INGERSOLL–RAND
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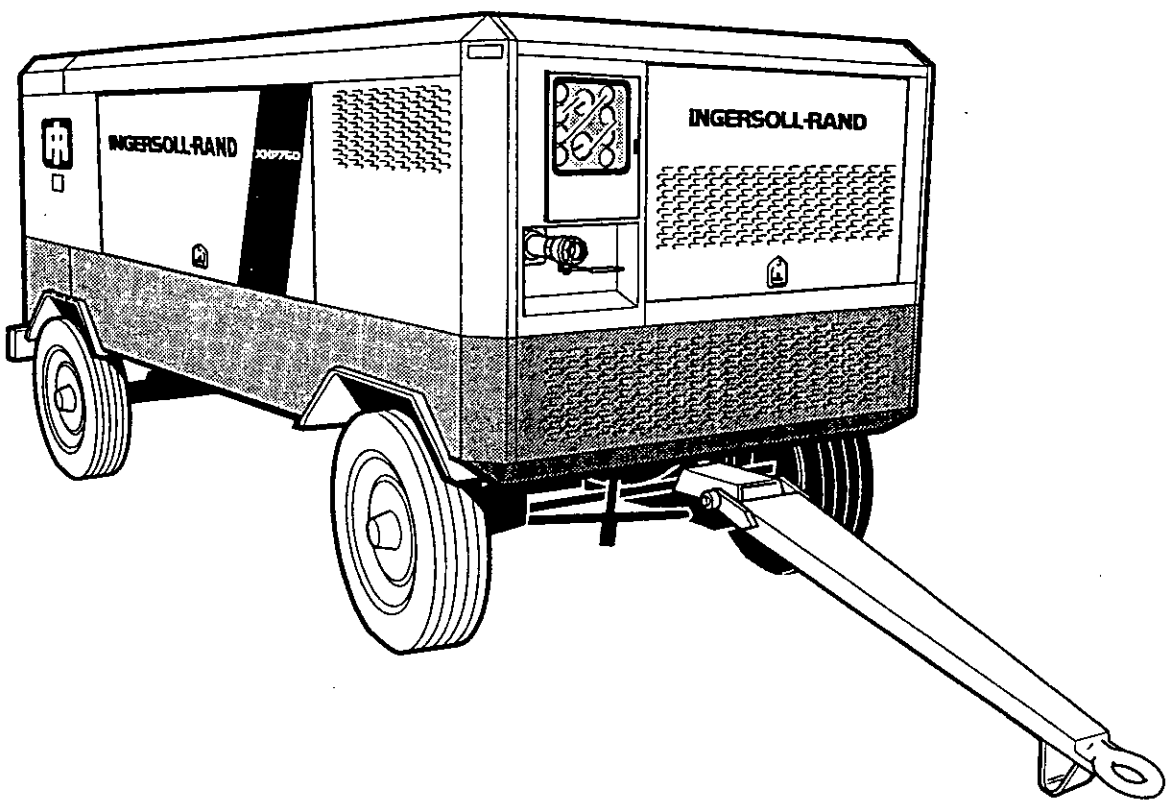

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OPERATION OF THE XHP 760 & 660–W–CA HIGH PRESSURE PORTABLE COMPRESSORS

CPN 92989235

Issue No. 1

April '93
Revised (09-12)

INGERSOLL–RAND
CONSTRUCTION & MINING GROUP

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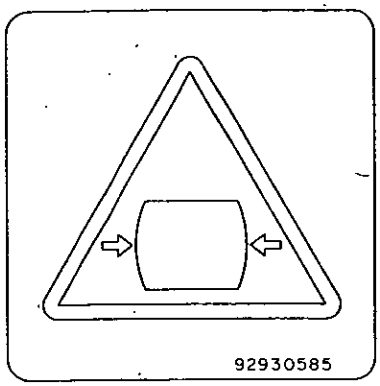
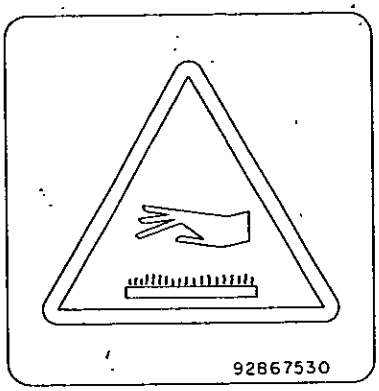
INDEX

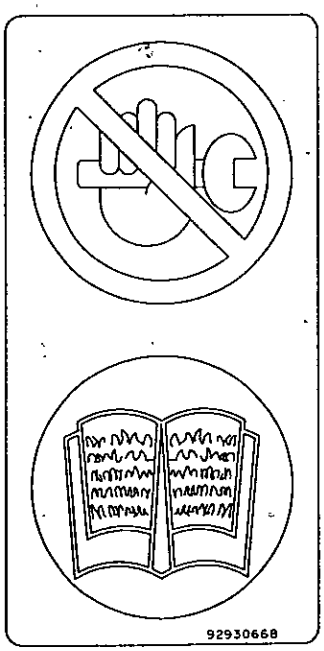
LOOK FOR THESE SIGNS WHICH INDICATE POTENTIAL HAZARDS TO THE SAFETY OF YOU AND OTHERS. READ AND UNDERSTAND THEM THOROUGHLY. FOLLOW INSTRUCTIONS. IF YOU DO NOT UNDERSTAND, INFORM YOUR SUPERVISOR



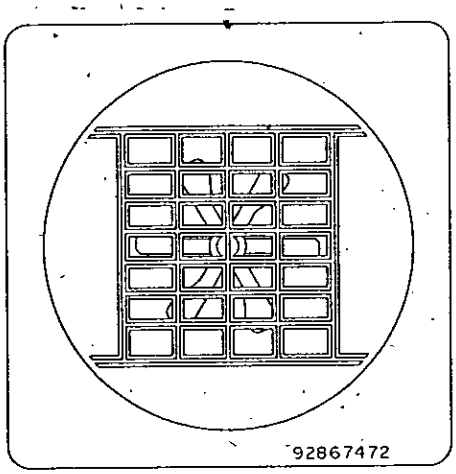
WARNING – Pressurised components or system



WARNING – Hot surface

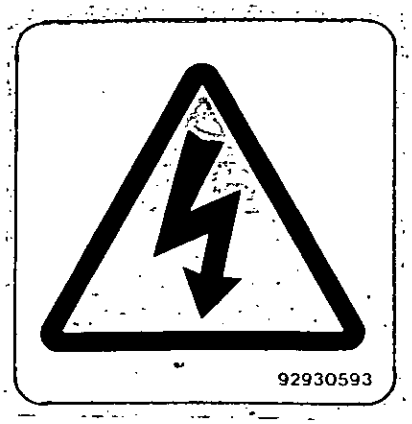


WARNING – Consult the operation & maintenance manual before commencing any maintenance



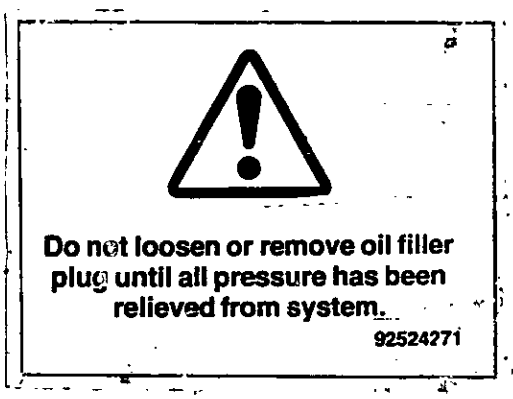
Do not the operate machine without the guard being fitted

Do not breathe the compressed air from this system



WARNING – Electric shock risk

WARNING – Corrosion risk



PREVENTIVE MAINTENANCE

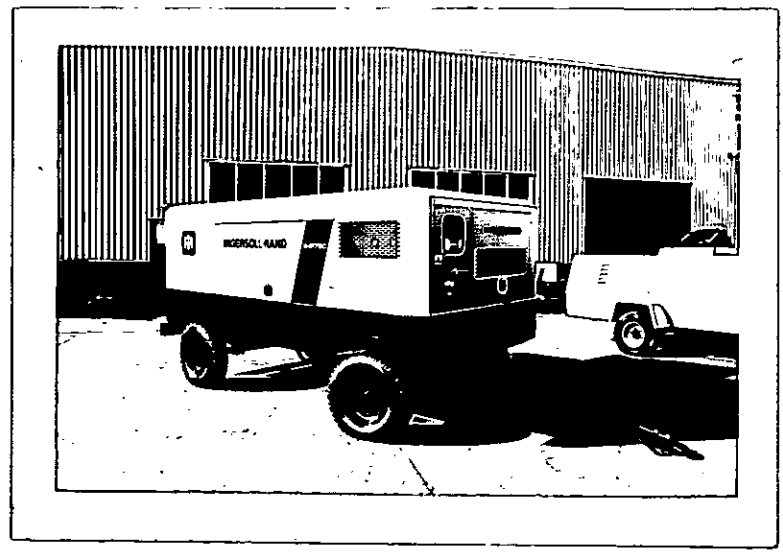
CAUTION : Be sure to disconnect battery cables before servicing unit.

CAUTION : If unit is not protected with sufficient antifreeze, coolant system must be drained in freezing weather to prevent damage to unit.

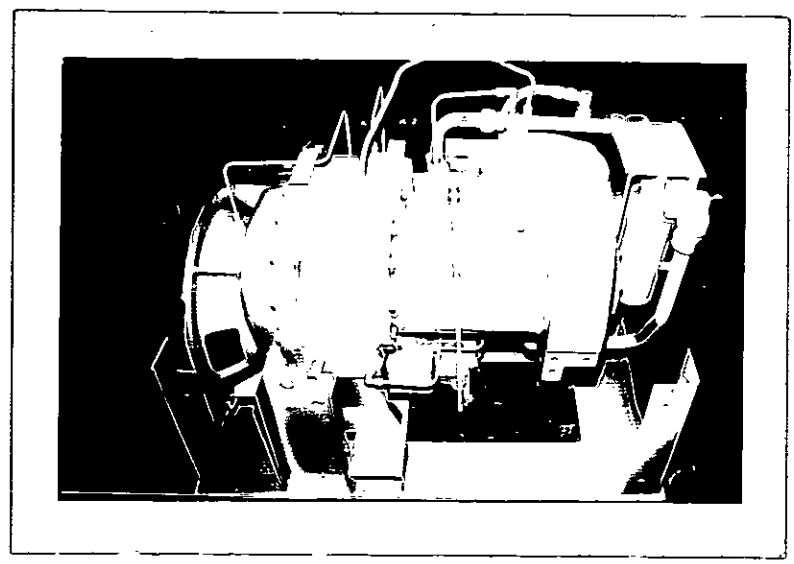
1. Inspect air cleaner service indicators daily. Service cleaner element when indicator shows red at full speed. Consult compressor operating manual for correct procedure on servicing primary and safety element.
2. Check battery electrolyte level weekly. Keep terminals clean and lightly greased.
3. Lubricate butterfly valve linkages weekly.
4. Inspect fan belts weekly.
5. Keep exterior of radiator and oil cooler clean of accumulated oil, dirt and grease.
6. Inspect air intake hoses, radiator hoses and all flexible hoses for wear every 500 Hours.
7. Service compressor oil filter every 500 Hours of operation. Inspect element for evidence of lacquer formation. Replace element and "O" rings with new element and new "O" rings. NOTE: On new or overhauled units replace element after first 50 and 150 Hours; thereafter service oil filter every 500 Hours.
8. Change compressor lube oil every 1000 Hours, or more frequently if operating unit under adverse conditions. NOTE: If a new or overhauled airend is installed in unit, be sure to thoroughly flush compressor lube system before adding new oil to system.

   CAUTION : Failure to follow the recommended operating practices and compressor oil sampling program outlined in the lubrication section of the operating manual will void the airend warranty.
9. Check operation of safety switches every three months. Remove switches and check settings every year. Consult compressor operating manual for correct procedure for checking operation and settings of switches.
10. Remove and clean oil line orifices in scavenger lines every 1000 Hours.
11. Maintain engine per engine operators manual.

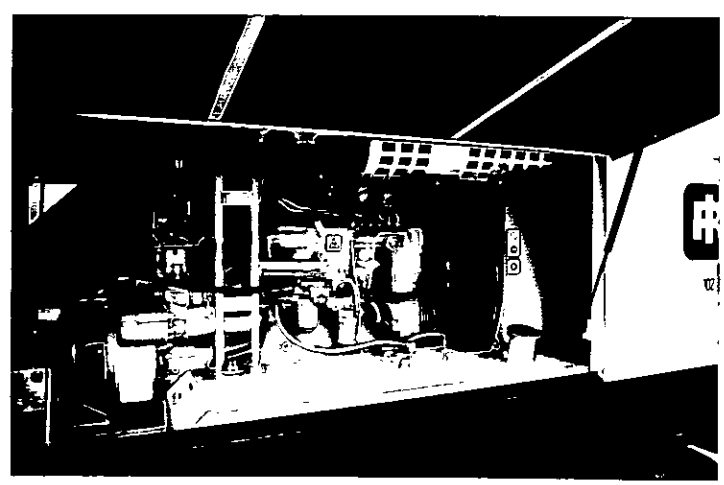
The Ingersoll–Rand XHP 760 and 660–W–CAT are high pressure, Portable Compressors for water–well and rock drilling, etc. They are manufactured at at the Hindley Green facility in the U.K.



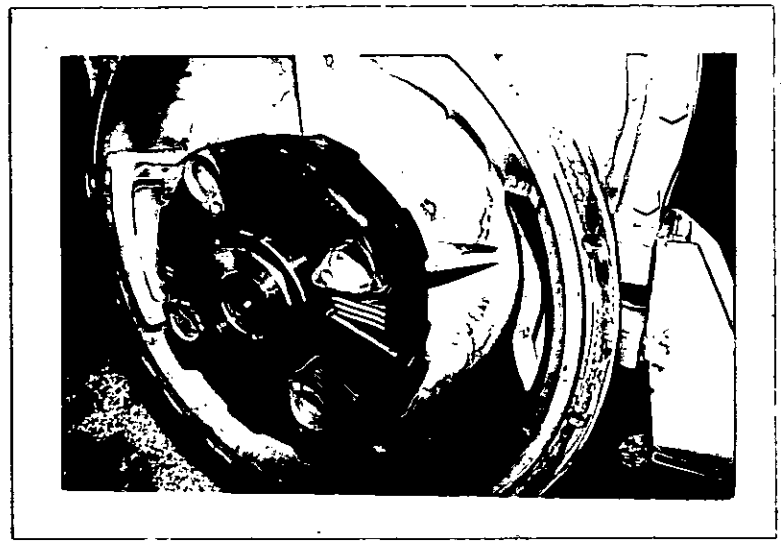
They utilise the well–established HR2, 2–stage, over–under airend. Like all the other I–R airends used in Portable products today, this is an oil–flooded, rotary screw type which provides optimum efficiency.



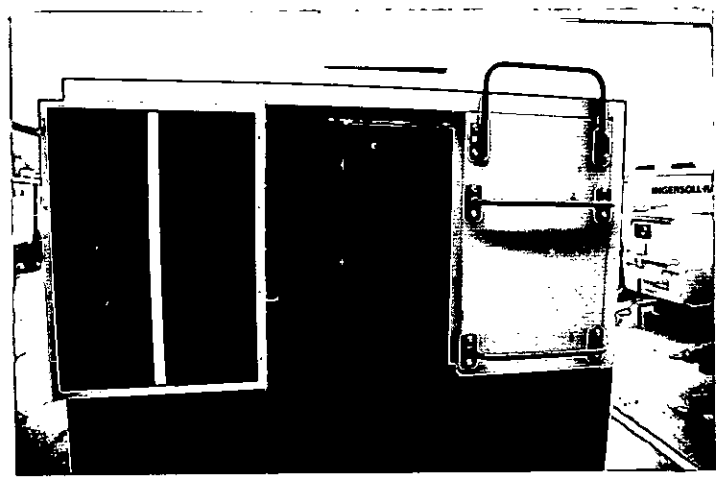
The engine is the Caterpillar 3306 DITA, developing 231 KW (300 bhp) at 1850 rpm full load speed.



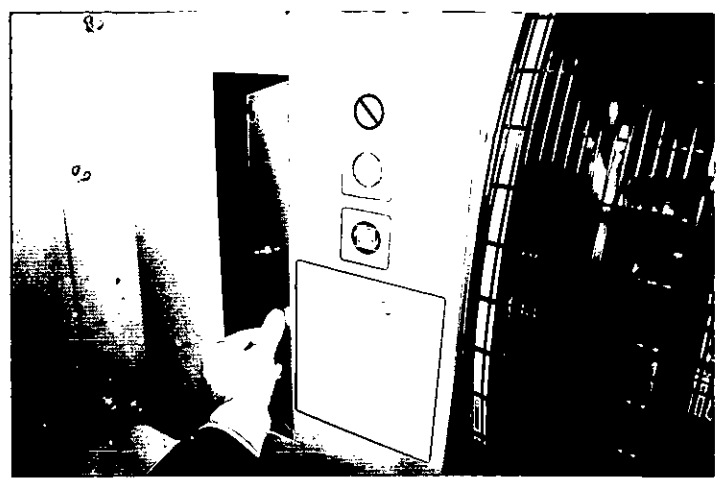
The engine is connected to the airend via a flexible drive coupling. This is capable of withstanding the wide variation in power demands and engine speeds.



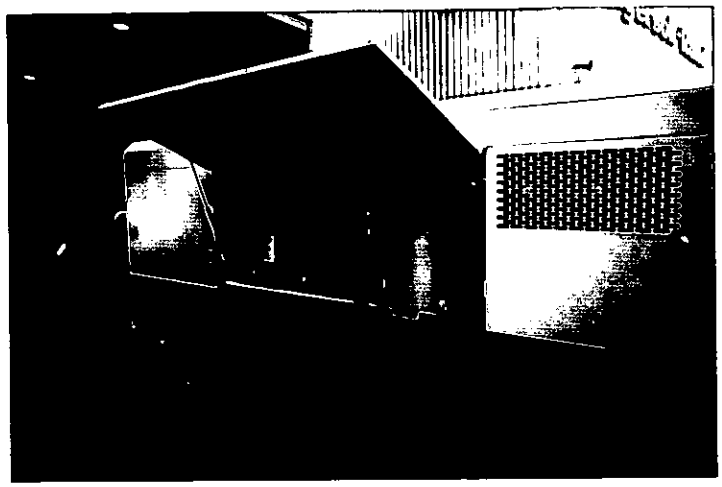
The package incorporates many design features which make it extremely user–friendly. For example, side–by–side engine radiator and compressor oil cooler for easy cleaning.....



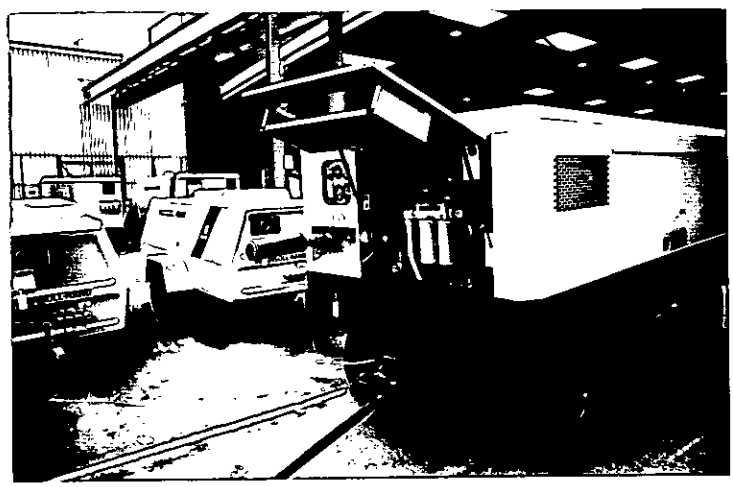
Additional side doors in the fan cowl also provide access for easier cleaning of the cooler and radiator.



