

## CHAPTER 7

### GENERATOR CONTROL CABINET

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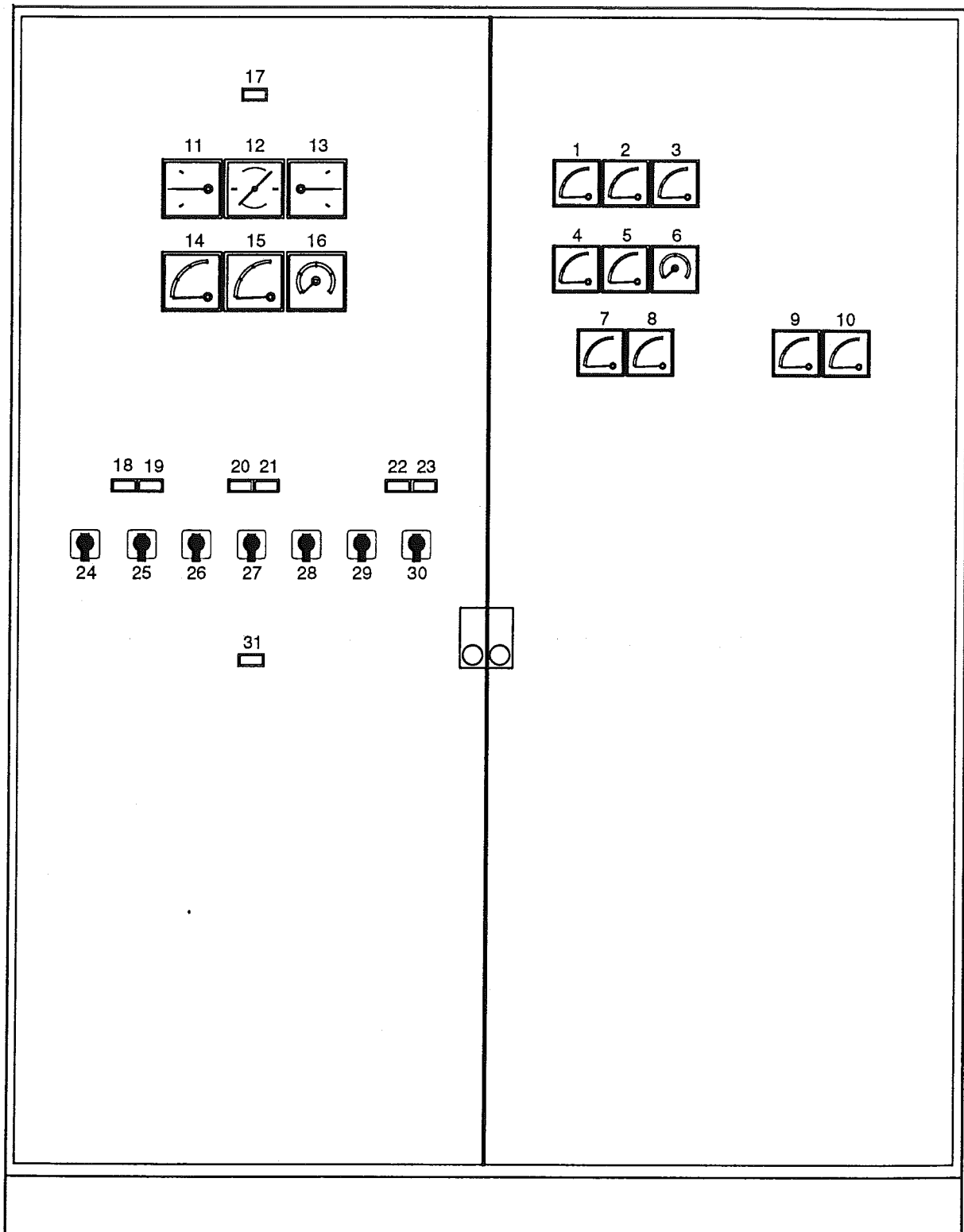


Figure 7.1 - Generator Control Panel

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**1 GENERAL**

The Generator Control and Synchronizing Control Panel comprise the two front panels of the Generator Control Cabinet for the Turbine/Generator Unit. The alpha-numeric codes in parenthesis '( )' following the item titles, relate to the figures opposite the following descriptions. The translation in the '{ }' brackets following the titles represents the actual dutch labelling on the front face of the respective panels.

