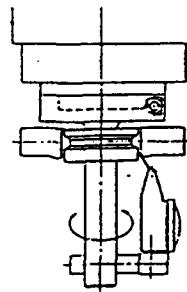


Replacement Parts	Part Name	Part Code	Jigs and Tools Required

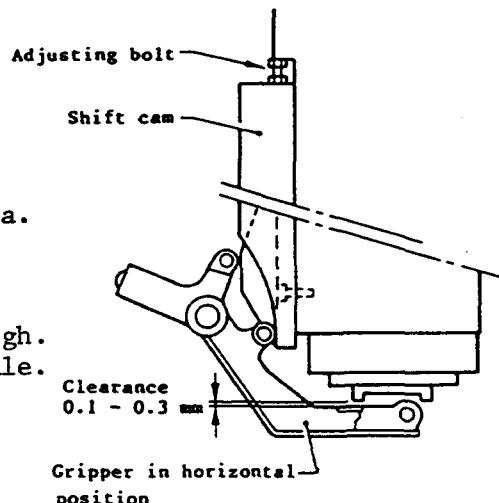
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- 14) Attach the tool unclamping cam.
- 15) Remove the small dial indicator, tool collar and the tool centering jig.
- 16) [ATC]
- 17) Press [RELEASE] and [+Z] to bring the gripper to the horizontal position. Check that there is a 0.1 - 0.3 mm clearance between the spindle key and gripper key.
Adjust the shift cam if the clearance is less than 0.1 mm or exceeds 0.3 mm.
- 17)-1 Press [RELEASE] and [-Z] to lower the Z-axis to its lower limit position.
(200 + high column)



- 17)-2 Remove the shift cam mounting screws and take off the shift cam.
- 17)-3 Turn the adjusting bolt at the top end of the shift cam to adjust the clearance.
Extending the adjusting bolt increases the clearance, and vice-versa.
- 17)-4 Press the shift cam upwards against the adjusting bolt and tighten the mounting screw.
- 17)-5 Make sure that the gripper is not high.
- 18) Mount a tool in the gripper below the spindle.
- 19) Press [RELEASE] and [-Z] to lower the Z-axis.
Make sure that the tool is clamped and unclamped smoothly.
- 20) Attach the gripper cover.



Replacement Parts	Part Name	Part Code	Jigs and Tools Required

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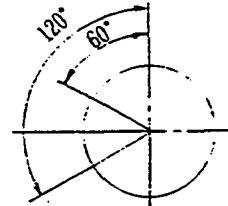
- 1) Remove all the tools from the magazine, labelling each one with the magazine number.
- 2) Remove the gripper cover.
- 3) Remove the address nameplate from the magazine.
- 4) Check that the magazine is indexed correctly in position.
(It should not move when turned manually.)

(入力)	(出力)
AZ1 00000000	00001 1100
AZ2 10000000	00002 00000
AZ3 21100000	00003 01000100
AZ4 00000000	00004 11100000
AZ5 00000000	00005 00000110
AZ6 01001010	00006 10000000
AZ7 00011110	00007 00000000
AZ8 11111111	00008 00000000
AZ9 00000000	00009 10000000
AZ10 11111111	

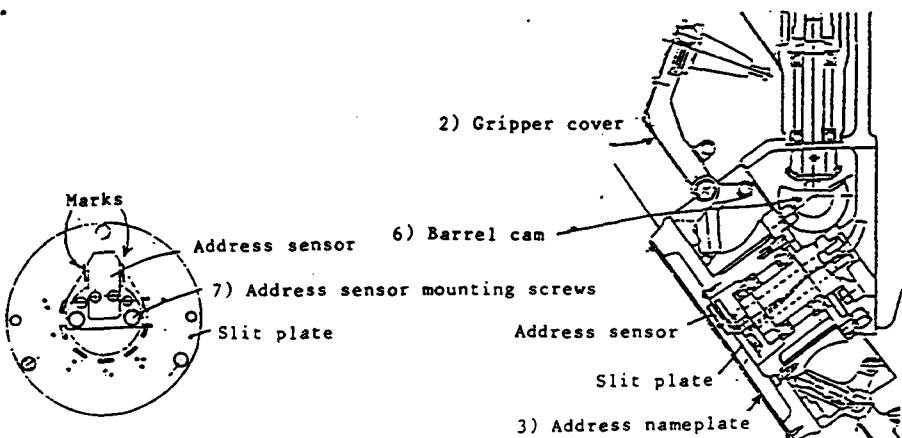
Bit	8	7	6	5
Key to IN6 display	Encoder signal 8	Encoder signal 4	Encoder signal 2	Encoder signal 1
Input display	0	1	0	1
Magazine number	$0 + 4 + 0 + 1 = 5$			

5) [I/O]

- Look at the IN6 value on the I/O display.
- 6) Turn the barrel cam clockwise and counter-clockwise with a wrench on the right end of the barrel cam. Make a mark on the slit plate at the points where the IN6 display becomes zero. Turn the barrel cam to the center of the flat (turn the barrel cam back 60°).
 - 7) Loosen the address sensor mounting screws and mount the sensor at the midpoint between the marks.



Center of 120° flat on the barrel cam (60°)



Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Phillips screwdriver 13 mm wrench

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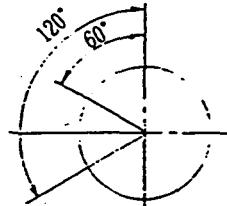
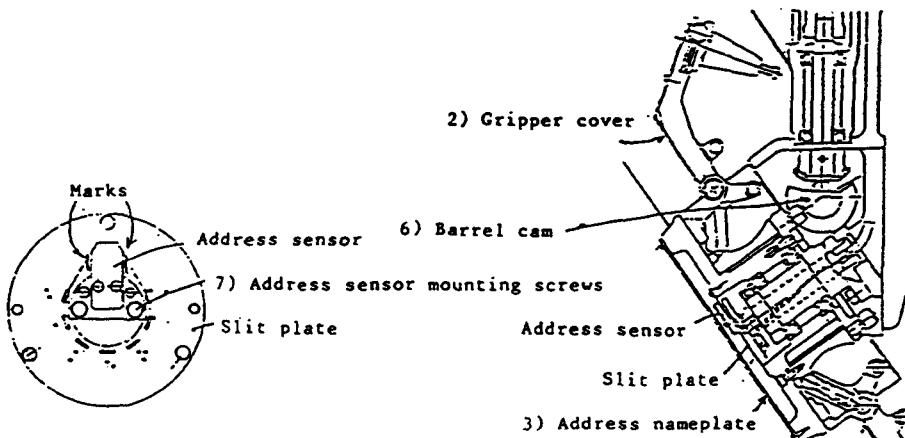
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- 8) Turn the barrel cam. Make sure that there is no dispersion of the display at the points where the magazines 1 ~ 10 index.
- 9) Press [ATC] repeatedly and make sure that there is no dispersion of the display at the points where the magazines 1 ~ 10 index.

(A)	(B)
A01 00000000 +0021	1100
A02 10000000 +0022	00000000
A03 21100000 +0023	01000000
A04 00000000 +0024	11100000
A05 00000000 +0025	00001110
A06 01100010 +0026	10000000
A07 00011110 +0027	00000000
A08 11111111 +0028	00000000
A09 00000000 +0029	10000000
A10 11111100	

Bit	8	7	6	5
Key to IN6 display	Encoder signal 8	Encoder signal 4	Encoder signal 2	Encoder signal 1
Input display	0	1	0	1
Magazine number	$0 + 4 + 0 + 1 = 5$			

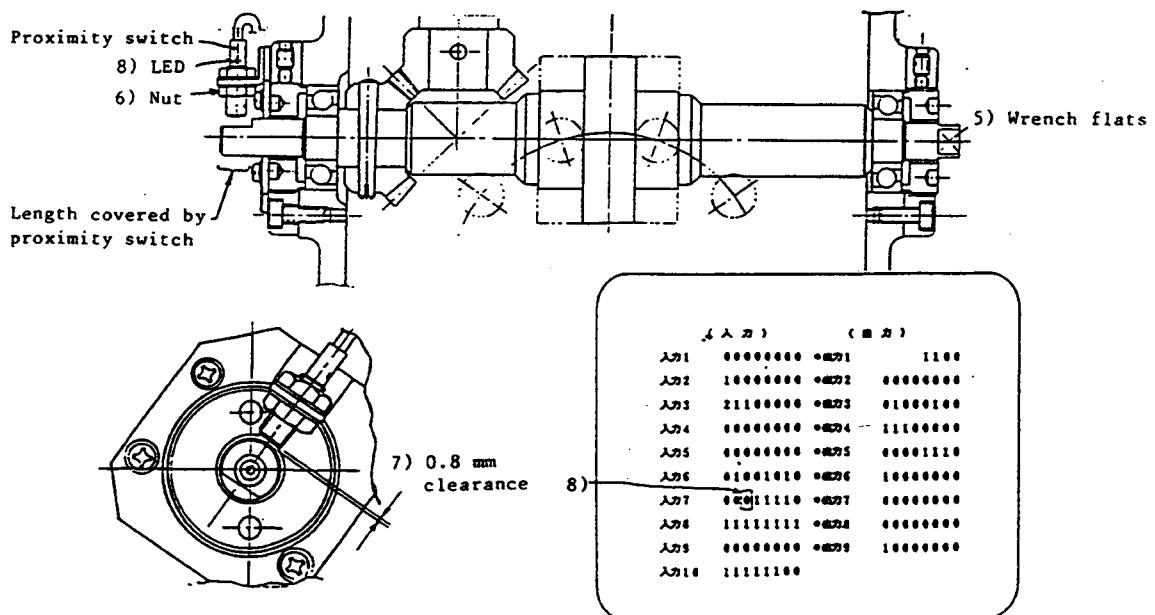
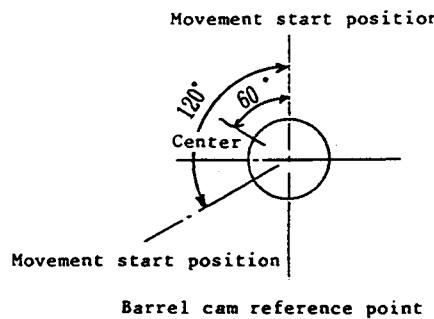
- 10) [MDI] [PRGRM]
Move the cursor to the TOOL row with the
[↑ CURSOR] [↓ CURSOR] keys.
- 11) [1] [ENTER] [START]
Select magazine 1.
- 12) Attach the address nameplate with "1"
downwards.
- 13) Attach the gripper cover.
- 14) Insert the tools in their original
magazines.

Center of 120° flat on the
barrel cam (60°)

Part Name	Part Code	Jigs and Tools Required
		Phillips screwdriver 13 mm wrench

Issued:	/	/
TC-215		TC-225

- 1) Remove all the tools from the magazine, labelling each one with the magazine number.
- 2) Remove the gripper cover from the top of the magazine.
- 3) [ATC]
- 4) [ATC] Move the Z-axis to its upper limit position.
- 5) Apply a wrench to the right end of the barrel cam and turn the barrel cam through 180° . (Take care as the magazine also turns.)
- 6) Loosen the proximity switch mounting nuts.
- 7) Set a clearance of 0.8 mm between the barrel cam shaft circumference and the proximity switch and tighten the mounting nuts.

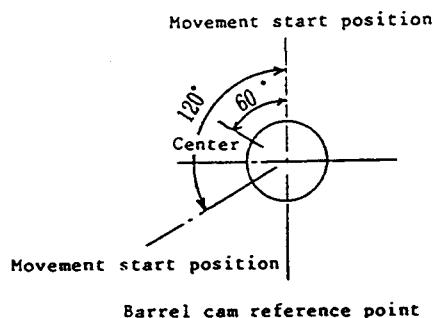


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
			Phillips screwdriver 13 mm wrench (x2) Clearance gauges

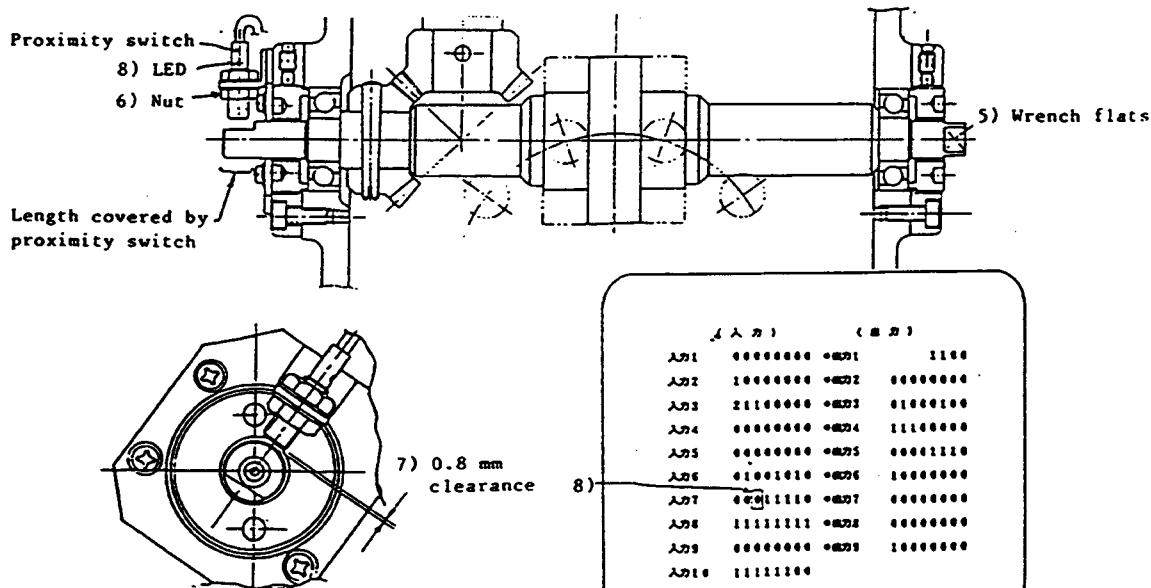
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- 8) Turn the barrel cam to its reference point. Make sure that the proximity switch LED goes out and that bit 6 of the IN7 value on the I/O display is "0". (Press the [I/O] key to select the I/O display.)
- 9) Turn the barrel cam away from its reference point. Make sure that the proximity switch LED lights and that bit 6 of the IN7 value on the I/O display is "1".
- 10) Attach the gripper cover.
- 11) Insert the tools in their original magazines.



Barrel cam reference point



Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Phillips screwdriver 13 mm wrench (x2) Clearance gauges

3.3 ADJUSTING THE AXIS FEED PARTS

360100 Setting the X- and Y-axis Grid Shift Amount A

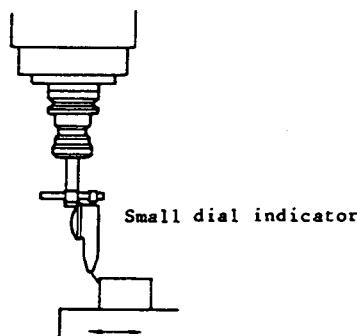
360200 Setting the X- and Y-axis Grid Shift Amount B

360300 Setting the Z-axis Grid Shift Amount

Issued: / /
TC-215 TC-225

Before replacing the motor:

- 1) Mount a small dial indicator in the spindle and measure the current position.
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current position.



After replacing the motor:

- 4) [MANU]
- 5) Press [JOG] or [STEP] to move to the position before the motor was replaced.
- 6) [POS]
- 7) Compare the current the machine coordinates position with that before the motor was replaced.
- 8) [MDI]
- 9) [PARAM]
- 10) [2] [ENTER]
- 11) [↓ PAGE]
- 12) Read the current GRID SHIFT VALUE.
- 13) Calculate the new grid shift value for the spindle.

New GRID SHIFT VALUE =

$$\text{Current grid shift value} - \frac{(\text{Machine coordinates position after motor replacement}) - (\text{Machine coordinates position before motor replacement})}{0.00122}$$

Example:

$$\text{GRID SHIFT VALUE} = 1000 - \frac{(-65.533) - (-66.000)}{0.00122} = 1000 - (-383)$$

$$= 1383$$

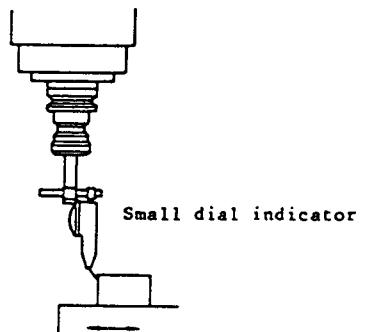
Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Small dial indicator 1/100

Issued: / /

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TC-225

- 14) PROGRAM PROTECT [OFF]
- 15) Use the [\uparrow CURSOR] [\downarrow CURSOR] keys to move the cursor to GRID SHIFT VALUE.
- 16) Input the calculated value.
- 17) [ENTER].
- 18) PROGRAM PROTECT [ON]
- 19) POWER [OFF]
- 20) POWER [ON]
- 21) Make a note of the adjustment in the Inspection Chart.

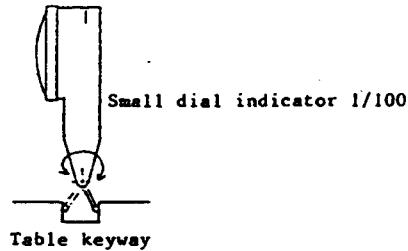


Replacement Parts	Part Name	Part Code	Jigs and Tools Required
			Small dial indicator 1/100

Issued: / /

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- 1) [MDI]
- 2) [PARAM]
- 3) [2] [ENTER]
- 4) [↓ PAGE]
- 5) PROGRAM PROTECT [OFF]
- 6) Use the [↑ CURSOR] [↓ CURSOR] keys to move the cursor to GRID SHIFT VALVE.
- 7) [0] [ENTER]
- 8) POWER [OFF] [ON]
- 9) [MANU]
- 10) [M.Z.RT]
- 11) Mount a small dial indicator in the spindle.
- 12) Use the manual keys to move the table so that the spindle is in the center of the table. (Left/right runout in the table keyway should not exceed 0.01 mm.)
- 13) [POS]
- 14) Read the machine coordinates position.
- 15) Calculate the new grid shift value for the spindle.



GRID SHIFT VALUE =

$$\frac{(\text{Axis travel} + (\text{Machine coordinates position}) \times 0.5)}{0.00122}$$

Axis Travel:

	TC-215	TC-225
X-axis	300	420
Y-axis	220	300

Example:

$$\text{GRID SHIFT VALUE} = \frac{300 \times 0.5 + (-145, 623)}{0.00122} = 3588$$

Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Small dial indicator 1/100

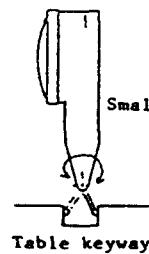
Issued: / /

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TC-225

- 16) [MDI]
- 17) [PARAM]
- 18) [2] [ENTER]
- 19) [↓ PAGE]
- 20) PROGRAM PROTECT [OFF]
- 21) Use the [↑ CURSOR] [↓ CURSOR] keys to move the cursor to GRID SHIFT VALUE.
- 22) Input the calculated value.
- 23) [ENTER]
- 24) PROGRAM PROTECT [ON]
- 25) POWER [OFF] [ON]
- 26) Repeat steps 9) - 14). Read the machine coordinates position and make sure it is within the range:

Axis travel x 0.5 ±0.01

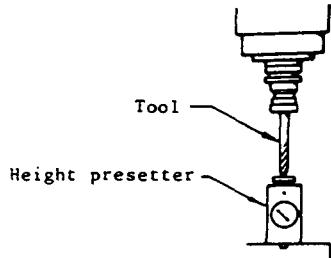


Part Name	Part Code	Jigs and Tools Required
		Small dial indicator 1/100

Issued: / /
 TC-215 TC-225

Before replacing the motor:

- 1) Mount a tool in the spindle and measure the current position with a height presetter.
- 2) [POS]
- 3) Make a note of the machine coordinates position and the current X-axis position.



After replacing the motor:

- 4) [MANU]
- 5) Press [JOG] or [STEP] to move to the position before the motor was replaced.
- 6) [POS]
- 7) Compare the current the machine coordinates position with that before the motor was replaced.
- 8) [MDI]
- 9) [PARAM]
- 10) [2] [ENTER]
- 11) [↓ PAGE]
- 12) Read the current GRID SHIFT VALUE.

- 13) Calculate the new grid shift value for the spindle.

New GRID SHIFT VALUE =

$$\text{Current grid shift value} - \frac{(\text{Machine coordinates position after motor replacement}) - (\text{Machine coordinates position before motor replacement})}{0.00122}$$

Example:

$$\begin{aligned} \text{GRID SHIFT VALUE} &= 1000 - \frac{245.835 - 245}{0.00122} = 1000 - 684 \\ &= 316 \end{aligned}$$

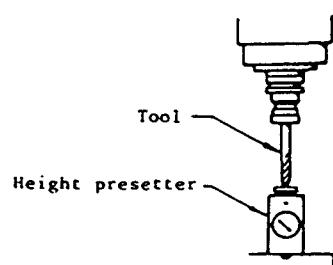
Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Height presetter

Issued: / /

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TC-225

- 14) PROGRAM PROTECT [OFF]
- 15) Use the [\uparrow CURSOR] [\downarrow CURSOR] keys to move the cursor to GRID SHIFT VALUE.
- 16) Input the calculated value.
- 17) [ENTER]
- 18) PROGRAM PROTECT [ON]
- 19) POWER [OFF]
- 20) POWER [ON]



Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Height presetter

3.4 ADJUSTING THE LIMIT SWITCHES

- 660100 Adjusting the X-, Y- and Z-axis Zero-Point Limit Switches
- 660200 Adjusting the X- and Y-axis Overrun Limit Switches
- 660300 Adjusting the Z-axis Overrun Limit Switches
- 660400 Adjusting the ATC Operation Area Limit Switch
- 660500 Adjusting the ATC Zero-Point Limit Switch

Issued: / /

TC-215

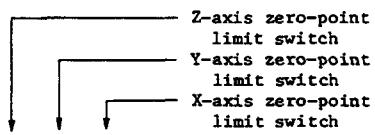
TC-225

- 1) [MDI]
- 2) [PARAM]
- 3) [2] [ENTER]
- 4) [\downarrow PAGE]
- 5) PROGRAM PROTECT [OFF]
- 6) Use the [\uparrow CURSOR] [\downarrow CURSOR] keys to move the cursor to GRID SHIFT VALUE X (Y, Z)
- 7) [0] [ENTER]
- 8) PROGRAM PROTECT [ON]
- 9) POWER [OFF] [ON]
- 10) [MANU]
- 11) [M.Z.RT]
- 12) Move the cursor to the STEP LENGTH row.
- 13) Press [Δ] to set the step length to 0.1 mm/step.
- 14) [I/O]
- 15) [JOG]
- 16) Press [-X] ($-Y$, $-Z$) until bit 2 (bit 3, bit 4) of the IN5 display becomes "1".
- 17) [STEP]
- 18) Press [+X] ($+Y$, $+Z$) until bit 2 (bit 3, bit 4) of the IN5 display becomes "0".
- 19) [POS]
Check the machine coordinates position.

Standard Values:

	TC-215	TC-225
X	-2.5 ± 0.5	-2.5 ± 0.5
Y	-2.5 ± 0.5	-2.5 ± 0.5
Z	397.5 ± 0.5	447.5 ± 0.5

Note: When using a high column, add the height of the high column to the Z value.



Replacement Parts	Part Name	Part Code	Jigs and Tools Required
			Small dial indicator 1/100 Magnetic stand Allen wrench (set)

Issued: / /

TC-215 TC-225

- 20) The adjustment is complete if the displayed machine coordinates position falls within these standard ranges. The zero-point offset value has to be set if the displayed position does not fall within these standard ranges.

- 20)-1 Calculate the zero-point offset value.

For the Z-axis, subtract the Z-axis zero point dimension from the Z-axis machine coordinates position, i.e., use (Z-axis machine coordinates position - Z-axis zero point dimension) in the following equations.

If the machine position lies in the range -5 to -3:

Zero-point offset value =

$$\frac{\text{Machine coordinates position} + 2.5}{0.00122} \times (-1)$$

If the machine position lies in the range -2 to 0:

Zero-point offset value =

$$\frac{\text{Machine coordinates position} - 2.5}{0.00122} \times (-1)$$

Example: Machine coordinates position = -4.5

$$\text{Zero-point offset value} = \frac{-4.5 + 2.5}{0.00122} \times (-1) = 1639$$

- 20)-2 [MDI]
- 20)-3 [PARAM]
- 20)-4 [2] [ENTER]
- 20)-5 [↓ PAGE]
- 20)-6 PROGRAM PROTECT [OFF]
- 20)-7 Use the [↑ CURSOR] [↓ CURSOR] keys to move the cursor to zero-point offset value.
X (Y, Z)
- 20)-8 Input the calculated value. [ENTER]
- 20)-9 PROGRAM PROTECT [ON]
- 20)-10 POWER [OFF] [ON]
- 20)-11 Repeat steps 10) - 19) to check the machine coordinates position.

Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Small dial indicator 1/100 Magnetic stand Allen wrench (set)

Issued: / /

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- 1) [MANU]
- 2) Move the cursor to the STEP LENGTH row.
- 3) Press Δ to set the step length to 1 mm/step.
- 4) [M.Z.RT]

For the X- or Y-axis (+) overrun limit switch:

- 5)-A [POS]
- 6)-A [STEP]
- 7)-A Press [+X] or [+Y] to step the axis until an overrun error is displayed for that axis (within 7 mm).

For the X- or Y-axis (-) overrun limit switch:

- 5)-B [MDI]
- 6)-B [1] [ENTER]
- Set the coordinate system.
- 7)-B Move the cursor to AXIS MOVE.
- 8)-B [0] [ENTER]
- Designate position.
- 9)-B Move the cursor to the axis being adjusted.
- 10)-B Input the axis travel. [ENTER]
- 11)-B Move the cursor to FEED.
- 12)-B [0] [ENTER]
- Carry out positioning.
- 13)-B [START]
- The table moves.
- 14)-B [POS]
- Check the position.
- 15)-B [MANU]
- 16)-B [STEP]
- 17)-B Press [-X] or [-Y] to step the axis until an overrun error is displayed for that axis (within 7 mm).

18) Check the machine coordinates position.

Axis Travel	TC-215	TC-225
X	-300	-420
Y	-220	-300

Standard Positions	TC-215	TC-225
+X	5 ±2	5 ±2
-X	-305 ±2	-425 ±2
+Y	5 ±2	5 ±2
-Y	-225 ±2	-305 ±2

Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Phillips screwdriver

Issued: / /

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- 19) The adjustment is complete if the displayed machine coordinates position falls within these standard ranges. The limit switch position must be adjusted if the displayed position does not fall within these standard ranges.

Procedure for adjusting the limit switch position:

- 19)-1 Remove the cover.
- 19)-2 Loosen the screws holding the limit switch and shift the limit switch.
- 19)-3 Repeat steps 4) - 19).
- 19)-4 Attach the cover.

Replacement Parts	Part Name	Part Code	Jigs and Tools Required
			Phillips screwdriver

Issued: / /

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- 1) [MANU]
- 2) Move the cursor to the STEP LENGTH row.
- 3) Press [Δ] to set the step length to 1 mm/step.
- 4) [M.Z.RT]

For the Z-axis (+) overrun limit switch:

- 5)-A [ATC]
- 6)-A [ATC]
- 7)-A [POS]
- 8)-A [STEP]
- 9)-A Press [+Z] to step the axis until an overrun error is displayed (within 7 mm).

For the Z-axis (-) overrun limit switch:

- 5)-B [MDI]
- 6)-B [1] [ENTER]
Set the coordinate system.
- 7)-B Move the cursor to AXIS MOVE.
- 8)-B [0] [ENTER]
Designate position.
- 9)-B Move the cursor to the Z-axis position (Z).
- 10)-B Input the axis travel. [ENTER]

$$\text{Travel} = 200 - \text{Tool length} + \text{High column amount}$$

- 11)-B [0] [ENTER]
Carry out positioning.
- 12)-B [START]
The spindle head moves.
- 13)-B [POS]
Check the position.
- 14)-B [MANU]
- 15)-B [STEP]
- 16)-B Press [-Z] to step the axis until an overrun error is displayed (within 7 mm).

Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Phillips screwdriver

Issued: / /

TC-215 TC-225

- 17) Check the machine coordinates position.

Standard Positions	TC-215	TC-225
+Z	543 ±2	598 ±2
-Z	195 ±2	195 ±2

Note: When using a high column, add the height of the high column.

- 18) The adjustment is complete if the displayed machine coordinates position falls within these standard ranges. The limit switch position must be adjusted if the displayed position does not fall within these standard ranges.

Procedure for adjusting the limit switch position:

- 18)-1 Remove the head side cover from the right of the column.
- 18)-2 Loosen the screws holding the limit switch and shift the limit switch.
- 18)-3 Repeat steps 4) - 18).
- 18)-4 Mount the head side cover.

Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Phillips screwdriver

Issued: / /

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- 1) [MANU]
- 2) Move the cursor to the STEP LENGTH row.
- 3) Press [Δ] to set the step length to 0.1 mm/step.
- 4) [M.Z.RT]
- 5) [I/O]
- 6) [JOG]
- 7) Press [RELEASE] and [+Z] to move the Z-axis unit bit 3 of the IN6 display becomes "1".

IN6 X X X X X 1 X X

- 8) [STEP]
- 9) Press [RELEASE] and [-Z] to step the Z-axis unit bit 3 of the IN6 display becomes "0".
- 10) [POS]

Check the machine coordinates position.

TC-215 TC-225

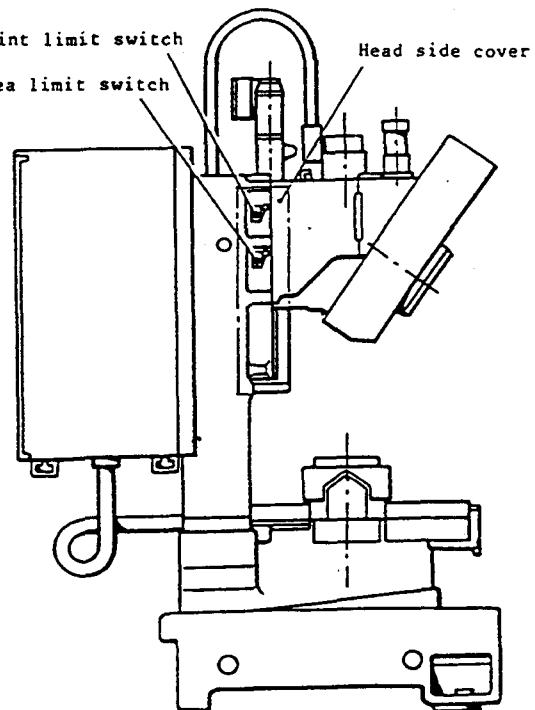
Standard values	405 ±3	455 ±3
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Note: When using a high column, add the height of the high column.

- 11) The adjustment is complete if the displayed machine coordinates position falls within these standard range. The limit switch position must be adjusted if the displayed position does not fall within these standard ranges.

Procedure for adjusting the limit switch position:

- 11)-1 Remove the head side cover from the left of the column.
- 11)-2 Loosen the screws holding the limit switch and shift the limit switch.
- 11)-3 Repeat steps 5) - 11).
- 11)-4 Mount the head side cover.



Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Phillips screwdriver

Issued: / /

TC-215 TC-225

- 1) [MANU]
- 2) Move the cursor to the STEP LENGTH row.
- 3) Press Δ to set the step length to 0.1 mm/step.
- 4) [ATC]
- 5) [ATC] Move the Z-axis to its upper limit position.
- 6) [I/O]
- 7) [JOG]
- 8) Press [RELEASE] and [+Z] to move the Z-axis unit bit 2 of the IN6 display becomes "1".

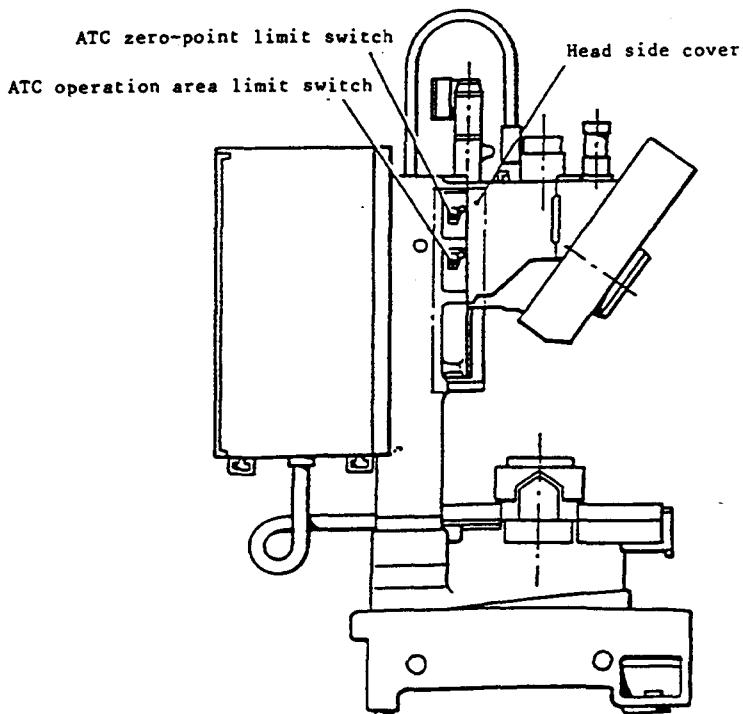
IN6 X X X X X X 1 X

- 9) [STEP]
- 10) Press [RELEASE] and [-Z] to step the Z-axis unit bit 2 of the IN6 display becomes "0".
- 11) [POS]
Check the machine coordinates position.