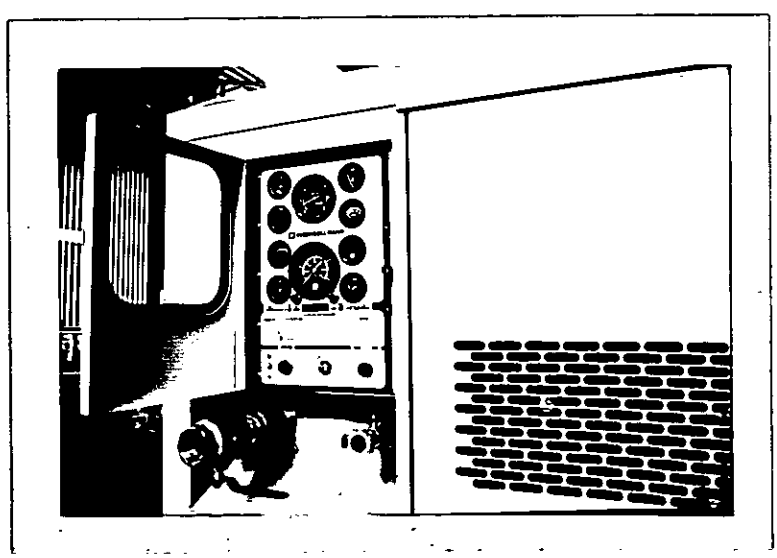
Large doors at the sides...



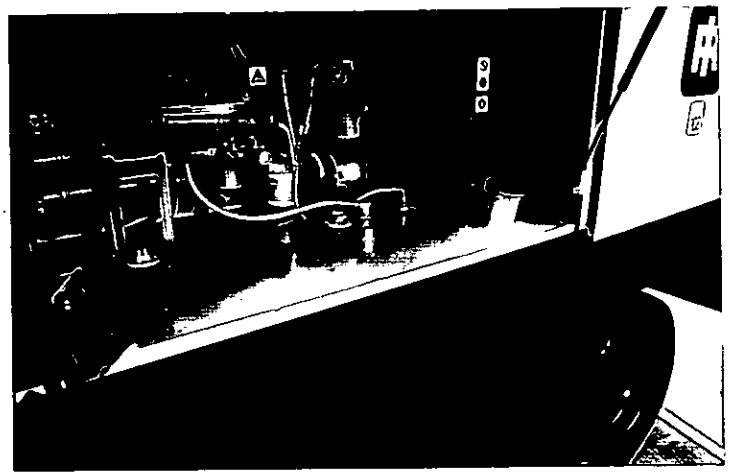
and at the front and rear...



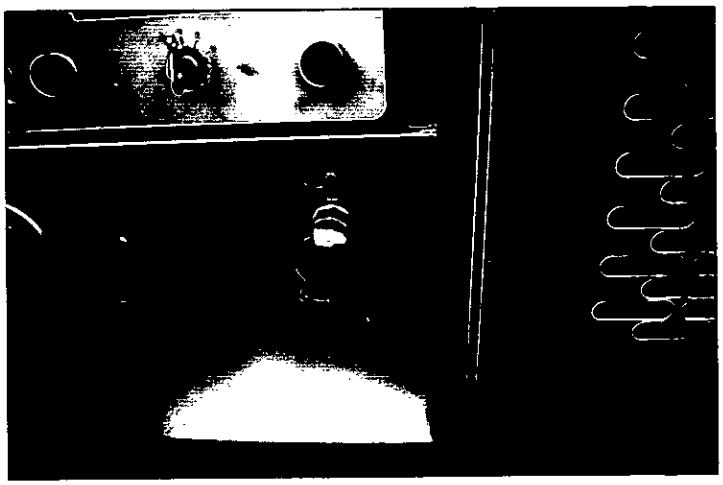
A hinged instrument panel...



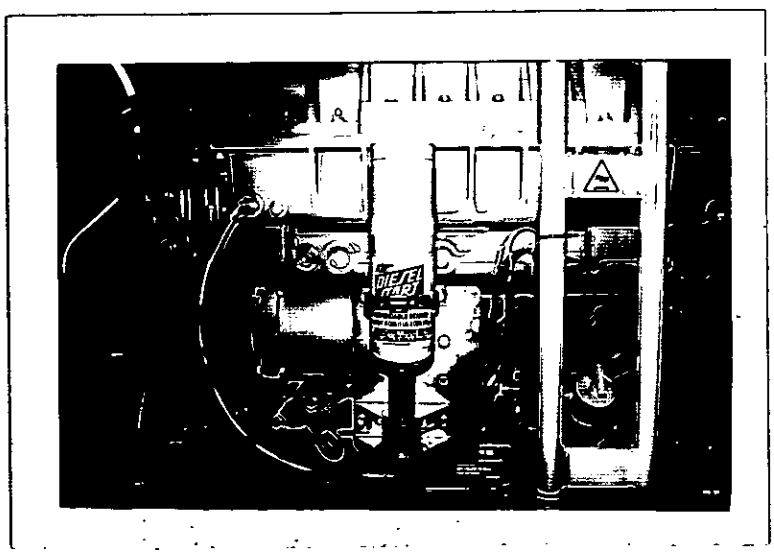
Twin fuel tanks provide 400 litres total capacity, enough for an 8 hour shift.



In addition to the 2" BSP service valve, there is also a 3/4" tap, operated at (adjustable) low pressure. This is ideal for cleaning of coolers, air filters, etc.



An ether cold start kit is standard equipment.
See later "Cold Start Section."



In this manual we will identify the major systems and their components, and how they operate.

The major systems are:–

1 COOLING & LUBRICATION

2 SEPARATION

3 REGULATION

4 BLOWDOWN

5 ELECTRICAL SYSTEM

6 SAFETY SHUTDOWN SYSTEM

7 FAULT FINDING

COOLING & LUBRICATION

There are 6 basic components:–

1 SEPARATOR RECEIVER

2 OIL TEMPERATURE BYPASS VALVE

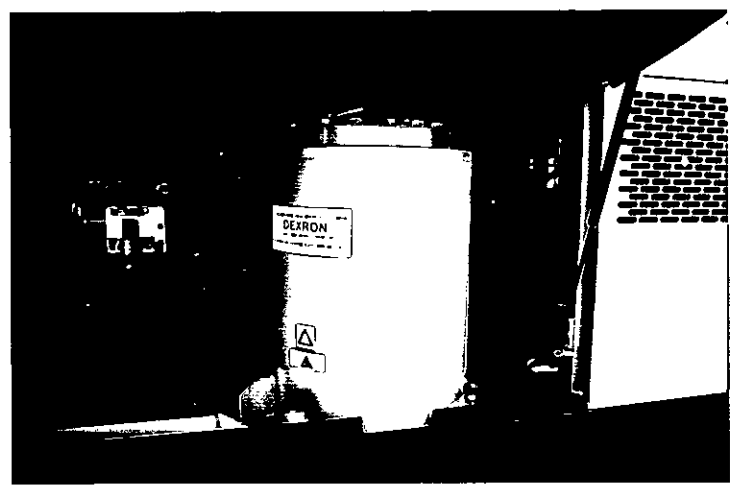
3 OIL COOLER

4 COOLING FAN

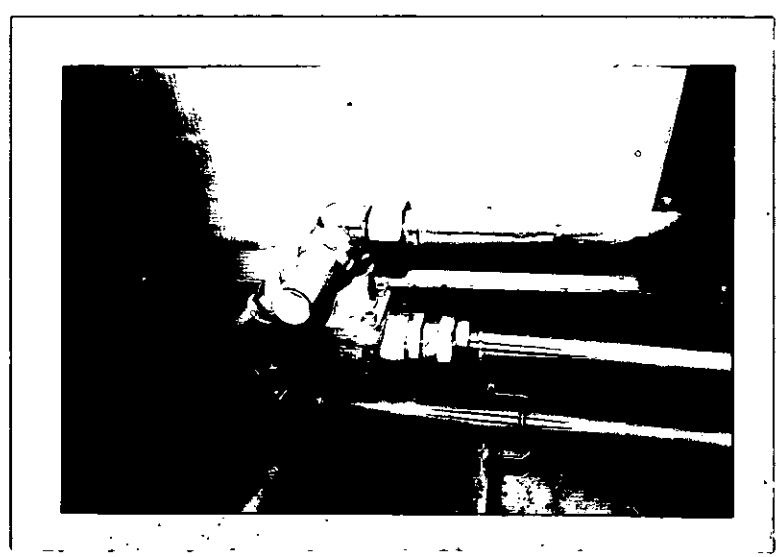
5 OIL PUMP

6 OIL FILTERS

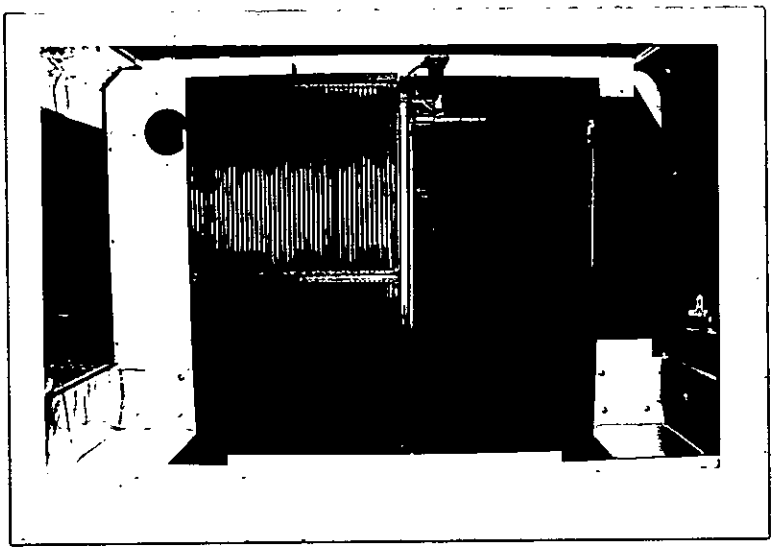
1. The high pressure air–oil mixture is discharged into a vertical Separator Receiver tank. This reservoir separates the high pressure air from the compressor oil.



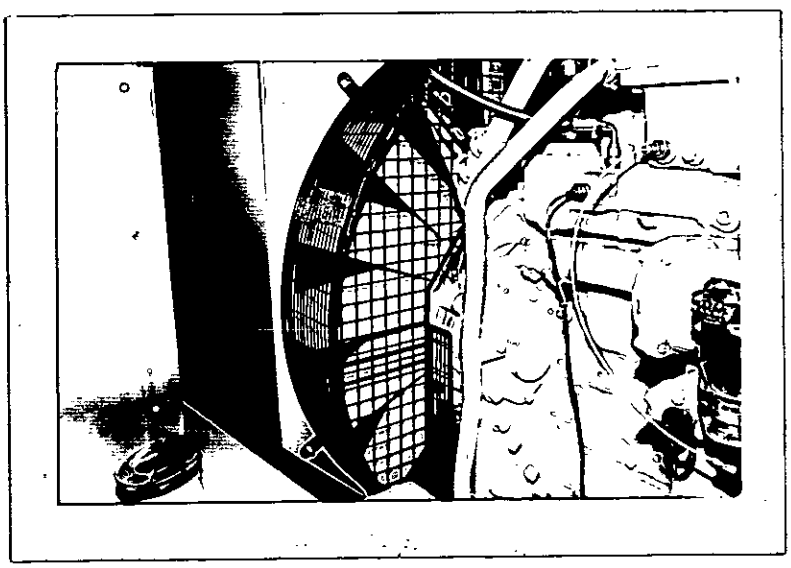
2. The Oil Temperature Bypass Valve is controlled thermostatically. It opens fully when the compressor oil temperature reaches 85 degC. This allows oil to flow through the compressor Oil Cooler.



3. The Oil Cooler dissipates the heat generated in the high pressure air.

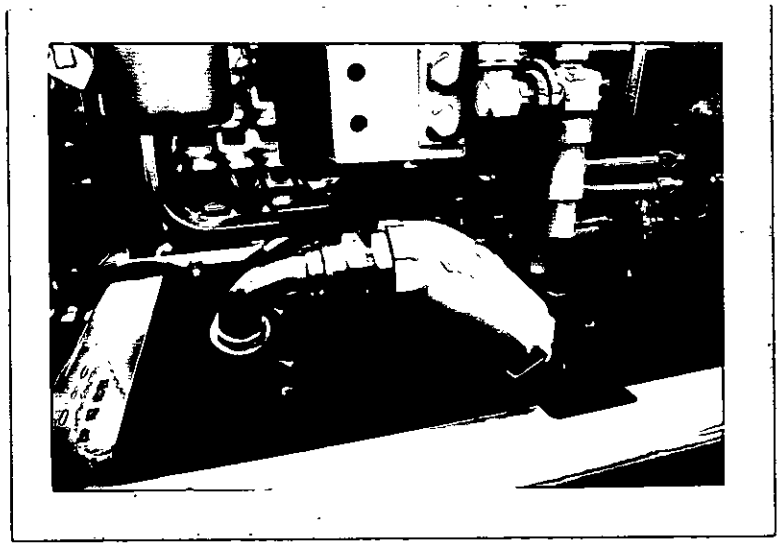


4. The Cooling Fan is belt–driven from the engine.
Note that I–R utilise a "pusher" type fan to create an air flow through the package and out through the cooler and radiator. This is the "cool box" design.
Some competitors' machines utilise a "sucker" type fan with their inherent higher interior temperatures.

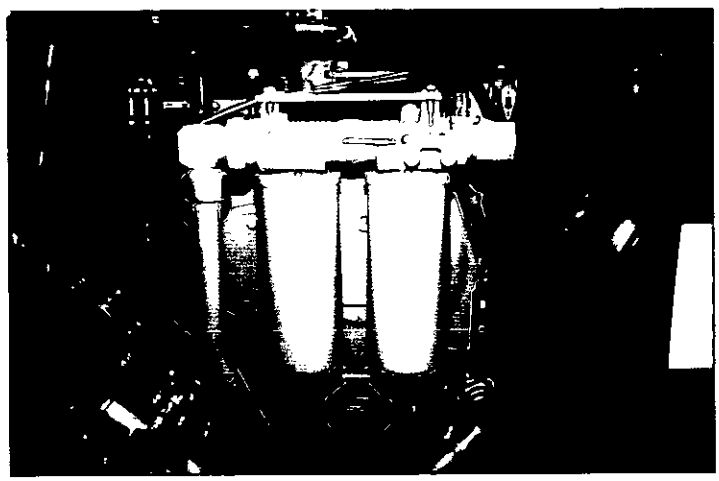


5a. A gear–type oil pump is mounted on the high pressure stage of the airend.
This ensures immediate oil circulation through the system, even at low temperature start–up.

5b. The Oil Pump is protected from dirt by a Strainer.
The metal screen inside the Strainer must be cleaned thoroughly at each oil change.



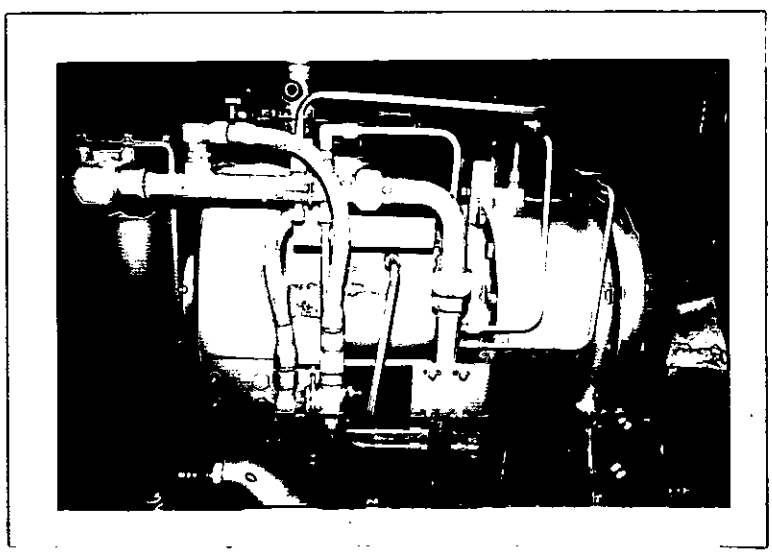
6. Large, dual, spin–on oil filters are mounted conveniently on the front of the airend.



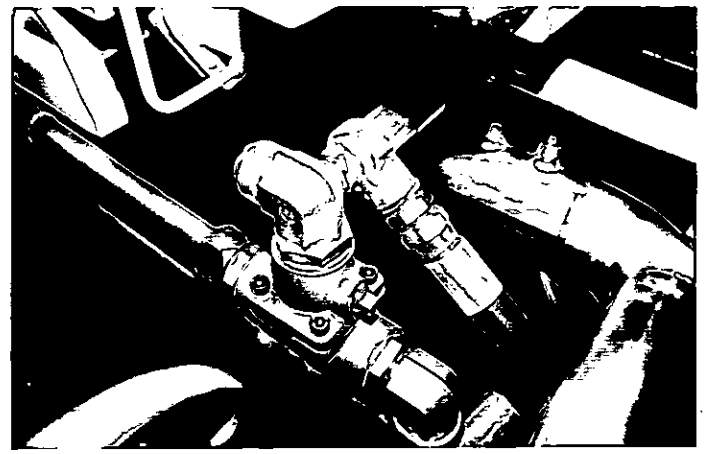
The cooled and filtered oil returns to the airend via a manifold. This distributes the oil to the rotors, bearings, seals, etc.

Note 1: Pressure relief valves throughout the system ensure that, in the event of blocked oil lines, some oil circulation is maintained.

Note 2: Steel piping is used almost throughout for increased safety.



In the event of a blocked Oil Cooler or Compressor Oil Filters, an Oil Bypass Valve is provided, which will maintain some oil circulation.
This valve has a set pressure of 29,5 bar (433 psi).



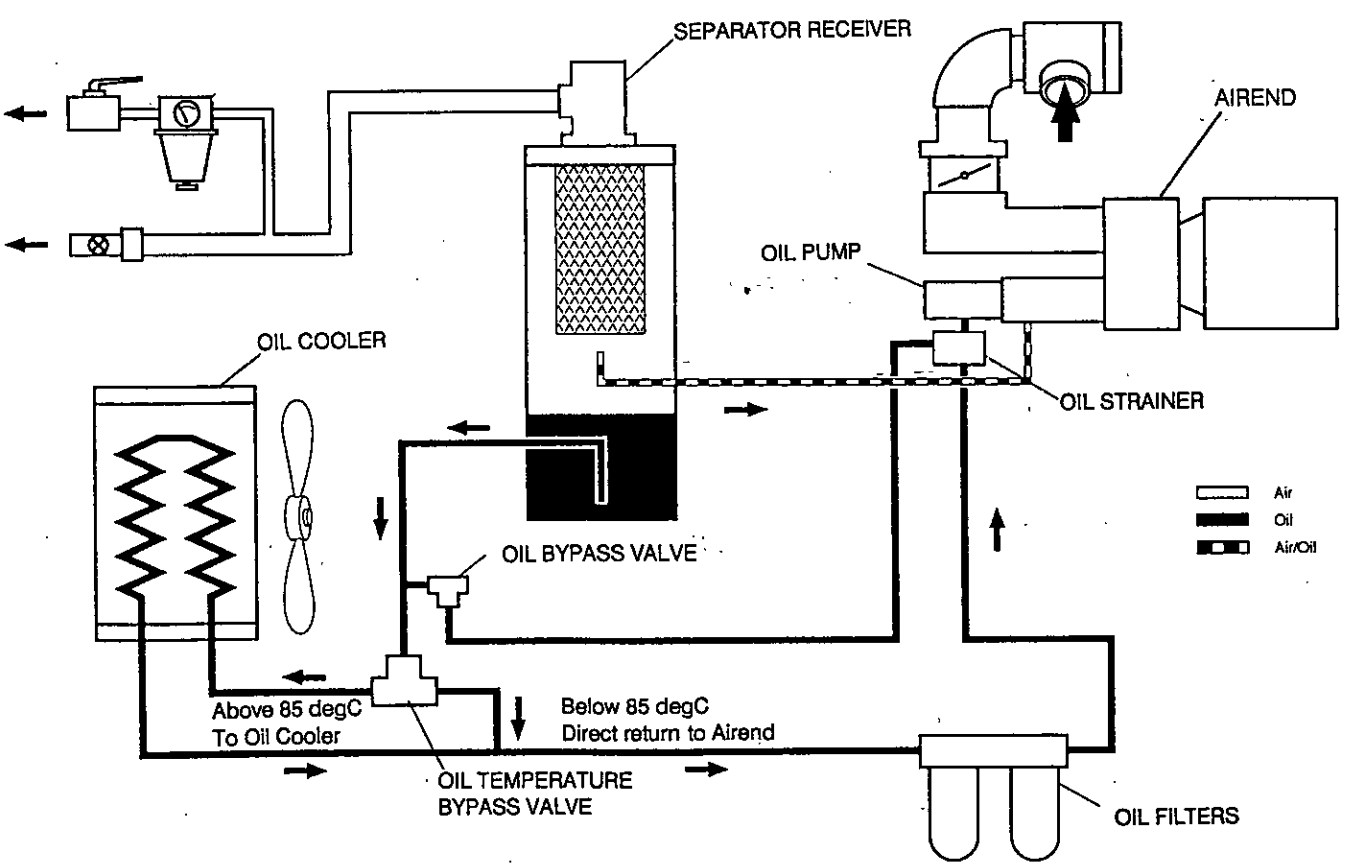
COOLING & LUBRICATION

The oil in the system has 3 functions: –

1. It cools the airend by taking away the heat generated during compression.
2. It lubricates the rotors, bearings, and seals.
3. It seals between the rotors and rotor housing.

