

INSTRUCTION MANUAL
FOR
SPEED RELAY

TYPE
ESR— Series

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※The operator should read this Instruction Manual carefully and handle the device correctly.

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General Precautions

- **Connect correctly the power supply cable according to the Instruction Manual.
Incorrect connection or wiring may cause electric shock.**
- **Do not touch the speed detecting roller while rotating.
Doing so may cause injuries.**
- **Matsushima is not responsible for any modification of the product made by the user since that will void our guarantee.**
- **The term of guarantee for the product is limited to one year after the date of delivery.**
- **The price of the product does not include the cost for on-site technical support and service.**

- **In this manual, the explanations are given on the base of the Speed Relay basic type ESRC-100.**

Refer to Fig. 1 for the basic components of ESRC-100.

The type codes other than ESRC indicate that components other than the basic components are attached on the Speed Relay. (Flange-Type:ESRK Base-Type:ESRB)

For each type of ESRK and ESRB internal structure, refer to Fig. 1(Structure of ESRC-100 type).

- **The type codes or numbers ended with L at the end indicate the Speed Relays for low-speed detection.**

Refer to Fig. 2 for the structure of Speed Relays for low-speed detection.

- **The type codes ended with N indicate the Speed Relay with special specifications.**

Special spec : (1) Accessories such as coupling

(2) Materials and microswitch types (DC type, moisture-proof type, etc.)

The details of special specifications are mentioned on the delivery drawing or final drawing.

- **Some drawings used in this manual may not apply to the Speed Relay with special specifications.**

1. Outline

The Speed Relay is designed as a safety device for loading/unloading machines such as belt conveyor, bucket elevators, screw conveyors, and cranes. The Speed Relay outputs the alarm signal to protect the machine equipment when the rotational speed of the machine shaft decreases to an abnormal value or the machine shaft stops rotating due to overloading, etc.

