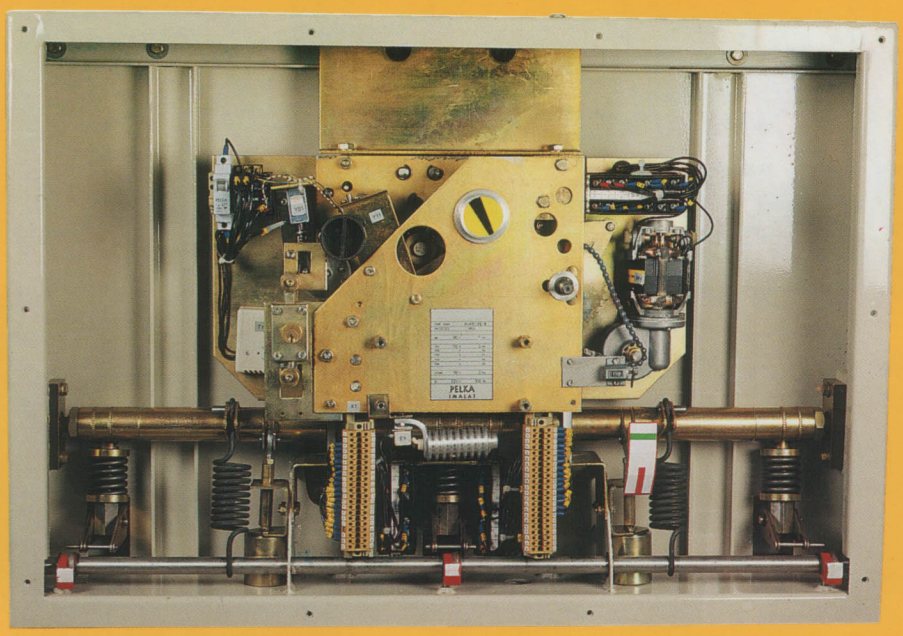
PELKA

# ASSEMBLING AND SERVICE MANUAL FOR PVB TYPE VACUUM CIRCUIT BREAKERS 7.2 kV to 36 kV



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# 1. GENERAL

The PVB type circuit-breakers are delivered fully assembled and complete with their operating systems.

All essential adjustments are carried out in the factory at the final inspection stage. Individual testing of the mechanical operation as well as dielectric tests are undertaken in a similar manner.

Consequently, the circuit-breakers are ready for use as soon as they reach their operational site.

For the transportation, the units must be set in the "open circuit position" with their spring "released".

The type coding of the units is given as follows:

PVBn-x/y "z"

where:

P : PELKA

V : vacuum

B : breaker

n : is a digit corresponding to the voltage level specified (3=7,2 kV, 4=12 kV, 5 = 17,5 kV, 6= 24 kV and 7 = 36 kV).

x : is the breaking capacity (round numbers in kA)

y : is the rated current (round numbers in Ax100).

"z" : is the complementary letter corresponding to the arrangement required .

"W" for Withdrawable type

"F" for Fixed type

# 2. STORAGE

Mechanism should be stored in dry location with enouqh ventilation. The air in the storage location must be free of dust, smoke and corrasive or flammable gases.

# 3. SAFETY

**PERSONAL SAFETY**

**The cover of the circuit breaker should not be taken out when the spring is charged.**

If any problem occurs in mechanism; before taking the cover out:

— The auxilliary circuit must be opened.

— The spring must be released.

**MATERIAL SAFETY**

**The mechanism should not be operated when the poles are not connected.**

— Some parts may be damaged if the mechanism is operated when the poles are not connected.

— The vacuum interrupters are fragile, must be carried properly.

**BEFORE OPERATING**

Internal cable connection of circuit breaker and the adjustment of the mechanism has been done in the factory. These must not be changed.

Spring tension is adjusted according to normal operation at -25 °C.

**Auxillary Circuits Connections**

The supply voltage for motor and auxillary circuits must be checked.

— Cable connections: use the o-ring to protect the cable under the mechanism.

— Circuit breaker wiring scheme should be used to make electrical connections.