Referring to the schematic:

Oil circulation is achieved by a combination of the Oil Pump and pressure differential. The compressed air–oil mixture is discharged from the airend, via a Discharge Check Valve, into the Separator Receiver. From here, the oil flows into the Oil Temperature Bypass Valve. At oil temperatures below 85 degC, it bypasses the Oil Cooler; above 85 degC, the thermostat has operated to permit full flow through the Oil Cooler. The oil flows from the Oil Cooler, through the dual Oil Filters, Strainer, and Oil Pump back into the airend via a manifold.



SEPARATION

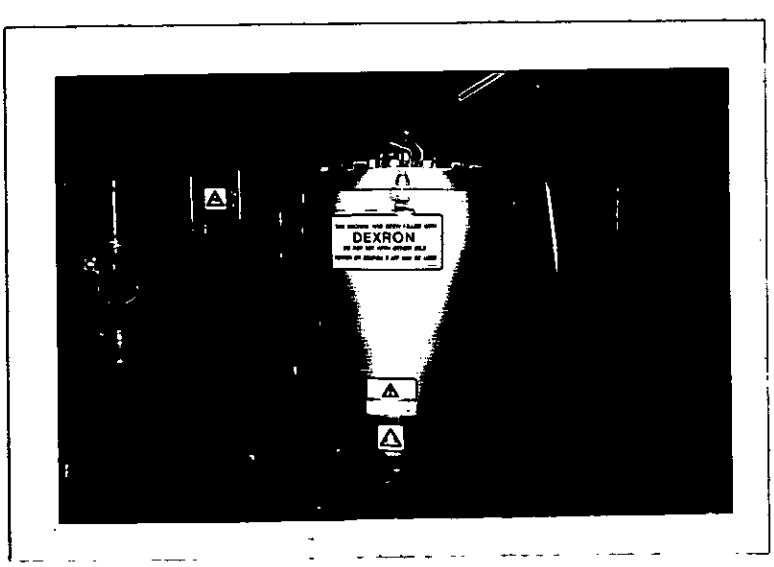
There are 5 basic components: –

1. DISCHARGE CHECK VALVE
2. SEPARATOR RECEIVER
3. SCAVENGE LINE
4. MINIMUM PRESSURE VALVE
5. SAFETY VALVE

1. The Discharge Check Valve closes at machine shutdown. This prevents high pressure air from the Separator Receiver acting in reverse back into the airend.

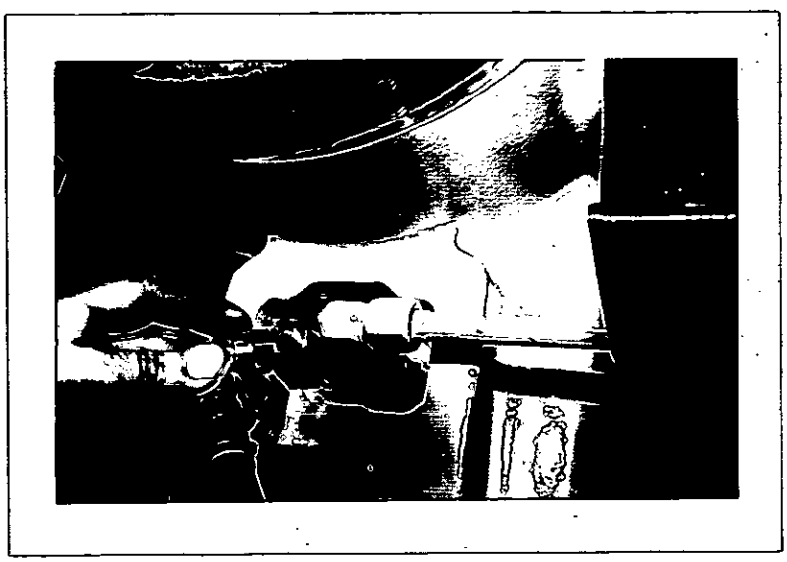
2. The vertical Separator Receiver houses the separator element and Scavenge Drop Tube. This ensures that the air discharged from the machine contains only 10 p.p.m. (maximum) of oil.

   Note: Air discharged from a Portable Compressor is not suitable for human consumption.

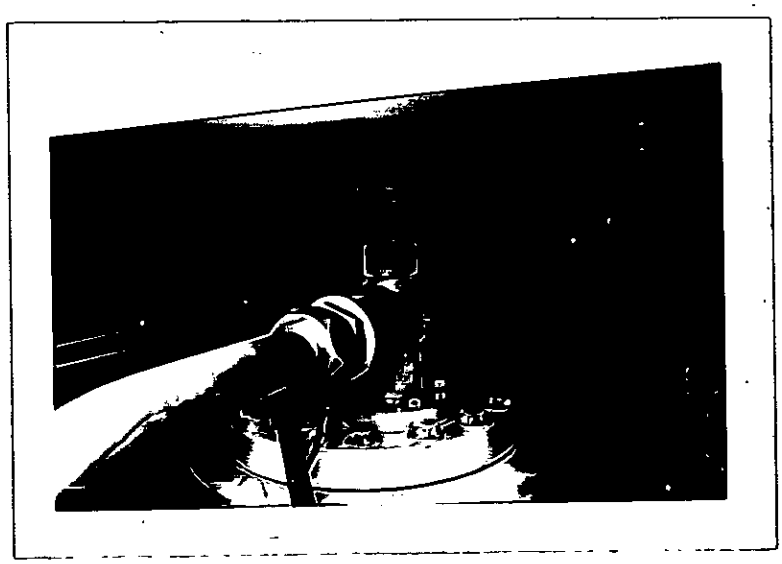


3a. The oil which accumulates on the dry side (interior) of the Separator Element returns up the Scavenge Drop Tube and connecting hose, back into....

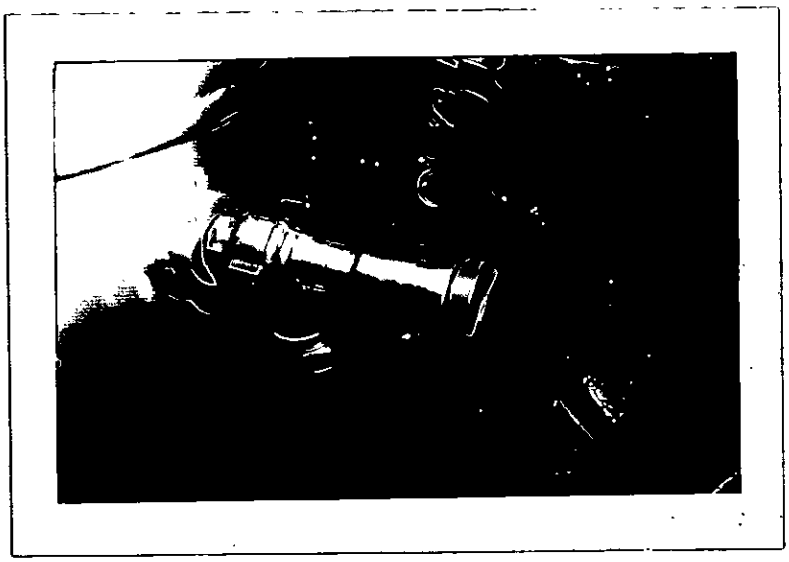
3b. ...the airend via a combined Scavenge Orifice–Check Valve (1,0 m/m dia.)



4. The Minimum Pressure Valve maintains a minimum pressure in the system of 10,0 bar (150 psi).



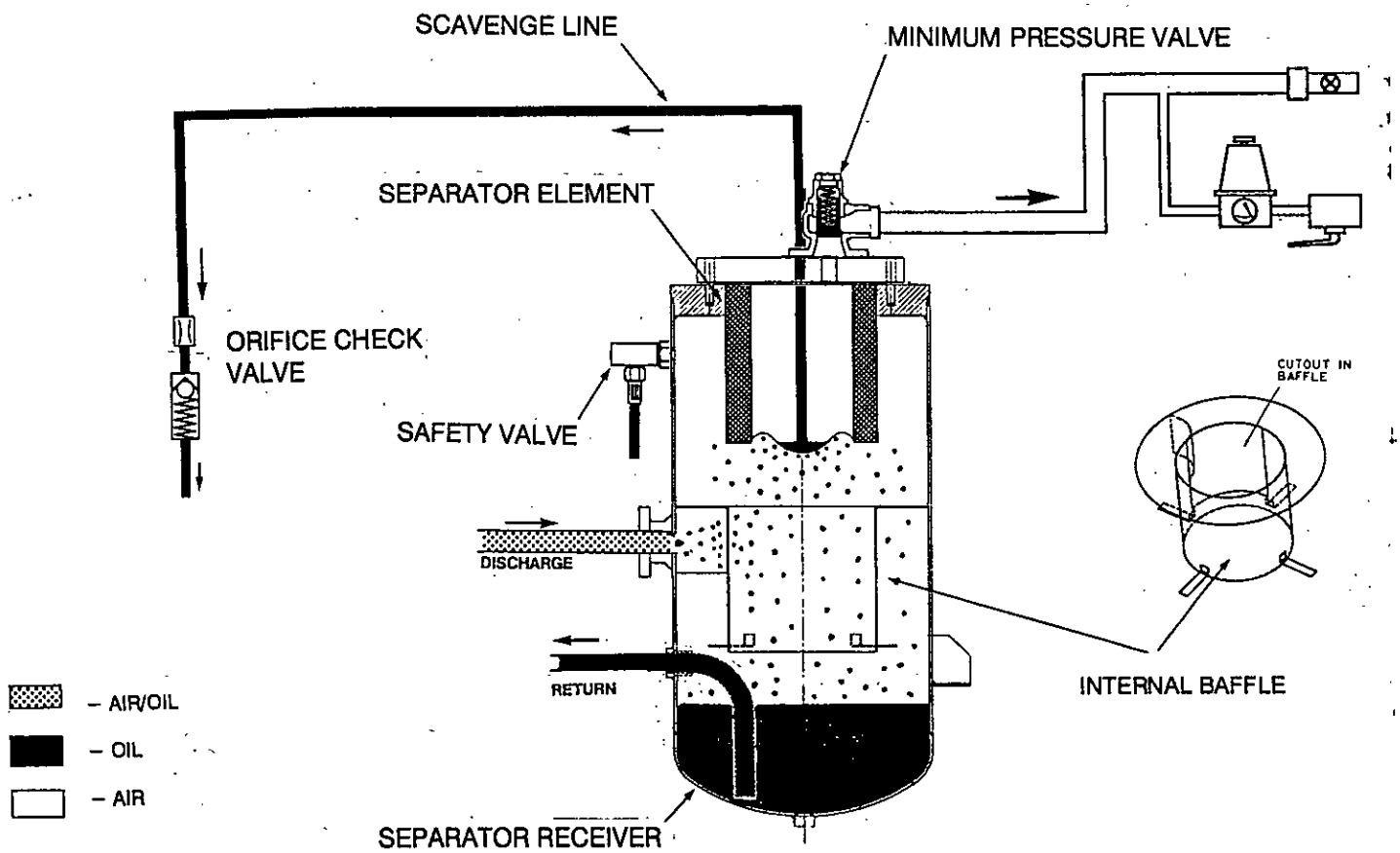
5. A Safety Valve relieves pressure in the Separator Receiver if the air pressure reaches an unsafe operating limit.
Set point is 28,5 bar (420 psi).



SEPARATION

Here is how the system operates:–

The air and oil mixture discharges from the airend via the Discharge Check Valve, into the Separator Receiver. Here most of the oil separates out from the mixture when it impinges on the underside of the Separator Element. The filter medium within the Separator Element then removes any remaining oil entrained in the air. The oil which flows down the inside surfaces of the Separator Element and accumulates in its base is returned via the Scavenge Line (because of the pressure differential) to the airend. The Scavenge Orifice–Check Valve controls the flow rate through the Scavenge Line. The Minimum Pressure Valve maintains a minimum pressure of 10,0 bar (150 psi). This aids compressor oil circulation, and also protects the Separator Element from high differential pressure.



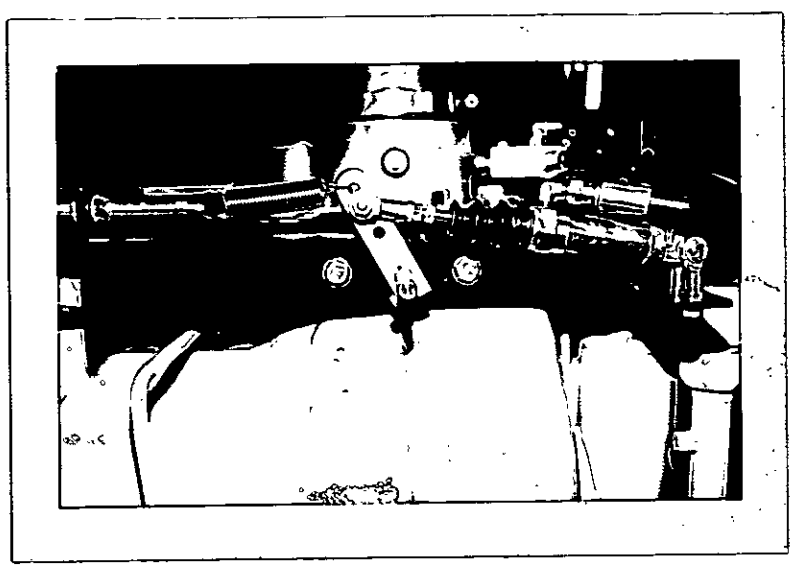
SEPARATION

REGULATION

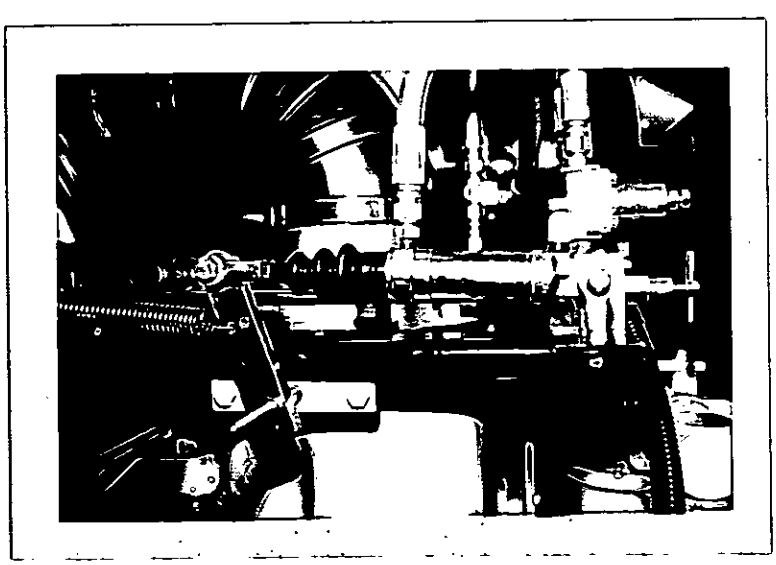
Regulation is achieved by means of 5 main components:–

1. BUTTERFLY VALVE
2. BUTTERFLY VALVE CONTROL CYLINDER
3. ENGINE SPEED CONTROL CYLINDER
4. PRESSURE REGULATOR VALVE
5. START–RUN SOLENOID VALVE

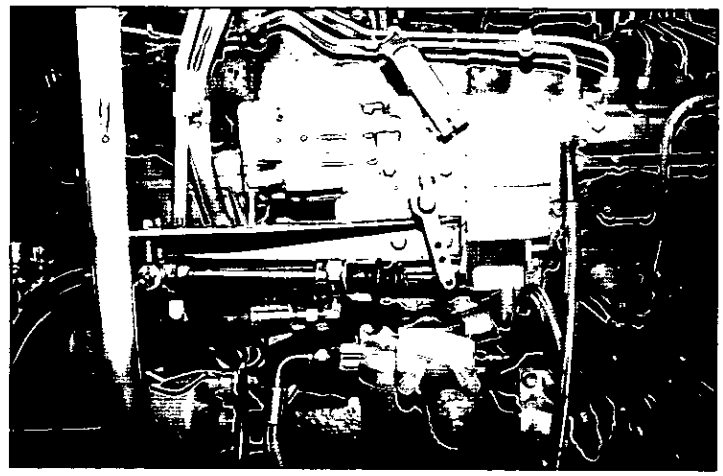
1. The Butterfly Valve regulates the flow rate of air entering (and therefore being discharged from) the compressor.



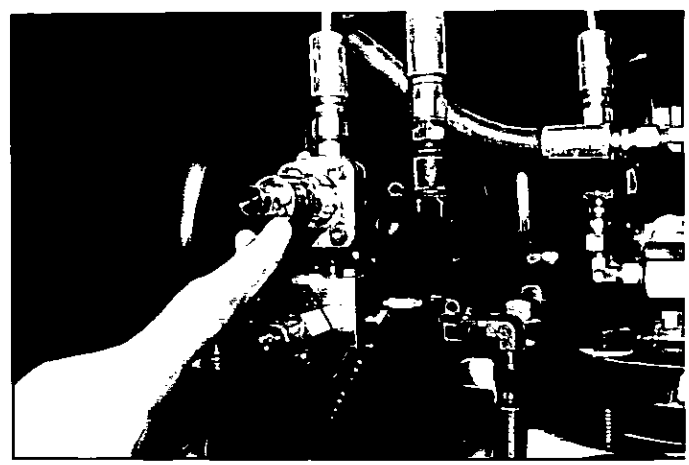
2. Its' position is regulated by an air–operated Control Cylinder.



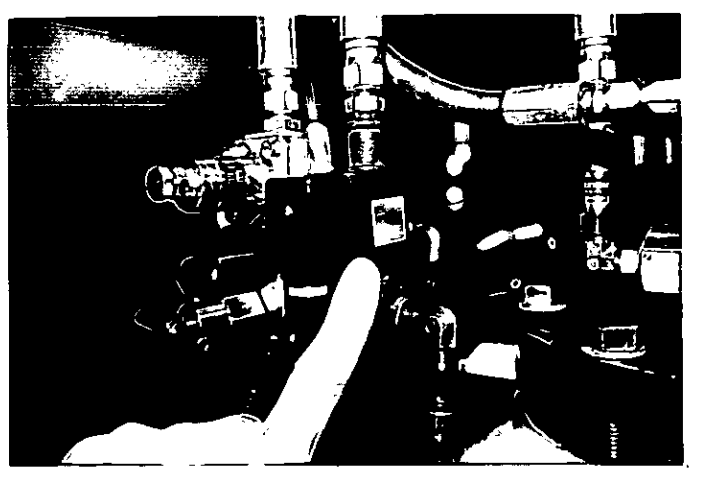
3. The Engine Speed Control Cylinder is also air–operated, and acts on the engine governor to match engine speed and power output to the air demand.



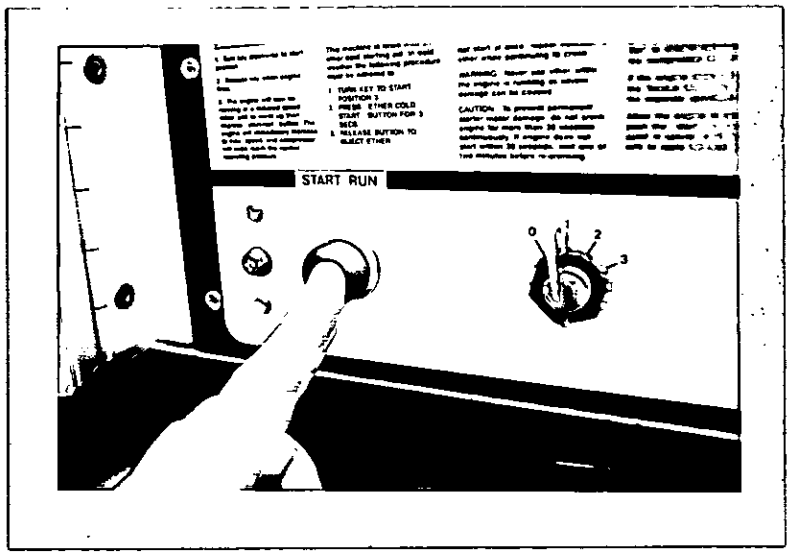
4. The Pressure Regulator Valve controls system pressure.
It is a normally–closed diaphragm valve, which opens at a pre–set (adjustable) pressure.