2. Basic Components

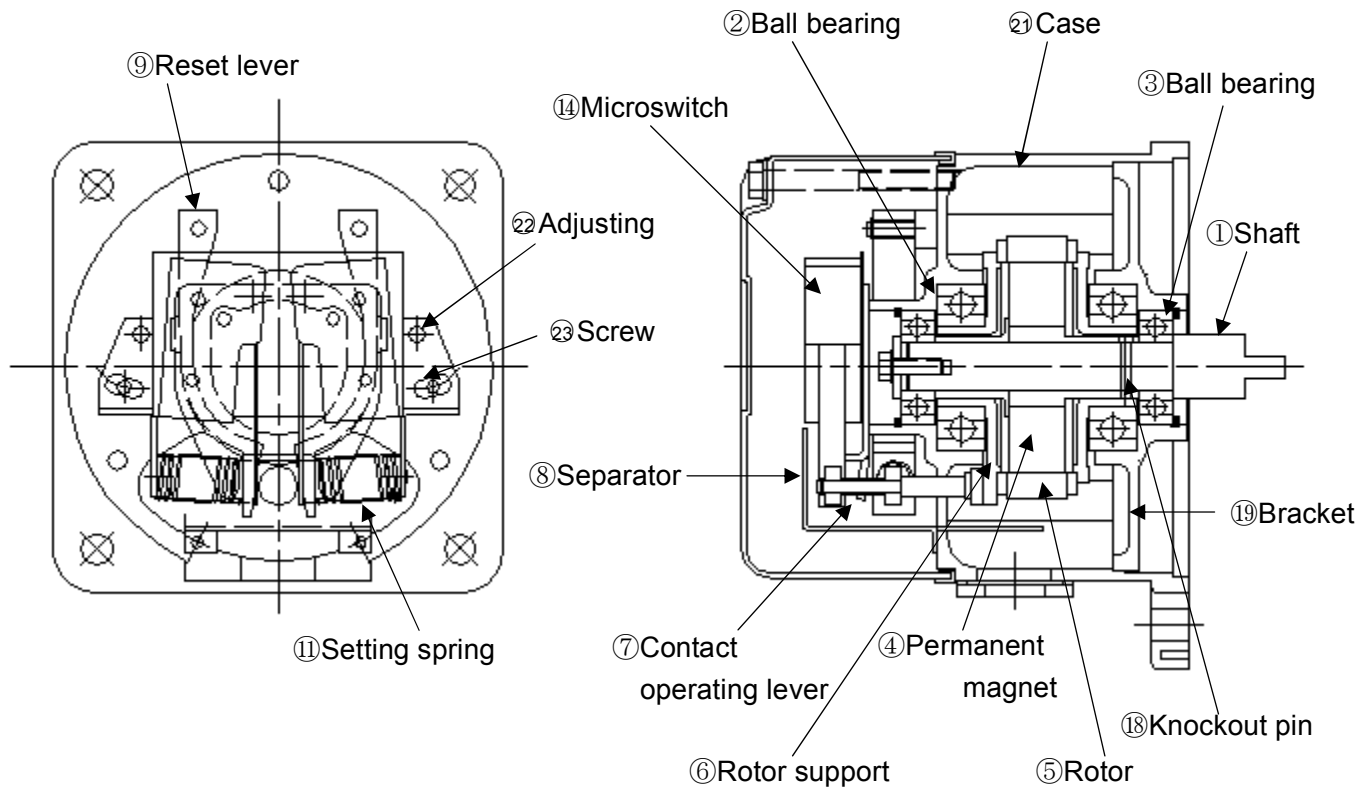


Fig. 1 Basic Components

2-1 Components of Speed Relay basic Type ESRC-100

Fig. 1 shows the components of Speed Relay basic type ESRC-100.

2-2 Functions of Main Components

- ① Shaft: Fastened to the permanent magnet (④) with a knockout pin (⑮).
- ④ Permanent magnet: Rotates together with the shaft (①) to produce a rotating magnetic field in the rotor (⑤) to generate inductive torque. A 2-pole permanent magnet is used for the actuating speed more than 600 rpm, and a 6-pole permanent magnet is used for 600 rpm or less. When the rated speed is 1300 rpm or more and the actuating speed is 100 rpm or less, a 12-pole permanent magnet is specially used.
- ⑤ Rotor: Rotates with the same mechanism as a squirrel-cage motor. The rotational speed increases in proportion to the shaft rotational speed.

- | | | |
|---|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ⑦ | Contact operating lever: | Turns ON or OFF the microswitch (⑭) according to the rotational speed of rotor (⑤) . |
| ⑭ | Microswitch: | Two microswitches are built in: one is for clockwise rotation of shaft (①) and the other for counterclockwise rotation. |
| ⑪ | Setting spring: | Used to set the rotational speed to actuate the Speed Relay. Two setting springs are built in: one for clockwise rotation and the other for counterclockwise rotation. |
| ⑨ | Reset lever: | Resets the contact operating lever (⑦) to the center position when the inductive torque for the rotor (⑤) decreases to a value smaller than the force of setting spring (⑪) as the rotational speed of shaft (①) decreases. |
| ② | Adjusting lever: | Used to adjust the actuating speed by adjusting the force of setting spring (⑪). |

3. Operations

3-1 The rotor support (⑥) and ball bearing (③) are mounted to keep a space between the rotor (⑤) and the permanent magnet (④).

3-2 The contact operating lever (⑦) fixed on one end of the rotor support (⑥) is kept on the center position by the force of a setting spring (⑪).

3-3 When the shaft (①) and permanent magnet (④) rotate, the inductive torque to the same direction as the shaft rotation is generated to rotate the rotor in the same mechanism as a squirrel-cage motor.

Characteristics of inductive torque:

- The amount of inductive torque increases in proportion to the shaft rotational speed,
- The larger the number of poles of permanent magnet is, the larger the amount of generated inductive torque: The 12-pole permanent magnet generates inductive torque more than 2- or 6-pole permanent magnet.

3-4 When the amount of inductive torque to rotate the rotor (⑤) increases to a value greater than the force of the setting spring (⑪) as the rotational speed of shaft (①) increases, the rotor (⑤), rotor support (⑥), and contact operating lever (⑦) move to the rotating direction of shaft (①) to turn ON or OFF the microswitch (⑭) of the corresponding rotation direction.

3-5 When the amount of inductive torque to rotate the rotor (⑤) decreases to a value less than the force of the setting spring (⑪) as the rotational speed of shaft (①) decreases, the force of setting spring (⑪) pushes back the contact operating lever (⑦), rotor support (⑥), and rotor (⑤) to the neutral center position to reset the microswitch (⑭).

3-6 The status (ON or OFF) of the microswitch (⑭) changes when the rotational speed of shaft decreases to about 75 to 80% of the actuating speed. Such hysteresis is the unique characteristic of the Speed Relay.

