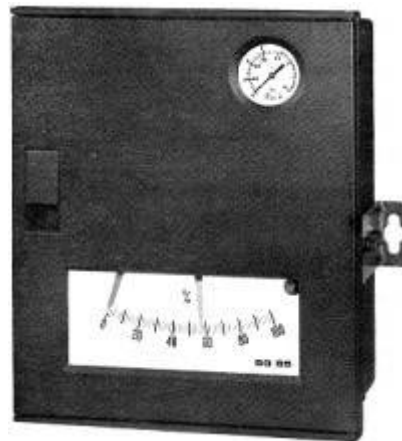


# TECHNICAL MANUAL

## PNEUMATIC CONTROLLER



**TYPE SG65**

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## 1. General technical data

<b>Principle</b>	: Motion balance
<b>Ambient temperature limits</b>	: Service: - 20 to + 60°C Storage: - 40 to + 80°C
<b>Air Supply</b>	: 1,4 ±0,1 bar
<b>Measurement signal</b>	: 0,2 - 1 bar
<b>Output signal</b>	: 0,2 - 1 bar
<b>Control action</b>	: Selectable Direct or Reverse, by rotating the BP dial
<b>Output Relay</b>	: Continuous bleed type with metallic diaphragm
<b>Control mode</b>	: <b>Proportional band:</b> 4 - 100% <b>Reset time:</b> 0.1 - 25 min.
<b>Automatic / Manual</b>	: internal switch for bumpless transfer
<b>Accuracy</b>	: ± 1% of span
<b>Repeatability</b>	: ≤ 0,25% of span
<b>Air Consumption</b>	: ≤ 400 g/h
<b>Indication</b>	: <b>Scale</b> : Eccentric, 120mm length, black numerals and graduation on white background <b>Pointers</b> : <b>Measure</b> : blue <b>Set-point</b> : orange
<b>Output Indicator</b>	<b>Scale</b> : 0 to 1,4 bar and 0 to 20 psi <b>Accuracy</b> : ± 2%
<b>Case (protection class)</b>	: IEC - IP 45, Anti-corrosive finish
<b>Mounting</b>	: Vertical, on surface or flush panel.
<b>Air Connections</b>	: 1/4" NPT f.
<b>Accessories</b>	: anti-vibration supports

## 2. INSTALLATION

### 2.1 - Mounting

The controller is fitted with two mounting brackets which are suitable for both the panel and wall mounting. To minimise the influence of the internal components weight, all the factory tests and calibrations are carried out with housing in vertical position. It is therefore important to install the controller in vertical position. On request, the controller can be furnished with bracket for mounting on a 2 inch horizontal or vertical pipe.

**NOTE:** Anti-vibration supports, suitable for wall mounting should be employed to reduce the dangerous effect of mechanical vibration transferred to the instrument housing and to the internal components.

### 2.2 - Pneumatic connections(refer to fig. 1)

The air supply "A" and output "U" connections are threaded 1/4" NPT (female). It is important that the air supply is clean, dry and oil-free. All the air line connections should be checked to ensure that they are free from leaks. For the reduction of the air supply pressure to 1.4 bar (20 psi), employ an air filter-regulator with an output gauge. Before connecting the controller, purge the supply line. Connect the output "U" to the control valve.

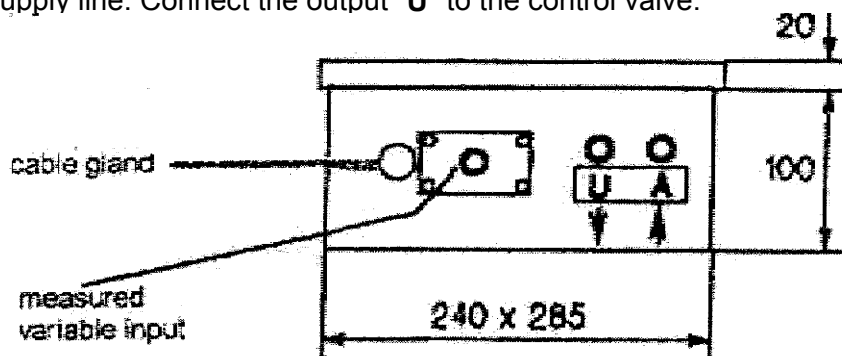


Figure 1: pneumatic connections

### 2.3 - Pneumatic signal receiver

For the connection to the pressure transmitter, use, preferably, new and clean copper pipes, o.d. 6 mm, i.d. 4 mm. Mount the instrument with block needle valve. It is important that the connection line between the instrument and the transmitter is leak free. To check for leaks apply a solution of soap water to the connections. Before connecting the instrument, purge the air line to remove moisture and solids.