TC-215 TC-225

Standard values	534 ± 2	589 ± 2
-----------------	-------------	-------------

Note: When using a high column, add the height of the high column.



Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Phillips screwdriver

Issued: / /

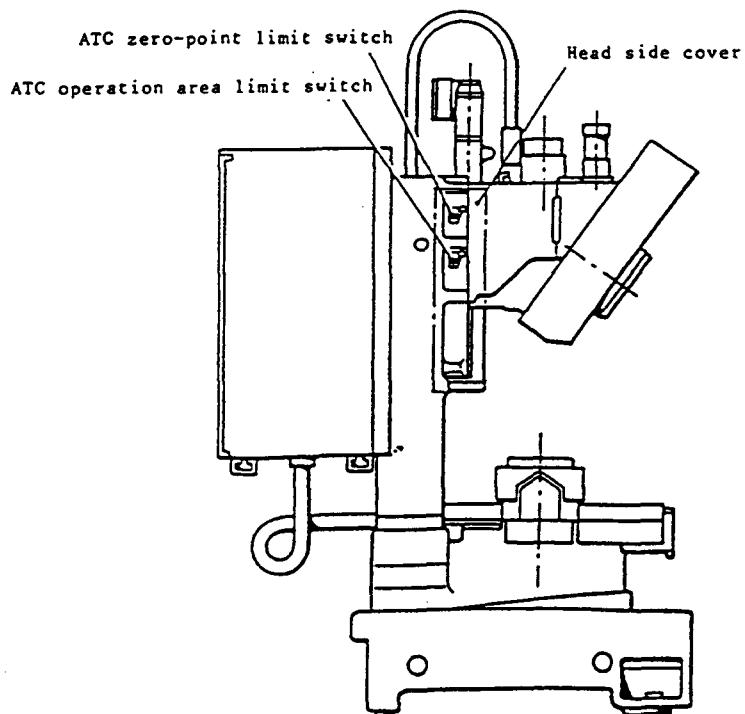
TC-215

TC-225

- 12) The adjustment is complete if the displayed machine coordinates position falls within these standard range. The limit switch position must be adjusted if the displayed position does not fall within these standard ranges.

Procedure for adjusting the limit switch position:

- 12)-1 Remove the head side cover from the left of the column.
- 12)-2 Loosen the screws holding the limit switch and shift the limit switch.
- 12)-3 Repeat steps 6) - 12).
- 12)-4 Mount the head side cover.



Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Phillips screwdriver

3.5 ADJUSTING THE NC PARTS

760100 Adjusting the Spindle, X-, Y- and Z-axis Drivers TC-215

760200 Adjusting the Spindle Driver when Replacing the Spindle Motor
TC-215

760300 Adjusting the Spindle, X-, Y- and Z-axis Drivers TC-225

Issued: / /

TC-215

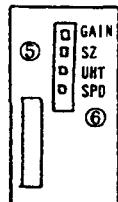
- 1) Turn the circuit breaker ON. POWER [ON]
- 2) [M.Z.RT]
- 3) [ATC]
- 4) [I/O] [\downarrow PAGE]
- 5) Adjust SZ of each of the drivers to bring the deviation amount for each axis to zero. If it is not possible to accurately zero the deviation value, set it as near as possible to zero (between -1 and +1).

* If there are large difference between the deviation values for each axis after the NC PCB has been replaced, adjust VR1 and VR2 on the NC PCB to bring the deviation values into the -1 to +1 range. If any deviation value still remains outside the -1 to +1 range, adjust the driver SZ to bring it within the range.

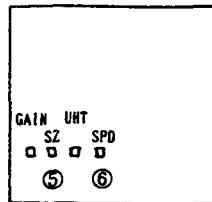
Refer to Replacing the NC PCB
(No. 700200).

- 6) Adjust the deviation values. The adjustment values and conditions differ for each axis, as shown in the table below.

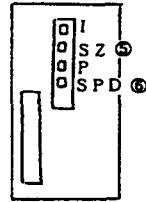
	Adjustment Values	Adjustment Conditions
X- and Y-axis	730 \pm 1%	Manual mode 10% of rapid feedrate (2000 mm/min)
Z-axis	736 \pm 10%	Manual mode 10% of rapid feedrate (2000 mm/min)
Spindle: 6000 min^{-1}	$18500 \pm 10\%$	Manual mode Spindle speed: 6000 min^{-1}
	$30800 \pm 10\%$	Manual mode Spindle speed: 10000 min^{-1}



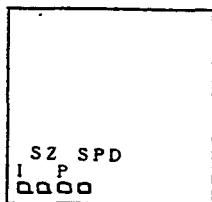
Type A X- and Y-axis driver
(6000 min^{-1})



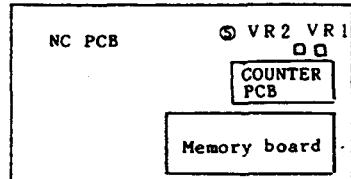
Type A spindle driver
(6000 min^{-1})



Type B X- and Y-axis driver
Z-axis driver



Type B spindle driver
(6000 min^{-1})
(10000 min^{-1})



1 scale unit = 1 notch
The counterclockwise limit position is the zero position.

Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Precision phillips screwdriver

Issued: / /

TC-215

Note: Adjust the X- and Y-axis deviation values to the same value.

The adjustment values are the same for both type A and type B drivers.

Adjust the driver SPD to set the adjustment values given in the table above.

- 7) Adjust the gain.
If a driver does not operate normally with the initial values (hunting or noisy operation), adjust the gain trimmer ± 1 notch.

Initial Values:

6000 min^{-1} specification:

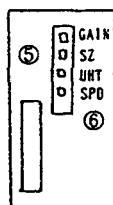
	X	Y	Z	Spindle
Type A	GAIN	8	8	-
	UHT	3	3	-
Type B	I	3	3	6
	P	2	2	4

10000 min^{-1} specification:

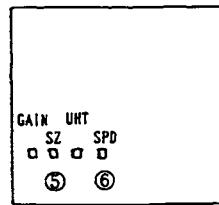
	X	Y	Z	Spindle
Type A	GAIN	8	8	-
	UHT	3	3	-
Type B	I	3	3	6
	P	2	2	1

* The numbers indicate numbers of notches.

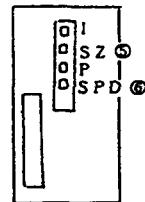
Type A: Export ... Nos. 111149 and below
Type B: Export ... Nos. 111150 and above



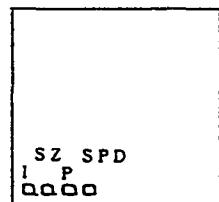
Type A X- and Y-axis driver
driver (6000 min^{-1})



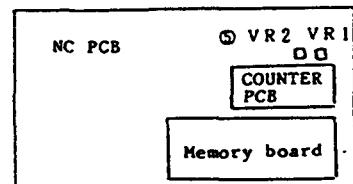
Type A spindle driver
(6000 min^{-1})



Type B X- and Y-axis driver
Z-axis driver (6000 min^{-1})



Type B spindle driver
(6000 min^{-1})
(10000 min^{-1})



1 scale unit = 1 notch
The counterclockwise limit position is the zero position.

Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Precision phillips screwdriver

Issued: / /

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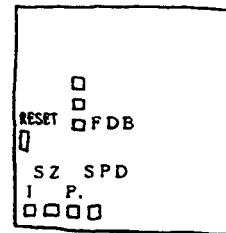
- 1) Before replacing the spindle motor, set both the driver P Gain and I Gain from 4/10N to 0/10N (from notch 4 to notch 0).
- 2) With the unmounted motor, press [MANU] and [ATC] to carry out spindle orientation. Press [I/O] and [\downarrow PAGE] to display the spindle deviation value. Adjust the driver SZ to bring the spindle deviation value into the range from +1 to -1.
- 3) Mount the motor to the machine. Adjust the parallelism and tighten the coupling. Set the P Gain and I Gain back to 4/10N (notch 4).
- 4) [MANU] [MANU COND]
Press the [Δ] key to set the spindle speed to 6000 min^{-1} . Press [S.CW] or [S.CCW] and adjust the spindle driver SPD to set the deviation value to 18500.

Note: If it is not possible to adjust the deviation value to 18500, adjust the FDB trimmer around the 3.5/10N position.

- 5) Press [MANU] and [ATC] once more to carry out spindle orientation. Press [I/O] and [\downarrow PAGE] to display the spindle deviation value. Adjust the driver SZ to bring the spindle deviation value into the range from +1 to -1.

Note 1: The adjustment procedure described above is only required after the TC-215 6000 min^{-1} spindle motor has been replaced.

Note 2: The adjustment procedure is not required when orientation is not carried out with the unmounted motor.



I scale unit = 1 notch
The counterclockwise limit position is the zero position.
4/ e N, 4/ e N
0/ e N, 0/ e N

FDB
Carry out fine adjustment around the 3.5/10N position.

Part Name	Part Code	Jigs and Tools Required
Replacement Parts		Precision phillips screwdriver

Issued: / /

TC-225

- 1) Turn the circuit breaker ON. POWER [ON]
- 2) [M.Z.RT]
- 3) [ATC]
- 4) [I/O] [↓ PAGE]
- 5) Adjust SZ of each of the drivers to bring the deviation value for each axis to zero. If it is not possible to accurately zero the deviation value, set it as near as possible to zero (between -1 and +1).

*If there are large differences between the deviation values for each axis after the NC PCB has been replaced, adjust VR1 and VR2 on the NC PCB to bring the deviation values into the -1 to +1 range. If any deviation value still remains outside the -1 to +1 range, adjust the driver SZ to bring it within the range.

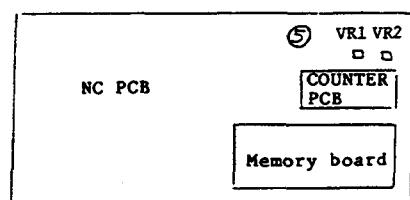
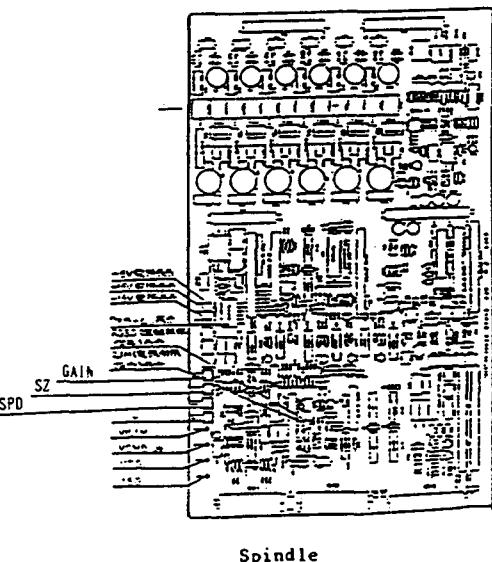
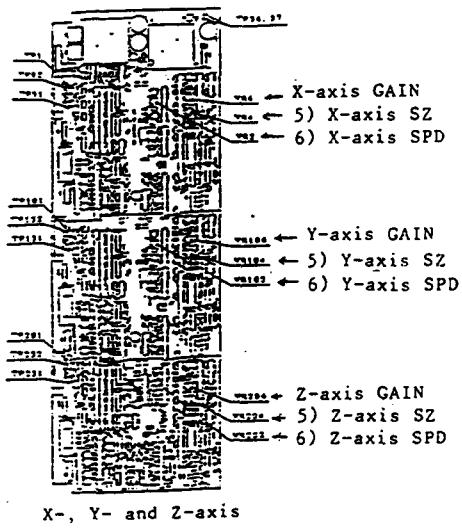
Refer to Replacing the NC PCB (No. 700200).

- 6) Adjust the deviation values. The adjustment values and conditions differ for each axis, as shown in the table below.

	Adjustment Values	Adjustment Conditions
X- and Y-axis	730 $\pm 1\%$	Manual mode 10% of rapid feedrate (2000 mm/min)
Z-axis	736 $\pm 10\%$	Manual mode 10% of rapid feedrate (1500 mm/min)
Spindle	18500 $\pm 10\%$	Manual mode Spindle speed: 6000 min ⁻¹

Note: Adjust the X- and Y-axis deviation values to the same value.

Adjust the driver SPD to set the adjustment values given in the table above.



Part Name	Part Code	Jigs and Tools Required	Precision phillips screwdriver
Replacement Parts			

Issued: / /

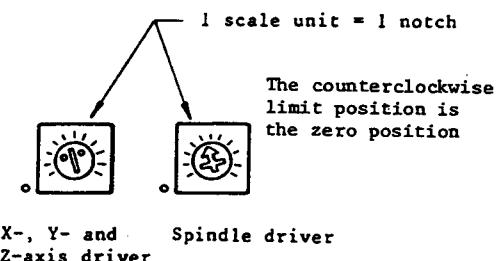
TC-225

7) Adjust the gain.

If a driver does not operate normally with the initial values (hunting or noisy operation), adjust the gain trimmer ± 1 notch.

Initial Values:

	X	Y	Z	Spindle
GAIN	8	8	7	8
UHT	-	-	-	5



* The numbers indicate numbers of notches.

Replacement Parts	Part Name	Part Code	Jigs and Tools Required

3.6 ADJUSTING THE OPERATION BOX PARTS

860100 Adjusting the CRT

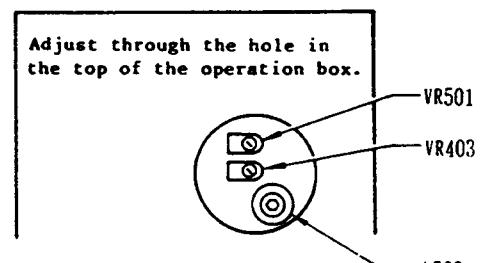
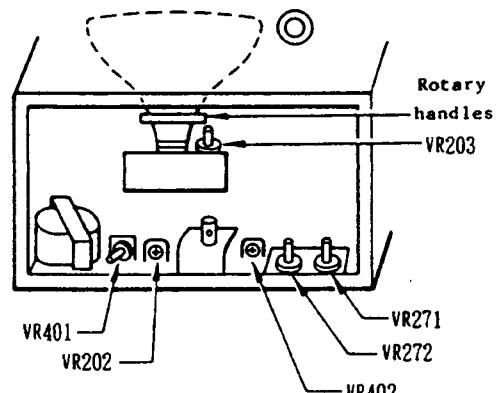
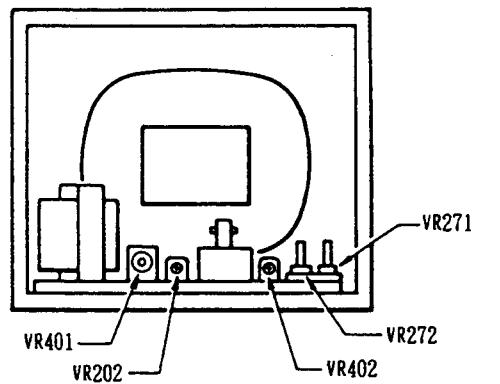
Issued: / /

TC-215

TC-225

- 1) POWER [OFF]
- 2) Remove the splash rear cover and the operation box rear cover.
- 3) Pull out the grommet (black rubber plug) from the top of the operation box.
- 4) Adjust the appropriate trimmers to carry out the required adjustments.

Function	Trimmer Name	Purpose
Vertical hold	VR401 (V. HOLD)	Adjust to stop the CRT display from "slipping" vertically.
Vertical linearity	VR403 (V. LINEAR)	Adjust if the heights of the characters at the top and bottom of the CRT display are not constant.
Vertical height	VR402 (V. HEIGHT)	Adjust if the CRT display is distorted vertically.
Horizontal hold	VR501 (H. HOLD)	Adjust to center the CRT display horizontally.
Horizontal linearity	DY (on the deflecting coil)	Adjust when the display is inclined horizontally. Adjust by rotating the DY handles.
Horizontal width	L502 (H. WIDTH)	Adjust if the CRT display is distorted horizontally.
Center/edge focus	VR203 (FOCUS)	Adjust if the characters displayed in the center or edges of the CRT are not clear.
Contrast	VR271 (CONT. R)	Adjust as required to suit the illumination level in the workshop.
Brightness	VR272 (BRIGHT)	



* Take care not to touch or short high-voltage parts of the CRT unit.

- 5) After completing the adjustments, replace the grommet and screw on the rear covers.

Replacement Parts	Part Name	Part Code	Jigs and Tools Required	Straight-headed screwdriver Allen wrenches * Use only tools with plastic handles, to prevent shorting.

3.7 ADJUSTMENT REFERENCE TABLE

Part Replaced	Adjustment	Spindle orientation measurements	Static accuracy measurement	Magazine	Address sensor	Barrel cam	Setting the grid point limit	Zero-point limit switch	Overrun limit switches	ATC operation area limit switch	ATC zero-point limit switch	Drivers	Spindle drivers when replacing the spindle motor	CRT
Spindle motor	o											o	o	
Spindle coupling	o											o		
Spindle	o	o												
Magazine				o	o	o								
Gripper				o	o									
Address sensor				o										
Barrel cam				o	o	o								
X-, Y- or Z-axis motor						o	o				o			
X-, Y- or Z-axis coupling						o	o							
X-, Y- or Z-axis ball screw						o	o							
Z-axis brake						o	o							
X-, Y- or Z-axis zero-point limit switches						o	o							
X-, Y- or Z-axis overrun limit switches							o							
ATC operation area limit switch								o						
ATC zero-point limit switch									o					
NC PCB											o			
Spindle driver	o										o			
CRT unit											o			

o: indicates required adjustment

4. CONFIGURATION OF THE ELECTRICAL SYSTEM

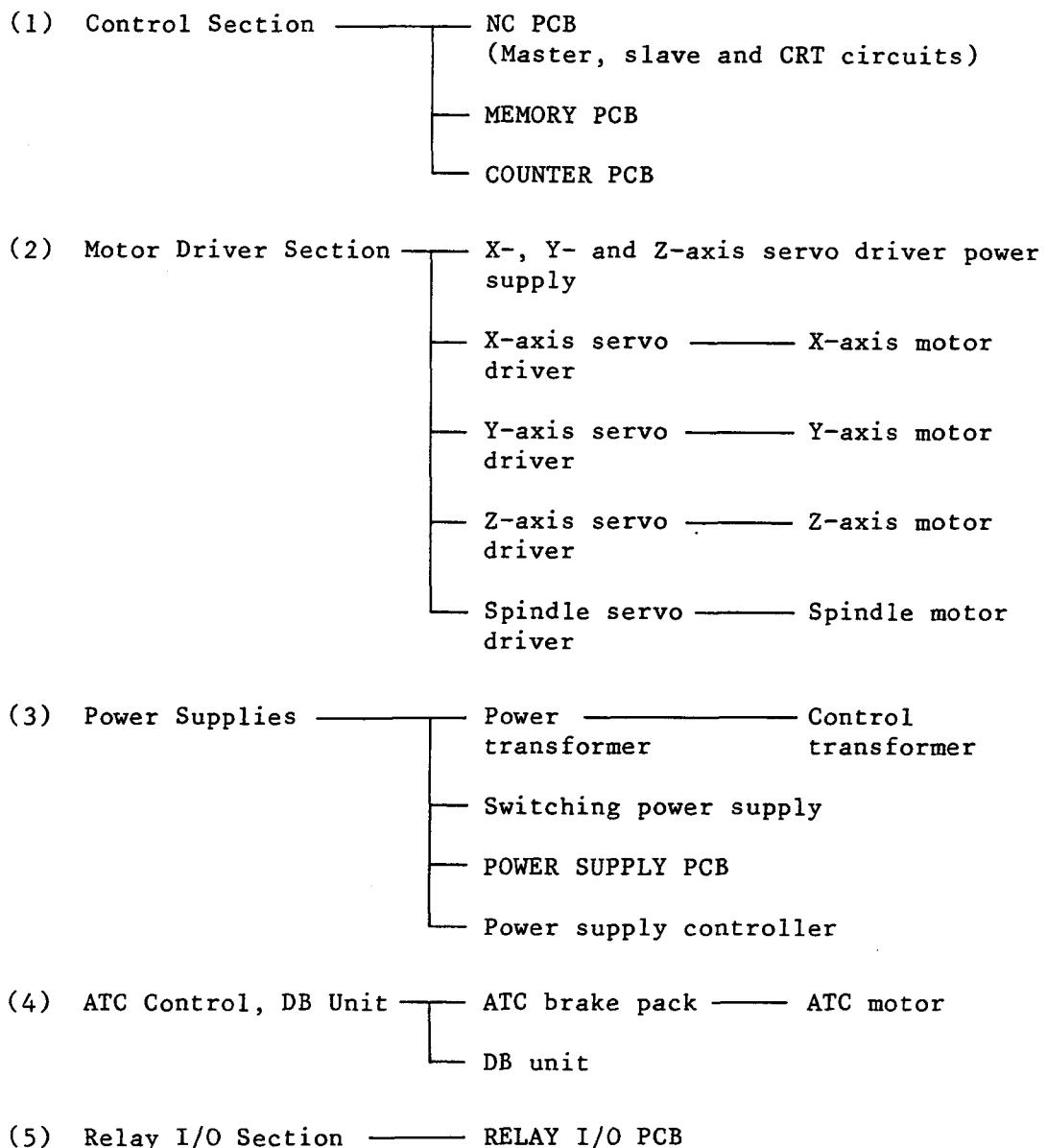
4.1 CONFIGURATION OF THE CONTROL SYSTEM (TC-215)

4.1.1 Configuration

The TC-215 CNC Tapping Center control system is made up of the sections listed below.

The NC functions depend on the software stored in semiconductor memory.

4.1.1.1 Control circuits



4.1.1.2 Power transformer

- Main circuit transformer

4.1.1.3 Cooling section

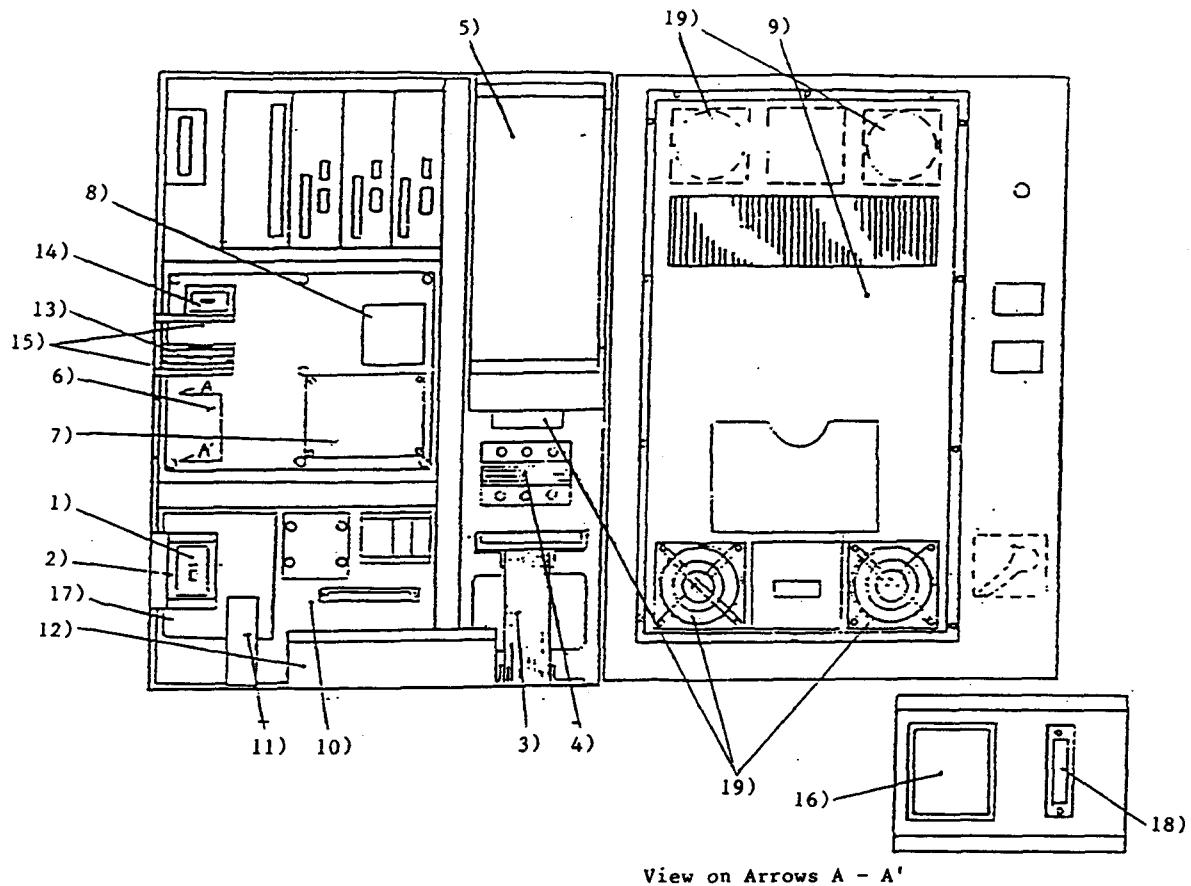
4.1.1.4 Operation box

- OPERATION PCB
- CRT unit

4.1.1.5 ATC sensor section

- ATC SENSOR PCB

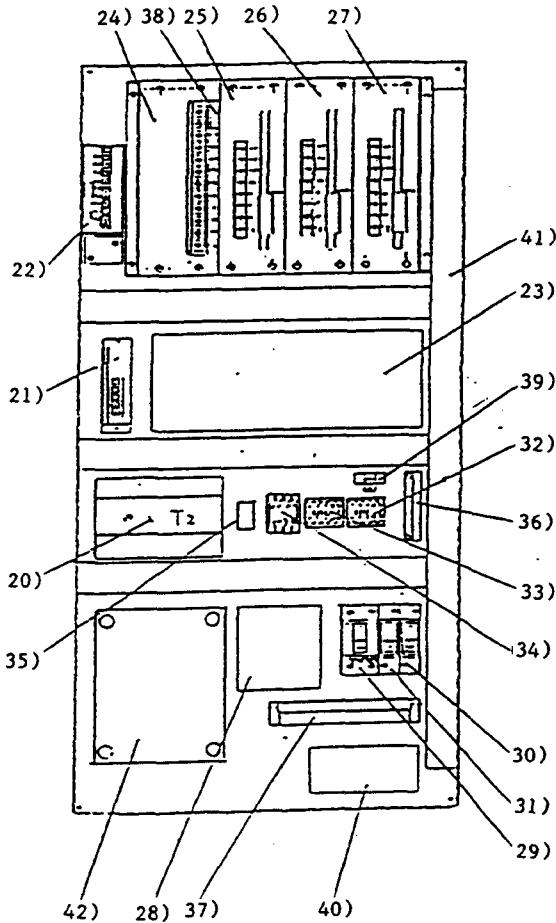
4.1.2 Control Panel Internal Layout (TC-215)



View on Arrows A - A'

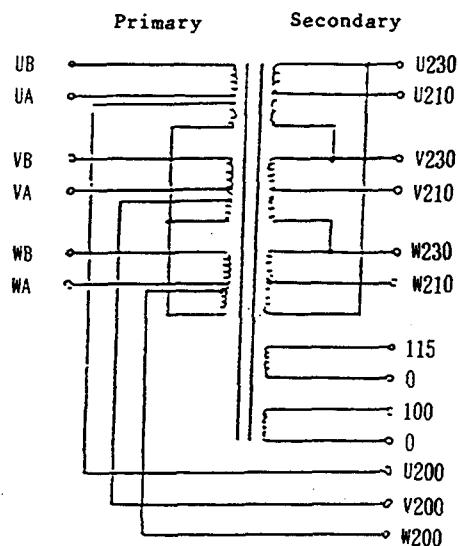
- 1) No-fuse circuit breaker
- 2) Noise filter
- 3) Power transformer (main circuit)
- 4) DCL
- 5) Spindle servo driver 1.5 kW (6000 min^{-1} or 10000 min^{-1})
- 6) NC PCB
- 7) Memory PCB
- 8) Counter PCB
- 9) Cooling unit
- 10) Control unit (Details shown in the next page.)
- 11) Broken tool detector (optional)
- 12) Sequencer (optional)
- 13) RS-PR unit (optional)
- 14) Bubble memory unit (optional)
- 15) DC converter PCB (optional)
- 16) Battery holder
(three AA batteries for backup (life - one year))
- 17) RELAY I/O PCB
- 18) Terminal block TB7
- 19) Cooling fan

Control Unit



- | | |
|-------------------------------|--|
| 20) Control transformer T2 | 35) ATC motor capacitor
(motor accessory) |
| 21) AVR2 (P24V) | 36) Terminal block TB4 |
| 22) AVR1 (P5V, P15V, N15V) | 37) Terminal block TB5 |
| 23) DB unit | 38) Surge absorber RC6 |
| 24) Servo power supply | 39) Surge absorber RC0 |
| 25) Z-axis servo driver 300 W | 40) Ground plate |
| 26) Y-axis servo driver 150 W | 41) Cable duct |
| 27) X-axis servo driver 150 W | 42) RELAY I/O PCB |
| 28) POWER SUPPLY PCB | |
| 29) Circuit protector CP3 | |
| 30) Circuit protector CP2 | |
| 31) Circuit protector CP1 | |
| 32) MC-1 | |
| 33) MC-2 | |
| 34) ATC brake pack | |

4.1.3 Power Transformer (62735800)



3-phase 230 V

210 V 2.84 kVA power supply
for the spindle motor drive

Single-phase, 115 V ... 660 VA power supply for X-, Y-, Z-axis motor drives

Single-phase, 100 V ... 200 VA power supply for valve drive
(air, coolant valves)

3-phase

Automatic 200 V 460 VA Power supply for ATC and coolant motors

Product Specifications	
Capacity	4.16 kVA
Phases	3-phase/single-phase
Frequency	50/60 Hz
Primary Voltage	3-phase AV, BV
Insulation Resistance	100 MΩ
Dielectric Strength	2 kV/minute
Insulation Type	Type E

Note 1: The input voltage must be maintained within +10% of the rated voltage.

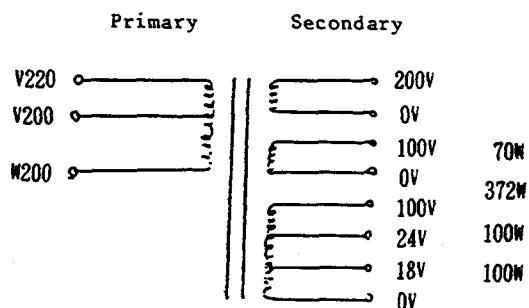
Note 2: The tap must be selected corresponding to input voltage.

Last Digits of Product Code	Voltage for Code A Parts	Voltage for Code B Parts	Application
001	200	220	Japan
002	208	230	U.S.A.
003	220	240	Norway, Korea
004	346	380	Hong Kong
005	380	415	Europe
006	400	440	India

4.1.4 Internal Configuration and Functions of the Control Unit

4.1.4.1 Power supply

(1) Control Transformer



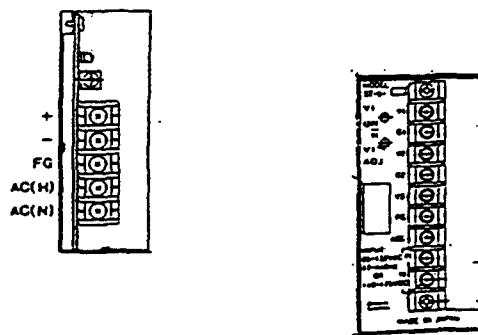
200 V ... Main control power supply
100 V ... Power supply sequencer for feed axis control
100 V ... Spotlight
24 V ... POWER SUPPLY PCB, Spotlight
18 V ... Power supply for handy sequence controller

Product Specifications	
Capacity	592 kVA
Phases	Single-phase
Frequency	50/60 Hz
Primary Voltage	200, 220 V
Insulation Resistance	At least 100 MΩ
Dielectric Strength	2 kV/minute

Note 1: The input voltage must be maintained within $\pm 10\%$ of the rated voltage.

Note 2: The tap must be selected corresponding to input voltage.

(2) Switching Power Supply



a) AVR2

P24V switching power supply:

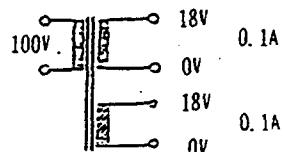
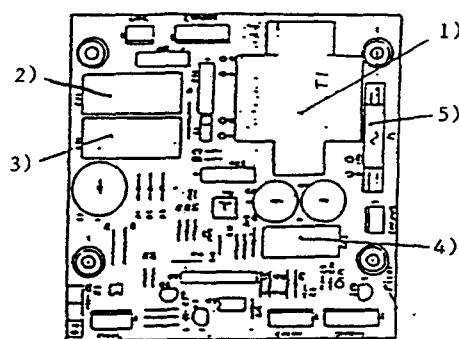
Power supply for the RELAY I/O PCB

b) AVR1

P5V, P15V, N15V switching power supply:

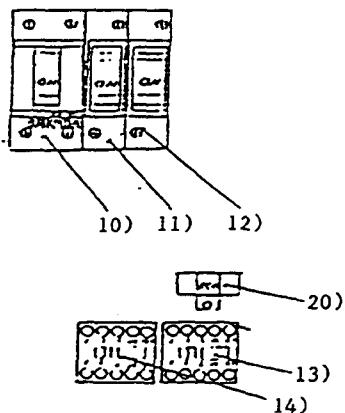
Power supply for the control section, RS-PR and bubble memory.

