

SS14-9B002

Applicable lots: Lot 0210 -

Prepared in Sept., 2002

7.3 Adjustment Procedure

After disassembly and reassembly work of TE-331/332, be sure to perform adjustments according to the procedures described in Para. 7.**List of checks and adjustments after disassembly, reassembly and replacement.**

Without the necessary adjustments, the alarm functions and the [BATTERY] indicator might not operate normally.

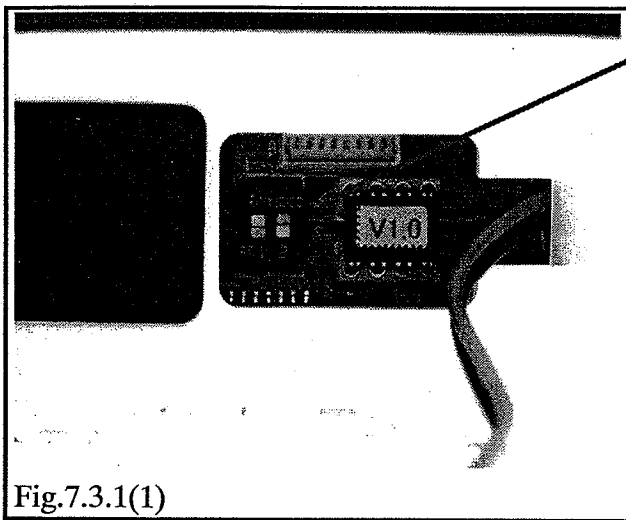
Note: Pressing the [START] switch clears all the data stored. To skip any adjustment item, press the [STOP] switch.

7.3.1 Adjusting the syringe size detection function

(1) Remove the battery cover from the bottom of the syringe pump. Without disconnecting the connector, take out the battery.

Now, the internal switches on the main board become accessible through the window at the back of the battery case. Turn the internal DIP switch 1 to ON, 2 to OFF.

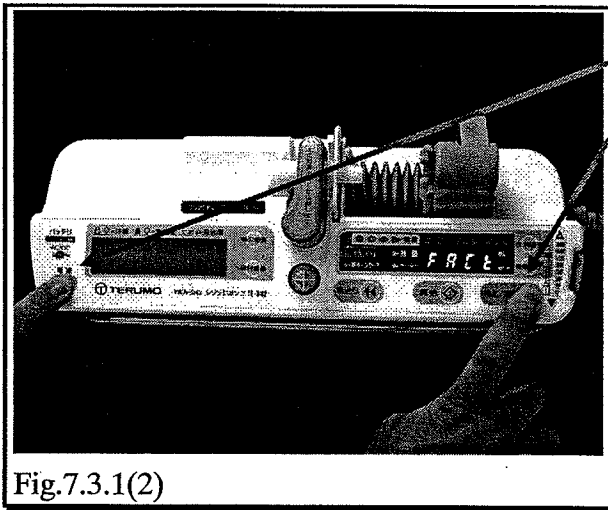
Note: When you have disconnected and reconnected the battery connector, be sure to perform the battery-inspection procedures given in the instruction manual.



Internal DIP switches
Setting: 1 → ON, 2 → OFF

Fig.7.3.1(1)

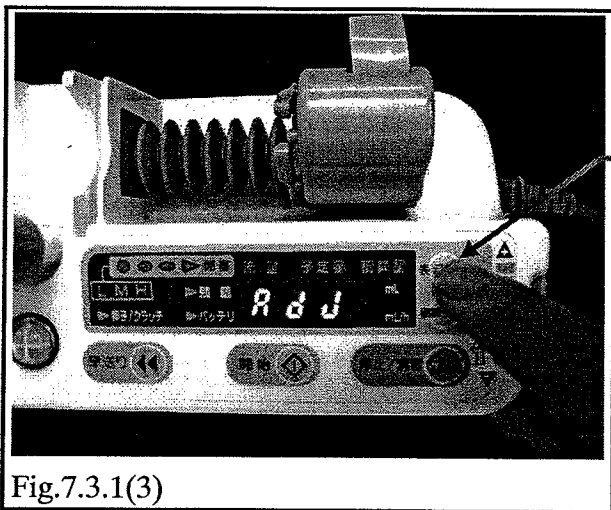
- (2) Press and hold the [ON/OFF] switch while holding down the [STOP] switch. First, “888.8”, then, “Fact” appears on the [FLOW RATE/D.LIMIT/VOLUME DELIVERED] display. Release the switches, and the display changes to “dIag” with a beep.



Press and hold the [ON/OFF] switch while holding down the [STOP] switch. Check that first, “888.8”, then, “Fact” appears on the display. Then Release the switches.

Fig.7.3.1(2)

- (3) Press the [DISPLAY SELECT] switch, and “dIag” on the display changes to “SPEC”. Press the [DISPLAY SELECT] switch again. The display changes to “ADJ”. Press the [STOP] switch, and the syringe size indicator “10” lamp lights up with a beep.



[DISPLAY SELECT] switch

Fig.7.3.1(3)

- (4) Pull the clamp up, and set the small jig for syringe size and nearly-empty detection adjustment (05LA42*). Gradually lower the clamp onto the syringe. Press the [START] switch to write the A/D value obtained.

Note: Lower the clamp gradually. Lowering in haste would cause an adjustment error.