Using this characteristic, the status of the contact is securely switched when the microswitch (⑭) actuates.

4. Structure

4-1 Low-Speed Speed Relay Type ESRL-100

Fig. 2 shows the structure of typical low-speed Speed Relay type ESRL-100.

For the structure of the Speed Relays with type code ended with L, refer to Fig. 2.

The structures of low-speed type and basic type are approximately identical except for the dimensions of permanent magnet (④) and rotor (⑤) in the axis direction.

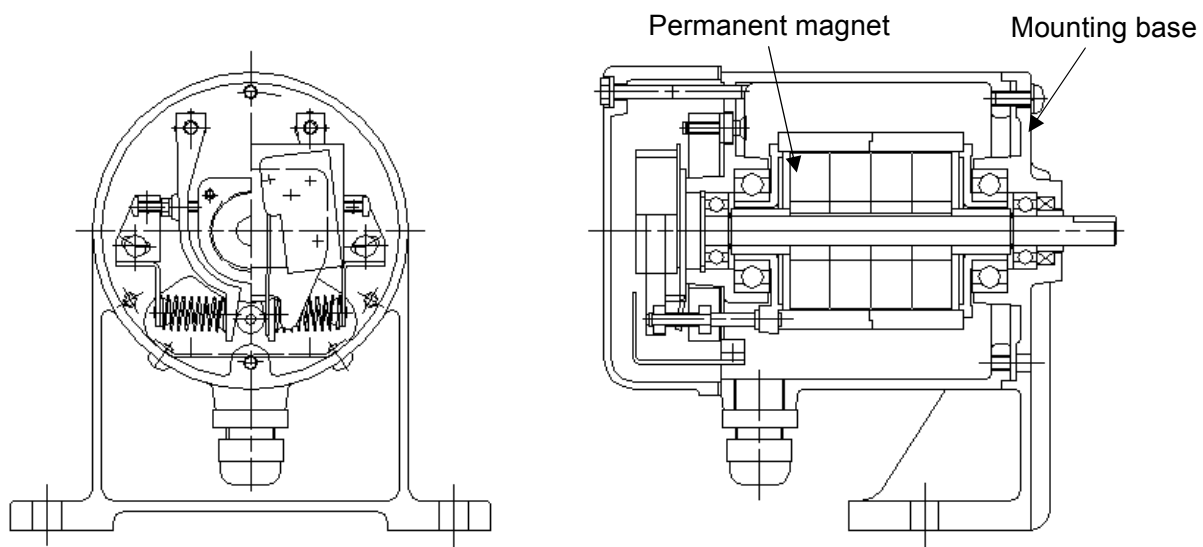


Fig. 2 Structure of Low-speed Speed Relay

4-2 Speed Relay Type ESRB-100

Fig. 3 shows the structure of Speed Relay type ESRB-100. See Fig. 1 for the basic components.