(3) POWER SUPPLY PCB



- 1) T1 : Input 100 V, output 18 V, 0.1 A
- 2) CR1: This relay delays application of the servo power supply after the main power supply is turned on.
(Delay time is approx. 2 sec.)
- 3) CR2: Relay to turn MC1 ON (control power supply)
- 4) CR3: Power supply alarm output relay
- 5) F1 : 0.1 A G fuse

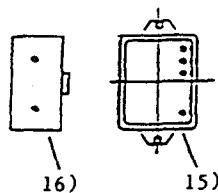
(4) Power Supply Controller



- 10) CP3: Circuit protector for coolant motor alarm output (1 A)
- 11) CP2: Circuit protector for the cooling fan and ATC brake pack alarm output (2 A)
- 12) CP1: Circuit protector for the control power supply (5 A)
- 13) MC1: Relay to turn ON the control power supply and the servo control power supply.
- 14) MC2: Relay to turn the coolant motor ON. (DC relay)
- 15) MC1: Power supply coil surge absorber

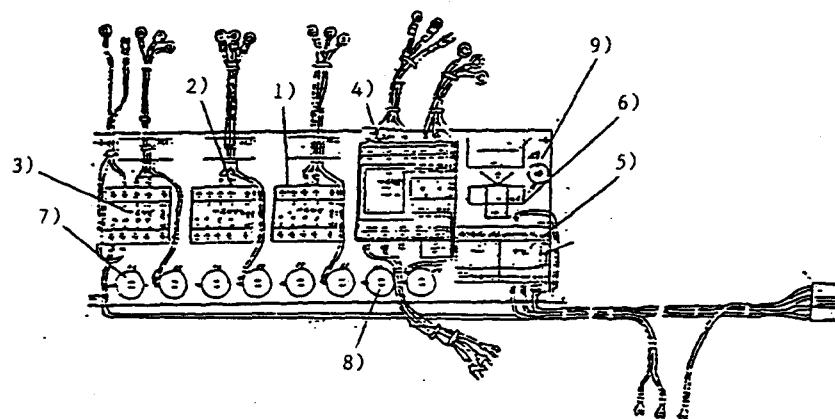
4.1.4.2 ATC, DB unit

(1) ATC



- 15) ATC motor brake pack for ATC control
16) ATC motor capacitor

(2) DB Unit



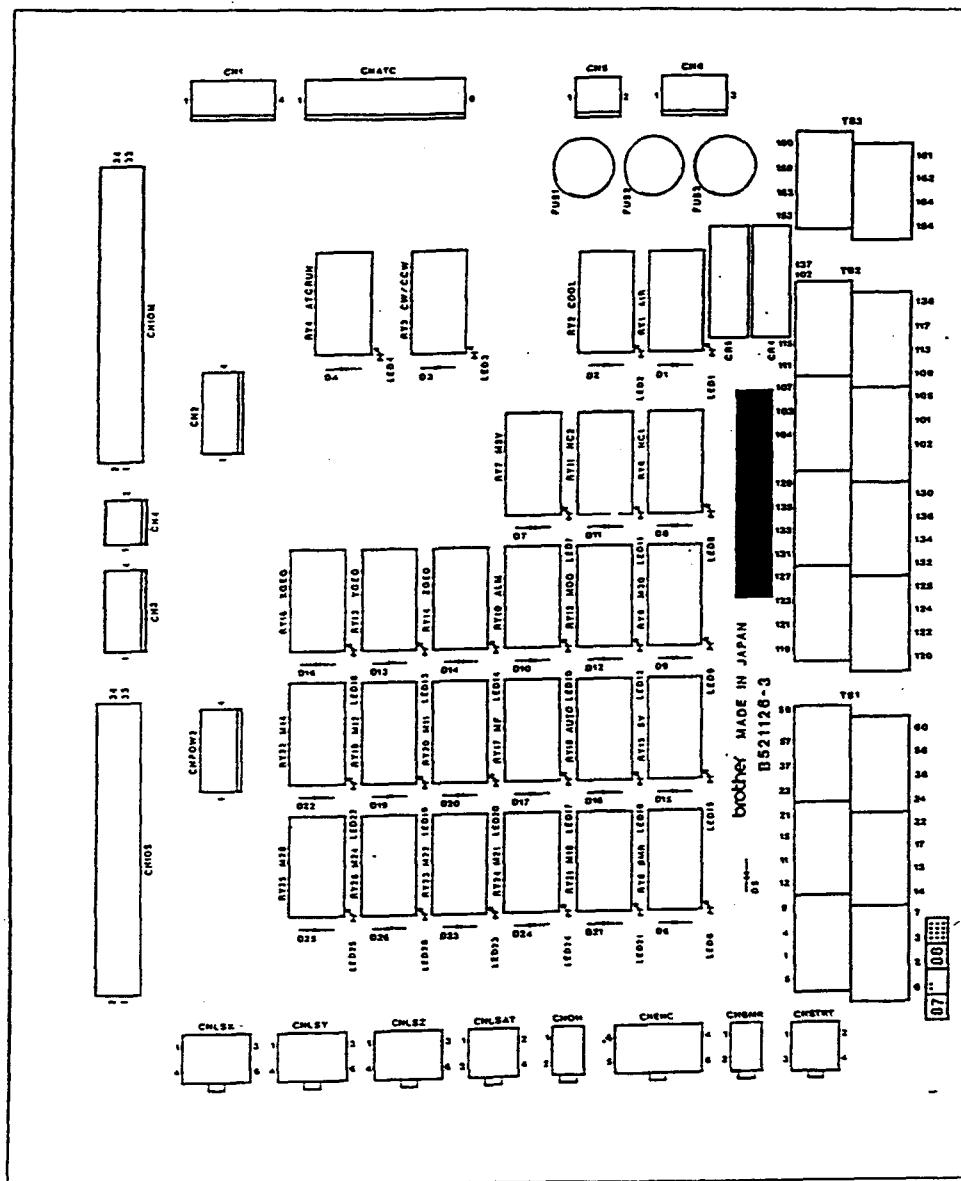
- 1) MSVX : Cuts off the drive power supply to the X-axis motor.
Applies the dynamic brake to the X-axis motor.
- 2) MSVY : Cuts off the drive power supply to the Y-axis motor.
Applies the dynamic brake to the Y-axis motor.
- 3) MSVZ : Cuts off the drive power supply to the Z-axis motor.
Applies the dynamic brake to the Z-axis motor.

- 4) MSVS : Cuts off the drive power supply to the spindle motor.
Applies the dynamic brake to the spindle motor.
- 5) RY1 : Relay to confirm that the servo power supply is ON.
Confirms the power supply input to the MSVX, MSVY, MSVZ and MSVS.
- 6) TM1 : Spindle servo power supply input delay timer
This relay delays application of the spindle servo power supply after the main power supply is turned on. (Delay time is 0.5 sec.)
- 7) R1 - 6: Resistances for the axis feed motor dynamic braking
- 8) R7, R8: Resistances for the spindle motor dynamic braking
- 9) R9 : Resistance to increase the current from the power supply confirm relay contacts.

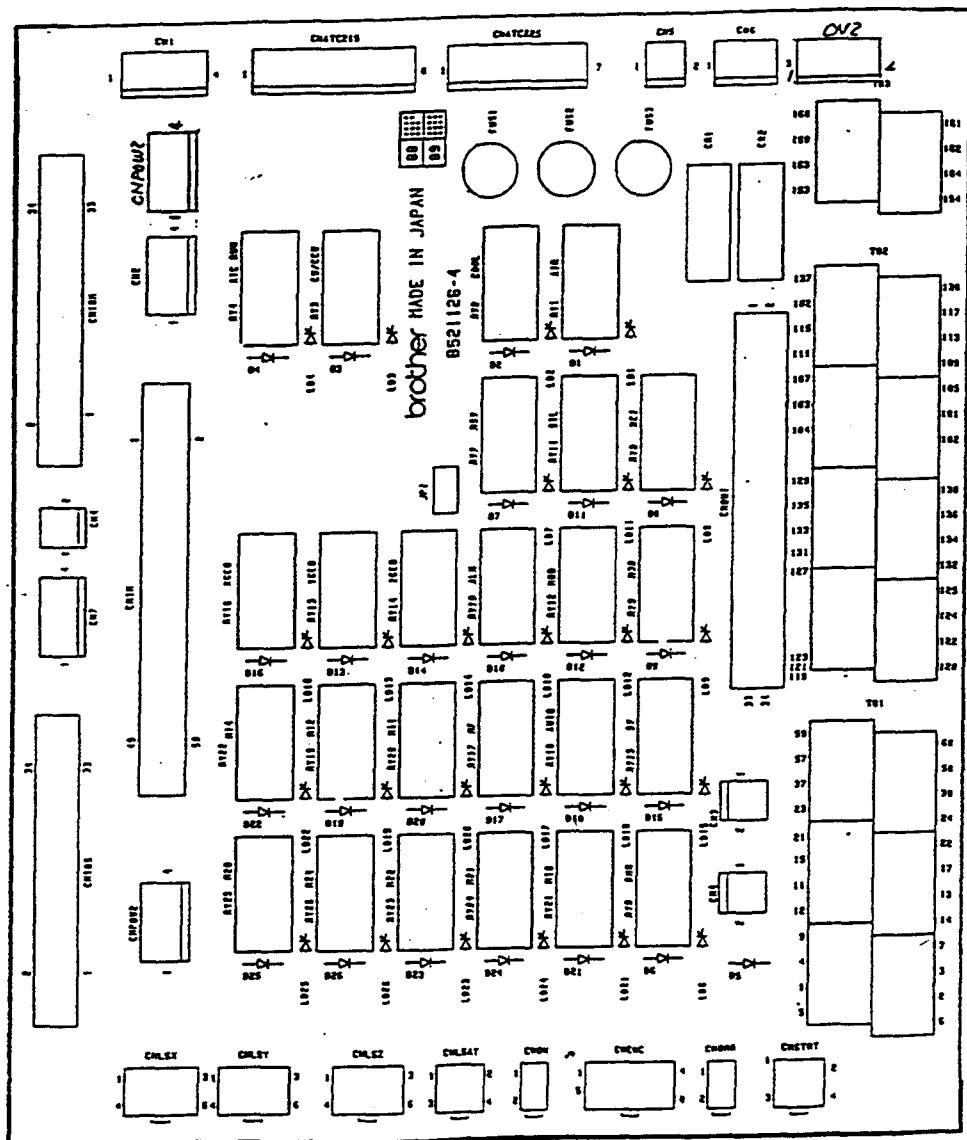
4.1.4.3 Relay I/O section

RELAY I/O PCB #3 TC-215

For machine No. _____ and below



New RELAY I/O PCB #4 TC-215, TC-225



TC-215: For machine No.
TC-225: For machine No.

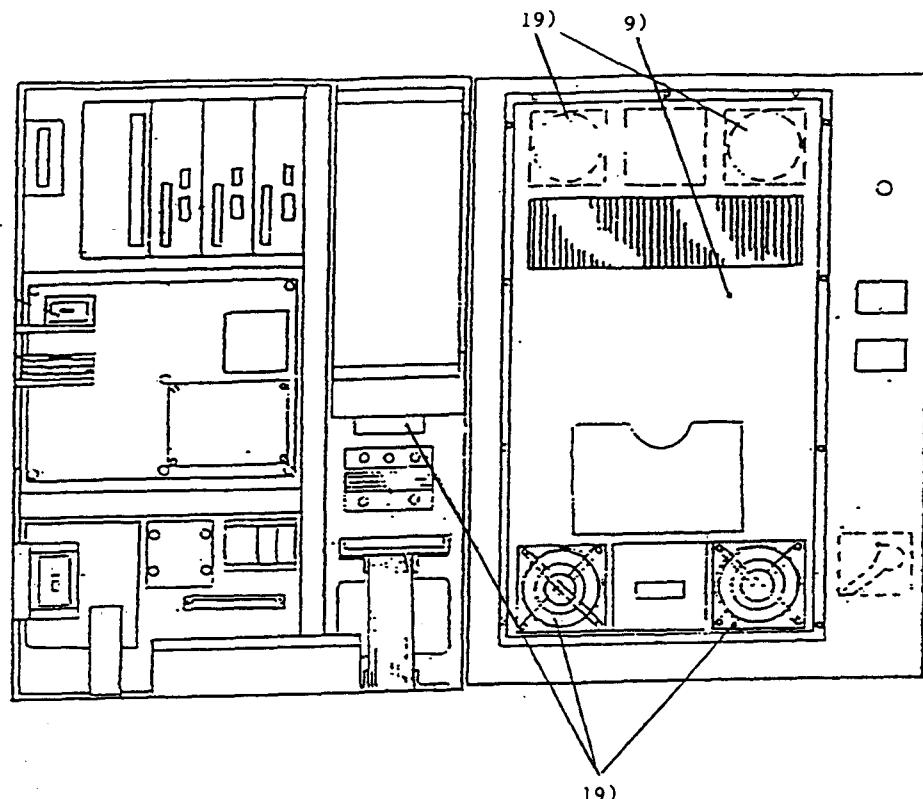
and above
and above

RELAY I/O PCB Relay Numbers, Signal Names and Functions

Relay No.	Signal Name	Function
RY16	XGEO : X-axis zero-point return complete	This signal is output when the X-axis returns to the machine zero point.
RY15	SV : Servo ON (external)	This signal is output from the time a servo turns ON after the NC power supply is turned ON until an alarm signal is output or the NC power supply is turned OFF.
RY20	M11 : External signal output 11	The NC unit outputs 2-digit, decimal values in BCD code to external units. These external signal outputs range from 00 to 89 depending on the designation set by key input or memory run.
RY19	M12 : External signal output 12	
RY22	M14 : External signal output 14	
RY21	M18 : External signal output 18	
RY24	M21 : External signal output 21	
RY23	M22 : External signal output 22	
RY26	M24 : External signal output 24	
RY25	M28 : External signal output 28	
RY17	MF : External signal output latch	This signal is output 20 msec after an external signal output and continues to be output until the external signal is complete.
RY11	STL : Automatic operation started	This signal is output from the time automatic operation is started until a HOLD or SINGL RUN command is received.
RY10	ALM : Alarm output	This signal is output when an alarm which turns the servo OFF (0 - 31, identified by two asterisks (**)) is displayed on the screen.
RY18	AUTO : Automatic operation	This signal is output from the time the START button is pressed to start automatic operation until the RESET button is pressed, or an equivalent signal is received.

Relay No.	Signal Name	Function
RY4	ATC RUN: ATC rotation	This signal turns the ATC motor.
RY12	M00 : Program stop	This signal is output when the external signal 00 is executed.
RY8	NC1 : Emergency stop	This signal is output when the EMERGENCY stop button is pressed.
RY6	BMR : Z-axis brake	This signal is ON when the Z-axis servo is OFF.
RY3	CW/CCW : ATC direction of rotation	This signal commands the ATC motor to rotate clockwise or counterclockwise.
RY13	YGE0 : Y-axis zero point return complete	This signal is output when the Y-axis returns to the machine zero point.
RY9	M30 : Program end	This signal is output when the end of the program is reached.
RY1	NC10 : Air valve ON	This signal turns the air valve ON.
RY14	ZGEO : Z-axis zero point return complete	This signal is output when the Z-axis returns to the machine zero point.
RY7	MSV : Internal servo ON signal	This signal turns the servo power supply ON.
RY2	M08 : Coolant ON	This signal turns the coolant valve ON.

4.1.5 Cooling Unit



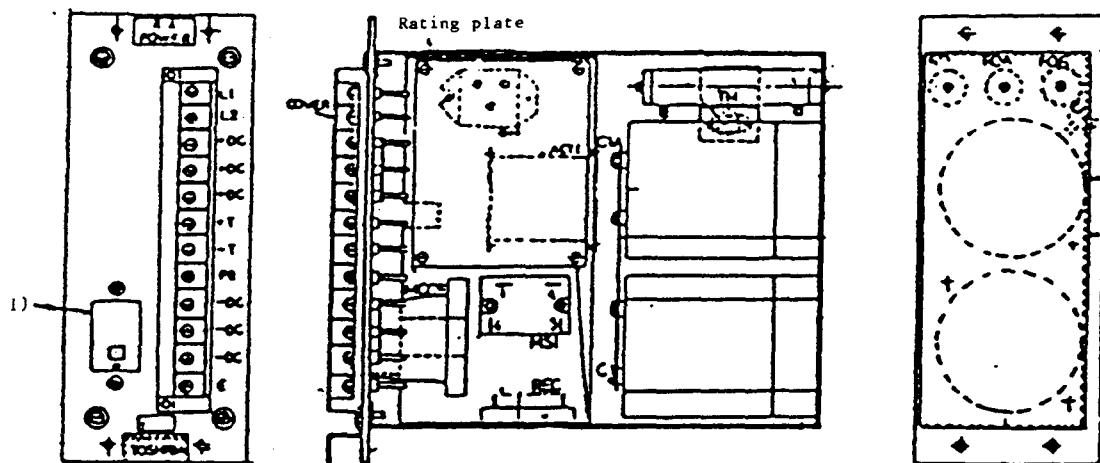
9) Cooling unit

19) Cooling fans to cool the inside of the control box and the spindle regenerative resistances

4.1.6 Servo Drivers

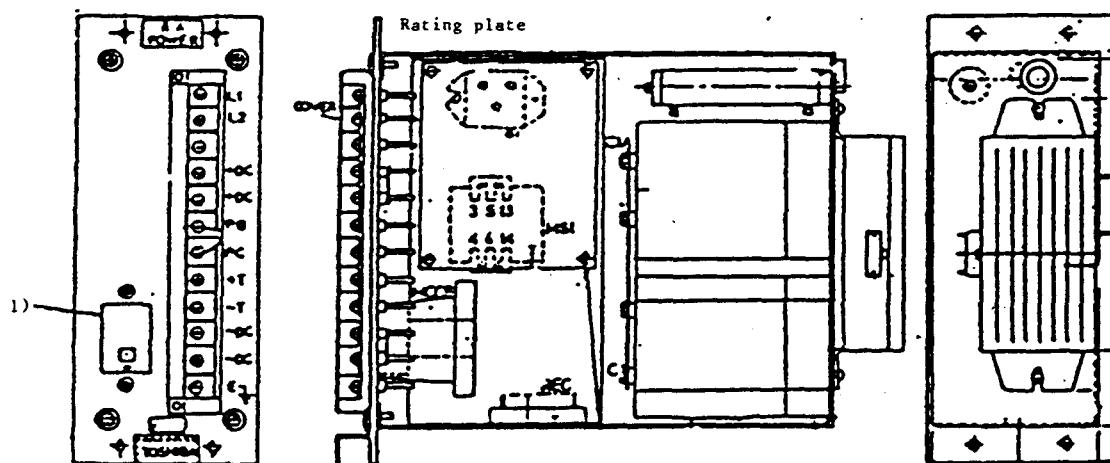
4.1.6.1 X-, Y- and Z-axis servo power supplies

(1) RAD 90-008 (Old model)



1) Circuit protector for the main circuit (15 A)

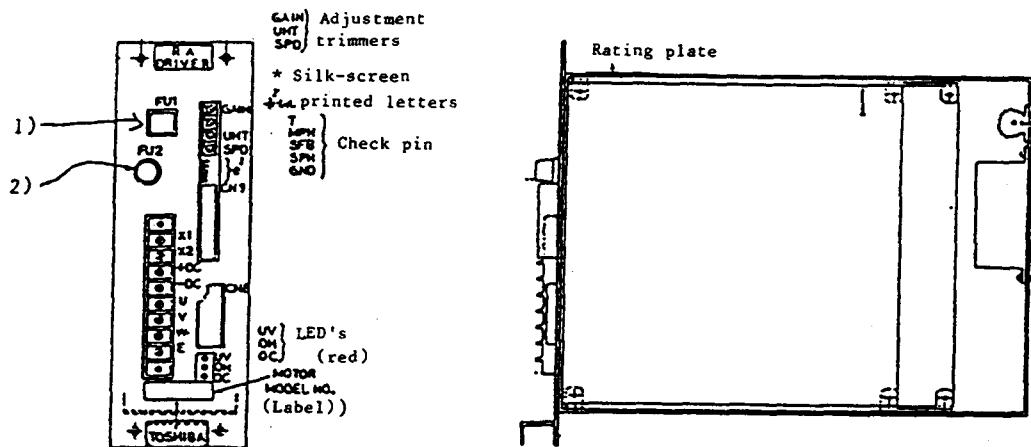
(2) RAD 92-1008 (New model)



1) Circuit protector for the main circuit (15 A)

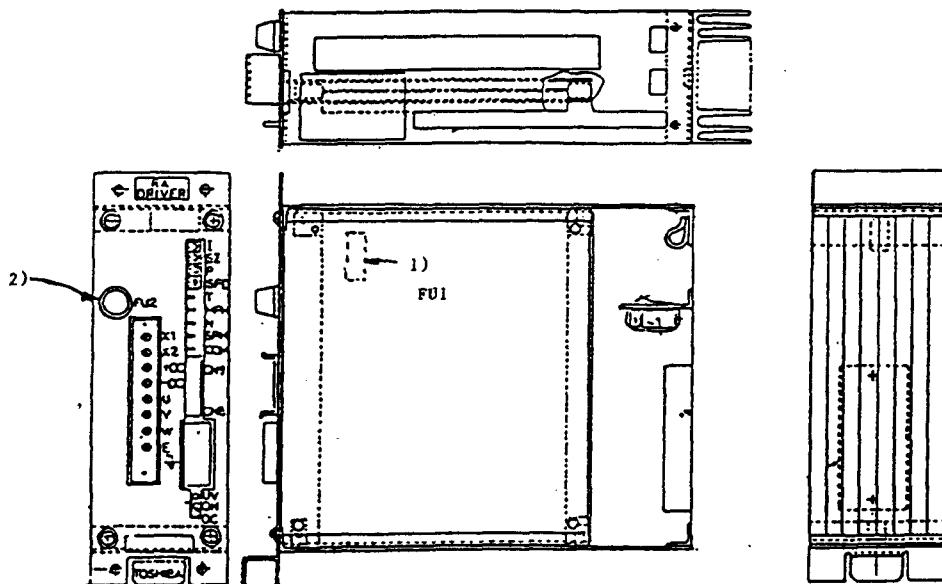
4.1.6.2 X- and Y-axis drivers (150 W)

(1) RAD 10-006 (old model)



- 1) FU1: Control circuit fuse (1 A)
 - 2) FU2: Main circuit fuse (10 A)

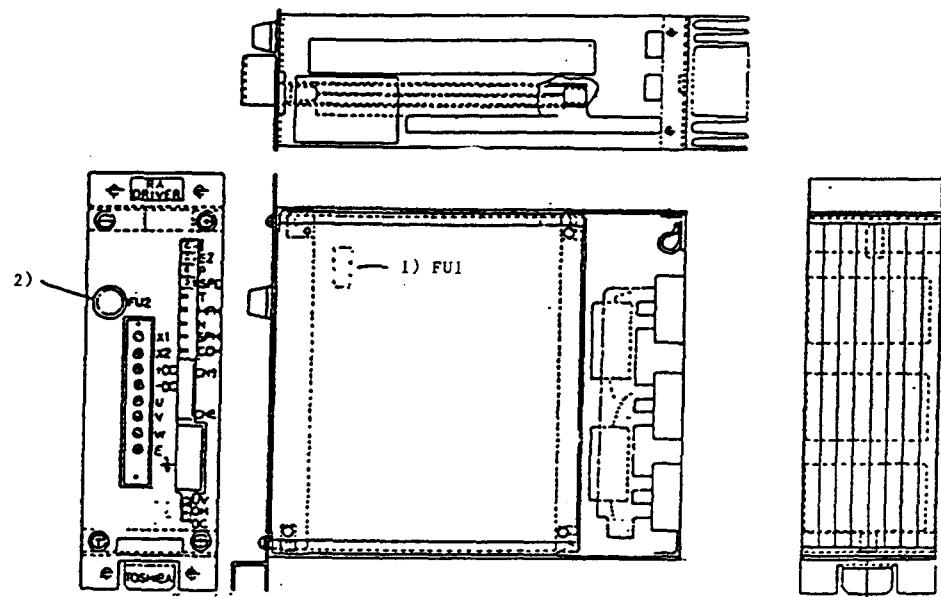
(2) RAD 12-1006 (New model)



- 1) FU1: Control circuit fuse (2 A)
(Located on the left face of the PCB, when viewed from the front.)
 - 2) FU2: Main circuit fuse (10 A)

4.1.6.3 Z-axis driver (300 W)

(1) RAD 12-1012

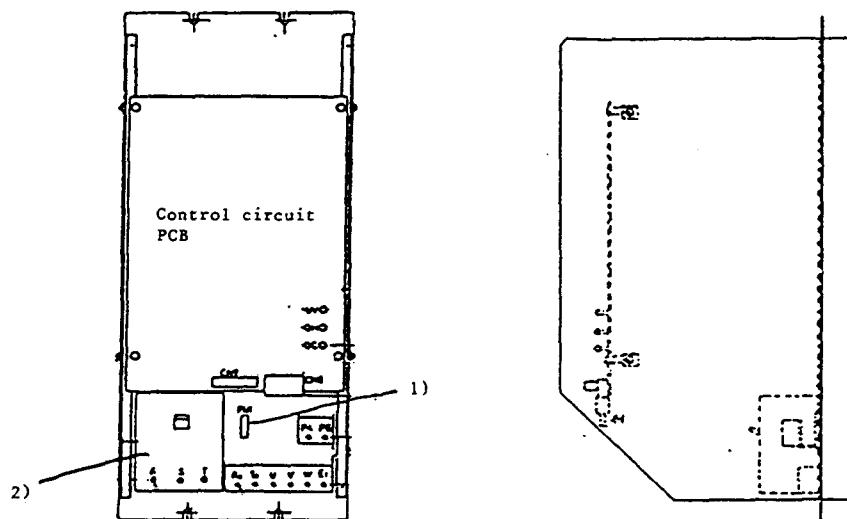


- 1) FU1: Control circuit fuse (2 A)
(Located on the left face of the PCB, when viewed from the front.)
- 2) FU2: Main circuit fuse (10 A)

4.1.6.4 Spindle driver (1.5 kW)

(1) 6000 min^{-1} Specification

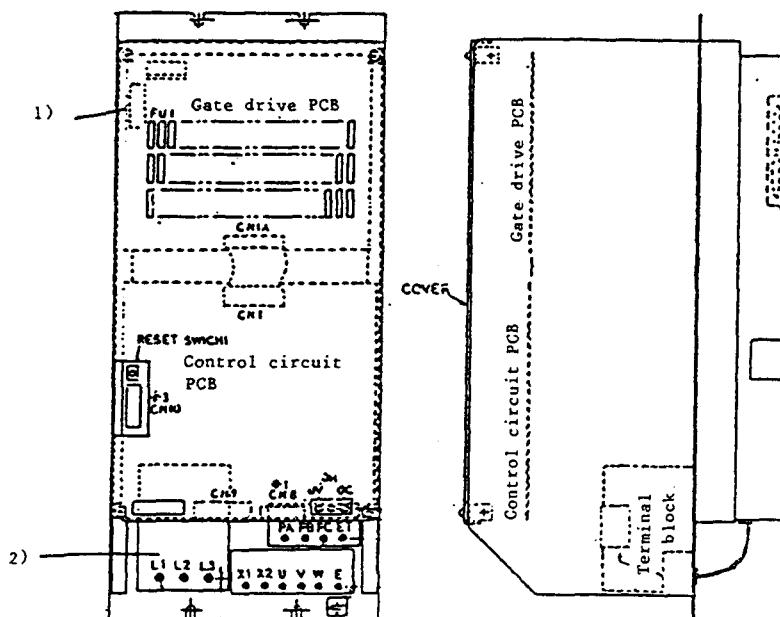
RAD 01-060 (Old model)



- 1) FU1: Control circuit fuse (2 A)
- 2) Main circuit breaker (30 A)

(2) 6000 min^{-1} Specification

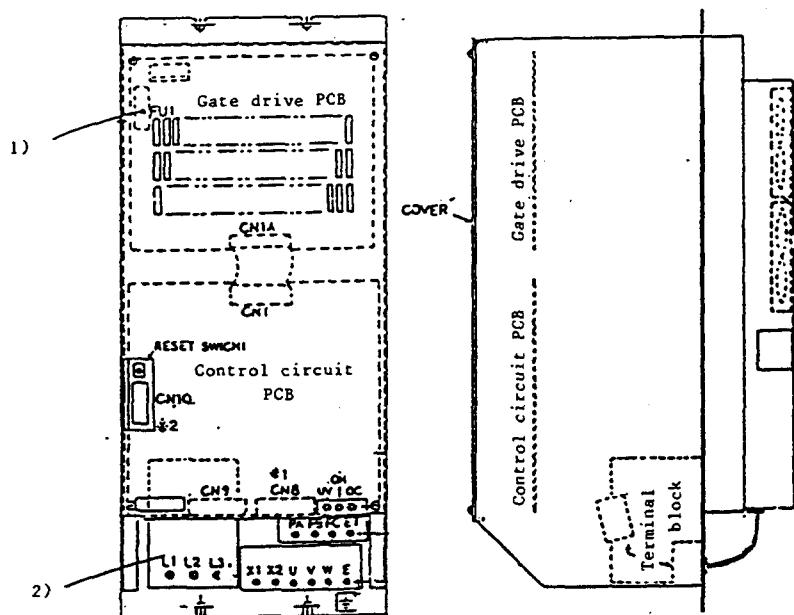
RAD 02-2060 (New model)



- 1) FU1: Control circuit fuse (2 A)
- 2) Main circuit breaker (30 A)

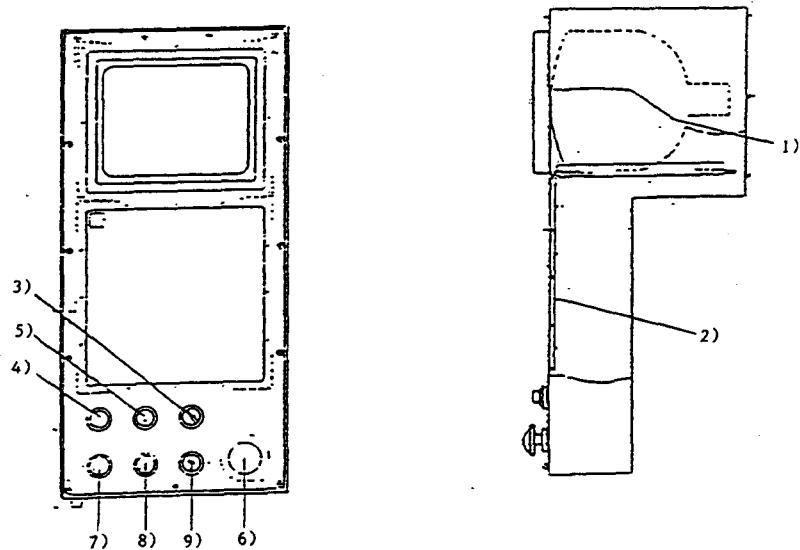
(3) 10000 min^{-1} Specification

RAD 02-2061



- 1) F1: Control circuit fuse (2 A)
- 2) Main circuit breaker (30 A)

4.1.7 Operation Box



Layout Drawing of Operation Box Parts

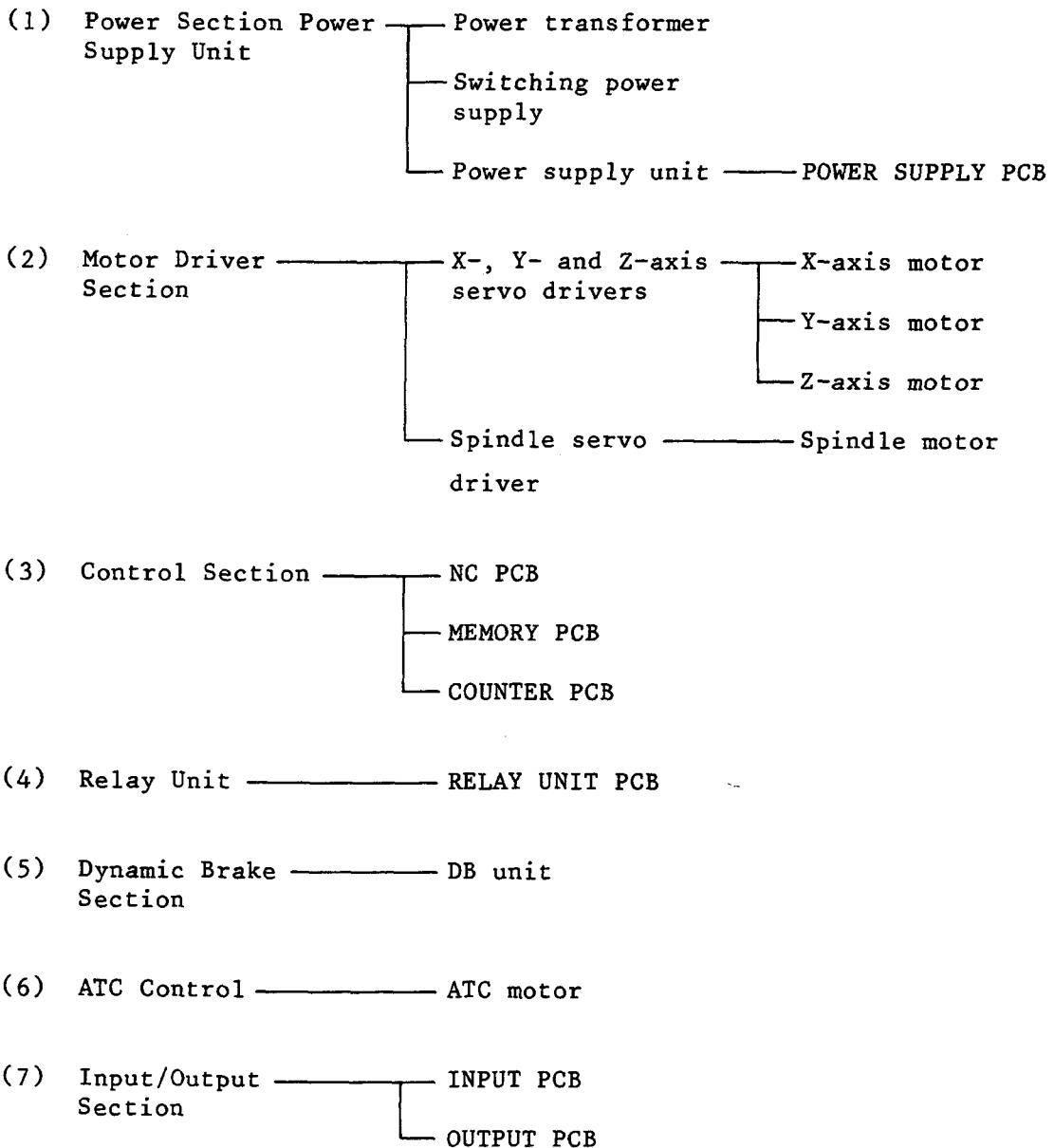
- 1) CRT unit NV-0932YU (Mitsubishi)
- 2) OPERATION PCB
- 3) COOLANT MOTOR ON/OFF switch
- 4) POWER ON switch
- 5) POWER OFF switch
- 6) EMERGENCY stop switch
- 7) AUTO START switch
- 8) AUTO HOLD switch
- 9) PROGRAM PROTECT ON/OFF switch

4.2 CONFIGURATION OF THE CONTROL SYSTEM (TC-225)

4.2.1 Configuration

The TC-225 CNC Tapping Center control system comprises the sections listed below.

