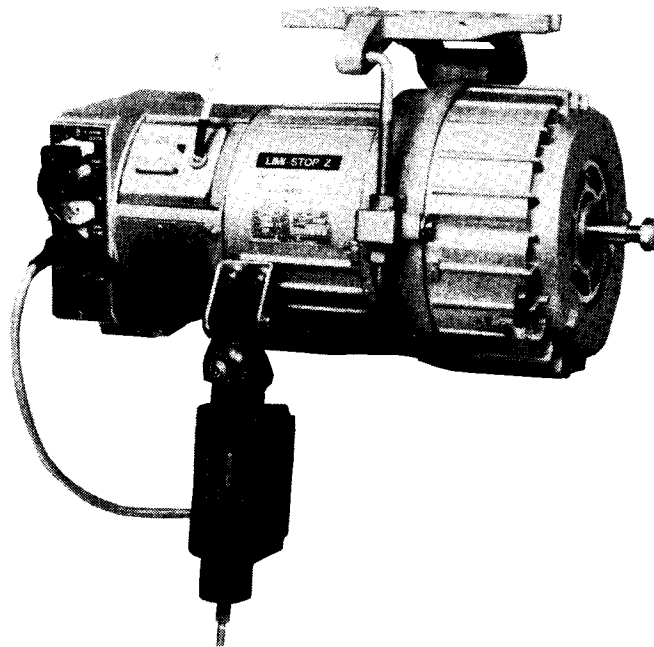


mitsubishi

LIMI-STOP Z (Technical Information)

Variable-Speed, Needle Positioning Clutch Motors with
a Non-contact Clutch and Built-in Microprocessor

ZK-Series



Since the LIM-STOP Z controls electrically the low inertia non-contact type clutch and the electromagnetic brake, it not only assists the fixed position stop of sewing machine needle but also provides the variable sewing speed depending on the extent of toe down on the pedal. In order to fully utilize the designed capacity of the LIM-STOP Z, please read carefully this technical information to learn the method of proper maintenance, inspection and handling.

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Specifications and Features

1. Specifications and Features

1.1 Specifications

(1) Motor specifications

Table 1

Motor type	Number of phases	Number of poles	Output (W)	Voltage (V)		Output shaft speed (spm)		Speed control range (spm)	Lever unit type
				Single phase	Three phases	50Hz	60Hz		
CA-ZK254F-20	1	4	250	100, 110	200, 200	1250	1550	200 to 2000*	LK-CL-1 With variable-speed operation, needle DOWN stop, needle UP stop functions
CB-ZK254F-20	3								
CA-ZK402F-50	1	2	400	110/220	200/380	2750	3350	200 to 5000*	
CB-ZK402F-50	3								
CA-ZK552F-50	1	2	550	230, 240	415	2750	3350	200 to 5000*	
CB-ZK552F-50	3								
CA-ZK254F-FL20	1	4	250	100, 110	200, 220	1250	1550	200 to 2000*	LK-CL-2 With variable-speed operation, needle DOWN stop, needle UP stop, automatic presser foot lifting functions
CB-ZK254F-FL20	3								
CA-ZK402F-FL50	1	2	400	110/220	220/380	2750	3350	200 to 5000*	
CB-ZK402F-FL50	3								
CA-ZK552F-FL50	1	2	550	230, 240	415	2750	3350	200 to 5000*	
CB-ZK552F-FL50	3								
CA-ZK402E-AMBL20 AMK20 AMKL20	1	2	400	100, 110 110/220 200, 220 230, 240	200, 220 220/380 346, 380 415	2750	3350	200 to 2000*	LK-CL-2 With variable-speed operation, needle DOWN stop, thread trimmer, automatic presser foot lifting functions (Only for model LK-AMK, LK-CL-1 is used.)
CB-ZK402E-AMBL20 AMK20 AMKL20	3							200 to 4000*	
CA-ZK402E-AMBL40 AMK40 AMKL40	1							200 to 4000*	
CB-ZK402E-AMBL40 AMK40 AMKL40	3							200 to 4000*	
CA-ZK552E-AMBL20 AMK20 AMKL20	1	2	550	100, 110 110/220 200, 220 230, 240	200, 220 220/380 346, 380 415	2750	3350	200 to 2000*	
CB-ZK552E-AMBL20 AMK20 AMKL20	3							200 to 4000*	
CA-ZK552E-AMBL40 AMK40 AMKL40	1							200 to 4000*	
CB-ZK552E-AMBL40 AMK40 AMKL40	3							200 to 4000*	

Note) *: May be changed to 160 to 8500 spm by operation variable resistor in the control box.

Specifications and Features

(2) Functions of control box

Table 2

Function		Model of control box	Model					Specifications	
			ZK	FL	AMBL	AMK	AMKL		
Output	Sewing machine	Thread trimmer T	x	x	o	o	o	Thread is trimmed with the full heeling of pedal or with the thread trimmer signal at the end of stitching and the thread is wiped as the needle stops at UP position.	
		Wiper W	x	x	o	o	o		
		Back tack B	x	x	o	o	o		Back tack motion is initiated as the external control signal S7 is turned ON or at the back tack stitch.
	Automatic presser foot lifter FU		x	o	o	x	o	As the automatic presser foot lifter is attached, the presser foot lifting motion is operated.	
	Constant-voltage power supply +12V		o	o	o	o	o	DC 12V (Max. 40mA) is output. It can be used also for the power supply to the photo switch, which is built in the amplifier, etc.	
Externally operated input	Run signal	Variable speed command VC	o	o	o	o	o	Command voltage input of speed proportional to the pedal press down depth. As the variable speed command voltage is given, the speed nearly proportional to the voltage is obtained.	
		Run signal (variable speed) S1	o	o	o	o	o	Pedal full toe down signal input. Operation speed is controlled with the value set with the external knob or external variable resistor.	
		Run signal (thread trimmer) S2	o	o	o	o	o	Pedal full heeling signal input. As S2 signal is turned ON, following operations are initiated. ZK: needle up, FL: needle up, presser foot lifter, AMBL, AMKL: thread trimmer, needle UP stop and presser foot lifter, AMK: thread trimmer, needle UP stop.	
		Run signal (foot lifter) S3	x	o	o	x	o	Pedal light heeling signal input. As S3 signal is turned ON, the presser foot lifting motion is operated with the auto presser foot lifter.	
	External control signal	Automatic presser foot lifter F	x	o	o	x	o	As F signal is turned ON while the sewing machine is stopped, the presser foot is lifted with the auto presser foot lifter.	
		Back tack S7	x	x	o	o	o	As S7 signal is turned ON during the sewing machine operation, the feed is reversed and the back tack can be done.	
		Thread trimmer cancel TL	x	x	o	o	o	Thread trimmer with the full heeling or the external thread trimmer signal S2 is cancelled, the needle stops at the UP position.	
	Internal switch	Slow start switch SL, +1		x	x	o	o	o	After the power ON or at the initial toe down after the thread trimmer, 0 to 2 stitches can be started with slow speed. (See the combination listed at right.)
		Trimmer interlock cancel switch IL		x	o	o	o	o	Restart prohibit command at thread trimmer is cancelled. When it is ON, the operation resumes after the duration of interlock. In case of FL model, it must be turned ON always.
Gain switch G		x	o	o	o	o	Increases the driving force at thread trimmer. If it is turned ON at the thread trimmer with thick cloth or thick thread, it will make easy the thread trimmer. If it is turned ON at the stitching of thin cloth, the deviation in the up position stop may be enlarged.		
Needle UP/DOWN control by back tack switch (S7) US		x	x	o	o	o	As the back tack switch S7 is turned ON at the needle DOWN stop, the needle goes up and stops at the UP position.		
Position select switch POS/U		o	o	o	o	o	1 position motion is operated and the needle stops at the UP position.		
Thread trimmer by backward feed TB		x	x	o	o	o	Auto thread trimmer is conducted at the reverse feed.		
Light heeling-triggered foot lifter cancel S3L		x	o	o	o	o	Auto presser foot lifting motion with light heeling is cancelled. To lift the presser foot when S3L is turned ON, use the control of presser foot lifting signal F.		
Momentary automatic presser foot lifter switch FUM		x	x	o	o	o	Switch to continue the auto presser foot lifting motion after the thread trimmer with the full heeling or with the external thread trimmer signal S2.		
Back tack stitch adjusting switch BM		x	x	o	o	o	Switch to set the motion timing of reverse stitch solenoid to adjust the back tack.		
Back tack stitch number setting switch		x	x	o	x	x	Switch to set the number of stitches for start or end back tack. 0 to 15 stitches can be set.		

Specifications and Features

Function		Model of control box		Model			Specifications															
		ZK	FL	AMBL	AMK	AMKL																
Internal switch	Soft brake BL	○	○	○	○	○	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="2">BL switch</th> <th>Function</th> </tr> <tr> <td>ZK</td> <td>ON</td> <td>Soft brake is released.</td> </tr> <tr> <td>ZK-FL</td> <td>OFF</td> <td>Soft brake is operated when the machine is stopped so that the turn of pulley is lightly restricted.</td> </tr> <tr> <td>ZK-AMBL</td> <td>ON</td> <td>Soft brake is operated when the machine is stopped so that the turn of pulley is lightly restricted.</td> </tr> <tr> <td>ZK-AMK</td> <td>OFF</td> <td>Soft brake is released.</td> </tr> </table>	BL switch		Function	ZK	ON	Soft brake is released.	ZK-FL	OFF	Soft brake is operated when the machine is stopped so that the turn of pulley is lightly restricted.	ZK-AMBL	ON	Soft brake is operated when the machine is stopped so that the turn of pulley is lightly restricted.	ZK-AMK	OFF	Soft brake is released.
	BL switch		Function																			
	ZK	ON	Soft brake is released.																			
	ZK-FL	OFF	Soft brake is operated when the machine is stopped so that the turn of pulley is lightly restricted.																			
ZK-AMBL	ON	Soft brake is operated when the machine is stopped so that the turn of pulley is lightly restricted.																				
ZK-AMK	OFF	Soft brake is released.																				
Speed adjust mode switch VEL	×	×	×	○	○	Switch to adjust the speed setting internal variable resistor with XC-C40-Y or XC-C250-Y control switch panel.																
Thread trimmer specifications	Pfaff type P	×	×	○	○	○	Switch to set the timing of thread trimmer at "Pfaff type".															
	Chain stitch sewing machine type K	×	×	×	○	○	Switch to set the timing of thread trimmer at "Chain sewing machine type".															
External switch	Speed setting knob	○	○	○	○	○	It controls the speed over the max. to slow speed which are set with the internal variable resistor H.															
	Back tack switch	×	×	○	○	○	Determines "to do/not do" the start and end back tack stitch. N back tack or V back tack stitch can be selected for both the start and end back tack stitch.															
Option	Control switch panel XC-C type	×	×	×	○	○	Used for start/end backtacking, pattern stitching and program/teaching stitching; number of items produced can be counted when model XC-CE counter input device is connected.															
	Sensor amplifier XC-CS1-Y Reflecting sensor	×	×	×	○	○	Used to detect end of fabric, stop sewing machine and trim thread; stop/thread trimming is enabled after end of fabric has been detected and set number of stitches have been sewn.															
	Ply sensor XC-CSR-LS XC-CSP-LS	×	×	×	○	○																
	Counter display XC-CC-Y type	○	○	○	○	○	Used to count the number of sewn products. XC-CE type counter input device must be connected.															
	Counter input device XC-CE type	○	○	○	○	○	This is connected with XC-CC-Y type counter display when the number of sewn products is counted.															
	Automatic presser foot lifter LE-FM-1 type (electromagnetic) LE-FM-2 type (electromagnetic) LE-FA type (pneumatic)	×	○	○	×	○	Used to operate the auto presser foot lifter with the presser foot lifting output from the control box.															
	Variable speed pedal XC-CVS-2 type	○	○	○	○	○	Designed for convenience at the standing work.															

(3) Rating of solenoid

Driving voltage is about 30V. Minimum value of resistor which can be connected is as listed below.

Table 3

Solenoid	Thread trimmer T	Wiper W	Back tack B	Presser foot lifter FU
Resistance (Ω)	5 (short time rating)	5 (short time rating)	5 (short time rating)	10 (continuous rating)

- Note**
- Presser foot lifting output is maintained at the half wave about 0.5 sec. later.
 - Thread trimmer output, wiper output and back tack output are inherent to AMBL, AMK and AMKL type only.
 - Presser foot lifting output is inherent to FL, AMBL and AMKL types only.

Specifications and Features

1.2 Features

(1) Wear on the clutch has been eliminated completely.

Life of non-contact clutch is almost indefinite. Arrangement for no contact driving is employed also on the control unit and position detectors so that it features the true maintenance free design.

(2) Improved convenience of maintenance

As the control box cover is removed, the printed circuit board is found there so that the adjustment and inspection can be readily done and the board itself can be replaced easily.

(3) Both for standing and sitting work

Although the pedal is designed for the sitting work, it can be adaptable also to the standing work using the external control. If the program controller is employed, it is adapted easily to the automated operation.

(4) Simple speed control with the knob

Max. speed can be adjusted easily using the knob on the control box without changing the pulley. Setting of 1 position or 2 position of needle stop position can be selected easily using the internal switch.

(5) Abundant functions and options

Depending on the models, the functions such as the 'external control', 'auto presser foot lifter', etc. can be added up if the external switches are connected with the operation connectors.

(6) Any kinds of work can be controlled with the pedal operation only

Double step pedal heeling mechanism (FL, AMBL, AMKL) provides all basic operations of sewing machine such as the auto presser lifter (FL, AMBL, AMKL) with the nonstep variable speed by the toe down and the 1st step heeling as well as the auto thread trimmer (AMBL, AMK, AMKL) with the 2nd step heeling. Further, the load of toe down can be easily adjusted to obtain the best pedal reaction for any specific work.

(7) Employment of protection cover to prevent the belt running out

When the sewing machine is inclined during the adjustment, V belt tends to be separated from the pulley. The cover holds effectively the belt in position.

Composition and Operation

2. Composition and Operation

2.1 Composition

LIMI-STOP Z, ZK series consist of following sections.

(1) Motor assembly

This assembly consists of a motor, which runs under a constant speed, highly responsive low inertia non-contact clutch and electromagnetic brake and provides the variable speed operation over a wide range.

(2) Control box

Controls the variable speed of operation of motor, the fixed position stop of needle, thread trimming, wiper, back tack, etc.

(3) Detector

The detector transmits signals of sewing machine's main shaft speed and of needle position of up or down to the control box. It is the non-contact photo sensor.

(4) Lever unit

It sends signals of pedal toe down and heeling to the control box.

(5) Control switch panel (option) (AMK, AMKL)

This panel is used to select the sewing pattern and the number of stitches.

(6) Counter input device (option) (AMK, AMKL)

When this input device is operated with each item produced, the number of items produced can be displayed on the control box.

(7) Sensor amplifier (option) (AMK, AMKL)

This employs a sensor to detect the edge of the fabric and stop the sewing machine.

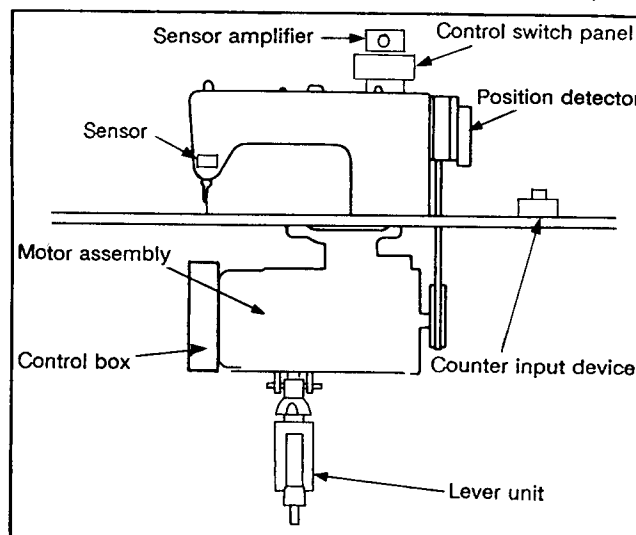


Fig. 1 Basic Composition

Composition and Operation

2.2 Mechanism of Operation and Function

(1) Mechanism of operation

Fig. 2 shows the drawing depicting the mechanism of motor. Drive member, which is connected to the motor rotor, rotates the driven member cup in the manner to squeeze it. Although there is no mechanical connection between the drive and the driven members, as the clutch coil is magnetized, the eddy current induced on the cup generates an electromagnetic connection so that the cup is rotated in the same direction as the drive member (rotor). This electromagnetic connection is well known long since by the experiment called "Arago's disc" and one of most popular applications is the rotating aluminum disc assembled in the integrating wattmeter at every home.