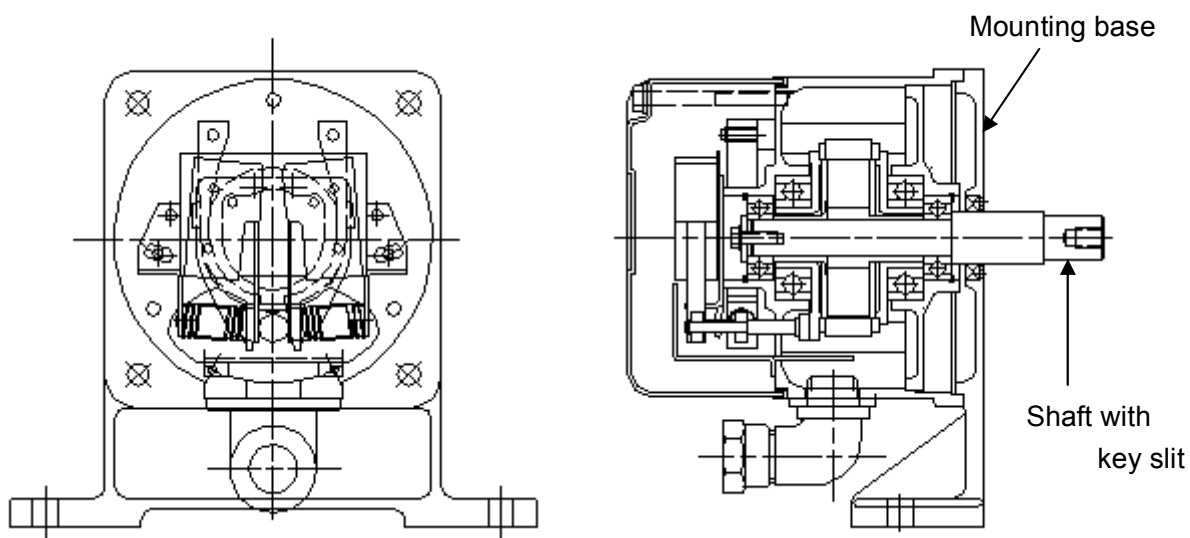


Fig. 3 Structure of Speed Relay Type ESRB-100

4-3 Speed Relay Type ESRW

Fig. 4 shows the structure of Speed Relay type ESRW.

See Fig. 1 for the basic components of Speed Relay type ESRW-102, ESRW-122, ESRW-302, and ESRW-322.

See Fig. 2 for the structure of low-speed type ESRW-102L, ESRW-122L, ESRW-302L, and ESRW-322L.

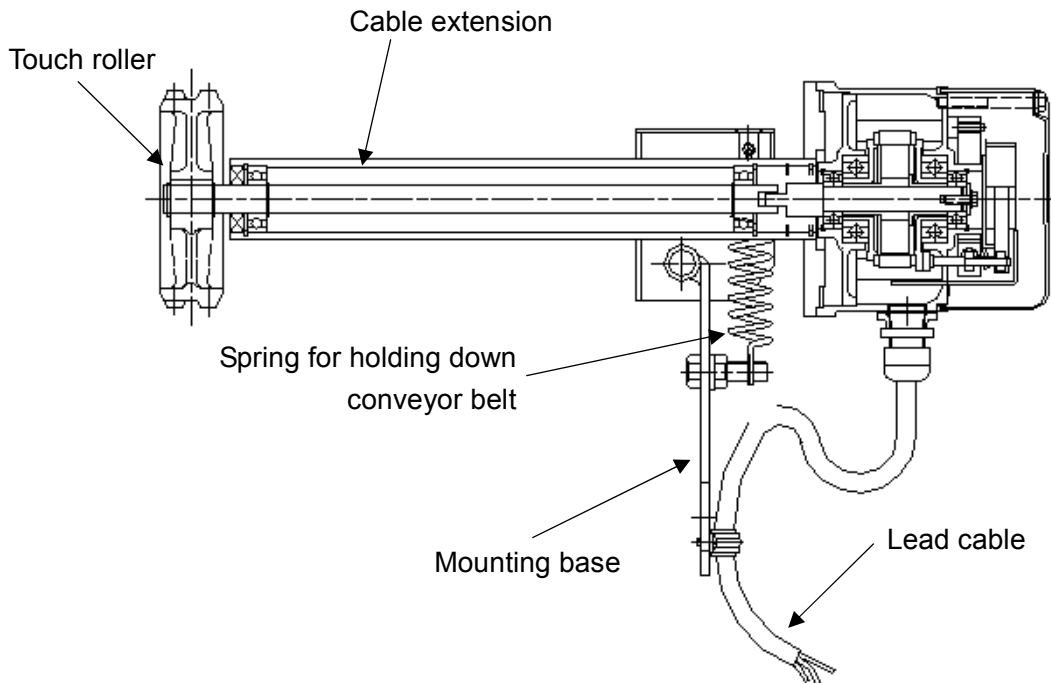


Fig.4 Structure of Speed Relay Type ESRW

5. Environmental Conditions at Installation Site

Use the Speed Relay in a location that satisfies the following requirements. For the Speed Relay with special specifications, observe the environmental requirements as per the approved drawing or final drawing.

5-1 Ambient Temperature

-10 to + 50°C without condensation

5-2 Ambient Humidity

80% max.

5-3 Dust

The dust adhered on the rotating section will cause malfunction of the Speed Relay. Remove periodically the dust on the rotating section.

5-4 Corrosive Environment

Never use the Speed Relay with standard specifications in corrosive environment.

5-5 Explosive or Inflammable Environment

Never use the Speed Relay in explosive or inflammable environment.

5-6 Vibration

Do not install the Speed Relay near large-amplitude vibration sources such as vibrating screen and vibrating feeder. Ordinary mechanical vibration such as motor or speed reducer vibration will not cause problems, but excessive vibration may cause malfunction of the Speed Relay.