### 3. STARTUP AND MAINTENANCE OPERATIONS

#### 3.1 - Operation Description (refer to fig. 2)

The measuring or receiving element is connected by the link [L] to the movement [M] from which a horizontal motion is transferred to point A. This horizontal motion is proportional to the shifting between the actual measure signal and set point. The horizontal motion, through point A, changes the position of the flapper-nozzle assembly [F] and its air loss, the airflow which is kept constant through the restriction [S], will change the backpressure on the pneumatic relay [R]; where output signal will change accordingly.

This output signal supplies also the proportional bellows [P]; its new loading pressure is balanced by the force of the feedback spring [V] and the motion of point B should restore the balance at flapper-nozzle [F].

The P+I control unit has a feedback [I] bellows instead of feedback spring [V]. This bellows receives the same output signal conditioned through a variable restriction [D] and a capacity volume [C]. Adjustments of restriction [D] calibrate the reset time, that is the automatic reset on flapper-nozzle assembly [F] through point B.

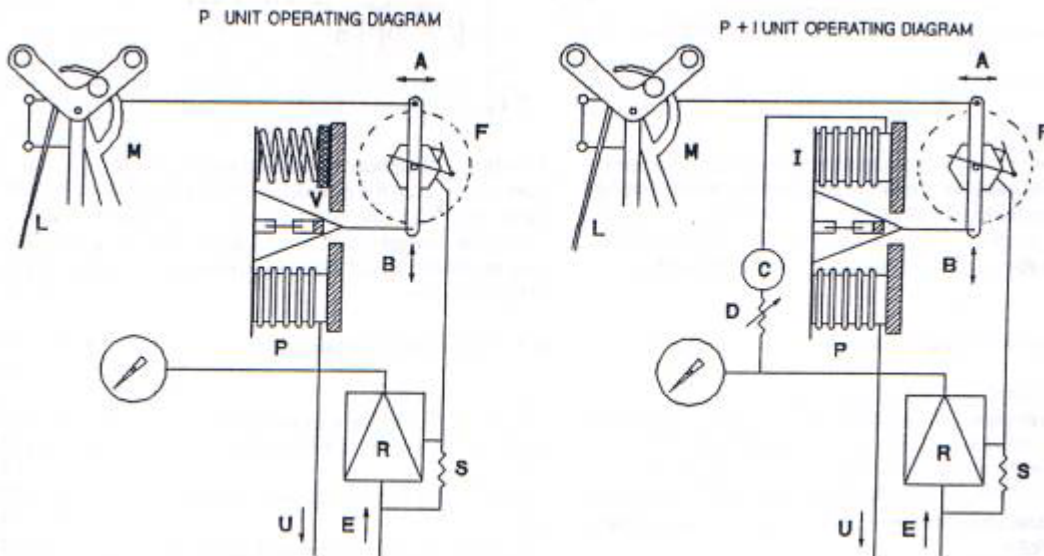


Figure 2. P and P+I unit operating diagram

#### 3.2 - Pre start-up checks

Before putting the controller into operation make sure that it has been correctly installed and is operative by checking the following:

- A Air supply is turned off.
- B Air lines are connected correctly and there are no leaks. Check all connections with water soap solution or other leak detector.
- C Measuring element is correctly installed.
- D The shut-off valves installed before and after the control valve are closed.
- E The set pointer and the process pointer operate freely without touching the scale.
- F Ensure that the controller is in the correct action (direct or reverse) to suit the action of control valve by positioning the proportional band dial in the correct segment:  
The stop between Direct and Reverse action is released by pushing the flexible stop plate on the red indicator of proportional band.