Extent of transmission torque can be adjusted by the current applied to the clutch coil (called the exciting current). Therefore, when the clutch is used with speed control system, if the exciting current is adjusted monitoring constantly the speed, the speed can be adjusted optionally.

To stop the revolution, the brake coil is excited to operate the lining. Speed control with electromagnetic force provides thus a smooth speed adjustment.

As the result of speed control, a loss (overcurrent loss) is generated at the driven member cup. This could be considered to correspond to the abrasion loss which is generated on the surface of lining with the conventional abrasion plate speed control method. Loss at the cup varies depending on the load torque and slip but the effect can be neglected in terms of temperature rise and life so far as it is concerned about the application on the ordinary sewing machine.

By the way, the cooling air is inhaled from the counter load side and discharged to the load side.

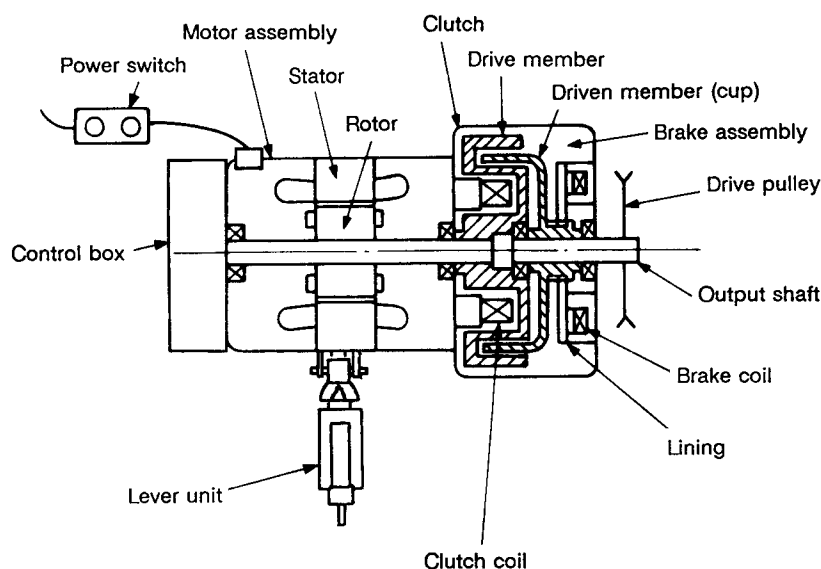


Fig. 2 Mechanism of LIM-STOP Z

Composition and Operation

(2) Basic motions and functions

- 1) Since it employs the feedback control by the speed detector signal, which produces the speed of sewing machine corresponding to the extent of pedal toe down, the speed can be changed stepless from slow to high speed.
- 2) Needle stop position
As the pedal is pressed with toe down to initiate the high speed operation and then the pedal is returned to the neutral position, the brake coil is energized so that the revolutions of sewing machine are reduced quickly to the positioning speed (low speed). As the needle stop position (DOWN position) is detected during the low speed operation, the brake is operated and the machine stops. Since the brake is released after a definite time, the sewing machine pulley can be turned freely with hand. By the way, if the 1-2 position select switch (U or POS switch) is turned on, the needle stops at UP position while it stops at DOWN position if it is turned off.
- 3) Thread trimmer, wiper motions (AMBL, AMK, AMKL)
If the pedal is pressed down with heel after the stitching with the pedal toe down, the thread trimmer solenoid energized over the range of needle UP to DOWN position so that the needle UP position stop and the wiper (with wiper mechanism) motions are conducted continuously.
- 4) Automatic presser foot lifter (FL, AMBL, AMKL)
If the external presser foot lifter switch (F) is pressed while the sewing machine is stopped, the presser foot is lifted while the switch is held down. Presser foot is lifted also while the pedal is heeled slightly and continuously (presser lifter switch S3 ON) at the sewing machine stop or the pedal is fully and continuously heeled (thread trimmer S2 ON) after the thread trimming. If the pedal is further pressed with toe down during the presser foot operation, the foot lifting operation stops immediately and, as the clutch is operated about 0.1 sec, the sewing machine starts again.
- 5) Back tack (AMBL, AMK, AMKL)
Back tack is initiated as the external back tack switch (S7) is turned ON.
This stitching is not operated, however, during the operation stop, thread trimming, wiper and back tack stitch operations.
- 6) Start, end back tack stitch (AMBL)
With AMBL, the start and end back tack stitch can be performed with the back tack stitch switch operation on the control box.
Basic operation pattern of sewing machine at the back tack stitch is as shown by Fig. 3.
- 7) Automatic start/end back tack stitch (AMK, AMKL)
Start and end back tack stitch and pattern sewing can be conducted using the optional XC-C02-Y, XC-C20-Y, XC-C40-Y or XC-C250-Y control switch panel.
Basic operation pattern of sewing machine at the back tack stitch is as shown by Fig. 3.

Composition and Operation

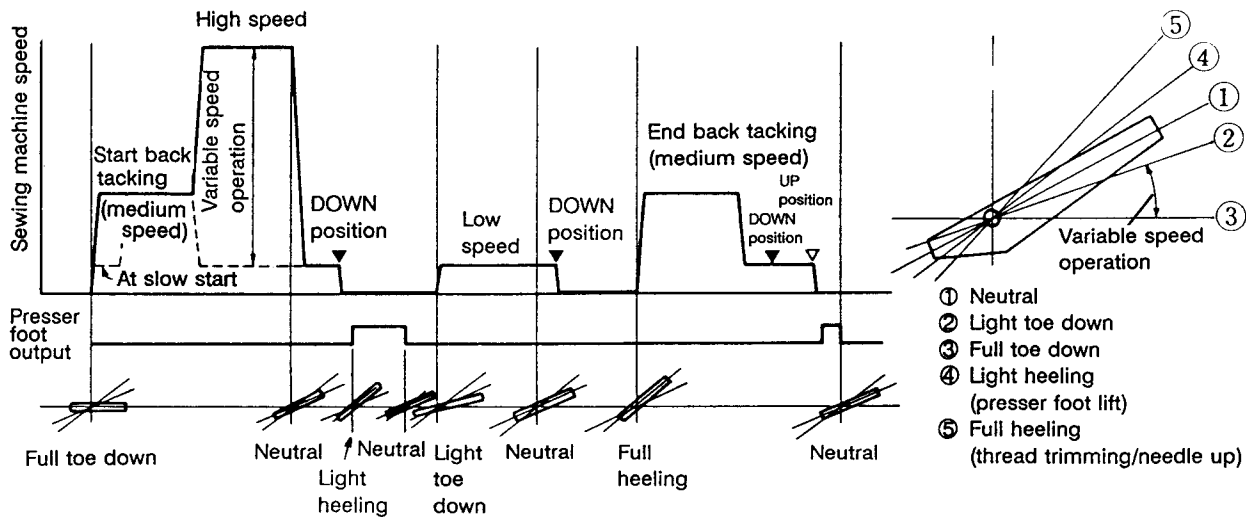


Fig. 3 Basic Operation Pattern of Sewing Machine (start, end back tack stitch mode)

Fig. 4 Pedal Operation

2.3 Applied Functions

(For the detail of connection, refer to the block diagrams of control circuit on pages 39 to 43.)

Following optional functions are available on each control box. Refer to the following specifications and conduct the setting of internal switches and the connection between the optional connectors and external switches. Be sure to turn off the power when the internal switches are set.

Contactors to be used for input signals must be for the lower current and with a higher reliability of contact.

(1) Internal switches

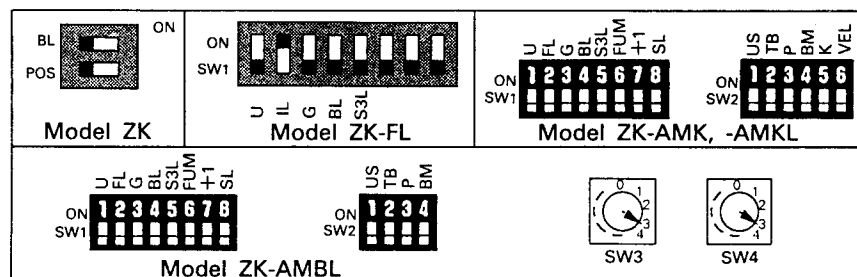


Fig. 5 Internal Switches

Composition and Operation

■ **POS: Selection of 1-2 positions (ZK type)**

If this switch is turned ON, 1 position is selected. Operation is prohibited even if the pedal is heeled after the operation stop.

■ **BL: Brake switch during the machine stop**

Switch to operate the soft brake during the machine stop.

Table 4 BL Switches and Functions

BL switch	Function	
ZK ZK-FL	ON	Soft brake is released.
	OFF	Soft brake is operated during the sewing machine stop so that the turn of pulley is lightly restricted.
ZK-AMBL ZK-AMK ZK-AMKL	ON	Soft brake is operated during the sewing machine stop so that the turn of pulley is lightly restricted.
	OFF	Soft brake is released.

■ **IL: Thread trimmer interlock cancel switch (ZK-FL type)**

If this switch is turned ON, the operation restart command by the repeated toe down at the full heeling becomes operative. (ON at shipping from factory)

The switch must be turned ON with ZK-FL type.

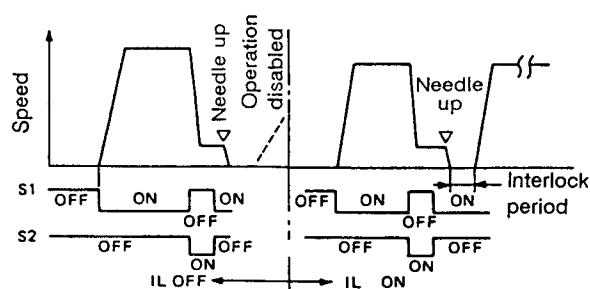


Fig. 6 IL Switch Operation

■ **G: Gain switch (ZK-FL, -AMBL, -AMK, -AMKL types)**

As this switch is turned ON, the driving force at thread trimming is intensified.

If this is at ON at the thread trimming with thick cloth or thread, the thread will be trimmed easily. Operate this switch carefully, because if this is at ON during the stitching of thin cloth, the deviation in the UP position stop may be enlarged.

■ **U: 1 - 2 positions select switch (ZK-FL, -AMBL, -AMK, -AMKL types)**

As this switch is turned ON, 1 position is selected. If the pedal is heeled after the operation stop when the switch (U) is at ON, it turns one turn and the UP position stop becomes effective.

Composition and Operation

■ **S3L: Switch to cancel the presser foot lifter with light heeling**
(ZK-FL, -AMBL, -AMK, -AMKL types)

If this switch is turned ON, the automatic presser foot lifting motion by the light heeling S3 is cancelled and disabled. Presser foot lifter is operated with the knee switch, etc. which is assembled on the external presser foot lifter signal F (see page 16) of presser foot lifting connectors ① - ②, etc.

■ **US: Switch to lift the needle with back tack switch (ZK-AMBL, -AMK, -AMKL type)**

This switch initiates the needle up motion with the back tack switch S7.
As the switch is turned ON, when the back tack switch S7 (see page 16) is turned ON at the needle DOWN stop, it moves up to and stops at the needle UP position.
There is no operation when it is at the needle UP position. When the machine is operated, it initiates the back tack motion.

■ **SL, +1: Slow start switch (ZK-AMBL, -AMK, -AMKL type)**

Switch to set the number of stitches for slow start after the power ON or at the initial toe down after thread trimming. Slow start of 0 to 2 stitches can be selected with combinations as listed below.

Table 5 SL, +1 switch and number of stitches

Number of stitches Switch	0 stitch	1 stitch	2 stitches
SL	OFF	ON	ON
+1	OFF	OFF	ON

■ **TB: Simultaneous drive switch of back tack solenoid at thread trimmer**
(ZK-AMBL, -AMK, -AMKL type)

As this switch is turned ON, the back tack solenoid is driven with the thread trimmer solenoid when thread is trimmed and the automatic thread trimmer is conducted with the reverse feed.

■ **FUM: Momentary presser foot lifter switch (ZK-AMBL, -AMK, -AMKL type)**

As this switch is turned ON, the auto presser foot lifter operates continuously after the power switch ON or after the thread trimming by the thread trimmer signal S2 (see page 13), which is initiated with the full heeling, at the end of stitching. As either one of thread trimmer signal S2 by repeated full heeling, thread trimmer signal S3 (see page 13) by light heeling or external presser foot lifter signal F (see page 15) is turned ON and then OFF, the presser foot comes down.

Composition and Operation

■ **BM: Back tack stitch adjusting switch (ZK-AMBL, -AMK, -AMKL type)**

Switch to set the timing of back tack solenoid for the back tack stitch.

If the switch is turned ON at a low speed back tack stitch (lower than about 1000 spm), the back tack stitch can be performed more easier.

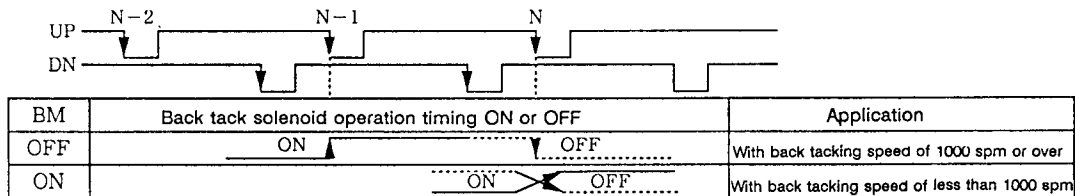


Fig. 7

■ **FL: Switch to release the presser foot lifter with full heeling (ZK-AMBL, -AMK, -AMKL type)**

If this switch is set to ON, it releases the auto presser foot lifter after thread trimming with thread trimmer signal S2 (see page 13), which is initiated with the full heeling. To lift the presser foot while the switch is at ON, operate the light heeling S3 or external signal F.

■ **P: Pfaff type thread trimmer switch (ZK-AMBL, AMK, -AMKL type)**

This switch must be turned ON when the Pfaff type auto thread trimming sewing machine (463 type) is used. For the detail of timing, refer 5.4 Adjustment of thread trimming timing for the various automatic thread trimmer sewing machine (page 29).

■ **K: Chain-stitch sewing machine thread trimmer switch (ZK-AMK, -AMKL)**

This switch must be turn ON when the chain-stitch type of automatic thread-trimming sewing machine.

For the detail of trimming, refer 5.4 Adjustment of thread trimming timing for the various automatic thread trimmer sewing machine (page 29).

■ **VEL: Speed adjustment mode switch (ZK-AMK, -AMKL)**

This switch is used when the internal variable resistor for setting the speed is to be adjusted.

During sewing operations, it must be set OFF.