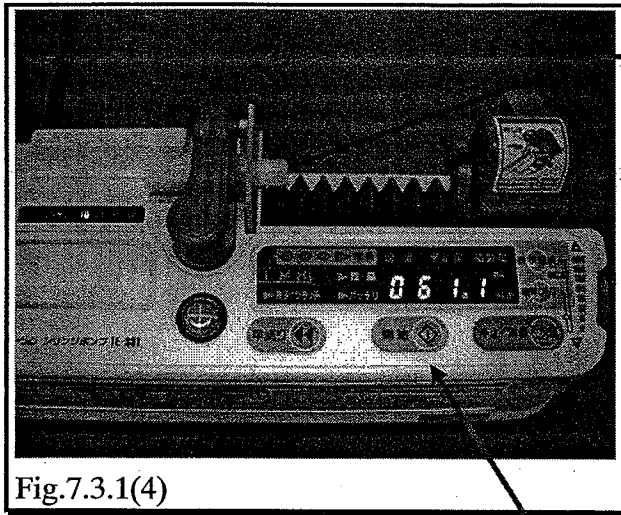
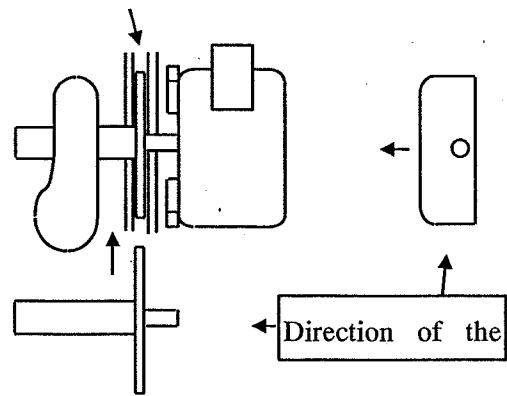


Fig.7.3.1(4)

Note: Direct the thinner end of the jig toward the slider and set the flange securely in the pump slit.



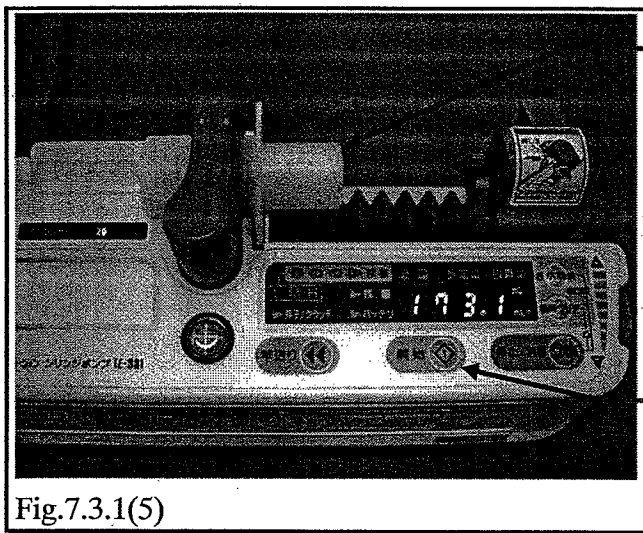
[START] switch

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- (5) After the A/D value has been written, syringe size indicator lamp automatically changes to “20”. Verify “20” is on, and remove the small jig. Set the large jig for syringe size and nearly-empty detection adjustment (05LA42*). Press the [START] switch to write the A/D value obtained. Then the adjustment for syringe size detection is complete.



Syringe size and nearly-empty detection adjustment jig (large)

[START] switch

Fig.7.3.1(5)

7.3.2. Adjusting the nearly-empty detection function

- (1) After the syringe size detection adjustment has been completed, the nearly-empty detection adjustment mode automatically starts.

Check that the [FLOW RATE] lamp is on.

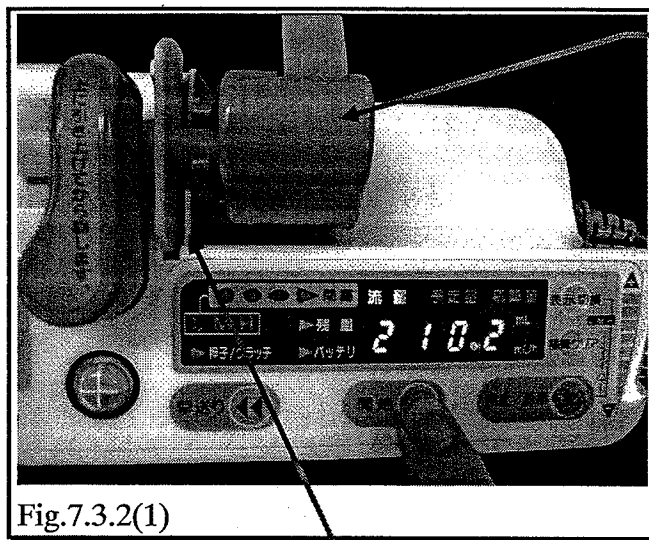
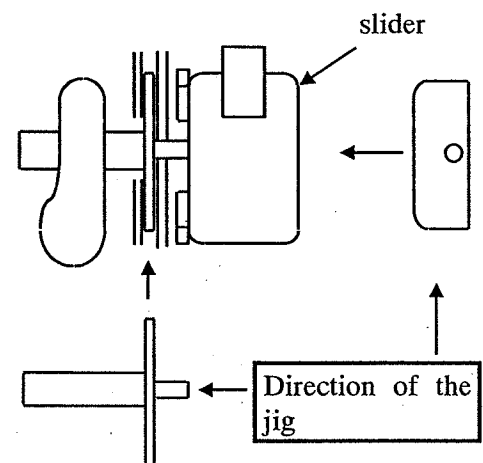


Fig.7.3.2(1)

Syringe size and nearly-empty detection adjustment jig (small)

Press the clutch and move the slider until it comes into contact with the jig.