The NC functions depend on the software stored in semiconductor memory.



(8) Cooling Unit

(9) Operation Box ————— OPERATION PCB
 |
 CRT UNIT

(10) ATC Sensor Section ————— ATC SENSOR PCB

The configuration and content of the CNC control unit are shown in Fig. 1.

4.2.2 Control Panel Internal Layout

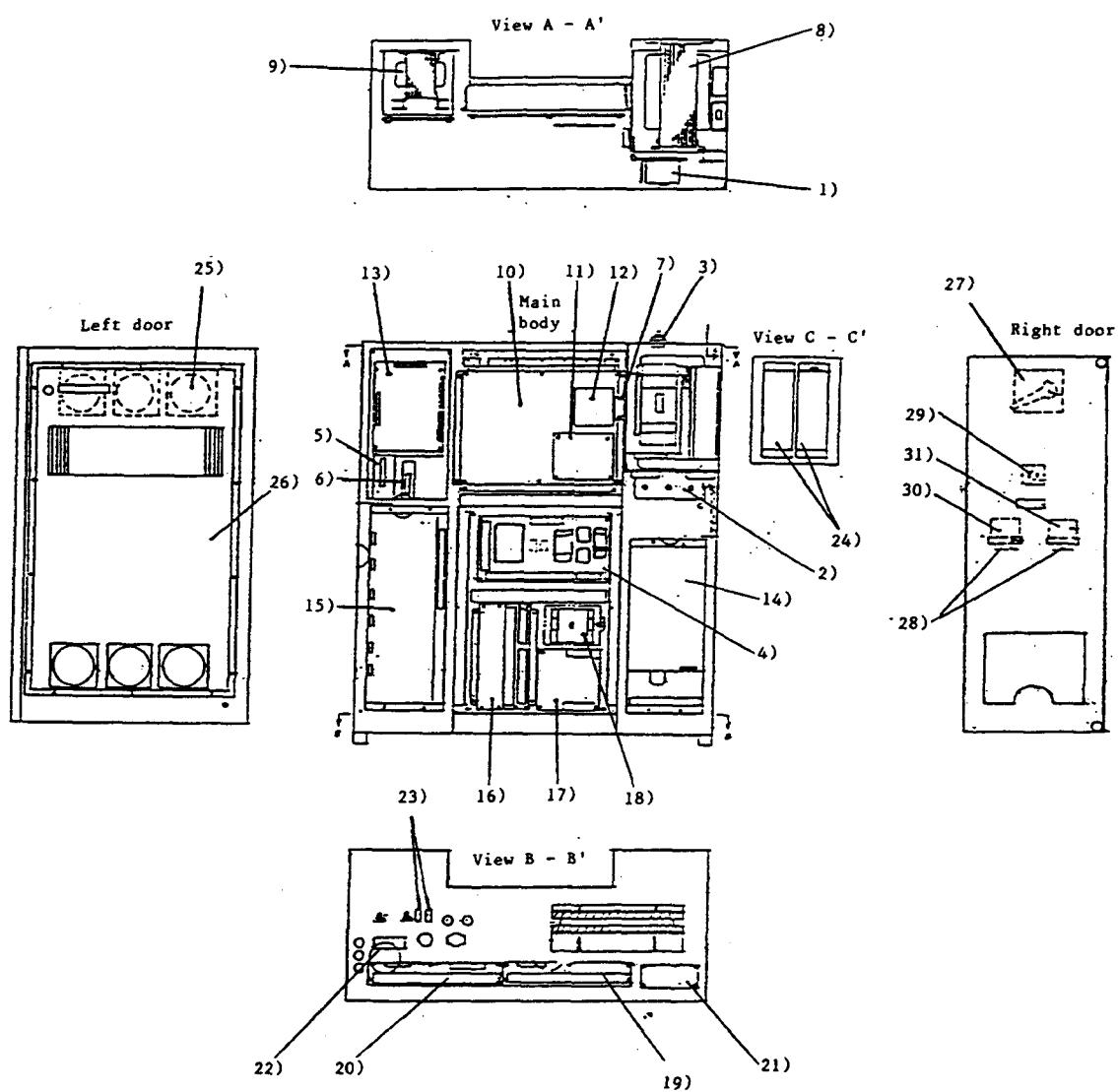
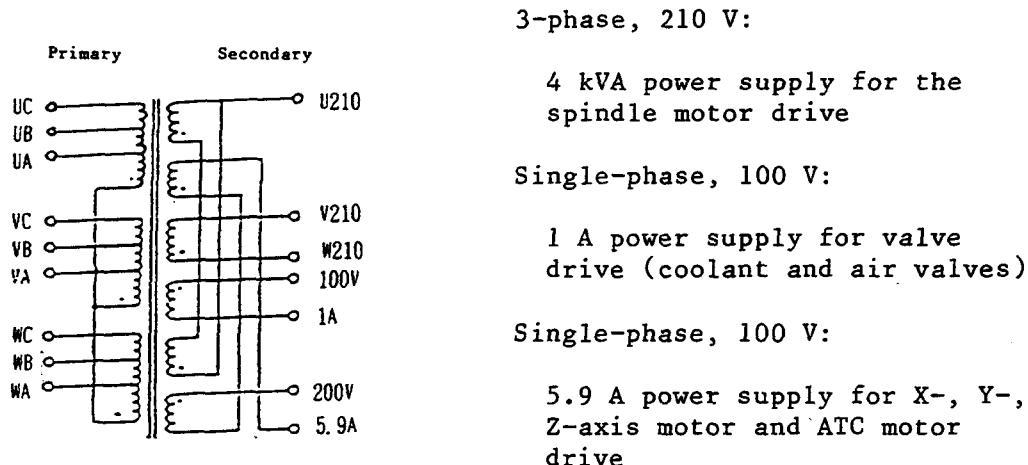


Fig. 1 Control Panel Internal Layout Diagram

- 1) No-fuse circuit breaker
- 2) Noise filter
- 3) Power cable lock
- 4) Power supply unit
- 5) AVR1 (P5V, P15V, N15V)
- 6) AVR2 (P24V)
- 7) Battery holder
(three AA batteries for backup (life - one year))
- 8) Power transformer 1 (main circuits)
- 9) Power transformer 2 (control circuits)
- 10) NC PCB
- 11) MEMORY PCB
- 12) COUNTER PCB
- 13) Relay unit
- 14) Spindle servo driver
- 15) X-, Y- and Z-axis servo drivers
- 16) DB unit
- 17) ATC control unit
- 18) Spindle DB electromagnetic switch
- 19) INPUT PCB
- 20) OUTPUT PCB
- 21) Ground plate
- 22) Coolant motor terminal block
- 23) 5 A fuses, to protect the coolant motor (2)
- 24) Spindle regenerative resistance
- 25) Cooling fan
- 26) Cooling unit
- 27) Circuit breaker handle
- 28) DC CONVERTER PCB (optional)
- 29) Inch/metric selector switch
- 30) Bubble memory unit (optional)
- 31) RS-PR unit (optional)

4.2.3 Power Section Power Supply Unit

4.2.3.1 Power supply transformer 1 (main circuits)

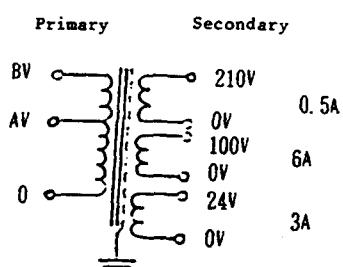


Primary Voltage B	Primary Voltage C
200	220
208	230
220	240
346	380
380	415
400	440

Product Specifications	
Capacity	6 kVA
Phases	3-phase/single-phase
Frequency	50/60 Hz
Primary voltage	3-phase BV, CV
Secondary Voltage Capacity Output 3-phase, 200 V, 0.8 kVA	3-phase : 210 V, 4 kVA Single-phase: 100 V, 1 A 200 V, 3.9 A
Voltage Deviation	Within <u>+3%</u>
Voltage Regulation	Within 5% or less
Wiring	Primary Y, Secondary Δ

4.2.3.2 Power supply transformer 2 (control circuits)

Single-phase, 210 V:



0.5 A power supply for the spindle motor drive

Single-phase, 100 V:

6 A power supply for X-, Y-, Z-axis control, switching regulator and CRT unit

Single-phase, 24 V:

3 A power supply for the spotlight

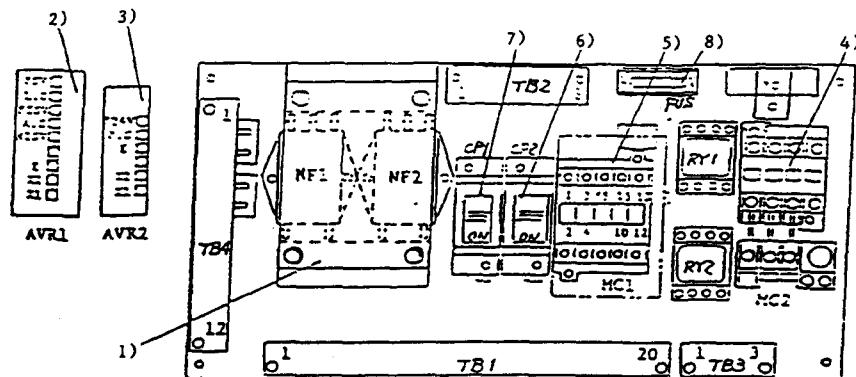
Primary Voltage A	Primary Voltage B
200	220
208	230
220	240
346	380
380	415
400	440

Product Specifications	
Capacity	777 VA
Phases	Single-phase
Frequency	50/60 Hz
Primary voltage	Single-phase AV, BV
Secondary Voltage	Single-phase: 210 V, 0.5 A 24 V, 3 A 100 V, 6 A
Voltage Deviation	Within <u>±</u> 3%
Voltage Regulation	Within 5% or less
Electrostatic Shielding	Provided

Note 1: The input voltage must be maintained within ±10% of the rated voltage.

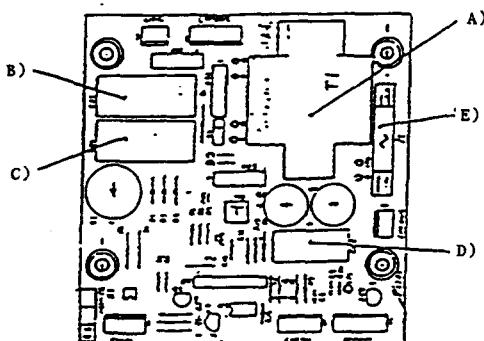
Note 2: The tap can be selected corresponding to the input voltage. (Refer to the Operation Manual.)

4.2.3.3 Power supply unit



This unit is made up of the parts listed below.

1) POWER SUPPLY PCB



A) T1 : Input 100 V, output 18 V, 0.1 A

100 V || 18V 0.1A

|| 18V 0.1A

B) CR1: This relay delays application of the servo power supply after the main power supply is turned on. (Delay time is approx. 2 sec.)

C) CR2: Relay to turn power relay MC1 ON (control power supply)

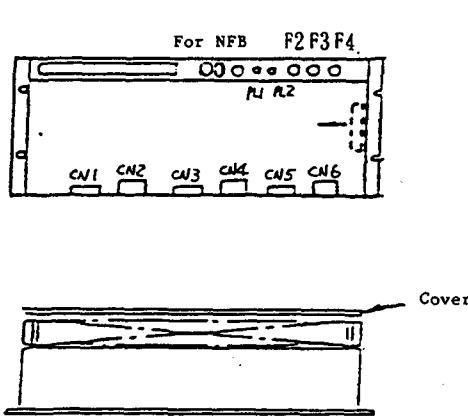
D) CR3: Abnormal power supply output relay

E) F1 : 0.1 A G fuse

- 2) AVR1: P5V, P15V, N15V switching regulator (power supply for the control unit)
- 3) AVR2: P24V switching regulator (Control power supply for the RELAY UNIT PCB and I/O PCB)
- 4) MC2 : Coolant motor thermal relay (1.7 A)
- 5) MC1 : Relay to turn ON the control power supply and the servo control power supply.
- 6) CP2 : Circuit protector for the ATC motor (2 A)
- 7) CP1 : Circuit protector for the AC 100 V control power supply (5 A)
- 8) FUS : Air valve power supply fuse (2 A)

4.2.4 Servo Drivers

4.2.4.1 X-, Y- and Z-axis servo drivers



NFB: (No-fuse circuit breaker)
motor drive system

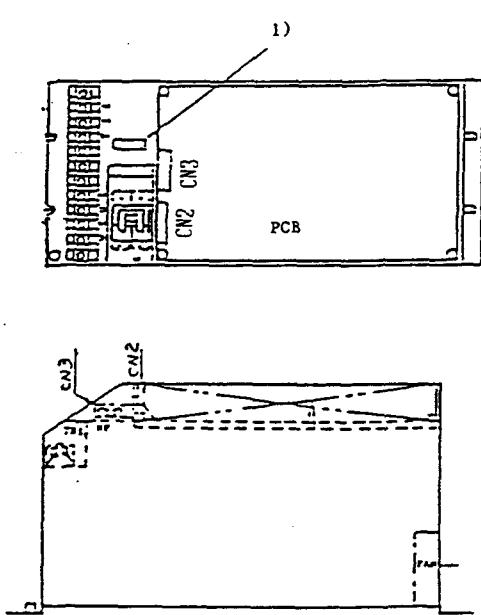
F2 : X-axis motor drive system
fuse 10 A

F3 : Y-axis motor drive system
fuse 10 A

F4 : Z-axis motor drive system
fuse 10 A

F1 : Control system fuse 3 A

4.2.4.2 Spindle servo driver



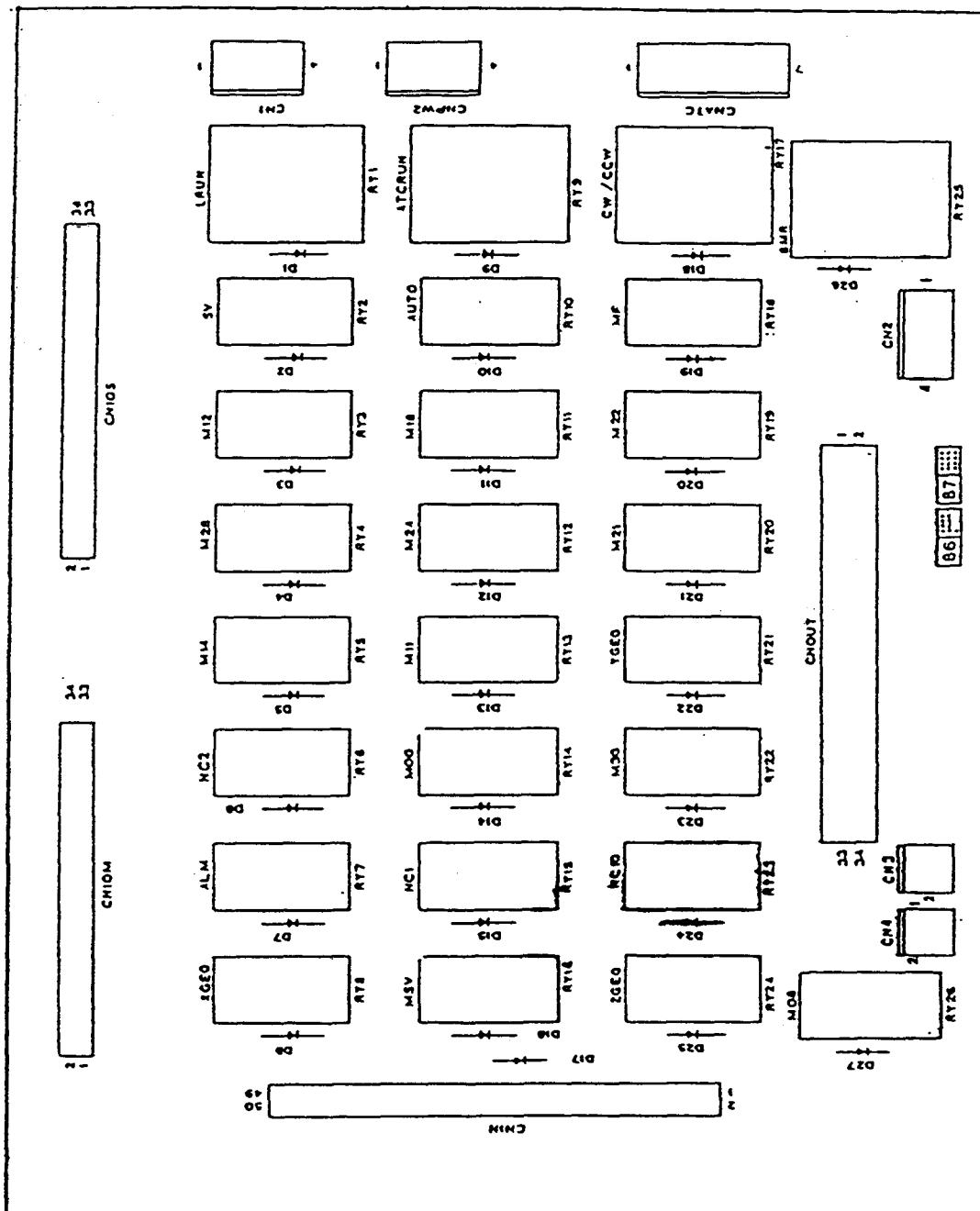
NFB: (No-fuse circuit breaker)
motor drive system

1) Control system fuse for
the alarm devices 1.3 A

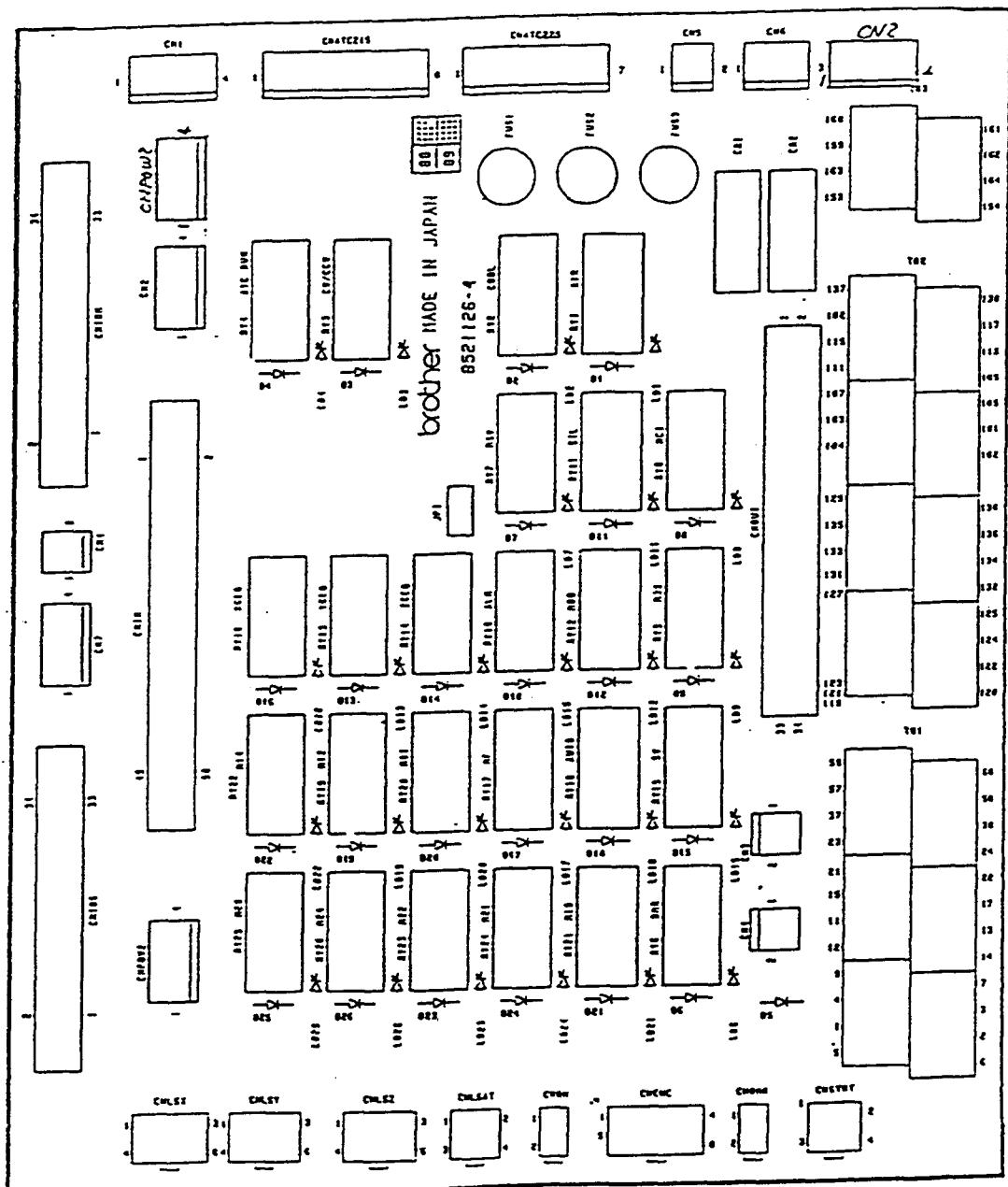
4.2.5 Relay Unit

RELAY UNIT PCB TC-225

For machine No. _____ and below



New RELAY I/O PCB #4 TC-215, TC-225



TC-215: For machine No. and above
TC-225: For machine No. and above

Relay Numbers, Signal Names and Functions of the PCB's
in the Relay Unit

Relay No.	Signal Name	Function
RY8	XGE : X-axis zero-point return complete	This signal is output when the X-axis returns to the machine zero point.
RY2	SV : Servo ON (external)	This signal is output from the time a servo turns ON after the NC power supply is turned ON until an alarm signal is output or the NC power supply is turned OFF.
RY13	M11 : External signal output 11	The NC unit outputs 2-digit, decimal values in BCD code to external units.
RY3	M12 : External signal output 12	These external signal outputs range from 00 to 89 depending on the designation set by key input or memory run.
RY5	M14 : External signal output 14	
RY11	M18 : External signal output 18	
RY20	M21 : External signal output 21	
RY19	M22 : External signal output 22	
RY12	M24 : External signal output 24	
RY4	M28 : External signal output 28	
RY18		This signal is output 20 msec after an external signal output and continues to be output until the external signal is complete.
RY6	STL : Automatic operation started	This signal is output from the time automatic operation is started until a HOLD or SINGL RUN command is received.
RY7	ALM : Alarm output	This signal is output when an alarm which turns the servo OFF (0 - 31, identified by two asterisks (**)) is displayed on the screen.
RY9	ATC RUN: ATC rotation	This signal turns the ATC motor.

Relay No.	Signal Name	Function
RY10	AUTO : Automatic operation	This signal is output before any other alarm is output if the RESET button is pressed, and external reset signal is received or the EMERGENCY button is pressed, during automatic operation started by key operation or memory run.
RY14	M00 : Program stop	This signal is output when the external signal 00 is executed.
RY15	NC1	Spare signal
RY16	MSV : Internal servo ON signal	This signal turns the servo power supply ON.
RY17	CW/CCW : ATC direction of rotation	This signal commands the ATC motor to rotate clockwise or counterclockwise.
RY21	YGEO : Y-axis zero point return complete	This signal is output when the Y-axis returns to the machine zero point.
RY22	M30 : Program end	This signal is output when the end of the program is reached.
RY23	NC10 : Air valve ON	This signal turns the air valve ON.
RY24	ZGEO : Z-axis zero point return complete	This signal is output when the Z-axis returns to the machine zero point.
RY25	BMR : Z-axis brake	This signal turns ON when the servo turns OFF.
RY26	M08 : Coolant	This signal turns the coolant power relay ON.

New RELAY I/O PCB Relay Numbers, Signal Names and Functions
 (Common for T-215 and T-225)

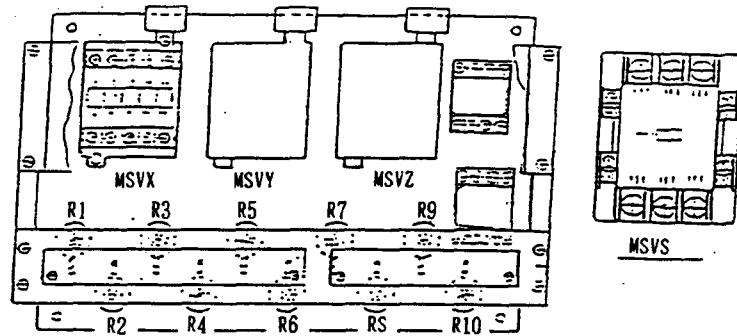
TC-225: For machine No. and above

Relay No.	Signal Name	Function
RY16	XGEO : X-axis zero-point return complete	This signal is output when the X-axis returns to the machine zero point.
RY15	SV : Servo ON (external)	This signal is output from the time a servo turns ON after the NC power supply is turned ON until an alarm signal is output or the NC power supply is turned OFF.
RY20	M11 : External signal output 11	The NC unit outputs 2-digit, decimal values in BCD code to external units. These external signal outputs range from 00 to 89 depending on the designation set by key input or memory run.
RY19	M12 : External signal output 12	
RY22	M14 : External signal output 14	
RY21	M18 : External signal output 18	
RY24	M21 : External signal output 21	
RY23	M22 : External signal output 22	
RY26	M24 : External signal output 24	
RY25	M28 : External signal output 28	
RY17	MF : External signal output latch	This signal is output 20 msec after an external signal output and continues to be output until the external signal is complete.
RY11	STL : Automatic operation started	This signal is output from the time automatic operation is started until a HOLD or SINGL RUN command is received.
RY10	ALM : Alarm output	This signal is output when an alarm which turns the servo OFF (0 - 31, identified by two asterisks (**)) is displayed on the screen.
RY18	AUTO : Automatic operation	This signal is output from the time the START button is pressed to start automatic operation until the RESET button is pressed, or an equivalent signal is received.

Relay No.	Signal Name	Function
RY4	ATC RUN: ATC rotation	This signal turns the ATC motor.
RY12	M00 : Program stop	This signal is output when the external signal 00 is executed.
RY8	NC1 : Emergency stop	This signal is output when the EMERGENCY stop button is pressed.
RY6	BMR : Z-axis brake	This signal is ON when the Z-axis servo is OFF.
RY3	CW/CCW : ATC direction of rotation	This signal commands the ATC motor to rotate clockwise or counterclockwise.
RY13	YGEO : Y-axis zero point return complete	This signal is output when the Y-axis returns to the machine zero point.
RY9	M30 : Program end	This signal is output when the end of the program is reached.
RY1	NC10 : Air valve ON	This signal turns the air valve ON.
RY14	ZGEO : Z-axis zero point return complete	This signal is output when the Z-axis returns to the machine zero point.
RY7	MSV : Internal servo ON signal	This signal turns the servo power supply ON.
RY2	M08 : Coolant ON	This signal turns the coolant valve ON.

* TC-225: For machine No. and below

4.2.6 DB Unit



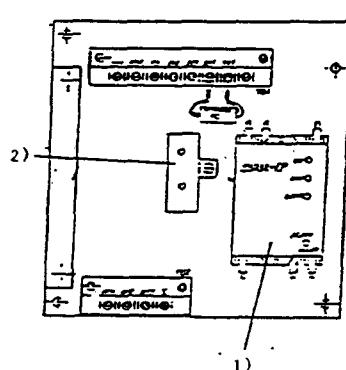
The functions of the DB unit are as follows:

MSVX: Cuts off the drive power supply to the X-axis motor.
Applies the dynamic brake to the X-axis motor.

MSVY: Cuts off the drive power supply to the Y-axis motor.
Applies the dynamic brake to the Y-axis motor.

MSVZ: Cuts off the drive power supply to the Z-axis motor.
Applies the dynamic brake to the Z-axis motor.

MSVS: Cuts off the drive power supply to the spindle motor.
Applies the dynamic brake to the spindle motor.



