

ZJ-12588- C

INSTRUCTION MANUAL

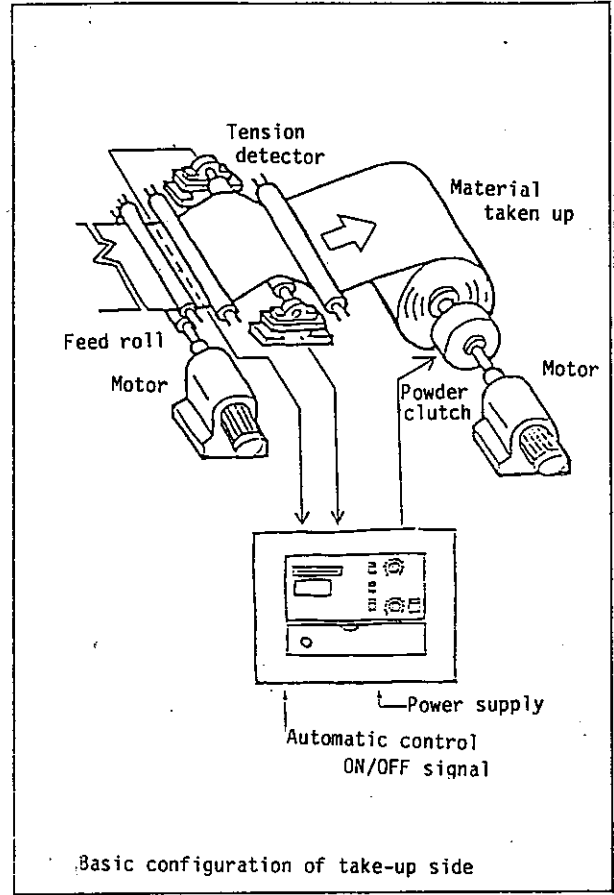
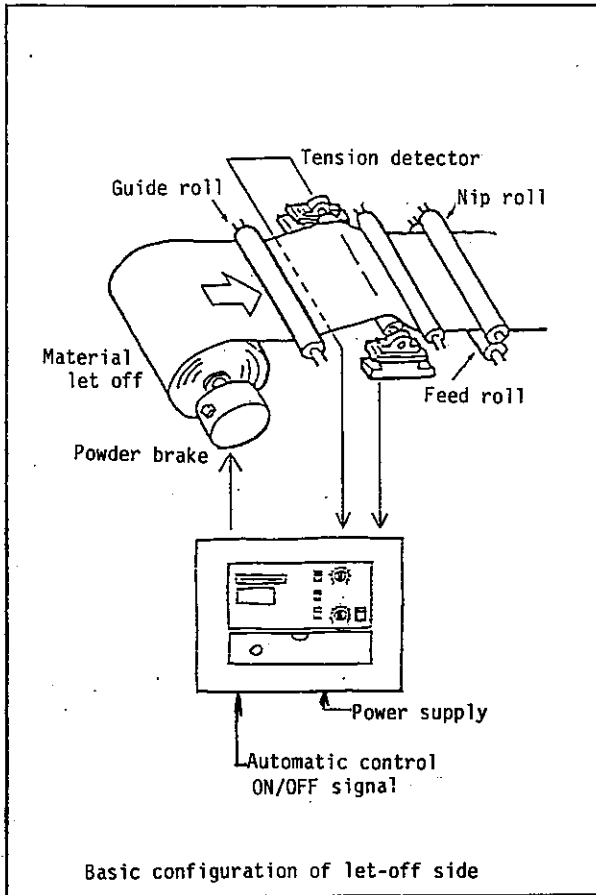
FOR

TENSION CONTROLLER MODEL LE-MU

MITSUBISHI ELECTRIC CORPORATION

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Thank you very much for your selection of Mitsubishi Tension Controller LE-MU.

Please read through this instruction manual before use, so that the unit will be used under optimum operating conditions for an extended period of time.

We would ask you that the manual will be kept near at hand for quick reference whenever it becomes necessary.

§ 0. Comparison with Conventional Tension Controllers

The new Tension Controller Model LE-MU is an improved version of the current LE-WGA series that has been in a wide use, intended as a low-cost tension controller adaptable to let-off, take-up and outfeed applications.

It offers a number of advantages over the current LE-WGA series, as envisaged with the following major features:

1. Compact and lightweight design

It has greatly been reduced as compared with the current series, to 52% and 65% in its volume and weight, respectively.

2. Adoption of the digital display

The digital display of tension measured is switchable between tension readings at LEFT, RIGHT and and TOTAL. It can also be switched for output display in percent.

In addition to this function, total tension is displayed at all times on the level meter (by digital/analog display).

3. Added functions

The following extra functions are provided for the new model to make it truly user-friendly:

(1) Stall memory function

..... To assure stabilized tension at the time of inching, or in starting and stopping operation.

(2) External tension setting function

..... Remote setting

(3) Deceleration gain function

..... To prevent sagging in deceleration

(4) Switching of stall adjustment to manual control knob

..... Improved operability

(5) Integral time adjustment function

..... Stability with expanded latitude

(6) Sliding tension function

..... For smooth shifting from MANUAL to AUTO operation

(7) Conditional tension function

..... To prevent excessive tension that may be applied in passing paper through

(8) Right/Left tension switching indication

..... For monitoring possible irregular tension

The following points should be taken note of on these additional functions:

- ① Output capacity is 24 V DC and 3.8 A max.
- ② No dimensional interchangeability is provided for mounting.
- ③ Because of the constant-voltage drive system employed, there is no need for adjustment of load when two or more of these extra functions are used for operation.

§ 1. Installation

(1) Upon delivery, please check with the nameplate put on the right side of the unit to confirm that the right one is delivered.

(2) Standard accessories

Confirm that the following accessories are supplied with the main body:

Fuse, 2 A 2 pcs.

Fuse, 3 A 2 pcs.

Fuse, 5 A 2 pcs.

Small screwdriver with regular type 1 pc. ⊖

Please see to it that these accessories are supplied to the end user, along with the main unit.

For detail on the locations for use of these fuses, refer to page 56 in this manual.

(3) Installation

This Tension Controller LE-MU can adapt to two types of mounting; floor mounting or wall mounting as desired.

Opening for wiring is provided on the bottom face of the unit. If it is floor-mounted, please arrange an opening for the wiring on the floor as well.

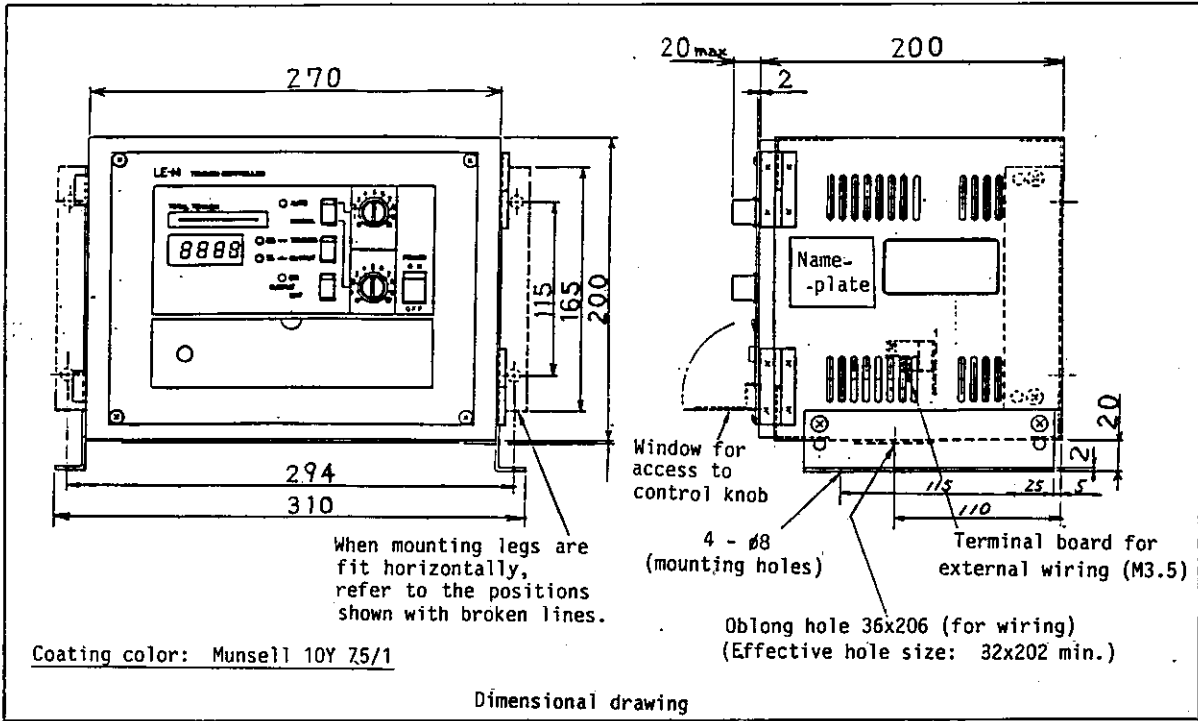
Floor mounting

As shown in the dimensional drawing, install the unit perpendicularly making use of the holes (ø8) provided at four mounting fixtures.

Wall mounting

Relocate the positions of the mounting fixtures as shown with the broken lines on the dimensional drawing, and fasten on the floor surface making use of the holes (ø8) provided at the four mounting fixtures.

Note: Select a proper place where the unit is not subjected to direct sunlight, high temperature and/or humidity, dust, corrosive gase, oil, or to vibration.



§ 2. Wiring

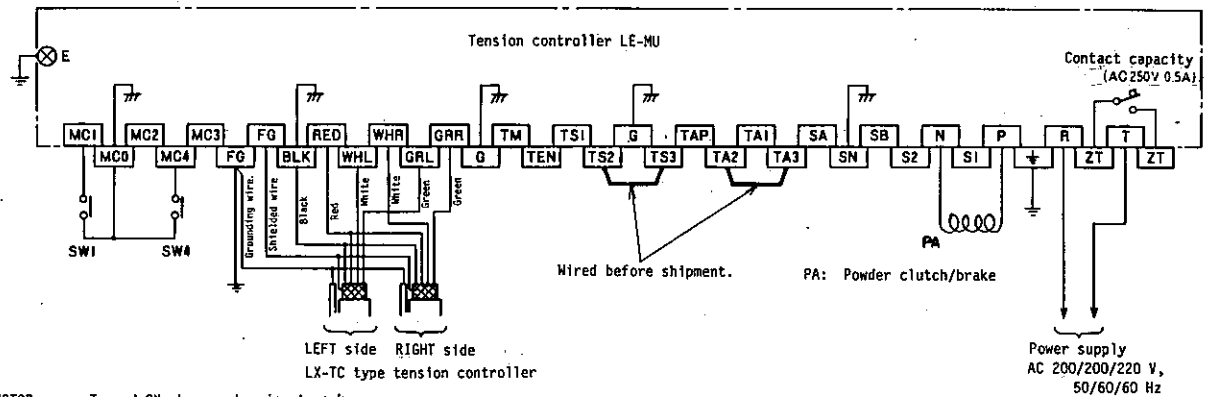
Arrange wiring properly according to the intended purpose.

Use shielded cables for wiring other than (1), (2), (6) and (8) described below. Arrange wiring conduit keeping away from other line which may produce significant amount of noise.

Terminal board is provided slightly lower position at the center, exposed when the front door is opened.

1. Basic connection

In the case of a single-shaft let-off and take-up system as shown on the basic configuration drawing, without using any of the optional functions, connect referring the basic connection diagram shown below.



SW1: RUN/STOP Turned ON when system is at work.

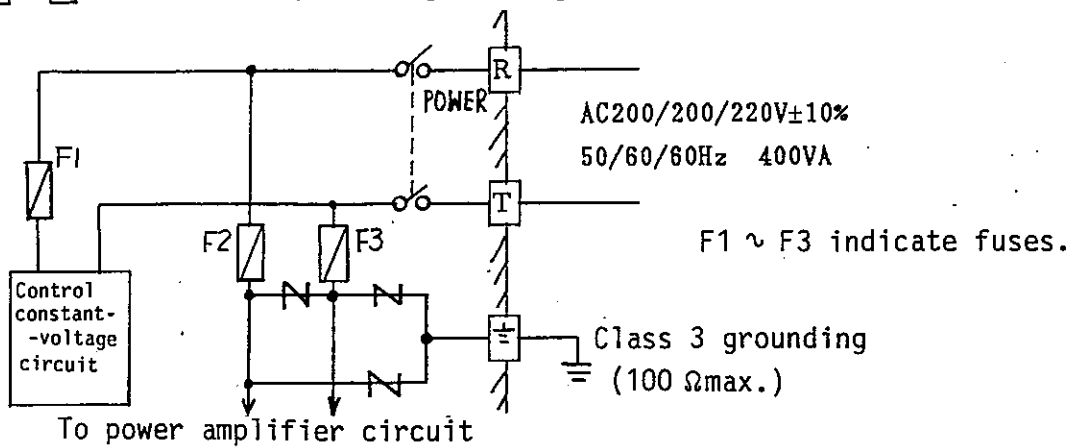
SW4: Stall memory reset Turned ON for abt. 1 second.

Note: The three points marked with should be grounded separately (E, FG and T terminal) on class 3 grounding.

More secure grounding is necessary if they are grounded altogether.

Functions of individual terminals are explained in detail in the following sections.

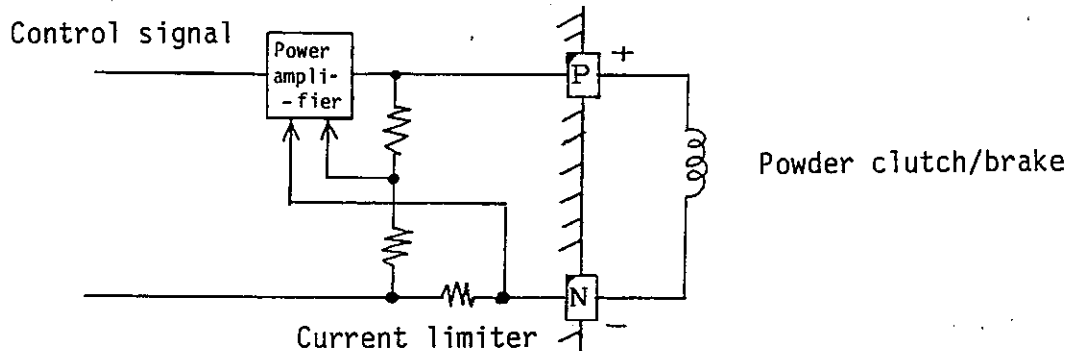
(1) **R** **T**, $\frac{+}{-}$ AC input and grounding



Connect an AC200V \pm 10%, 50/60 Hz or an AC220V \pm 10%, 60 Hz power supply line between **R** and **T** terminals. In either case, voltage to ground should be kept at AC250 V or DC320 V max.

Apply class 3 grounding for the $\frac{+}{-}$ terminal.

(2) **P** and **N** Output signal



These are the terminals across which the tension-controlling power clutch/brake are connected.

Use a power clutch/brake of 3.8 A max. current rating for use with DC24 V system.

When operated with changeover between 2-shaft or 3-shaft setup, refer to the examples of external connection diagrams shown on pages 12 or 13.