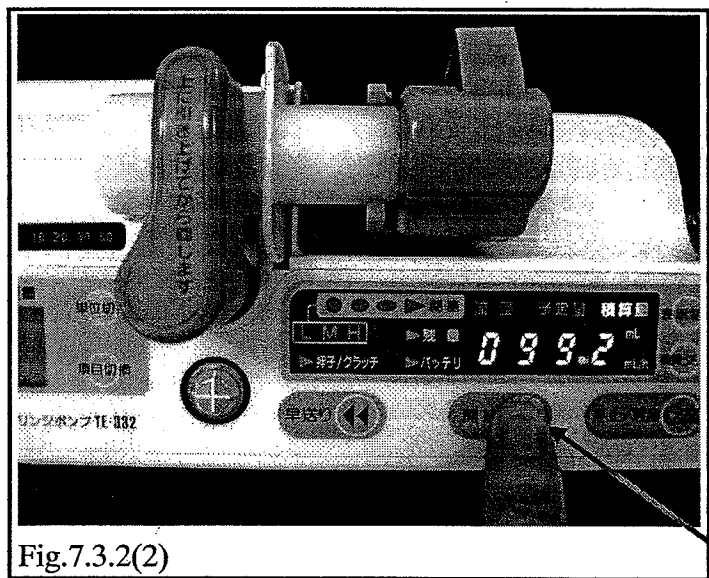
- (2) Pull the clamp up, and set the small jig for syringe size and nearly-empty detection adjustment (05LA42*). Press the clutch and move the slider until it comes into contact with the jig. Press the [START] switch to write the A/D value obtained.

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- (3) After the A/D value has been written, the Σ mL lamp lights on. Check that the Σ mL is on, and set the large jig for syringe size and nearly-empty detection adjustment (05LA42*). Press the [START] switch to write the A/D value obtained. Then the adjustment for nearly-empty detection is complete.

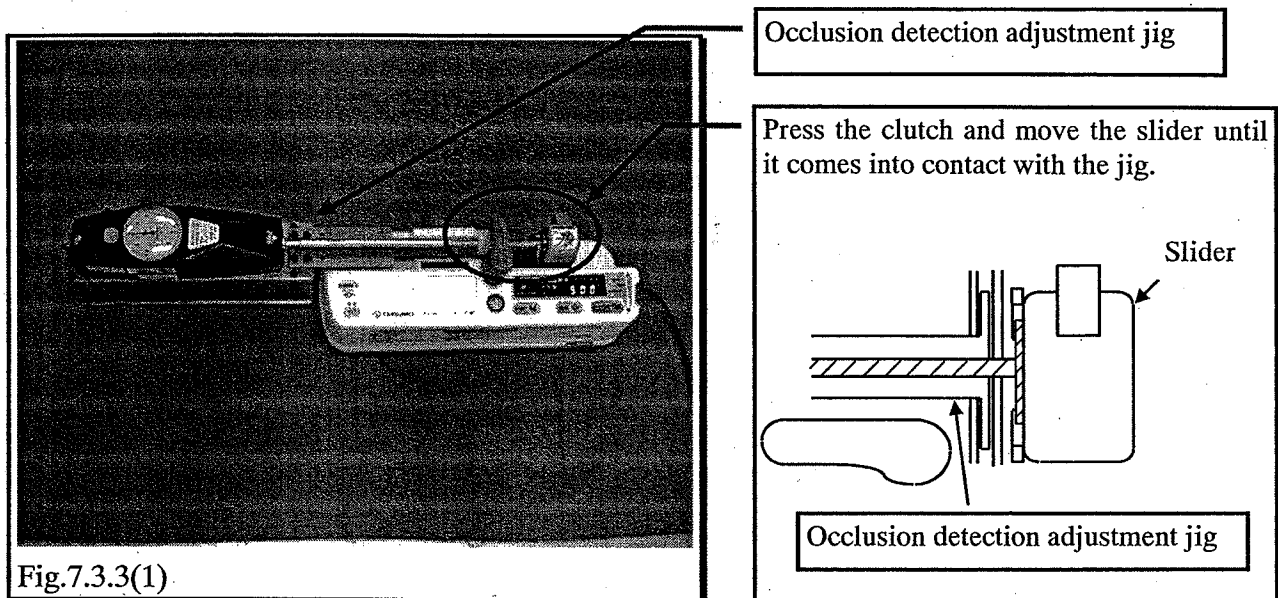


[START] switch

7.3.3. Adjusting the occlusion detection function

- (1) After the nearly-empty detection adjustment has been completed, occlusion detection adjustment mode automatically starts.

Check that the [OCCLUSION LIMIT] " I " lamp is on.



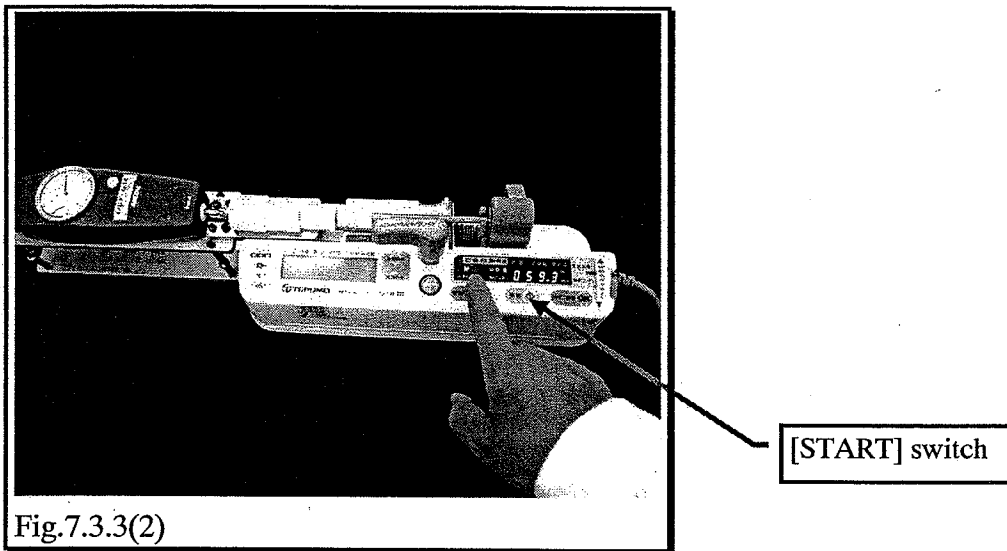
- (2) Pull the clamp up, and set the occlusion detection adjustment jig. Press the clutch and move the slider until it comes into contact with the jig.