5-7 Shock and Impact

Never use the Speed Relay in a location subjected to shock or impact.

6. Installation

6-1 Fitting bolts

Fitting bolts are not delivered. Prepare the bolts of the length required for the thickness of the mounting base.

6-2 Mounting Base

Prepare the mounting base referring to the dimensions shown in the dimensional drawing.

6-3 Precautions

1) Installation Direction

As a rule, install the Speed Relay horizontally. When the Speed Relay is inevitably installed to a slope or vertical plane, the shaft (①) must be directed downward. The line A-A' shown in Fig. 5 must be horizontal. If the line A-A' tilts for 5 degrees or more, the error of the actuating speed will cause malfunction.

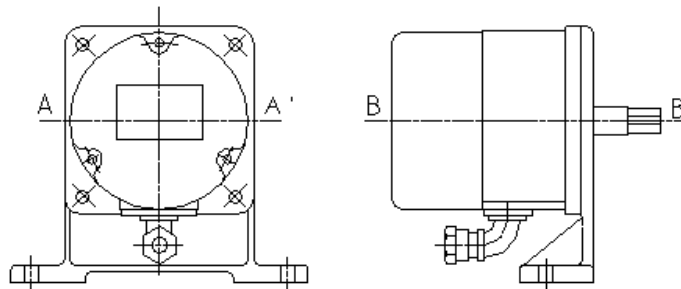


Fig. 5 Installation Direction

2) Shocks to Axis Direction

Avoid any shocks to the shaft of Speed Relay in the axis direction when installing.

Forcibly inserting couplings, etc. may damage the interior parts, resulting in critical failure.

3) Force and Pressure In Direction Perpendicular to Shaft

The Speed Relay is a precision device. Do not apply excessive force or pressure to the shaft (①) when installing. When using a chain or V-belt for coupling the shaft, stretch the chain or V-belt not to give stress to the shaft.

4) Coupling to the Shaft

Couple the Speed Relay shaft (①) with the machine axis so that the center lines of the shaft and the axis are parallel to each other. When coupling directly using a flexible coupling, two center lines must be exactly aligned.

5) Installation of Speed Relay Type ESRW

Install the Speed Relay type ESRW so that the touch roller (see Fig. 4) has contact with the belt conveyor in parallel. Fig. 6 shows the example of horizontal installation, and Fig. 7 shows the example of installation on a slope.

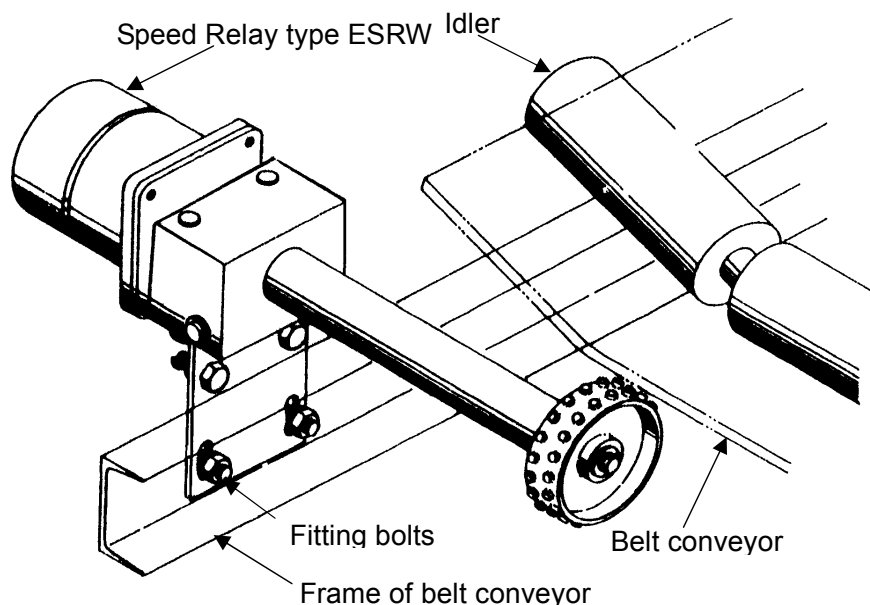


Fig. 6 Horizontal Installation of Type ESRW

7. Wiring

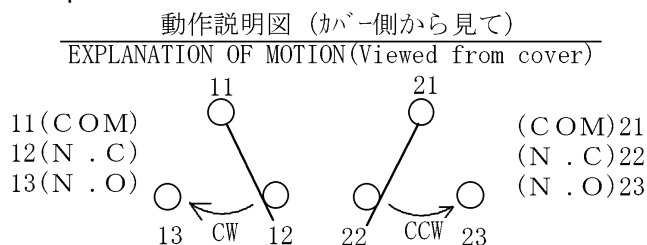
7-1 Wire Type and Size

Use vinyl-insulated wires of dia.1.25 to 2 mm². For connection to the microswitch terminals, use crimp terminals of 4 mm diameter.