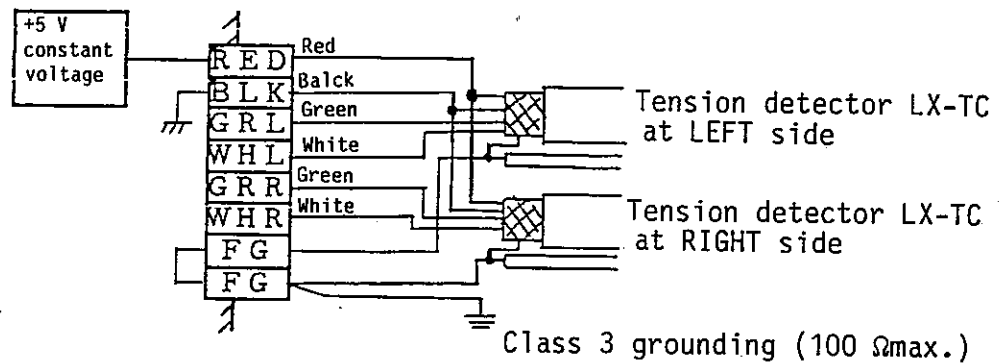
Note: ° If an excessive current should flow by a short-circuit occurred between terminals **P** and **N**, the overcurrent protection function is activated to cut off output instantaneously, thereby protecting the internal circuit. At this moment, the OVER CURRENT indication lamp (*) on

the power card goes out. It is rest to normal by making power supply again.

(*) Two indication light (LEDs) are exposed by opening the panel door; the one on the left is the POWER indication lamp and the other on the right is the OVER CURRENT indication lamp.

° OUTPUT indicates the command signal. Therefore, in the range where the OUTPUT indication exceeds 100%, the actual output may not agree with the value of the OUTPUT indication.

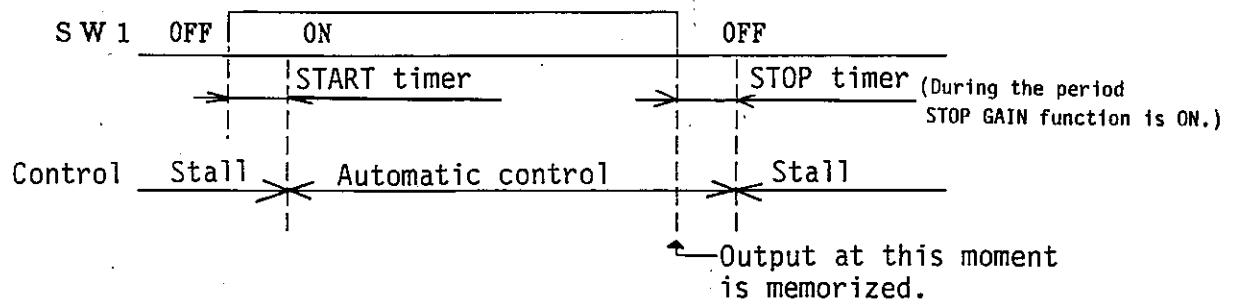
(3) RED, BLK, GRL, WHL, GRR, WHR, FG, and FG
 Tension detection signal



These are the terminals to which the tension detectors LX-TC are connected.

The above figure shows the case where the load due to tension is being applied in the direction of compressing the tension. If the load is applied in the stretching direction, exchange each of the white and green wires.

If only one tension detector is used, short-circuit between terminals GRL and GRR, and between terminals WHL and WHR, respectively. (Values indicated on the tension detectors at RIGHT and LEFT should be adjusted to 1/2 that to be indicated when two tension detectors are used.)



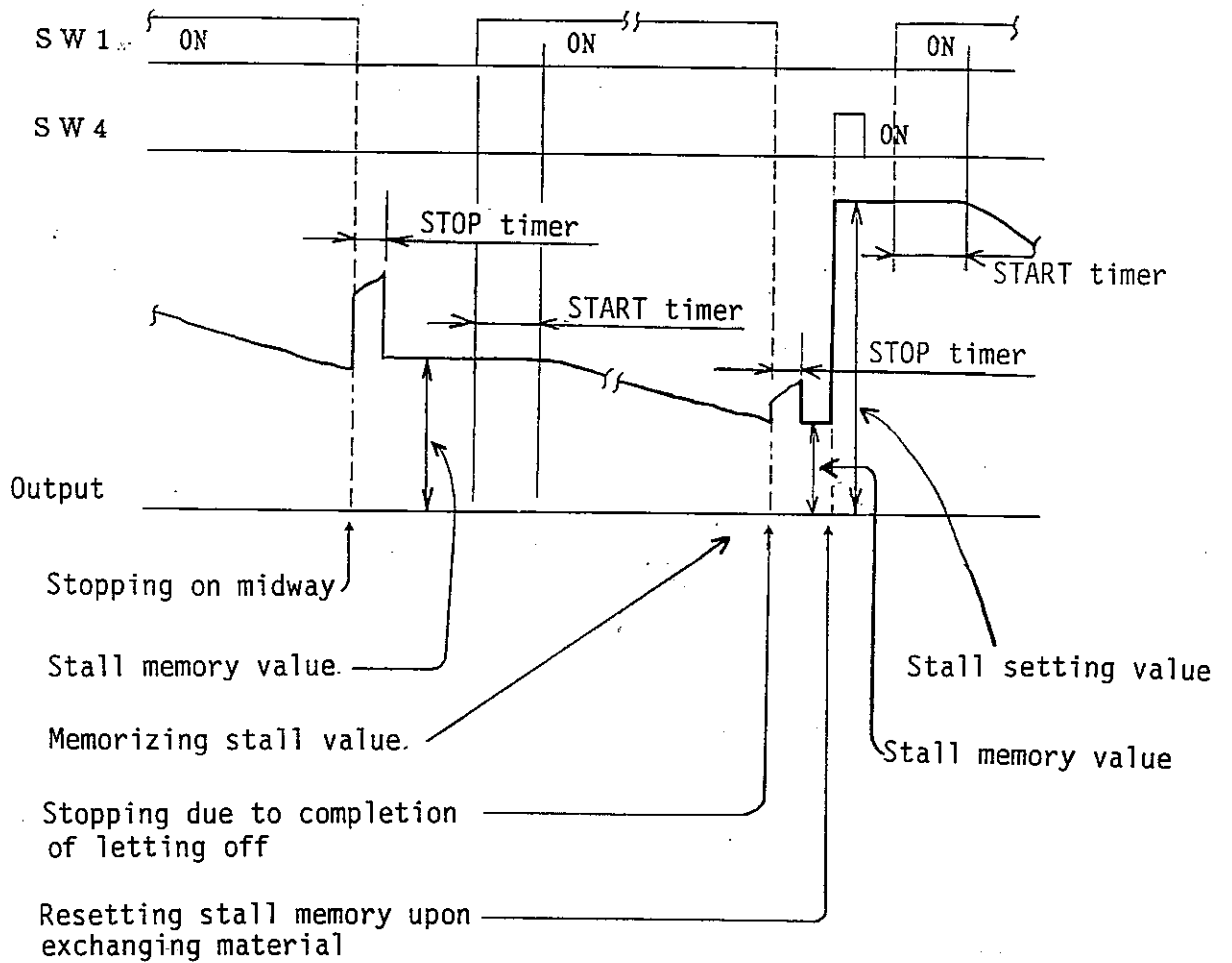
If the conditional tension function is used, the automatic control function is ON if a stall takes place, but the tension in this case never exceeds the stall value, therefore, scale-out of output or an excessive tension can be eliminated.

Left short-circuited, instantaneous switching is possible to the automatic control in the AUTO mode, and to the manual control state with the MANUAL control knob in case of MANUAL operation mode. Output scale-out may occur when in a recess in AUTO mode.

(5) **MCO** and **MC4** Stall memory (AUTO)

The contact input terminals used for resetting stall memory; when in OFF state, the stall memory function is preserved. If these contacts are turned ON (for about one second), the value set on the STALL control (or on the MANUAL control) becomes the stall value. (SM4) If this stall memory function is not used, between the terminals **MCO** and **MC4** should be short-circuited.

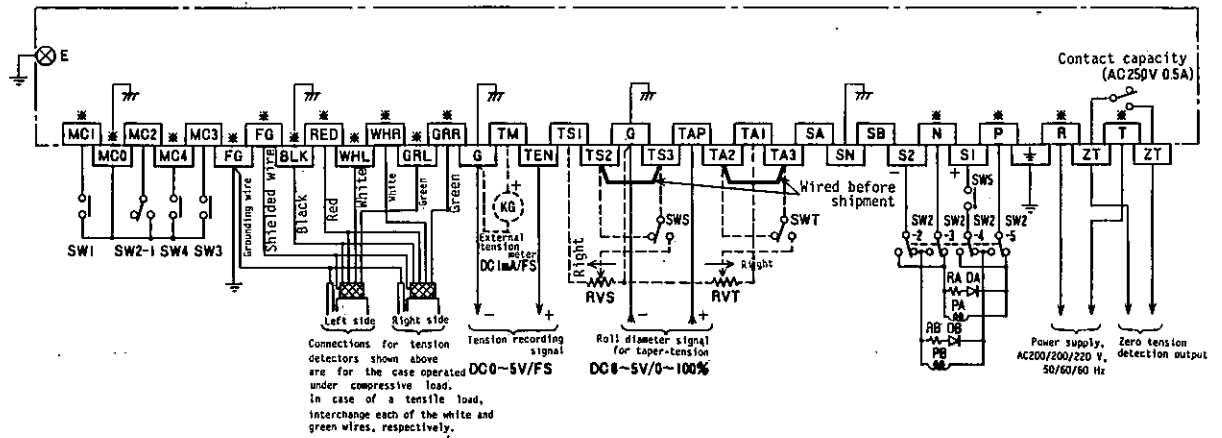
In AUTO mode:



° The stall memory is reset when power supply is switched from OFF to ON, restoring the stall setting value.

2. 2-shaft setting with optional functions

Make connections referring to the external connection diagram below, to fit the particular applications.



- SW1: RUN/STOP ... Turned ON when system is working.
- SW2: Reel change ... Switched from ON to OFF or vice versa each time of reel change.
- SW3: Deceleration gain ... Deceleration gain function is put in motion when the switch is turned ON.
- SW4: Stall memory reset ... Remains ON for abt. 1 second.

- RVS: External control for tension setting
 - SWS: Internal/external select switch for tension setting
 - RVT: External control for taper setting, 0.5 W, 10 kΩ
 - SWT: Internal/external select switch for taper setting
- Note: When external control is used, remove jump wires used for short-circuiting between **TS2** and **TS3**; and between **TA2** and **TA3**.

Terminals indicated with * must always be connected.
Class 3 grounding should be made for the grounding terminal.

- PA, PB: Powder clutch, and powder brake
- RA, RB: Protective resistor, 10 W, 47 Ω
- DA, DB: Diode, 200 V, 5 A

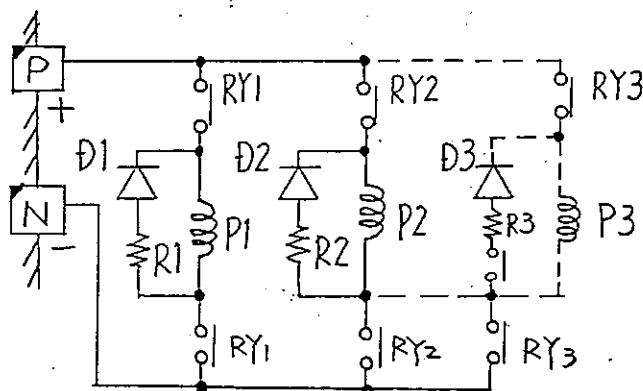
Note: The three points marked with (x , FG and terminal) should be grounded separately, to conform to class 3 grounding. If grounding is done altogether for all the points marked with , ground them more securely.

SW5 : Instantaneous stopping rotation of one shaft that has been at work, starting simultaneous pre-driving of another shaft ... Remains ON for abt. 5 to 10 seconds.

2-1. Operation with two shafts

In case of a two-shaft setting using two sets of powder clutch and brake for let-off and take-up, the following should be connected, in addition to the change-over contacts, to prevent wear loss on the contacts:

(6) **P** and **N** Output signal



- P1, 2 & 3: Powder clutch and
- D1, 2 & 3: Diode, DC200 V, 5 A
- R1, 2 & 3: Protective resistor, 10 W, 47 Ω

R1, 2 & 3: Contact of switching relay.

Set the sequence for changing over the powder clutch and brake as shown above. (In case of a three-shaft setting, add as shown with broken lines.)

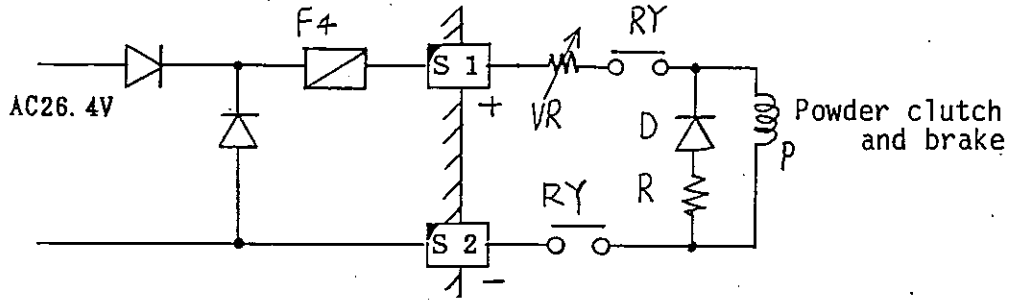
(7) **S1**, **S2** Auxiliary output

Auxiliary output terminals used for stopping rotation of the one shaft then at work and for pre-driving the other shaft.

DC approx. 10 V (fixed), 1.9 A, 10 seconds rating.

When used for pre-driving, connect an adjusting resistor VR.

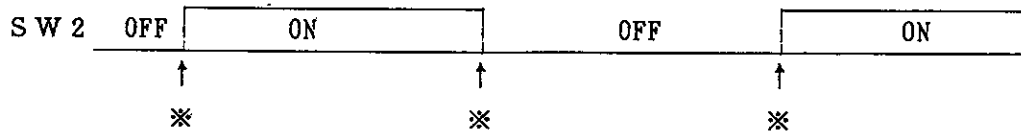
Provide sequence in combination with **P** and **N**.



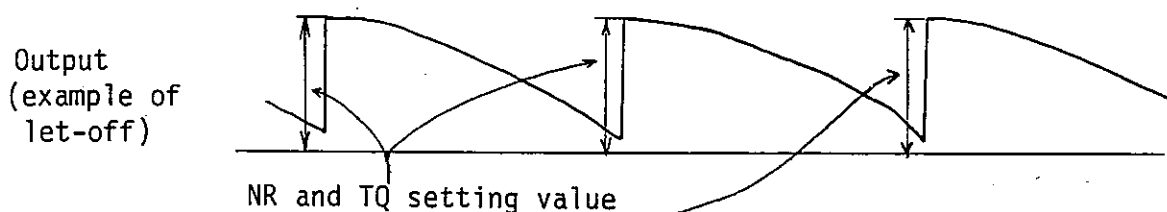
Note: Separate terminal **N** from **S2** with switching contact relay.
(Not in the same potential.) Refer to the external
connection diagram on page 12.

(8) **MCO**, **MC2** For switching shaft

Contacts interlocked with the reel change mechanism are connected here. (To be left open in case of single-shaft setup.) (SW2) Changing over of these contacts from ON to OFF, or from OFF to ON causes the setting value for pre-setting for the new reel to be output (preset with NR, TQ controls). At the same time, the additive component of output set with the mechanical loss compensation controls (MLA and MLB) is switched over for take-up operation.



Stand-by shaft presetting value is output at the points marked with *.



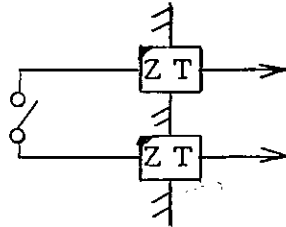
2-2. Expansion functions

Connect any of the following expansion functions required as it becomes necessary.