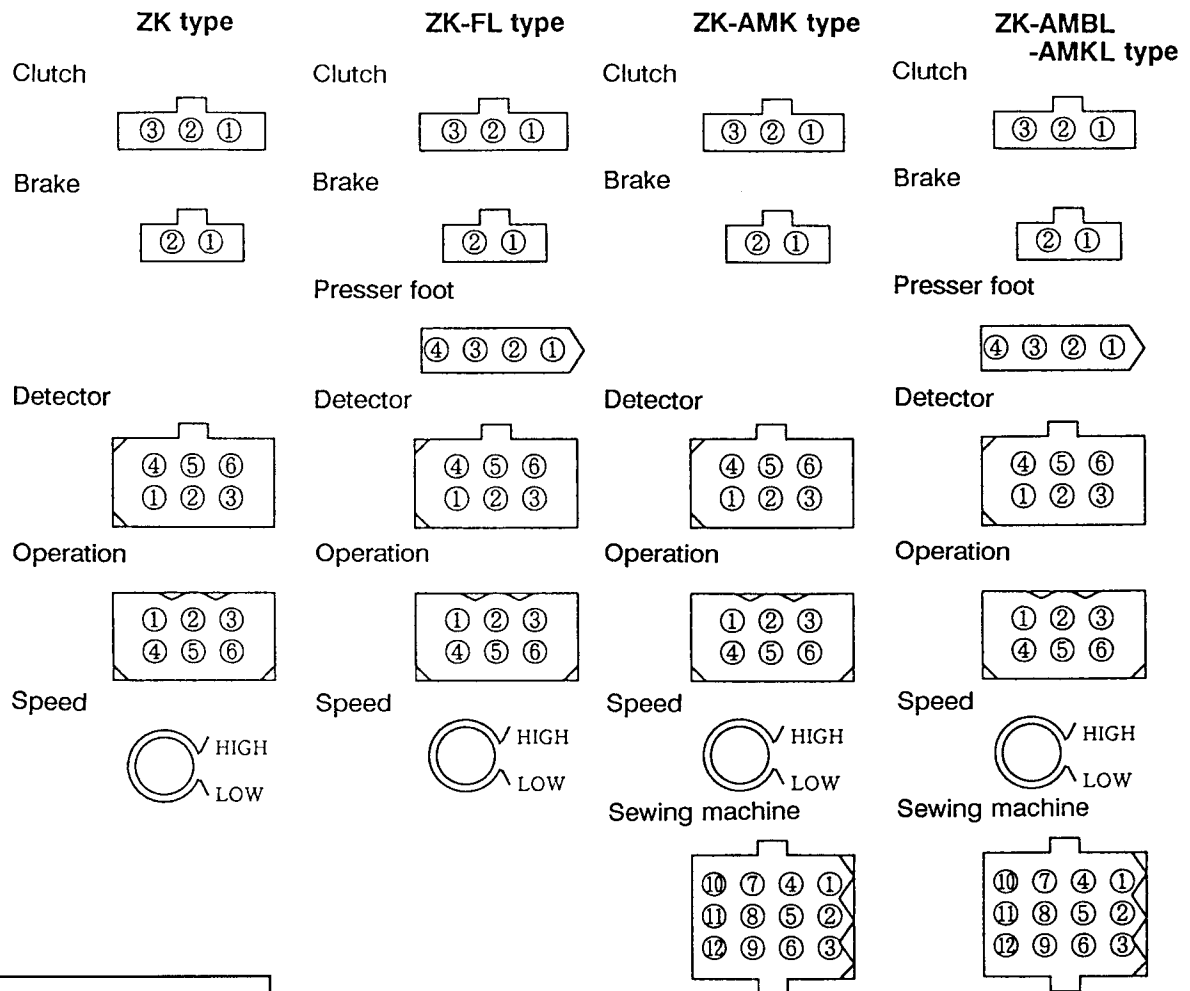
■ **SW3, SW4: Back tack stitch number setting switch (ZK-AMBL type)**

Switch to set the number of stitches for start and end back tack stitch which has been specified with the external switch "START" or "END".

For further detail, refer to the section of back tack stitch select switch (page 17).

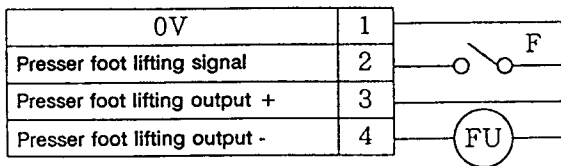
Composition and Operation

(2) External function

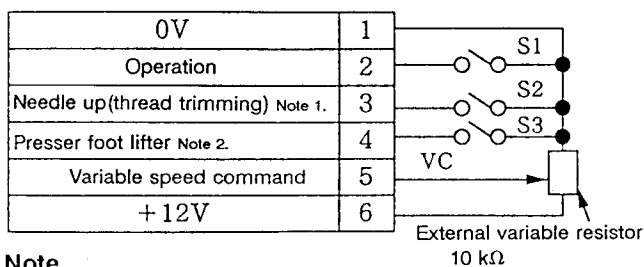


Presser foot connector

(ZK-FL, -AMBL, -AMKL type)



Operation connector



Note

- 1) This becomes the thread trimmer signal with ZK-AMBL, -AMK, and -AMKL type.
- 2) There is no presser foot lifting input signal with ZK and -AMK type.

Sewing machine connector

(ZK-AMBL, -AMK, -AMKL type)

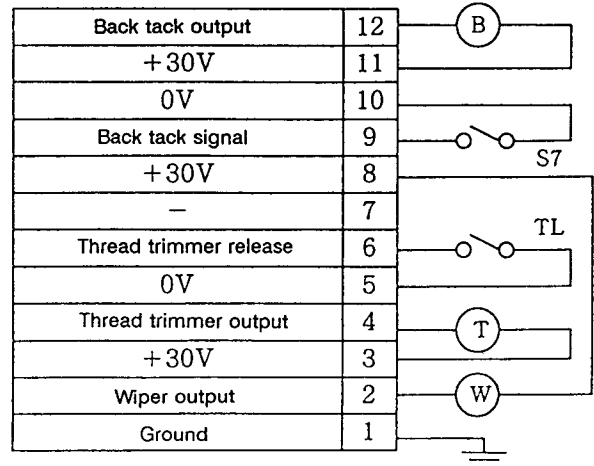


Fig. 8 Connector Terminals

Composition and Operation

Operation connector (See Fig. 11 for application examples of the operation connector.)

■ S1: Operation signal (variable speed)

This is the signal input terminal of full toe down by the pedal operation. As S1 signal is turned ON, the operation is controlled with the extent of pedal toe down and the speed is set with the external knob (setting speed between low to high: medium speed). With the signal OFF, the positioning speed (which is set with P/position variable resistor) and the needle DOWN position stop are selected. When the external signal is used, the variable speed command must be input from the outside.

When the start back tack is stitched with ZK-AMBL type, the back tack stitch speed prevails during the start back tack stitch period.

■ S2: Needle up/thread trimmer signal

ZK-AMBL, AMKL type: Thread trimmer signal

This is the input terminal of full heeling signal by the pedal operation. If this S2 signal is turned ON after the operation signal (S1) has been set to ON, the thread trimming operation (or after end backtacking with backtacking speed, when there is the end back tack stitch) stops at the needle UP position and then the auto presser foot lift operation is conducted while the switch is at ON.

By the way, when the operation signal S1 and S2 are turned ON simultaneously, the priority is given to S1 and, after S1 is turned OFF, the auto thread trimming operation is performed.

ZK-AMK type: Thread trimmer signal

Excepting there are no presser foot lifting operation, it is same as ZK-AMBL, AMKL type.

ZK-FL type: Needle up signal

Excepting there is no thread trimming, it is same as ZK-AMBL, -AMKL type.

ZK type: Needle up signal

Excepting there are no thread trimming and presser foot lifting operations, it is same as ZK-AMBL, -AMKL type.

■ S3: Presser foot lifter signal (ZK-FL, -AMBL, -AMKL)

This is the input terminal of light heeling signal by the pedal operation.

If S3 signal is set to ON during stop of the sewing machine, the auto presser foot lifter is operated with the auto presser foot lifter.

By the way, when the operation signal S1 and presser foot lifter signal S3 are turned ON simultaneously, the priority is given to the operation signal S1 and, after S1 has been turned OFF, the auto presser foot lifting motion takes place.

Composition and Operation

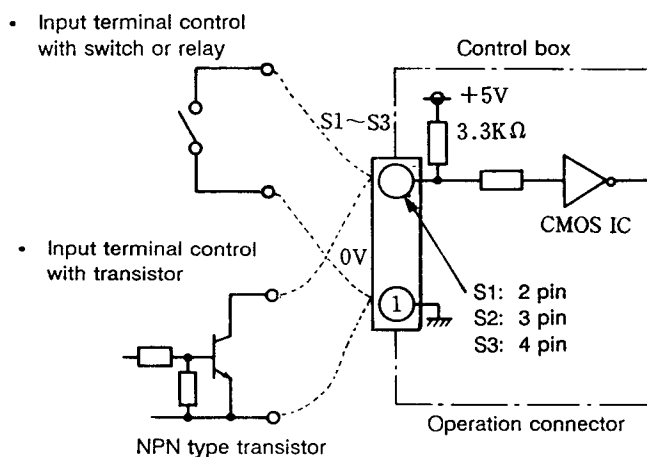


Fig. 9 Input Circuit (S1, S2, S3)

■ VC: Variable speed command

This is the input terminal which receives the speed command voltage corresponding to the extent of pedal toe down for the lever unit.

When the sewing machine is controlled by external signals, speed approximately proportional to voltage can be obtained by giving speed command voltage from outside the unit.

Speed can be changed optionally over 0V (low speed) to 10V (high speed). If an external variable resistor is employed, the speed can be set from the hand box.

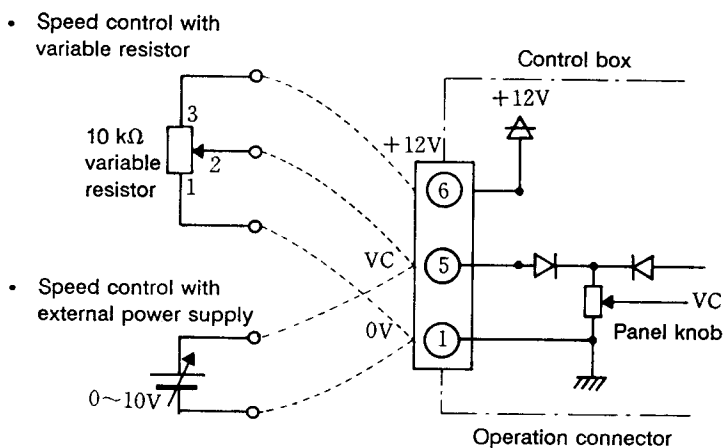


Fig. 10 Variable Speed Input Circuit

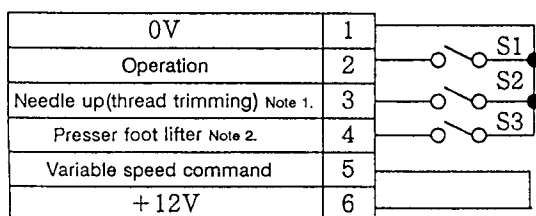
Composition and Operation

■ 12V: Power supply

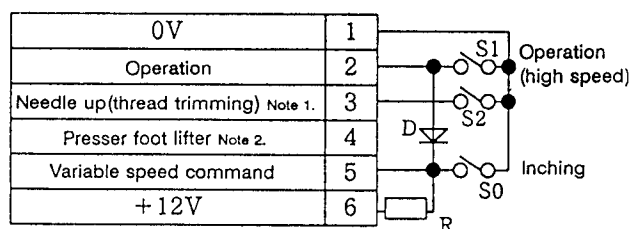
DC12V (MAX. 40mA) power supply is output from the control box.

Application example of operation connector

High speed operation with the stand work sewing machine



High speed and inching operation with stand work sewing machine



D: Equivalent to 1S953 (NEC) (VR≥30V IF≥30mA)
R: 1 kΩ, 1/2W or over

- Note** 1) This is the thread trimmer signal with ZK-AMBL, -AMK and -AMKL type.
2) There is no presser foot lifting input signal with ZK and -AMK type.

Fig. 11 Application Example of Operation Connector

Presser foot lifting connector

(ZK-FL, -AMBL, -AMKL types)

■ F: Auto presser foot lifter signal

If this is turned ON during stop of the sewing machine, the auto presser foot lifting motion is initiated with the auto presser foot lifting output. F signal input is invalid while the sewing machine is operated. (Auto presser foot does not lift.)

If the machine operation signal is input during the auto presser foot lifting motion, the auto presser foot lifter is turned OFF and the operation starts again about 1 sec. later.

■ FU: Auto presser foot lifting output (solenoid drive output)

Auto presser foot lifting output allows to use the solenoid or solenoid valve of larger than DC24V, 10 Ω.

Mitsubishi's auto presser foot lifter LE-FM-1, 2 and LE-FA types can be connected directly with this output.

Composition and Operation

Sewing machine connector (ZK-AMBL, -AMK, -AMKL type)

■ **S7: Back tack switch**

As the back tack switch is turned ON, the direction of stitching is inverted. This is prohibited, however, during the operation stop, thread trimming, wiper and automatic backtacking.

■ **TL: Thread trimmer release signal**

If the thread trimmer operation is initiated while the thread trimmer signal TL is left at ON, both the thread trimmer solenoid and wiper solenoid are not operated and the operation is stopped with the needle UP position stop.

■ **B: Back tack output (solenoid drive output)**

It is operated when the back tack signal S7 is turned on during the machine operation or at the automatic backtacking. It is not operable during the machine stop. (solenoids larger than 5 Ω can be connected.)

■ **T: Thread trimmer output (solenoid drive output)**

Thread trimmer solenoid output is obtained with the thread trimmer signal (operation). (solenoids larger than 5 Ω can be connected.) Regarding the operation timing, refer to 5.4. Adjustment of thread trimming timing for the various normal stitching automatic thread trimmer sewing machine (page 28).

■ **W: Wiper output (solenoid drive output)**

This is output simultaneously with the UP position stop after the thread trimming motion. (solenoids larger than 5 Ω can be connected.) Regarding the operation timing, refer to 5.4. Adjustment of thread trimming timing for the various normal stitching automatic thread trimmer sewing machine (page 28).

■ **Ground:** This must be connected with the sewing machine without fail because it improves noise-resistant properties.

This is connected automatically by connecting the connector of Mitsubishi's sewing machine.

Composition and Operation

(3) External switches

Back tack select switch (ZK-AMBL type)

- Start back tack can be selected by operating START switch (start back tack select switch) in Fig. 12.

To change from start back tack to N back tack, turn the start back tack select switch to right.

To change from start back tack to V back tack, turn the start back tack select switch to left.

If the start back tack is not necessary, turn the start back tack switch to the neutral position.

- End back tack can be selected by operating END switch (end back tack select switch) in Fig. 12.

To change from end back tack to N back tack, turn the switch to right.

To select V back tack, turn the switch to left. If the back tack is not necessary, turn the switch to the neutral position.

- Number of stitches with N back tack can be set over 0 to 15 stitches using the internal switches SW3 and SW4.
- Number of stitches with V back tack can be set over 0 to 15 stitches using the internal switch SW4.

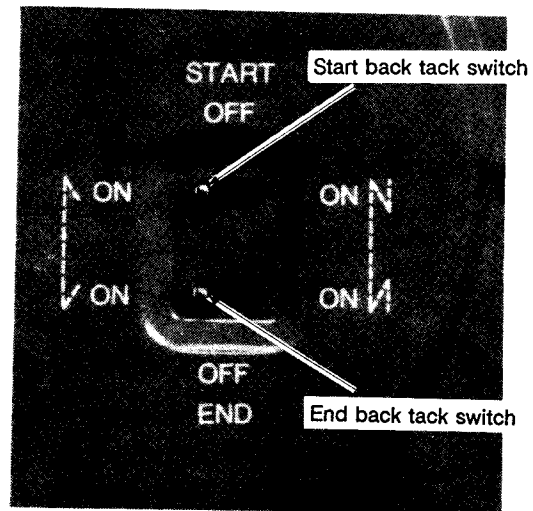
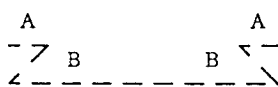


Fig. 12 Back Tack Stitch Switch

[Example of sewing pattern]

(when N back tack ON for both the start and end back tack switches)

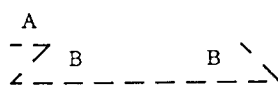


A: Number of stitches (1 to 15 stitches) set with the internal switch SW3 (see Fig. 5).

B: Number of stitches (0 to 15 stitches) set with the internal switch SW4 (see Fig. 5).

[Example of sewing pattern]

(When start back tack switch: N back tack ON, end back tack switch: V back tack ON)



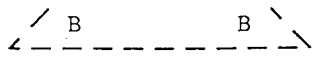
A: Number of stitches (0 to 15 stitches) set with the internal switch SW3 (see Fig. 5).

B: Number of stitches (0 to 15 stitches) set with the internal switch SW4 (see Fig. 5).

Composition and Operation

[Example of sewing pattern]

(when V back tack ON for both the start and end back tack switches)



B: Number of stitches (0 to 15 stitches) set with the internal switch SW4 (see Fig. 5).

- Relation between the display of internal switch and number of stitches is as listed below.

Table 5 Relation between Number of Stitches and Display

Display	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Number of stitches	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Optional Device

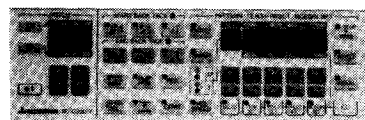
3. Optional Devices

Regarding the detail of each optional device, refer to the technical information of specific device.