7-2 Connection

Fig. 8 shows the terminal names and numbers of microswitches.

The microswitch is provided each for clockwise and counterclockwise rotation. Connect the required terminals. When the Speed Relay deactivates, the contact between the terminals COM and N.O opens and the contact between the terminals COM and N.C closes.



矢印は軸の回転方向を示し、矢印の数字はその方向にて動作する接点符号を示します。

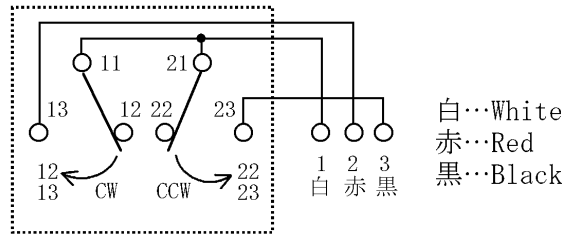
Arrow marks show the direction of revolution and numbers on arrow head indicate the actuating contact marking.

Fig. 8 Terminal Names and Numbers of Microswitches

For the Speed Relay type ESRW, the cable specification differ depending on the contact to be connected: N.O (a) or N.C (b). Connect the cable correctly. Check the delivery drawing or final drawing to make sure which contact is used.

動作説明図 (カバー側から見て)

EXPLANATION OF MOTION (Viewed from cover)



a 接点 (a contact)

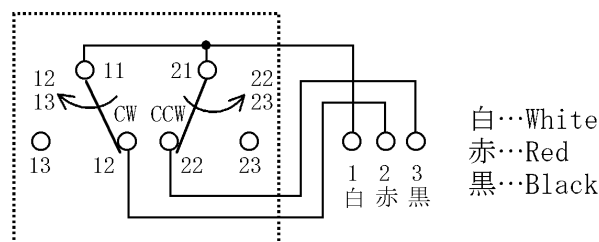
矢印は軸の回転方向を示し、矢印の数字はその方向にて動作する接点符号を示します。

Arrow marks show the direction of revolution and numbers on arrow head indicate the actuating contact marking.

“ a Contact “

動作説明図 (カバー側から見て)

EXPLANATION OF MOTION (Viewed from cover)



b 接点 (b contact)

矢印は軸の回転方向を示し、矢印の数字はその方向にて動作する接点符号を示します。

Arrow marks show the direction of revolution and numbers on arrow head indicate the actuating contact marking.

“ b Contact “

Fig. 9 Explanation of Motion

7-3 Interconnection

The separator (⑧) is provided to prevent the outgoing lead wire of the microswitch (⑭) from contacting with the setting spring (⑪), reset lever (⑨), and contact operating lever (⑦).

If the lead wire comes into contact with the above components, the microswitch will fail to operate normally.

8. Adjustment

Normally adjustment of the Speed Relay is not necessary since each Speed Relay has been properly adjusted before shipment. This section explains the procedure to modify the actuating speed in case the modification is required because of re-installation of the Speed Relay or replacement of spare parts.

8-1 Modification of Actuating Speed for Approx. $\pm 10\%$

Use an instrument to observe the rotational speed during adjustment

The actuating speed changes according to the force of the setting spring (①).

1. Loosen the screw (②) to turn the adjustment lever (②) clockwise (outside) or counterclockwise (inside). Turning the lever clockwise decreases the actuating speed while turning counterclockwise increases the speed.
2. Turning the adjustment lever (②) up to the end of the oval hole changes the actuating speed for about $\pm 10\%$.
3. After confirming the correct action of the Speed Relay by repeatedly starting and stopping the machine, tighten the screw (②).

8-2 Modification of Actuating Speed for more than $\pm 10\%$

It is necessary to replace the setting spring (①). Contact Matsushima, stating the serial number mentioned on the last line of the nameplate affixed on the cover.