(9) **ZT**, **ZT** Zero tension detection function

These are the contact output terminals for detecting zero tension. Contact rating: AC 250 V, 0.5 A or DC 30 V, 0.5 A (in case of applying inductive load)

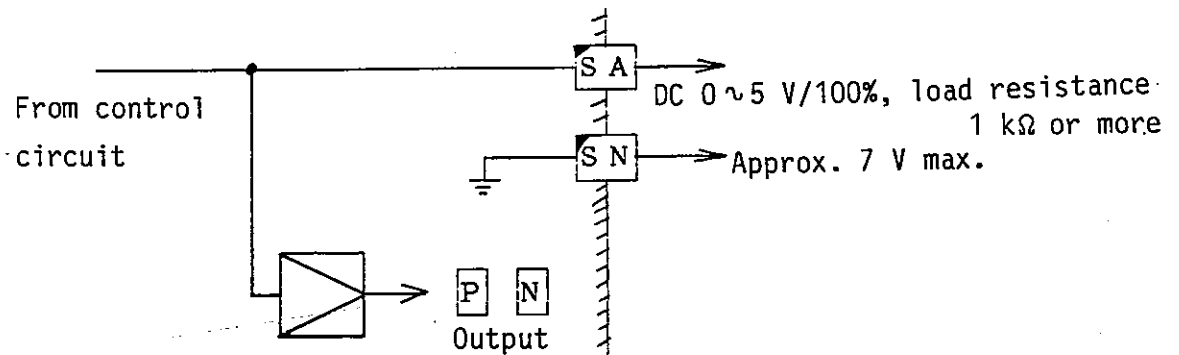
Turned ON if the total tension becomes lower than the value set with the zero tension (ZT) control.



Provided with hysteresis characteristics (approx. 3% of the full scale of tension) to prevent chattering.

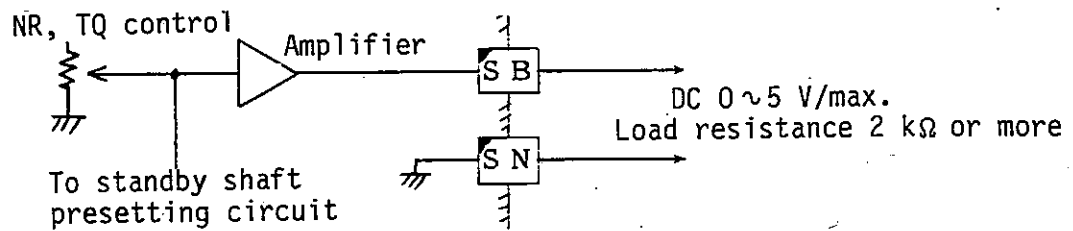
(10) **SA**, **SN** Control output signal

Control signal output terminals to which input signal to the power amplifier is connected. Used for recording output values on the recorder.



If two units of powder clutch and brake are run in parallel, connect the power amplifier to these terminals.

- (11) **SB**, **SN** Auxiliary output signal for predriving the shaft then in standby



Auxiliary output signal terminals for predriving the shaft then in standby. By connecting power amplifier to these terminals, appropriate amount of predriving torque can be obtained, that can match the preset value for the shaft then in standby.

If should be noted, however, that the mechanical loss compensation is not added, which is to be set with MLA and MLB.

- (12) **TAP**, **TA1**, **TA2**, **TA3**, **G** For external setting of taper tension

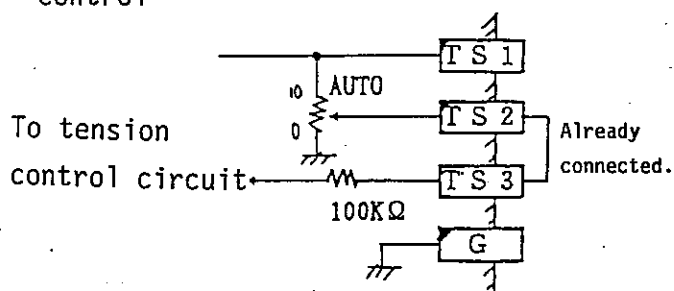
Can accommodate externally provided taper tension signal and provision of an external taper setting control (for take-up).

In case of a taper tension control done on external roll diameter detection, the roll diameter detection signal is input between the terminals **TAP** and **G**, with the EXT/INT select switch set at EXT side.

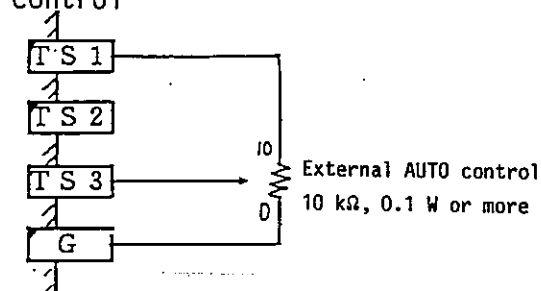
If the taper tension control is done on the internal roll diameter detection, the EXT/INT select switch is set at INT side. The select switch is to be set at EXT side, if it is done on the external roll diameter detection method.

Connections for terminals **TA1** to **TA3** should be made as shown in (a) below, when adjustment for the taper ratio is to be done with the internal TAPER control, whereas connections are being made as shown in (b) if it is to be done with an external TAPER control. All the terminals are to be left open in case of the constant-tension control only.

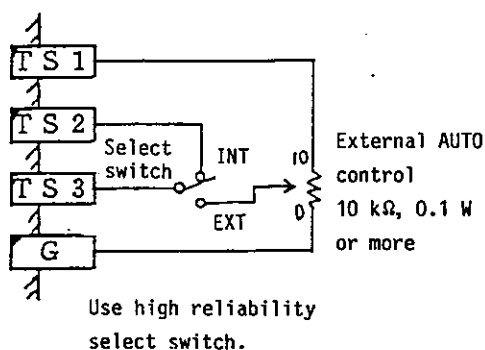
(a) Setting with internal tension control



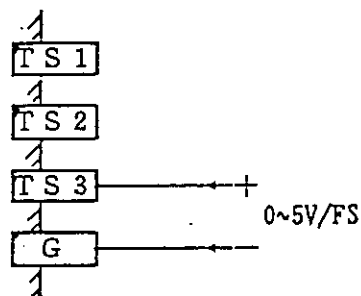
(b) Setting with external tension control



(c) Switching between INT/EXT



(d) Setting with voltage signals



If all these terminals are left open, in which case no automatic control is possible, make connections in any of the above shown methods without fail. (In such a case, the tension setting will become 0 kg.)

It is possible to connect a personal computer or sequencer, when connected according to (c) or (d) shown above.

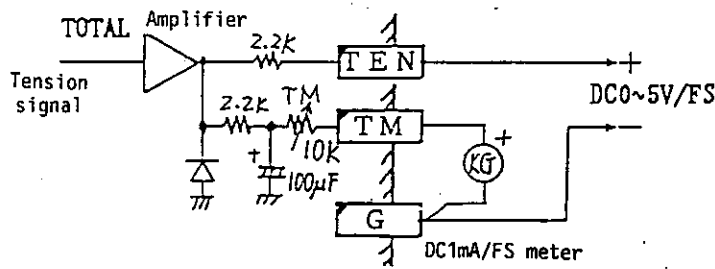
It is also possible to limit the maximum setting value with the AUTO control, by adding resistor. (Please consult to our company.)

(14) **TEN**, **TM**, **G** Tension signal

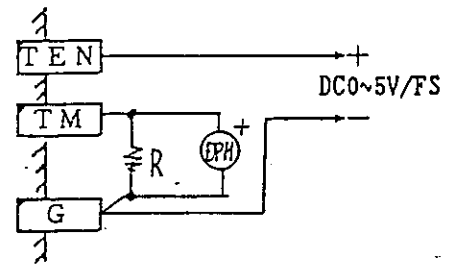
Terminals **TEN** and **G** are terminals for the tension recorder. Use a recorder of input resistance of 10 kΩ or higher. [(If high-frequency component is to be removed, connect a capacitor (of 100 μF, for example)] between the terminals **TEN** and **G**.

Terminals **TM** and **G** are for connecting external tension meter.

(a) When analog meter is used



(b) When digital meter is used



Adjustment of full-scale is made with the TM control.

When analog meter is used:

Using a DC1mA/FS meter of 2 k Ω or less internal resistance, connect as shown in (a) above.

When digital meter is used:

Using a digital panel meter with 1.999 V decimal point setting terminal, connect as shown in (b) above.

Connect the decimal point setting position properly to match the tension full-scale applied.

Select proper resistor R according to the guideline below.

When tension is 1,000, 100, or 10 kg/FS ... 1.5 k Ω , 1/4 W

When tension is 500, 50 or 5 kg/FS ... 1 k Ω , 1/4 W

When tension is 200, 20 or 2 kg/FS ... 300 Ω , 1/4 W

It is possible to connect a personal computer, sequencer, etc. via the **TEN** terminal.

(15) **MCO**, **MC3** Deceleration gain

Contact input terminals for actuating the deceleration gain (DEC.G) control. While these contacts are ON, output value is changed over at the predetermined ratios. (Actuated irrespective of whether operation is made on AUT or MANUAL mode.) (SW3)

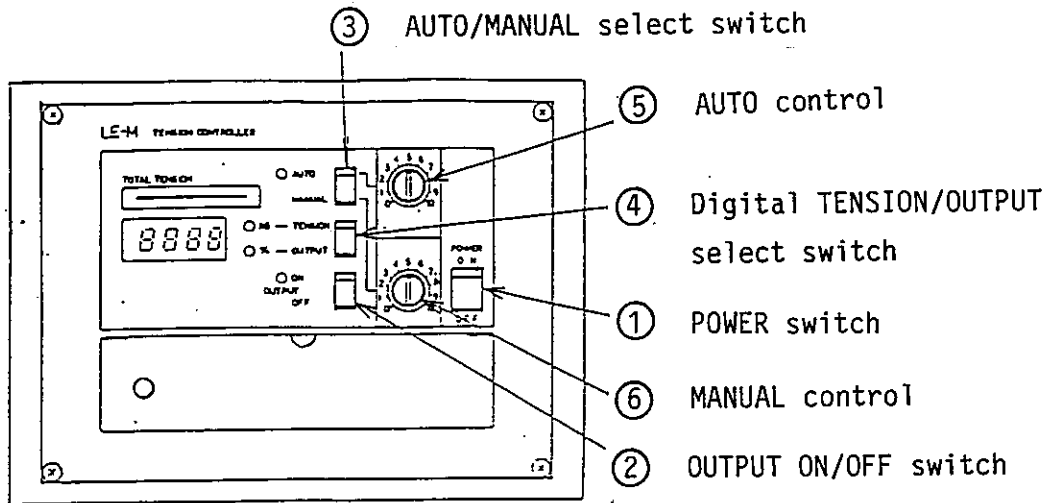
Priority for the internal operations for gain selection is as follows:

Stop gain > Deceleration gain > Normal gain

This function is utilized for inertia compensation in deceleration, for example. If not used, leave these terminals open.

§ 3. Explanation on Operation Control Unit

1. Switches and Controls



① POWER switch

By turning ON this switch, electric power is supplied to the unit and the digital display and the POWER ON indication lamp are lit up.

② OUTPUT ON/OFF switch

If only output is to be cut off while power is ON, turn OFF this switch, and output becomes 0%. When it is turned ON again, it starts with a stall state. The output indication lamp ⑨ is lit up while this switch is ON.

③ AUTO/MANUAL select switch

Select switch used for changing over between AUTO control operation and MANUAL operation.

When the switch is set at AUTO side, with the automatic control indication lamp ⑩ lit up, tension during operation is controlled automatically at the value set with the AUTO control ⑤. If it is set at MANUAL side, tension during operation is controlled at the output that has been set with the MANUAL control ⑥.

④ Display select switch

Used for selecting contents indicated on the digital display ⑦. When the switch is set at TENSION side, value of tension detected is indicated, with the KG side of the unit indication lamp ⑪ being lit up. If it is set at OUTPUT side, the output value is indicated

in percent (%), with the % side of the unit indication lamp ⑪ being lit up.

⑤ AUTO control

The control used for setting the target value for the tension control on the automatic control system. The scale ranging from 0 to 10 corresponds to 0 kg to FS (*) kg in terms of tension value.

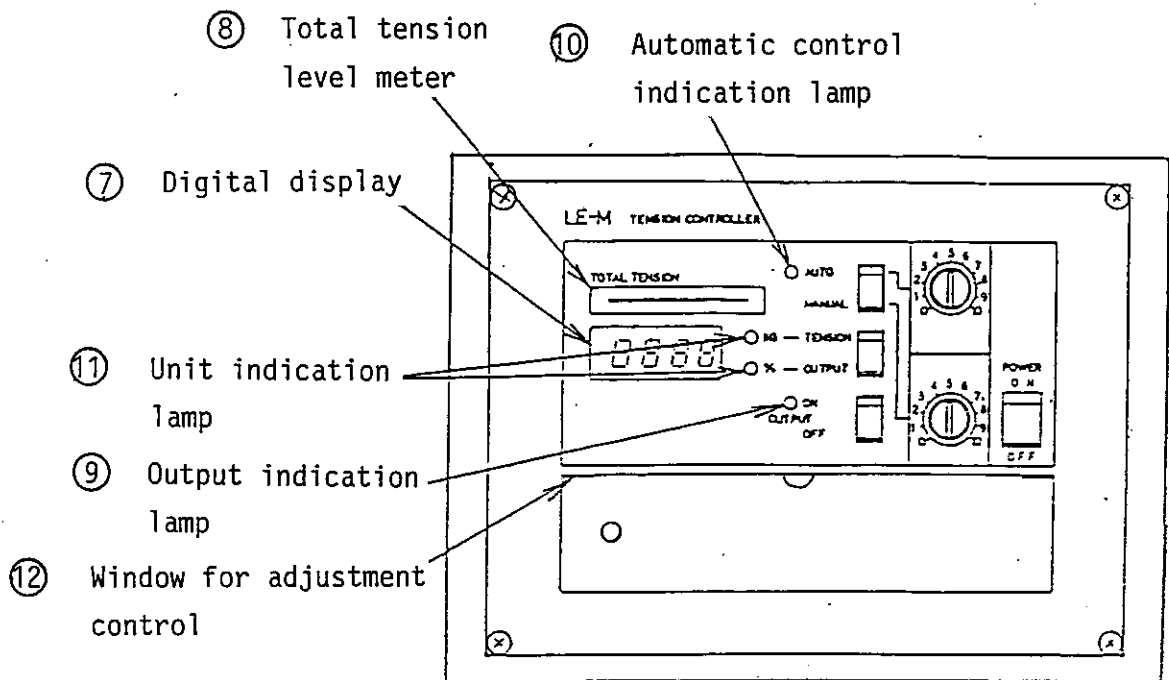
*FS: Full-scale of tension measurement

⑥ MANUAL control

The control used for manual controlled operation. The scale ranging from 0 to 10 corresponds to outputs from 0 to 100 (%). This function is effective only when the AUTO/MANUAL select switch is set at MANUAL side.

It can also be used as the Stall setting control in AUTO mode, if the select switch DS7 (which is to be described later) is turned ON.

2. Display, etc.



⑦ Digital display

Digital display of four columns (using red LED) used for indicating tension valued detected or control output value in percent (%). When the indication select switch ④ is set at TENSION side, it indicates detected tension (in KG), and indicates output (in %),

if it is set at OUTPUT side.