**VCB Operation**

In order to check the proper operation of the VCB, make several open/close operations manually and automatically.

If the VCB is equipped with "Low voltage relay", during checking the VCB operation, fix the moving core of relay when the low voltage circuits are cut off. (Otherwise VCB will open immediately).

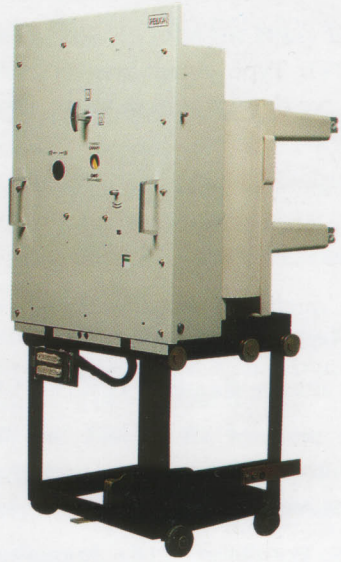
# 4. PRODUCTION RANGE

| Rated Voltage | Rated Current | Rated Short Circuit Breaking Current | Rated Short Circuit Duration | Circuit Breaker Type |
|---|---|---|---|---|
| 7.2 kV | 800A | 16 kA | 3 sec | PVB3-16/8 (W or F) |
| 7.2 kV | 1250A | 16 kA | 3 sec | PVB3-16/12 (W or F) |
| 7.2 kV | 800A | 20 kA | 3 sec | PVB3-20/8 (W or F) |
| 7.2 kV | 1250A | 20 kA | 3 sec | PVB3-20/12 (W or F) |
| 7.2 kV | 1600A | 20 kA | 3 sec | PVB3-20/16 (W or F) |
| 7.2 kV | 2000A | 20 kA | 3 sec | PVB3-20/20 (W or F) |
| 7.2 kV | 800A | 25 kA | 3 sec | PVB3-25/8 (W or F) |
| 7.2 kV | 1250A | 25 kA | 3 sec | PVB3-25/12 (W or F) |
| 7.2 kV | 1600A | 25 kA | 3 sec | PVB3-25/16 (W or F) |
| 7.2 kV | 2000A | 25 kA | 3 sec | PVB3-25/20 (W or F) |
| 7.2 kV | 2500A | 25 kA | 3 sec | PVB3-25/25 (W or F) |
| 7.2 kV | 800A | 31.5 kA | 3 sec | PVB3-31/8 (W or F) |
| 7.2 kV | 1250A | 31.5 kA | 3 sec | PVB3-31/12 (W or F) |
| 7.2 kV | 1600A | 31.5 kA | 3 sec | PVB3-31/16 (W or F) |
| 7.2 kV | 2000A | 31.5 kA | 3 sec | PVB3-31/20 (W or F) |
| 7.2 kV | 2500A | 31.5 kA | 3 sec | PVB3-31/25 (W or F) |
| 7.2 kV | 3150A | 31.5 kA | 3 sec | PVB3-31/31 (W or F) |
| 7.2 kV | 800A | 40 kA | 3 sec | PVB3-40/8 (W or F) |
| 7.2 kV | 1250A | 40 kA | 3 sec | PVB3-40/12 (W or F) |
| 7.2 kV | 1600A | 40 kA | 3 sec | PVB3-40/16 (W or F) |
| 7.2 kV | 2000A | 40 kA | 3 sec | PVB3-40/20 (W or F) |
| 7.2 kV | 2500A | 40 kA | 3 sec | PVB3-40/25 (W or F) |
| 7.2 kV | 3150A | 40 kA | 3 sec | PVB3-40/31 (W or F) |
| 12 kV | 800A | 16 kA | 3 sec | PVB4-16/8 (W or F) |
| 12 kV | 1250A | 16 kA | 3 sec | PVB4-16/12 (W or F) |
| 12 kV | 800A | 20 kA | 3 sec | PVB4-20/8 (W or F) |
| 12 kV | 1250A | 20 kA | 3 sec | PVB4-20/12 (W or F) |
| 12 kV | 1600A | 20 kA | 3 sec | PVB4-20/16 (W or F) |
| 12 kV | 2000A | 20 kA | 3 sec | PVB4-20/20 (W or F) |
| 12 kV | 800A | 25 kA | 3 sec | PVB4-25/8 (W or F) |
| 12 kV | 1250A | 25 kA | 3 sec | PVB4-25/12 (W or F) |
| 12 kV | 1600A | 25 kA | 3 sec | PVB4-25/16 (W or F) |
| 12 kV | 2000A | 25 kA | 3 sec | PVB4-25/20 (W or F) |
| 12 kV | 2500A | 25 kA | 3 sec | PVB4-25/25 (W or F) |
| 12 kV | 800A | 31.5 kA | 3 sec | PVB4-31/8 (W or F) |
| 12 kV | 1250A | 31.5 kA | 3 sec | PVB4-31/12 (W or F) |