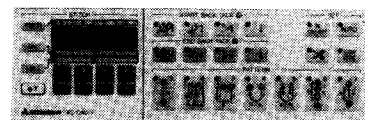
1) XC-C control switch panel (ZK-AMK, -AMKL)

The stitching patterns (sewing machine operations) listed in Table 6 can be performed when this control switch panel is connected to the LIM-STOP Z motor ZK-AMK, -AMKL control box and the sewing machine is operated.

XC-C250-Y



XC-C40-Y



XC-C20-Y



XC-C02-Y

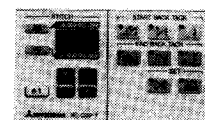


Fig. 13 XC-C Control Switch Panel

Table 6

Type	XC-C02-Y	XC-C20-Y	XC-C40-Y	XC-C250-Y
Number of display digits	2	2	4	7
Straight lock stitching	○	○	○	○
Start/end backtack- ing	2 patterns	3 patterns	3 patterns	2 patterns
Stitching with fixed stitches	-	○ (1 to 99 stitches)	○ (1 to 9999 stitches)	○ (1 to 999 stitches)
Continuous pattern stitch- ing with fixed stitches	-	-	○	Max. 8 patterns and max. 25 processes according to program.
Start/end backtack- ing	-	○	○	
Cycles	-	○	○	
Continuous tack stitch	-	○	○	
Cycles	-	○	○	
Output setting	*○	*○	*○	○
Bobbin thread run-out alarm setting	-	-	-	○
Trim (cancel) key	○	○	○	○
Auto key	-	○	○	○
Slow start key	○	○	○	-
Counter input device connection	○	○	○	○

Note: The function marked * is valid when the counter input device (option) is connected.
In this case, the output can be counted from 0 to 9999.

Note: Use the separately available relay connector when mounting the LD or LF control switch panel on the ZK-AMK, -AMKL control box.

The LS or LA control switch panel cannot be mounted on the ZK-AMK, -AMKL control box.

Optional Device

2) XC-CC-Y counter display

XC-CC-Y counter display is used coupled with XC-CE type counter input device in order to display the number of sewn products.

As the programmed number of products are output, it sounds in the buzzer to announce the scheduled production has been achieved.

Count range is 0 to 9999.

This is recommended where the function of control switch panel is unnecessary but the number of products must be counted.

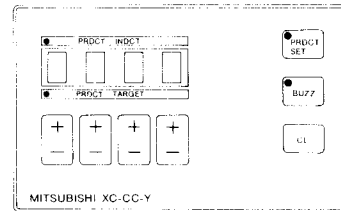


Fig. 14 XC-CC-Y Counter Display

3) XC-CE counter input device

If the counter input device is operated after it was connected to XC-C control switch panel or XC-CC-Y counter display, the number of sewn products can be displayed on the counter, which has the subtracting function for correction of set count.

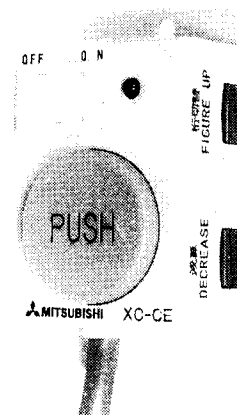
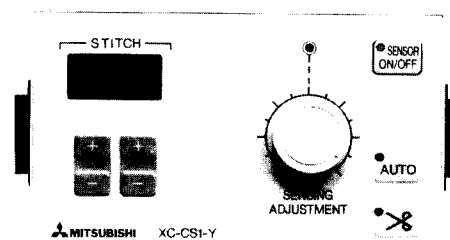


Fig. 15 XC-CE Counter Input Device

4) XC-CS1-Y sensor amplifier (-AMK, -AMKL)

By means of the separately available reflecting type of sensor (XC-CSR-LS) or transparent sensor (XC-CSP-LS), this amplifier detects the edge of the fabric so that the machine can be stopped when the set number of stitches has been sewn after edge detection. (The machine can also be stopped after thread trimming.)



XC-CS1-Y

Fig. 16 XC-CS1-Y Sensor Amplifier

5) LE-FM-1, LE-FM-2 auto electromagnetic presser foot lifter

An automatic presser foot lifter based on the electromagnetic force. Auto presser foot lifting will enhance the production efficiency.

This device cannot be used with ZK and -AMK type.



Fig. 17 LE-FM-1, LE-FM-2 Auto Electromagnetic Presser Foot Lifter

Optional Device

Table 7

Spec. \ Type	LE-FM-1	LE-FM-2
Presser foot lifting torque	Abt. 50 kg-cm	Abt. 60 kg-cm
Operating condition	40%ED	Continuous
Purpose	Thin to moderately thick cloth	Thick cloth

6) LE-FA automatic pneumatic presser foot lifter

It is operated with pneumatic force.

Lifting torque with the normal air pressure (approx. 5 kg/cm²) is about 2 times of electromagnetic type (LE-FM-2).

This device cannot be used with ZK and -AMK type.

Table 8

Air pressure range	1.5 to 9.9 kg/cm ²
Presser foot lifting torque	MAX. 140 kg-cm (With air pressure 5 kg/cm ²)
Purpose	Thick cloth (With specially strong presser foot pressure)

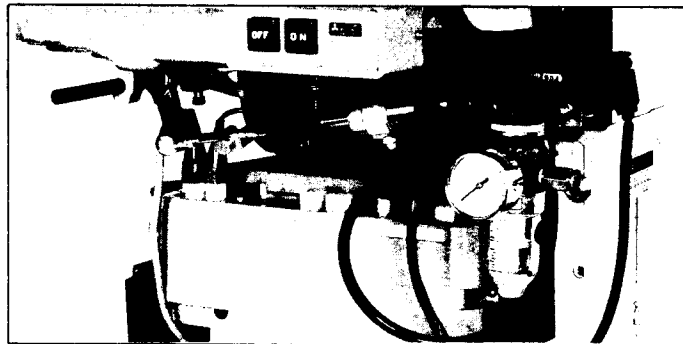


Fig. 18 LE-FA Automatic Pneumatic Presser Foot Lifter

7) XC-CVS-2 variable speed pedal (for standing work)

Speed can be controlled at the standing work so that it is most effective at the stitching at the corner or curving section especially.

- Speed is controlled with the extent of pedal toe down.
- A pair of foot switches enables the external signal operation such as the thread trimmer, presser foot lifter, etc.

Caution

LE-CVS variable speed pedal cannot be used with ZK Series models. Order XC-CVS-2 variable speed pedal for the Series.

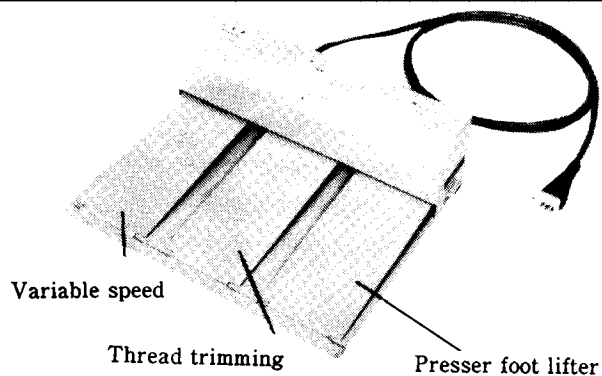


Fig. 19 XC-CVS-2 Variable Speed Pedal

Installation

4. Installation

4.1 Installation of Motor Assembly

(1) Installation of motor

Place the pattern sheet for drilling and drill 3 holes of 9 mm dia. Use the mounting bolts, washers, spring washers and nuts and fix the motor securely. Pattern sheet, bolts, etc. are included in the accessory.

(2) Installation of belt

1) Use JIS K6323 V belt M type for sewing machine.

2) Adjust the belt tension. Turn the upper and lower adjust nut of adjust bolt to change the center height of motor so that the belt can be warped about 15 mm. (Fig. 21)

If the belt tension is too weak, the speed tends to fluctuate under the medium or low speed operation so that the accuracy of stop position becomes unreliable. If it is too tight, the life of motor bearing will be curtailed.

(3) Installation of position detector

The method of installation of position detector varies depending on the kinds of sewing machine. Contact the dealer of sewing machine for the detail. Example of installation is shown by Fig. 22.

(4) Installation of lever unit

Lever unit is fixed on the motor frame using the mounting brackets (2 pcs.) as shown by Fig. 23. It could be mounted also at any other most appropriate position such as the backside of ceiling plate, etc.

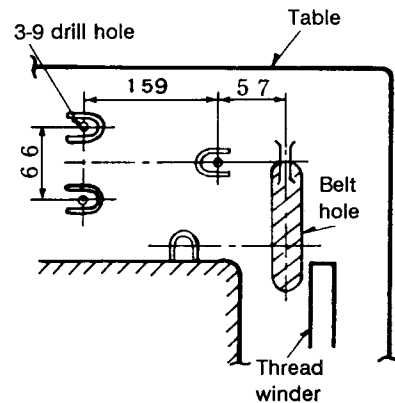


Fig. 20 Motor Mounting Holes

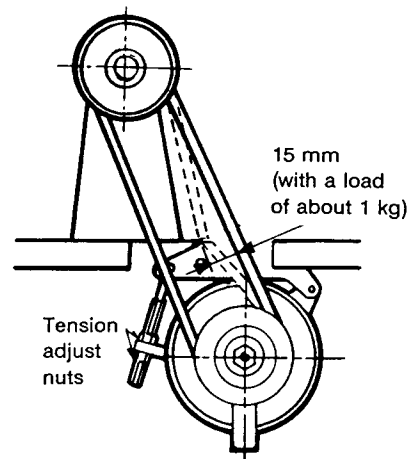


Fig. 21 Installation of Belt

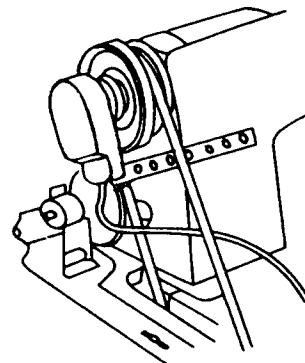


Fig. 22 Installation of Position Detector

Installation

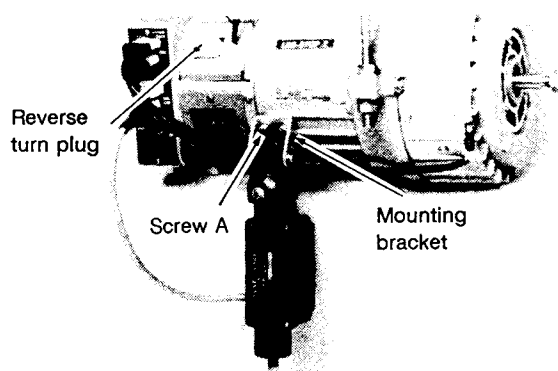


Fig. 23 Example of Installation of Lever Unit

(5) Selection of motor pulley

Since the max. speed of sewing machine is determined depending on the motor pulley and speed which are set on the control box, make sure to adjust the max. speed, when the pulley has been determined, with reference to 5.6. Adjustment of Operation Speed (see page 31).

Select the motor pulley dia. with reference to the table below.

By the way, when only the speed is reduced using the pulley which is set on the sewing machine, it can be set using the external adjust knob on the control box.

Table 9 Selection of Motor Pulley Dia. (motor 400W, 2P)

Sewing machine speed (spm)	Motor pulley (O.D.) (mm)	
	50Hz	50Hz
5000	135	115 (120)
4500	125 (135)	105 (120)
4000	110 (120)	95 (100)
3500	95	80
3000	85	70
2500	70	60
2000	60	50

- Note**
- 1) Pulleys in the table are applicable to the sewing machine pulley of (effective dia.) 70 mm.
 - 2) Figure in () of listed pulleys indicates the diameter of pulley which is mounted on Mitsubishi's sewing machine.
 - 3) When it is installed on a sewing machine of lower speed, if the speed is reduced by the external knob only, the torque may become insufficient due to the load of sewing machine. Be sure to select from the list the optimum diameter also for the motor pulley.

Installation

When the specifications is different from the contents of Table 8, select the motor pulley based on following condition.

$$\text{Motor pulley O.D. (mm)} = \frac{\text{Standard speed of sewing machine}}{(*1) \text{ Motor speed}} \times \text{Sewing machine pulley dia. (effective dia.)} \times 1.05(*2) + 5 \text{ mm}$$

(*1): With 2 poles, set the motor speed: 50 Hz: 2750 rpm
60 Hz: 3350 rpm
With 4 poles, set the motor speed: 50 Hz: 1250 rpm
60 Hz: 1550 rpm

(*2): Constant 1.05 is employed in order to set the max. speed a little higher than the speed which is set with the pulley ratio and to set the max. speed using the knob (or internal variable resistor) of control box.
This arrangement enhances the efficiency of operation.

When the motor pulley has been selected as described above, if the pulley dia. becomes too small, employ the pulley of minimum size which does not slip. And then reduce the speed with reference to 5.6 (5) Max. speed adjustment (see page 32).
(Make sure to lock securely the pulley's lock nut. Please note there is no change on the positioning (thread trimming) speed and back tacking speed even if the pulley is changed.)
When a motor pulley with a lager effective dia. and the max. speed has been reduced for adjustment using the knob of control box (or internal variable resistor), please note that the rated motor output becomes small and it may cause the temperature rise or insufficient torque.

[Reference] Motor output can be calculated as shown below:

$$\text{Motor output (W)} = \frac{\text{Speed after adjustment of max. speed}}{\frac{\text{Motor pulley dia.} - 5 \text{ mm}}{\text{Sewing machine pulley dia. (effective dia.)}}} \times \text{Motor speed} \times 400(*)$$

(*) (With a 400W motor)
When a 250W motor is used, substitute with 250.

(Example)

When the speed of sewing machine after the adjustment of speed is set to 2500 rpm at 50 Hz area.

Condition Effective dia. of sewing machine pulley: 70 mm
Motor pulley O.D.: Comparison of results when 120 mm and 70 mm are used.

Installation

- 1) With the motor pulley of O.D. 120 mm:

$$\text{Motor rated output} = \frac{2500}{\frac{120 - 5}{70} \times 2750} \times 400 = 221 \text{ [W]}$$

- 2) With the motor pulley of O.D. 70 mm:

$$\text{Motor rated output} = \frac{2500}{\frac{70 - 5}{70} \times 2750} \times 400 = 392 \text{ [W]}$$

This means that, when the motor pulley of O.D. 120 mm is used, it is same as to use the motor of 221W to that, if the load of sewing machine exceeds 221W, the motor is operated under the overload. In order to avoid such inconvenience, be careful in selecting motor pulley.

It is apparent from the above that the reduction of speed using the external knob is effective only when the speed is reduced to adjust the optimum touch of stitching from one products to another on the same type of sewing machine.

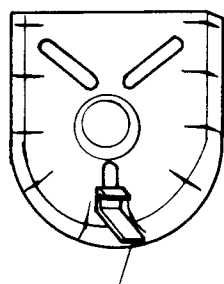
(It is because, in such occasion, the reduced speed of sewing machine means the reduced load of the machine.)

If the speed is reduced using the external knob only when a machine with lower speed is operated, the torque may become insufficient due to the load of sewing machine, make sure to employ the motor pulley with the optimum diameter according to the calculation as quoted above.

(6) Installation of protective cover (cover to prevent the run out of belt)

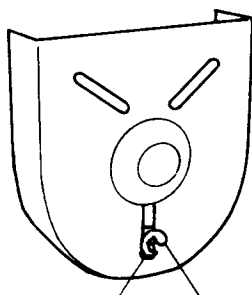
In order to prevent the run out of belt, install the protective cover with following procedures.