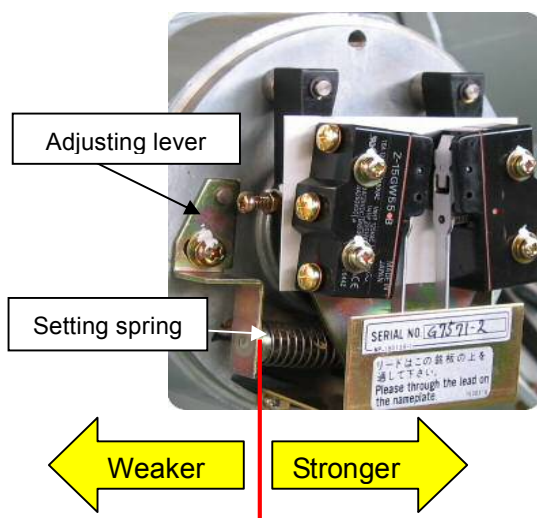


Fig. 10 Modification of Actuating Speed

9. Maintenance and Inspection

9-1 Periodic Inspection

1) Cleaning

Remove dust accumulated or adhering to the shaft connecting section of the Speed Relay.

2) Tightening of screws and bolts

Be sure to tighten the loose coupling, chain wheel, etc. of the shaft connecting section, and fitting bolts.

9-2 Lubrication

1) The Speed Relay does not require lubrication.

2) Shaft seal

Speed Relay types that require lubrication on shaft seal: ESRB, ESRL, and ESRU

Supply machine oil (#120) to the mating surface between the shaft and oil seal every 1 to 3 months.

3) Chain coupling

When using a chain coupling to connect the Speed Relay to the machine, lubricate the chain.

An insufficiently lubricated or rusted chain will cause excessive load to the shaft (①) of the Speed Relay, resulting in failure such as shaft breakage.

Install an automatic lubricator or feeder for the chain to provide optimum lubrication.

9-3 Replacement of Parts

1) Replacement of touch roller of Speed Relay type ESRW (See Fig. 11)

When replacing Touch Roller, remove the claw washer and detach Touch Roller.

After replacement, attach the claw washer and the locking washer and then securely tighten them with M8 bolt.

(Refer to Fig.11)

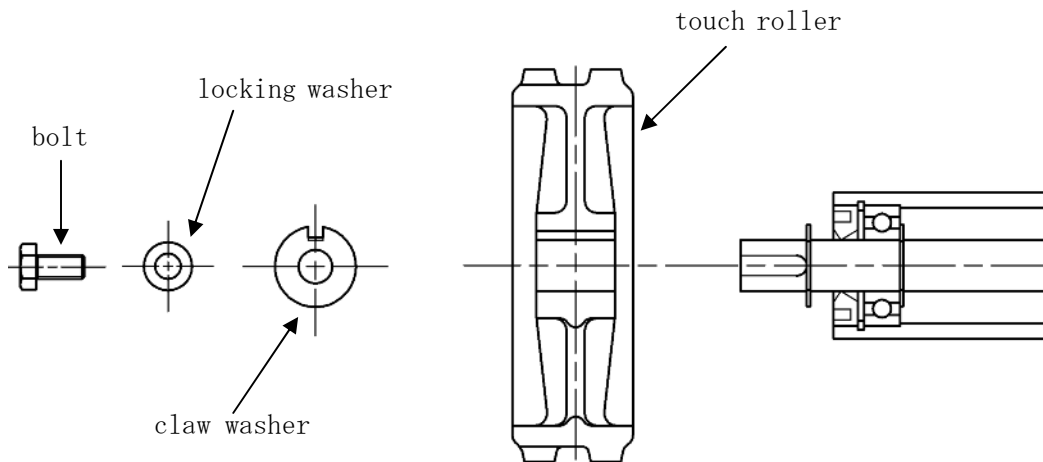


Fig.11 Replacement of Touch roller

9-4 Tightening of Cover

When the cover of the Speed Relay is removed for wiring or inspection, be sure to tighten the fitting bolts of the cover after completing the work. A loose cover may cause trouble due to entering of rain drops or dusts from the clearance between the cover and case.

9-5 Recommended Spare Parts

1) Touch roller (used only for Speed Relay type ESRW)

2) Specify the followings when ordering.

- Product name: Touch roller for Speed Relay
- Roller diameter: 130 mm or 200 mm
- Drawing number: DWG #/1530184-3 for roller diameter 130 mm
DWG #/1530183-4 for roller diameter 200 mm
- Product type