| 12 kV | 1600A | 31.5 kA | 3 sec | PVB4-31/16 (W or F) |
| 12 kV | 2000A | 31.5 kA | 3 sec | PVB4-31/20 (W or F) |
| 12 kV | 2500A | 31.5 kA | 3 sec | PVB4-31/25 (W or F) |
| 12 kV | 3150A | 31.5 kA | 3 sec | PVB4-31/31 (W or F) |
| 12 kV | 800A | 40 kA | 3 sec | PVB4-40/8 (W or F) |
| 12 kV | 1250A | 40 kA | 3 sec | PVB4-40/12 (W or F) |
| 12 kV | 1600A | 40 kA | 3 sec | PVB4-40/16 (W or F) |
| 12 kV | 2000A | 40 kA | 3 sec | PVB4-40/20 (W or F) |
| 12 kV | 2500A | 40 kA | 3 sec | PVB4-40/25 (W or F) |
| 12 kV | 3150A | 40 kA | 3 sec | PVB4-40/31 (W or F) |
| 17.5 kV | 800A | 16 kA | 3 sec | PVB5-16/8 (W or F) |
| 17.5 kV | 1250A | 16 kA | 3 sec | PVB5-16/12 (W or F) |
| 17.5 kV | 800A | 20 kA | 3 sec | PVB5-20/8 (W or F) |
| 17.5 kV | 1250A | 20 kA | 3 sec | PVB5-20/12 (W or F) |
| 17.5 kV | 1600A | 20 kA | 3 sec | PVB5-20/16 (W or F) |
| 17.5 kV | 2000A | 20 kA | 3 sec | PVB5-20/20 (W or F) |
| 17.5 kV | 800A | 25 kA | 3 sec | PVB5-25/8 (W or F) |
| 17.5 kV | 1250A | 25 kA | 3 sec | PVB5-25/12 (W or F) |
| 17.5 kV | 1600A | 25 kA | 3 sec | PVB5-25/16 (W or F) |
| 17.5 kV | 2000A | 25 kA | 3 sec | PVB5-25/20 (W or F) |
| 17.5 kV | 2500A | 25 kA | 3 sec | PVB5-25/25 (W or F) |
| 17.5 kV | 800A | 31.5 kA | 3 sec | PVB5-31/8 (W or F) |
| 17.5 kV | 1250A | 31.5 kA | 3 sec | PVB5-31/12 (W or F) |
| 17.5 kV | 1600A | 31.5 kA | 3 sec | PVB5-31/16 (W or F) |
| 17.5 kV | 2000A | 31.5 kA | 3 sec | PVB5-31/20 (W or F) |
| 17.5 kV | 2500A | 31.5 kA | 3 sec | PVB5-31/25 (W or F) |
| 17.5 kV | 3150A | 31.5 kA | 3 sec | PVB5-31/31 (W or F) |
| 17.5 kV | 800A | 40 kA | 3 sec | PVB5-40/8 (W or F) |
| 17.5 kV | 1250A | 40 kA | 3 sec | PVB5-40/12 (W or F) |
| 17.5 kV | 1600A | 40 kA | 3 sec | PVB5-40/16 (W or F) |
| 17.5 kV | 2000A | 40 kA | 3 sec | PVB5-40/20 (W or F) |
| 17.5 kV | 2500A | 40 kA | 3 sec | PVB5-40/25 (W or F) |
| 17.5 kV | 3150A | 40 kA | 3 sec | PVB5-40/31 (W or F) |
| 24 kV | 800A | 16 kA | 3 sec | PVB6-16/8 (W or F) |
| 24 kV | 1250A | 16 kA | 3 sec | PVB6-16/12 (W or F) |
| 24 kV | 1600A | 16 kA | 3 sec | PVB6-16/16 (W or F) |
| 24 kV | 800A | 25 kA | 3 sec | PVB6-25/8 (W or F) |
| 24 kV | 1250A | 25 kA | 3 sec | PVB6-25/12 (W or F) |
| 24 kV | 1600A | 25 kA | 3 sec | PVB6-25/16 (W or F) |
| 24 kV | 2000A | 25 kA | 3 sec | PVB6-25/20 (W or F) |
| 24 kV | 2500A | 25 kA | 3 sec | PVB6-25/25 (W or F) |
| 36 kV | 800A | 16 kA | 3 sec | PVB7-16/8 (W or F) |
| 36 kV | 1250A | 16 kA | 3 sec | PVB7-16/12 (W or F) |
| 36 kV | 800A | 25 kA | 3 sec | PVB7-25/8 (W or F) |
| 36 kV | 1250A | 25 kA | 3 sec | PVB7-25/12 (W or F) |
| 36 kV | 2000A | 25 kA | 3 sec | PVB7-25/20 (W or F) |