**Protective cover,
seen from rear side**



Attachment plate

**Front face of protective
cover**



Washer Butterfly bolt

Fig. 24 Protective Cover

Installation

(a) Motor pulley O.D. ϕ 55 to 80

(b) Motor pulley O.D. ϕ 80 to 125

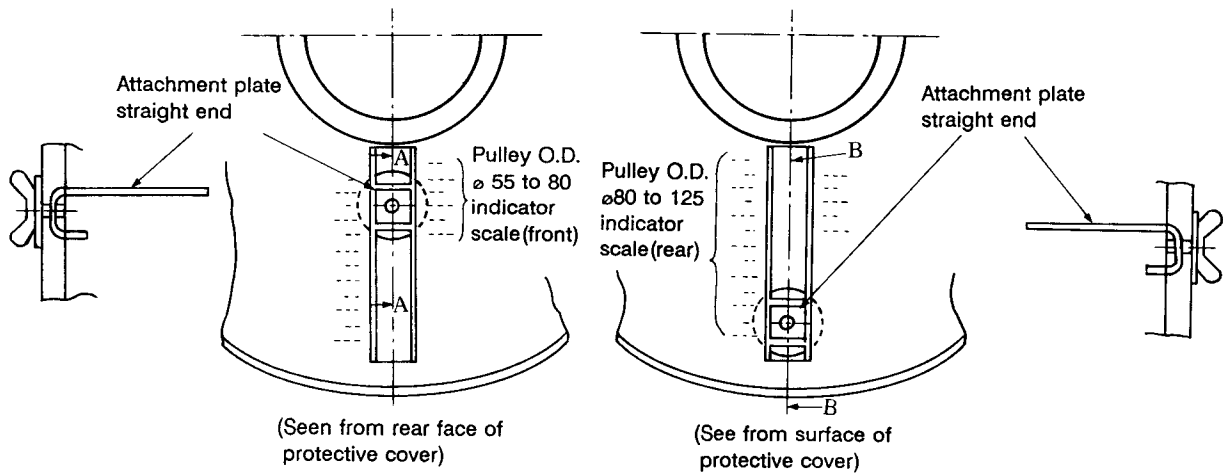


Fig. 25 Direction of Attachment Plate

- Change the direction of attachment plate straight end according to the motor pulley O.D.
- Align the center of washer with the indicator scale of motor pulley O.D.
- Make sure that the belt does not contact the plate.

4.2 Wiring, Connection

(1) Connector

Check the shape and the direction of insert of counterpart connector and insert securely the connector which is connected to the control box.

(2) Lamp leads (standard)

- 1) When an illumination lamp is installed on the sewing machine, use the connecting cord provided behind the motor. Remove the insulation tube and inner cover, connect the wire and wrap the knot with insulation tape.

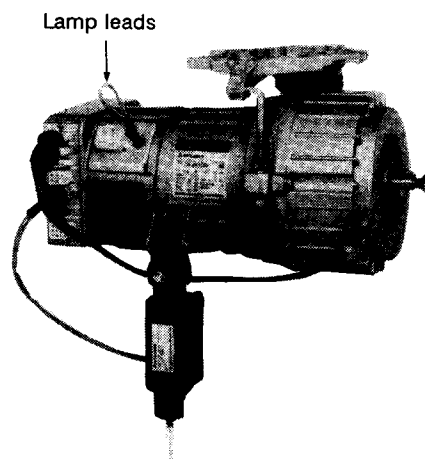


Fig. 26 Lamp Leads

Caution

Lamp voltage is 6V but the voltage to ground is about 100V. Make sure to turn off the power before the wire connection.

Installation

- 2) Use the parts which match the lamp rating (6V, 15 to 20W).
- 3) When the lamp is not used, insulate each of 2 lead wires. (See Fig. 26) When the insulation tube, which was set at shipment from factory is removed, insulate the ends of lamp lead wires to prevent shortcircuit with 2 wires as shown by ① or ② of Fig. 27.
If they are shortcircuited, the motor coil may be burned.

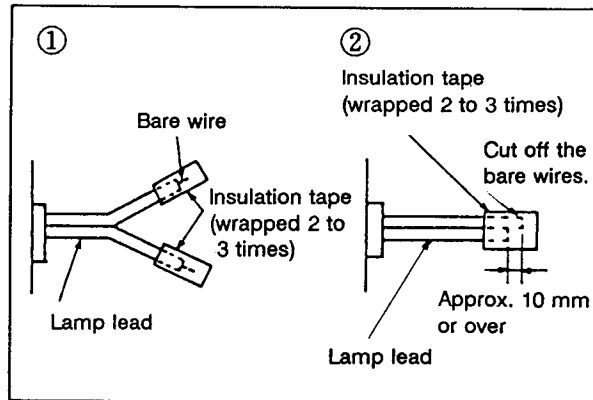


Fig. 27 Protection of Lamp Leads

Caution

If the illumination lamp and the heating device such as the leg heater, etc. are connected in parallel, it may exceed the load capacity so that the motor coil may be burned. Be sure to avoid the parallel connection.

(3) Connection of power supply

Capacity of power supply must be matched with the motor rating. The cord must have a sufficient allowance in length.

- 1) Regarding the phases of 3P motor, connect U phase with a red wire, V phase a white wire and W phase a black wire.
- 2) In case of 3P motor, connect the green wire to the grounding terminal and arrange the grounding without fail. (Consult your electric service shop regarding the wiring for grounding.)
- 3) In case of single phase motor, do not get the power from the multiple receptacle connector.

(4) Selection of rotary direction

Direction of motor revolution can be inverted by inserting the reversing plug by 180°. Make sure to insert fully the plug.

With the single phase motor, wait till the motor stops completely (about 2 min.) before turning on the power switch.

(Direction of revolution will not change even if the power switch is turned on while the motor is still running.)

Adjustment

5. Adjustment

5.1 Stop Position Adjustment

Install the unit on a sewing machine by conducting UP position and DOWN position stops and adjust with following procedures. Be sure not to connect the sewing machine's connector for safety.

(1) UP position adjustment

Unfasten 2 set screws of detector's coupling and turn the coupling to align the stop position. (See Fig. 28) If it cannot be adjusted by the turn of coupling, unfasten also Phillips type screw A of Fig. 29 and turn all detector plates simultaneously to adjust at the stop position.

(2) DOWN position adjustment

Since the relation of UP and DOWN positions varies depending on the kinds of sewing machine, adjust the position according to the machine. (Interval between UP and DOWN positions is set at about 180° at the shipment from factory.) To change DOWN position, remove the detector cover, turn the red detector plate (see Fig. 29) only to set at the position. (It is not necessary to unfasten Phillips type screw at this occasion.)

5.2 Adjustment of Pedal Assembly

(1) Adjustment of pedal toe down and heeling strength

Strength of spring can be adjusted with 3 steps by changing the hook of spring adjust knob of lever unit. (See Fig. 30)

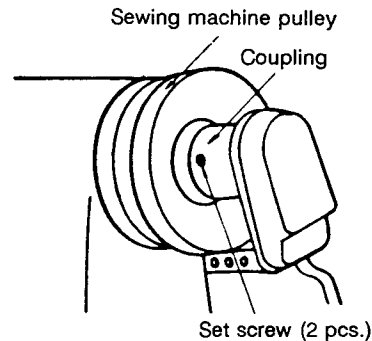


Fig. 28 Stop Position Adjustment

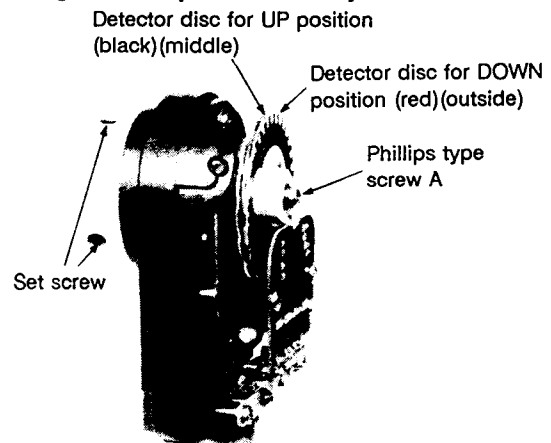


Fig. 29 Stop Position Adjustment

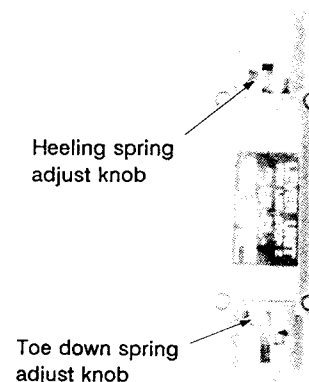


Fig. 30 Pedal Operating Strength Adjustment

Adjustment

(2) Pedal operation

Table 10

Model	Pedal setting Position setting	Toe down → Neutral	Neutral → Light heeling	Neutral → Full heeling
ZK	1 Position	Needle UP position stop	—	No motion
	2 Position	Needle DOWN position stop	—	Needle UP position stop
ZK-FL	1 Position	Needle UP position stop	Presser foot goes up.	Presser foot goes up after needle UP position stop with a full turn.
	2 Position	Needle DOWN position stop	Presser foot goes up.	Presser foot goes up after needle UP position stop with a half turn.
ZK-AMK	1 Position	Needle UP position stop	—	Thread trimming with a full turn.
	2 Position	Needle DOWN position stop	—	DOWN - UP position, thread trimming with a half turn.
ZK-AMBL ZK-AMKL	1 Position	Needle UP position stop	Presser foot goes up.	Presser foot goes up after thread trimming with a full turn.
	2 Position	Needle DOWN position stop	Presser foot goes up.	DOWN - UP position, thread trimming with a half turn and then presser foot goes up.
Pedal operation				

- Note**
- 1) Variable speed operation can be operated with the extent of toe down.
 - 2) Auto presser foot lifter, LE-FM-1, LE-FM-2 and LE-FA types, are available as the optional device. When the solenoid valve is employed, use the type larger than DC 24V and withstanding voltage 50V.

5.3 Selection of 1 - 2 Positions

Stop position of sewing machine can be changed with the internal switch POS or U.

POS or U switch OFF 2 positions
 ON 1 position

5.4 Adjustment of Thread Trimming Timing for the Various Automatic Thread Trimmer Sewing Machine

With ZK-AMBL, -AMK, -AMKL, the thread trimming timing can be selected from those listed below using the internal switch P and K.

- Turn OFF the internal switch P and K with sewing machines of Mitsubishi, Juki, Brother (other than 705, 715 and 716 types), Seiko, Toyota and Yakumo.
- Turn ON the internal switch P with the sewing machine of Pfaff (463 type).
- Turn ON the internal switch K with the Chain-stitch sewing machine.

Adjustment

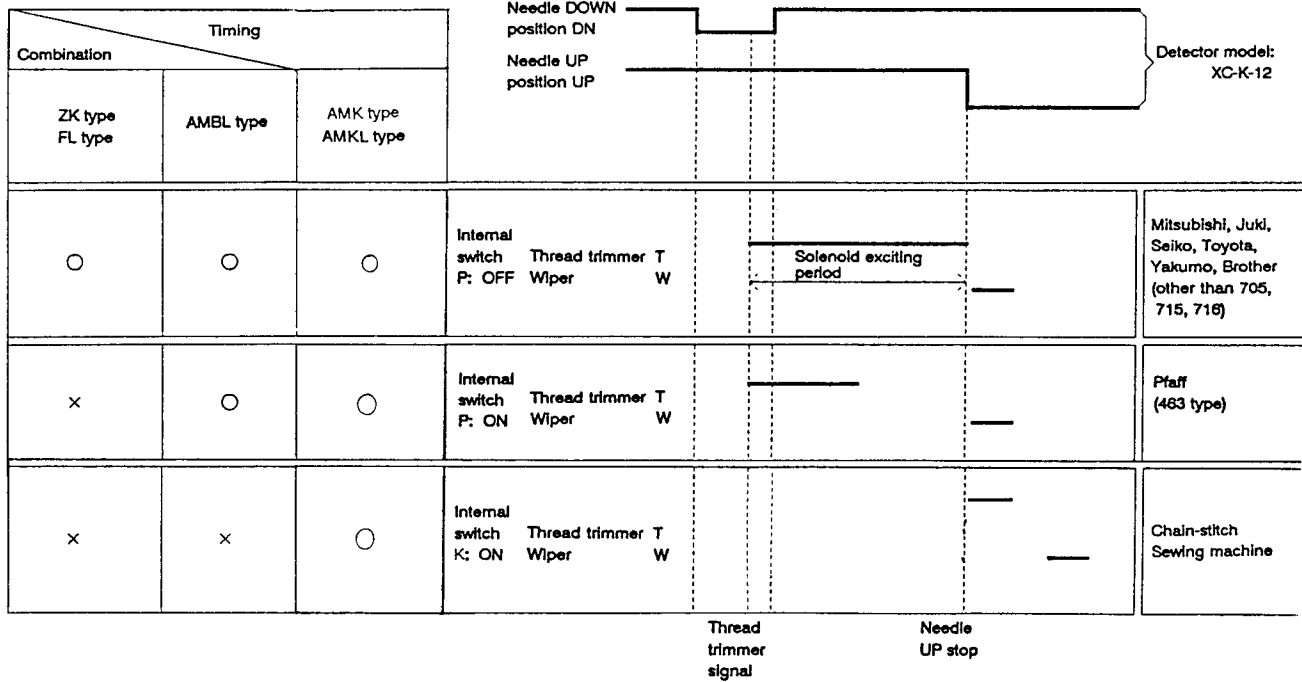


Fig. 31 Adjustment of Thread Trimming Timing

5.5 Cautions for Adjustment of Operation Speed

(1) Max. speed adjustment with external knob

Standard speed for each model can be achieved when the external knob is turned fully to right. When the speed is reduced depending on the cloth, use the external knob and adjust at the optimum sewing speed. Range of adjustment with the external knob covers from the low speed (which is set with the internal variable resistor at low/L) to the high speed (which is set with the internal variable resistor at high/H).

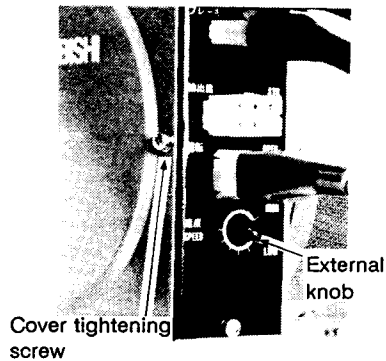


Fig. 32 External Knob

When the max. speed has been adjusted with the external knob, it is achieved when the pedal is at the full toe down. Medium (back tack stitch speed and low speed (thread trimming speed) do not change.

(2) Adjustment with the variable resistor in the control box

Caution

This adjustment is conducted while the power is turned on. Sufficient attention should be paid to avoid the electrical shock or damage by careless contact with other parts.

Adjustment

It is adjusted at the optimum speed at the shipment from factory but, when a large change in the speed is necessary due to condition of sewing cloth, when the pulley has been selected in accordance with 4.1 (5) for combination with another sewing machine or when it is necessary to change the back tack stitch speed, change the adjustment with reference to 5.6. Adjustment of Operation Speed.

Please note, by the way, that the speed will not exceed the one which has been set using the internal variable resistor (high speed) and the external knob, how much the diameter of pulley is increased. When the operation speed may fluctuate or the stop position may become inaccurate, check the belt for looseness, the pulley for play, the brake for wear, etc. Conduct the inspection and maintenance accordingly.

When the motor pulley is changed, refer to 4.1 (5) Selection of motor pulley (page 23).

- 1) There are the adjustments of low, medium, high and thread trimming speed. Adjust these with reference to the explanation of each variable resistor in the next section. Be sure to turn the external knob fully to right before adjusting the internal variable resistor.
- 2) Remove 2 control box cover tightening screws to open the cover and turn each internal variable resistor with a small flat head screwdriver.
- 3) Respective speed control variable resistors have some effect on the others. Please read carefully the explanation on these variable resistors at the adjustment.

5.6 Adjustment of Operation Speed

Use the tachometer, etc. and conduct the adjustment of operation speed with the steps (1) to (6) described below.

Regarding the variable resistor, refer to Fig. 33.

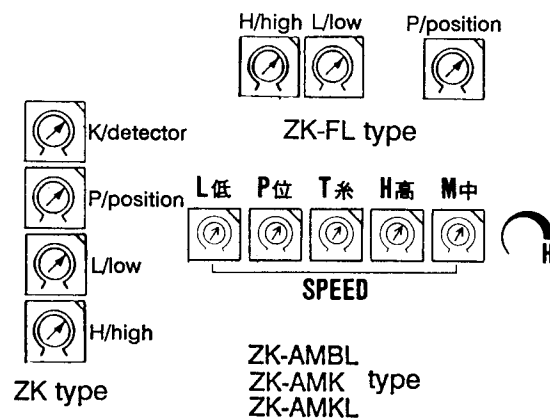


Fig. 33 Internal Variable Resistors for Speed Adjustment

Adjustment

(1) Low speed adjustment (speed available with the pedal light toe down)

Low speed is adjusted with the internal variable resistor L/low.
Speed increases with right turns while it slows down with left turns.
Adjustment range is 160 to 320 spm. (200 spm at the shipment from factory)

(2) Positioning speed adjustment

Positioning speed is adjusted with the internal variable resistor P/position.
Speed increases with right turns while it is reduced with left turns.
Adjustment range is 160 to 320 spm. (250 spm at the shipment from factory) When the needle stop position fluctuates or when the continuous low speed operation prevails and cannot be stopped as the result of this adjustment on ZK type, it is necessary to adjust the low speed detection speed of the step (3) described below.