Note: Never tamper with the volume knob on the occlusion detection board, which has been properly adjusted in the factory. The service parts have also been adjusted before shipment.

Note: Align the push-pull gauge shaft with the pump shaft.

- (3) Press the [PURGE] switch once to move the slider. When the value of 9.8N(1kgf) is obtained with the jig, press the [PURGE] switch again to stop the slider. Then press the [START] switch to write the A/D value obtained.

*In this mode, the [PURGE] switch serves as the motor start/stop switch.



- (4) After the A/D value has been written, the [OCCUSION LIMIT] indicator lamp automatically changes to "II". Press the [PURGE] switch once to move the slider. When the value of 49.0N(5kgf) is obtained with the jig, press the [PURGE] switch again to stop the slider. Then, press the [START] switch to write the A/D value obtained.

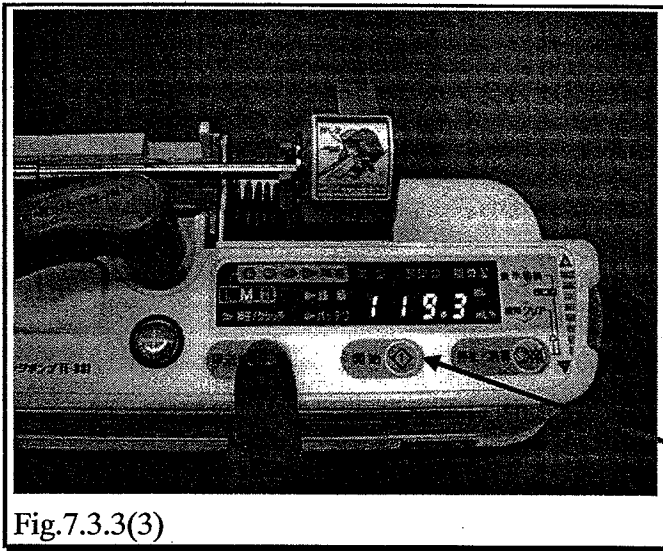


Fig.7.3.3(3)

- (5) After the A/D value has been written, the [OCCLUSION LIMIT] lamp automatically changes to "III". Press the [PURGE] switch once to move the slider. When the value of 88.3N(9kgf) is obtained with the jig, press the [PURGE] switch again to stop the slider. Then, press the [START] switch to write the A/D value obtained.

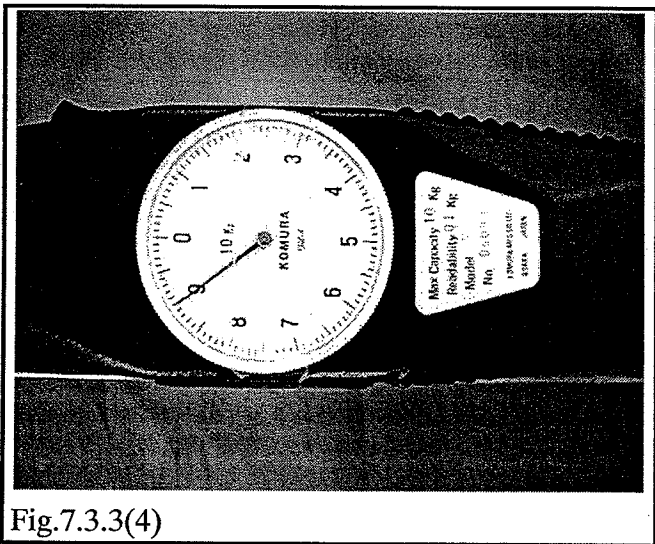


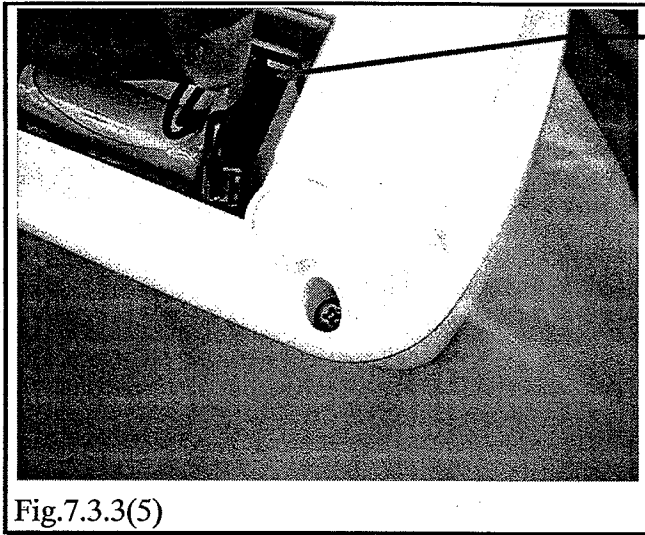
Fig.7.3.3(4)

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- (6) Now all the necessary adjustments have been completed. Press the [ON/OFF] switch to turn off the pump. Reset the internal DIP switches 1 and 2 to OFF. Mount the battery in the battery case and put the battery cover back.