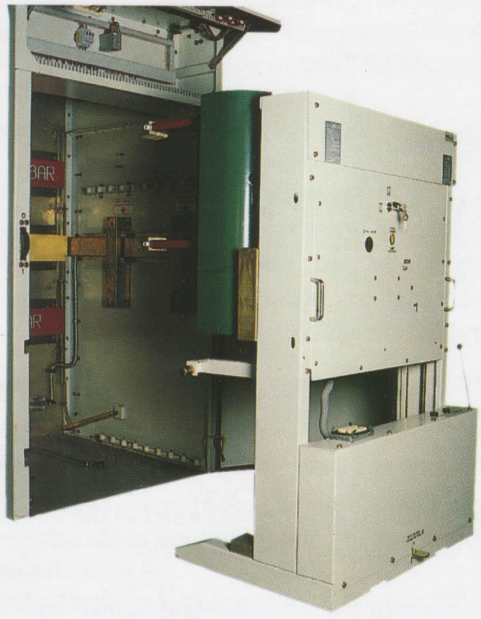
# 5. STANDARD PRODUCTIONS

Pelka circuit - breakers are supplied in the following types:

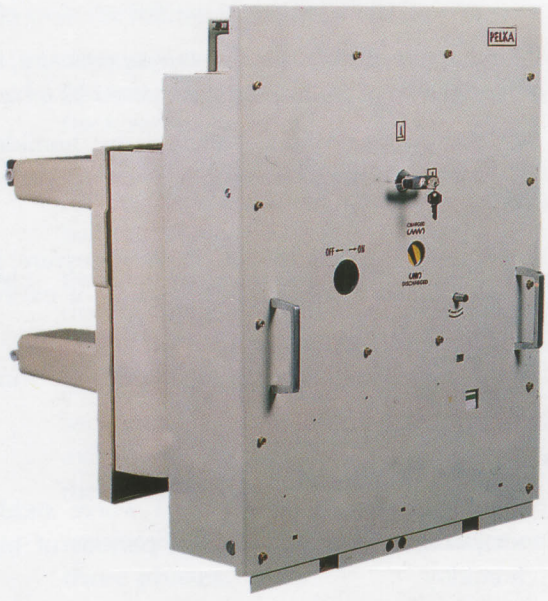

Fixed Type




Withdrawable Type



Elevator Type (For Double Busbar S/G's)




Withdrawable Cassette Type

# 6. INSTALLATION AND COMMISSIONING

Whatever the arrangement of the circuit-breaker is; the connection of the conductors to the terminals must be such that no undue load is applied to the latter, particularly when short-circuits occur.