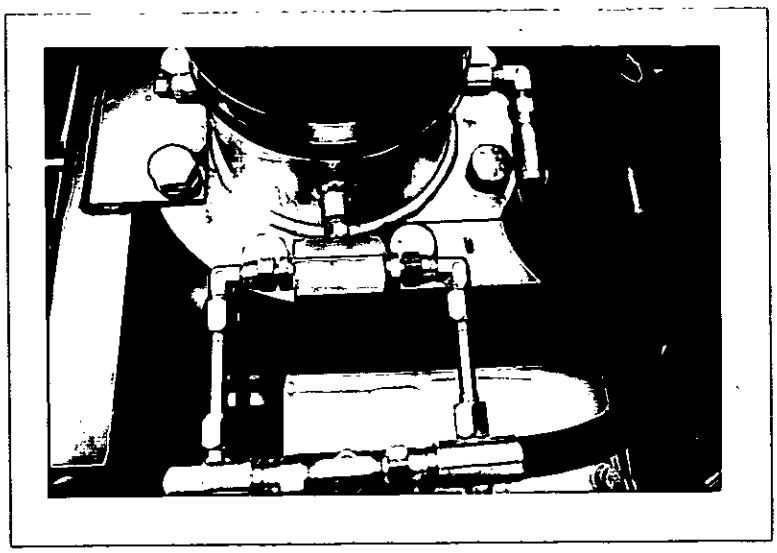
5a. The Start–Run Valve enables the unit to start at a reduced pressure (approx. 3,3 bar).
It is a solenoid–operated valve.
In the start–up (normally–open) position, it allows the Pressure Regulator Valve to be by–passed.
It is energised from the Start–Run button....



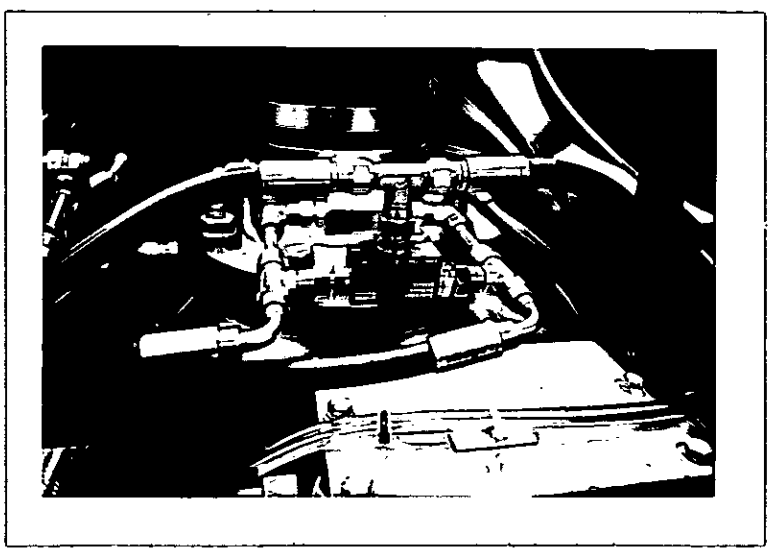
5b. .....which is located on the instrument panel.



6. There are 2 orifi in an Orifice Block. The left orifice (2,5 m/m dia.) is used at start–up.
The right orifice (5,5 m/m dia.) is used during normal running, after the Start–Run button has been pushed.
(See next section.)



A Shuttle Valve determines which route the regulation air is directed (i) at start–up,and (ii) after pushing the Start–Run button.

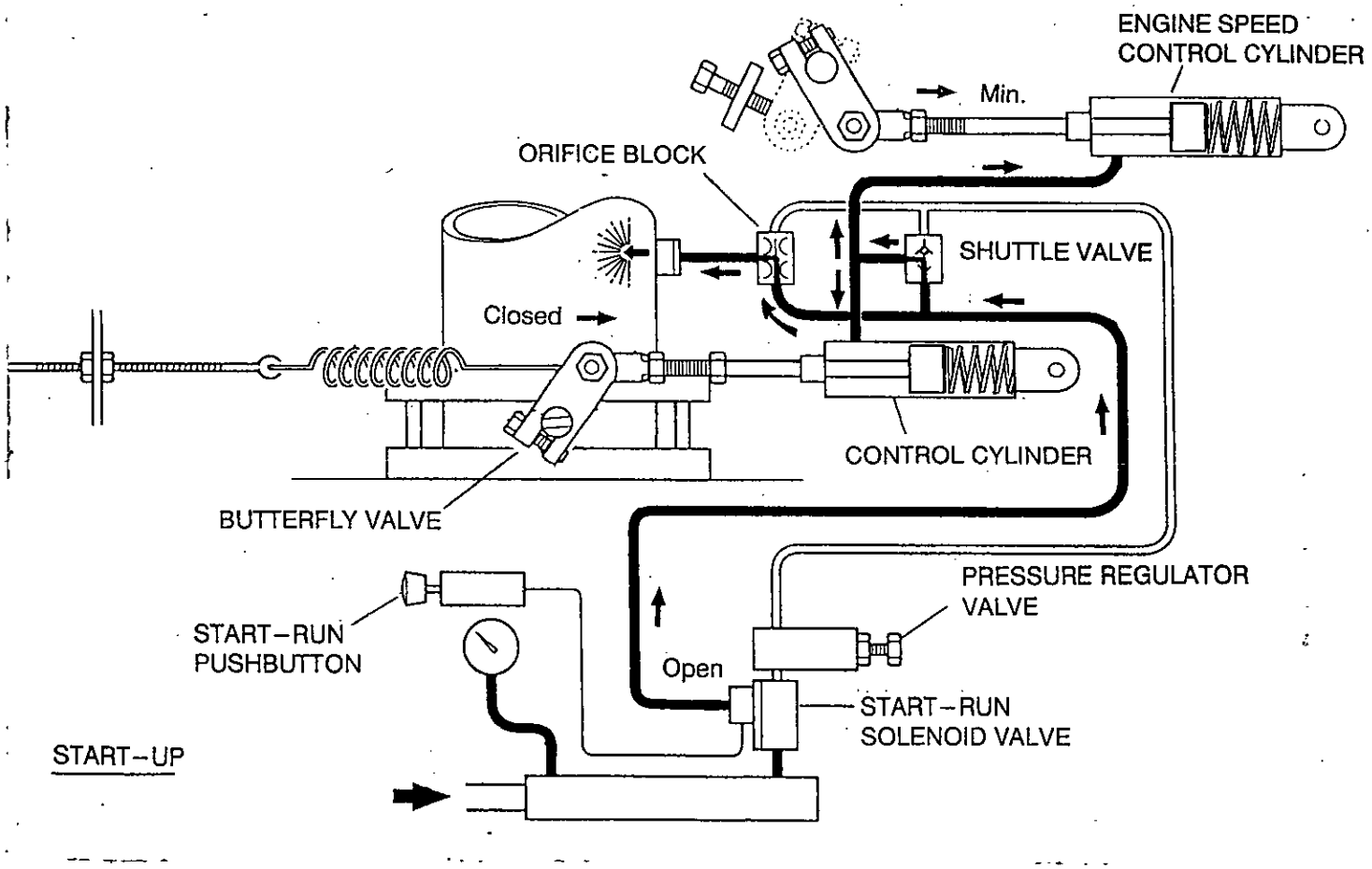


REGULATION

Here is how the system operates:–

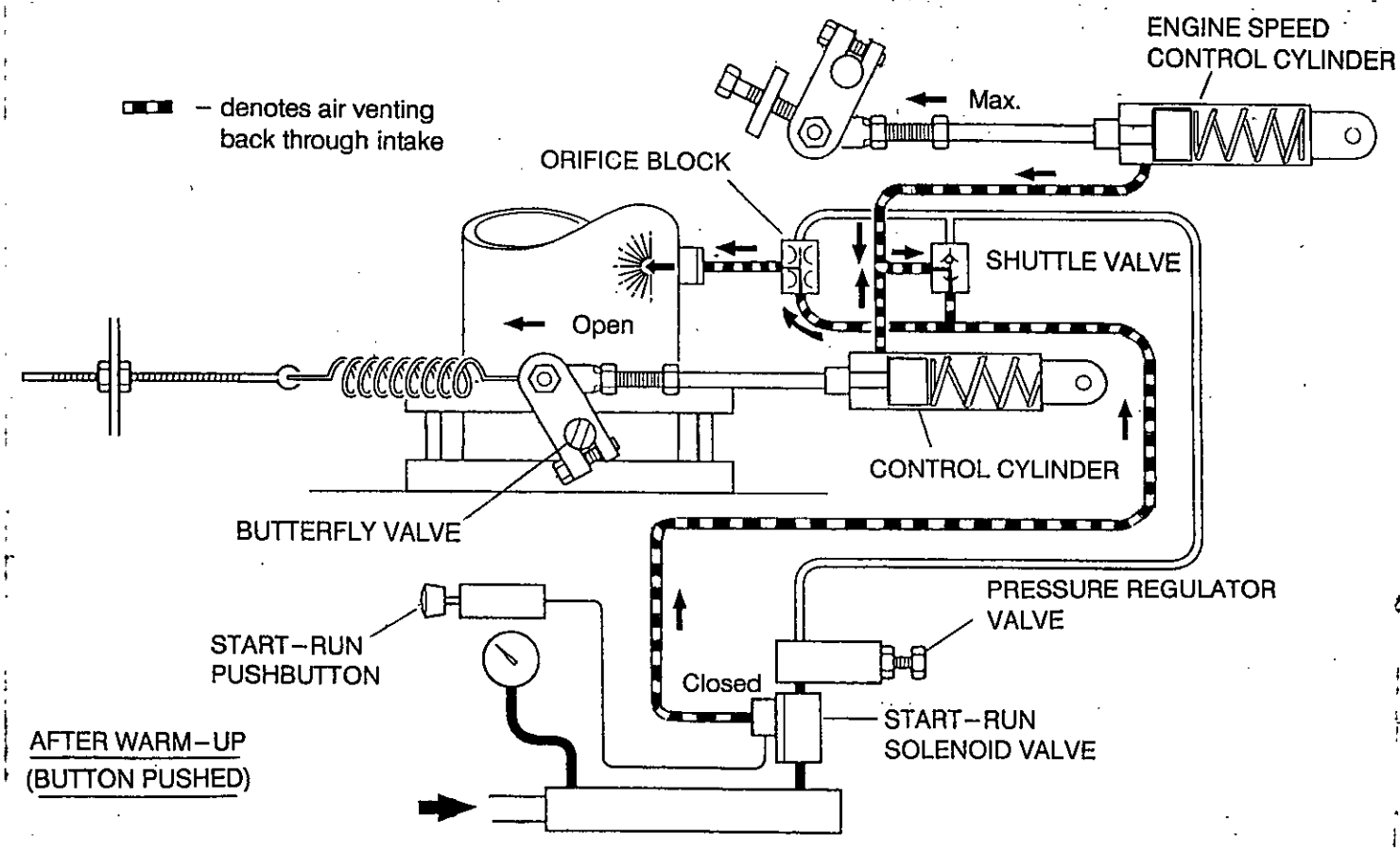
1 Start–Up

The Butterfly Valve is open (under the spring action of its Control Cylinder). The Engine Speed Control Cylinder is in its max. speed position (under the action of its internal spring). After starting the engine, air pressure rises quickly inside the Separator Receiver to approximately 3,3 bar (50 psi). This presure passes through the (open) Start–Run Solenoid Valve to the left hand port of the Shuttle Valve. This pressure operates both Control Cylinders to close the Butterfly Valve and reduce engine speed to idle. Air also bleeds back into the air intake, via the left–hand orifice (2,5 m/m dia.) in the Orifice Block. The machine should be allowed to warm up in this condition for approx. 2 minutes,depending on local ambient conditions.



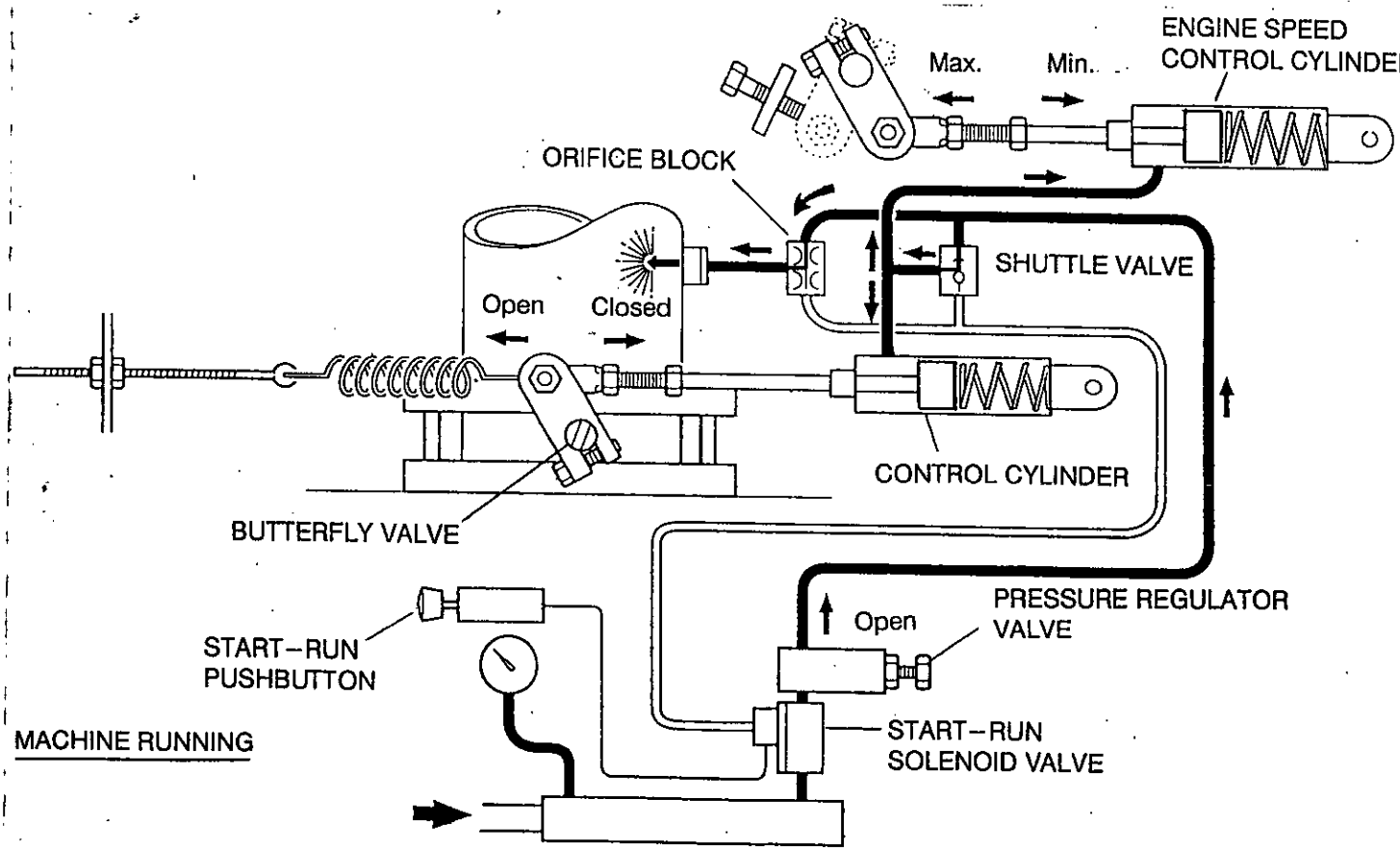
2 After Warm–Up

When the unit has warmed up, the Start–Run button is pushed. This momentarily energises the solenoid, which closes the Start–Run Valve. The air path to the Control Cylinders is now closed, which allows them both to bleed back into the air intake via the left hand orifice. As air pressure falls, the Control Cylinders stroke under the action of their internal springs to allow the Butterfly Valve to open and the engine throttle to return to full speed.



3 Machine Running

When system air pressure rises to the unloaded pressure, (typically 1,3 bar above rated pressure) it will be sufficient to open the Pressure Regulator Valve. The Shuttle Valve changes over. Air pressure acts upon the Control Cylinders. The Butterfly Valve closes and the engine throttle returns to idle. Air pressure in the Control Cylinders now bleeds back into the air intake via the right–hand orifice (5,5m/m dia.) in the Orifice Block. Thereafter, the regulation system responds according to air demand to control the Butterfly Valve and engine speed.

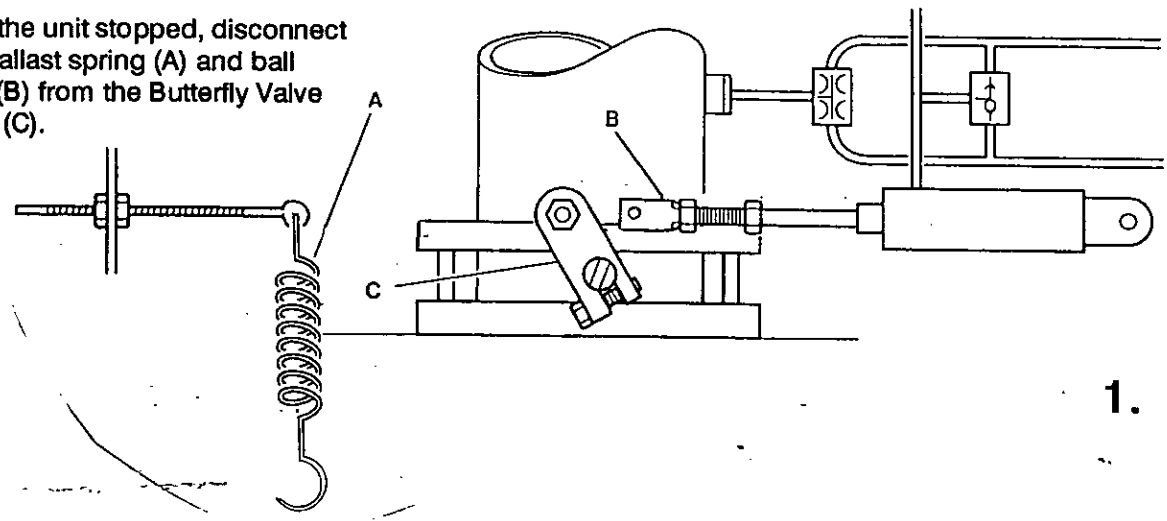


REGULATION ADJUSTMENT

Normally, the operating pressure of the machine requires no adjustment.
but if correct pressure is lost proceed as follows: –

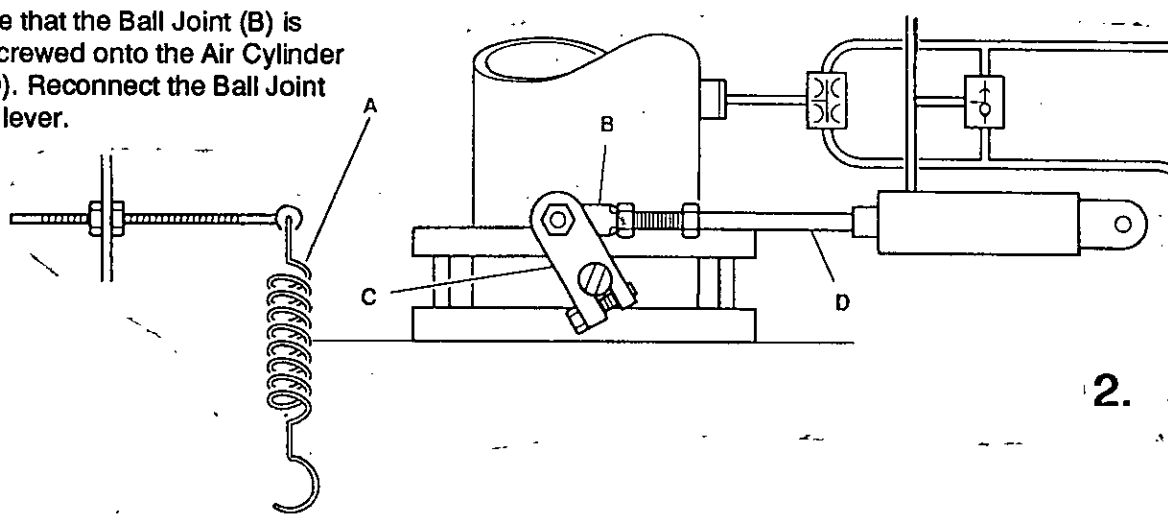
1. BEFORE STARTING THE UNIT.