Note: For proper installation of the battery cable, refer to 7.2.5 Installing the battery.

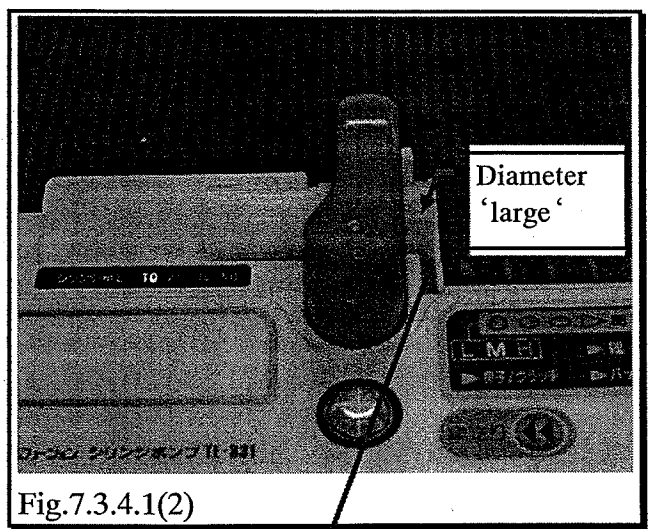
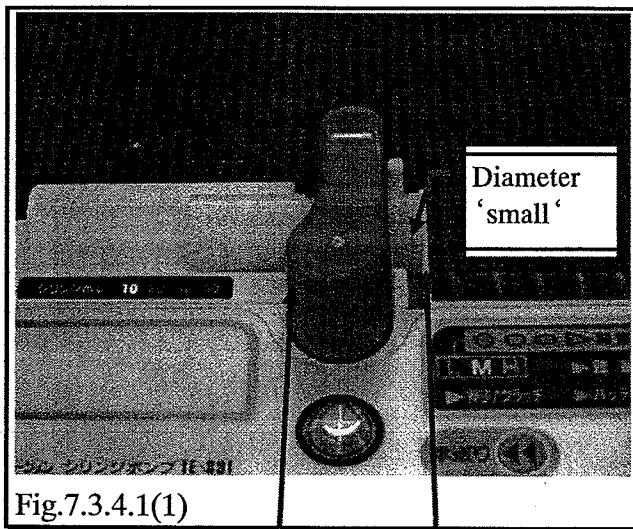
Fig.7.3.3(5)

7.3.4 Checking for proper adjustment

7.3.4.1 Checking for syringe size detection function

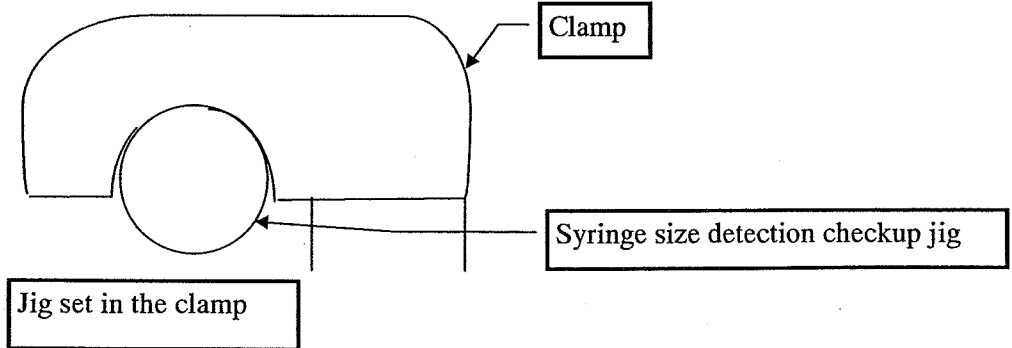
*The principle of syringe size detection is that the syringe recognition sensor output is in linear proportion to the syringe diameter. Therefore you can check whether the adjustment for the syringe size detection is correct with the brand in the pump set to TERUMO. For the details of the principle, see Para.5.2.2.12. in 5. PRINCIPLE OF OPERATION.

- (1) Press the [ON/OFF] switch to turn on the power. Set the syringe size detection checkup jig (05LA41*) for 10mL in the clamp. Make sure the "10" lamp on the syringe size indicator lights up regardless of which end of the jig (thin end or thick end) faces the slider.



Syringe size detection check up jig (05LA41*)

Note: When setting the jig, take care not to allow it to override here.

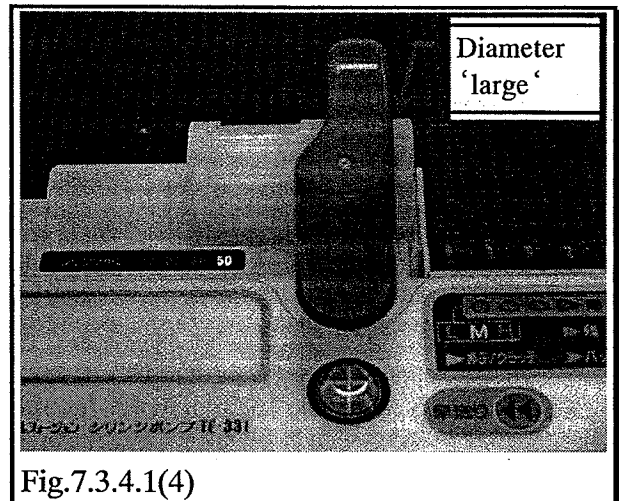
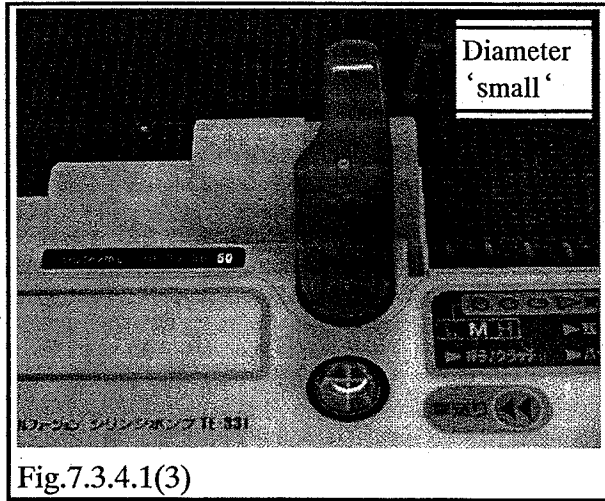