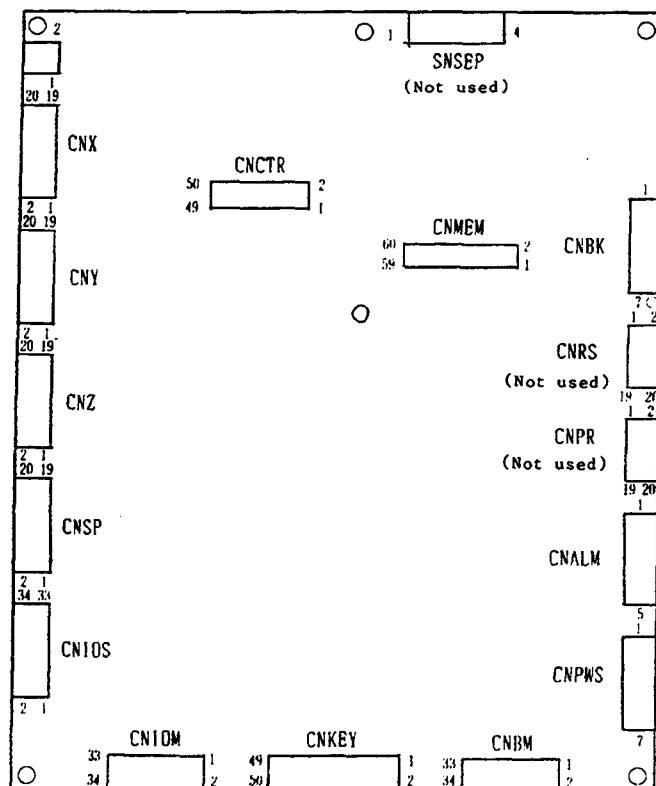
- 1) ATC motor brake pack SBR 32-ZP
- 2) ATC motor capacitor 3.5 μ F 400 V
(motor accessory)

ATC Control Unit

4.3 CONNECTOR LOCATIONS AND SIGNAL NAMES ON EACH PCB

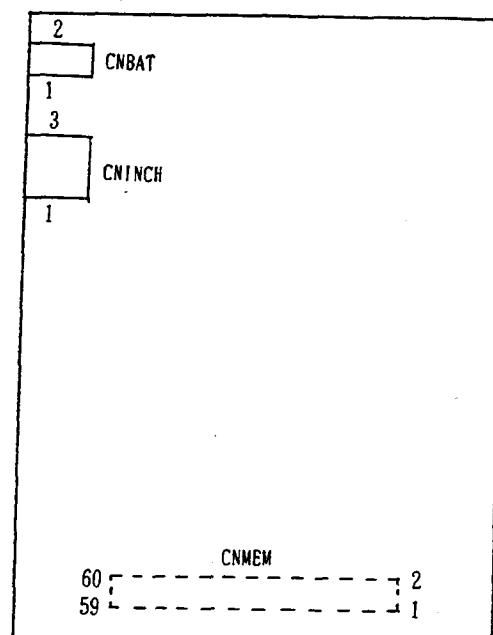
NC PCB:

Connector Name	Function
CNCO	CRT
CNX	NC: X-axis servo driver control
CNY	NC: Y-axis servo driver control
CNZ	NC: Z-axis servo driver control
CNSP	NC: Spindle servo driver control
CNIOS	Slave I/O control
CNCTR	NC: counter control
CNKEY	NC: OPERATION PCB control
CNBMD	NC: External communication device control
CNPWS	NC: Power supply
CNALM	Power supply monitor
CNBK	Bubble memory power supply
CNIOM	Master I/O control
CNMEM	NC: Memory board control



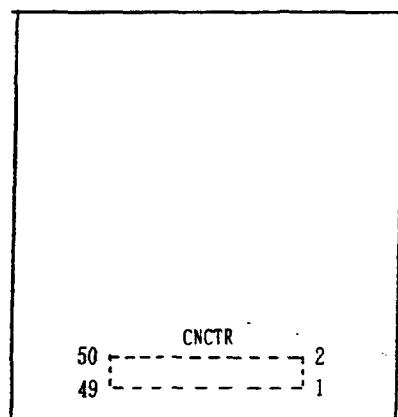
MEMORY PCB:

Connector Name	Function
CNMEM	NC: Memory PCB control
CNBAT	Backup power supply
CNINCH	Inch/metric system selection



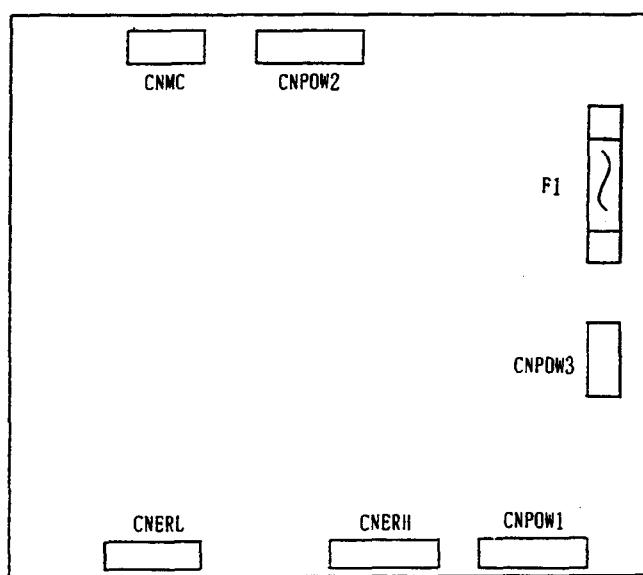
COUNTER PCB:

Connector Name	Function
CNCTR	NC: Counter control



POWER SUPPLY MONITOR PCB:

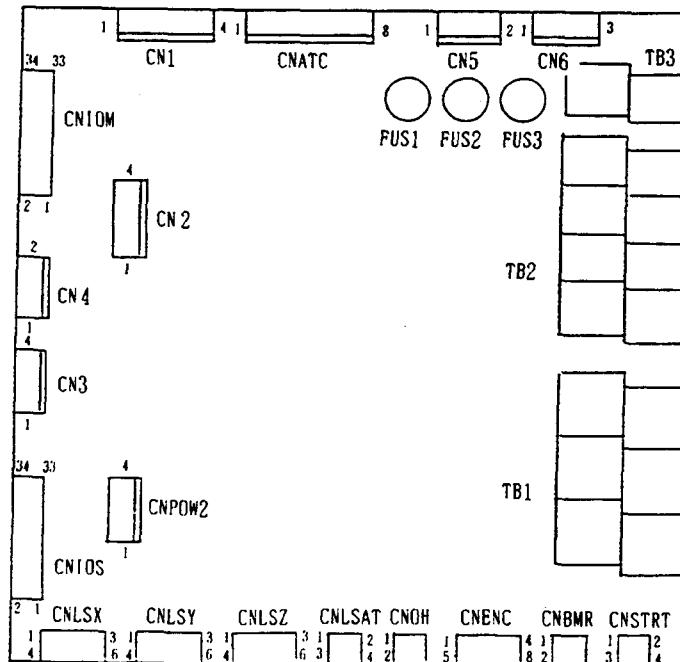
Connector Name	Function
CNPOW1	Power supply ON/OFF
CNPOW2	External power supply ON/OFF
CNPOW3	100 V input
CNMC	MC1 ON
CNERH	Abnormal power supply display
CNERL	Power supply monitor



RELAY I/O PCB TC-215:

For machine No. and below

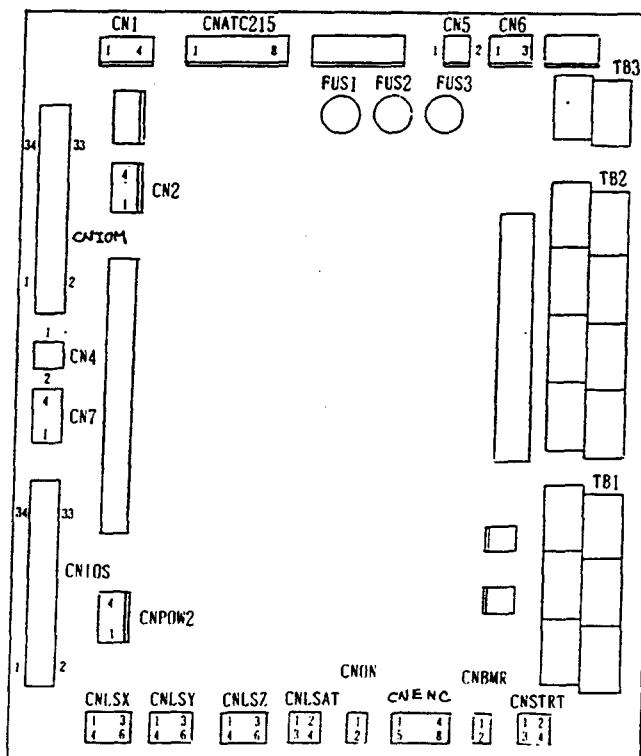
Connector Name	Function
CNIOS	Slave I/O control
CNIOM	Master I/O control
CNLSX	X-axis limit switch
CNLSY	Y-axis limit switch
CNLSZ	Z-axis limit switch
CNLSAT	ATC limit switch
CNOH	Spindle overheat
CNENC	ATC sensor
CNBMR	Z-axis brake
CNSTRT	Start/Stop
CNATC	ATC brake control
CNPOW2	External power supply ON/OFF
CN1	ATC coolant motor thermal relay
CN2	Servo ON
CN3	ATC proximity switch
CN4	Thermal relay for the servo power supply and spindle regenerative resistance
CN5	Valve power supply input
CN6	Spotlight power supply input
TB1	Input terminal block
TB2	Output terminal block
TB3	Valve, spotlight power supply output



New RELAY I/O PCB #4 TC-215:

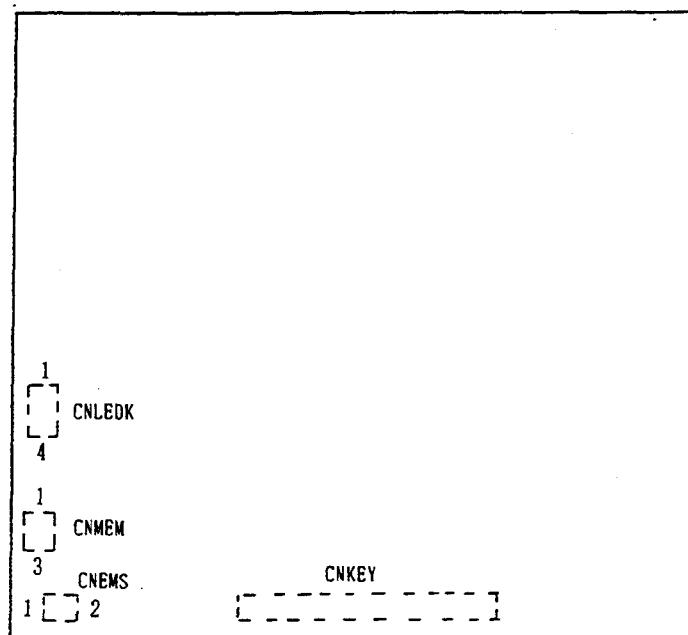
For machine No. and above

Connector Name	Function
CNIOS	Slave I/O control
CNIOM	Master I/O control
CNLSX	X-axis limit switch
CNLSY	Y-axis limit switch
CNLSZ	Z-axis limit switch
CNLSAT	ATC limit switch
CNOH	Spindle overheat
CNENC	ATC sensor
CNBMR	Z-axis brake
CNSTRT	Start/Stop
CNATC215	ATC brake control
CNPOW2	External power supply ON/OFF
CN1	ATC coolant motor thermal relay
CN2	Servo ON
CN4	Thermal relay for the servo power supply and spindle regenerative resistance
CN5	Valve power supply input
CN6	Spotlight power supply input
CN7	ATC proximity switch
TB1	Input terminal block
TB2	Output terminal block
TB3	Valve, spotlight power supply input



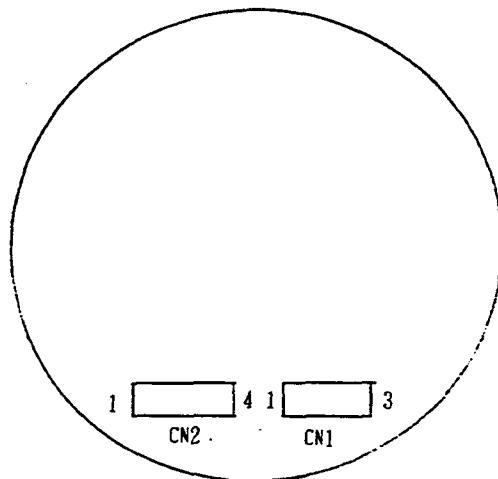
OPERATION PCB:

Connector Name	Function
CNKEY	NC: OPERATION PCB control
CNMEM	Program protect ON/OFF
CNLEDK	Power supply abnormal display
CNEMS	Emergency stop



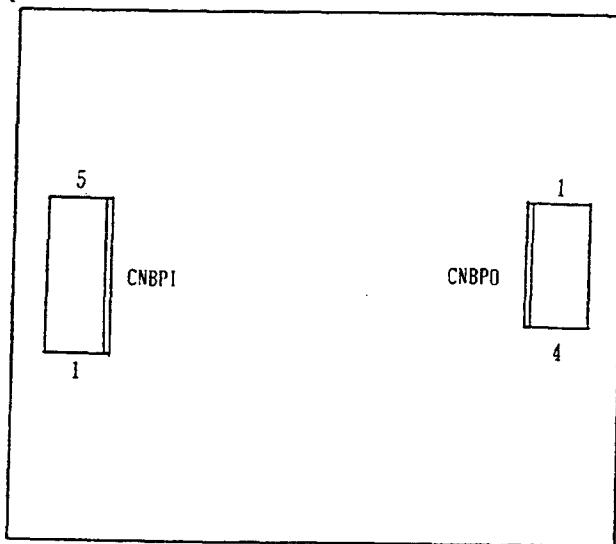
ATC SENSOR PCB A:

Connector Name	Function
CN1	+24 V
CN2	Encoder signal



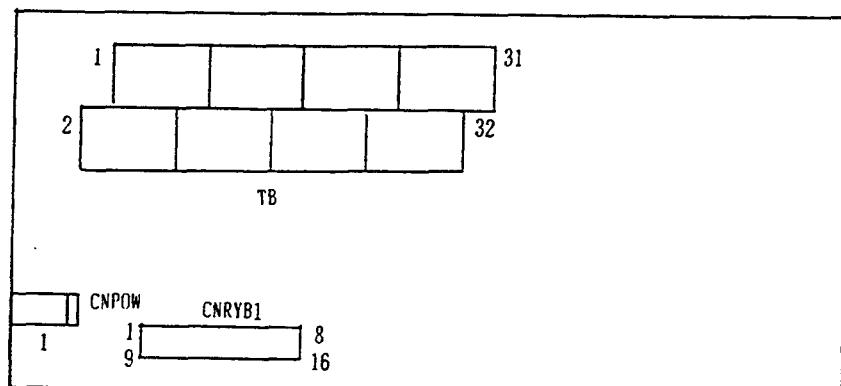
DC - DC CONVERTER PCB (optional):

Connector Name	Function
CNBPI	DC <u>+15</u> V input
CPBPO	DC <u>+12</u> V output



External Relay PCB (Handy Sequence Controller) (optional):

Connector Name	Function
CNRYB1	Input/Output signals
CNPOW	Control power supply
TB	External connection



RS-PR PCB (optional):

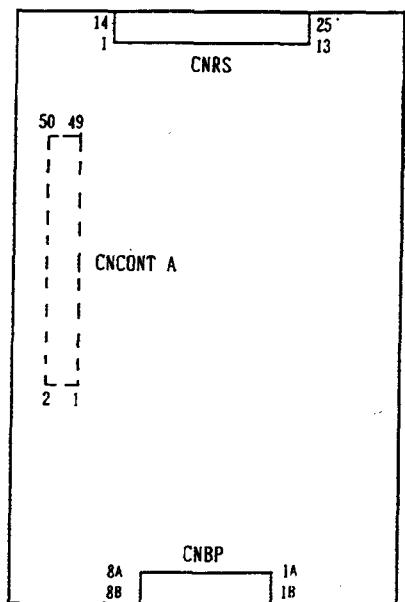
RS-PR PCB A:

Connector Name	Function
CNBP	DC power supply
CNRS	RS-232C
CNCONTA	Communication data

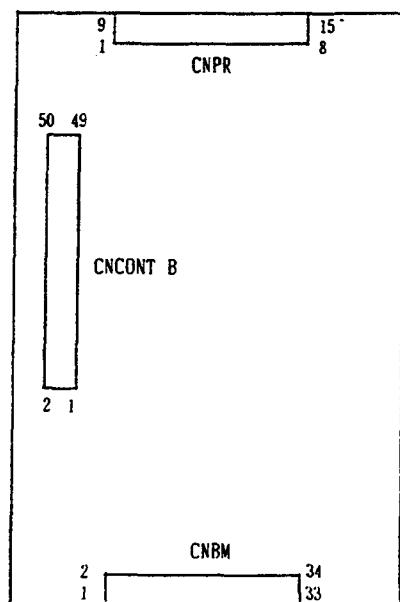
RS-PR PCB B:

Connector Name	Function
CNBM	NC: External communication device control
CNPR	Centronix
CNCONTB	Communication data

RS-PR キバンA



RS-PR キバンB



RS-PR PCB A

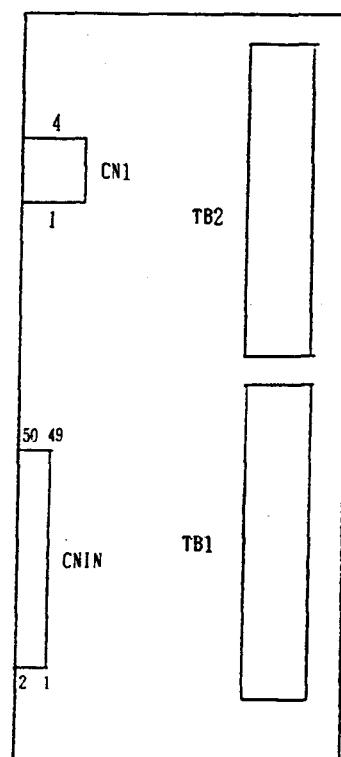
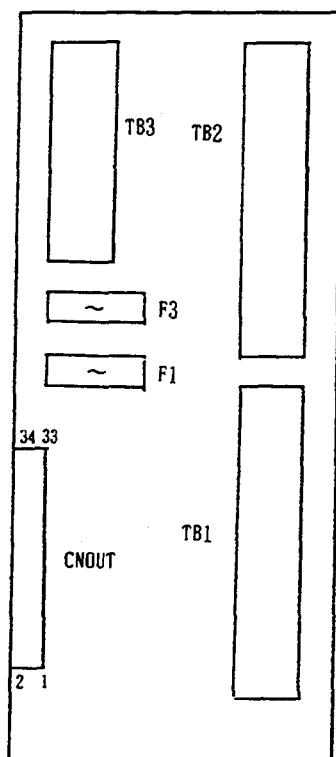
RS-PR PCB B

OUTPUT PCB:

INPUT PCB (TC-255):

Connector Name	Function
CNOUT	External output signal
TB1	External output terminal
TB2	External output terminal
TB3	External power supply output

Connector Name	Function
CNIN	External output signal
CN1	ATC sensor
TB1	External input terminal
TB2	External input terminal



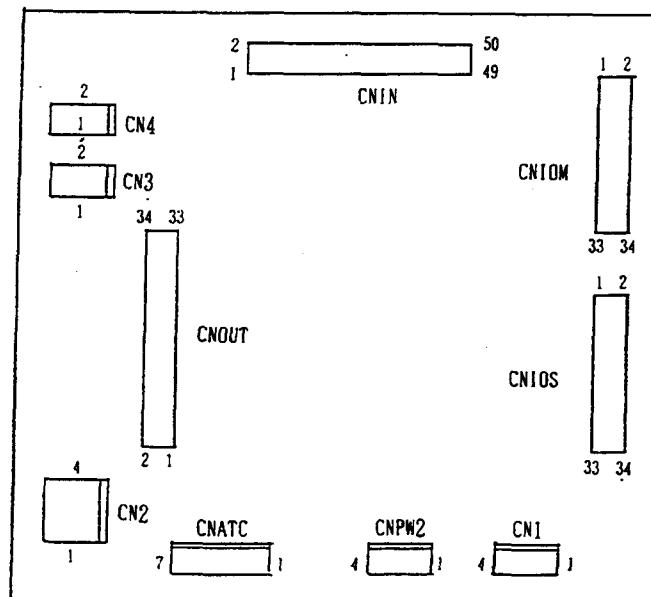
OUTPUT PCB

INPUT PCB (TC-225)

RELAY PCB TC-225:

For machine No. and below

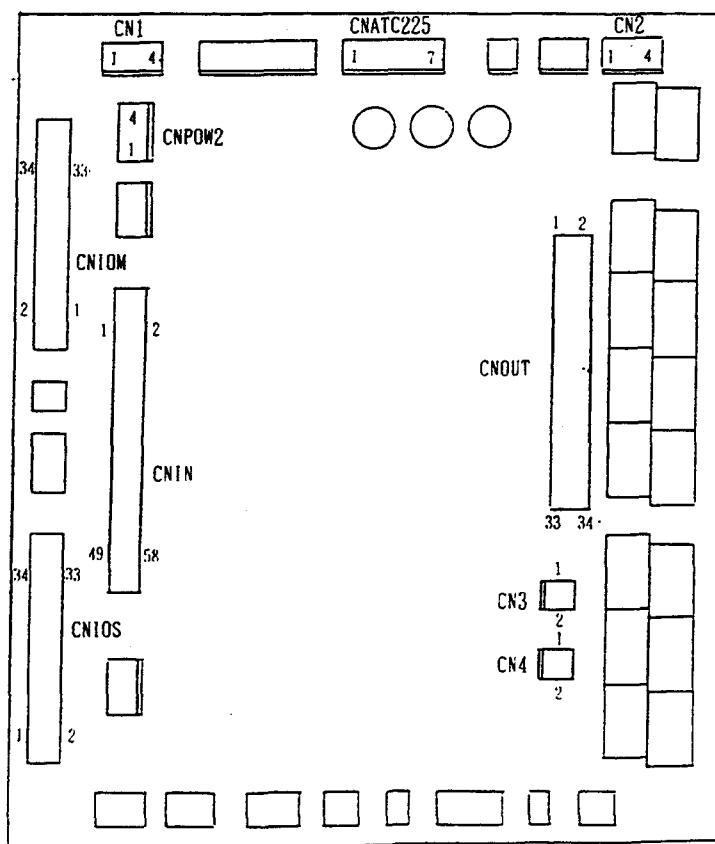
Connector Name	Function
CNIOS	Slave I/O control
CNIOM	Master I/O control
CNIN	External input signal
CNOUT	External output signal
CNATC	ATC brake control
CN1	ATC coolant thermal relay
CN2	Servo ON
CN3	Coolant ON/OFF
CN4	Thermal relay for the servo power supply and spindle regenerative resistance
CNPW2	External power supply ON/OFF



New RELAY I/O PCB #4 TC-255:

For machine No. and above

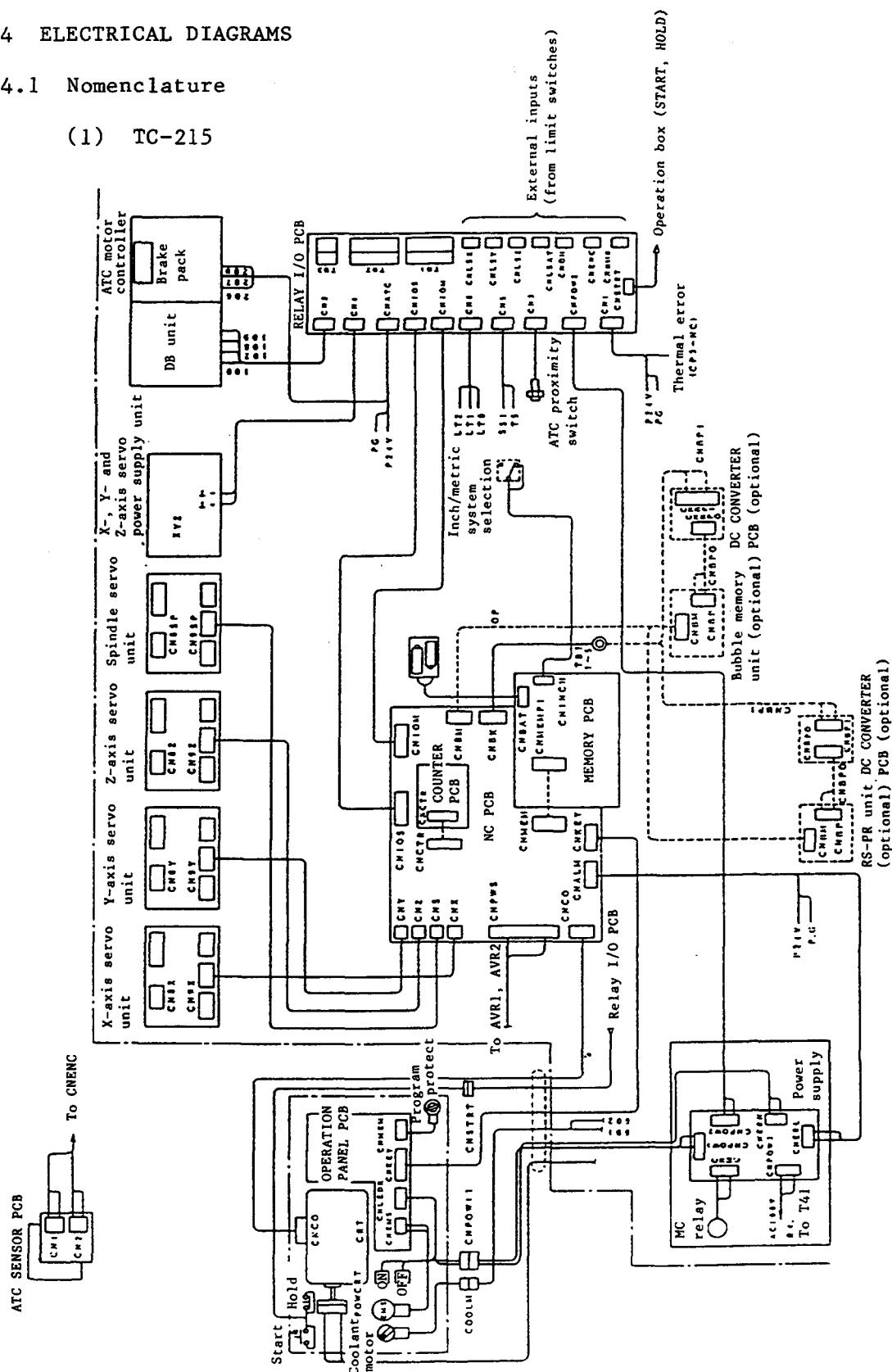
Connector Name	Function
CNIOS	Slave I/O control
CNIOM	Master I/O control
CNIN	External input signal
CNOUT	External output signal
CNATC225	ATC brake control
CNPOW2	External power supply ON/OFF
CN1	ATC coolant thermal relay
CN2	Servo ON
CN3	Coolant ON/OFF
CN4	Thermal relay for the servo power supply and spindle regenerative resistance

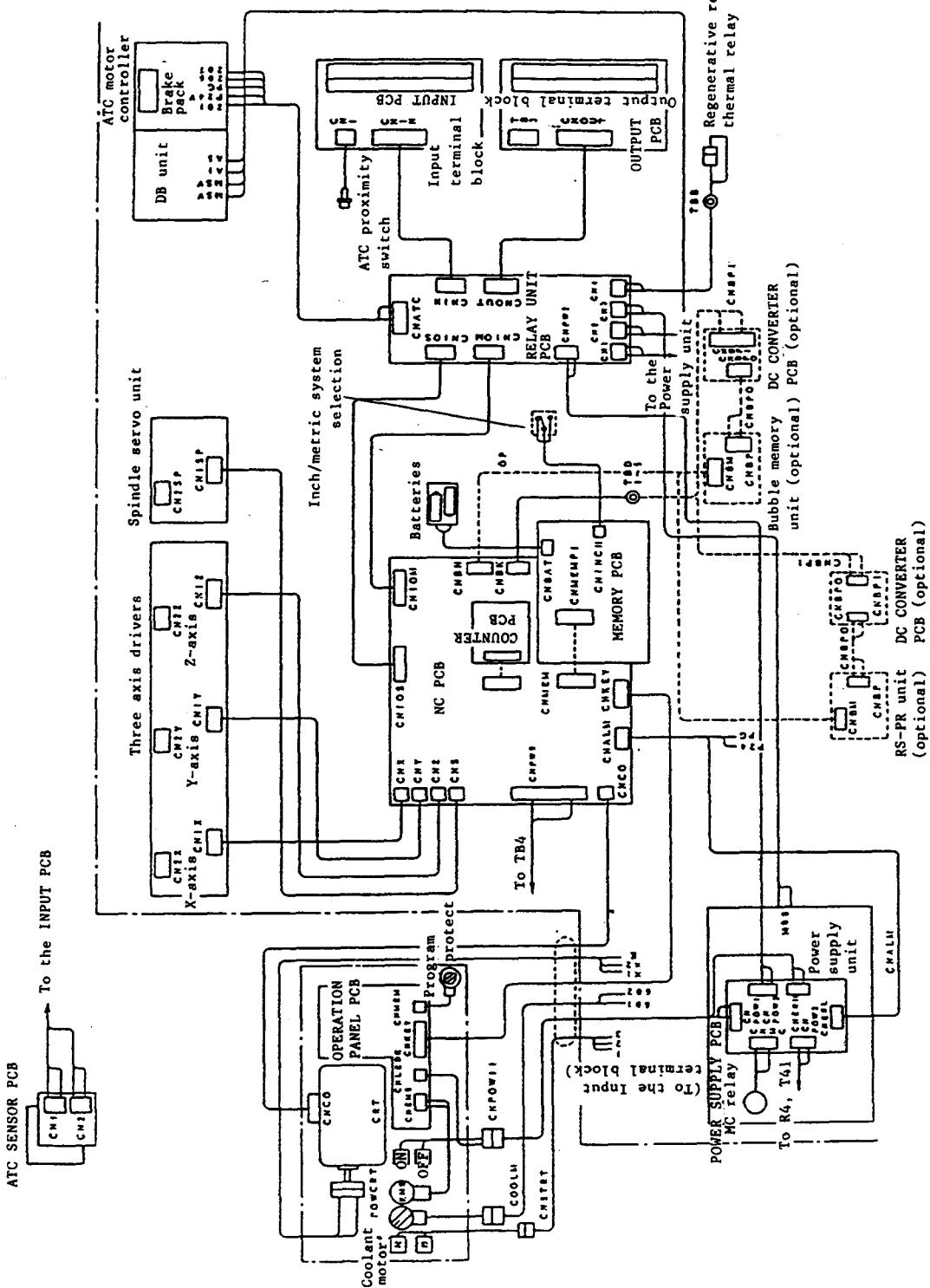


4.4 ELECTRICAL DIAGRAMS

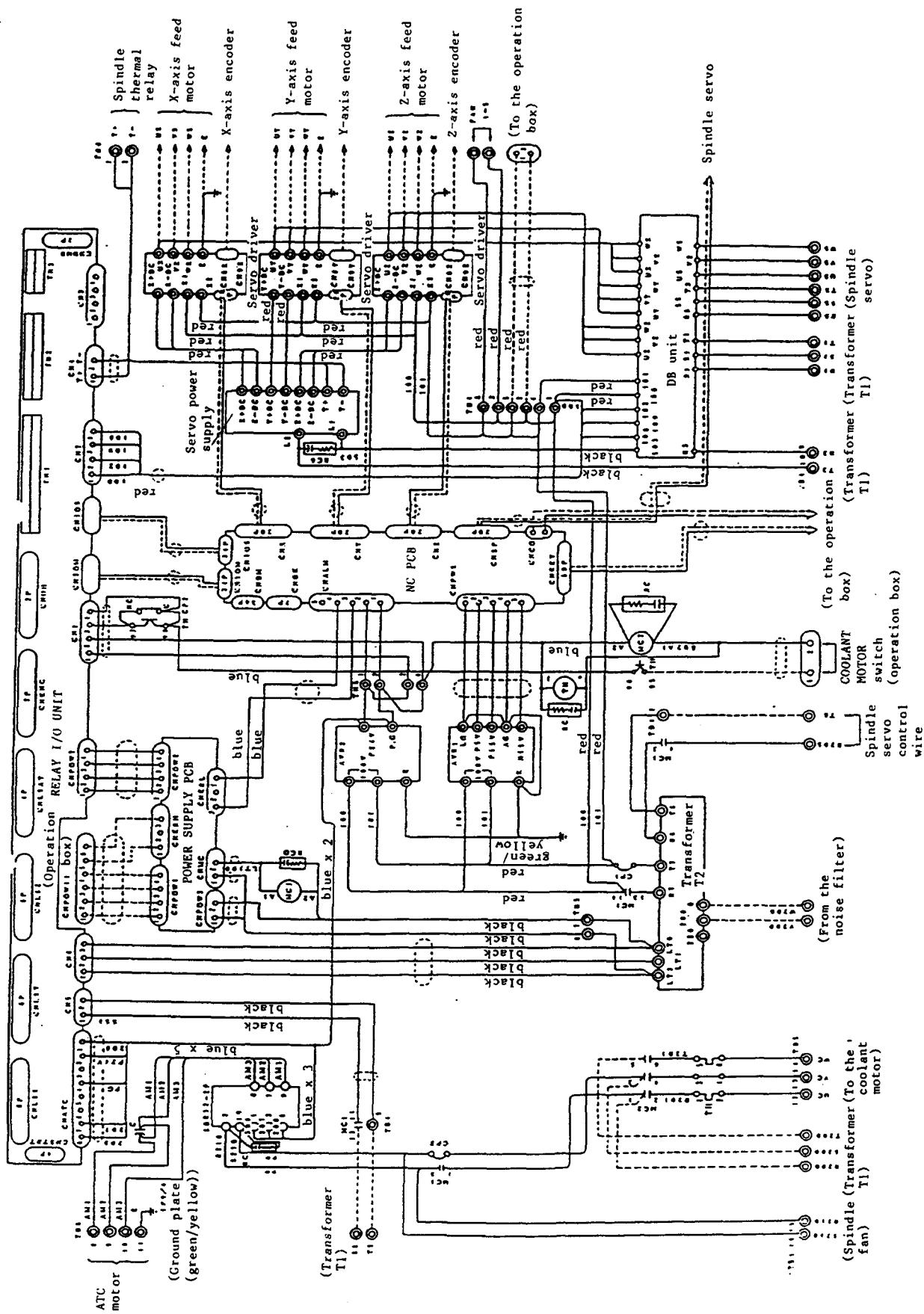
4.4.1 Nomenclature

(1) TC-215

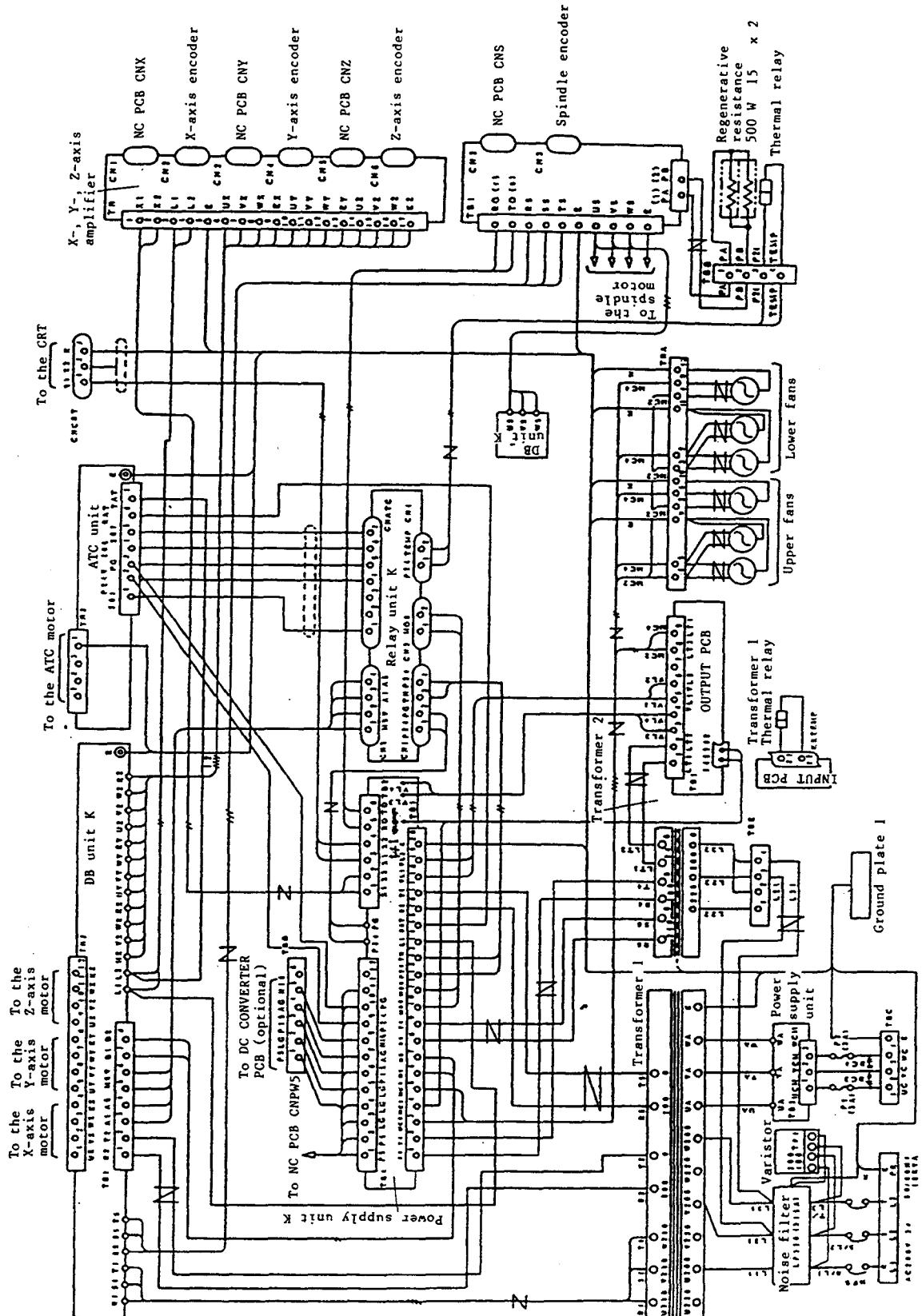




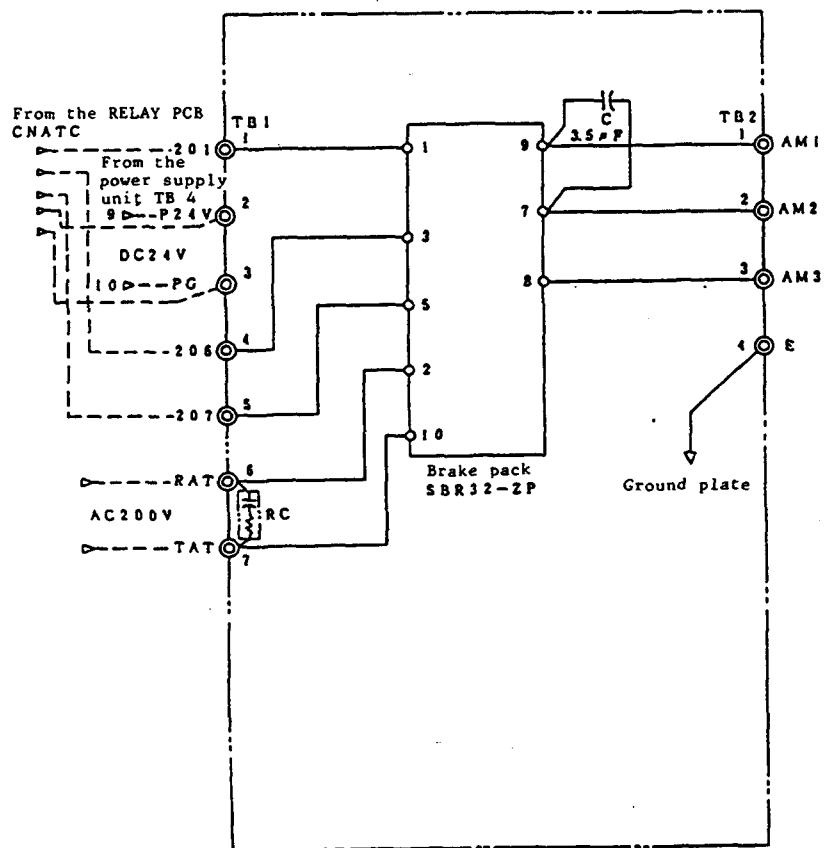
4.4.2 Control Unit Wiring Diagram (TC-215)