(3) Low speed detection speed adjustment (ZK type)

When the needle stop position fluctuates or when the continuous low speed is maintained and cannot be stopped, adjust the internal variable resistor K/detection as explained below.

- When the needle stop position fluctuates: Turn to left.
(Low speed detection speed is delayed.)
When the continuous low speed operation cannot be stopped: Turn to right.
(Low speed detection speed is increased.)

(4) Thread trimming speed adjustment (ZK-AMBL, -AMK, -AMKL type)

Thread trimming speed can be adjusted with the internal variable resistor T/thread.
Speed increases with right turns while it is reduced with left turns.
(200 spm at the shipment from factory)
Please note that the thread trimming speed may vary depending on the sewing machine.
Refer to the adjustment manual of the machine or consult the dealer of machine.

(5) Max. speed adjustment (speed available with pedal full toe down)

Max. speed can be adjusted with the internal variable resistor H/high.
Speed increases with right turns while it is reduced with left turns.
Make sure to turn fully to right the external knob on the panel before the adjustment.
At the shipment from factory, the speed which is set with the internal variable resistor H/high is as listed on the next page.

Adjustment

Table 11

	Speed set with internal variable resistor H/high	Range of adjustment with external knob
C□-ZK □□□F- □□50	5000 spm (Adjust range 1200 to 8500 spm)	From low speed (set with internal variable resistor L/low) to high speed (set with internal variable resistor H/high)
C□-ZK □□□E/F□□□40	4000 spm (Adjust range 1200 to 8500 spm)	
C□-ZK □□□E/F□□□30	3000 spm (Adjust range 1200 to 8500 spm)	
C□-ZK □□□E/F□□□20	2000 spm (Adjust range 1200 to 8500 spm)	

Caution

Speed cannot exceed the one which has been set with the internal variable resistor H/high and the external knob how much the diameter of pulley is increased.

(6) Back tack speed adjustment (ZK-AMBL, -AMK, -AMKL type)

Back tack stitch speed for the start and end back tack, which is determined by the back tack select switch, can be adjusted with the internal variable resistor M/medium. At the shipment from factory, the speed which is set with the internal variable resistor M/medium, is as listed below.

Table 12

Model	Speed set with internal variable resistor M/medium
C□-ZK□□□E-AMBL40 -AMK40 -AMKL40	1700 spm
C□-ZK□□□E-AMBL30 -AMK30 -AMKL30	1200 spm
C□-ZK□□□E-AMBL20 -AMK20 -AMKL20	700 spm

Cautions for Handling

6. Cautions for Handling

- 1) Fasten securely the motor pulley lock nut. (Refer to 4. Installation, page 22) If it is loose, the stop position becomes inaccurate or noises may be raised during operation.
- 2) Adjust the belt tension with reference to 4. Installation (page 22).
- 3) Following motions are designed with this unit. Do not mistake them as troubles.
 - (1) When the connector of position (speed) detector is disconnected, at the belt run out or a complete block on motor revolution, the motor clutch is disconnected automatically after a definite time. (It may not be disconnected with an incomplete block on motor revolution or the overload.) As the cause of trouble is removed, the power is turned off and then backed on again, the normal operation is recovered.
The same applies with the cases of trouble on detector or wire breakage. In such occasions, conduct the replacement or repair with reference to 9. Diagnosis and Repair of Trouble (page 44).
 - (2) At the back tack stitch operation, it is impossible to change the start back tack stitch or the number of stitches before the entire processes are completed after the initial pedal toe down. However, the changes of end back tack pattern and number of stitches can be done till immediately before the heeling. Therefore, these settings must be done after the end of thread trimming motion or before starting the operation.
If the pedal is operated with toe down during the end back tack or thread trimming, the toe down becomes invalid and, to start again the operation, it can be made to be valid by returning to the neutral position first and then repeating the pedal toe down.
 - (3) Back tack switch is operative only when the sewing machine is operated (it is inoperative during the control of stitch number such as back tack stitch, etc.)
- 4) Brake may be disabled when the power was turned off during sewing machine operation or the power failure occurred.
- 5) Control box is susceptible to malfunction or trouble due to intrusion of dirt. Be sure to close the cover securely during the operation.
- 6) Keep away the foot from the pedal when the power is turned on or off. With the single phase motor, it is recommended not to operate the pedal before the motor starts (about 10 sec.).
- 7) Power must be turned off before any adjustment is made on the sewing machine or when the control box cover is opened for adjustment.
- 8) It is strictly prohibited to use the tester for inspection within the control circuit because the semiconductor may be damaged due to the voltage of tester.

Cautions for Handling

9) Others

(1) Prevention of malfunction due to noise

- 1) Withstanding capacity against noise can be enhanced by grounding the control box, detector and sewing machine head. (Grounding is indispensable with the power supply higher than AC 150V.)
- 2) It is prohibited to install the unit close to any devices such as the high frequency sewing machine which generate strong noises.
- 3) When the control is made with the external relay circuit or the program controller, use the noise absorber to suppress as much as possible noises of relay coil or solenoid operation.
- 4) Do not bundle together the output cable of solenoid and the control input cable.

(2) Maintain the sewing machine head and the cabinet of control box at the same electric charge level (grounding connection).

- 3) Since the optical means is employed on the element of detector, special care should be taken not to contaminate the detector plate with dirt, oil, etc. when the cover was removed for adjustment, etc. When it was stained, use a soft cloth and clean carefully avoiding any scratch or damage.

Sufficient care should be taken not to introduce oil, etc. between the detector plates.

Procedures of Maintenance, Inspection and Replacement

7. Procedures of Maintenance, Inspection and Replacement

7.1 Motor Assembly

(1) Clean periodically dirt caught by the dust protection filter. (Negligence may result in the overheat of motor.)

(2) Internal inspection and replacement

Normally, the motor does not need to be disassembled but, when the positioning accuracy became unreliable, revolutions may fluctuate or metallic noises are generated from the brake assembly at the operation stop, conduct the inspection and replacement with following procedures.

- 1) Turn off the power to stop the motor.
(Wait about 2 minutes before the motor stops completely after the power off.)
- 2) Disassemble the belt and motor pulley.
- 3) Disconnect, from the bracket, plugs (for the brake) connected with the control box.
- 4) Remove 3 mounting screws of bracket.
(See Fig. 34)
- 5) Utilize the clearance of bracket and remove it. Brake assembly can be disassembled as a whole. (Fig. 35)
- 6) Check the brake lining and brake plate under this condition. If the brake lining has been worn and contacting other parts, it must be replaced.
(When the brake lining, bearing, etc. are replaced, further refer to following procedures.)
- 7) Hold the clutch shaft by hand and pull to this side gently. Driven member (cup section) and brake lining can be disassembled together with the clutch shaft. (Fig. 36)

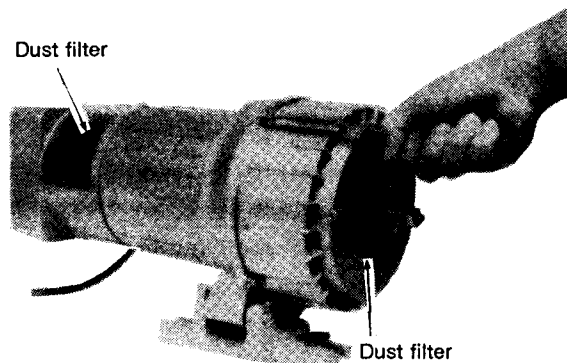


Fig. 34 Removal of Bracket Mounting Screws

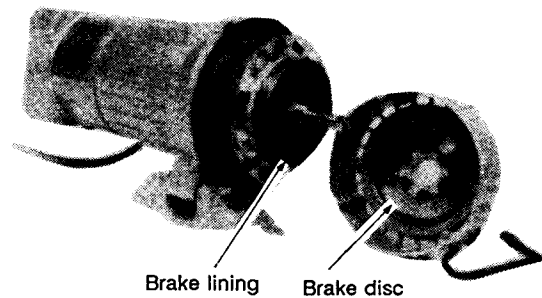


Fig. 35 After Bracket Removal

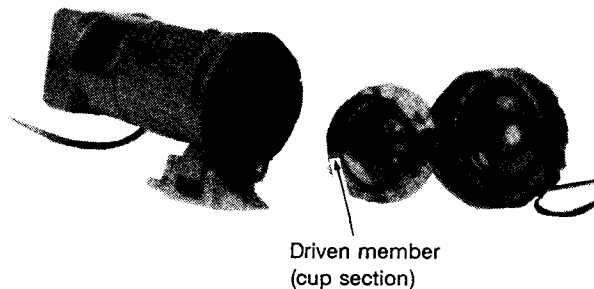


Fig. 36 View of Motor after Bracket and Clutch Shaft Are Removed

Procedures of Maintenance, Inspection and Replacement

- 8) To replace the brake lining, remove the bearing at pulley side (Fig. 37) and replace with new brake lining and bearing. (When the bearing was disassembled, it must be replaced with a new one.)
- 9) Assemble the parts in the reverse order of removal. When the clutch shaft cannot be inserted by hand, hit gently the end of clutch shaft with a wood hammer. (Do not hit hard.)
- 10) When the brake lining has been replaced, turn the clutch shaft by hand, after it was assembled, to see if it turns smoothly and conduct the warm up running. The running is completed if the pedal is operated more than 100 times after the power was turned on and the motor was started.

Caution

- Handle with care not to deform the cup section at the removal and reassembly.
- Since the special bearing is used, please contact your dealer at the replacement.

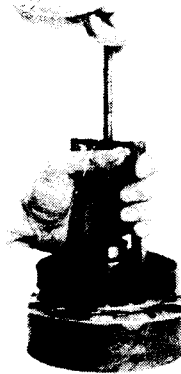


Fig. 37 Removal of Pulley Side Bearing

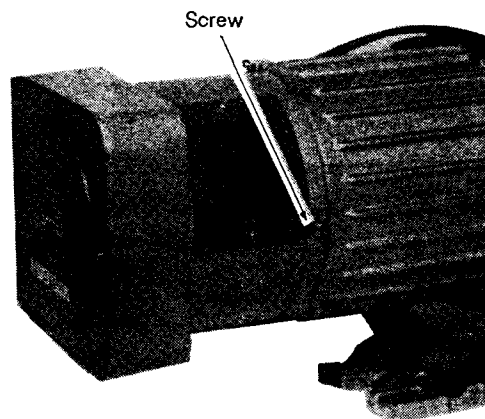


Fig. 38 Replacement of Control Box

7.2 Replacement of Control Box and Parts

(1) Replacement of control box

- 1) Turn off the power.
- 2) Disconnect all plugs connected to the control box.
- 3) Remove 3 screws and remove the control box. (See Fig. 38)
- 4) Separate connectors connected to the printed circuit board.
- 5) Replace with a new control box and assemble it in the reverse order of removal.

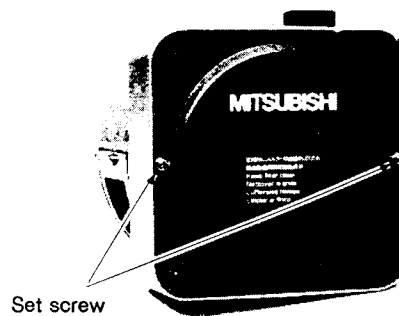


Fig. 39 Set Screw of Cover

Procedures of Maintenance, Inspection and Replacement

(2) Replacement of printed circuit board

Replace the board under the state when the control box is removed in the step 4).

- 1) Remove set screws of cover to open it. (See Fig. 39)
- 2) Disconnect the receptacle from the connector of printed circuit board.
- 3) Remove the mounting screws (at four places) of printed circuit board and disassemble the board. (See Fig. 40)
- 4) Replace with a new printed circuit board and reassemble in the reverse order of removal.

Printed circuit board
mounting screw

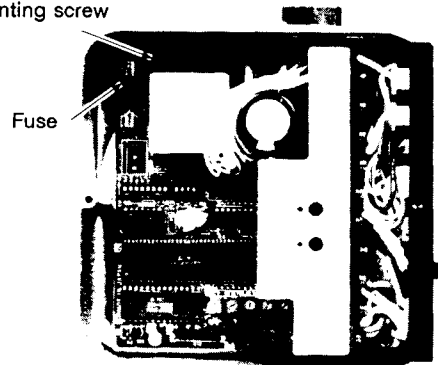


Fig. 40 Replacement of Fuse

(3) Replacement of fuse (See Fig. 40)

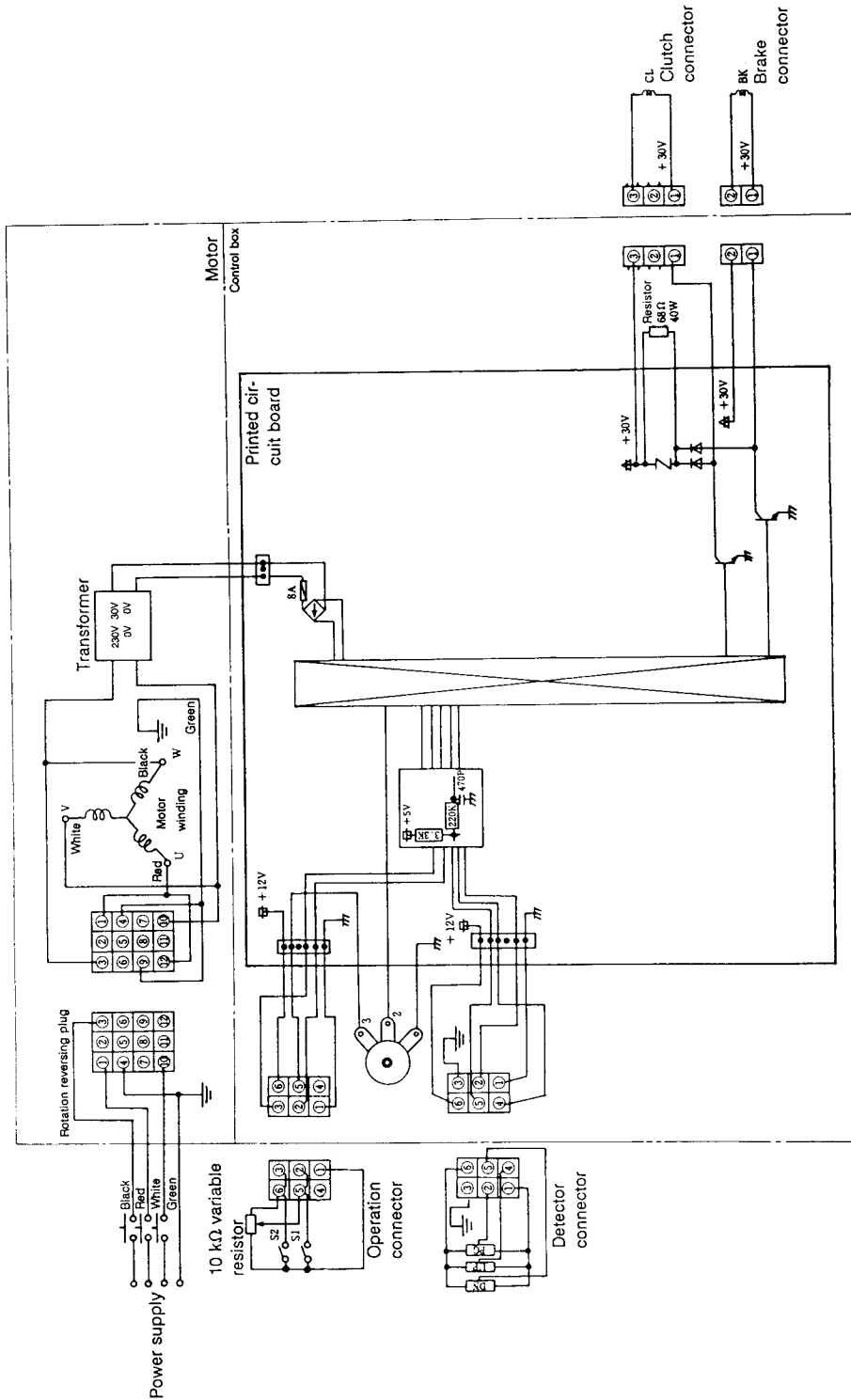
- 1) Replace the fuse (8A) while the cover is opened.