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- (2) Similarly, set the other syringe size detection check up jigs (for 20mL, 30mL, 50mL) in the clamp, one after another, and make sure that the corresponding syringe size lamps light up.



7.3.4.2. Checking for nearly empty detection function

- (1) With the plunger of a 10mL syringe drawn to approx. 5 mL position, set the syringe in the clamp. Press the clutch and move the slider until it touches the plunger.

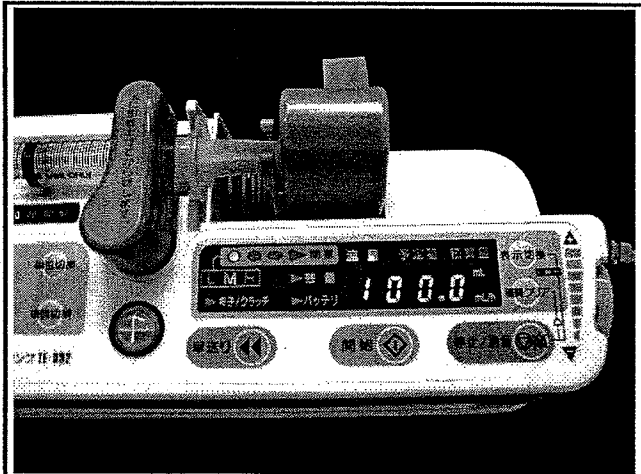


Fig.7.3.4.2(1)

- (2) After the slider has come into contact with the plunger, start the pump at a flow rate between 50 and 100mL/h until the nearly-empty alarm occurs. Visually check the plunger position (the tick on the syringe) at which the alarm starts.

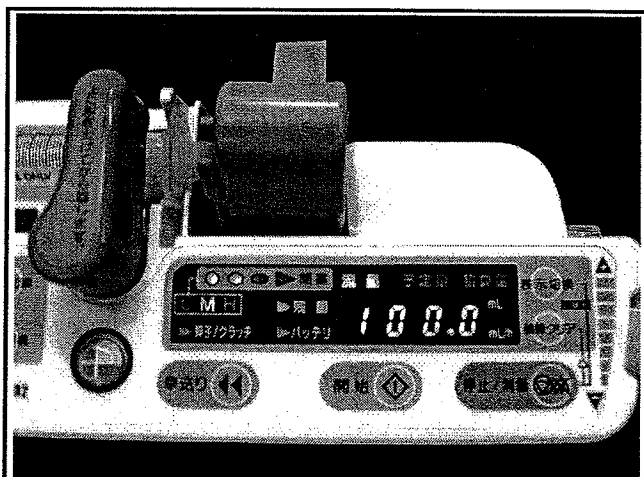


Fig.7.3.4.2(2)

*The nearly-empty alarm position for each syringe size is shown below:

Syringe size	Nearly-empty alarm position (the tick on the syringe)
10	Approx. 0.5 mL
20, 30, 50	Approx. 1.0 mL

(3) Set the other syringes (20mL, 30mL and 50mL) in the clamp, one after another, and make sure that the nearly-empty alarm is generated properly for each syringe size.