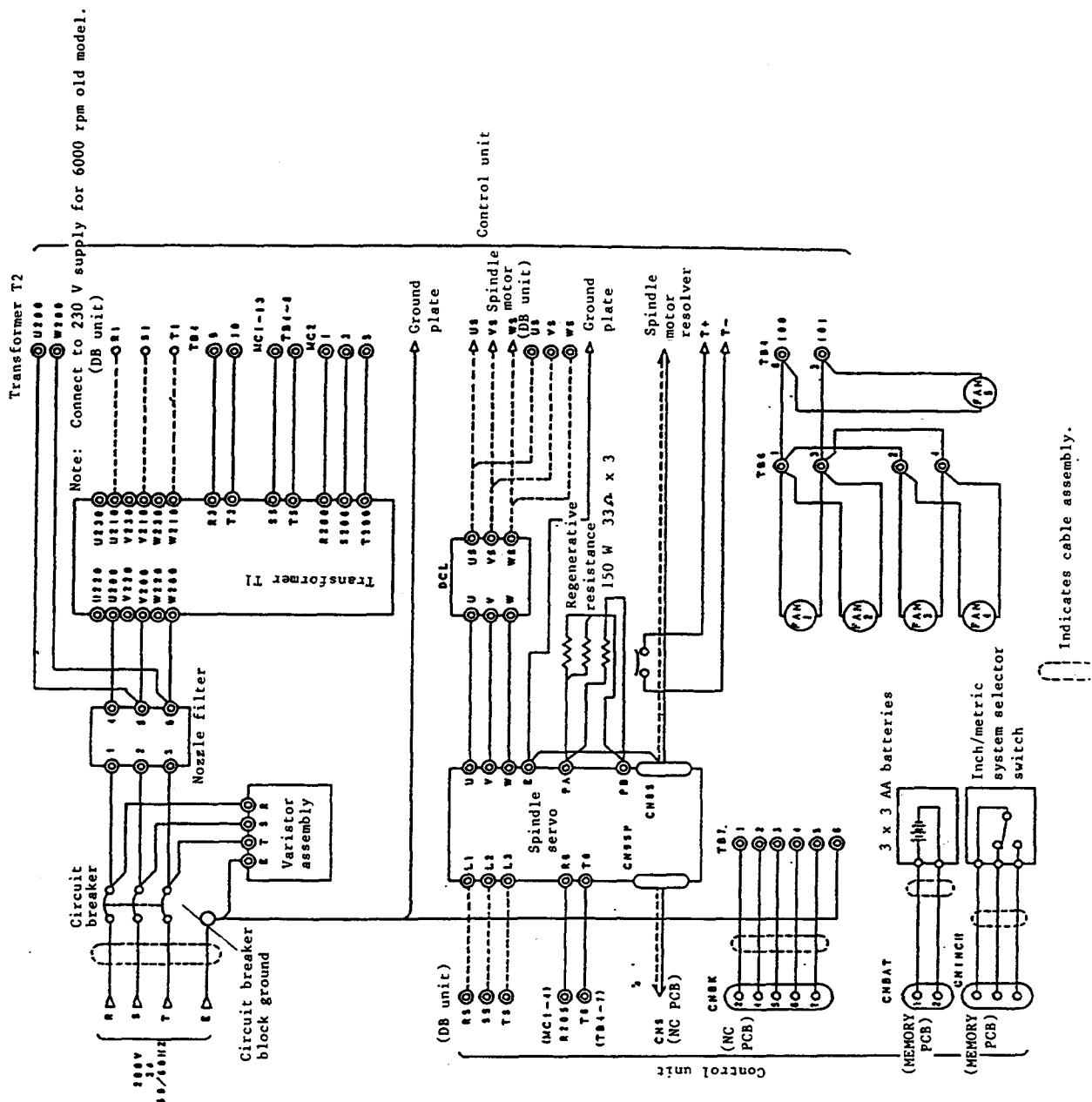
4.4.3 Wiring Diagram of Inside the Control Panel (TC-225)



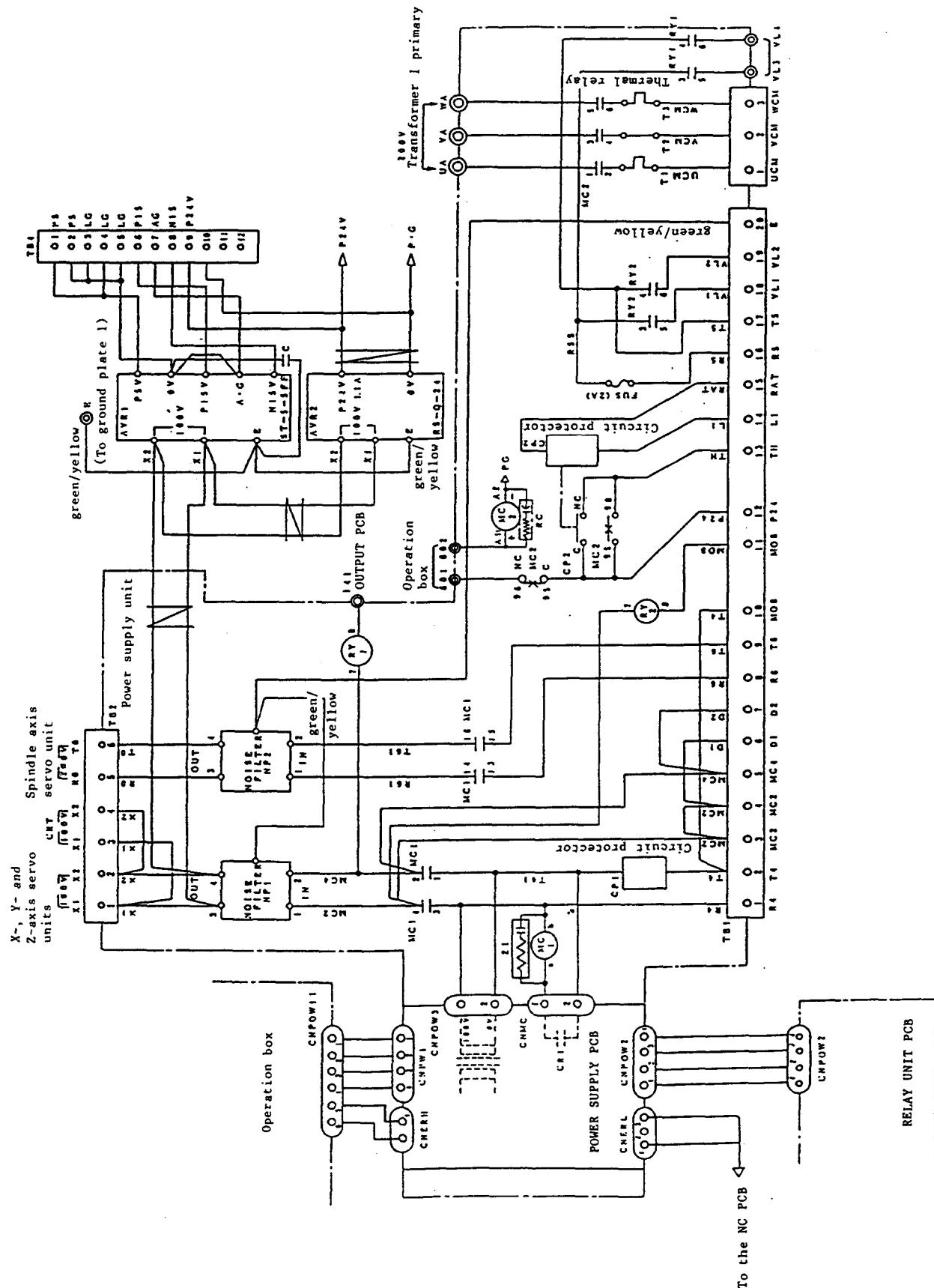
4.4.4 ATC Unit Wiring Diagram (TC-225)