The Synchronizing Panel provides the means of synchronizing the generator output with the main power system bus, prior to closing the Generator Circuit-breaker. The actual status of this Circuit-breaker is displayed by a Indicator Lamps on the Synchronizing Control Panel.

**2 METERS****AMPEREMETER PHASE L1 (1) {GENERATORSTROOM L1}**

This continuous-scale meter, (0 - 2000 Ampere), indicates the current in Phase L1 of the generator.

**AMPEREMETER PHASE L2 (2) {GENERATORSTROOM L2}**

This continuous-scale meter, (0 - 2000 Ampere), indicates the current in Phase L2 of the generator.

**AMPEREMETER PHASE L3 (3) {GENERATORSTROOM L3}**

This continuous-scale meter, (0 - 2000 Ampere), indicates the current in Phase L3 of the generator.

**WATTMETER (4) {GENERATOR MW}**

This is a continuous-scale meter, (-5 - 0 - 30 MW), indicating the generator active power load in MegaWatts.

**VAR METER (5) {GENERATOR MVAR}**

This is a continuous-scale meter, (-5 - 0 - 30 MVar), indicating the reactive power load on the generator. The meter is scaled in MVar.

**GENERATOR POWER FACTOR METER (6) {GENERATOR COS  $\phi$ }**

This is a continuous-scale meter, (0.5 - 1 - 0.5), indicating the power factor on the generator. The meter is scaled as the Cosine of the Phase Angle ( $\phi$ ).

**VOLTMETER (7) {GENERATOR SPANNING}**

This continuous-scale meter, (0 - 12 kV), indicates the generator phase-to-phase voltage. The phase-to-phase voltage displayed is measured between the generator phases L1 and L2.

**FREQUENCY METER (8) {GENERATOR FREKWENTIE}**

This continuous-scale meter, (0 - 55 Hz), indicates the frequency of the generator (Hz).

The meter shows the frequency at the generator side of the generator circuit-breaker. When the generator circuit-breaker is open, or the generator is the sole supplier to the busbar, the generator frequency may be adjusted by varying the turbine speed. Turbine speed may be adjusted by means of the SPEED REGULATOR Switch (28) when operating the turbine/generator in 'local' mode.

**VOLTMETER (9) {NET SPANNING}**

This continuous-scale meter, (0 - 36 kV), indicates the main power grid phase-to-phase voltage. The phase-to-phase voltage displayed is measured between the phases L1 and L2 of the main power supply.

**FREQUENCY METER (10) {NET FREKWENTIE}**

This continuous-scale meter, (0 - 55 Hz), indicates the frequency of the main power supply (Hz).