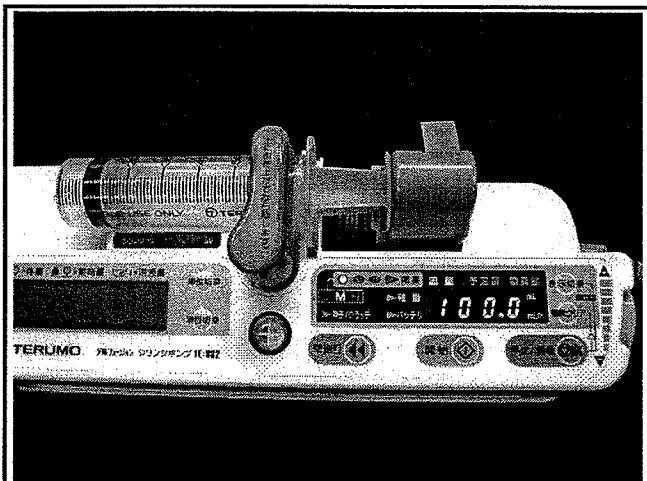


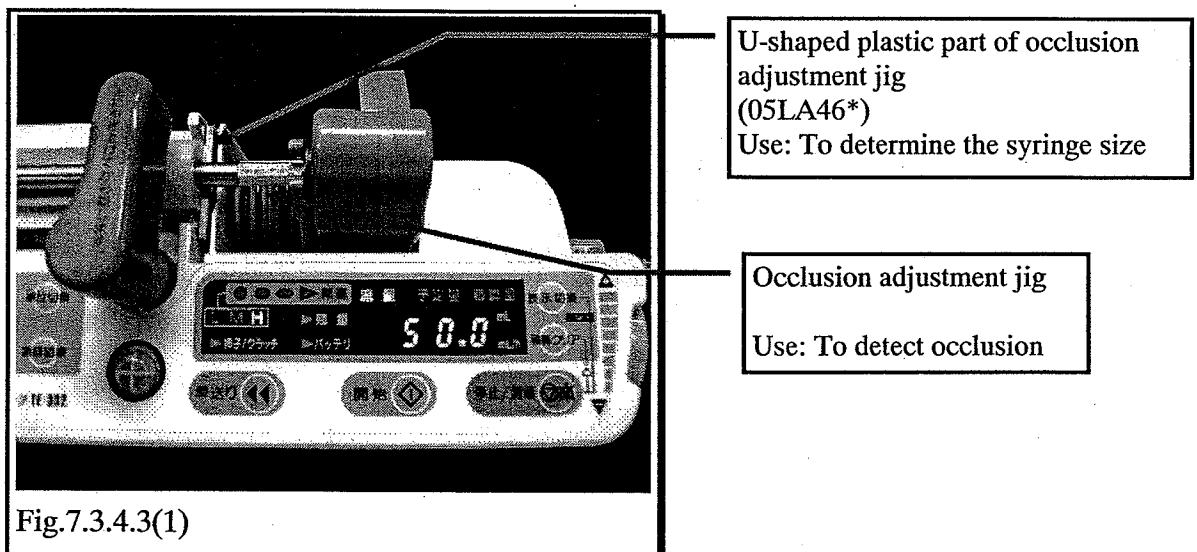
Fig.7.3.4.2(3)

7.3.4.3 Checking for occlusion detection function

The principle of occlusion detection is that the occlusion sensor output is in linear proportion to the load on the slider. Therefore, make sure that the occlusion detection loads fall in the range at the three points in load between 1 to 9kgf to check the occlusion adjustment is correct. For the principle of occlusion detection, see Para. 5.2.2.11 in 5. PRINCIPLE OF OPERATION.

(1) When using the occlusion adjustment jig for checkup.

- 1) Set the occlusion adjustment jig (05LA46*) in the pump body. Press the clutch and move the slider until it touches the jig.



- 2) Set the occlusion limit and flow rate to the values shown in the table below, then purge to the target value shown. Press the [START] switch to check for proper action of occlusion alarm.

Syringe size [mL]	Occlusion limit	Flow rate [mL/h]	Target of purge [N] ([kgf])
10	I	30	4.90(0.5)
30	II	30	19.6 0 - 24.5(2.0 - 2.5)
50	III	50	24.5 - 63.7(6.0 - 6.5)

*You can not change the occlusion limit while any alarm is on. Correct the alarm state to change it.

3) Make sure that the load at which occlusion alarm occurs is within the specified range.

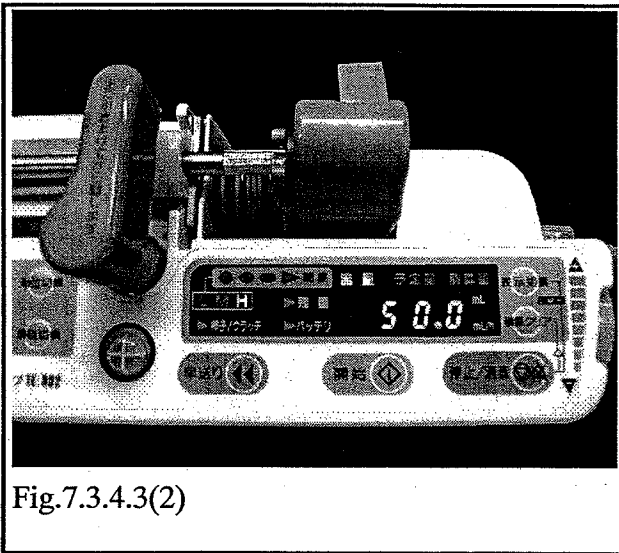


Fig.7.3.4.3(2)

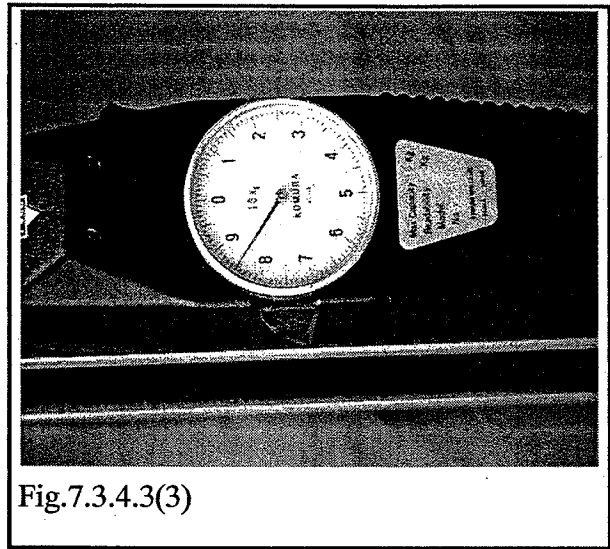


Fig.7.3.4.3(3)

Syringe size [mL]	Occlusion detection load range [N] ([kgf])
10	(TC) 10.1 - 15.3(1.03 - 1.57) *1
30	(TC) 30.3 - 41.6(3.10 - 4.24) *2
50	(TC) 59.2 - 94.7(6.04 - 9.66) *3 (TE) 57.8 - 93.1(5.90 - 9.50) *4

*If any of the occlusion detection load falls outside the range above, readjust the occlusion detection function according to 7.3.3. Adjusting occlusion detection function.