4.4.5 Power Supply System Wiring Diagram (TC-215)

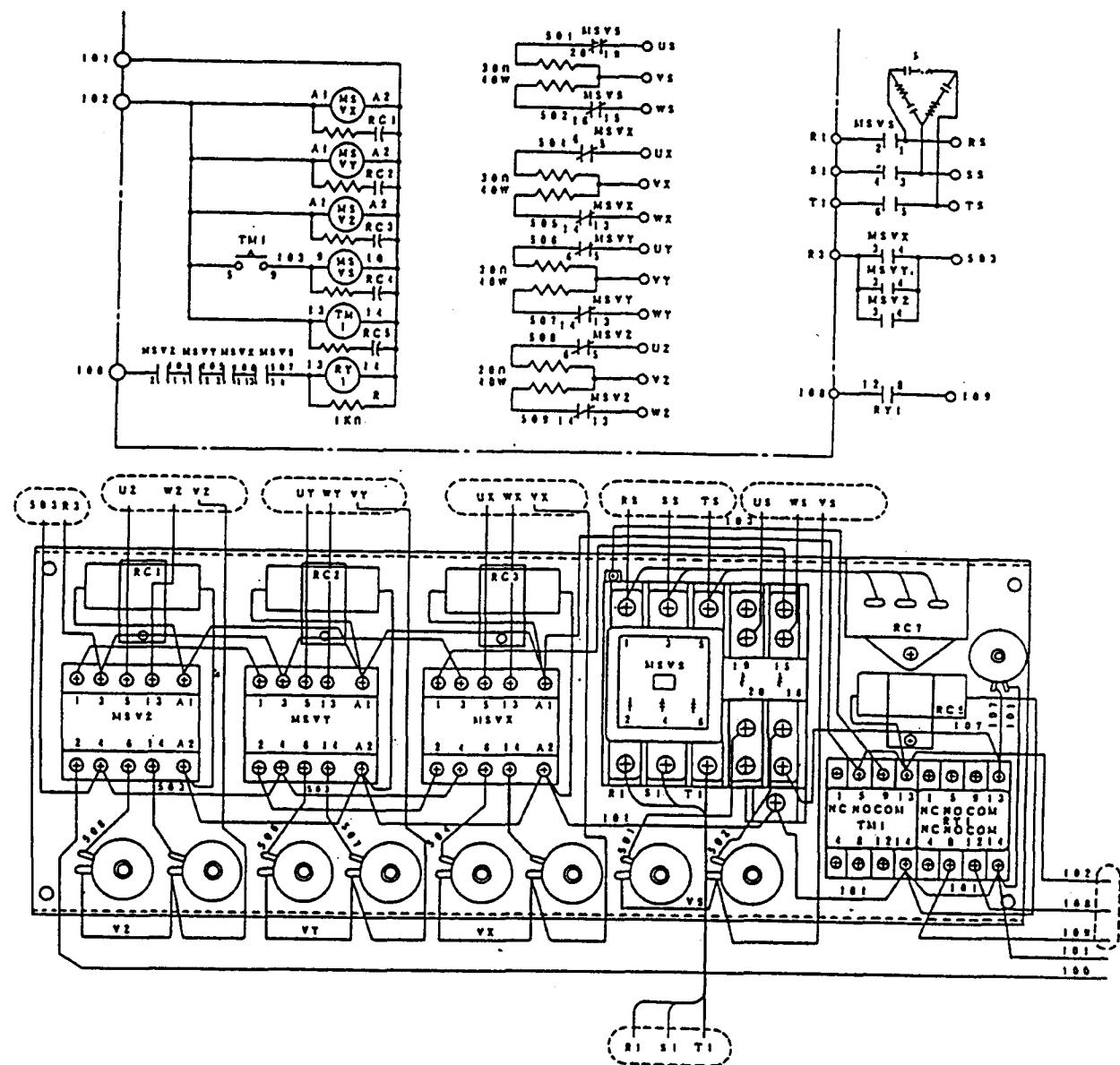


4.4.6 Power Supply System Circuit Diagram (TC-225)

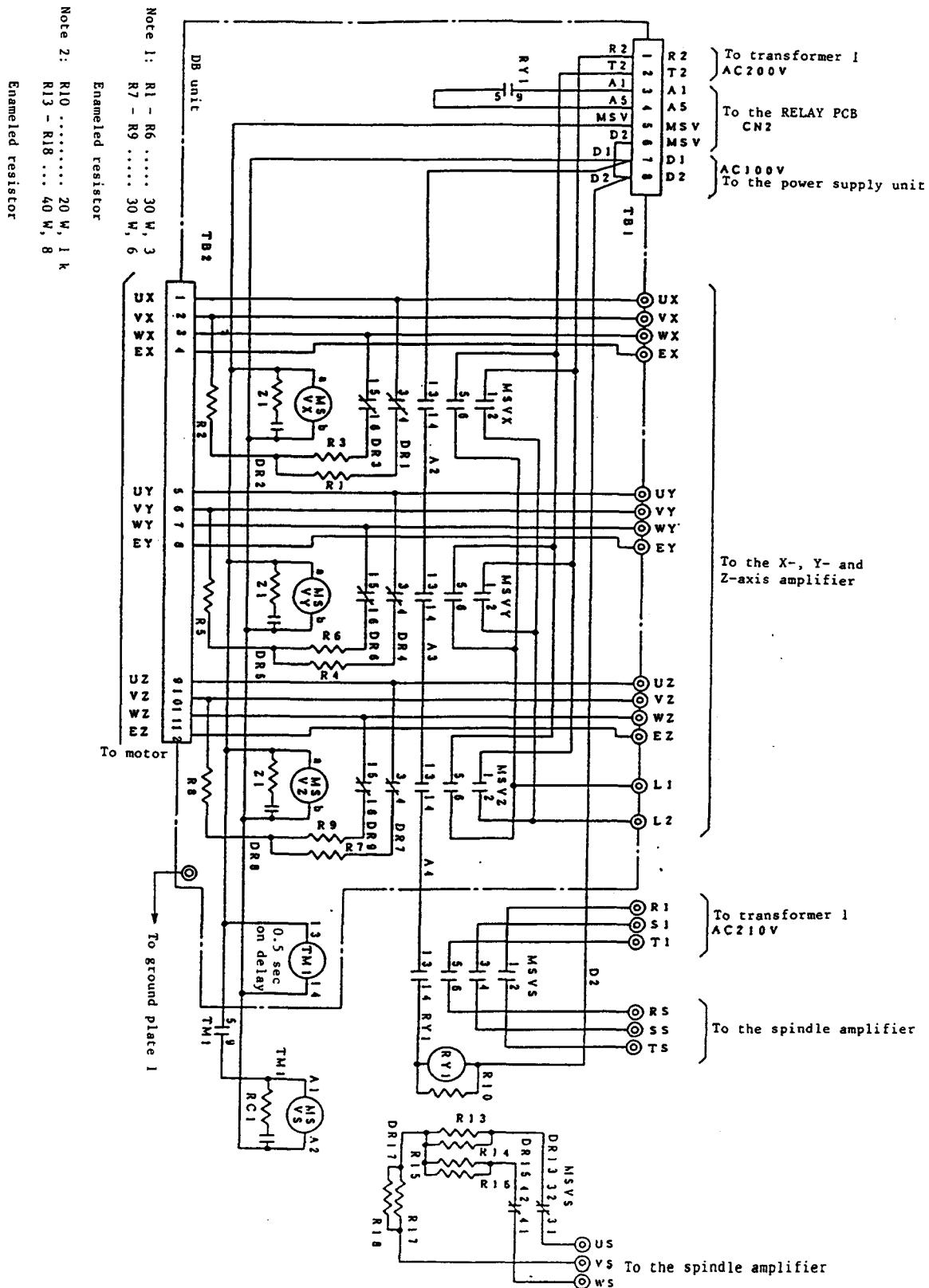


4.4.7 DB Unit Wiring Diagram

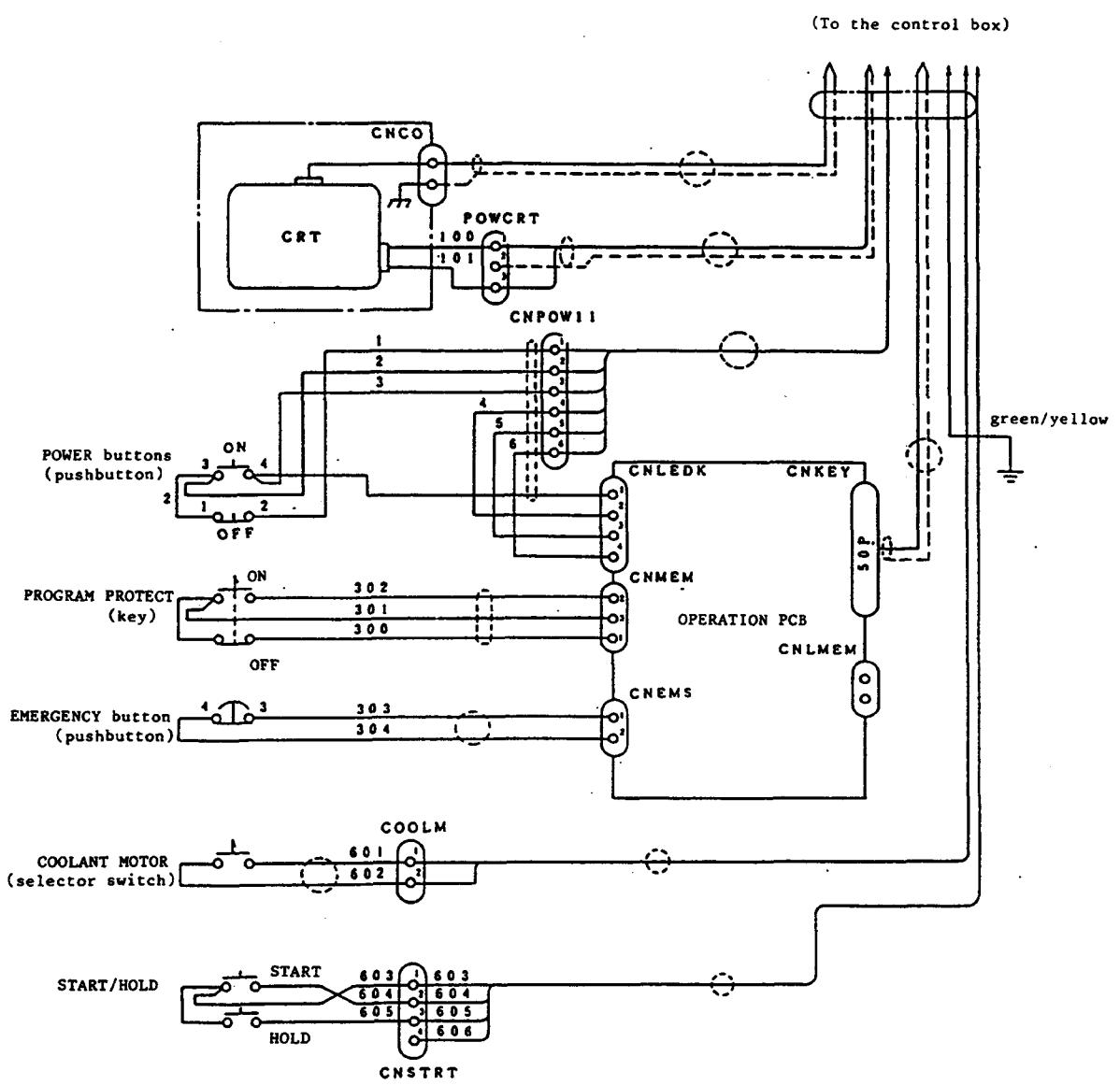
(1) TC-215



(2) TC-225

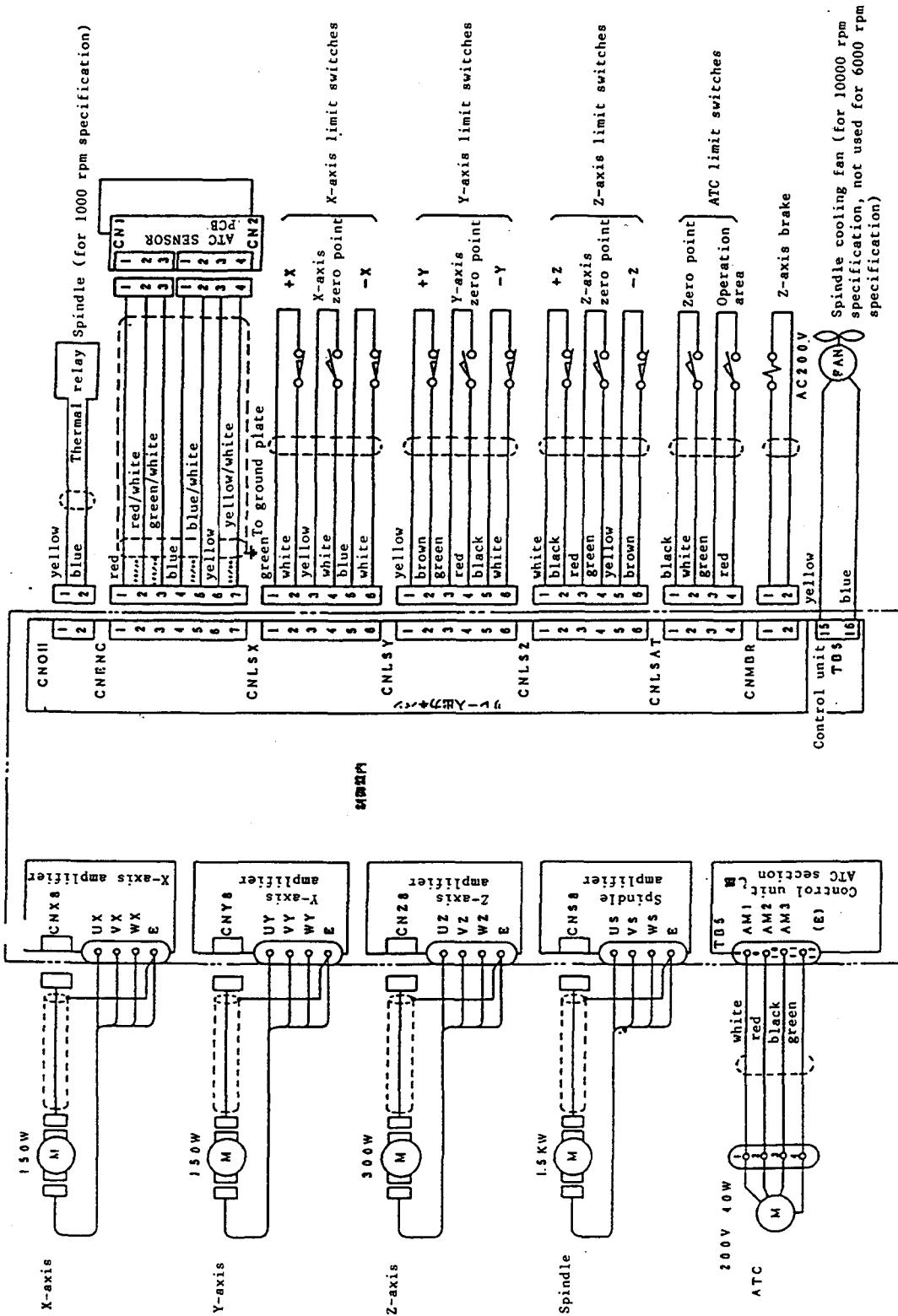


4.4.8 Operation Panel Wiring Diagram (TC-215, TC-225)

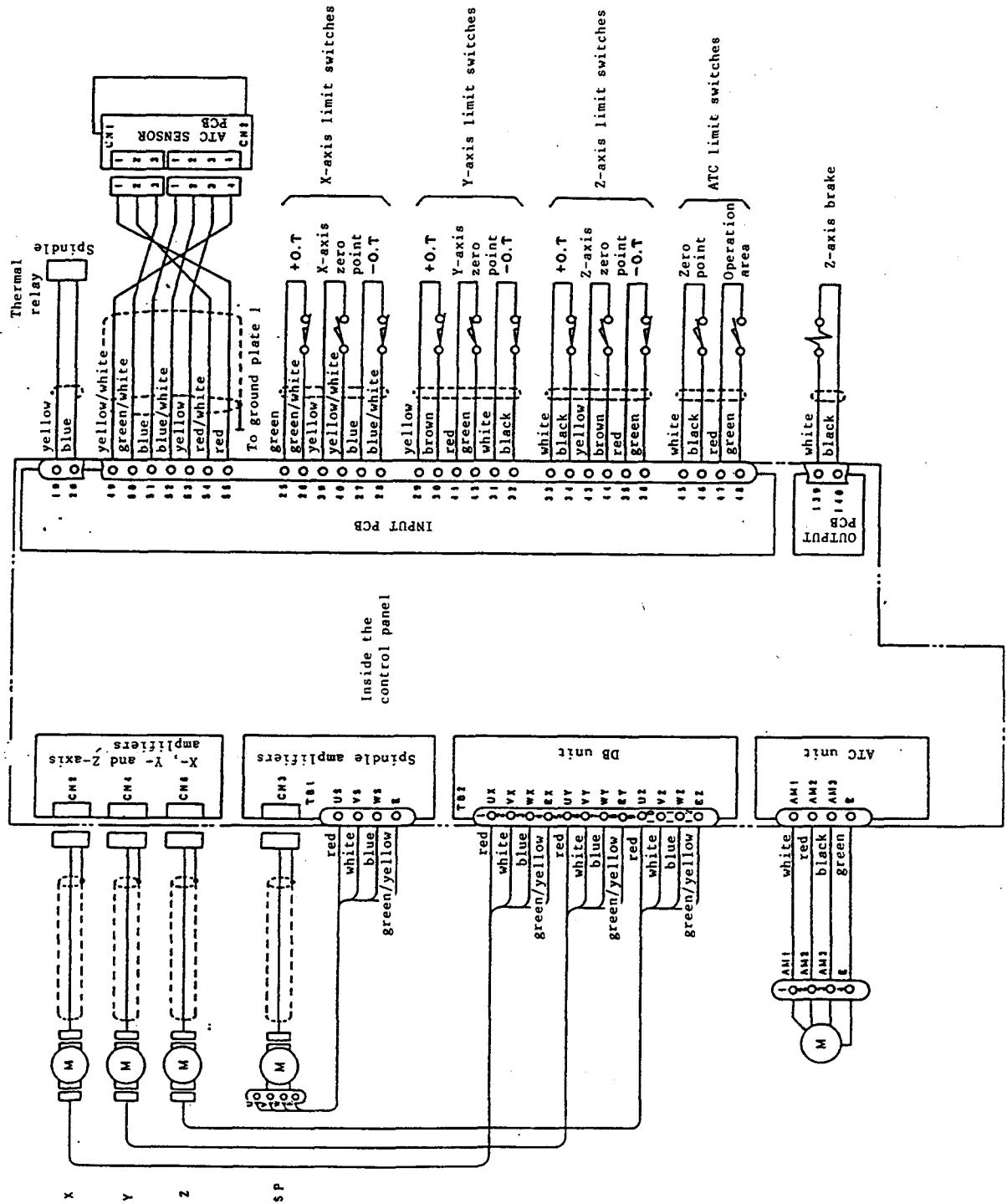


4.4.9 External Wiring Diagram

(1) TC-215

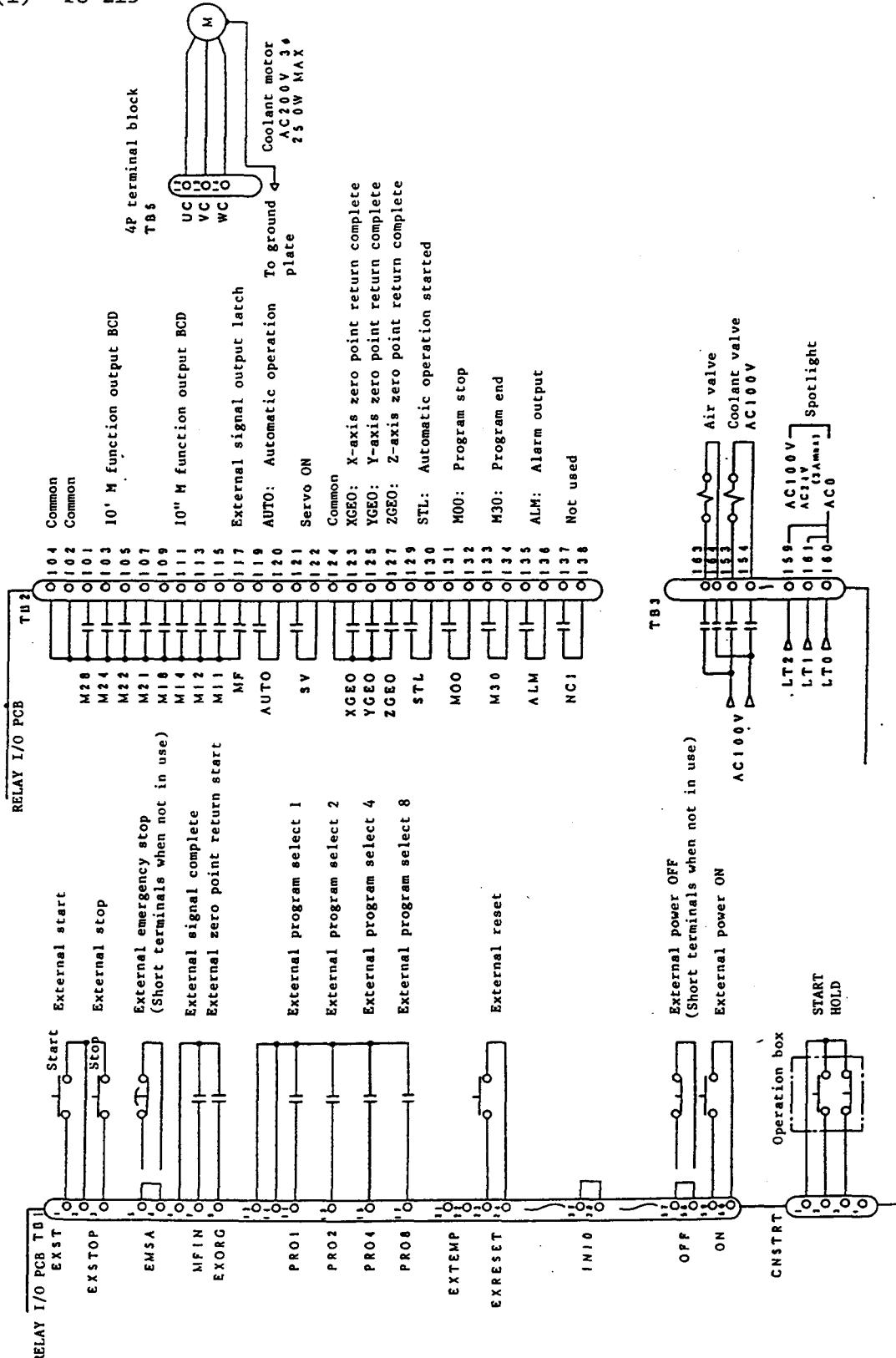


(2) TC-225

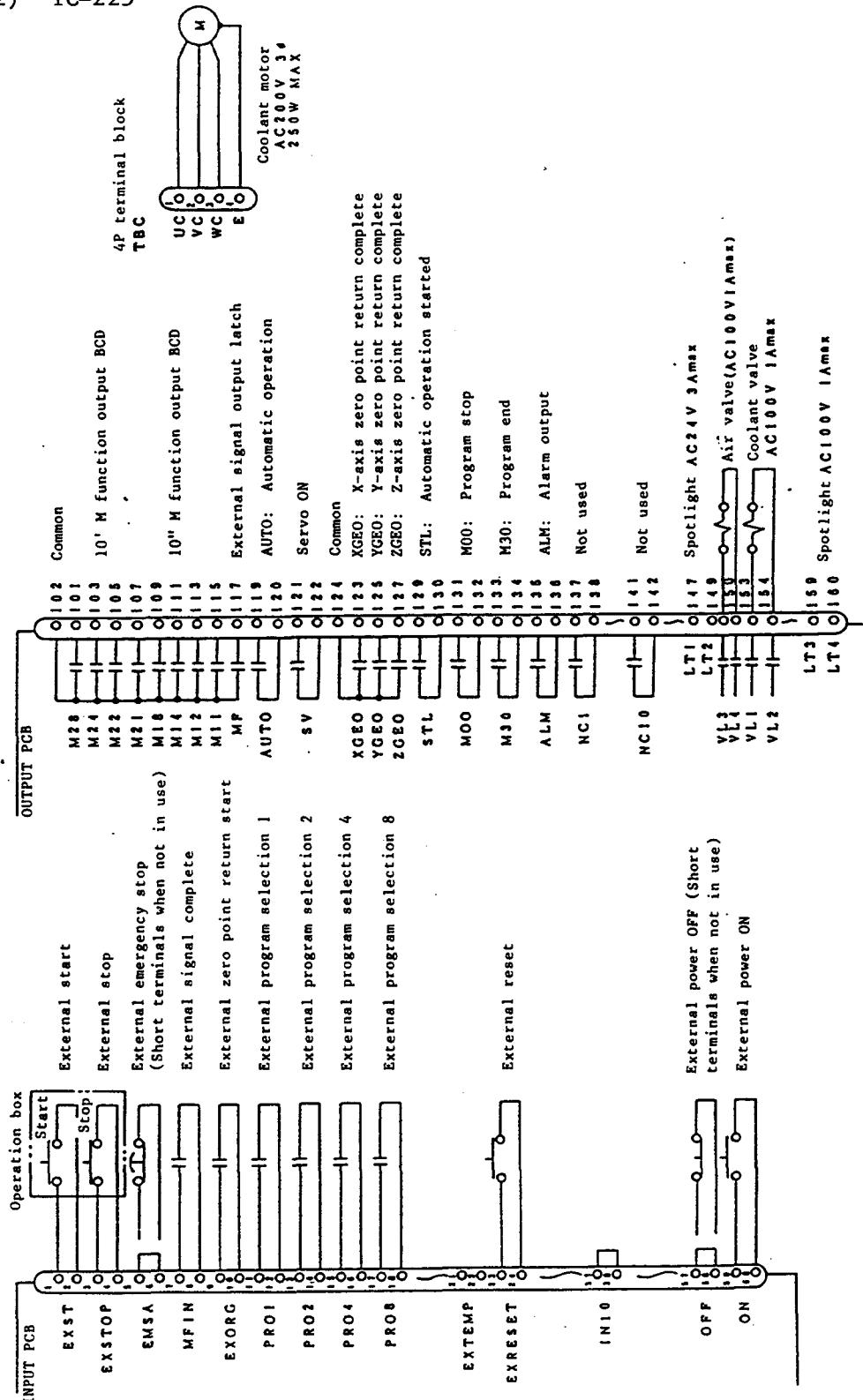


4.4.10 User's External Circuit Diagram

(1) TC-215



(2) TC-225

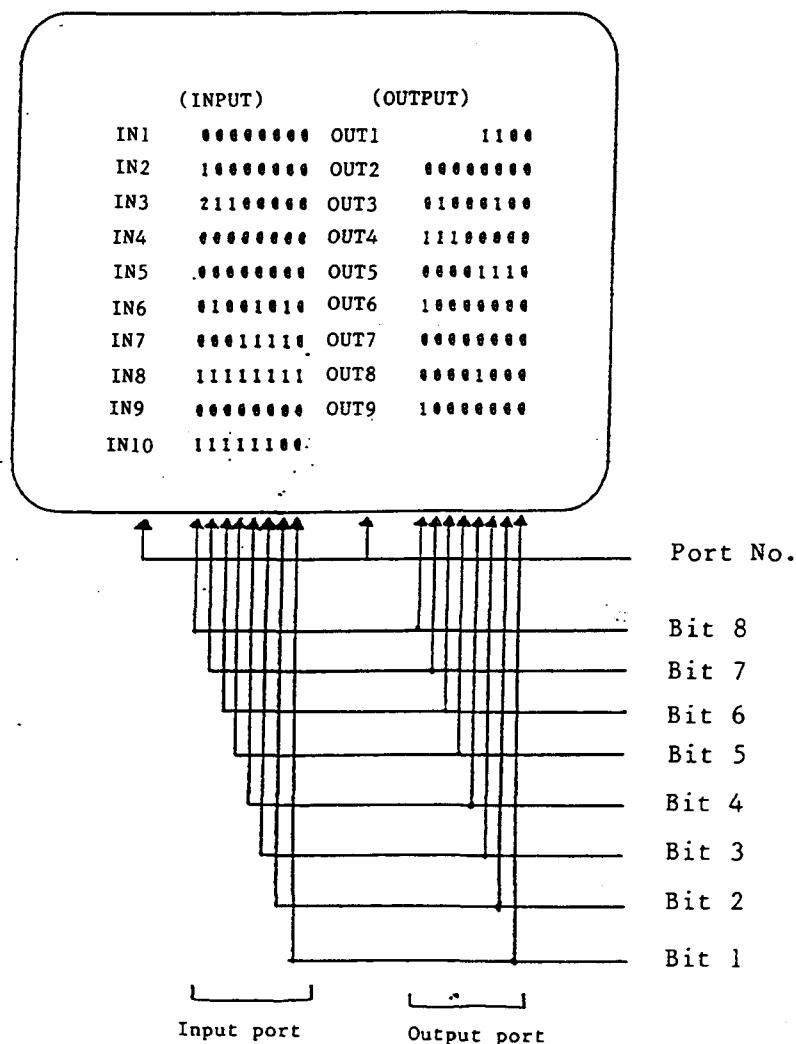


5. DIAGNOSIS WITH THE NC

5.1 I/O DISPLAY

5.1.1 I/O Display Screen

Press the [I/O] key to display the I/O Display screen on the CRT. This display shows the input and output signals to and from the NC and provides useful information on the machine status and NC operation status during maintenance, repair and adjustment.



5.1.2 I/O Signal Names

An asterisk (*) after a signal name indicates a negative-logic signal. When these status of a negative-logic signal is displayed as "0", the status or signal described in the Function column of the table is ON.

5.1.2.1 Input signals

IN1:

Bit	Signal Name	Function
8	MEMOKI	Program protect OFF
7	MFIN	External signal end
6	STOP	HOLD key, external stop signal
5	START	START key, external start signal
4	PWALM2	Supply voltage input or DC supply voltage abnormal
3	CPUALM2	Master CPU timer time-up
2	FUSE	Circuit protector CP3 OFF
1	EXEMS	EMERGENCY stop switch, external emergency stop signal

IN2:

Bit	Signal Name	Function
8	VSYNC*	CRT vertical synchronization signal
7	BATALM2	Low battery voltage (below 1.8 V)
6	ALMINT1	Abnormal signal
5	EXORG	External zero return signal
4	PRO2 ³	External program select 8
3	PRO2 ²	External program select 4
2	PRO2 ¹	External program select 2
1	PRO2 ⁰	External program select 1

IN3:

Bit	Signal Name	Function
8	SLAVE CPU RUN	Slave CPU RUN permission
7	SLAVE CPU READY	Slave CPU READY for command
6	SLAVE CPU STOP	Slave CPU HOLD command
5	SLAVE CPU START	Slave CPU START command
4	RESET	RESET key
3	EXRESET	External reset signal
2	TEMP	Regenerative resistance overheating
1	O.H	Spindle motor overheating

IN4:

Bit	Signal Name	Function
8	ABERR	Slave CPU timer time-up
7		Not used
6	-Z	-Z overrun
5	+Z	+Z overrun
4	-Y	-Y overrun
3	+Y	+Y overrun
2	-X	-Z overrun
1	+X	+X overrun

IN5:

Bit	Signal Name	Function
8	SPSVA	Spindle servo abnormal
7	ZSVA	Z-axis servo abnormal
6	YSVA	Y-axis servo abnormal
5	XSVA	X-axis servo abnormal
4	ZGEN	Z-axis zero-point return limit switch
3	YGEN	Y-axis zero-point return limit switch
2	XGEN	X-axis zero-point return limit switch
1	IN10	Broken tool detector

IN6:

Bit	Signal Name	Function
8	T8	Magazine number
7	T4	Magazine number
6	T2	Magazine number
5	T1	Magazine number
4	TDEC	ATC decelerate signal
3	ZATIN	Z-axis ATC operation area limit switch
2	ZATORG	Z-axis ATC zero point limit switch
1		Not used

IN7:

Bit	Signal Name	Function
8	IN13	Index error signal
7	IN12	Not used
6	IN11	Index error signal
5	RELEASE*	RELEASE key
4	SPZ	Spindle zero point signal
3	ZPZ	Z-axis zero point signal
2	YPZ	Y-axis zero point signal
1	XPZ	X-axis zero point signal

IN8:

Bit	Signal Name	Function
8	CME	Command end
7	TDRA	Data write enabled
6	RDA	Data read enabled
5	SCE	Special commands enabled
4	MEMON	Bubble memory connected
3	WPRT	Bubble memory write protected
2	ERROR	Internal bubble memory error
1	BUSY	Bubble memory busy

IN9:

Bit	Signal Name	Function
8		Not used
7		Not used
6		Not used
5		Not used
4		Not used
3		Not used
2		Not used
1		Not used

IN10:

Bit	Signal Name	Function
8		Not used
7		Not used
6		Not used
5		Not used
4		Not used
3		Not used
2	SW2	NC PCB DIP switch
1	SW1	NC PCB DIP switch

SW2	SW1	Max. Tapping Speed (min^{-1})
1	1	2000
1	0	3000
0	1	4000

5.1.2.2 Output signals

OUT1:

Bit	Signal Name	Function
8		Not used
7		Not used
6		Not used
5		Not used
4	RESETALM*	Reset alarm latch
3	NMIGAT*	Master CPU NMI interrupt
2	TIMABD	External signal timer
1	WATDOG	Master CPU timer

OUT2:

Bit	Signal Name	Function
8	M28	External signal output 28
7	M24	External signal output 24
6	M22	External signal output 22
5	M21	External signal output 21
4	M18	External signal output 18
3	M14	External signal output 14
2	M12	External signal output 12
1	M11	External signal output 11

OUT3:

Bit	Signal Name	Function
8	ZOOM*	Magnified display
7	MASK*	Clear CRT display
6	ZGENO	Z-axis machine zero point
5	YGENO	Y-axis machine zero point
4	XGENO	X-axis machine zero point
3	SV	Servo ON
2	AUTO	Automatic operation
1	MF	External signal output latch

OUT4:

Bit	Signal Name	Function
8	SVREADY1	Servo ON
7	SVREADY2	Servo ON
6	SPROT	Program protection
5	ALM	Alarm that turns servos OFF (**)
4	M30	Program end
3	M08	Coolant ON
2	M00	Program stop
1	STL	Automatic operation in progress

OUT5:

Bit	Signal Name	Function
8		Not used
7		Not used
6		Not used
5	APC4	Spindle servo ON
4	APC3	X-, Y-, Z-axis servo ON
3	NMIGAT2	Slave CPU NMI interrupt
2	TMAB	Slave CPU timer
1	DOG	Not used

OUT6:

Bit	Signal Name	Function
8	2^{15}	Speed commands (upper 8 bits of the D/A converter output pulse)
7	2^{14}	
6	2^{13}	
5	2^{12}	
4	2^{11}	
3	2^{10}	
2	2^9	
1	2^8	

OUT7:

Bit	Signal Name	Function
8	SSYNC*	Spindle zero point detection enabled
7	ZSYNC*	Z-axis zero point detection enabled
6	YSYNC*	Y-axis zero point detection enabled
5	XSYNC*	X-axis zero point detection enabled
4	NC10	Air blaster valve ON
3	LRUN	ATC deceleration command
2	CW/ <u>CCW</u>	ATC rotation clockwise/counterclockwise
1	ATC ST/STOP	ATC rotation start

OUT8:

Bit	Signal Name	Function
8	2^7	Speed commands (lower 8 bits of the D/A converter output pulse)
7	2^6	
6	2^5	
5	2^4	
4	2^3	
3	2^2	
2	2^1	
1	2^0	

OUT9:

Bit	Signal Name	Function
8	Sampling	D/A output sampling timing signals for each axis.
7	-	
6	IREF sampling	The Slave CPU operates when one of these signals changes status.
5	-	
4	Spindle sampling	
3	Z-axis sampling	
2	Y-axis sampling	
1	X-axis sampling	

APPENDIX

TOOL LIST 1

Name	Name
Phillips screwdriver 1 x 75	Both ended box wrench, nominal size 17 x 19
Phillips screwdriver 2 x 100	Monkey wrench, nominal size 150
Phillips screwdriver 3 x 150	Monkey wrench, nominal size 250
Phillips screwdriver 3 x 300	Pliers, nominal size 150
Straight-headed screwdriver 4.5 x 50	Water pump pliers, nominal size 250
Straight-headed screwdriver 6 x 100	Cutting nipper, nominal size 150
Straight-headed screwdriver 8 x 150	Radio pliers
Precision Phillips screwdriver 0 x 75	Snap-ring pliers for hole
Precision straight-headed screwdriver 2.5 x 75	Socket driver 7 (across flats) x 125
Allen wrench, nominal size 2.5	Flat file (small)
Allen wrench, nominal size 3	Round file (small)
Allen wrench, nominal size 4	Plastic hammer
Allen wrench, nominal size 5	Metal scale, C type, class 1, 150 mm
Allen wrench, nominal size 6	Linear scale, class 1, 2 m
Allen wrench, nominal size 8	Feeler gauges
Allen wrench, nominal size 10	Vernier callipers
Wrench, nominal size 7	Base master (tool chip measurement)
Wrench, nominal size 8	Small dial indicator 1/100
Wrench, nominal size 10	Small dial indicator 2/1000
Wrench, nominal size 13	Magnetic base
Wrench, nominal size 16	AV voltmeter (0 - 250 V)
Wrench, nominal size 18	Grease gun
L wrench, nominal size 22	Grease

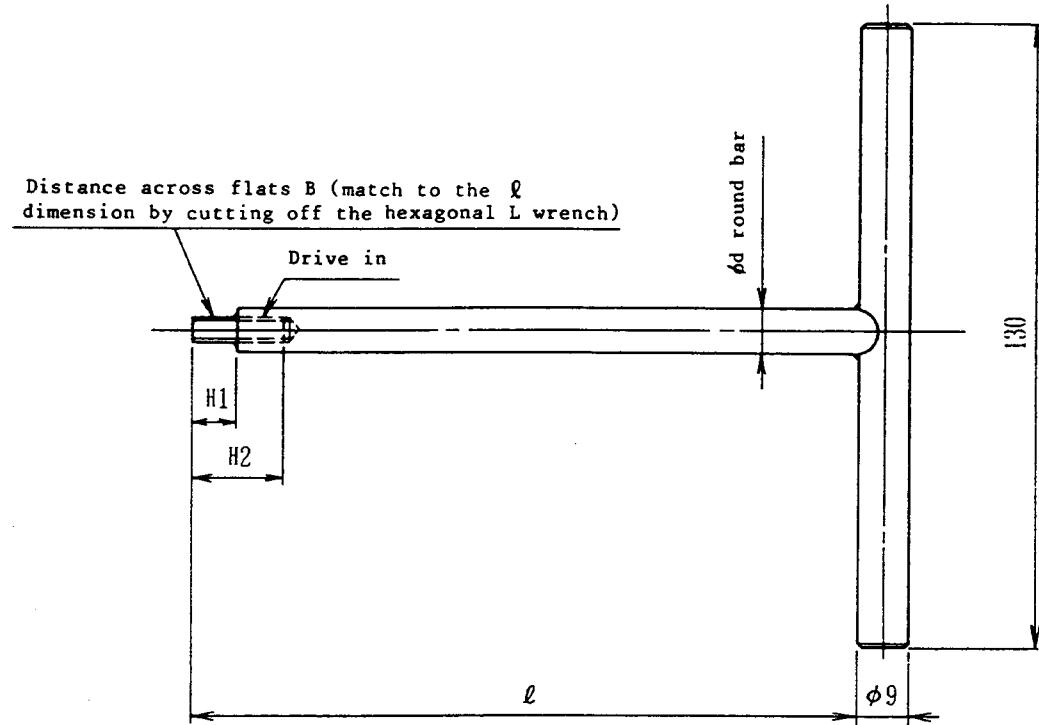
Name	Name
Screw locking agent	Waste cloth
Vinyl tape	Tags
Seal tape	Silicon rubber
Lubrication oil spray	Vinyl cord fastener

TOOL LIST 2

Name	Drawing No.	Remark
T wrench 2.5 x 150	1	
T wrench 3 x 150	1	
T wrench 4 x 150	1	
T wrench 4 x 360	1	
T wrench 5 x 150	1	
T wrench 6 x 150	1	
Spindle retraction jig, body	2	This jig is for removing the spindle. Remove the spindle motor, attach the retraction jig and turn the bar to retract the spindle.
Spindle retraction threaded bar	3	
Collar for spindle retraction threaded bar	4	
ø8 x 240 bar	5	
Spindle roller retraction jig	6	This jig is to replace the clamp shaft. Turn the bar to remove the roller.
Screw L	7	
Screw S	8	
Pad ring	9	
Clamp shaft guide 225	10	
Clamp shaft guide 215	11	
Spindle driving jig (upper)	12	This jig is to insert the spindle. Mount the spindle driving jig and lower the Z axis to drive the spindle into position.
Spindle driving jig (lower)	13	
Spindle driving collar 225	14	
Spindle driving collar 215	15	
Wrench for round nut	16	This wrench is to remove and tighten the round nut on the magazine center shaft when replacing the magazine.
ø8 x 240 bar	5	

Name	Drawing No.	Remark
Wrench for cams	17	This wrench is to carry out left and right centering of the magazine and spindle when replacing the saddle.
ø8 x 150 bar	18	
Wrench for flats	19	This wrench is to rotate the magazine when adjusting the ATC.
ø8 x 150 bar	18	
Saddle measurement collar	20	This collar is to measure the surface flatness to determine whether or not to replace the saddle.
Coil spring 50	21	
Liner mounting jig	22	This jig is to center the saddle cover when replacing the saddle.
Wrench for U nuts	23	
Pipe for inserting balls into grip	24	
Swinging test bar	25	This wrench is to carry out left and right centering of the magazine and spindle when replacing the magazine.
Rotating shaft	26	
Small dial indicator mounting bar	27	
Dummy tool	28	
Pull stud	29	
Bearing retainer	30	This retainer is to prevent the bearing coming out when replacing the magazine.
Bubble cassette	-	Used to transfer memory contents when replacing the MEMORY PCB.
Portable bubble cassette unit	-	

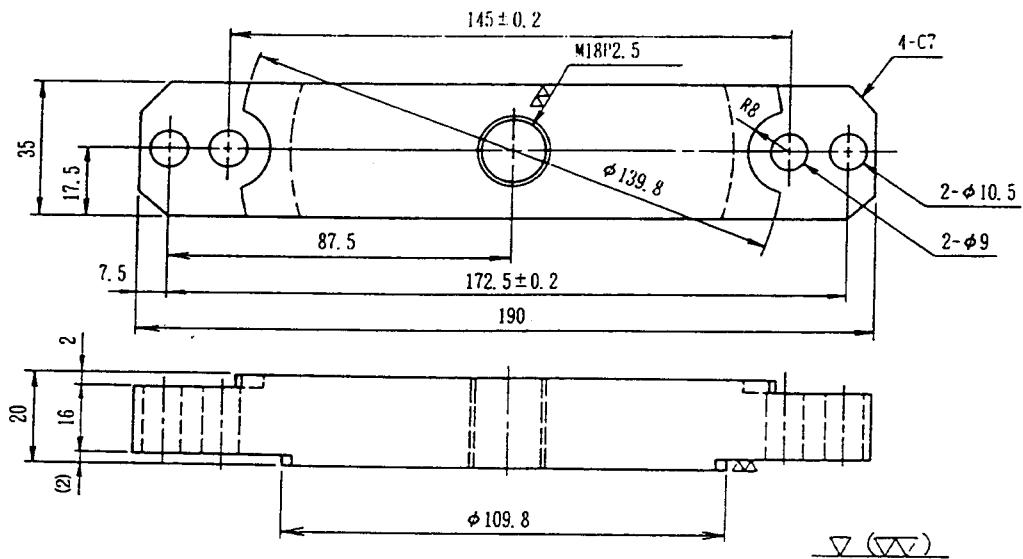
(1) T WRENCH (SET)



Material: S10C-D

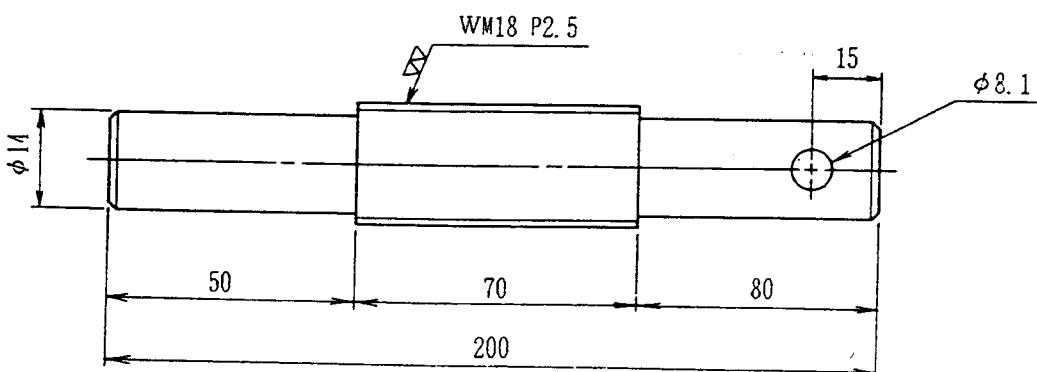
No.	B (Distance across flats)	H1	H2	d	ℓ	Q'ty	Remarks
1	2.5	15	25	8.1	150	1	For X-, Y-axis couplings
2	3	15	25	8.1	150	1	For X-, Y-axis couplings
3	4	20	30	9	150	1	
4	4	20	30	8.1	360	1	For replacing the X- and Y-axis ball screws
5	5	20	30	9	150	1	
6	6	25	40	9	150	1	For clamp shaft roller set screw

(2) SPINDLE RETRACTION JIG, BODY



Material : S45C
 Heat Treatment: H1
 Hardness : HV 250 ± 50

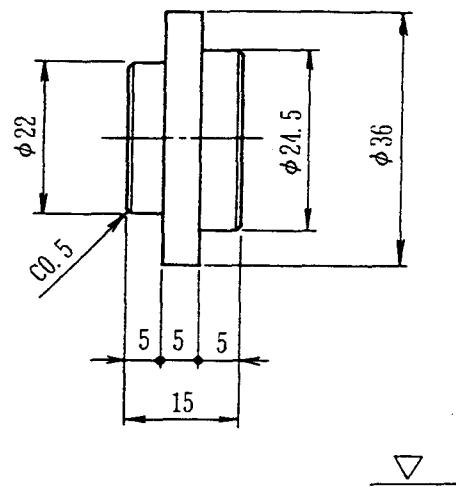
(3) SPINDLE RETRACTION THREADED BAR



Material : S45C
 Heat Treatment : H1
 Surface Treatment: S2
 Hardness : HV 250 ± 50

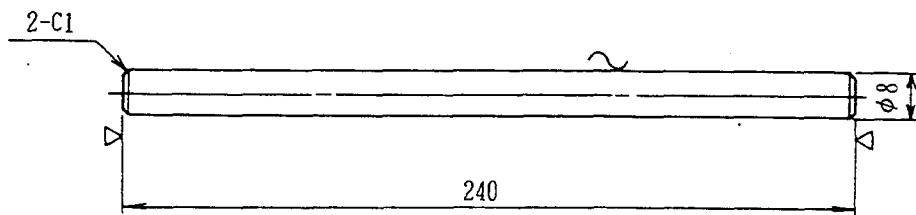
$\nabla (\nabla \nabla)$

(4) COLLAR FOR SPINDLE RETRACTION THREADED BAR



Material: S45C

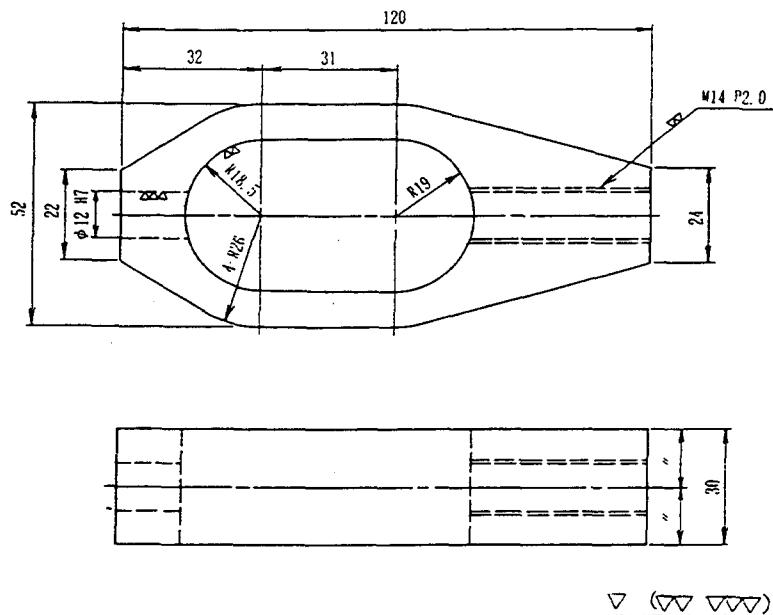
(5) $\phi 8 \times 240$ BAR



$\sim (\nabla)$

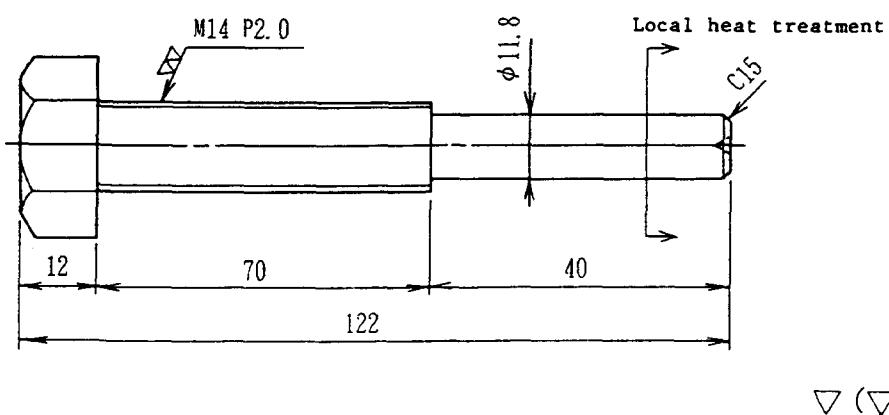
Material: S10C-D

(6) SPINDLE ROLLER RETRACTION JIG, BODY



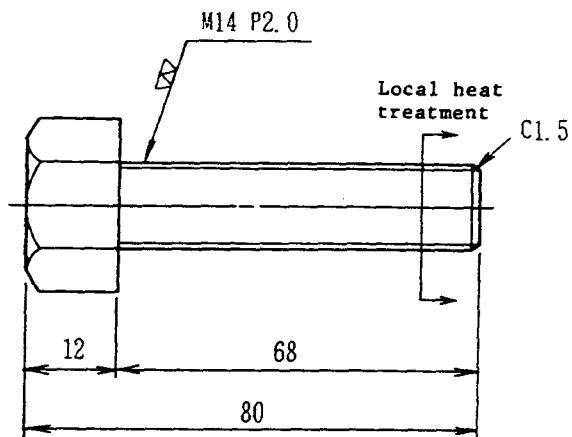
Material: S45C

(7) SCREW L



Material : S45C
 Heat Treatment: H1
 Hardness : HV 250+50

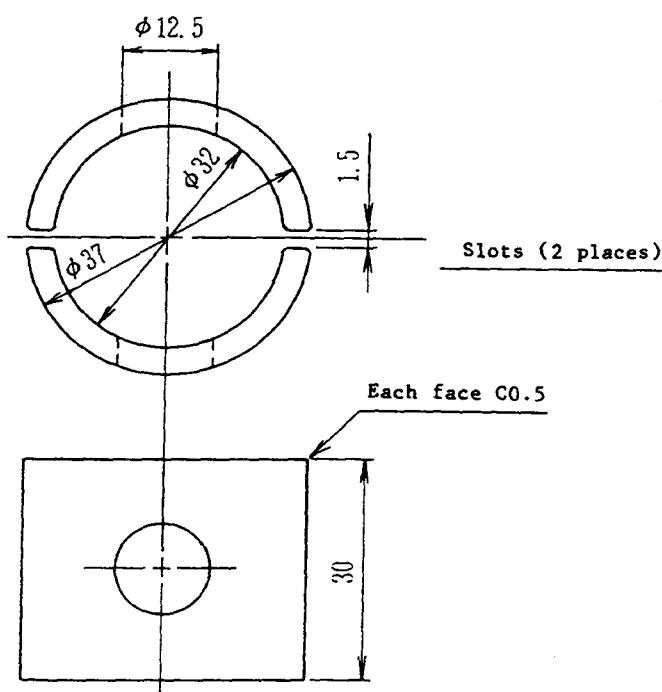
(8) SCREW S



Material : S45C
Heat Treatment: H1
Hardness : HV 250+50

∇ ($\nabla\nabla$)

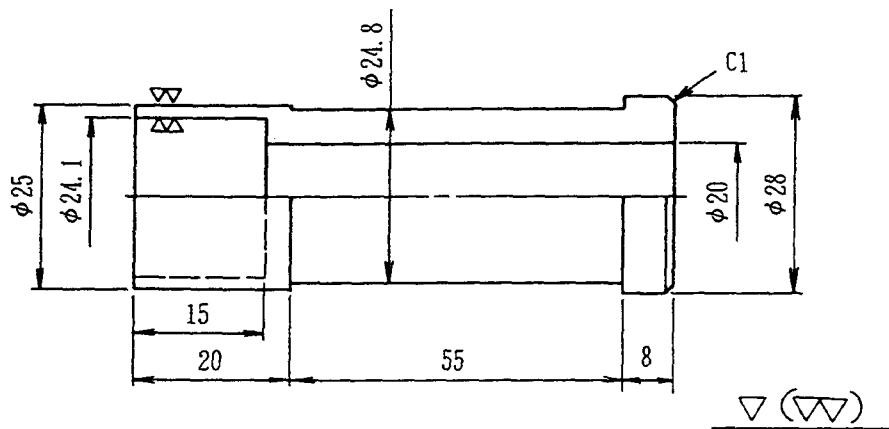
(9) PAD RING



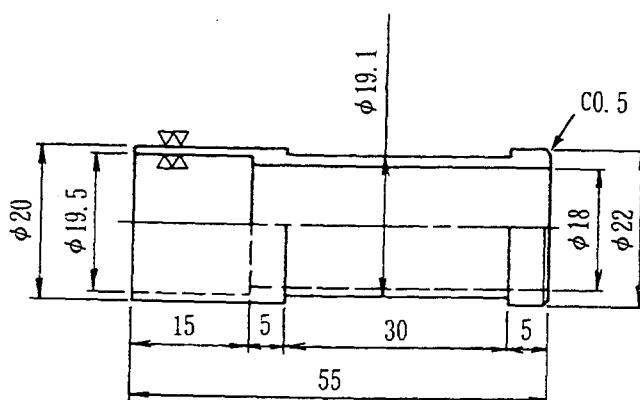
Material : S45C
Heat Treatment: H1
Hardness : HV 250+50