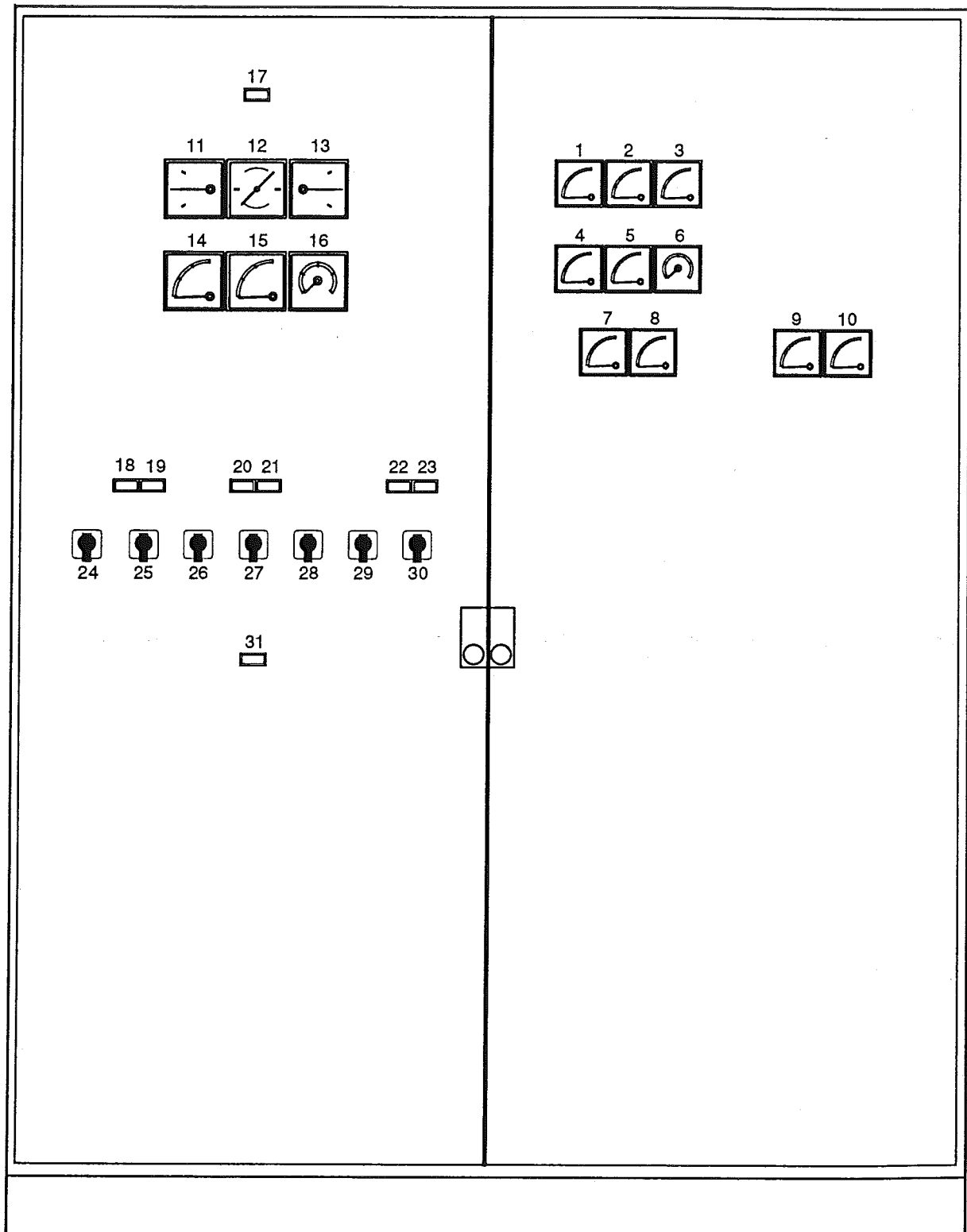


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**SYNCHRONOSCOPE (11 - 13) {SYNCHRONOSCOPE}**

This combination of three instruments indicates the relative voltage, angular displacement and frequency variation between the phases of the generator output with those of the main power network. To enable the synchronizing of them prior to closing circuit-breakers to feed the same bus.

The synchronization across the Generator Circuit-breaker can be automatically carried-out by the Control System where the Generator achieves 'Ready to Load Status'; or it may be carried out using the controls on the Turbine and Generator Control Panels. The synchronizing mode, 'Manual' or 'Auto', is selected by the MODE SELECTOR Switch (29).

The three component parts of the Synchronoscope are as follows:

**COMPARISON VOLTMETER (11)**

This is arcuate continuous-scale meter, graduated in volts (20 - 0 - 20), to show the relative difference in voltage between the generator and the main power network. Where the generator voltage is too low {Te laag} the needle will deflect down to indicate the voltage difference. Too high {Te hoog} a generator voltage will cause the needle to deflect upward.

**COMPARATIVE PHASE POSITION METER (12)**

The instrument has an indicator needle rotating about its centre point. If the needle appears to rotate, then the generator frequency does not exactly match that of the reference frequency. A clockwise rotation indicates the generator is running fast {Te snel}; conversely an anti-clockwise rotation, the generator is running slow {Te langzaam}.