Block Diagram of Circuit

8. Block Diagram of Circuit

ZK type Block diagram of control circuit

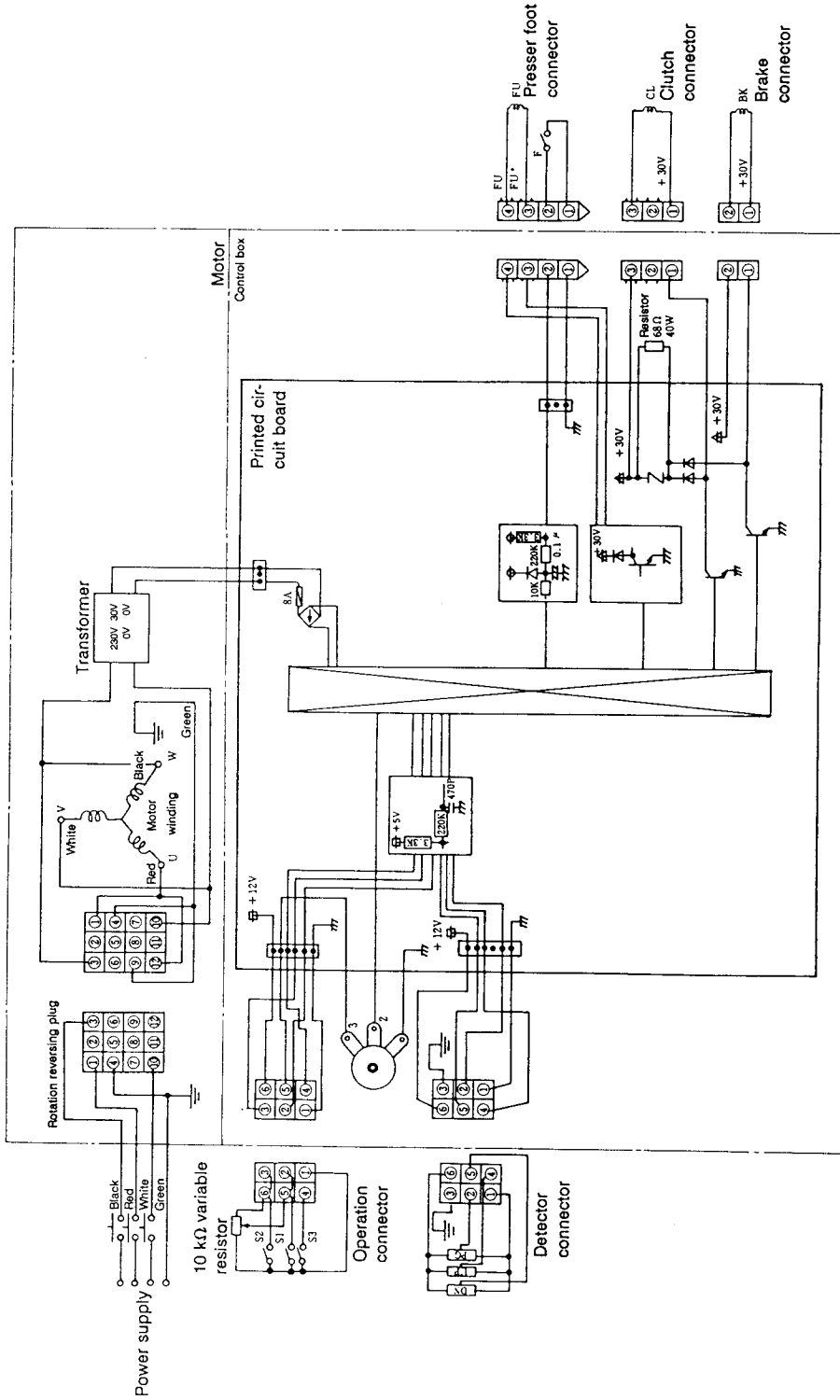
- *1 Connectors are in the state seen from the pin side.
- *2 This diagram shows the case of AC 220V, 3 phases.



Block Diagram of Circuit

ZK-FL type Block diagram of control circuit

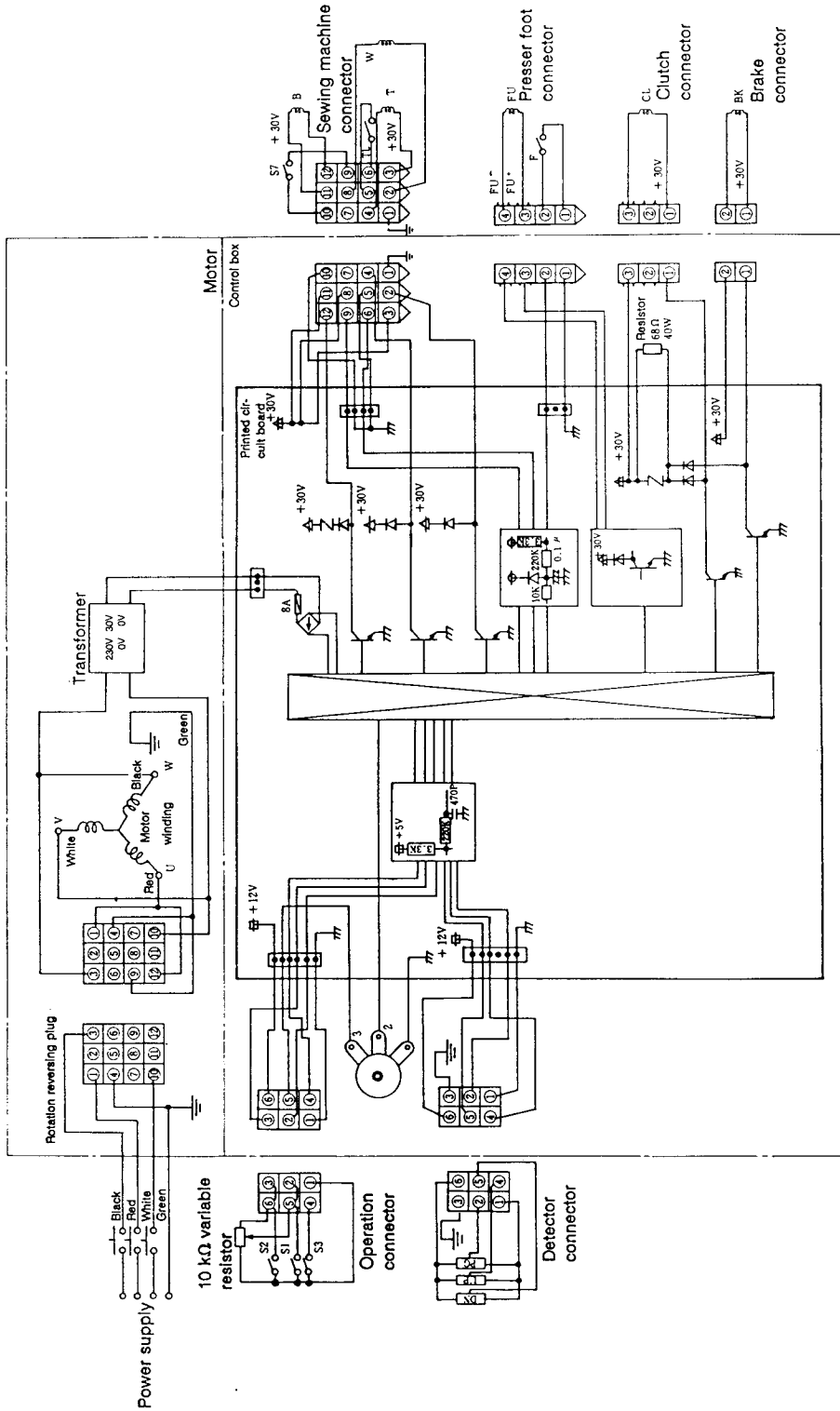
- *1 Connectors are in the state seen from the pin side.
- *2 This diagram shows the case of AC 220V, 3 phases.



Block Diagram of Circuit

ZK-AMBL type Block diagram of control circuit

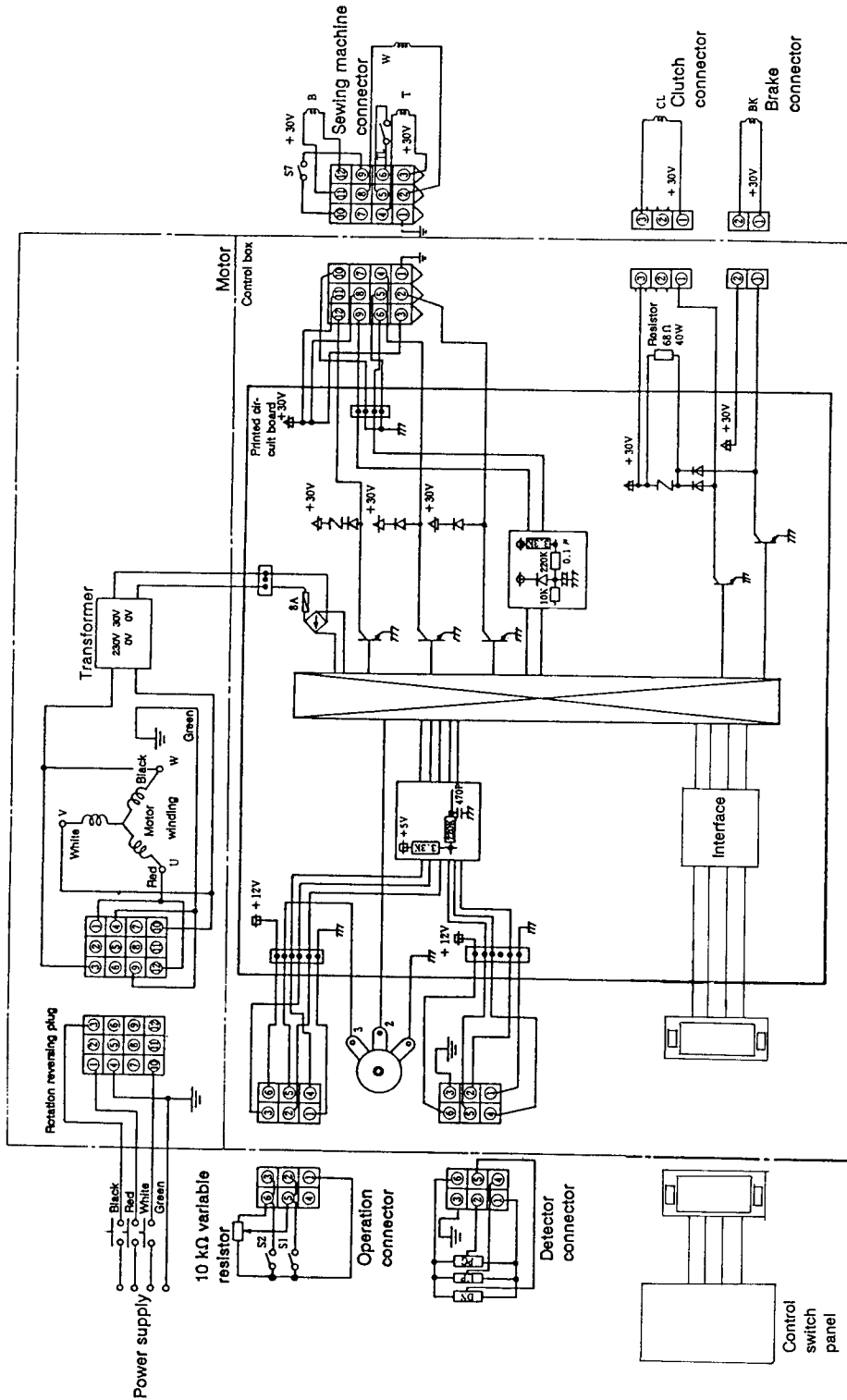
- *1 Connectors are in the state seen from the pin side.
- *2 This diagram shows the case of AC 220V, 3 phases.



Block Diagram of Circuit

ZK-AMK type Block diagram of control circuit

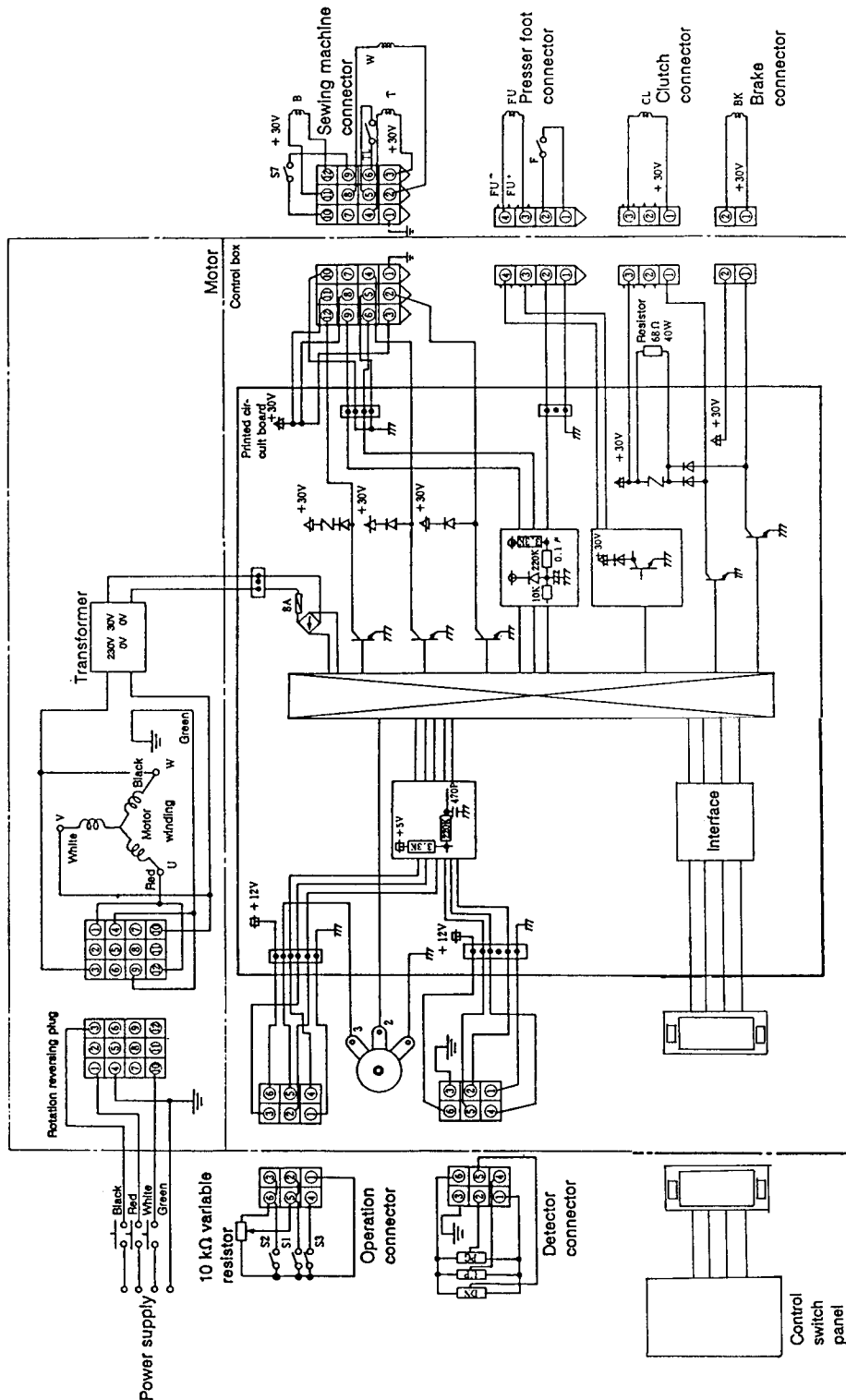
- *1 Connectors are in the state seen from the pin side.
- *2 This diagram shows the case of AC 220V, 3 phases.