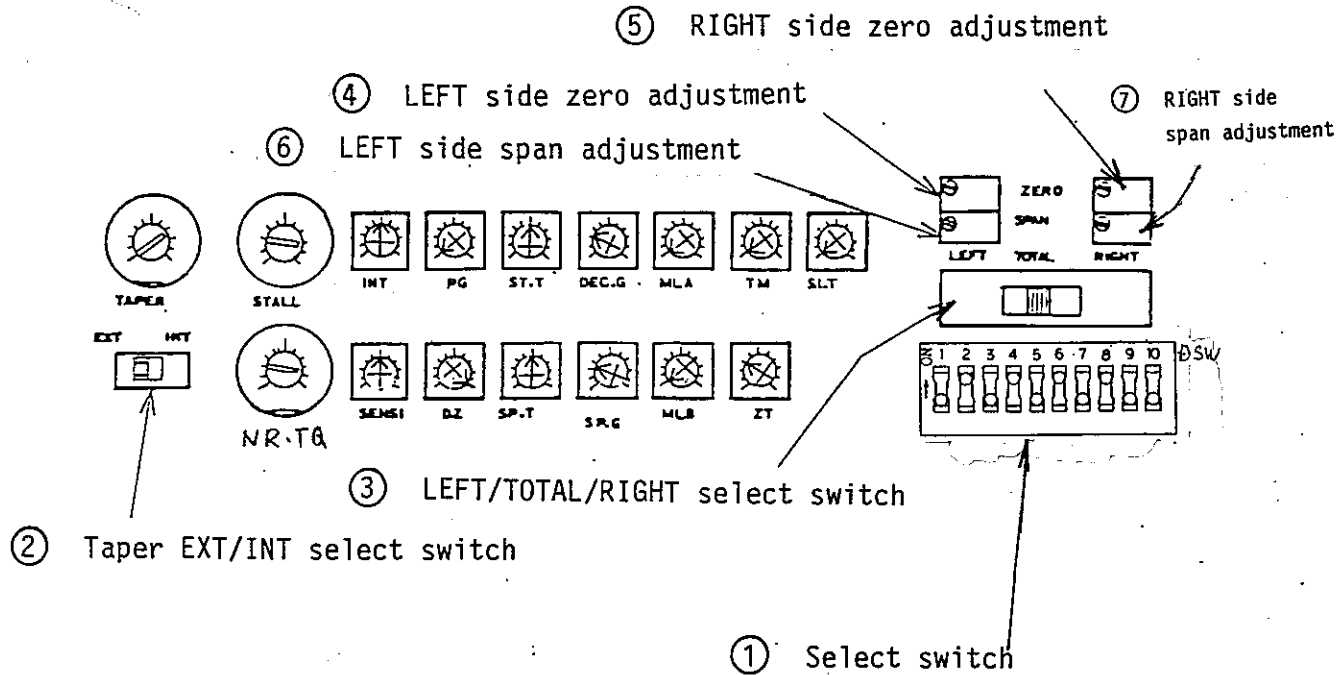
The tension indication allows further selection between indication of tension at LEFT side/TOTAL tension/tension at RIGHT side by selecting with the select switch inside the window for the adjustment control ⑫. This function can be used for checking for irregular tension, etc.

- ⑧ Total tension level meter
Indicates the level of total tension in bar form with LEDs arranged at 12 positions dividing the 100% FS of total tension.
- ⑨ Output indication lamp
Lights only when the OUTPUT ON/OFF switch is turned ON.
- ⑩ Automatic control indication lamp
Lights when the automatic control function is actually at work (e.g. during the period, in AUTO mode, from the START timer ON to the STOP timer count-up).
- ⑪ Unit indication lamp
LEDs used for indicating the units for the ⑦ digital display; the KG side is lit when the display select switch is set at TENSION side, while the % side is lit if it is set at OUTPUT side.
- ⑫ Window for adjustment control
Houses the controls and switches used for initial setting and for adjustment of various functions. For details on these controls and switches, please refer to the next section.
It can be opened by pulling with the grip lightly.

§ 4. Explanation on Adjustment Unit

1. Initial adjustment

Make initial setting as follows without fail before conducting a trial run.



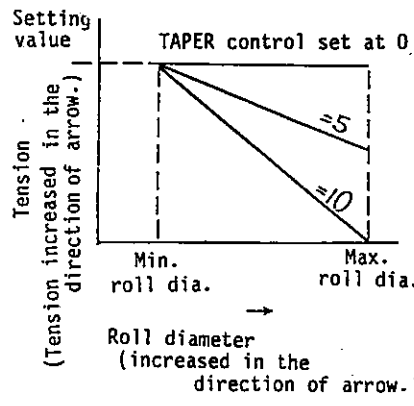
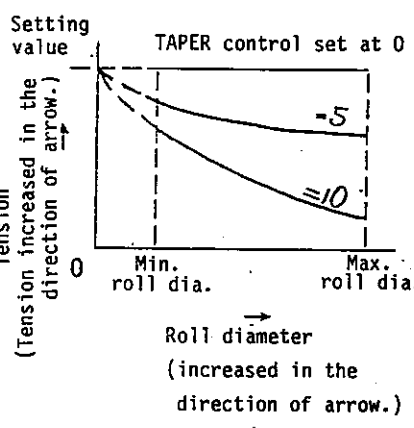
	1	2	3	4	5	6	7	8	9	10
	Tension Full-Scale					Filter	Stall select	Condit ional tension	Start timer	Stop timer
	1000 kg	500 kg	200 kg	X 0.1	X 0.01					
ON	○	○	○	○	○	NOT USED	MANUAL	NOT USED	NOT USED	NOT USED
						USED	STALL	USED	USED	USED

Note: Do not operate the switches 1~5, and 9 and 10 during operation.

	Function	Characteristics	Adjustment made before shipment																																																																	
<p>① DSW1~5 Tension full-scale setting switches</p>	<p>Switches used for setting maximum tension. Scale 10 on AUTO control corresponds to the value set with these switches.</p> <p>Switches DSW1~3 set numerals, and switches DSW4 and 5 set decimal point.</p> <p>(Standard voltage applied across terminals TEN and G is +5 V.)</p>	<table border="1" data-bbox="826 510 1241 779"> <thead> <tr> <th rowspan="2">Full-scale setting FS (KG)</th> <th colspan="5">DSW</th> </tr> <tr> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> </tr> </thead> <tbody> <tr> <td>1000</td> <td>ON</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>500</td> <td></td> <td>ON</td> <td></td> <td></td> <td></td> </tr> <tr> <td>200</td> <td></td> <td></td> <td>ON</td> <td></td> <td></td> </tr> <tr> <td>100.0</td> <td>ON</td> <td></td> <td></td> <td>ON</td> <td></td> </tr> <tr> <td>50.0</td> <td></td> <td>ON</td> <td></td> <td>ON</td> <td></td> </tr> <tr> <td>20.0</td> <td></td> <td></td> <td>ON</td> <td>ON</td> <td></td> </tr> <tr> <td>10.00</td> <td>ON</td> <td></td> <td></td> <td></td> <td>ON</td> </tr> <tr> <td>5.00</td> <td></td> <td>ON</td> <td></td> <td></td> <td>ON</td> </tr> <tr> <td>2.00</td> <td></td> <td></td> <td>ON</td> <td></td> <td>ON</td> </tr> </tbody> </table> <p>Switches other than those shown with ON should be turned OFF.</p> <p>Refrain from using them in other combinations than those shown above.</p>	Full-scale setting FS (KG)	DSW					1	2	3	4	5	1000	ON					500		ON				200			ON			100.0	ON			ON		50.0		ON		ON		20.0			ON	ON		10.00	ON				ON	5.00		ON			ON	2.00			ON		ON	<p>FS- 50.0 kg DSW2 DSW4 ON</p>
Full-scale setting FS (KG)	DSW																																																																			
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<p>① DSW6 Tension indication filter (OFF/ON) select switch</p>	<p>By turning OFF this switch, change in tension readings becomes slower making them easier to read.</p> <p>It is set at ON (using filter) side before shipment to allow easy ZERO and SPAN adjustments.</p>	<p>OFF: Filter use ON: Filter not use</p>	<p>Filter is not used (ON)</p>																																																																	

	Function	Characteristics	Adjustment made before shipment
① DSW7 Stall setting value STALL/ MANUAL select switch	Select either with STALL control ①, or with MANUAL control on the panel for holding torque (stall torque) setting during machine shutdown. Setting is made with % value for output. In the state of stall memory is ON, the memorized value is output.	OFF: Setting with STALL control ON : Setting with MANUAL control	Set at STALL control side (OFF state)
① DSW8 Conditional tension OFF/ON select switch	Sets control characteristics during machine shutdown (in STALL condition).	OFF: Used Automatic control is continued even during shutdown, but upper limit of output is limited with stall setting value or memory value. ON : Not used. During shutdown, it is fixed at the stall setting value or the memory value.	Set at ON

	Function	Characteristics	Adjustment made before shipment
① DSW9 Start timer OFF/ON select switch	The START timer refers to the function which provides a certain time lag in switching from stall state to automatic control at the time of machine start-up. This switch sets whether this START timer function is used or not.	OFF: Used. START timer is set with ST.T control ⑧. ON : Not used. START timer is set at 0 second.	Set at OFF state (STOP timer function is used).
② DSW10 STOP timer OFF/ON select switch	STOP GAIN (SP.G) is available as the function to select gain for inertia compensation during machine shut-down. STOP timer is provided for setting the time to put this function at work. This switch sets whether this STOP timer function is used or not.	OFF: Used. STOP timer is set at the value set with SP.T control ⑨. ON : Not used. STOP timer is set at 0 second.	Set at OFF state (STOP timer function is used).

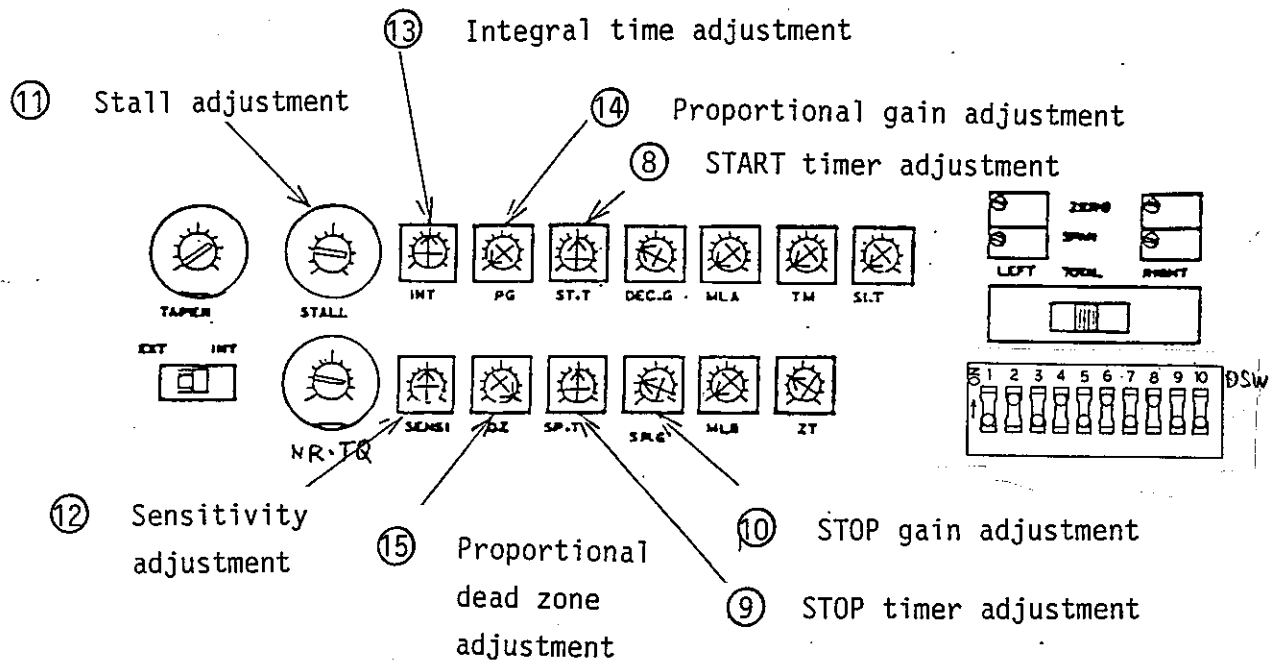
	Function	Characteristics	Adjustment made before shipment
<p>② Taper EXT/INT select switch</p>	<p>Taper tension refers to such a method of control, in which tension applied is reduced gradually as the roll diameter increases in take-up operation. This switch selects between EXT, where signal for roll diameter necessary for this control is given externally, and INT, in which such control signal is obtained hypothetically within the tension control unit.</p>	<p>EXT: External control signal supply system</p>  <p>Roll diameter signals are given in DC voltages between 0 V (representing the minimum roll dia.) and +5 V (representing the maximum roll dia.).</p> <p>INT: Internal control signal supply system</p>  <p>Control characteristics change substantially depending on the characteristics of the load combined, gear ratio, etc.</p>	<p>Set at EXT side.</p>

	Function	Characteristics	Adjustment made before shipment
③ LEFT/TOTAL /RIGHT select switch	While digital display on the panel is indicating TENSION, this switch allows selection of a desired display mode from among the display of reading on the detector on the LEFT side only, that of the detector on the RIGHT side only, and the display of the TOTAL tension reading (e.g. tension readings on the LEFT side detector + that on the RIGHT side detector). This function enables checking for irregular tension applied to the material processed.	LEFT : Indicates tension detected with the detector at LEFT side only. TOTAL: Indicates the TOTAL tension (e.g. the sum of the tension readings on the detectors provided at both sides. RIGHT: Indicates tension detected with the detector at RIGHT side only.	Set at TOTAL position.
④, ⑤ ZERO ad- justment control (ZERO)	Even if actual tension imparted to the material is zero, tension detector is permanently applied with weight of roller and bearing. Zero adjustment is made to cancel signals resulting from such weights applied to the detector. provided for use at the LEFT and the RIGHT sides (in a form of multi-rotation type control).	Adjustable range Adjustable in a range between 0 to +80% of the loads applied to the tension detector.	Zero adjustment has been made by shorting between GHL and WHI , and between GRR and WHR .

	Function	Characteristics	Adjustment made before shipment
<p>⑥, ⑦ Span adjustment control (SPAN)</p>	<p>Even if the tension applied to the material is the same, magnitude of the load applied to the tension detector vary according to the mounting position of the tension detector and roller arrangement. Span adjustment is made to correct such deviation, so that the actual tension applied to the material agrees with the value indicated on the panel display. The SPAN adjustment control (of multi-rotation type) is provided for LEFT and RIGHT sides.</p>	<p>Adjustable range Rated to be adjustable between 10% to 100% of the tension Full-Scale in terms of the load applied to the tension detector.</p>	<p>Set at MIN position.</p>

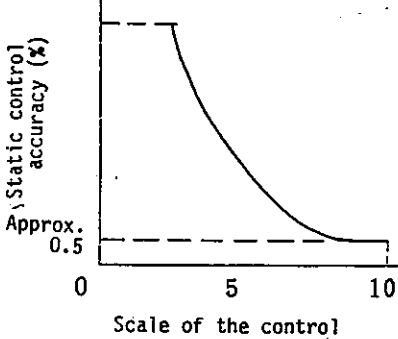
2. Basic Adjustments

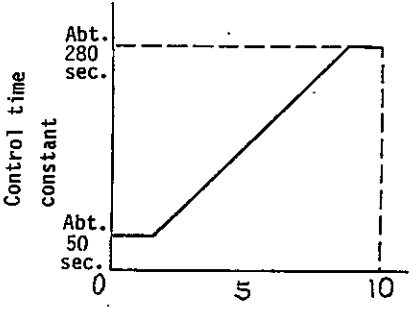
Basic adjustments for the following controls and timers have already been made by the maker before shipment. If in case of any nonconformance found upon the test run, make readjustment according to the explanations give below.