### **3.3 - Start-up procedure**

#### **FIRST PART**

If the controller response settings are not known, make initial adjustments as follows, to adjust the proper commands:

- A Controller with PI or PID modes
- |                        |   |          |
|------------------------|---|----------|
| Proportional band (BP) | : | 100%     |
| Integral action (I)    | : | 1 minute |
| Derivative action (D)  | : | minimum  |

These settings are purely arbitrary values. Final settings must be applied after the start-up procedures and after tuning the controller settings for optimum control, as described in the related paragraphs.

#### **SECOND PART**

- A** Start-up in automatic control mode and adjusting of set pointer.
- a** Position the set pointer at the lower end of the scale.
  - b** Turn on the air supply, 1.4 bar (= 20 psi).
  - c** Open the shut-off valves around the control valve and close the by-pass valve.
  - d** Adjust the set pointer gradually upscale until the set point index is at the required value (note 1).
- B** Automatic start-up and adjusting of air supply regulator.
- a** Position the set pointer at the required value without air supply.
  - b** Open the shut-off valves around the control valve and close the by-pass valve.
  - c** Turn on the air supply gradually until 1.4 bar (see note 1).
- C** Start-up in automatic control with internal auto/manual switch "bump-less" (for controllers with this option).
- a-** Set the auto/manual switch to the manual position (M).
  - b-** Check that the air supply to the relay is switched on and the manual regulator wheel is turned completely anti-clockwise.
  - c-** Position the set pointer at the required value.
  - d-** Turn on the air supply, 1.4 bar (= 20 psi).
  - e-** Open the shut-off valves around the control valve and close the by-pass valve.
  - f-** Slowly turn the manual regulator wheel until the process pointer coincides with the set pointer.

**Note:** *If during the operation f) - controller in manual control - oscillation or bumping is indicated, eliminate or reduce to a minimum value before switching into automatic.*

- g** Observe the balance detector. When the ball in the balance indicator is centred, turn the switch in automatic position (A).

**Note 1:** *If the controller doesn't have integral action there may be an offset between the process pointer or pen and set pointer. This offset will be reduced with the final adjustment described later and may be eliminated completely by adjusting the pre-load of proportional spring (see fig. 2).*

#### **4. Tuning the controller settings for optimum control**

The final check of actions that should be made after start-up procedure are indicated as follows.

##### **4.1 - Controllers with proportional action**

- A Make a small change in set pointer of an allowable value. Observe process and output responses.
- B If cycling of measured value doesn't occur, adjust proportional band to half of its value.
- C Repeat step a) and b) until cycling is observed, then increase proportional band to twice its value.
- D Reset the set-point at the desired value.

##### **4.2 - Controllers with proportional band and integral action**

- A Turn off integral action by rotating the integral action knob to max time.
- B Adjust proportional band as described in the previous paragraph.
- C Set the integral action time at one minute.
- D Make a small change in set point of an allowable value. Observe process and output responses.
- E If cycling doesn't occur, adjust the integral action time to half previous time.
- F Repeat step D and E until cycling is observed. Then increase integral action to twice its value.
- G Reset the set pointer index at the desired value. The coincidence between set and process pointers will be made automatically.

##### **4.3 - Alignment of the Controller (refer to fig.4)**

The purpose of the controller alignment is to ensure that, with the Set Pointer and Measured Value Pointer coincident, the Proportional Band Dial may be rotated from Maximum to Minimum without a significant change in the controller output.

The alignment may be made in the following procedure:

- Remove the scale dial. The auto/manual unit must be turned to AUTO position.
- Disconnect the measuring element link at the side of measuring element.
- Adjust the Set Pointer to approximately mid-scale, overlap the Set Pointer and Measured Value Pointer and fix the two together with tape or a clip.
- Rotate the Integral Action knob to 0.1 minute (Integral valve fully open)
- Put the Proportional Band to infinity Reverse Action.
- Connect a 1.4 bar air supply to the instrument supply port.
- Imprison 0.6 ± 0.04 bar in the Integral bellows. To have that proceed as follows;
  - > If the output signal pressure increases slowly, await until it arrives to 0.6 bar, then turn off quickly the Integral valve by rotating the Integral Action knob to 25 minutes.
  - > If the output signal pressure does not increase, screw in the maximum Proportional Band alignment screw (pos.5 in figure 4) until the output pressure begins to increase. Arrived at 0.6 bar turn off the Integral valve.
- Put the Proportional Band Dial to 20% Reverse Action and adjust the minimum Proportional Band adjustment screw (pos.3 in figure 4) to obtain 0.6 bar.
- Put the Proportional Band to maximum (or infinity) Reverse Action and turn the maximum Proportional Band alignment screw (pos.5 in figure 4) until the output pressure is 0.6 bar.
- Repeat the preceding two operations until turning the Proportional Band Dial the output