A stationary needle indicates the relative angle between the phases. For the phases to be in synchronization the needle has to be in the horizontal position.

Adjustment of the generator speed to synchronize with the bus is achieved with the SPEED ADJUSTMENT Switch (28) prior to closing the Generator Circuit-breaker.

**COMPARATIVE FREQUENCY METER (13)**

This is arcuate continuous-scale meter, graduated in Hertz (10 - 0 - 10), to show the relative difference in frequency between the generator and the main power network. Where the generator frequency is too low {Te laag} the needle will deflect down to indicate the frequency difference. Too high {Te hoog} a generator frequency will cause the needle to deflect upward.

Synchronization is achieved when the needles on all three gauges are horizontal.

**EXCITATION VOLTAGE METER (14) {BEKRACHTIGINGSSPANNING}**

This continuous-scale meter, (0 - 150 V), indicates the generator excitation voltage. The excitation may be adjusted by the EXCITATION LOWER/RAISE Switch (26) when the EXCITATION AUTO/MANUAL Switch (25) is set to the 'Manual' position.

**EXCITATION CURRENT METER (15) {BEKRACHTIGINGSSTOOM}**

This continuous-scale meter, (0 - 15 A), indicates the generator excitation current.

**NULL BALANCE METER (16) {VERSCHILSPANNING REGELAARS}**

This is arcuate continuous-scale meter, graduated in volts (10 - 0 - 10), to show the relative difference in voltage between the generator and the main power network. This enables the Operator to adjust the generator excitation to achieve a balance with the voltage in the main power grid.