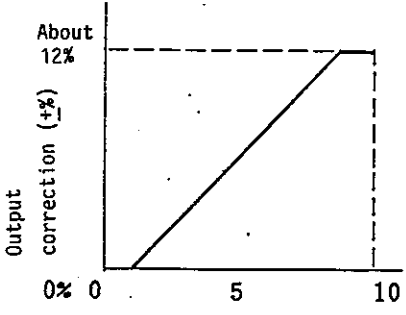
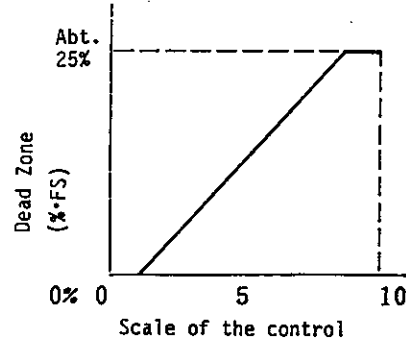


	Function	Characteristics	Adjustment made before shipment
⑧ START timer ad- justment control (ST.T)	When starting up the machine, automatic control is started from the time set with this control, after START signal (MC1) is turned ON.	<p>Abt. 12 sec.</p> <p>Abt. 1 sec.</p> <p>0 5 10</p> <p>Scale on the control</p>	Set at abt. 6 seconds (at graduation 5).

	Function	Characteristics	Adjustment made before shipment
<p>⑨ STOP timer adjustment control (SP.T)</p>	<p>Sets the time whereat STOP gain function is effected in slow-down (deceleration) before stopping the machine. Automatic control is continued during the period, even after the STOP signal (MC1) is turned OFF.</p>		<p>Set at abt. 6 seconds (at graduation 5).</p>
<p>⑩ STOP gain adjustment control (SP.G)</p>	<p>Sets gain in the STOP timer. At the moment when STOP signal (MC1) is turned OFF, switched over to the multiple ratio (in percent) to the value then being output. Since it is designed to be OUTPUT MAX. at 140%, any outputs beyond this limit are saturated at 140%. (for both AUTO and MANUAL modes)</p>		<p>Set at 100% (around graduation 2.5)</p>
<p>⑪ STALL output adjustment control (STALL)</p>	<p>Sets STALL output value in case of resetting the STALL memory. (This can take effect only when DSW7 ① is in OFF state. If DSW7 is in ON state, the MANUAL control is used in place of this control.</p>		<p>Set at abt. 15% (at graduation 2)</p>

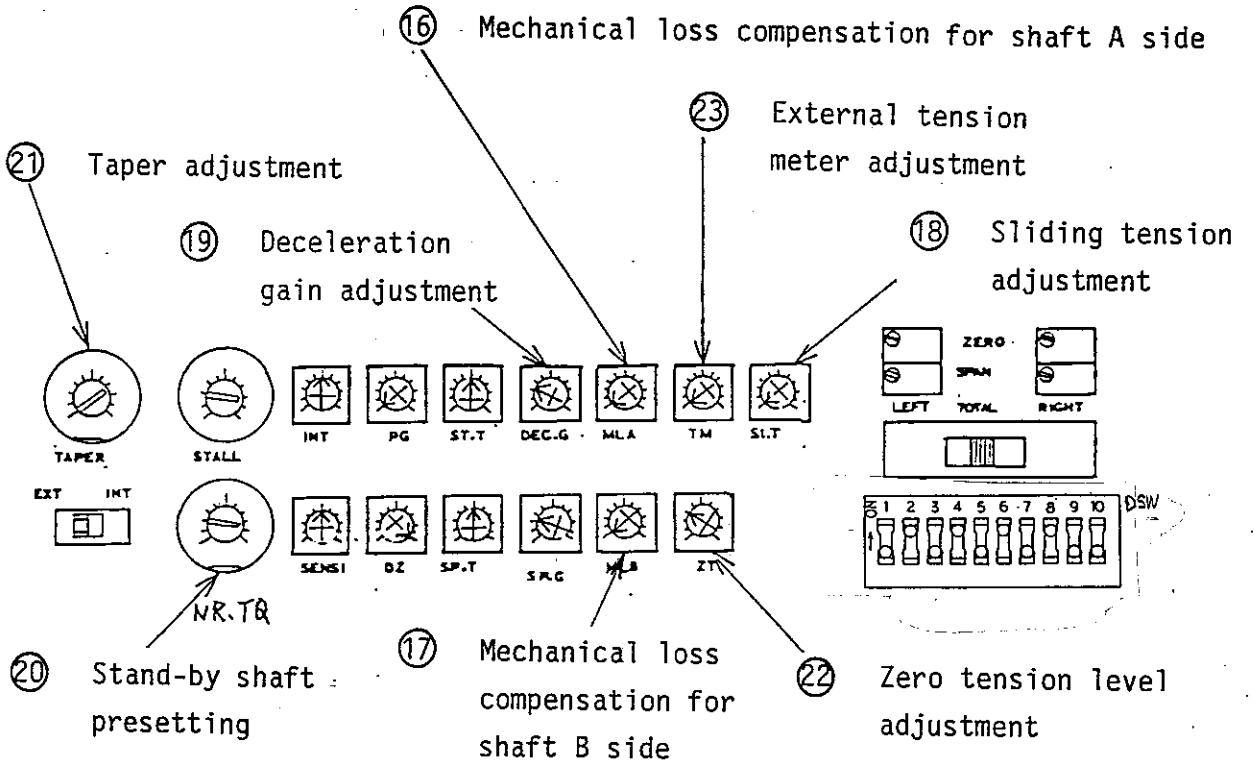
	Function	Characteristics	Adjustment made before shipment
<p>⑫</p> <p>Sensitivity adjustment control (SENSI)</p>	<p>Control used for setting accuracy of the tension control performance; Turn the control clockwise, and the sensitivity is enhanced to give better control accuracy, but becomes more likely to cause hunting effect. Also, the optimum position may vary depending on the setting position of the integral time constant set with ⑬. Therefore, it is necessary to determine the optimum position upon a test run using the actual machine.</p>		<p>Set at around 1% (at graduation 5).</p>

	Function	Characteristics	Adjustment made before shipment
<p>⑬</p> <p>Integral time adjustment control (INT)</p>	<p>Control used for adjusting response performance of tension control; response time become slow by turning the control clockwise. By turning it counter-clockwise, response time becomes quicker, but becomes more likely to cause hunting. Since the optimum position may vary depending on the position of the sensitivity adjustment control ⑫, it is necessary to determine the optimum position upon conducting a test run using the actual machine.</p>		<p>Set at abt. 170 seconds (at graduation 5).</p>

	Function	Characteristics	Adjustment made before shipment
<p>⑭</p> <p>Proportional gain adjustment control (PG)</p>	<p>Control used for setting the proportional control gain, to allow instantaneous reaction to error in the tension measurement. The graph shown on the right is the characteristics of the output correction in case of tension measurement error of 10%/FS. Use the control normally set at zero gain position to prevent hunting that may otherwise be likely to occur.</p>	 <p>The graph plots Output correction (%) on the y-axis against the Scale of the control on the x-axis. The x-axis has markings at 0, 5, and 10. The y-axis has a marking at 'About 12%'. The curve starts at the origin (0,0), rises linearly to a point at approximately x=9 and y=12, and then remains constant at 12% for the remainder of the scale up to x=10.</p>	<p>Set at 0% (at graduation 0).</p>
<p>⑮</p> <p>Proportional dead zone control (DZ)</p>	<p>The control used for providing dead zone for the above-mentioned proportional gain. Any proportional gains for tension errors less than the values set with this control will become ineffective. Use the control normally set at graduation 10.</p>	 <p>The graph plots Dead Zone (%FS) on the y-axis against the Scale of the control on the x-axis. The x-axis has markings at 0, 5, and 10. The y-axis has a marking at 'Abt. 25%'. The curve starts at the origin (0,0), rises linearly to a point at approximately x=9 and y=25, and then remains constant at 25% for the remainder of the scale up to x=10.</p>	<p>Set at around 25% (at graduation 10).</p>

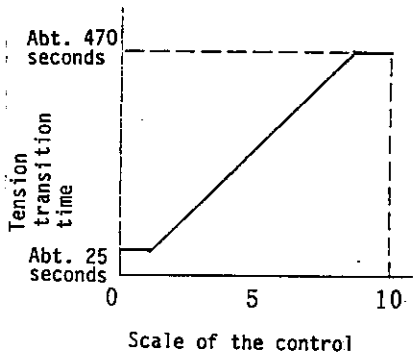
3. Adjustment for expansion

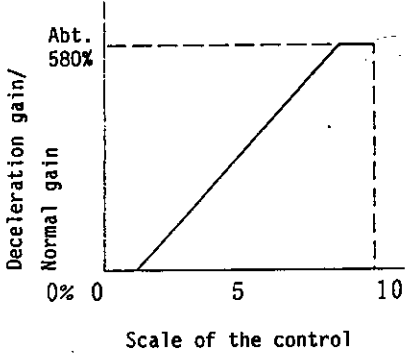
Adjust properly according to the intended purpose, referring to the figure and explanations given below.

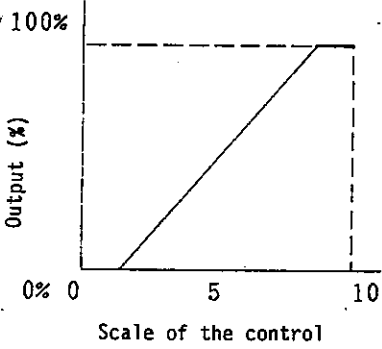


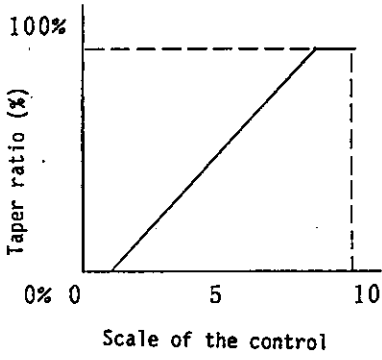
	Function	Characteristics	Adjustment made before shipment
<p>①6</p> <p>Mechanical loss compensation control for shaft A side (MLA)</p>	<p>This is for cancelling the mechanical loss at the shaft A side at the time of taking up with two shafts, and is to be set at the position where the take-up shaft at the shaft A side is about to rotate, in the condition of feeding no material.</p> <p>It is to be set at graduation 0 if used for let-off.</p> <p>It is also to be set at zero graduation in taking up with a single shaft.</p>		<p>Set at 0% (at graduation 0).</p>
<p>①7</p> <p>Mechanical loss compensation control for shaft B side (MLB)</p>	<p>Mechanical loss compensation control for the shaft B side serving for the same function as described above.</p>	<p>Same as above.</p>	<p>Set at 0% (at graduation 0).</p>

Note: Setting with these mechanical loss compensation controls is added to the MANUAL setting value or to the AUTO control value, so the resultant output value indicated may sometimes exceed 100%.

	Function	Characteristics	Adjustment made before shipment
<p>⑱</p> <p>Sliding tension adjustment control (SLT)</p>	<p>This is the function provided to ensure smooth transition of tension at the time of changing over from MANUAL control to AUTO control. The characteristics as shown on the right will result when error in tension between MANUAL and AUTO controls 100%/FS. The transition time is shortened if difference in tension is small. Please note that this function is effective only when the tension value employed in MANUAL control is greater than the tension value set with the AUTO control.</p>	 <p>The graph plots 'Tension transition time' on the vertical axis against 'Scale of the control' on the horizontal axis. The vertical axis has two marked points: 'Abt. 25 seconds' at the origin and 'Abt. 470 seconds' at the top. The horizontal axis has three marked points: 0, 5, and 10. The curve begins at (0, 25), increases linearly to reach (10, 470), and then continues as a horizontal line at the 470-second level.</p>	<p>Set at abt. 25 seconds (at graduation 0).</p>

	Function	Characteristics	Adjustment made before shipment
<p>①9 Deceleration gain adjustment control (DEC. G)</p>	<p>This is to set gain when between terminals MC0 and MC3 is ON. Changed over to the preset multiples (%) with respect to the output value at the moment when deceleration signal supply terminal (MC3) is turned ON. This function can also be used as the acceleration gain control. Because of the OUTPUT MAX=140%, however, outputs beyond the limit will result in saturation at 140%.</p>	 <p>The graph plots the ratio of deceleration gain to normal gain against the control scale. The y-axis is labeled 'Deceleration gain/Normal gain' and has a tick mark at 'Abt. 580%'. The x-axis is labeled 'Scale of the control' and has tick marks at '0% 0', '5', and '10'. The curve starts at the origin (0,0), rises linearly to a point corresponding to a scale of 10 and a gain of approximately 580%, and then remains constant at that level for higher scale values.</p>	<p>Set at 100% (at around graduation 2.5).</p>

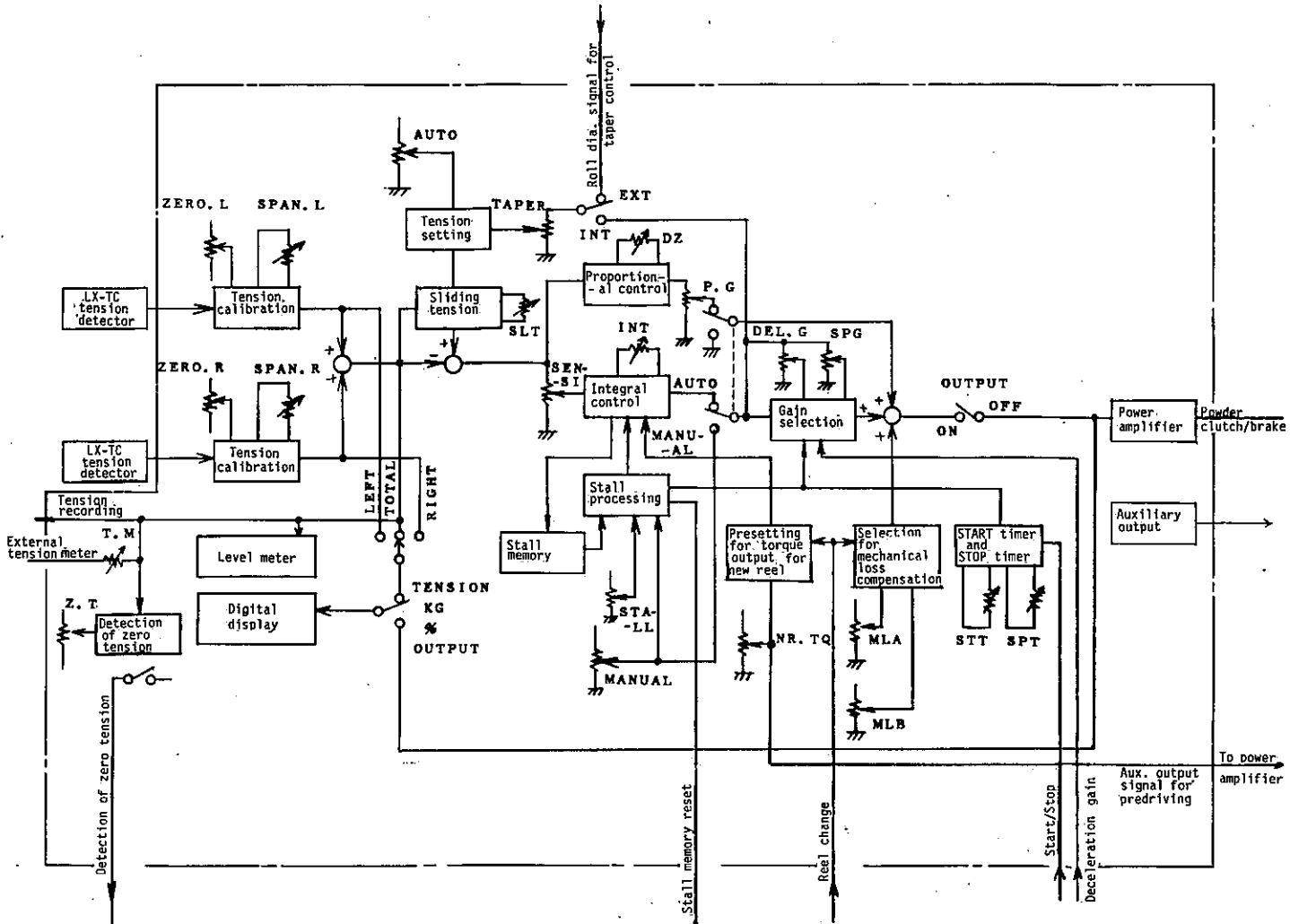
	Function	Characteristics	Adjustment made before shipment
<p>②0 New reel torque pre-setting control (NR•TQ)</p>	<p>Sets appropriate initial output value that matches the new reel diameter at the time of reel change. This setting value is output at the time of the change-over of the reel change signal (supplied through making or braking of the contacts between MCO and MC2), either in switching from ON to OFF or from OFF to ON. It is to be set approximately at the new reel diameter x the target value of the desired tension, being used as a guideline. Signal equivalent to the setting value of this control is output at all times across terminals SB and SN. Therefore, by connecting a power amplifier between terminals SB and SN, an appropriate predriving torque matching the preset value for the new reel can be obtained.</p>		<p>Set around 15% (at graduation 2).</p>