remains constant at 0.6 bar.

- Put the Proportional Band to 20% Direct Action, if the output signal remains at 0.6 bar the control unit is aligned has been carefully carried out.

If it is not so, put the Proportional Band Dial to between 100% and 200% Reverse Action and proceeds as follows:

- > If the output was less than 0.6 bar, turn clockwise the baffle adjustment screw (pos.4 in fig.4) by 1/4 revolution.
- > If the output was greater than 0.6 bar, unscrew the baffle adjustment screw (pos.4 in fig.4) by 1/4 revolution.
- Repeat the previous four operations (Put the Proportional Band Dial from 20% Direct action to 20% Reverse action) until the output remains 0.6 bar.
- Unfasten the two pointers and replace the measuring element link in the correct position.

### **5. - Auto / Manual control unit (extra feature)**

This option, see the sketch below, provides Auto / Manual switching to permit remote manual control or automatic control of the measured variable. The transfer balance detector [T] facilitates the balancing of the output pressures of the manual pressure regulator and the controller relay. When the pressures are balanced, with the ball detector in the centre of the tube, the Auto / Manual selector switch [A/M] can be switched without disturbing the output to the control valve. At the right side of the Auto / Manual selector switch there is a shut-off valve V having letter C written on it. With the Auto/Manual switch in the manual position and the shut-off valve V turned, with the help of a screw driver, to position C, the air supply to the controller output relay B is excluded. Thus permitting maintenance of the controller while the measured variable is under manual control.

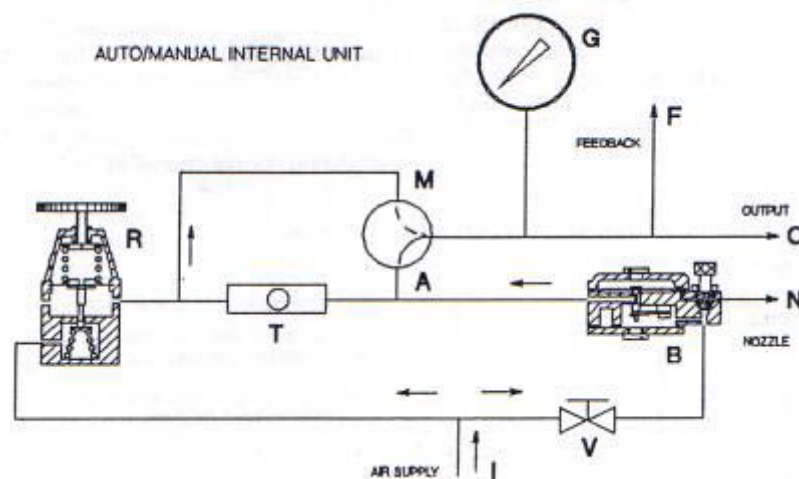


Figure 3. Auto /Manual internal unit

#### **5.1 - Switching from Automatic to Manual mode (refer to fig.3)**

- Slowly rotate the hand-wheel of the air pressure regulator [R] (lower left side into the case) until the ball in the balance indicator [T] is centred.
- Switch the Auto / Manual selector [A/M] to manual position [M]. The process is now on manual control and the output to the control valve is adjusted by the manual regulator knob. The output pressure signal can be read on the same gauge [G]

### 5.2 - Switching from Manual mode to Automatic mode (refer to fig.3)

Open the shut-off valve **V** to generate the output signal from the pneumatic control unit, the set point index will be drawn in coincidence with measured variable index. The small ball of the balance indicator [**T**] will reach the centre of the indicator with small oscillations for little movements of the set point index.