With the unit stopped, disconnect the ballast spring (A) and ball joint (B) from the Butterfly Valve lever (C).



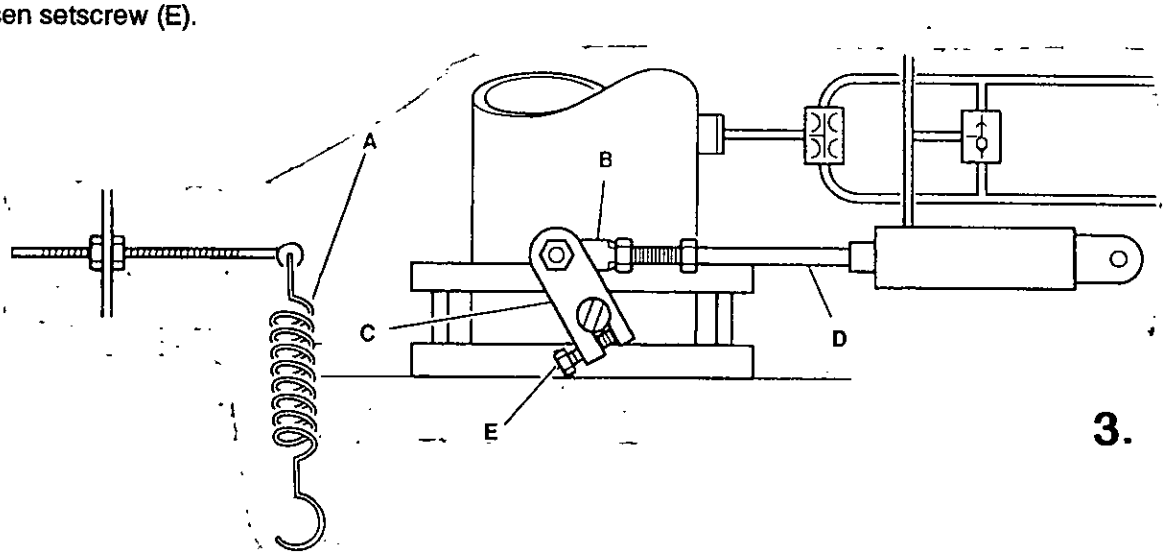
1.

2. Ensure that the Ball Joint (B) is fully screwed onto the Air Cylinder rod (D). Reconnect the Ball Joint to the lever.



2.

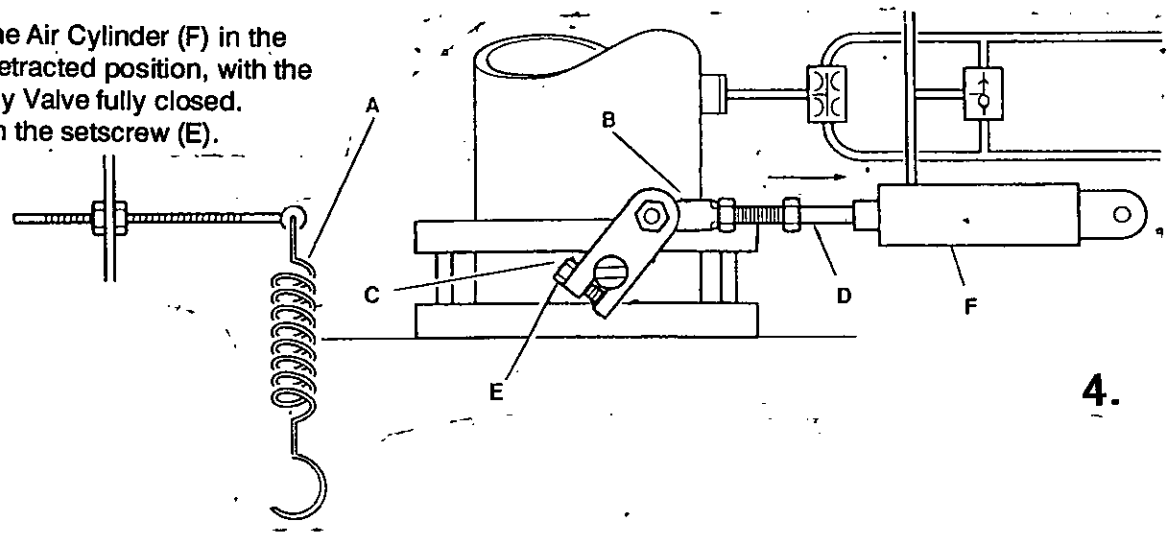
3. Loosen setscrew (E).



3.

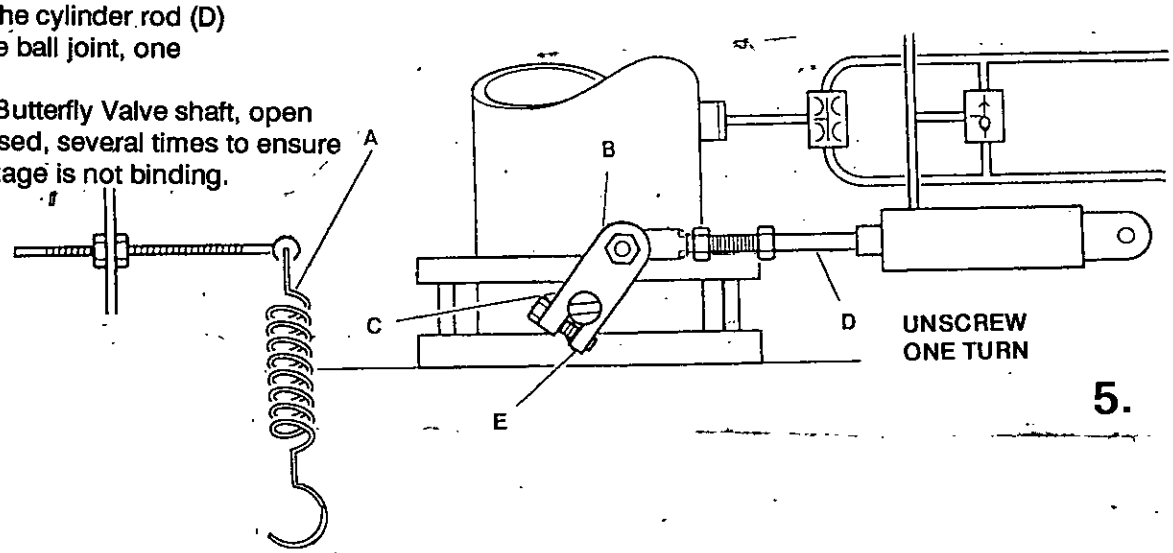
REGULATION ADJUSTMENT (cont'd.)

4. Hold the Air Cylinder (F) in the fully–retracted position, with the Butterfly Valve fully closed. Tighten the setscrew (E).



4.

5. Screw the cylinder rod (D) from the ball joint, one turn.
Rotate Butterfly Valve shaft, open and closed, several times to ensure that linkage is not binding.

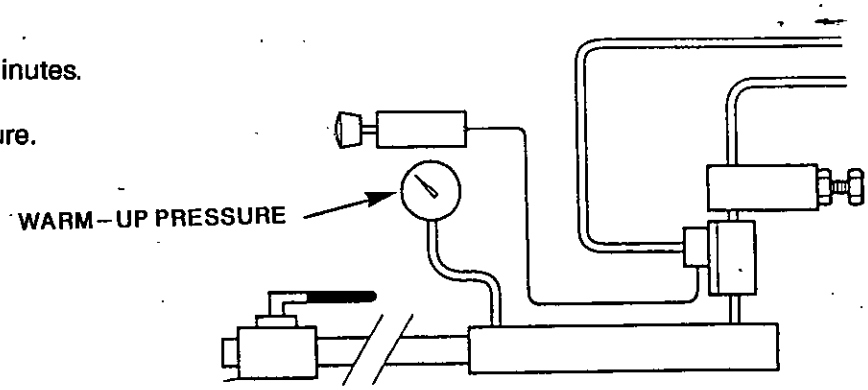


5.

6. START THE UNIT.

Allow to warm up for 3 to 5 minutes.

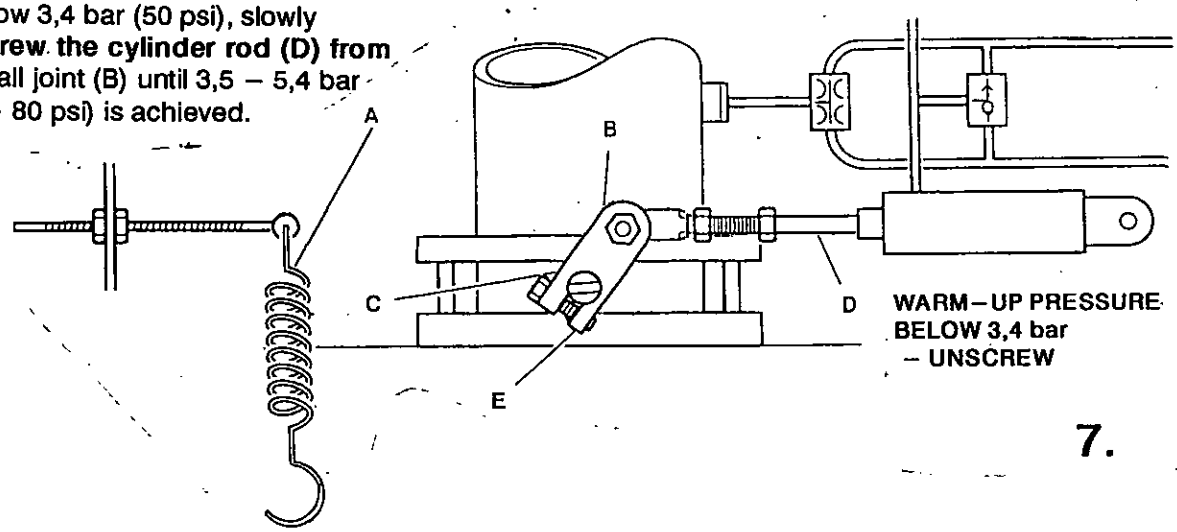
Note the warm–up air pressure.



6.

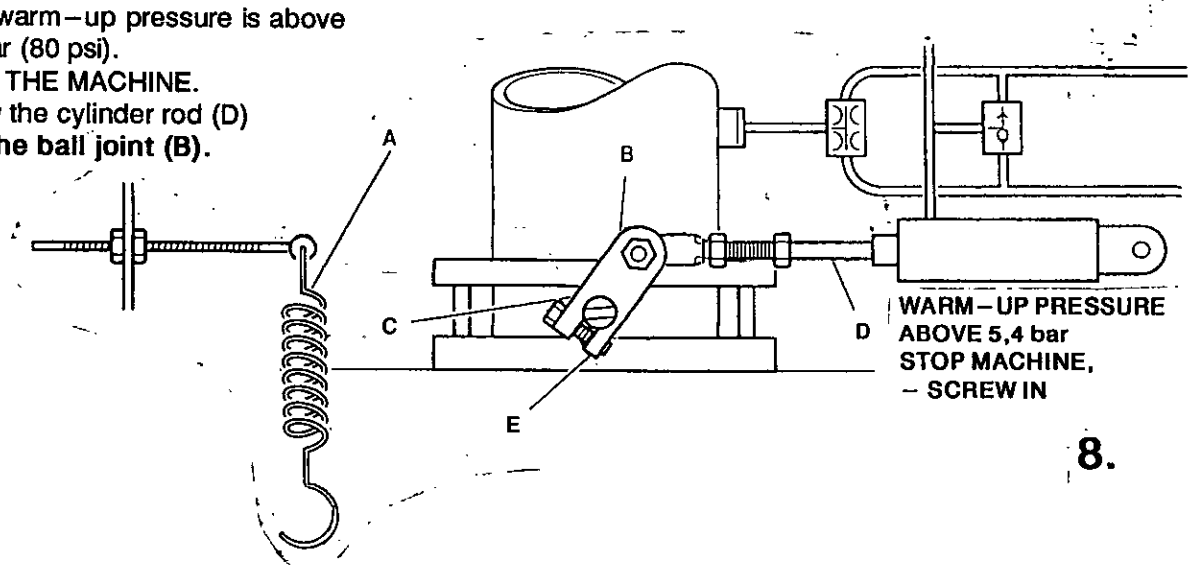
REGULATION ADJUSTMENT (cont'd.)

7. STOP THE MACHINE.
If below 3,4 bar (50 psi), slowly **unscrew the cylinder rod (D) from** the ball joint (B) until 3,5 – 5,4 bar (50 – 80 psi) is achieved.



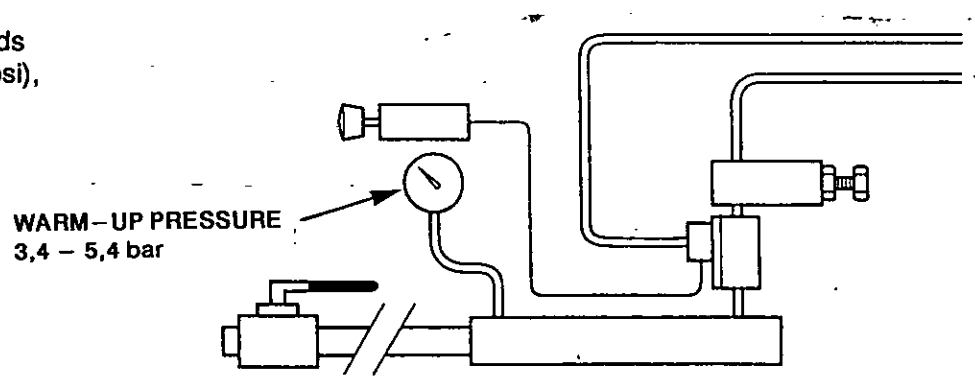
7.

8. If the warm–up pressure is above 5,4 bar (80 psi).
STOP THE MACHINE.
Screw the cylinder rod (D) **into the ball joint (B).**



8.

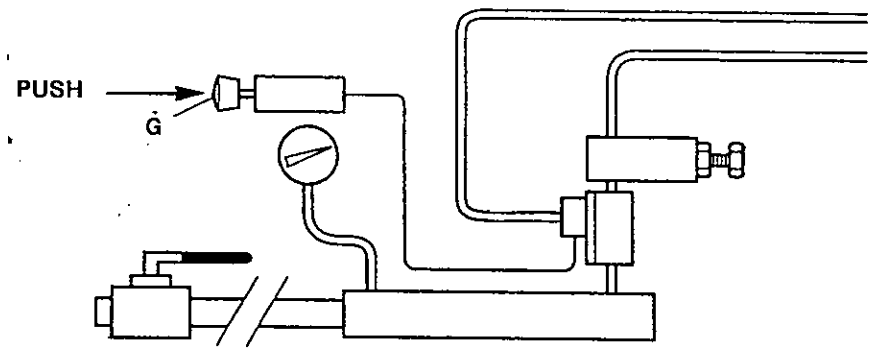
9. Re–start and check the warm–up pressure on the gauge. Repeat if necessary. When the warm–up pressure reads 3,4 – 5,4 bar (50 – 80 psi), the Butterfly Valve is correctly set.



9.

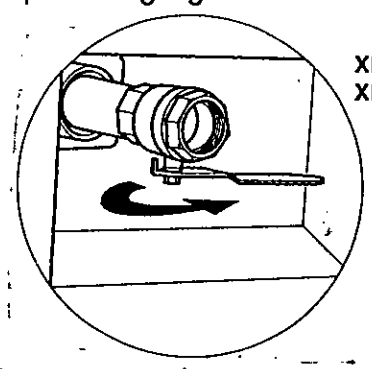
REGULATION ADJUSTMENT (cont'd).

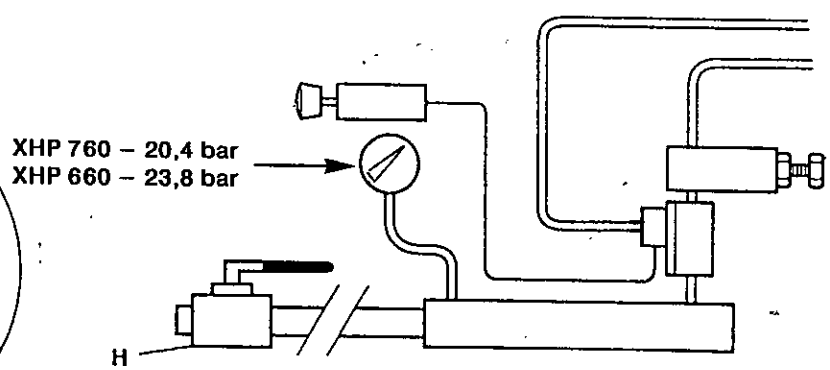
10. Push the Load Button (G) on the control panel.



10.

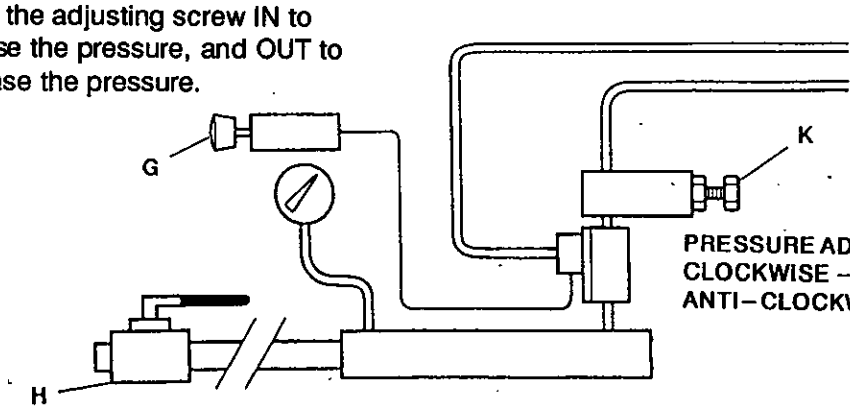
11. Adjust the Service Valve (H) to obtain the maximum rated working pressure; either 20,4 bar (300 psi), for the XHP 760 or 23.8 bar (350 psi) for the XHP 660 on the discharge pressure gauge.





11.

12. To select any pressure between the maximum and minimum ratings of the unit, adjust the Pressure Regulator Valve (K) at full speed.
Rotate the adjusting screw IN to increase the pressure, and OUT to decrease the pressure.

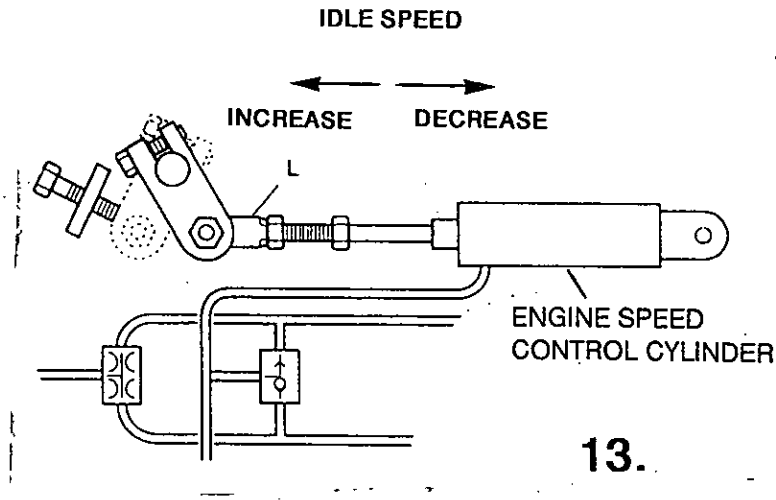


PRESSURE ADJUSTMENT
CLOCKWISE – INCREASES PRESSURE
ANTI–CLOCKWISE – DECREASES PRESSURE

12.