Since the PVB Type circuit-breakers are designed for indoor use, we draw attention to the climatic utilization criteria below:

a) The ambient air temperature should not exceed 45°C and its average value, measured over a period of 24 hr, should not exceed 40 °C.

The minimum ambient air temperature should not be lower than -25°C.

b) The altitude should not exceed 1000 m.

c) The ambient air should not be significantly polluted by dust, smoke, corrosive or flammable gases, vapours or salt.

d) The conditions of humidity are under consideration but, in the meantime, the following figures can be used as a guide:

- the average value of the relative humidity, measured during a period of 24 hr, must not exceed 95 %.
- the average value of the vapour pressure, for a period of 24 hr, must not exceed 22 mbar.
- the average value of the relative humidity, for a period of one month, must not exceed 95 %.
- the average value of the vapour pressure, for a period of one month, must not exceed 18 mbar.

For these conditions, condensation may occasionally occur.

**Notes:**

1. Condensation can be expected where sudden temperature changes occur in periods of high humidity.
2. To withstand the effects of humidity and heavy condensation, such as breakdown of insulation or corrosion of metallic parts, indoor switchgear, designed for such conditions and tested accordingly, or outdoor switchgear may be used.
3. Condensation may be prevented by special design of the building or housing, by suitable ventilation and heating of the station or by the use of dehumidifying equipment.

e) Vibrations due to causes external to the switchgear and controlgear or earth tremors are negligible.

The circuit-breakers of PVB Type belong to class" minus 25 indoor".

When installing circuit-breakers in metal roofed sub-stations, it is essential to provide adequate heating and ventilation.

In order to connect the conductors to the circuit-breaker terminals, the following operations must be completed:

1) brush the contact surfaces to remove all oxyde deposits.

2) immediately after operation 1), apply a thin coating of neutral vaseline and smear carefully with a brush for filling up all the apertures of material.

3) wipe-off all the swarf left over from operation 2) with a clean rag, while avoiding complete degreasing. Immediately after this smear a new vaselin layer and then connect the conductors to the circuit-breaker terminals.

**COMMISSIONING**

Though prior to leaving our works, all circuit-breakers are very severely inspected, nevertheless it is advisable that they must be carefully examined prior to commissioning in order that any damage during transport be ascertained.

Normally, no adjustments are necessary after receipt of the unit.

The following verifications must be undertaken:

- the operating system is coupled to the terminals of the circuit-breaker.
- no foreign matter remains in the operating system (packing, electrical wiring, etc.)
- the unit is dustfree and the transport labels are removed.

In the case of a motor driven operating system, it will be necessary to connect up to the electrical supply by following the wiring diagram enclosed with the unit.

If the circuit-breakers are fitted with primary relays, set these to the values required.

When the circuit-breakers are considered to be in good working order, they may be connected to the grid.

Prior to applying voltage check to the terminals, carefully clean the surface of all insulating components with a soft and very dry cloth.

Circuit-breakers fitted with a non-motorized operating system must be switched on by two consecutive operations; the first operation consists in binding and locking the engagement springs by a pendular movement of the lever; the second operation causes switching-on of the unit by un-locking the spring by means of the operating knob located on the front face of the operating-system: the knob must be rotated clockwise.

Dis-engagement (or switching-off) of the unit is obtained by rotating the same knob (located on the front face of the operating system) in a-counter-clockwise direction. Repeat several times the engagement and dis-engagement operations and control the position indicators located on the terminals and on the operating-system.

The circuit-breakers fitted with a motor driven operating-system type PCRR are fitted with engagement springs which are bound and locked automatically as soon as the voltage is applied. The engaging operation is then performed by the knob located on the front face of the system.

For dis-engagement, proceed as for non-motorized systems.

In this case also, repeat several times the engagement and disengagement operations, and in the case of remote control operating, monitor the position signalization.

**PRIMARY RELAYS**

1. **Primary relays fitted in the plant prior to delivery.**

   The primary relays factory assembled to PVB type circuit-breakers do not require any mechanical adjustment on site.