At this point it is possible to move the switch to Automatic control and then, if required to adjust the position of the set point index.

### 6. Direct and reverse action (refer to fig. 4)

The control unit may be preset in either direct or reverse action by positioning the proportional band dials in sector "Direct or Reverse" The stop between the two sectors is released by keeping the flexible stop plate [**2**] pressed.

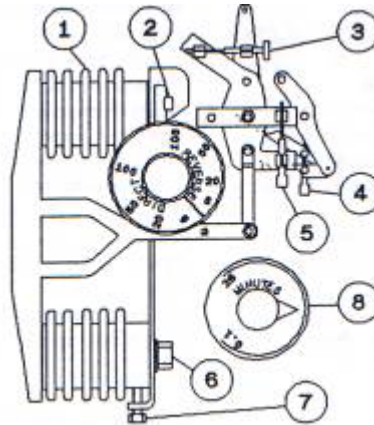


Figure 4. P+I control unit

### 7. Periodic maintenance

To ensure continuous and reliable operation it is important that a regular program of cleaning is adopted, to remove deposits of dust, oil and accumulation of water that might be present in the air supply and carried to the regulator. Accumulation of dust and/or oil can cause functional errors to control unit. Periodic maintenance should follow the following sequence:

- A Clean the calibrated restrictor [**1**] in the relay RE21 (see fig.5).
- B Clean the flapper/nozzle assembly.
- C Disassemble and clean the relay RE21.

The frequency of the cleaning procedures will depend upon the quality of the air supply which should be clean, dry and oil free.

#### 7.1 - Cleaning the calibrated restrictor

- A Switch off the air supply or, if the instrument has an internal Auto / Manual control, switch into Manual mode.
- B Loosen the clamp screw [**2**] to unlock the small fixing plate.
- C Remove the calibrated restrictor [**1**].
- D Wash the calibrated restrictor [**1**] in gasoline or trichloroethylene solvent and dry it with air.
- E The small hole into the hard stone of the restrictor [**1**] should be cleaned with a thin stainless metal (0.2 mm) wire.
- F Remount the restrictor [**1**] and tighten the clamp screw [**2**] to lock the fixing plate. Place the Auto / Manual control switch in Auto position.

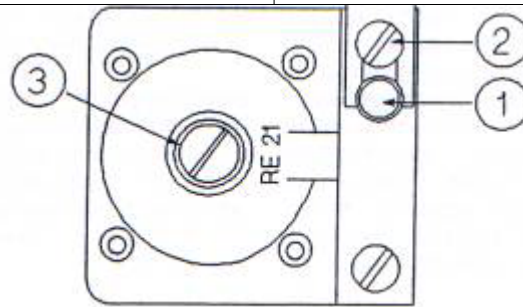


Figure 5. Pneumatic relay RE21

## 7.2 - Clean the Flapper / Nozzle assembly

A dirty flapper/nozzle assembly can cause a span base drift. It is necessary to dismount the control unit for cleaning.

### Dismantling the control unit and controllers with Auto/Manual control

- A Switch into manual action.
- B Remove the dial or diagram plate of the controller for approaching the control unit. For a good adjusting, without the graduated dial indicator, keep controlled variable pointer index, coinciding with the set pointer index, at maximum during the operation.
- C Turn the relay air supply shut-off valve [V] (see fig. 3) to position (C).
- D Detach the link from the control unit.
- E Remove the screws which fix the control unit to the case.
- F Remove the rubber pipes; thus allowing the control unit to be removed.

### Cleaning the nozzle

- A Clean the nozzle with a non-flexible wire ( $\varnothing$  0.2mm) or blow compressed air in the nozzle connection. Also clean the flapper surface with soft cloth.
- B Reinstall the control unit in reverse order. Place shut-off valve [V] in position A and place the Auto / Manual control switch in Auto position.
- .C Check the alignment of controller.