	Function	Characteristics	Adjustment made before shipment
<p>②1 Taper adjustment control (TAPER)</p>	<p>Sets taper ratio in taper tension control. (Refer to Item ② on Taper select switch). Shown on the right is the characteristics obtained when a 5 V roll diameter signal is fed across terminals TAP and G. (When taper tension control is made on EXT mode.) In the case of taper tension control on INT mode, the maximum taper ratio varies depending on such factors as the rated torque of the powder clutch/brake used in combination, winding ratio, gear ratio, etc.</p> <p>Taper ratio = $1 - \frac{\text{Tension applied at max. roll dia.}}{\text{Tension applied at min. roll dia.}} \times 100 (\%)$</p> <p>It should be fixed at graduation 0 at the time of a constant tension control.</p>		<p>Set at 0% (at graduation 0, for constant tension control)</p>

	Function	Characteristics	Adjustment made before shipment
<p>②②</p> <p>Zero tension level adjustment control (ZT)</p>	<p>Sets the working point for the zero tension detection function.</p> <p>About +3% of hysteresis is involved in the direction of ON→OFF, with respect to that in OFF → ON.</p>		<p>Set at abt. 6%•FS (at graduation 3).</p>
<p>②③</p> <p>External tension meter adjustment control (TM)</p>	<p>The control used for adjusting deflection in the externally provided tension meter between terminals TM and G.</p> <p>Adjust in such a manner that the total tension reading given on the panel of the tension controller becomes equal to the reading on the externally provided tension meter.</p>	<p>Deflection becomes greater by turning the control clockwise, and it becomes smaller by turning it counterclockwise.</p> <p>Internal resistance 200 Ω/1 mA is standard.</p>	<p>Set at MIN position (at graduation 0).</p>

§ 5. Explanation on Operation

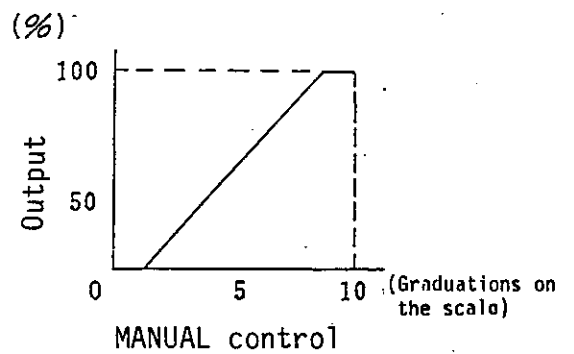
Shown below is the block diagram of the Tension Controller.



Tension of the material is detected with the fine displacement measuring tension detectors (LX-TC series), and the excitation current for the powder clutch/brake is adjusted automatically, so that the tension actually applied to the material becomes equal to the setting value.

(1) MANUAL operation

Operation is switched over to the MANUAL mode by setting the AUTO/MANUAL select switch to the MANUAL side. Thereupon, it is separated completely from the automatic control, and output matching the value preset with the MANUAL control is supplied.



(2) Automatic control operation

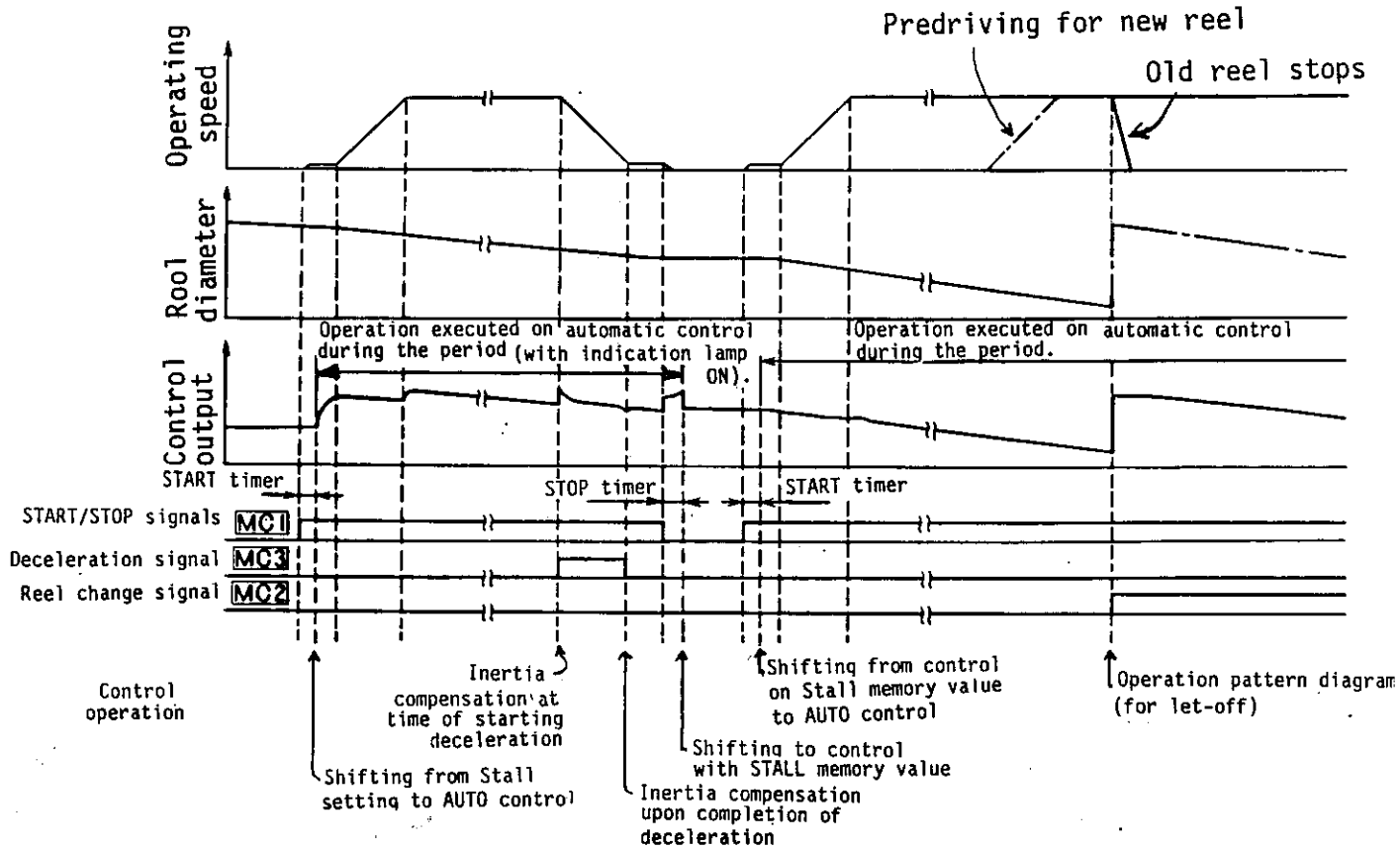
The machine is set at the automatic control operation mode by setting the AUTO/MANUAL select switch at AUTO side.

Operation pattern diagrams are shown on page 43 for both let-off and take-up.

Adjust each of the controls used for adjustments upon conducting a test run, referring to these operation pattern diagrams.

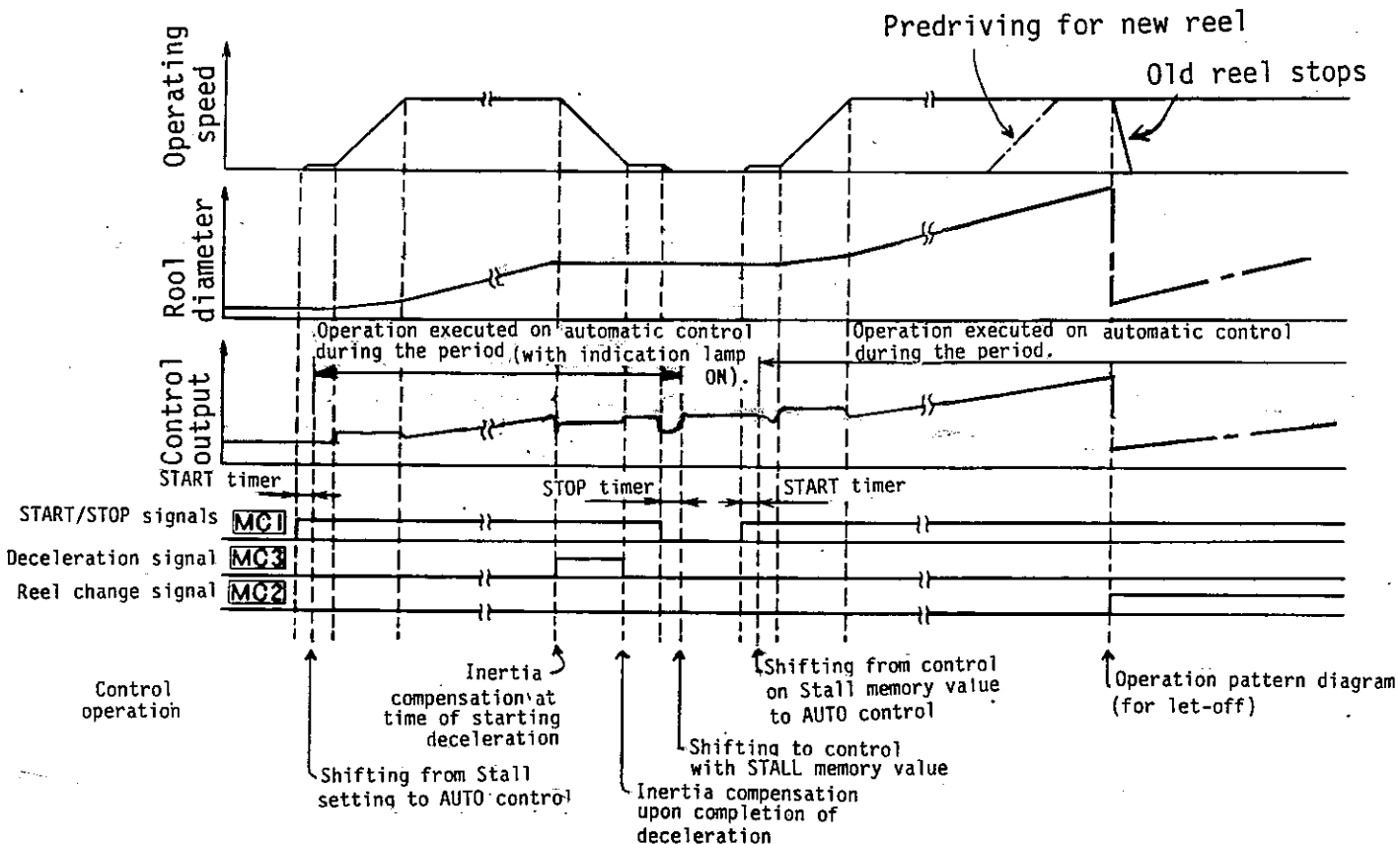
Operation pattern diagram. (for let-off)

Let-off operation (With Stall memory function provided, but conditional tension function not provided)



Operation pattern diagram (for take-up)

Take-up operation (With Stall memory function provided, but conditional tension function not provided)



§ 6. Initial Adjustments

(1) Preparative work

- ① Before turning ON the power switch, check again to see if all the wiring has been arranged correctly. Be sure not to conduct megger test and proof-pressure test. ... Refer to Section 9-3.
- ② Check to see that the powder clutch/brake and the tension detectors used are of the right types and ratings.
 - ° Current rating for the powder clutch/brake used shall be 3.8 A max. at DC 24 V. No further adjustment is required even in case of a change in the load used in combination. Check the rating on the nameplate stuck to the powder clutch/brake, or in the catalog.
 - ° Allowable load on the tension detector
Check in the catalog.
 - ° Correct mounting condition, etc.
Check in the catalog.
- ③ Opening the adjustment controls window, set each of the following switches correctly as shown below.
 - (a) Tension Full-scale setting switch DSW1~5 .. } Set as required without fail.
 - (b) Tension indication filter DSW6
 - (c) STALL setting select switch DSW7
 - (d) Conditional tension setting switch DSW8
 - (e) START timer select switch DSW9
 - (f) STOP timer select switch DSW10
 - (g) Taper EXT/INT select switch } Refer to items ① and ② in Chapter 4 Explanations on Adjustment Unit.
- ④ When all of the switches mentioned above have been set correctly, turn ON the power switch. The STOP gain function is at work at the moment of switching ON, and it is restored to the normal output after the STOP timer has counted up.

(2) Calibration of tension reading

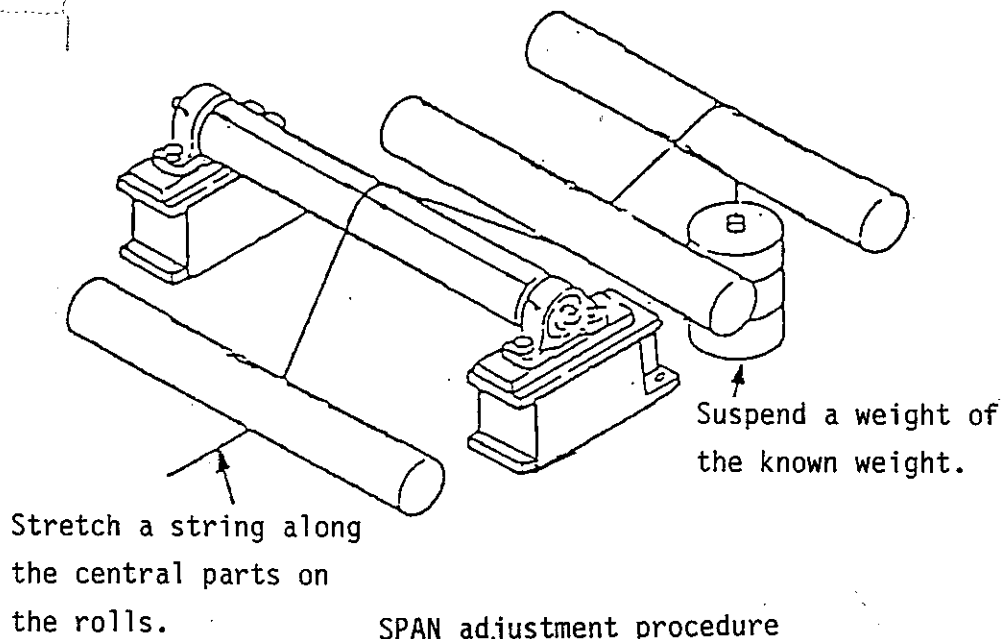
- ① First, change over the digital TENSION/OUTPUT select switch in the operation control unit to TENSION side. Also, set the tension indication filter switch DSW6 at ON side (provided with the filter function).

ZERO adjustment

- ② After confirming that no material or other stuff is applied to the tension detection roll, set the LEFT/TOTAL/RIGHT select switch in the adjustment unit to the LEFT position. Thereafter, turning the ZERO adjustment control on the left side and adjust so that the digital display indicates zero.

The control, which is of a multi-rotation type, may rotate 10 and odd number of turns in some cases.