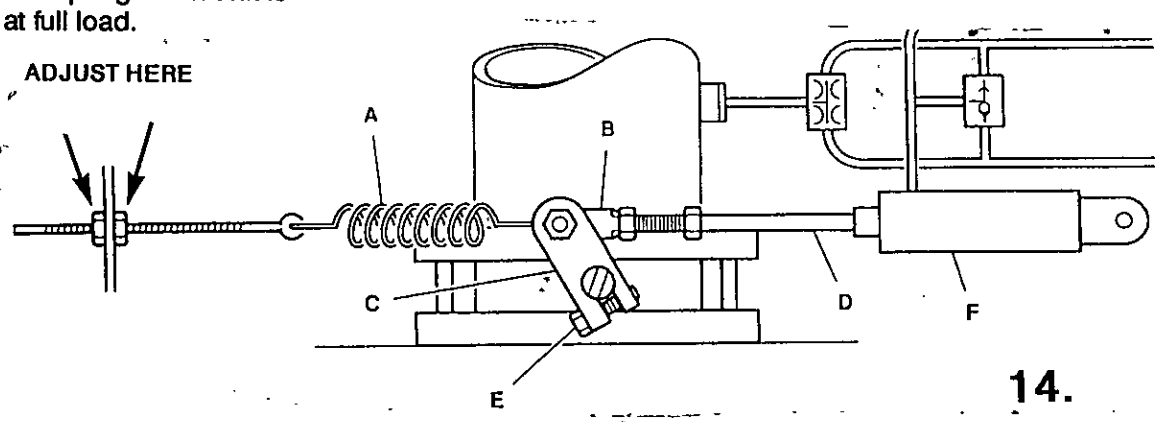
REGULATION ADJUSTMENT (cont'd).

13. Adjust the idle speed by adjusting the ball joint (L) on the end of the engine Speed Cylinder.



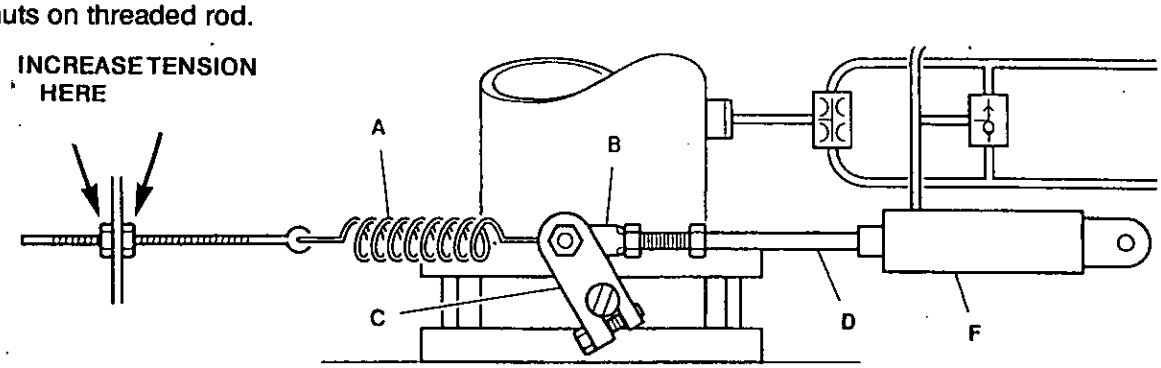
13.

14. Re-connect Ballast Spring (A). Adjust spring tension, using nuts on threaded rod, to ensure there is no tension on spring when unit is operating at full load.



14.

15. Slowly open Service Valve. If engine speed does not stabilise, increase tension on Ballast Spring, using nuts on threaded rod.



15.

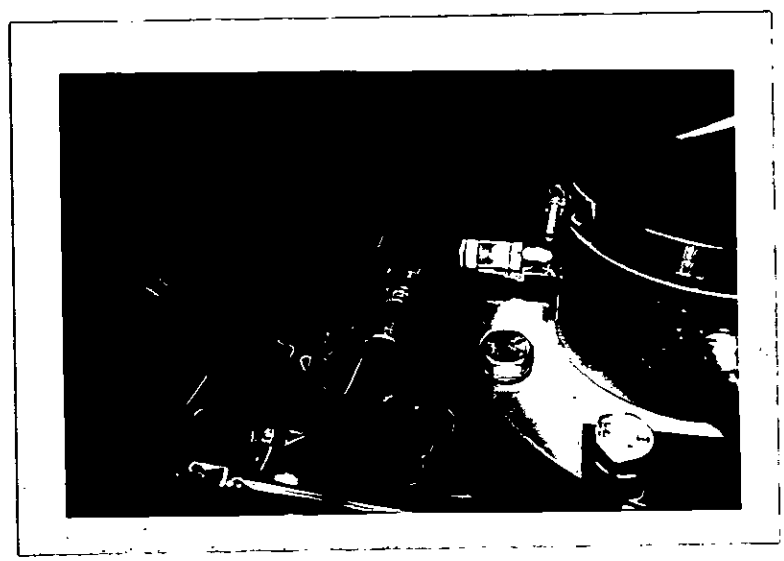
BLOWDOWN

When the machine is shutdown, all system pressure must vent to atmosphere. This is for both safety reasons and also to facilitate any re–start. Always allow the machine to blowdown at the controlled rate, through the Automatic Blowdown Valve. Do not open the service valve to speed up this process, as this can cause oil turbulence inside the Separator Receiver with subsequent oil carryover.

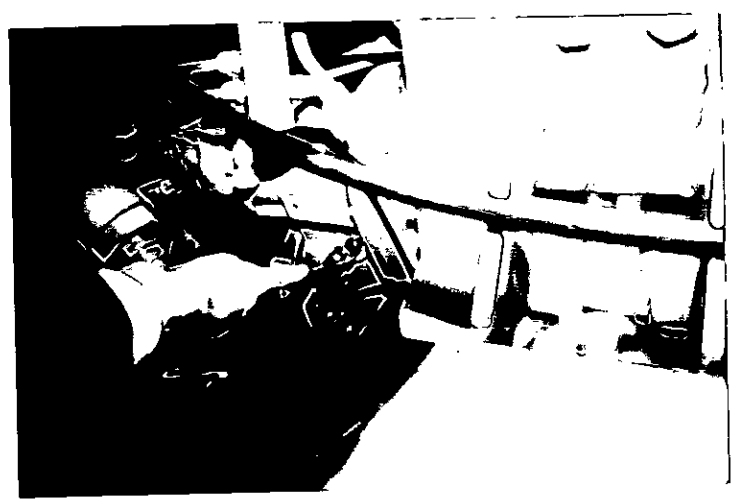
The major components are:–

1. AUTOMATIC BLOWDOWN VALVE
2. SILENCER–ORIFICE
3. MANUAL BLOWDOWN VALVE

1. This is the Automatic Blowdown Valve. It is normally kept closed by....

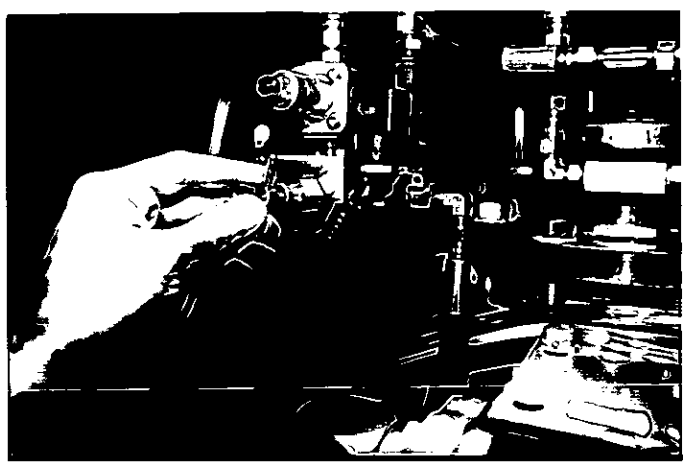


....a pilot hose connection in the side of the high pressure stage of the airend.



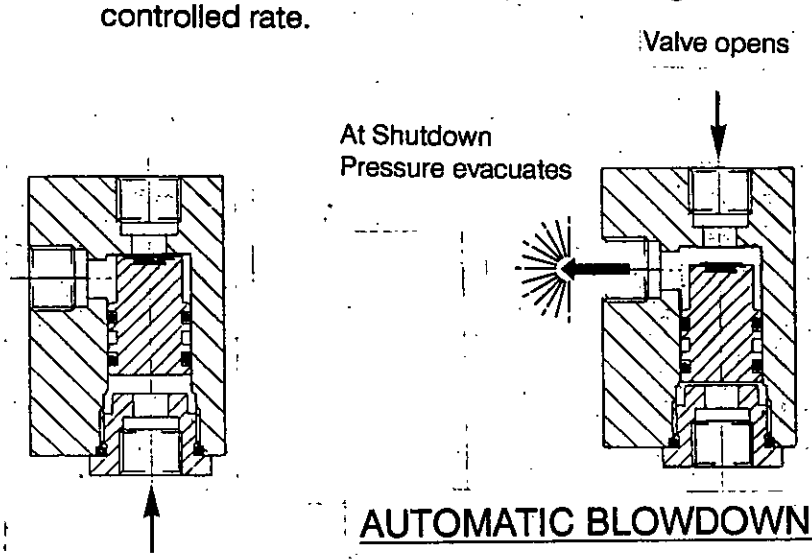
2. When the machine is shutdown, the Blowdown Valve opens and vents system pressure through an Orifice (4,0 m/m dia.) in the side of the air intake.

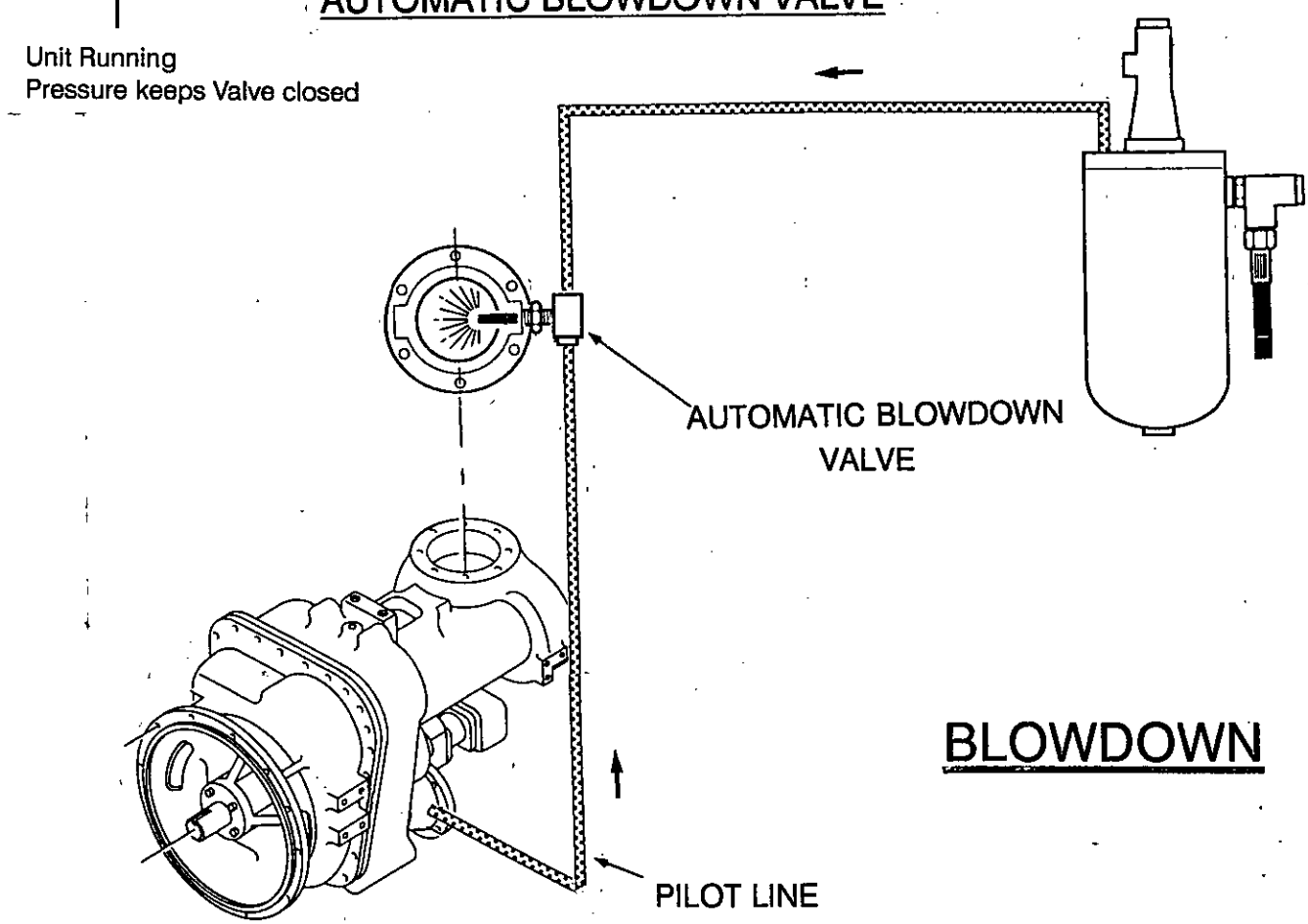
3. A Manual Blowdown Valve is also provided.
Note: This valve may be left open overnight to remove condensate in conditions of high humidity.



BLOWDOWN

When the unit is shutdown, air pressure in the Separator Receiver forces the Discharge Check Valve to close. The Butterfly Valve opens, thereby relieving air pressure inside the airend. Therefore, air pressure in the pilot line is also vented, which allows the Automatic Blowdown Valve to open under the action of its internal spring. System pressure now vents to atmosphere through the Silencer–Orifice at the controlled rate.





BLOWDOWN

ENGINE COLD STARTING

An Ether cold start aid is standard equipment.

It consists of the following:–

1. A Pushbutton....

2. ....which injects a metered quantity of Ether via a solenoid valve....

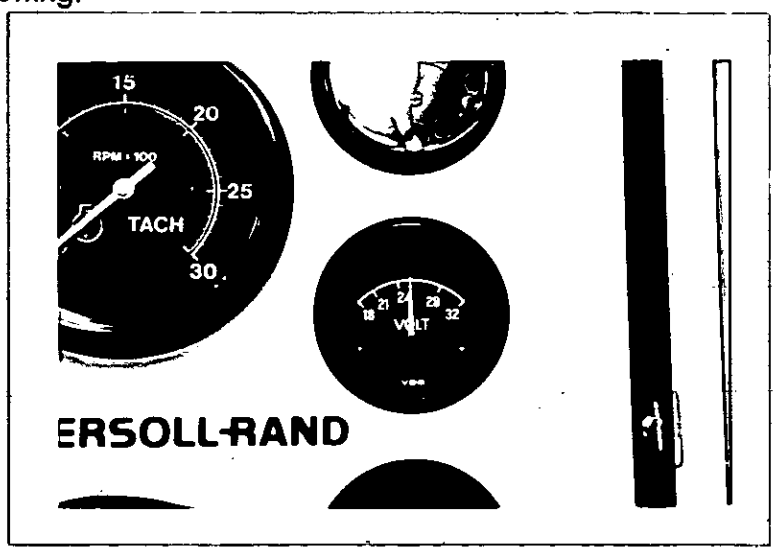
3. .....into the engine intake manifold via an atomiser.
Note: Never use Ether while the engine is already running, as this may result in serious damage.

ELECTRICAL

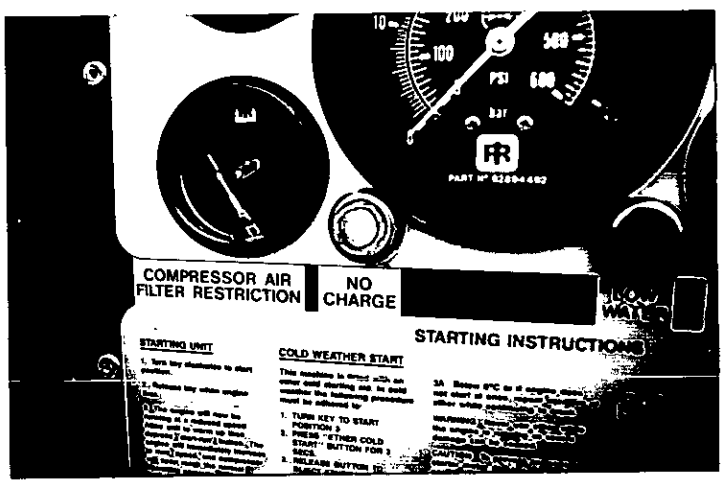
Firstly, we'll look at the basic components, and then we'll look in detail at the Safety Shutdown System.

The instrument panel contains the following:–

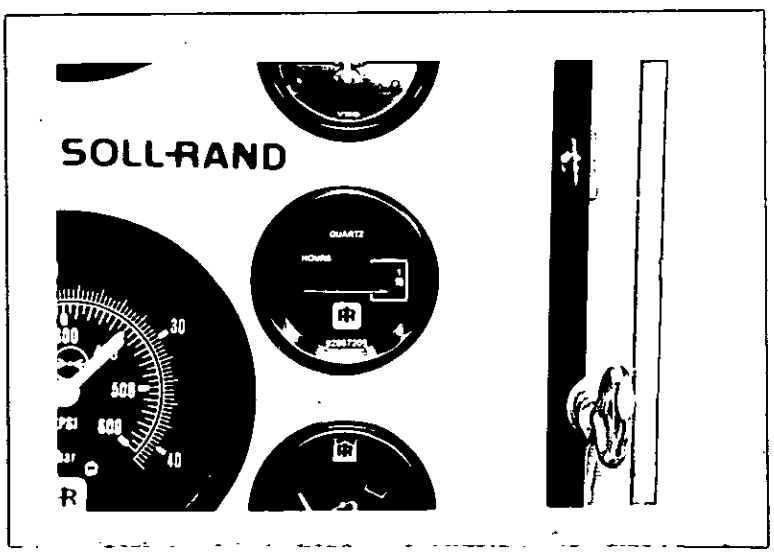
1. A Voltmeter (to indicate battery charging when the machine is running).



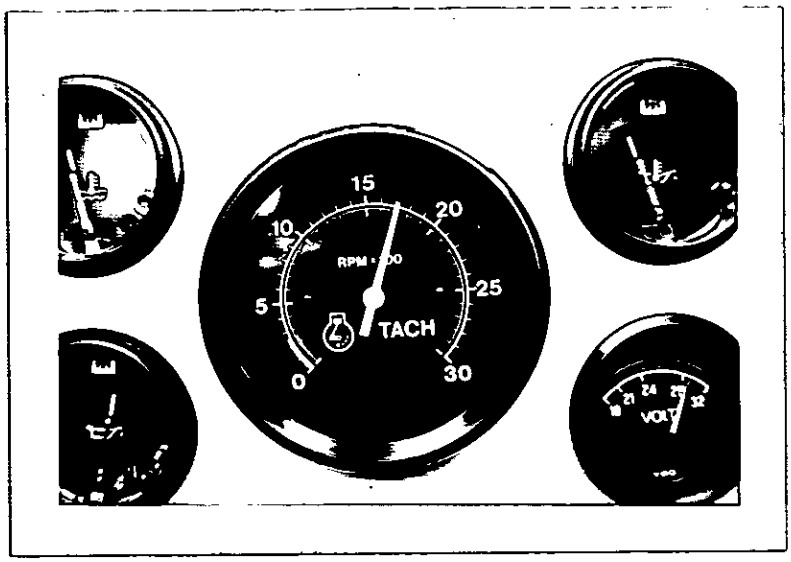
2. An Alternator NO CHARGE lamp. Note: If this lamp is illuminated with the engine running, the cause of the problem must be remedied immediately; it may be because the alternator drive belt has broken and this same belt also drives the cooling fan.



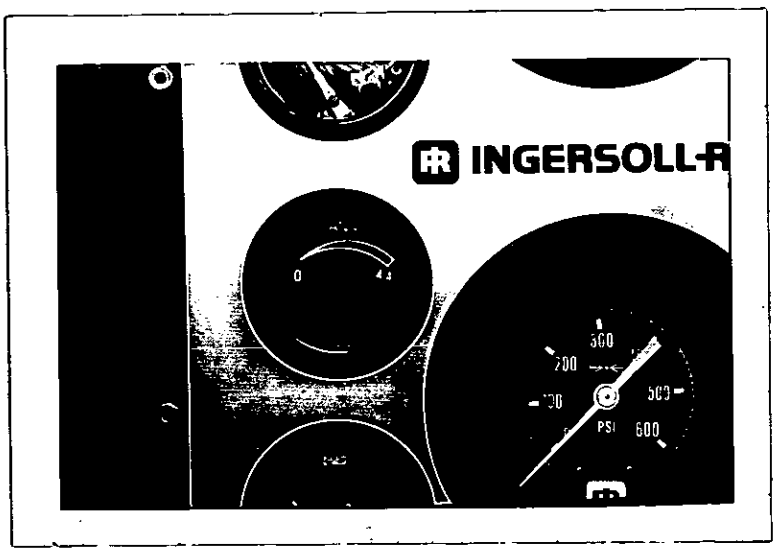
3. An Hourcounter.
This has an electronic "memory," which will retain the recorded service hours, even if the batteries are disconnected for up to 6 months.