### 7.3 - Dismantling and cleaning the output relay (refer to figure 6)

It is a recommended procedure to replace the relay (type RE21) with a new one when the relay doesn't operate satisfactory. For the best cleaning it is necessary to disassemble the relay. As the factory centring of diaphragm 5 could be lost, the cleaning operation should be carried out with great care. Proceed as follows:

- A Turn the air supply off or, if the instrument has internal Auto/Manual control, switch over into manual mode and place shut-off valve [V] in position (C). See also figure 3.
- B Remove the dial of the diagram plate of the controller for approaching the relay. For good adjusting, without the graduated dial indicator, keep controlled variable pointer index the maximum possible coincident with the set pointer index during operation.
- C Unscrew the related screws. The relay is now separated from the instrument.
- D Unscrew the top plug of the relay.
- E Unscrew the screws to remove the top plate of the relay and the gasket.
- F Remove the metal diaphragm with the vent baffle and clean with suitable solvents.
- G Replace the metal diaphragm and gasket in its seat.

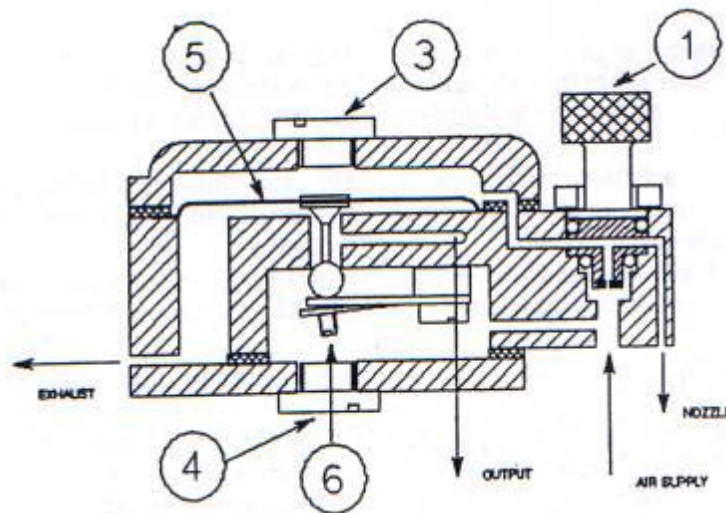


Figure 6. Cross section Pneumatic relay RE21

When reassembling, take care to:

- Use new gaskets
- Take off screw 3 to centre diaphragm 5 plug pushing gently with a small screwdriver or small rod.

Check that with way to nozzle closed and air supply set at 0,4bar, also the output pressure is stable at 0.4 bar. If it is necessary to correct the output pressure, shut off air supply, remove screw 4 and by trials, adjust the flat spring tension, tuning the screw 6. Screw the screw 4 back.

## 8. Trouble Shooting

### DEFECT

### PROBABLE CAUSE IN THE CONTROLLER

### PROBABLE CAUSE OUTSIDE CONTROLLER

Output too high

- verify for the correct Controller action (direct/reverse)
- verify if the nozzle exhaust is clean and that its supply piping is free
- check that the small air filter inside the output connection is not dirty.
- verify that the A/M switch is in Automatic mode

- control Valve undersized or oversized
- de differential pressure across the valve is too high

Output too low

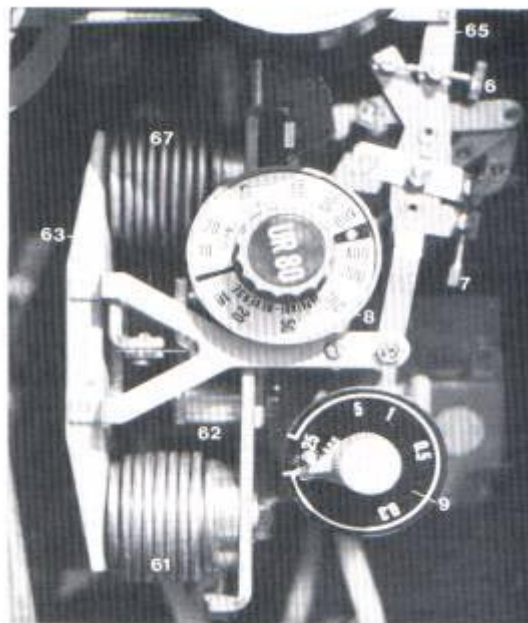
- The flapper does not properly cap the nozzle.
- Calibrated orifice (in output relay) clogged.
- Controller in wrong control action.
- Leak around Integral restrictor stem.
- Dirty relay stem.
- A/M switch in manual mode

- Valve oversized / undersized.
- Leak in output line or valve actuator.
- Low air supply pressure.