- ③ In the same manner, set the LEFT/TOTAL/RIGHT select switch to RIGHT position, and adjust by turning the ZERO adjustment control on the right side.



SPAN adjustment

- ④ As illustrated in the above figure, let a string go passing along the material pass line, so that the string is routed along the central portion on each roll, and suspend a weight weighing less than the full scale of the tension meter. (If such a weight is unavailable, use an appropriate spring balance in its place.)
- ⑤ Set the LEFT/TOTAL/RIGHT select switch at RIGHT position, and adjust by turning the SPAN adjustment control on the right side, so that the digital indicator indicates $W/2$ kg. The SPAN control is of a multi-rotation type.

- ⑥ Set the LEFT/TOTAL/RIGHT select switch to the LEFT position in the same manner, and adjust by turning the SPAN adjustment control on the left side, so that the digital indicator indicates W/2 kg.
- ⑦ Set the LEFT/TOTAL/RIGHT select switch at TOTAL position, and check to see that the digital indicator indicates Wkg.
- ⑧ Remove the string and the weight, and check to see that the TOTAL reading becomes zero. If the zero position displaces, make ZERO adjustment again for both the left and the right sides starting with the step ②.
- ⑨ Return the LEFT/TOTAL/RIGHT select switch to the TOTAL position.
- ⑩ Return the tension indication filter switch DSW6 to the OFF side (with the filter function provided).

(3) Check of adjustment controls

Each of the adjustment controls in the adjustment unit have roughly been adjusted before shipment. For details on proper setting (Adjustment) of these controls, please refer to the right hand side column in Chapter 4.

- ① Mechanical loss compensation To be adjusted only when two shafts (two reels) are used for take-up.

Changing over to MANUAL mode, set the MANUAL control at zero, and while the input side of the powder clutch being rotated without feeding material, adjust to the value slightly lower than the value, whereat the take-up shaft is about starting turning.

(Control MLA is selected when reel change signal supply terminal MC2 is turned OFF, while control MLB is selected when it is turned ON.)

§ 7. Test Run

Before entering normal operation, a test run should be conducted to check if each of the settings for the Tension Controller is correctly done, and also to break in the powder clutch/brake.

(1) Preparative work

- ① After the material has been properly routed along the rolls, set the OUTPUT ON/OFF switch to ON side.
- ② Set the TENSION/OUTPUT select switch for the digital display to TENSION side.
- ③ Set the AUTO/MANUAL select switch to MANUAL side, and set the MANUAL control at around graduation 2.
- ④ Where an independent motor is provided for take-up operation, switch ON the take-up motor as well.

(2) Starting test run Proceed referring to the operation pattern diagram.

- ① Switch ON the main (line) motor. (By shorting between terminals MCO and MC1).
- ② After running on the MANUAL mode for a while, align the actual tension obtained in operation with the tension setting set with the AUTO control, and then change over to AUTO mode operation. Confirm that the automatic control indication lamp is lit up.
- ③ Subsequently, adjust with the INT control and SENSI control following the instructions given below.

While the machine is being run under the normal operating condition, lower the setting with the INT control to the extent where no hunting occurs. If hunting occur, raise the control little by little and set to the proper position where no hunting occurs (a little higher).

If there is a problem in response performance after the above adjustment (in case of a change in the tension setting, for example), lower the setting with the SENSI control and make adjustment with the INT control once again. It should be noted, however, the lower limit for adjustment with the SENSI control is about two graduations on the scale.

- ④ When stabilized, stop the main motor in the AUTO control mode. (By

breaking between terminals **MC0** and **MC1** .)

At this time, check to see if the deceleration gain and STOP gain, and the STOP timer are working normally.

⑤ Then, restart the main motor.

At this time, check to see if the START timer and STALL function are working normally.

⑥ Thereafter, change the shaft (reel) and check to see if the new reel preset/predriving is functioning normally.

⑦ Lastly, check for normal taper adjustment function, to complete the test run.

⑧ Depending on the intended purpose of application, make necessary adjustment for zero tension level and for the externally provided tension meter.

* Amount of mechanical loss will become lower when parts of the machine have been broken in adequately. Make mechanical loss compensation adjustment once again.

§ 8. Specifications

1. General Specifications

(1) Supply voltage

AC200/200/220V +10%, 50/60/60Hz (R , T)

(2) Environmental requirements

- Ambient temperature -10° ~ 40°C
- Ambient humidity 80% or less
- Vibration 0.5 G max.
- Atmosphere There shall be no corrosive gases or dust in the surrounding atmosphere, and there shall be no exposure to rain or splashes of water.

(3) Dimensions 200(L) x 270(W) x 200(D) mm

(4) Weight 11 kg

2. Output rating

(1) Control output

DC24V, 3.8A max., constant-voltage control (P , N)

(2) Fixed output

DC10V, 1.9A max., 10-second rating (S1 , S2)

(3) Zero tension contact output

AC250V, 0.5A, or DC30V, 0.5A (with inductive load) (ZT , ZT)

(4) Signal output

◦ Tension

DC5V, Full Scale (TEN , G)

◦ Control output

DC5V/100% load resistance 1 kΩ or more (SA , SN)

◦ Auxiliary output

DC5V/100% load resistance 2 kΩ or more (SB , SN)

3. Input rating

(1) Contact input No-voltage contact, DC12V, 2mA rating

◦ START/STOP signal (MC1 , MCO)

◦ STALL memory reset signal (MC4 , MCO)

◦ Reel change (shaft changeover) signal (MC2 , MCO)

◦ Deceleration signal (MC3 , MCO)

- (2) Signal input
 - Taper control external roll dia. signal
DC5V/max. roll dia. (TAP , G)
 - Tension control external voltage setting
DC5V/Full Scale
input resistance 100 kΩ or more (TS3 , G)

4. Performance

- (1) Control method
Tension detection type closed loop, P·I control
- (2) Tension control accuracy
Static control accuracy ±3%
- (3) Tension control range
6 ~ 100% of Full-Scale
- (4) Display function
 - Digital display (with 4 columns)
Tension (kg) 1,000 , 500 , 200
100.0 , 50.0 , 20.0
10.00, 5.00, 2.00
Output (%) 100%
 - Total tension level meter (divided into 12 sections)
 - Indication lamp in units of kg. & %, automatic control, output ON
- (5) Setting function (provided on panel)
 - Switches Power, AUTO/MANUAL, Display selection, Output ON/OFF
 - Controls Tension setting (AUTO)
MANUAL control
- (6) Setting function (in adjustment unit)
 - Switches Tension Full/Scale,
Tension indication filter OFF/ON,
STALL setting selection,
Conditional tension OFF/ON,
START/STOP timer variable/zero second,
Taper tension control EXT/INT,
Tension indication LEFT/TOTAL/RIGHT

- ° Controls ZERO adjustment (Left and right)
SPAN adjustment (Left and right)
STALL, Taper, New Reel torsion preset,
START and STOP timers,
STOP gain, Sensitivity, Integral time,
Proportional gain, proportional dead zone,
Mechanical loss compensation (A.B.),
Sliding tension control,
Deceleration gain, zero tension level,
Externally provided tension meter

(7) STALL memory Capacitor memory system, variation $\pm 10\%$ of output per hour (equivalent to ± 2.4 V) max.

5. Others

(1) Mounting method

Wall-mounting or floor-mounting

(2) Equipment can be used in combination

- ° Fine displacement measurement tension detector (LX-TC series)

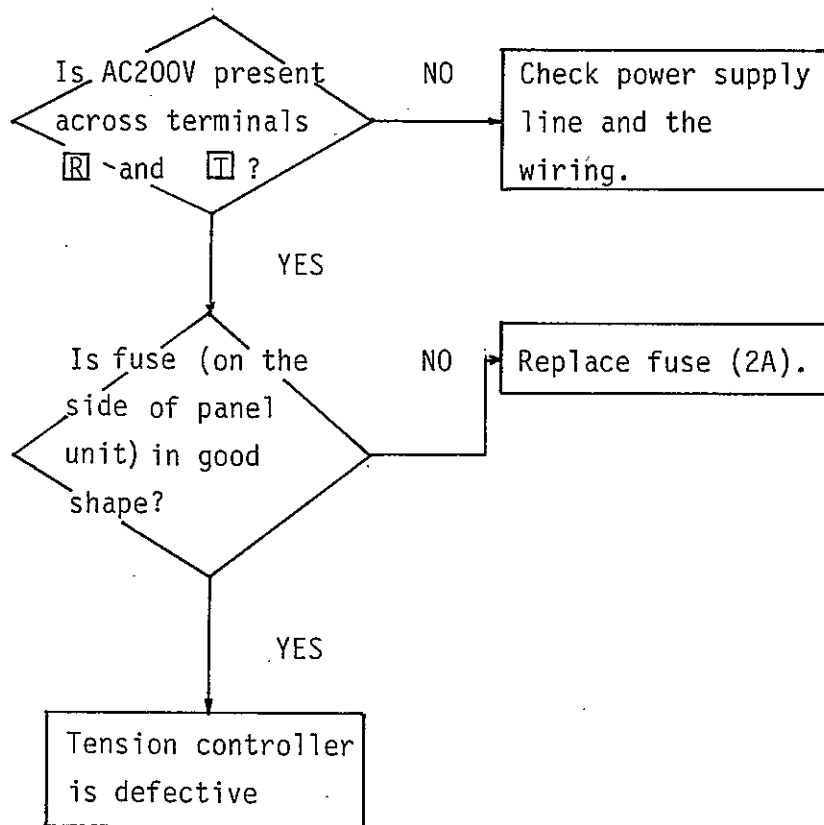
- ° Powder clutch/brake (DC24V, 3.8A rating max.)

§ 9. Troubleshooting and Maintenance

1. In this chapter, explanation is given on the procedures for troubleshooting in case of a trouble, taken to determine whether it is attributable to a failure occurred in the Tension Controller or not.

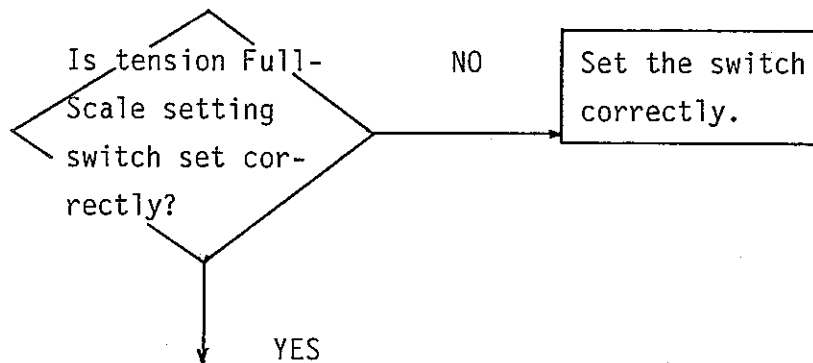
If you have any question or doubt in this regard, please inquire our service center (service station) in your area.

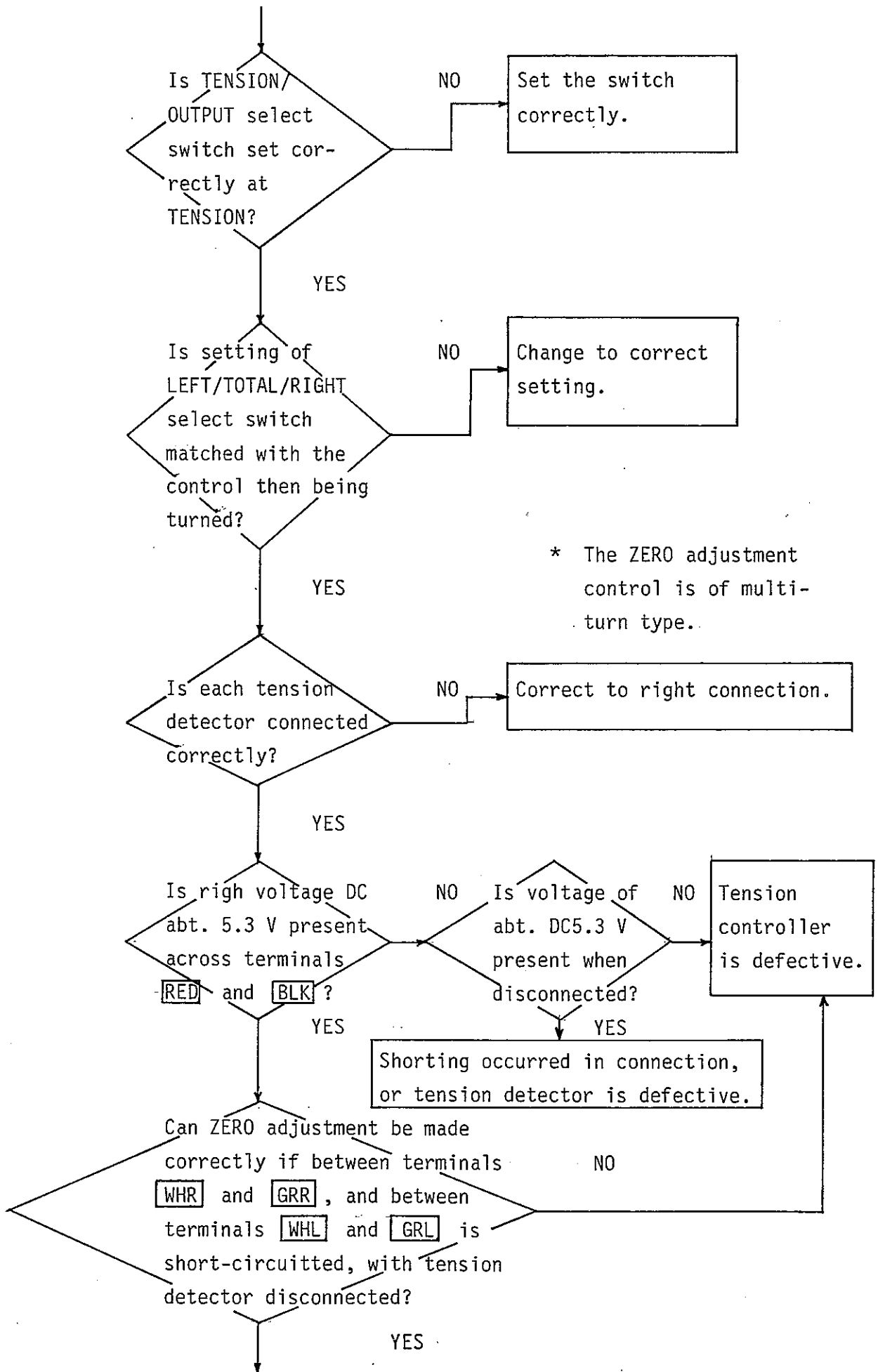
- (1) Digital display fails to light even after the power switch is turned ON.

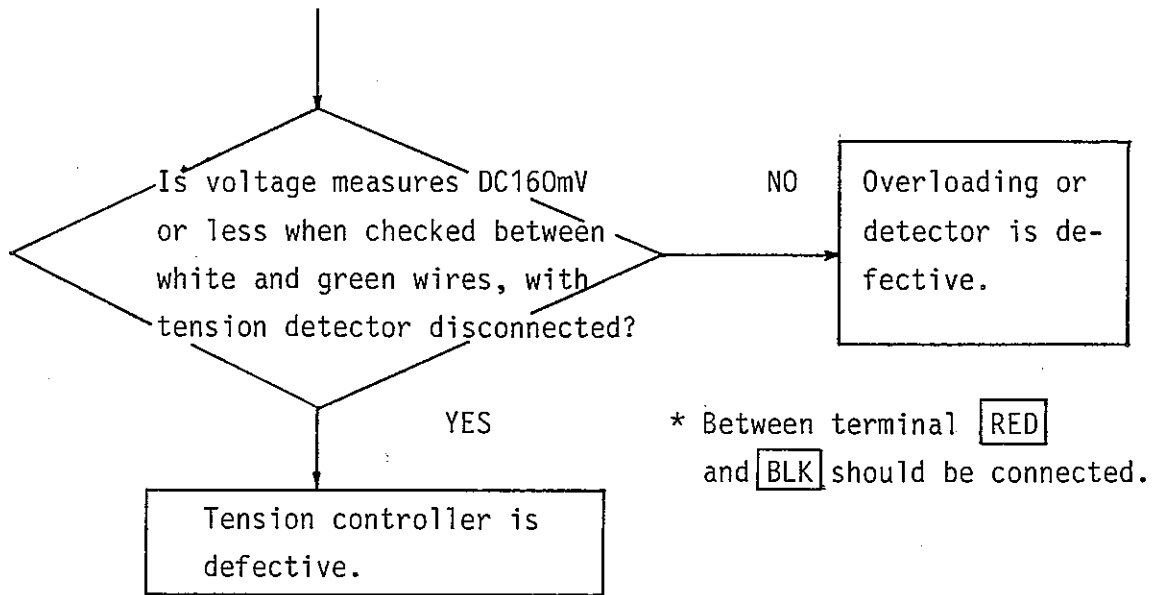


* Refer to Section 9.2.