2. **Circuit - breaker supplied with linkage but without relays.**

   The relays must be set according to the assembly instructions.

   The final setting must be done as per par. 4 hereunder.

3. **Replacement of one or more relays.**

   The circuit-breaker must be removed from its installation, in the switched-off position and closing spring released, and then the relay(s) to be replaced must be removed.

   Then proceed as from par. 2.

4. **Adjustment of the linkage for relay tripping and resetting**

   A PVB circuit-breaker fitted with direct relays of MU, MUT or MT type must be suitable for operating as follows, after commissioning (unit disconnected):

   a) when switched-on, the unit must remain switched-on.

   b) when switched-on, the unit must switch-off when pressing the tripping push-button of one of the relays. This operation must automatically reset the relay.

   Before installation of the circuit-breaker, it will consequently be necessary to undertake:

   - the switching-on and switching-off operations of the circuit - breaker.

   - the switching - off operations (caused by each relay) and verification of the hereabove conditions.

In case of maloperation, undertake successively on the faulty pole the following operations:

- disengage the insulated connecting - rod from the axle of the relay by removing the safety hook and the washer.
- lengthen the insulating connecting - rod by rotating the top end counter-clockwise by a half-turn (or more).

**Note :** the length of the insulating crank must be such that the lower part of the top end contacts the axle of the relay lever when the latter is pushed against its stop, at the top.

- secure the insulating connecting - rod to the axle of the relay by repositioning washer and the safety hook.
- resume verification of correct operation on **the three phases.**
- when the unit complies with the two operating criteria (a) and (b) hereabove, then par 1 applies

# 7. SPRING OPERATING MECHANISM TYPE PCRR 1000

**TYPE PCRR 1000**

The model PCRR 1000 is a mechanism in which the closing springs are charged **automatically** by a motor and is fitted with a shunt closing release. Provision is also made for manual charging of the closing spring. The mechanism can be easily motorized after delivery. The diagram of operation is shown in fig. 1

It represents the circuit-breaker open, closing springs charged and locked, and the mechanism ready for closing.

The main elements are as follows:

- A closing system "A" controlled by a closing lever fitted to the closing shaft (5) or by an electric motor (4)
- The "C" sub-system which includes the camshaft (9) and lever (3) linked to the closing spring (1).
- The "L" main lever system (11) - the connecting rod (13) transmitting the movement to the drive shaft.
- A drive shaft (14) linked to the connecting rod system of the circuit - breaker, to the tripping springs (17) and to the damping system.
- A system of connecting rods fitted with pressure springs (18).
- A setting latch "E" allowing resetting of the controls while maintaining the poles of the circuit - breaker in the open position.
- A tripping lock "D" that maintains the circuit-breaker closed.
- A tripping release (22).
- A shunt closing release (8) OPTIONAL.
- Auxillary equipment such as:
  - auxiliary switches (18)
  - anti-pumping relay (24)
  - a manual trip-close knob (7).
  - spring wind motor with gear train (4)
  - motor limit switch (21)
- The following indicators are on the front panel:
  - circuit-breaker position (close-open)
  - main contact wear (on each tube)
  - condition of closing springs (charged - discharged).

**OPERATION**

**Closing**

The closing spring (1) is compressed by traction on the chain (2) produced by the rotation of crankshaft (3) moved manually by means of a handle actuating the shaft (5), or electrically by the motor with reducing gears (4)

When, on charging of spring (1), the crankshaft (3) exceeds its dead-point by some degrees, the closing spring (1) tends to continue its stroke, but the latch (6), an element of the closing lock, prevents it from doing so. In this state, the closing lock can be released at any desired moment, either locally by clockwise rotation of the trip-close knob (7) or, if fitted, electrically by remote impulse to the shunt release (8).

The crankshaft (3) is then released. It drives the cam (9) which by its action on roller (10) gives rise to the rotation of lever (11) which holds the tripping latch (12) and is connected to the main operating shaft (14) by the connecting rod (13). The rotation of this shaft (14) controls the closing of the poles (16) by means of lever (15); it also produces the charging of the tripping spring (17), the compression of spring (18) ensuring the pressure on the main contacts of the poles (16) and the operation of the auxiliary switch (19).