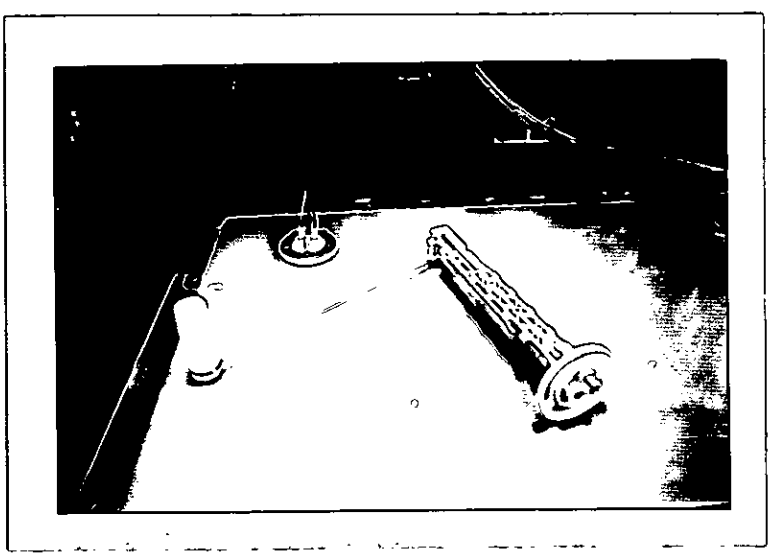
4. An engine Tachometer, which is powered from the Alternator.



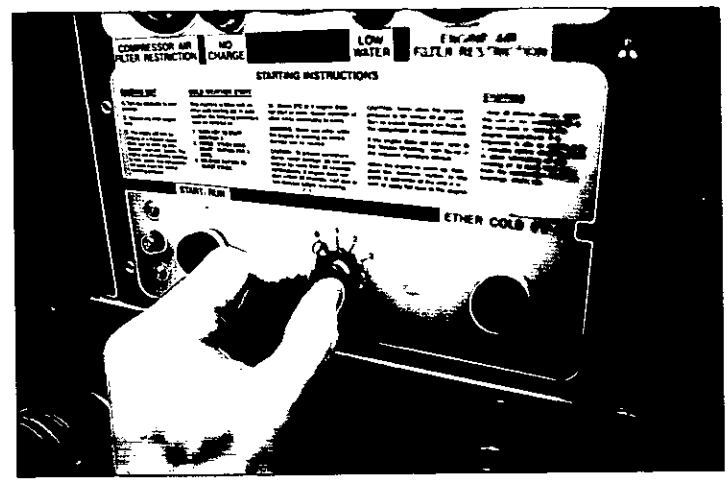
5. A Fuel Gauge....



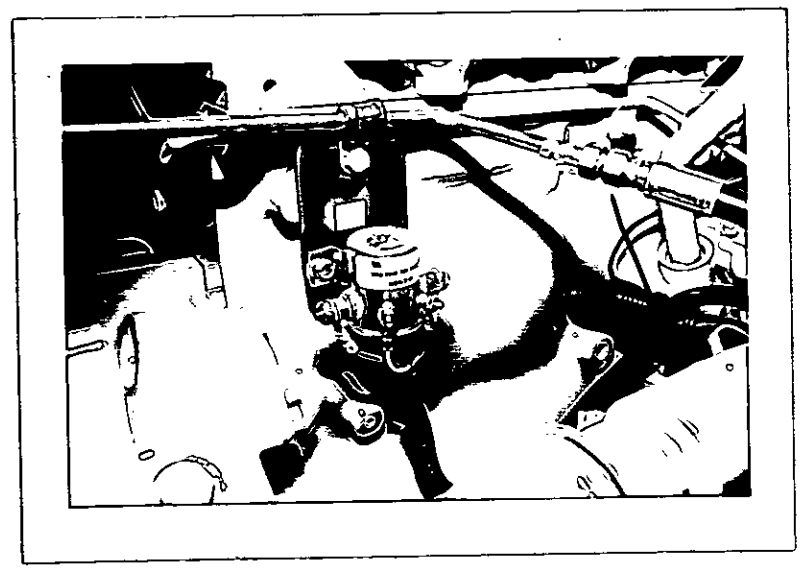
....which receives its signal from a float–controlled sender unit in the right–hand fuel tank.



6. The Keyswitch initiates the start–up and shutdown of the machine.
Note: It is also the Emergency Stop switch.



7. During cranking,the Keyswitch energises a Magnetic Switch, mounted adjacent to the Starter Motor, which, in turn, energises the Starter Motor. The Magnetic Switch carries the heavy current required during cranking.

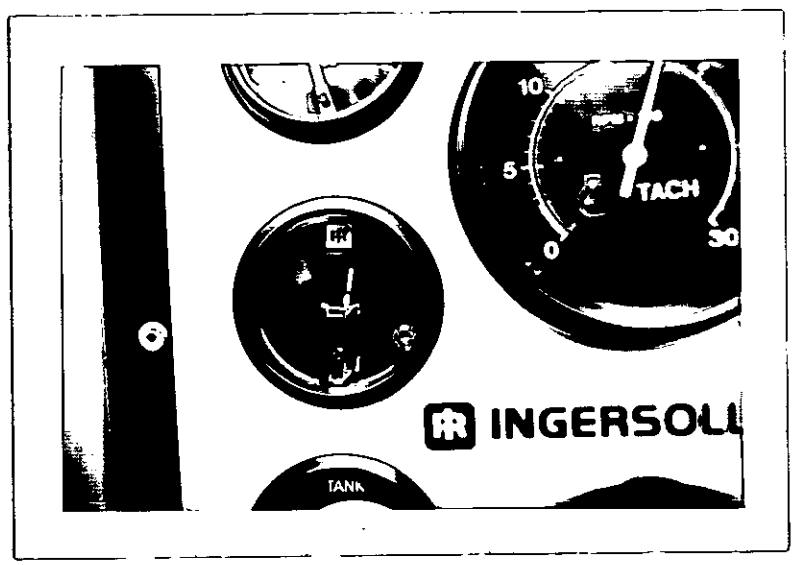


SAFETY SHUTDOWN SYSTEM

The Safety Shutdown System monitors the following 4 conditions, and will shut the machine down if an abnormal condition is detected:–

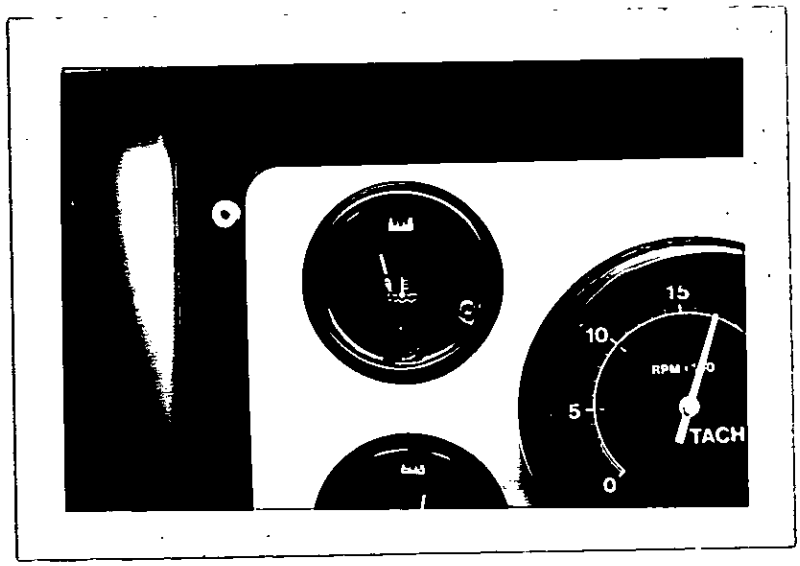
1. LOW ENGINE OIL PRESSURE (below 1,0 bar)
2. HIGH ENGINE COOLANT TEMPERATURE (above 100 deg C)
3. HIGH AIR DISCHARGE TEMPERATURE (above 120 deg C)
4. LOW ENGINE COOLANT LEVEL

1a. The Engine Oil "switchgauge" is a combination switch and gauge. It switches from its START (bypass) position to its RUN position when engine oil pressure attains 1,0 bar (15 psi).

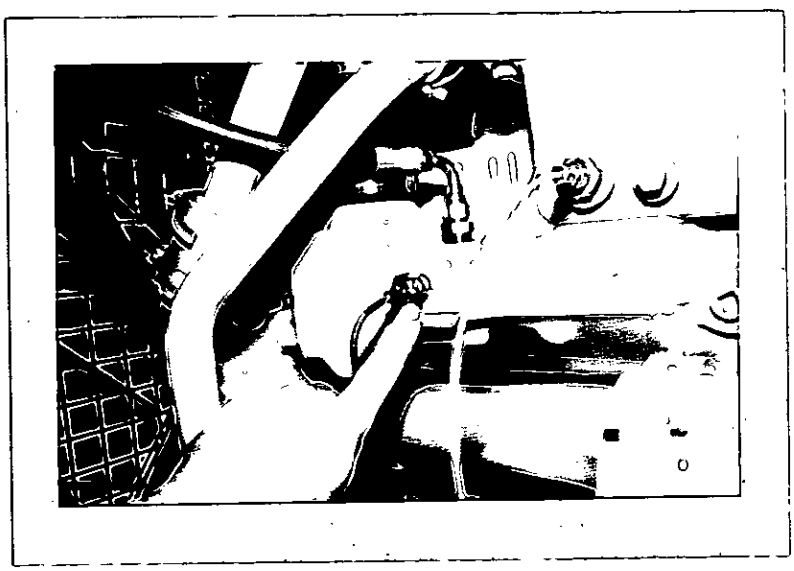


1b. It receives its signal from a hose connection in the engine block.

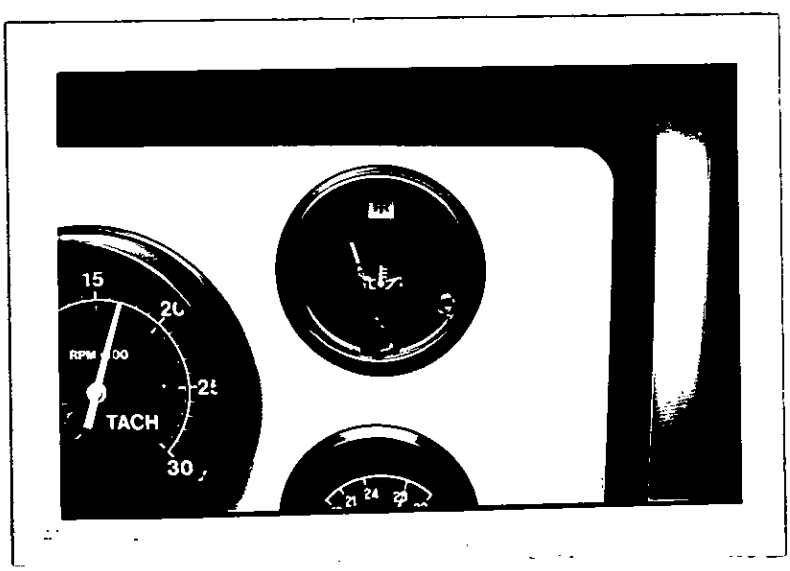
2a. The Engine Coolant Temperature "switchgauge" is a combined switch (normally–closed) and gauge. It switches to the OPEN position if engine coolant temperature rises to 100 deg C.



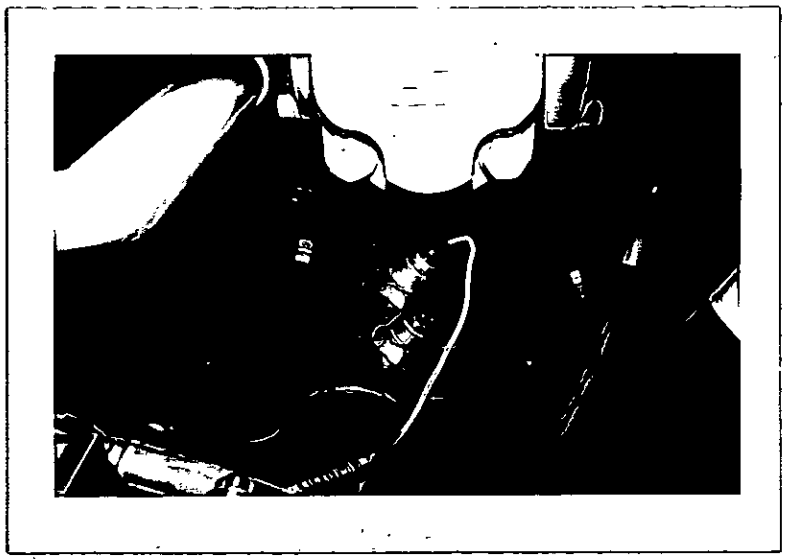
2b. It receives its signal from a probe in the engine cooling system.



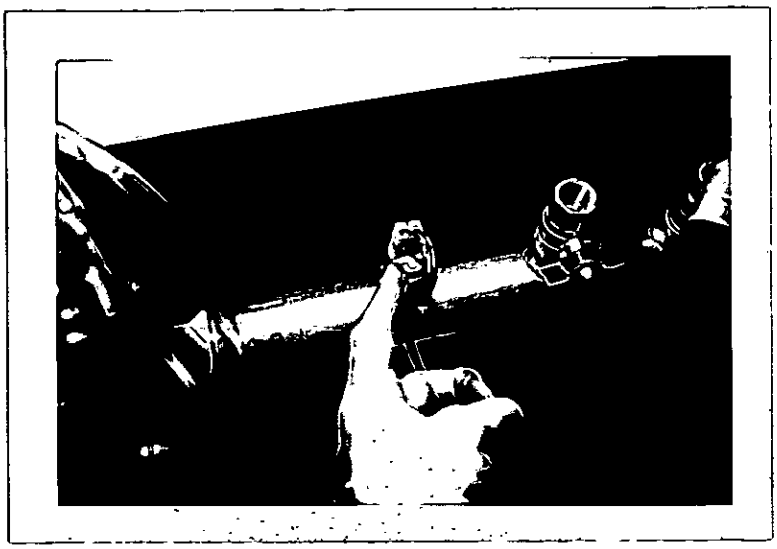
3a. The Air Discharge Temperature "switchgauge" is a combination switch (normally–closed) and gauge. It switches to the OPEN position if air discharge temperature rises to 120 deg C.



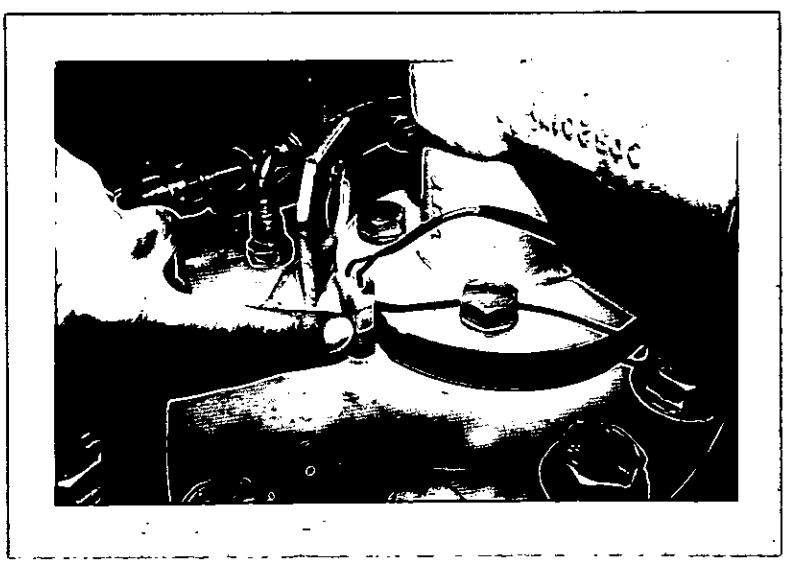
3b. It receives its' signal from a probe in the airend discharge pipe.



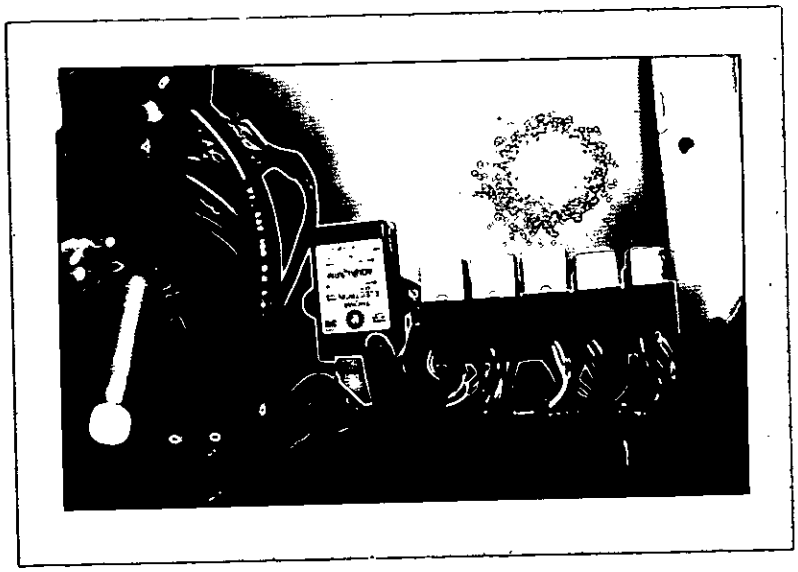
3c. In addition, there is a second High Air Discharge switch (normally–closed) in the air discharge pipe after the Separator Receiver. It switches to the OPEN position if air discharge temperature rises to 120 deg C.



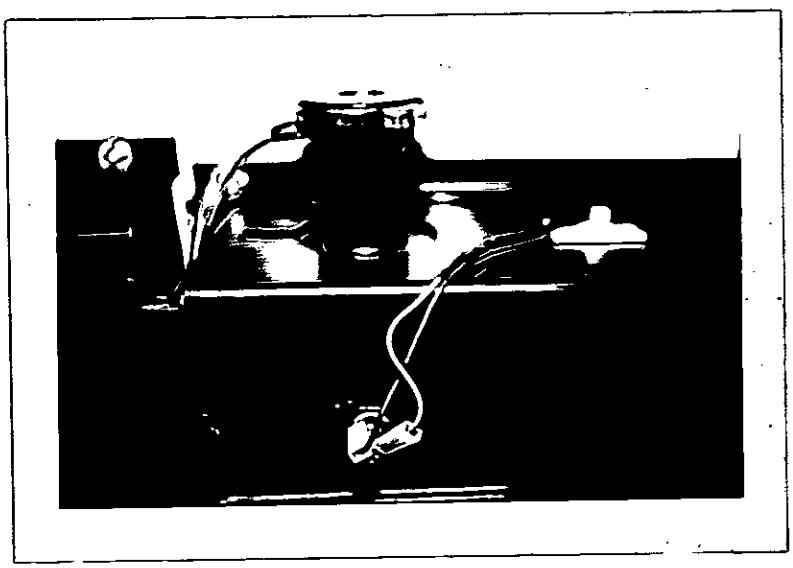
3d. There is also a Thermal Fuse in the top of the Separator Receiver. This will melt if the discharge air temperature in the Separator Receiver reaches 170 deg C.



4a. Finally, the Engine Low Coolant Level switch (Radolarm) is located inside the instrument panel.



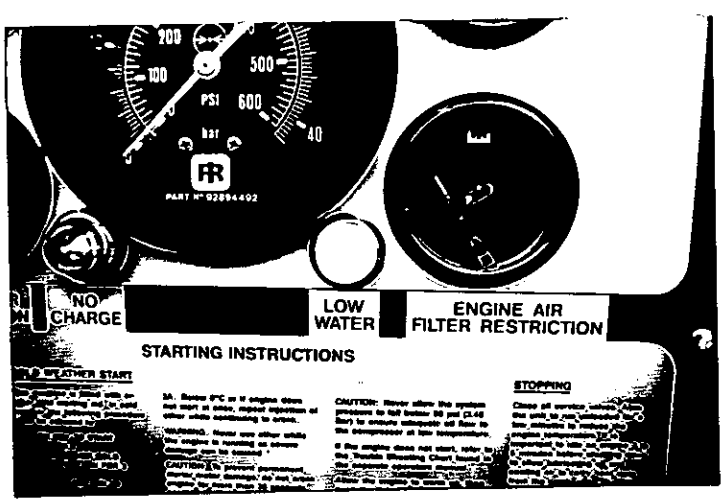
4b. It receives its' signal from a probe in the top of the radiator. Provided the coolant level covers the probe, the Radolarm remains in the RUN position.