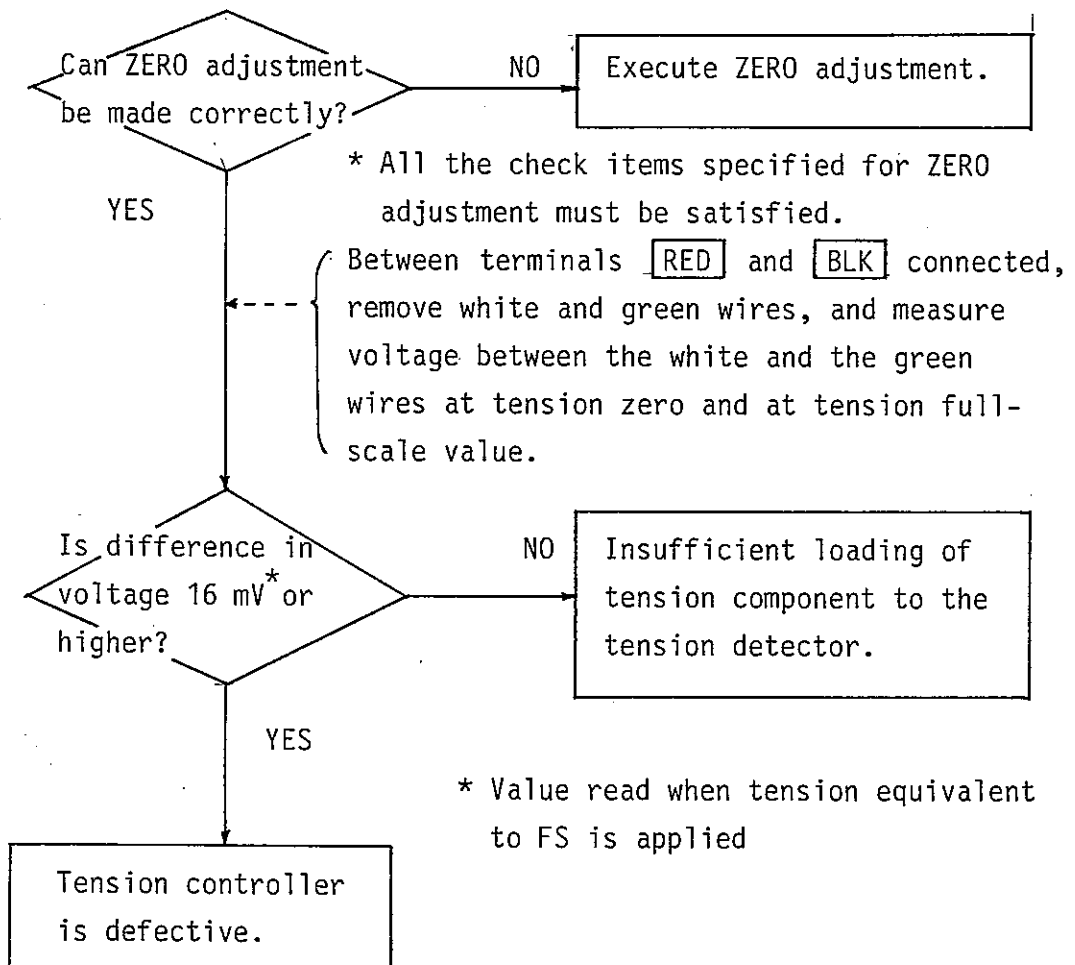
- (2) Cannot make ZERO adjustment for tension readings.



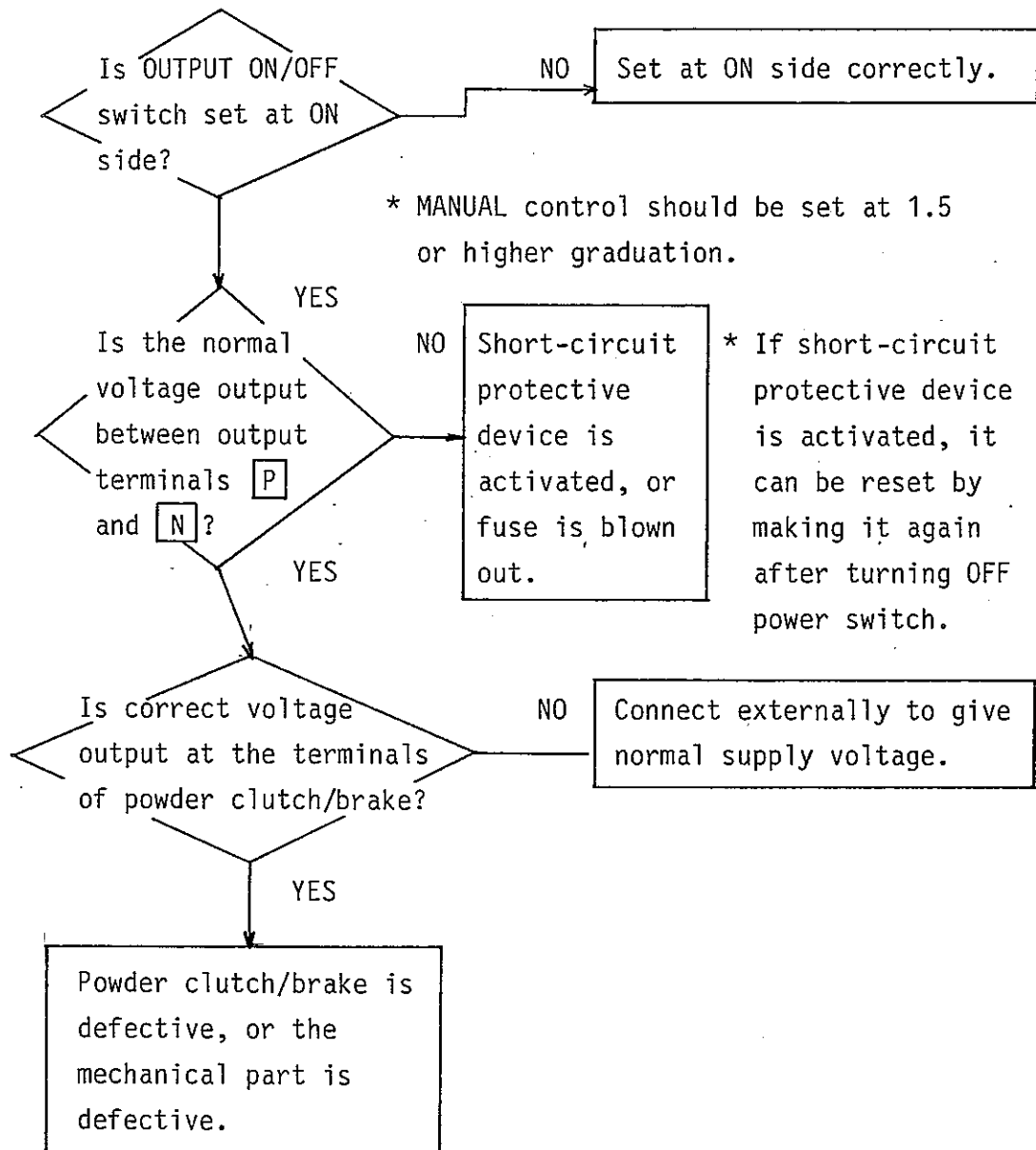




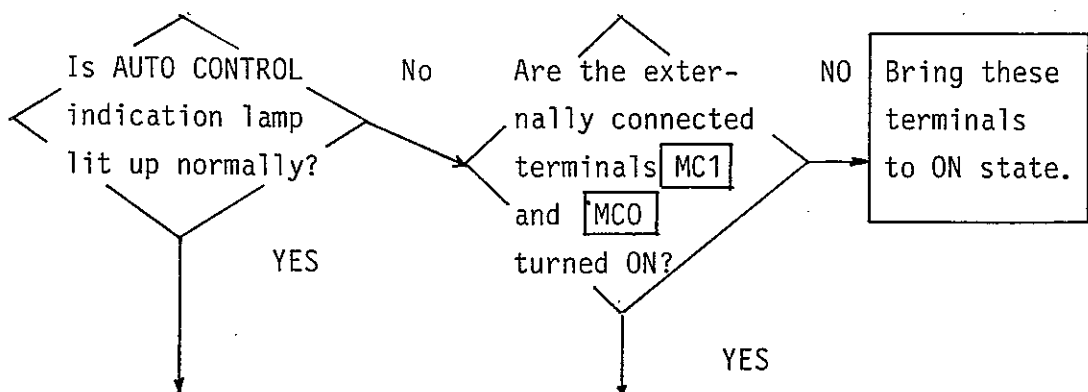
(3) SPAN adjustment cannot be made for tension readings.

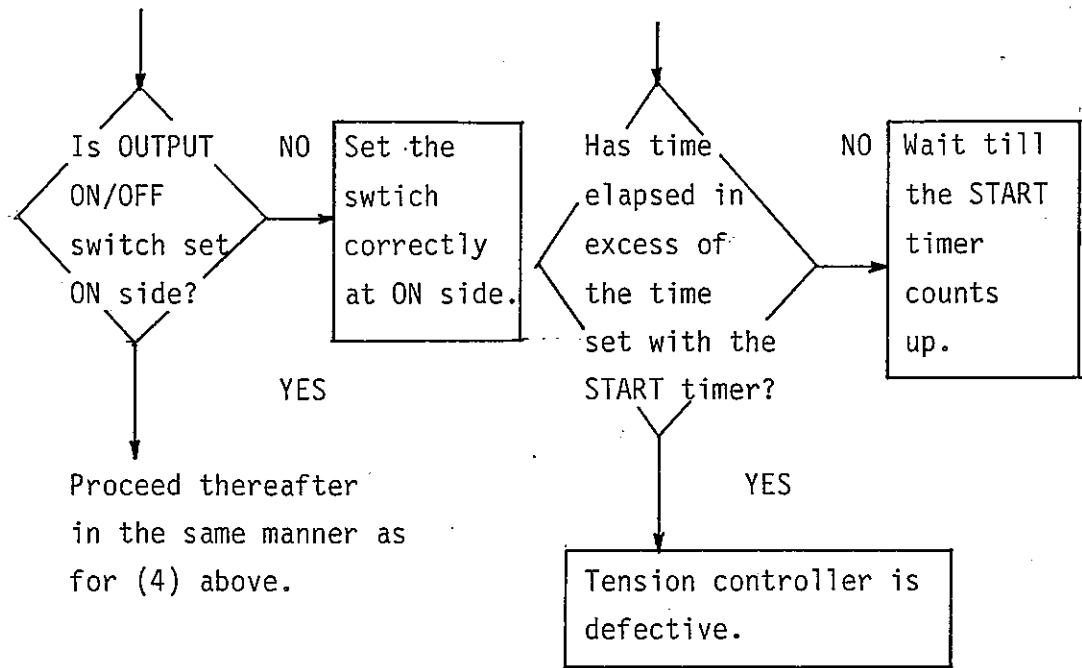


- (4) No required torque can be obtained, while operating on manual mode.

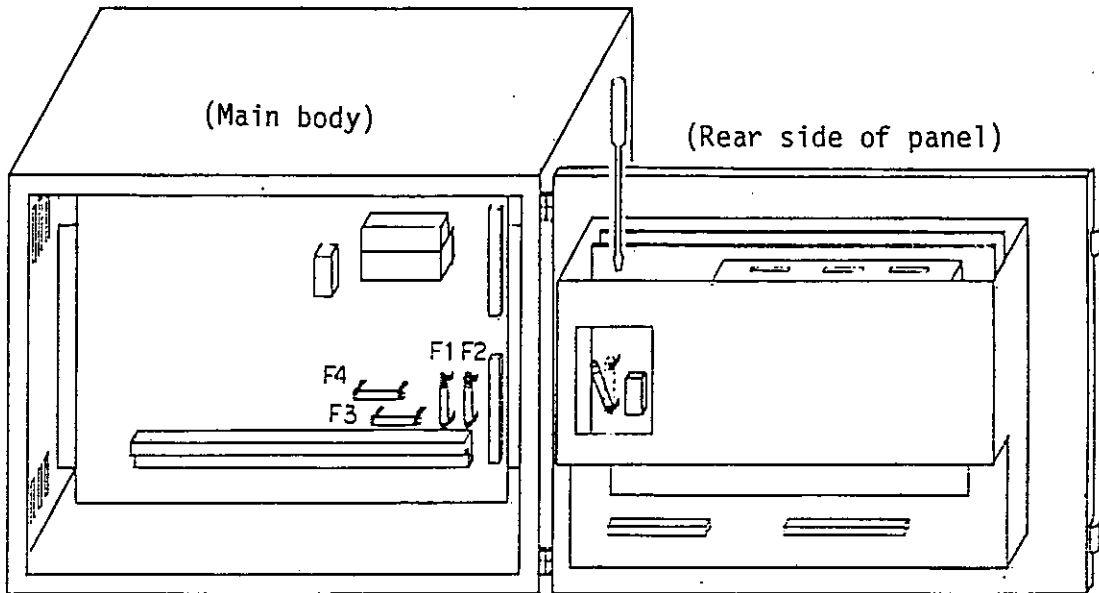


- (5) There is substantial difference between the values set with AUTO control and actual tension applied during operation.





2. Fuse Replacement



Turn OFF the AC200V power supply.

By opening the panel door, control power supply fuse and zero tension detection relay are exposed on the left hand side, when viewed from the rear side of the panel.

To replace burnt-out fuse, raise it with a small screwdriver and remove it, and replace with a new fuse inserted through the access window.

If the relay has become defective, request Service Center of Mitsubishi Electric Corporation in your area.

Also, fuses for the power supply and for output are provided on the right hand side of the main body.

These fuses are specified as follows. Be careful not to use fuse of wrong rating when replacing it.

Fuse in the panel 2A rating ... For control power supply

Fuses provided in main body	F1, 3A rating	} ... For power supply
	F2, 3A rating	
	F3, 5A rating	... For P - N output
	F4, 2A rating	... For S1 - S2 outputs

3. Insulation resistance test and breakdown voltage test

- (1) When measuring insulation resistance or breakdown voltage on the control panel, disconnect wiring for the Tension Controller and for the tension detectors before testing, so as to protect the Tension Controller and/or the tension detector from damage due to possible erroneous wiring or misoperation. Use test of low-voltage application specified for DC6V max. for simplified measurement of insulation resistance of the Tension Controller or the tension detector.

(2) When measuring formally insulation resistance or breakdown voltage of the Tension Controller, observe the following test conditions, measuring between the terminals en bloc and the case. Refrain from taking measurement on the tension detector.

° Insulation resistance:

5 M Ω or more when measured with a DC500V megger.

° Breakdown voltage:

AC1,500V, applied for one minute.