On completion of this rotation, the latch (12) is locked in the tripping position lock by the release of the detent catch (26)

Moreover, the rotation of crankshaft (3) allows the action of the clutch (20) of the motor and speedreducer combination and the inversion of the contacts of the motor limit switch (21) which controls the supply to the motor (4) and indicates the position of the closing spring (1).

**Tripping**

The tripping spring (17) has been charged during the closing cycle and locked by the tripping lock by means

of latch (26). The opening of poles (16) occurs by the release of spring (17) made possible by the releasing of latch (12) when the detent catch (26) is moved by:

- either locally by counter-clockwise rotation of Trip-Close knob (7)
- or, where remote shunt tripping or undervoltage release have been provided (22), by electrical impulse
- or by primary relays action.

The end of the stroke of the moving components is damped by the hydraulic damper (23).

**Auto-reclosing**

As soon as the circuit has been closed, the closing spring (1) is automatically recharged by the spring wind motor. The control mechanism is then ready for auto-reclose by means of a remote signal to the shunt closing release (8).

An anti - pumping relay (24) prevents the inadvertent auto-reclosing of the circuit-breaker when the electrical closing command is maintained by mistake. When the circuit-breaker is closed, the roller (25) of lever (11) blocks the latch (6) of the closing lock, preventing its release and the false release of the closing spring (1) energy.