<Formula>

$$*1 \quad 300 \text{ (mmHg)} \times \frac{1.03323 \text{ (kgf/cm}^2\text{)}}{760 \text{ (mmHg)}} \times 1.960 \text{ (cm}^2\text{)} + 0.5 \text{ (kgf)}$$

$$*2 \quad 500 \text{ (mmHg)} \times \frac{1.03323 \text{ (kgf/cm}^2\text{)}}{760 \text{ (mmHg)}} \times 4.222 \text{ (cm}^2\text{)} + 0.8 \text{ (kgf)}$$

$$*3 \quad 800 \text{ (mmHg)} \times \frac{1.03323 \text{ (kgf/cm}^2\text{)}}{760 \text{ (mmHg)}} \times 6.667 \text{ (cm}^2\text{)} + 0.6 \text{ (kgf)}$$

$$*4 \quad 800 \text{ (mmHg)} \times \frac{1.03323 \text{ (kgf/cm}^2\text{)}}{760 \text{ (mmHg)}} \times 6.618 \text{ (cm}^2\text{)} + 0.5 \text{ (kgf)}$$

↑
Cross section area
of the syringe

↙
Sliding resistance of
the syringe

(2) When using the pressure gauge for check up.

1) Connect a TERUMO 50 mL syringe (filled with 20 - 30 mL of water) and a pressure gauge with a tube (approx. 50 cm long). Set the syringe in the clamp. Press the clutch and move the slider until it touches the plunger.

Note: For this checkup, be sure to use a new syringe. (A used syringe may result in inaccurate occlusion detection.)

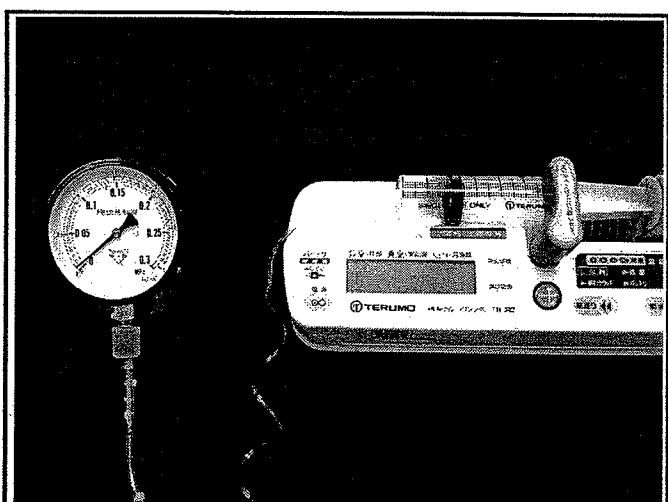


Fig.7.3.4.3(4)

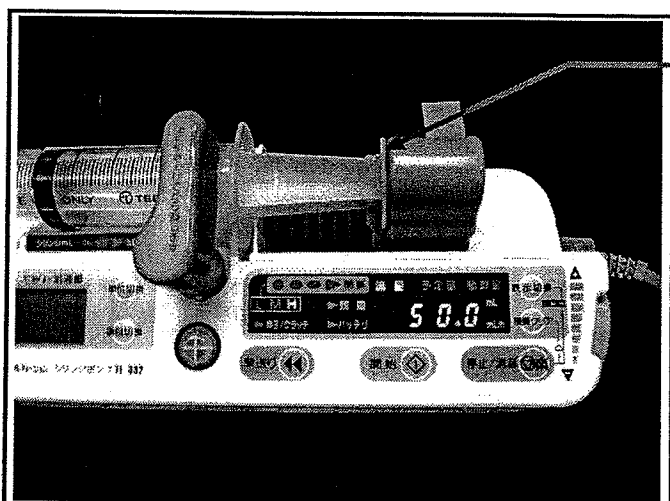


Fig.7.3.4.3(5)

*Move the slider until it comes into contact with the syringe.

- 2) Set the occlusion limit and flow rate to the values shown in the table below. Press the [START] switch to check for proper action of occlusion alarm.

Syringe size [mL]	Occlusion limit	Flow rate [mL/h]	Occlusion detection pressure range [kPa] ([kgf/cm ²])
50	II	50	53.4 - 80.0(0.54 - 0.82)

- (3) Make sure that the occlusion detection pressure at which an occlusion alarm occurs is within the specified range.

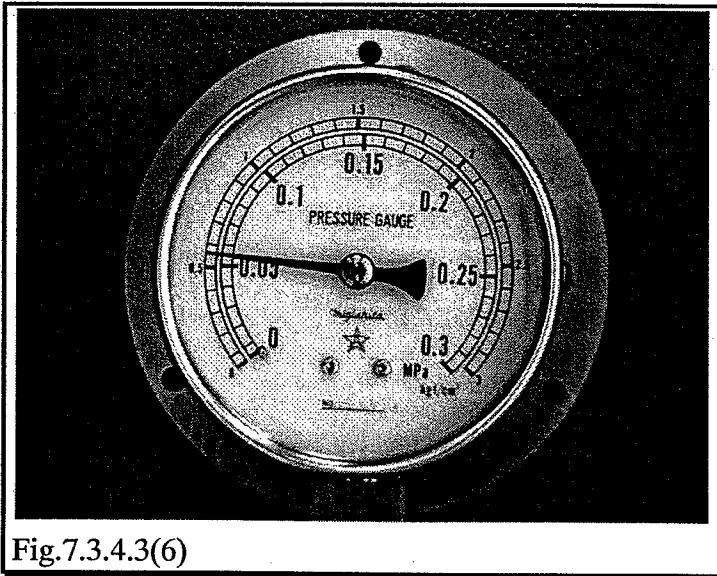


Fig.7.3.4.3(6)

*If any occlusion detection pressure is out of range, readjust it according to the procedure in 7.3.3
Adjusting the occlusion detection function.