Block Diagram of Circuit

ZK-AMKL type Block diagram of control circuit

- *1 Connectors are in the state seen from the pin side.
- *2 This diagram shows the case of AC 220V, 3 phases.



Troubleshooting and Repair

9. Troubleshooting and Repair

When the XC-C control switch panel is used with the ZK-AMK or -AMKL control box, the error numbers corresponding to the problems detected by the control box are indicated on the display of the control switch panel.

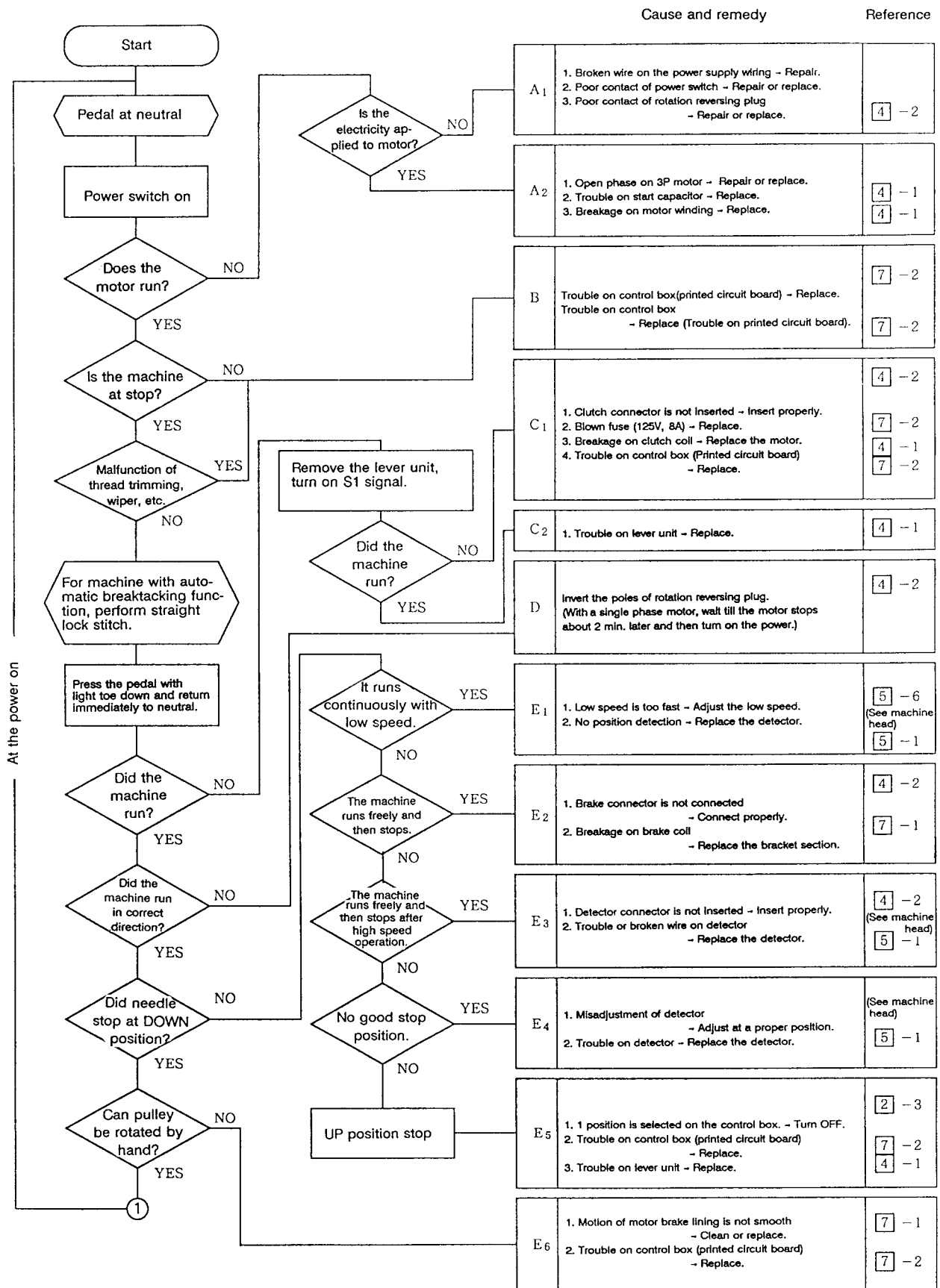
When an error number is indicated, proceed to inspect as instructed in the table.

Refer to the flow charts on the following pages for inspection when the XC-C control switch panel is not used or when the error number is not indicated on the control switch panel

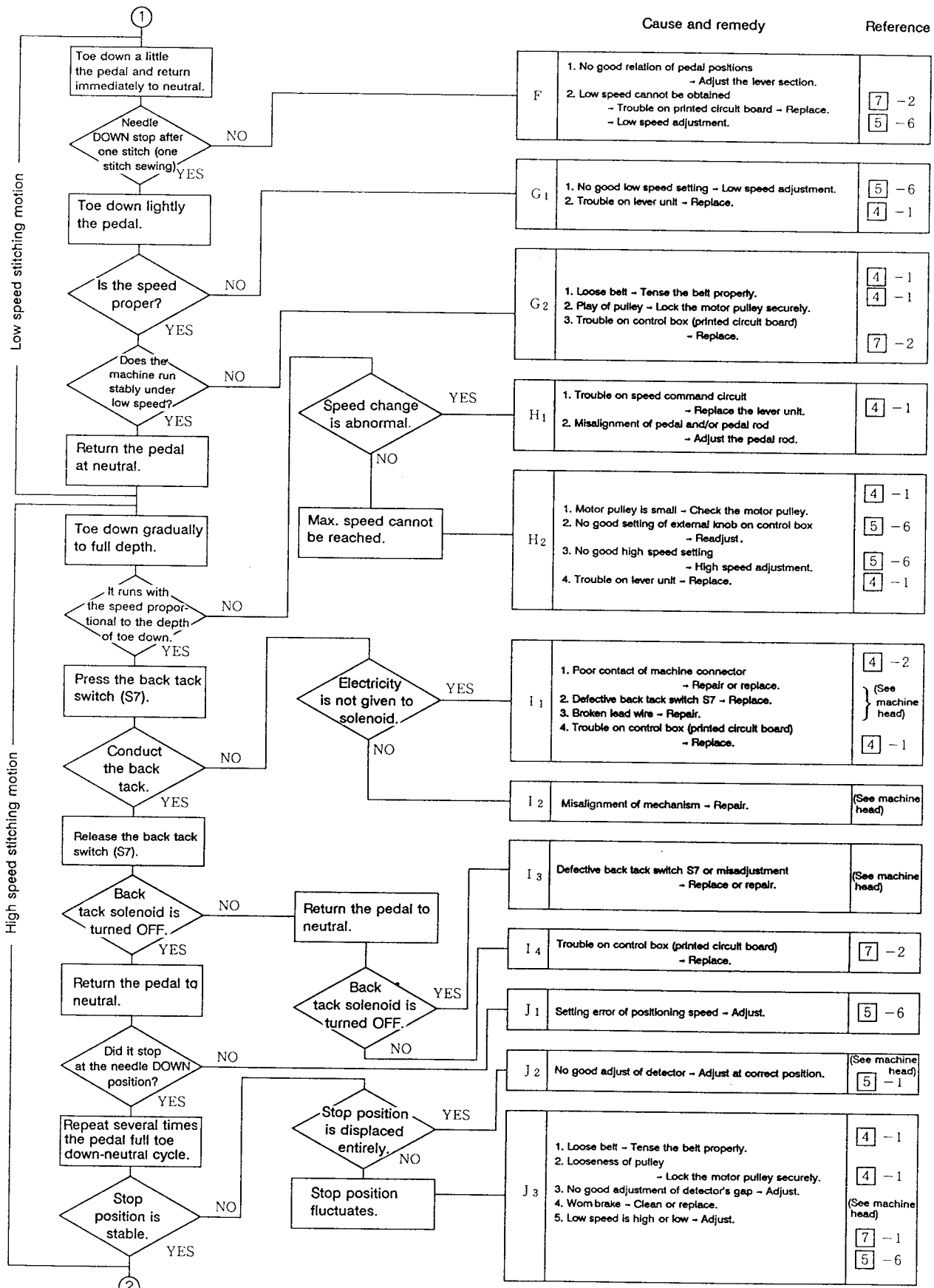
Table 13 Error Numbers and Details of Inspection

No.	Details of inspection
E8	Check that the sewing machine detector cord has not been disconnected and that the connectors are still properly connected. Check that the sewing machine has not locked up.
E9	Check that no errors have been made in the connections to the solenoids (thread trimmer, presser foot lifting, etc.)
E0	Check that the supply voltage has not dropped. Check that the power supply capacity is not too low.

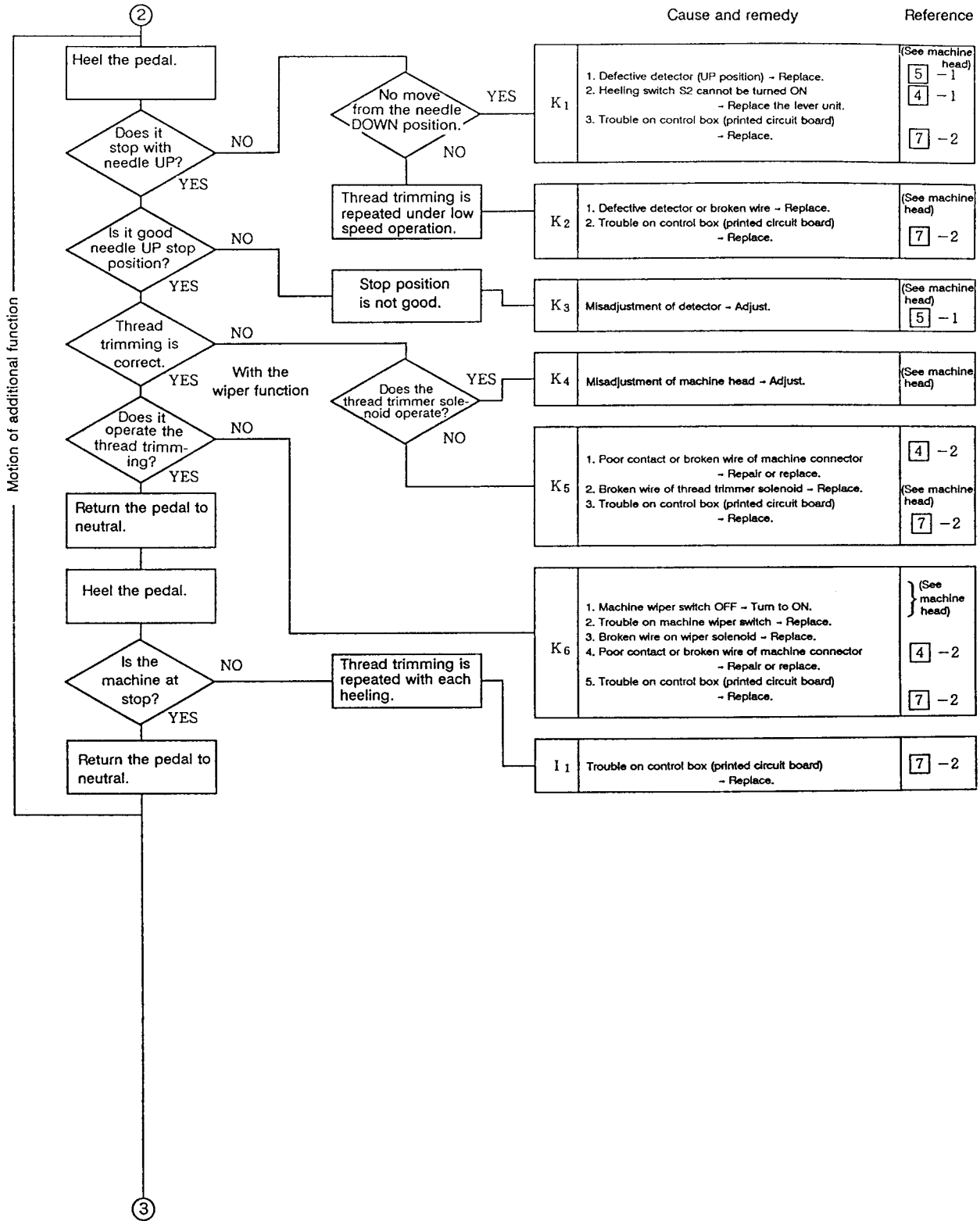
Troubleshooting and Repair



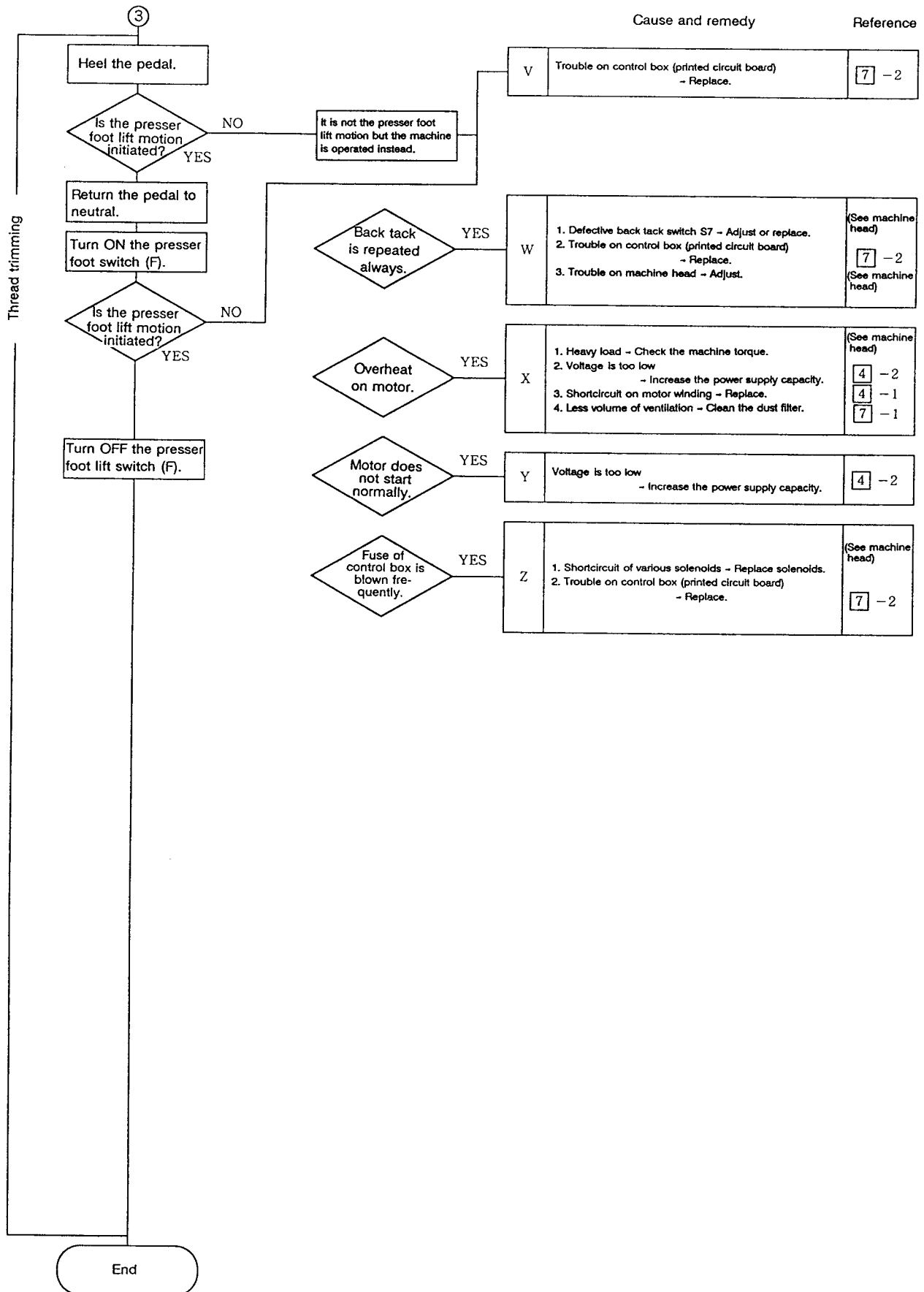
Troubleshooting and Repair



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Specifications subject to change without notice.