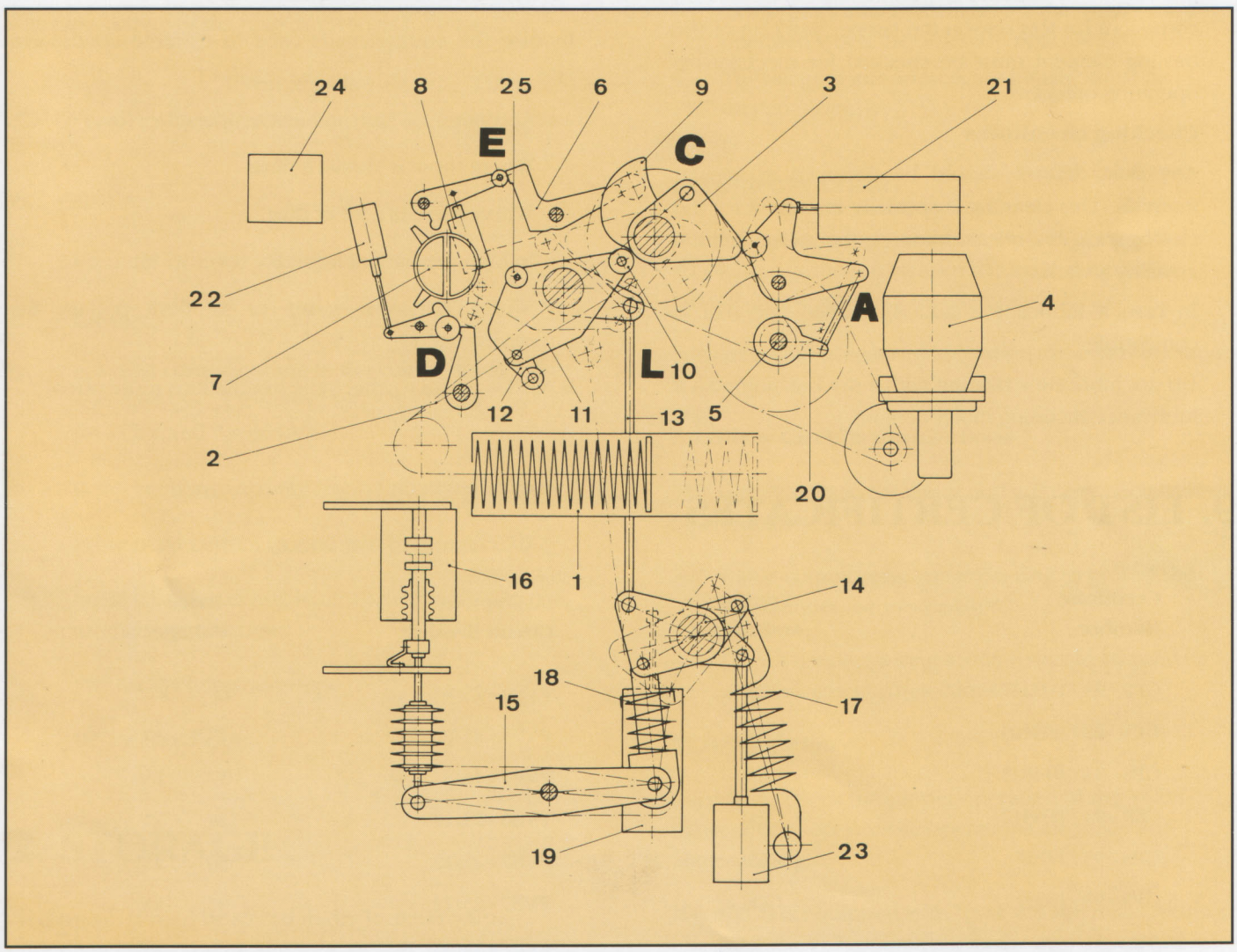



FIG. 1 - PCRR Operation Diagram

# 8. MAINTENANCE

Under normal operating conditions PVB type VCBs do not need maintenance at least 20 years. (no lubrication, no adjustment, no change of vacuum interrupters)

In practice, we nevertheless advise a few tasks for the proper management of an installation:

- The operating mechanism should not remain outside or in a damp place without heating. It shall be stored standing up (in its installation position). If it is not equipped with heating elements, it must be stored in a heated room.
- **Monitoring humidity**

  It is important to avoid any condensation to prevent corrosion; for this reason the proper working of the heating element must be checked for mechanisms operating outdoors.
- **Checking cleanliness**

  Any dust deposit should be removed at regular intervals. This cleaning is specially important for the closing lock, the release devices, the motor and the ancillary switch.
- In case a lubricant is added, choose one that is compatible
- Do not lubricate a bearing with a dry bushing with a lubricant containing molybdenium.
- It is recommended to operate several times devices that have been inactive for two to three years.
- **A general check up** of our mechanisms is recommended after 20 years of operation or 20.000 operations. This revision must be made by qualified personnel, or better by our specialized technicians. During this check up, all the parts are carefully cleaned. Any damaged or worn-out part must be replaced.

**Note:**

The frequency of the check up operation depends on the service conditions and on the pollution at the place where the devices are installed.

In case the equipment is used in extreme conditions, i.e.:

- At continuous high ambient temperatures (over 60 °C).
- Where there is abrasive dust.
- Where there is a lot of dust.
- In high permanent humidity (over 95 %).
- Where corrosive gases or vapours pollute the environment.

It will be useful to check the installations more often.

# 9. LIST OF CERTIFICATES

| Certificate Number | Testing Authority | Type Of Circuit Breaker | Rated Voltage |
|---|---|---|---|
| GPS - 93 / 008237 | CESI | PVB4 - 25/8 | 12 kV |
| GPS - 92 / 003409 | CESI | PVB5 - 25/8 | 17.5 kV |
| GPS - 93 / 014823 | CESI | PVB5 - 16/8 | 17.5 kV |
| CER - 94 / 004312 | CESI | PVB6 - 25/12 | 24 kV |
| GPS - 93 /29707 | CESI | PVB7 - 25/12 | 36 kV |
| GPS - 93 /29699 | CESI | PVB7 - 25/12 | 36 kV |
| 352 - 91 | KEMA | PVB7 - 16/12 | 36 kV |
| 353 - 91 | KEMA | PVB7 - 16/12 | 36 kV |


CESI
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KEMA
De Zoeten Laboratorium
CERTIFICATE OF RATING
REPORT OF PERFORMANCE
351-91
test report
certificate of conformity

PELKA

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