**9. Spare parts (refer to figures 4, 5, 6, 7 and 8)**

- |     |  |                 |
|-----|--|-----------------|
| 6-  | Minimum proportional band alignment screw (BP).  |                 |
| 7-  | Infinite proportional band alignment screw (BP). |                 |
| 8-  | Proportional band adjustment knob                |                 |
| 9-  | Integral action adjustment.                      |                 |
| 10- | Set pointer index                                | code 22/7       |
| 11- | Measured value pointer                           | code 22/7       |
| 13- | shut-off valve with O-ring                       | code PR 8/15    |
| 14- | auto-manual switch                               |                 |
| 30- | Measuring (receiving) element                    |                 |
| 31- | Control unit link                                | code 41/8       |
| 33- | Measuring element link                           |                 |
| 34- | Output gauge                                     | code MA 53      |
| 35- | PI Control unit UR 80 PI                         | code 47/13      |
| 40- | Pneumatic relay                                  | code RE21       |
|     | Gasket for relay RE21                            | code PR 7/3     |
| 41- | Calibrated orifice                               | code F-43/39127 |
| 43- | Balance detector                                 | code PR 8/16    |
| 44- | Manual output regulator                          | code 47/17      |
| 61- | Feedback (P) bellows                             | code PR 8/5     |
| 62- | Reaction unit support                            |                 |
| 63- | Reaction lever.                                  |                 |
| 65- | Proportional motion lever                        | code 23/14      |
| 67- | Integral action bellows                          | code PR 8/4     |
| 68- | I –action restrictor                             | code F47/55034  |

**Figure 7. PI Control unit UR80**



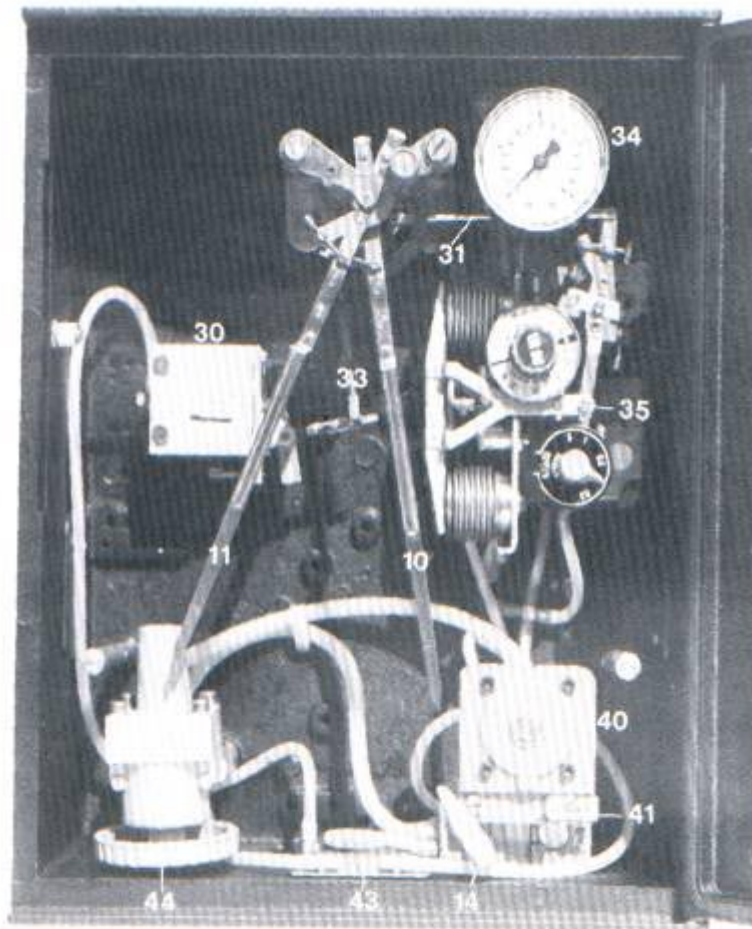


Figure 8. Pneumatic controller SG65