∇

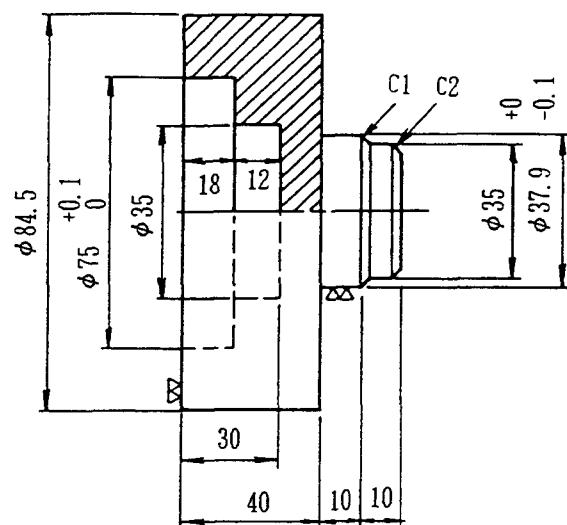
(10) CLAMP SHAFT GUIDE 225



(11) CLAMP SHAFT GUIDE 215



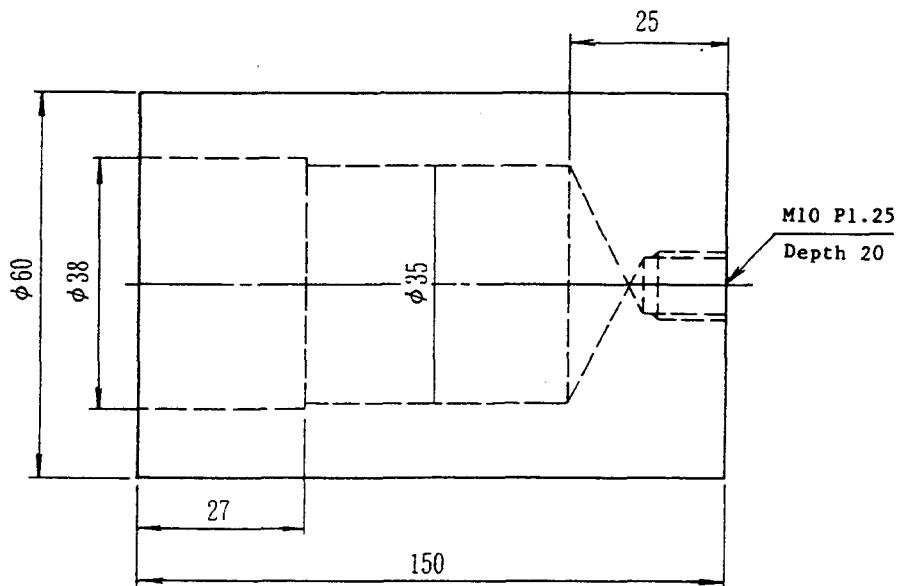
(12) SPINDLE DRIVING JIG (UPPER)



∇ ($\nabla\nabla$)

Material : S45C
 Heat Treatment: H1
 Hardness : HV 250+50

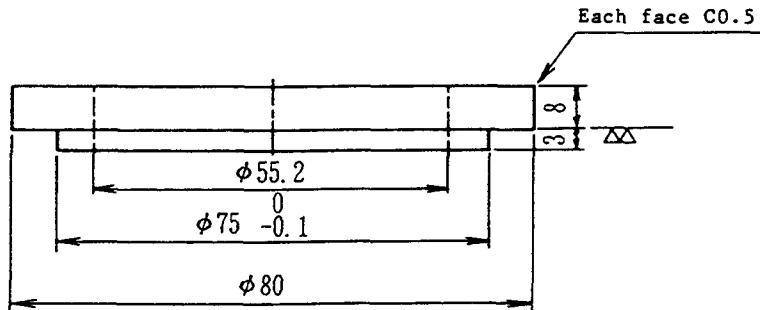
(13) SPINDLE DRIVING JIG (LOWER)



Material: Al

∇

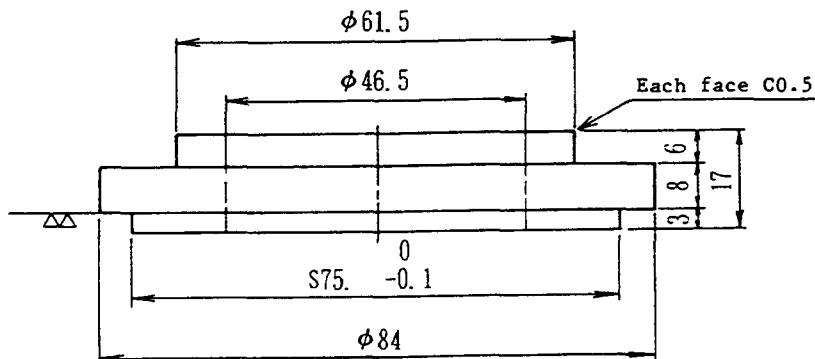
(14) SPINDLE DRIVING COLLAR 225



$\nabla (\nabla \nabla)$

Material: S45C

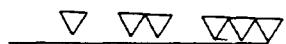
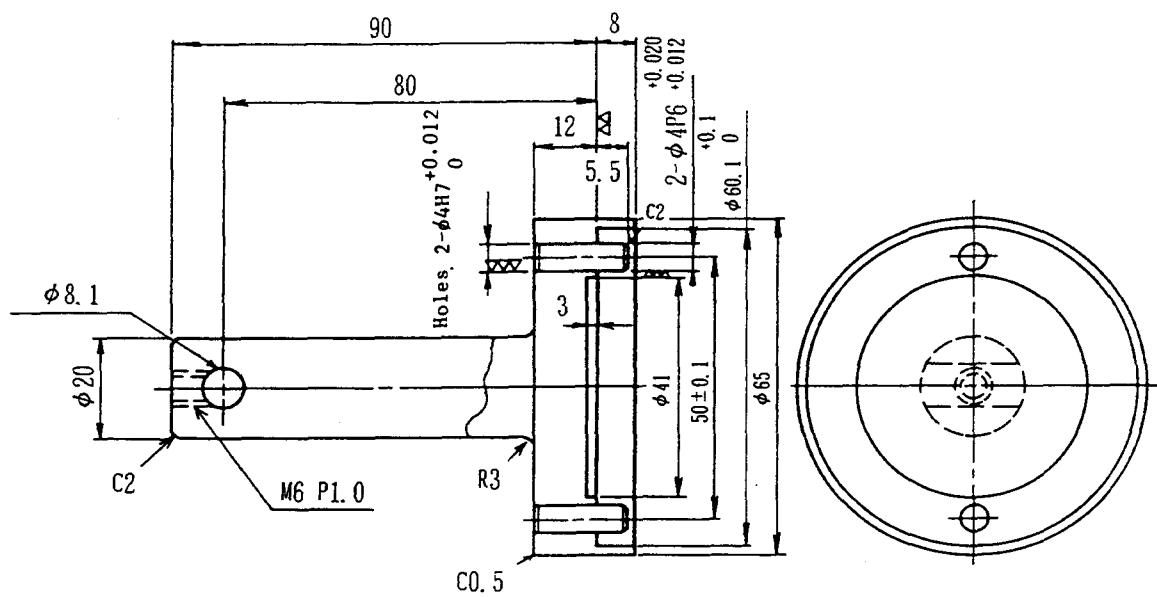
(15) SPINDLE DRIVING COLLAR 215



$\nabla (\nabla \nabla)$

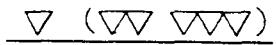
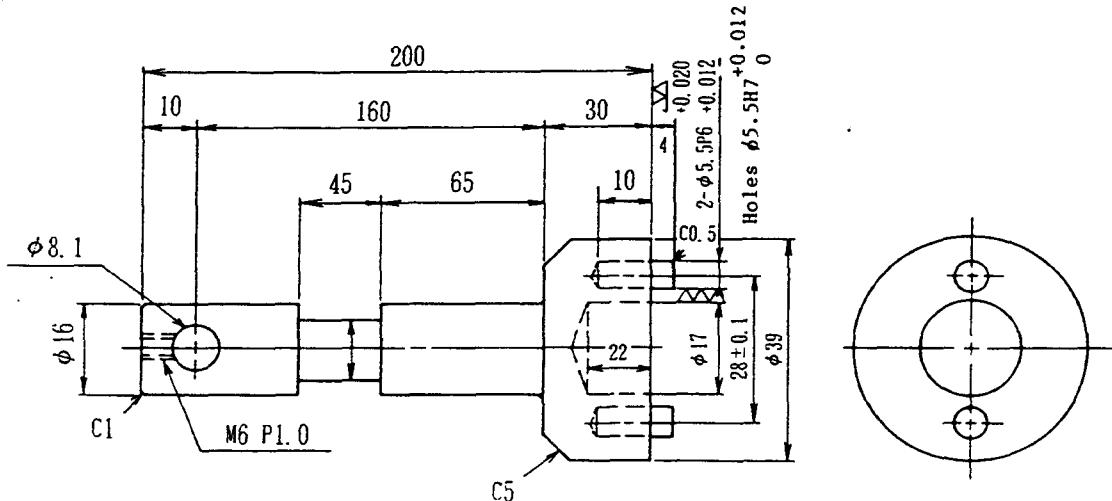
Material: S45C

(16) WRENCH FOR ROUND NUT



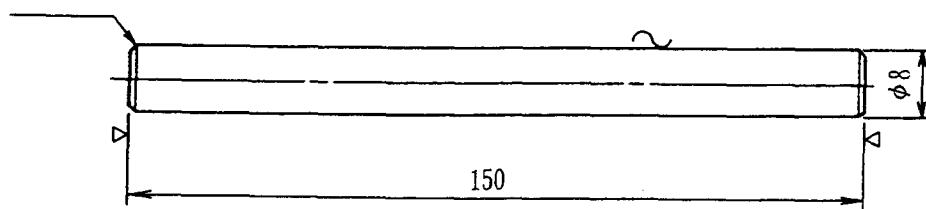
Material: S45C

(17) WRENCH FOR CAMS



Material: S45C

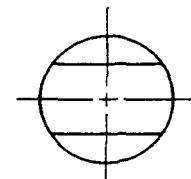
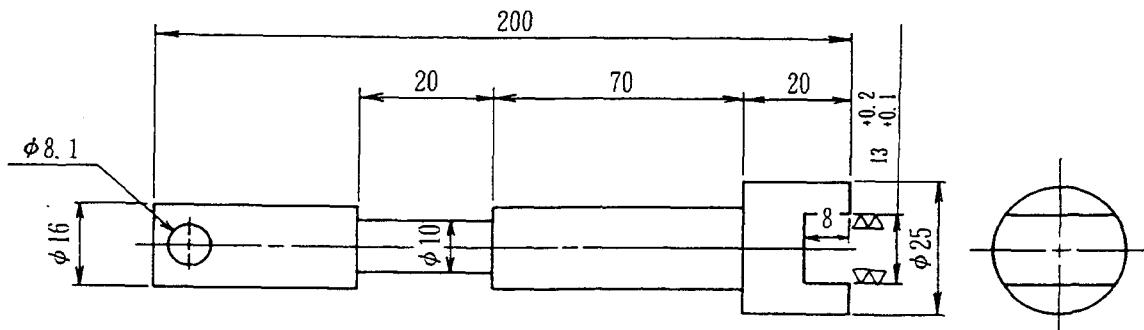
(18) $\phi 8 \times 150$ BAR



~ (▽)

Material: S10C-D

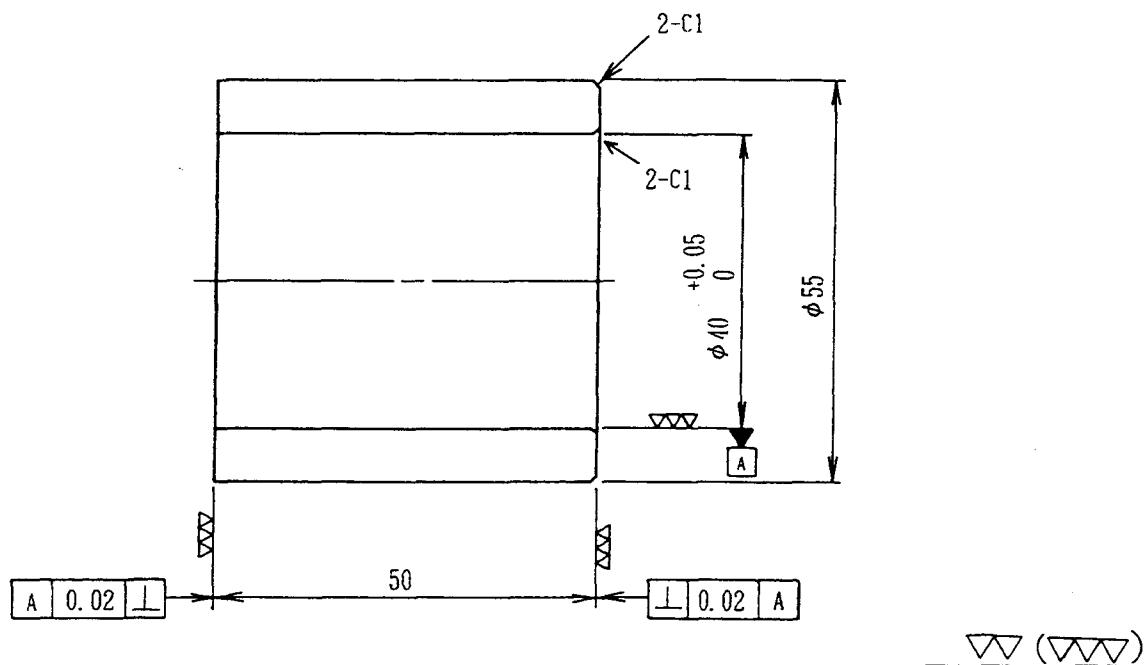
(19) WRENCH FOR FLATS



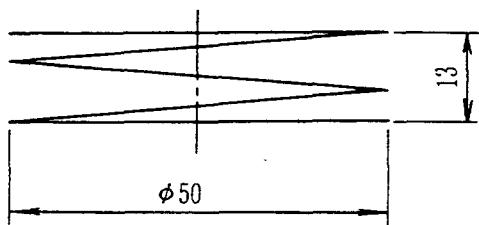
▽ (▽▽)

Material: S45C

(20) SADDLE MEASUREMENT COLLAR



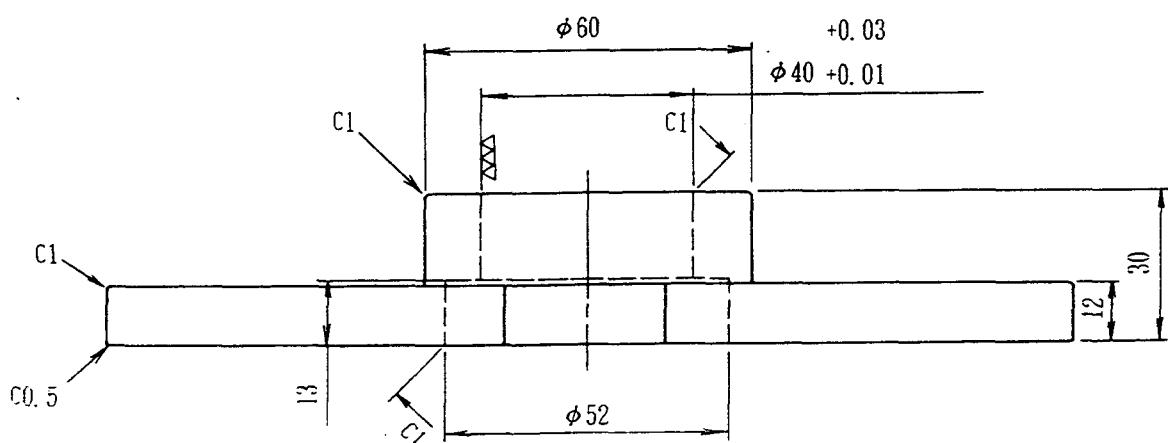
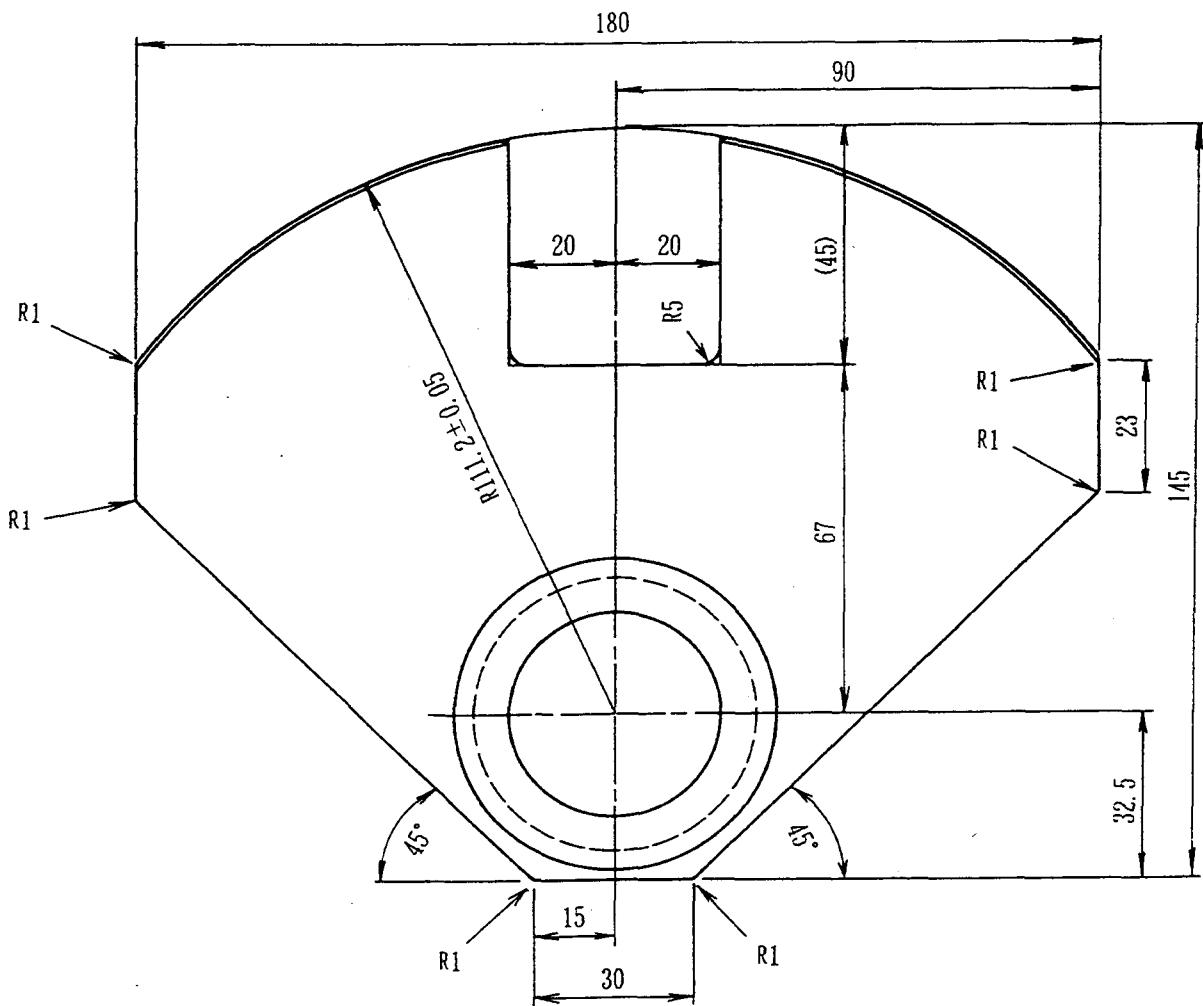
(21) COIL SPRING 50



Outside Diameter:	φ50
Wire Diameter :	φ2.3
Spring Constant :	0.072
Free Length :	13
No. of Turns :	3

Material : SWPA
 Heat Treatment: H6

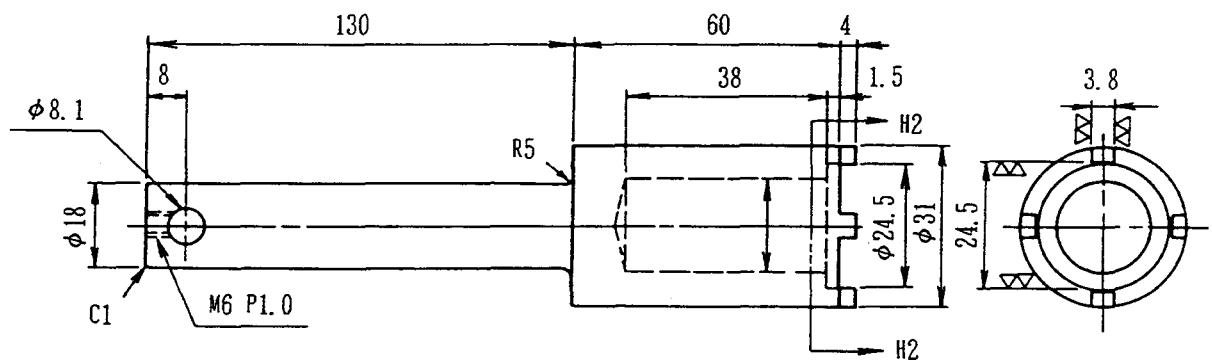
(22) LINER MOUNTING JIG



Material: Al100BE-F

The diagram consists of two separate parts. On the left, there is a horizontal line with two upward-pointing triangles positioned above it. To the right of a small gap, there is another horizontal line with a bracket underneath it enclosing three upward-pointing triangles.

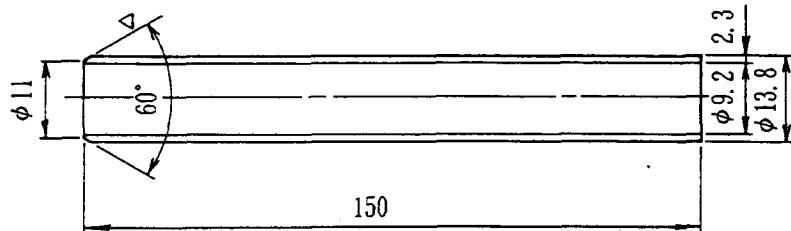
(23) WRENCH FOR U NUTS



∇ ($\nabla\nabla$)

Material : S45C
Heat Treatment: H2 (Induction hardened)
Hardness : HRC 40 - 50

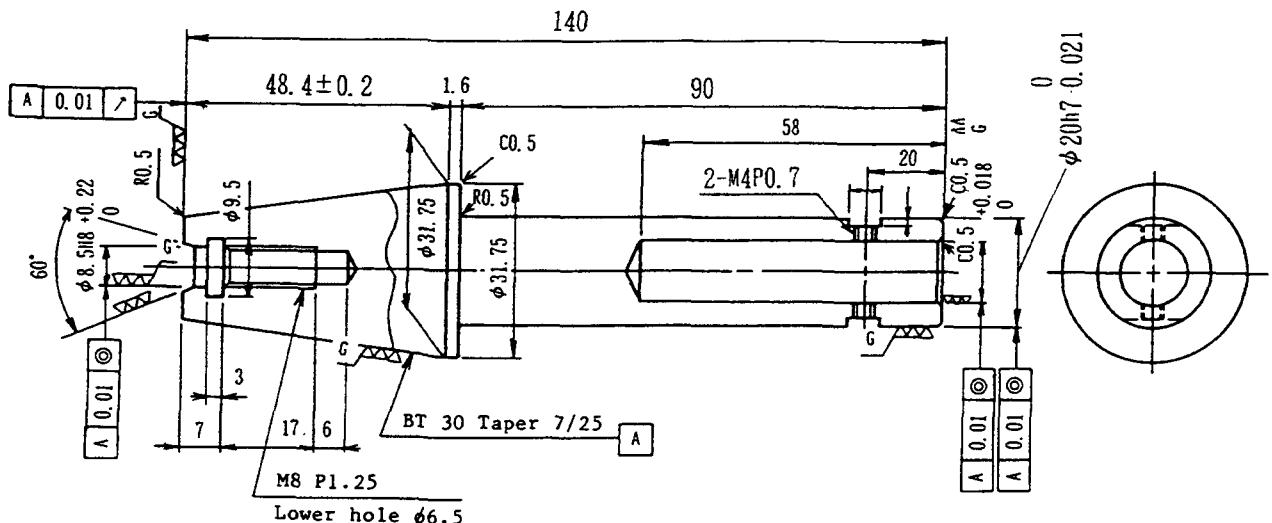
(24) PIPE FOR INSERTING BALLS INTO GRIP



\sim (∇)

Material: SGP

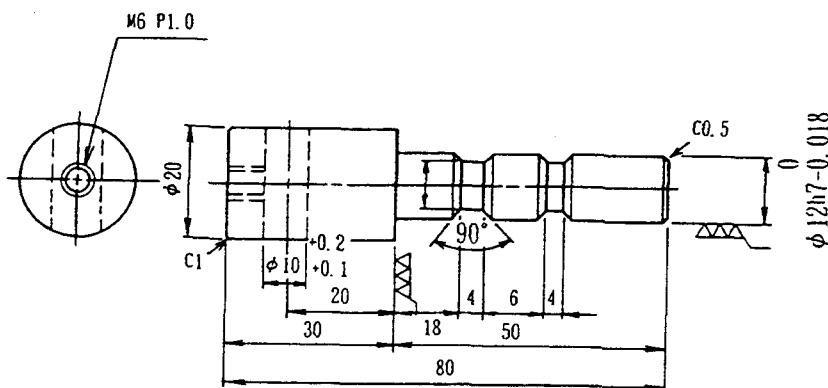
(25) SWINGING TEST BAR



▽▽ (▽▽▽)

Material : S45C
 Heat Treatment: H2 (Induction hardened)
 Hardness : HRC 50 or more

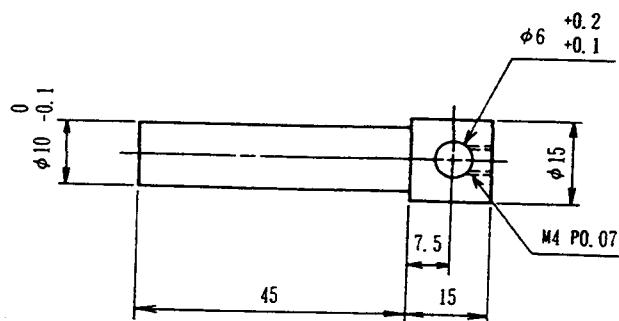
(26) ROTATING SHAFT



▽▽ (▽▽▽▽)

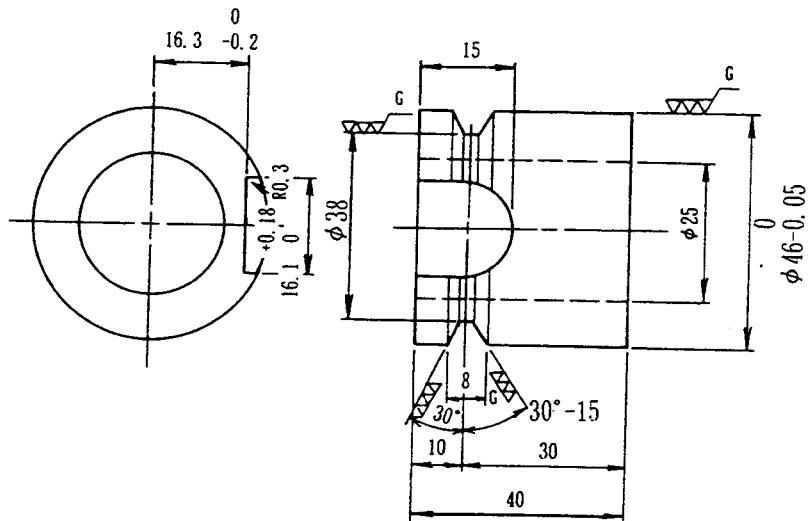
Material : S45C
 Heat Treatment: H2 (Induction hardened)
 Hardness : HRC 50 or more

(27) SMALL DIAL INDICATOR MOUNTING BAR



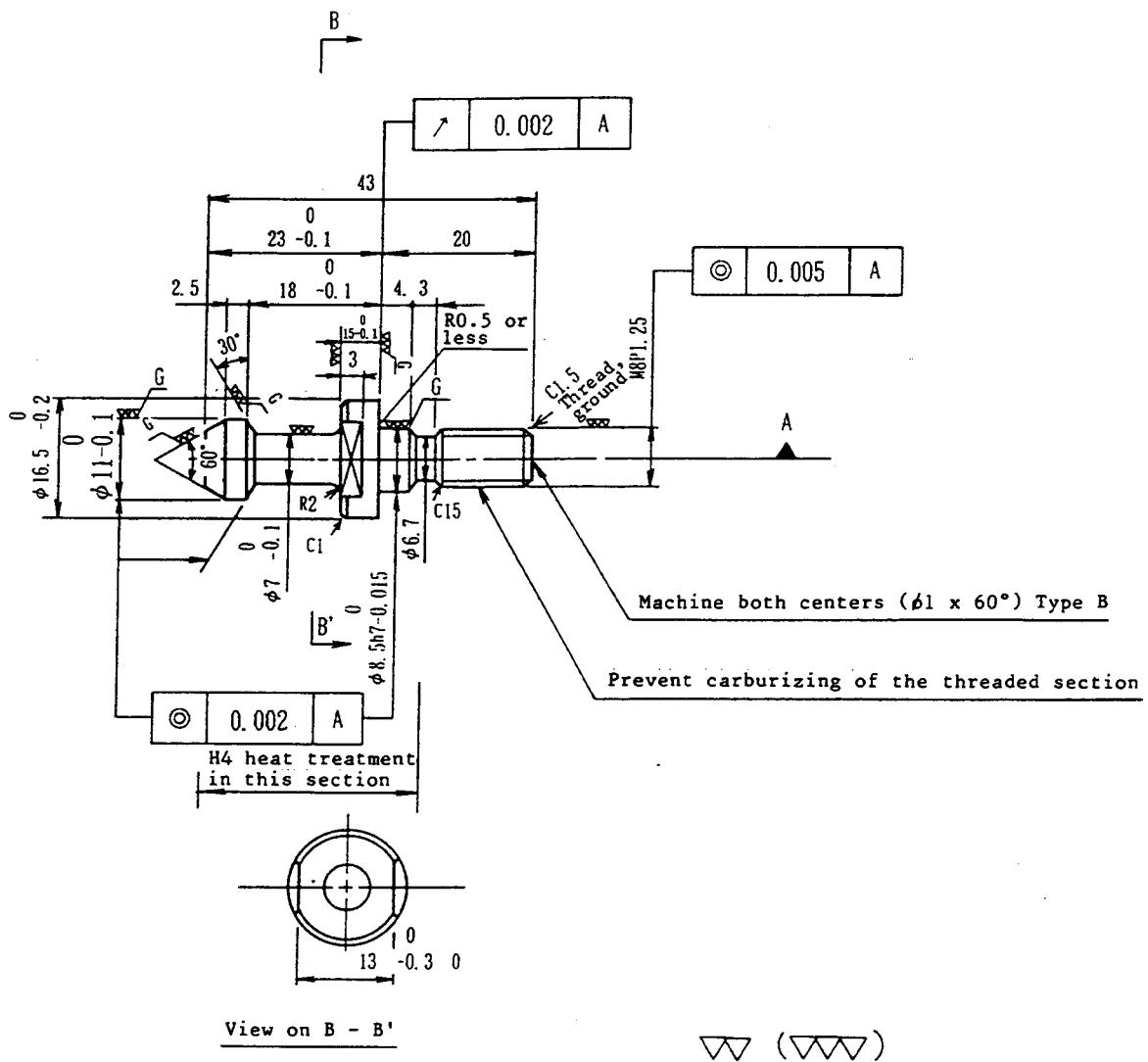
Material: S45C

(28) DUMMY TOOL



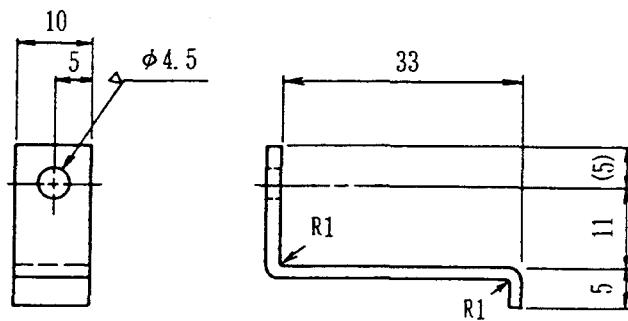
Material : S45C
 Heat Treatment: H2 (Induction hardened)
 Hardness : HRC 50 or more

(29) PULL STUD



Material : SCM415
Heat Treatment: H4
Hardness : HV 450 or more

(30) BEARING RETAINER



t: 2.0

~ (▽)

Material: SPCC-SD