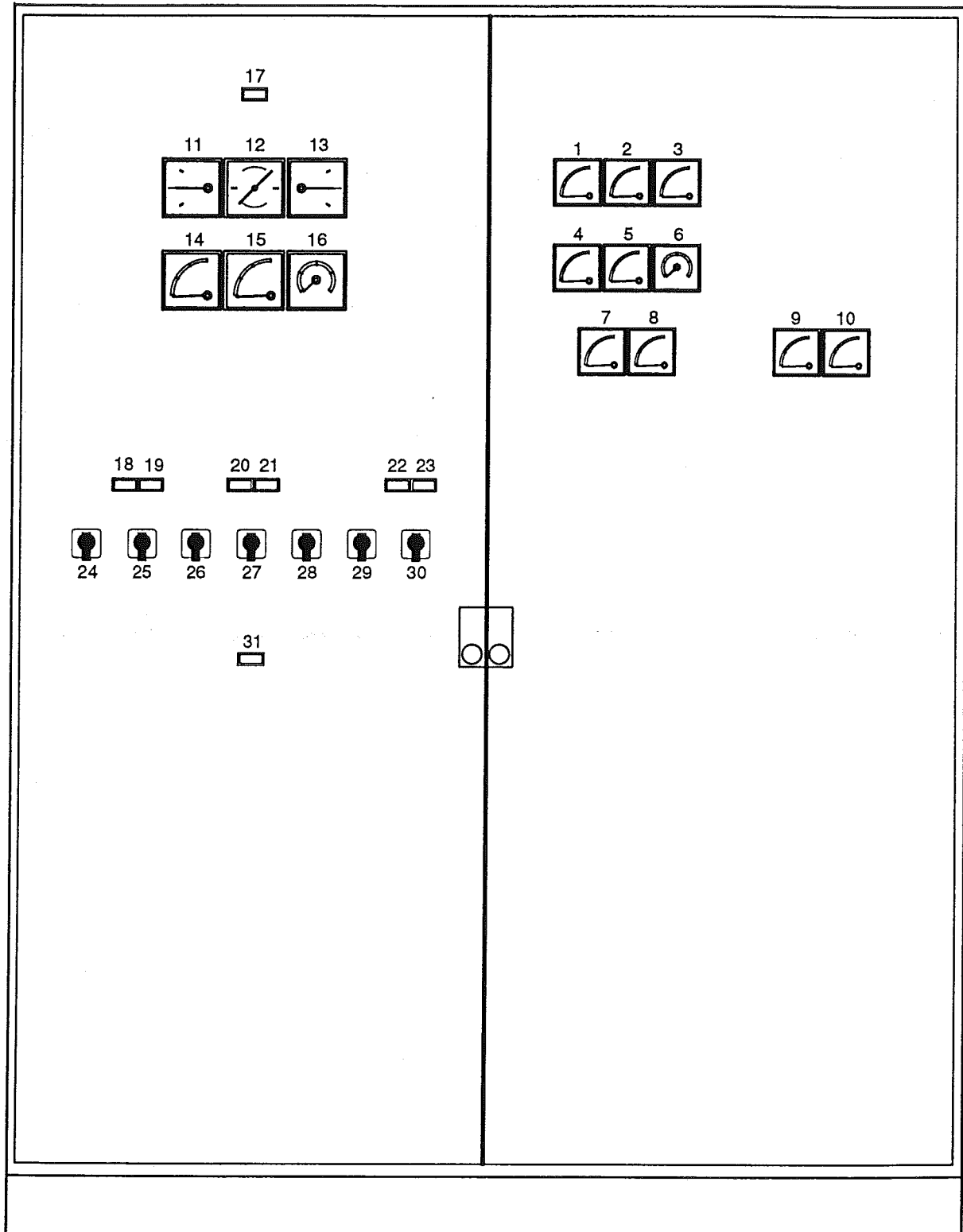


Figure 7.1 - Generator Control Panel

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**3 INDICATORS**

The control panel contains seven indicator lamps.

All indicator lamps relating to the Generator and Synchronizing Control functions may be tested by operation of the LAMP TEST Switch (31).

**3.1 INDICATOR LAMPS****TEST IN (17) {TEST IN}**

This white indicator lamp will illuminate to represent the activation of the Generator Circuit-breaker when carrying out synchronization in the 'Test' mode. The 'Test' mode is selected by the MODE SELECTOR Switch (29). In this mode the synchronisation of the Generator to the main power grid will be carried out, but, the closing of the Circuit-breaker will be inhibited.

**AUTOMATIC VOLTAGE REGULATOR (18) {AUTO}**

This white Indicator Lamp will illuminate when the Automatic Voltage Regulator is selected for operation. Selection is made by setting the EXCITATION AUTO/MANUAL Switch (25) to the 'Automatic' { 'Auto' } position.

**MANUAL VOLTAGE REGULATOR (19) {HAND}**

This white Indicator Lamp will illuminate when operation of the Voltage Regulator is to be carried out manually from this panel. Selection is made by setting the EXCITATION AUTO/MANUAL Switch (25) to the { 'Manual' } position.

**EXCITATION FIELD BREAKER OPEN (20) {UIT}**

This green Indicator Lamp will illuminate when the Excitation Field Breaker is open. Manual operation is made using the EXCITATION FIELD BREAKER Switch (27).

**EXCITATION FIELD BREAKER CLOSED (21) {IN}**

This red Indicator Lamp will illuminate when the Excitation Field Breaker is closed. Manual operation is made using the EXCITATION FIELD BREAKER Switch (27).

**GENERATOR CIRCUIT-BREAKER OPEN (22) {UIT}**

This green Lamp, when illuminated, indicates that the Generator Circuit-Breaker is open. Manual operation is made using the GENERATOR CIRCUIT-BREAKER Switch (27).

**GENERATOR CIRCUIT-BREAKER CLOSED (23) {IN}**

This red Lamp, when illuminated, indicates that the Generator Circuit-Breaker is closed connecting the Generator to the Bus. Manual operation is made using the GENERATOR CIRCUIT-BREAKER Switch (27) when the Generator and main grid bus have been synchronized.

**4 SWITCHES**

The switches for the general control of the generator are mounted on the front face of the Generator Control Panel.

**POWER FACTOR LOWER/RAISE SWITCH (24) {MVAr REGELING}**

This three-position rotary switch, with spring bias to the central position, enables the Power Factor value to be raised or lowered as required.

**EXCITATION AUTO/MANUAL SWITCH (25) {BEKRACHTIGING}**

This two-position rotary switch enables the type of voltage controller used by the system to be selected or the operating condition to be displayed by the instruments. The Generator Voltage Control Regulation may be by an Automatic Voltage Regulator or by Manual Control from this Panel.

Should the Automatic Voltage Regulator (AVR) fail then the control will automatically change to 'Manual' Control to provide continuity of operation. This switch will normally be set to the 'Auto' position.

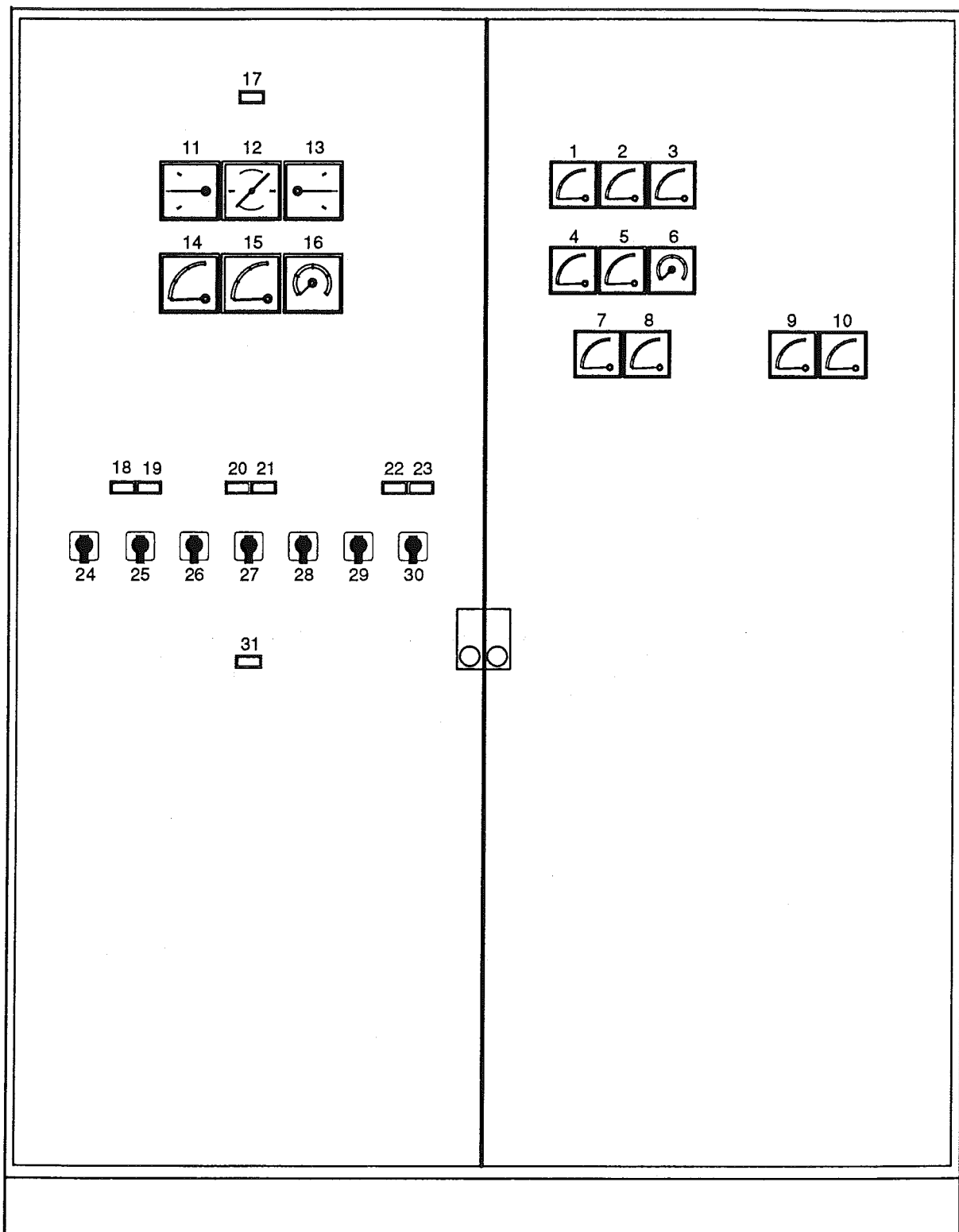


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**EXCITATION RAISE/LOWER SWITCH (26) {SPANNINGSREGELING}**

This three-position rotary switch, with spring bias to the central position, enables adjustment of the Excitation Voltage. Turning and holding this switch to the 'Raise' or 'Lower' position whilst the Generator is functioning will adjust the output voltage as displayed on VOLTMETER (14). Once the desired value is attained release the switch and it will return to the central neutral position.

**EXCITATION FIELD BREAKER SWITCH (27) {BEKRACHTIGING}**

This three-position rotary switch is used to open {uit} or close {in} the EXCITATION FIELD BREAKER. The switch is spring biased to the central 'off' position. Turning the switch momentarily to the left will open {uit} the excitation field breaker.

Turning the switch momentarily to the right will close {in} the generator circuit-breaker; provided that the conditions for closing the circuit-breaker are correct.

**SPEED ADJUSTMENT (28) {TOERENTAL}**

This three-position rotary switch is spring biased to the central 'Off' position. When turned, momentarily, to the left (LOWER) or right (RAISE), will vary the speed of the Turbine Generator Unit.

This will have a directly proportional effect on:-

- » the frequency of the generator output when operating without load, or
- » the load when the Generator Circuit-breaker is closed.

The switch is spring biased to the central 'off' position.

This control will only be operational when the SYNCHRONIZATION MODE SELECTOR Switch (29) on the Generator Control Panel is set to the 'Manual' position.

**SYNCHRONIZATION MODE SELECTOR SWITCH (29) {SYNCHRONISATIE}**

This two-position key operated rotary switch allows for the selection of the mode of synchronization to be utilized:

- » Automatic With the switch set to this position the synchronization of the Generator will be carried out automatically by the Control System when the 'Ready to Load' status is attained.
- » Manual The switch set to this position enables the Synchronization of the Generator to the Bus to be carried out utilizing the controls on this Panel.
- » Test With the switch set to this position the synchronization of the Generator will be carried out automatically by the Control System, but, the Generator Circuit-breaker will be inhibited from closing. The TEST IN Indicator (17) will illuminate to signify the simulation of the closing of the Generator Circuit-breaker.

**GENERATOR CIRCUIT-BREAKER SWITCH (30) {GENERATOR SCHAKELAAR}**

This three-position rotary switch is used to open {åpne} or close {lukke} the Generator Circuit-breaker when operating in the 'Manual' mode. The switch is spring biased to the central 'off' position. Turning the switch momentarily to the left will open {åpne} the generator circuit breaker.

Turning the switch momentarily to the right will close {lukke} the generator circuit-breaker; provided that the conditions for closing the circuit-breaker are correct.

**LAMP TEST (31) {LAMP TEST}**

This push-button switch, when depressed, will illuminate all the Indicator Lamps on the Synchronizing and Generator Control Panels.

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**5 CONTROLS WITHIN CABINET**

Mounted within the cabinet, behind the right-hand door, on a swing-out panel are the synchronizer; check synchronizer and voltage regulator modules. These modules and their facilities are detailed in the suppliers documentation within Part 7 of the Technical Manual.

**NOTE:** No adjustments should be made to the adjustable controls on these panels without the authorization of **Dresser-Rand Power**. Unauthorized adjustments could invalidate any warranty in force at that time.

Mounted on the rear wall of the cabinet behind the inner swing-out door are the following fuses and fuse switches:

- » Two push-button operated three-pole switches rated at 7.5 Ampere
- » Two melt fuses that are rated at 2.2 Ampere.
- » Eight two-pole miniature circuit-breaker type fuses. Two rated at 2 Ampere and the remaining at 4 Ampere.
- » Five four-pole miniature circuit-breaker type fuses. Each rated at 2 Ampere.