4c. A Low Coolant Level shutdown condition is indicated by a warning lamp on the instrument panel.

Note 1: The Radolarm circuit will self–test (lamp illuminated) for 1–4 secs. every time the Keyswitch is turned to the Power On position.

Note 2: A loss of approx. 9 litres of coolant from the system will expose the probe and initiate a safety shutdown.

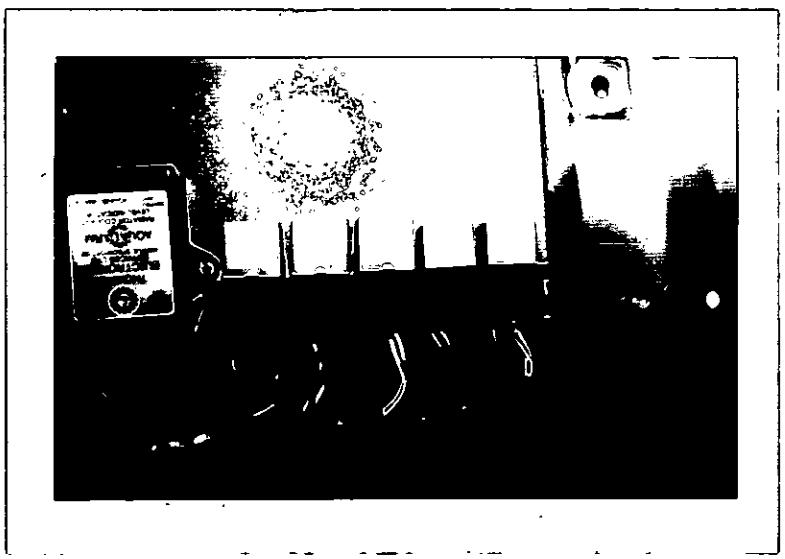


Any of the above 4 safety features will initiate a shutdown by de–energising the Engine Stop Solenoid, which is situated on, and acts directly on, the fuel governor. This Solenoid must be energised in order for the unit to run.

A 25 Amp Circuit Breaker Re–set button will "trip" and stop the unit if there is a high current e.g. a short–circuit in the electrical system.

Here are the 5 Relays in the electrical circuit. They are as follows (from left to right):–

1. Override (Bypass) Relay (24 volt)
2. Fuel Stop Solenoid Relay (24 volt)
3. Radolarm* Relay (24 volt)
4. Alternator No Charge Relay (12 volt)
5. Start Inhibit Relay (12 volt)



Note: the cause of a safety shutdown must be remedied before attempting to re–start the machine.

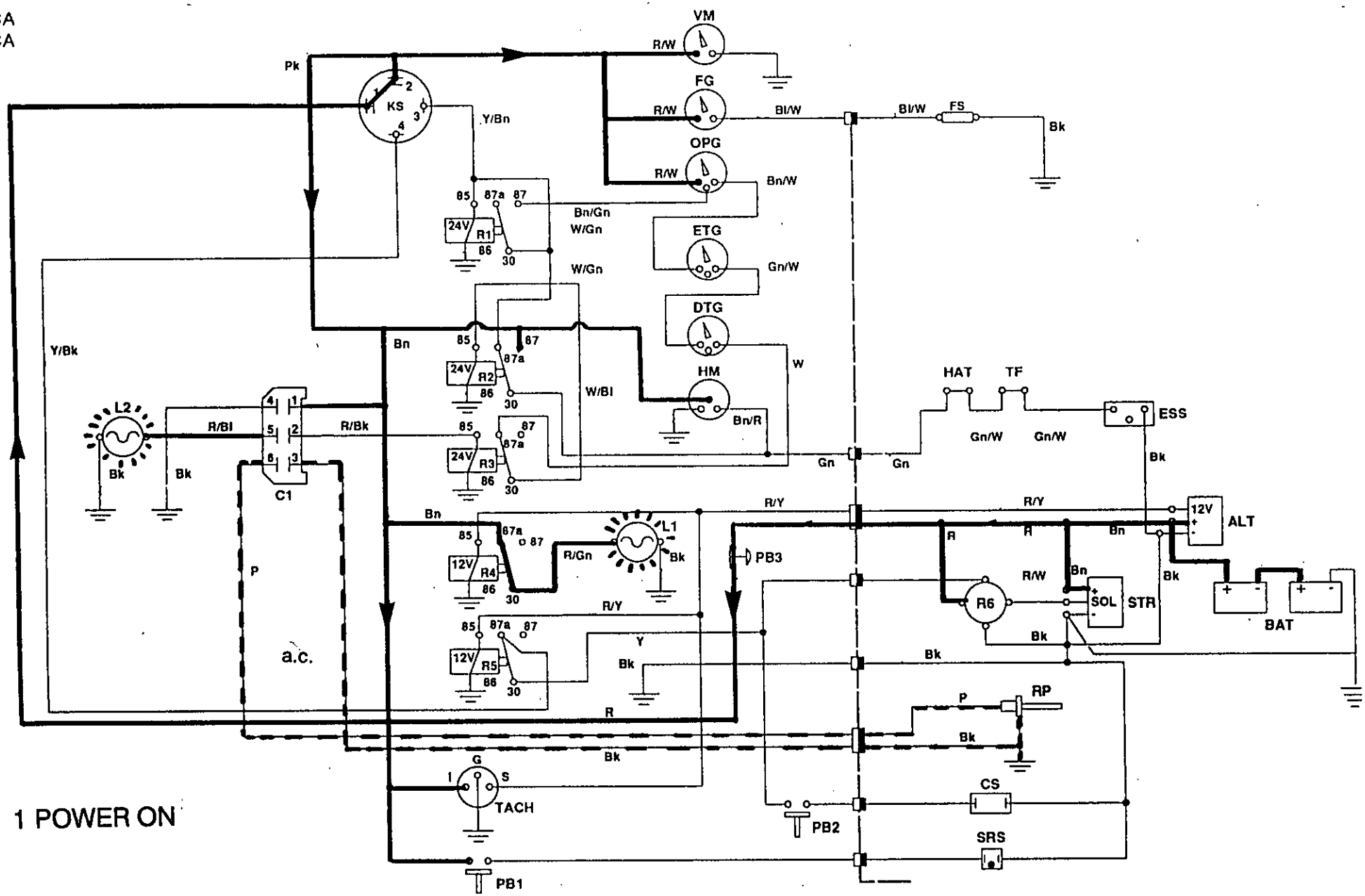
SAFETY SHUTDOWN SYSTEM

Let's look at how the Safety Shutdown system operates.....

1. Power On

The Keyswitch (KS) is turned to the POWER ON position (2). This connects the LIVE terminal (1) to (2).
This energises the Voltmeter (VM) and the Fuel Gauge (FG); it also connects power to the Hourmeter (HM), but does not energise it.
Power also feeds to terminal 1 on the Radolarm unit (C1). This initiates an a.c. signal via terminals 3,6 to the probe (RP). The Radolarm orange lamp (L2) illuminates for a self–test period of 1–4 secs.
The Alternator No Charge red lamp (I1) also illuminates.

XHP660 CA
XHP760 CA

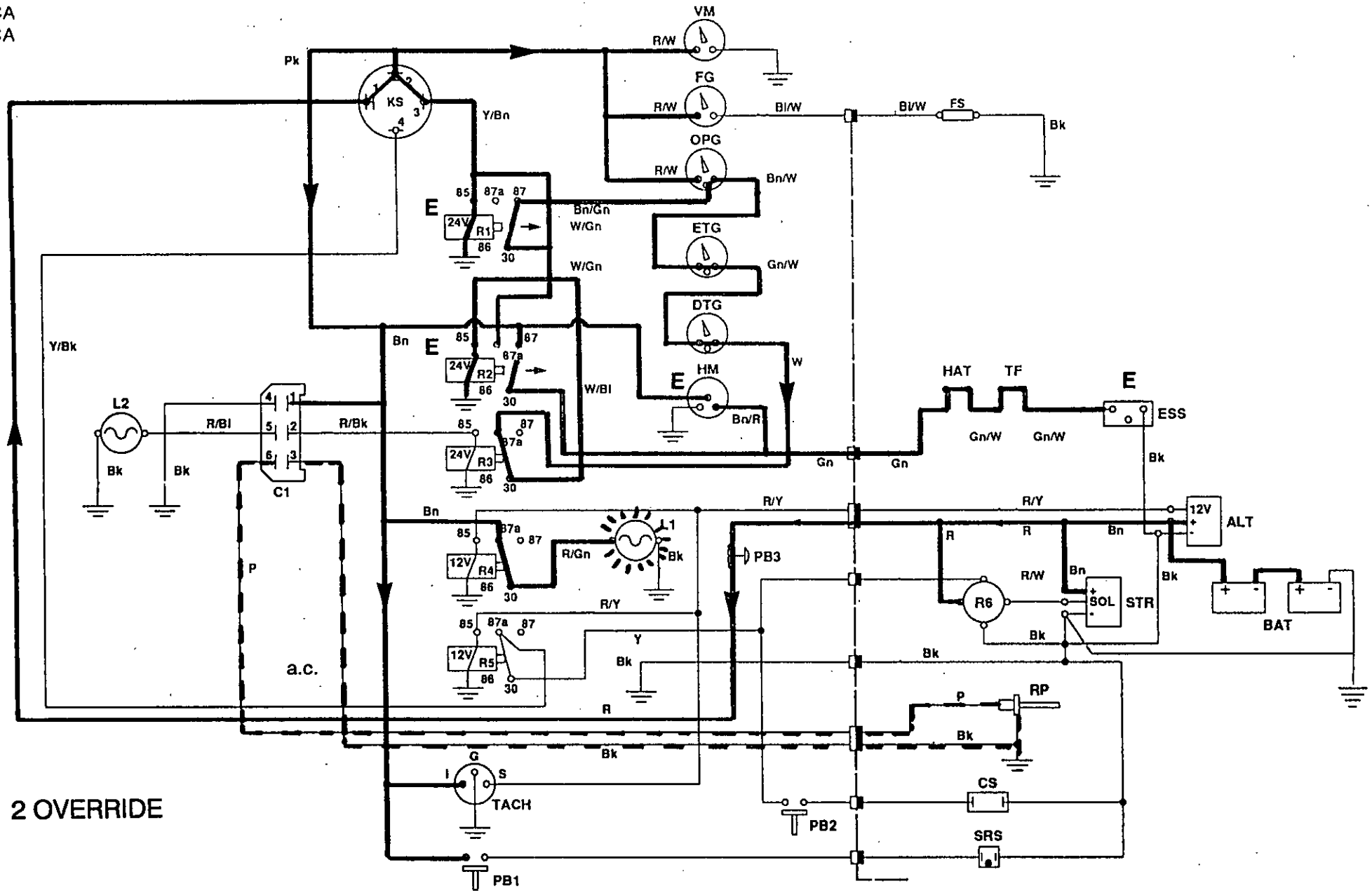


1 POWER ON

2. Override

The Keyswitch (KS) is turned to the OVERRIDE (BYPASS) position (3). Terminal 1 now connects to terminal 3, which feeds power to the Override Relay (R1). This energises, which changes over its contacts to 30,87.
Power now feeds through 30,87 to the (normally–open) contacts on the Engine Oil Pressure switch–gauge (OPG), and from here through the (normally–closed) contacts on the Engine Water Temperature switch–gauge (ETG), the Air Discharge Temperature switch–gauge (DTG) to the Radolarm Relay (R3) contacts 30,87a.
From here, power continues through to energise the Fuel Solenoid Relay (R2).
Consequently, power can now pass through contacts 87,30 on this relay, through the High Air Temperature Switch (HAT), and Thermal Fuse (TF)to the Engine Stop Solenoid (ESS) to energise it to its RUN position.
The Hourmeter (HM) is now energised.

XHP660 CA
XHP760 CA

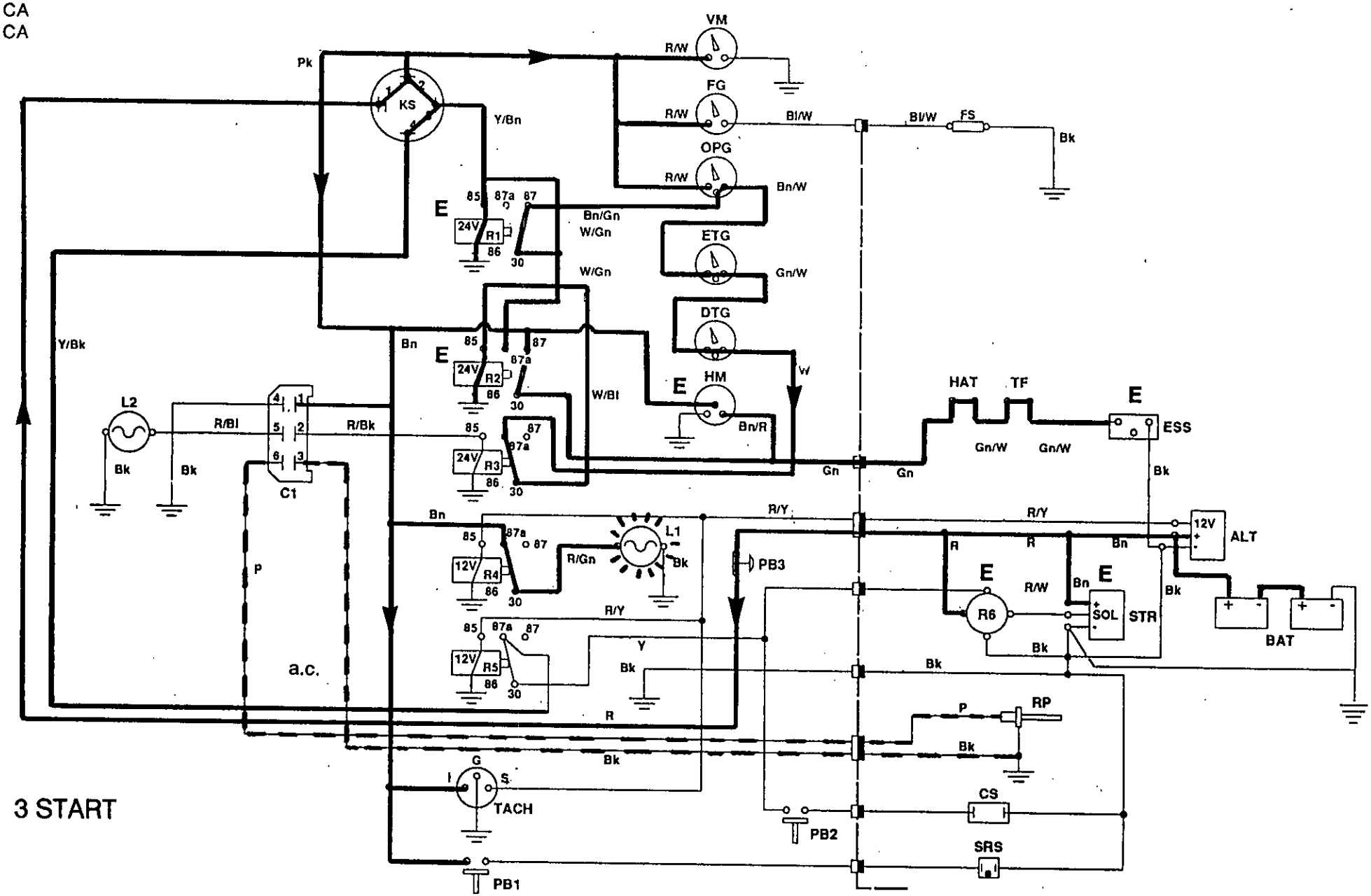


2 OVERRIDE

3. Start

The Keyswitch is turned to the START position (4).
This energises the Magnetic Switch (R6), which in turn energises the Starter Solenoid (SOL). The Engine commences cranking.

XHP660 CA
XHP760 CA

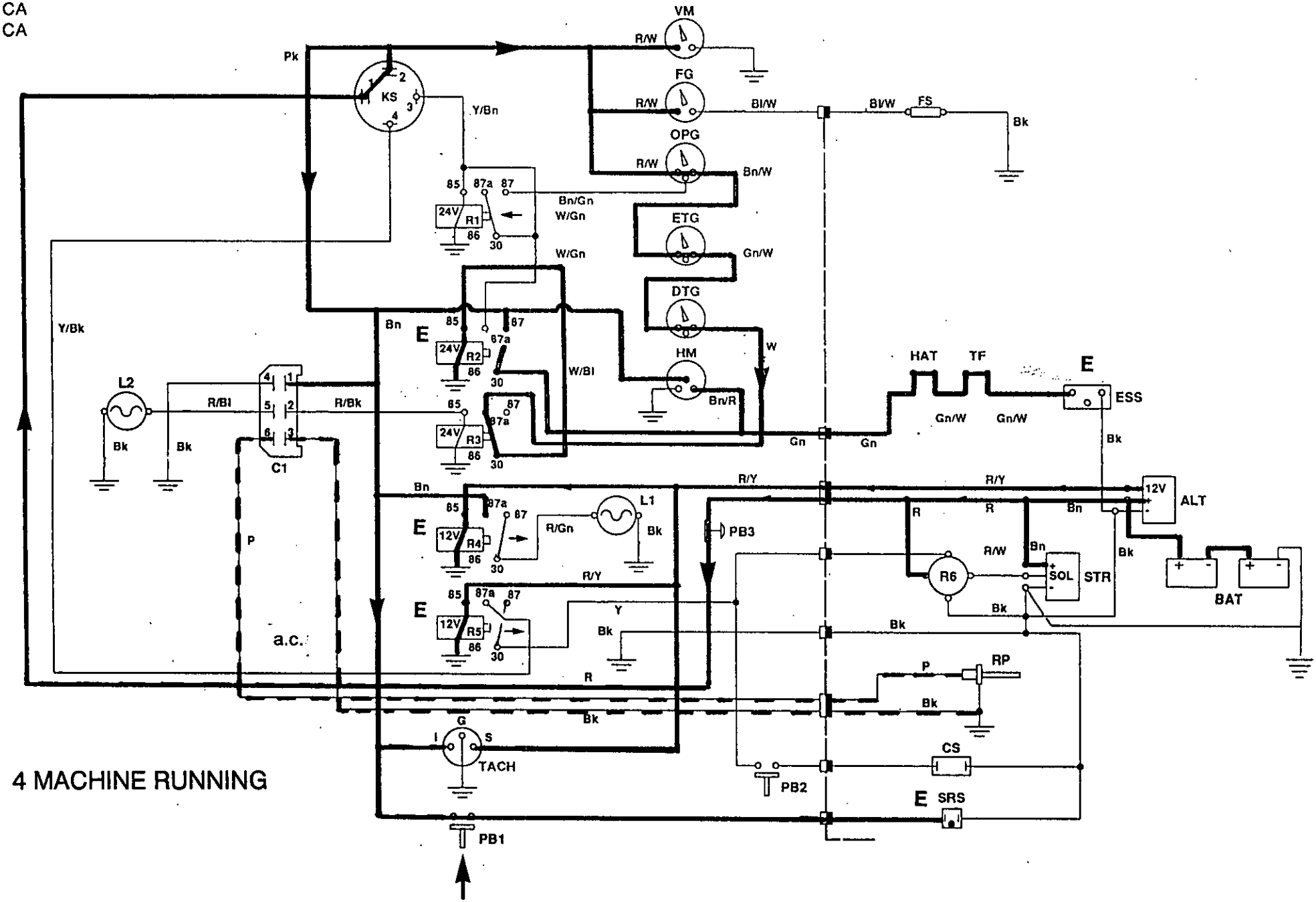


3 START

4. Machine Running

The engine has started.
The rise in engine oil pressure enables Engine Oil Pressure switch–gauge (OPG) to switch to its RUN position.
Consequently, the Keyswitch can be released, allowing it to spring–return to its Run position (2).
The Override Relay (R1) therefore de–energises.
Therefore, Fuel Solenoid Relay (R2) remains energised via OPG,ETG, and DTG.
Therefore, power is maintained via contacts 87,30 on R2, through HAT and TF to keep ESS energised in the RUN position.
The Alternator (ALT) is now charging the circuit and its 12 volt tapping energises the Alternator No Charge Relay (R4), so that its red lamp (L1) extinguishes, and also energises the Start Inhibit Relay (R5).
This prevents the Starter from being re–cranked when the engine is already running.
After allowing the machine to warm up (2–3 minutes), the Start–Run button (PB1) can be pushed. This momentarily energises the Start–Run solenoid (SRS), and so the machine is able to go on load.

XHP660 CA
XHP760 CA



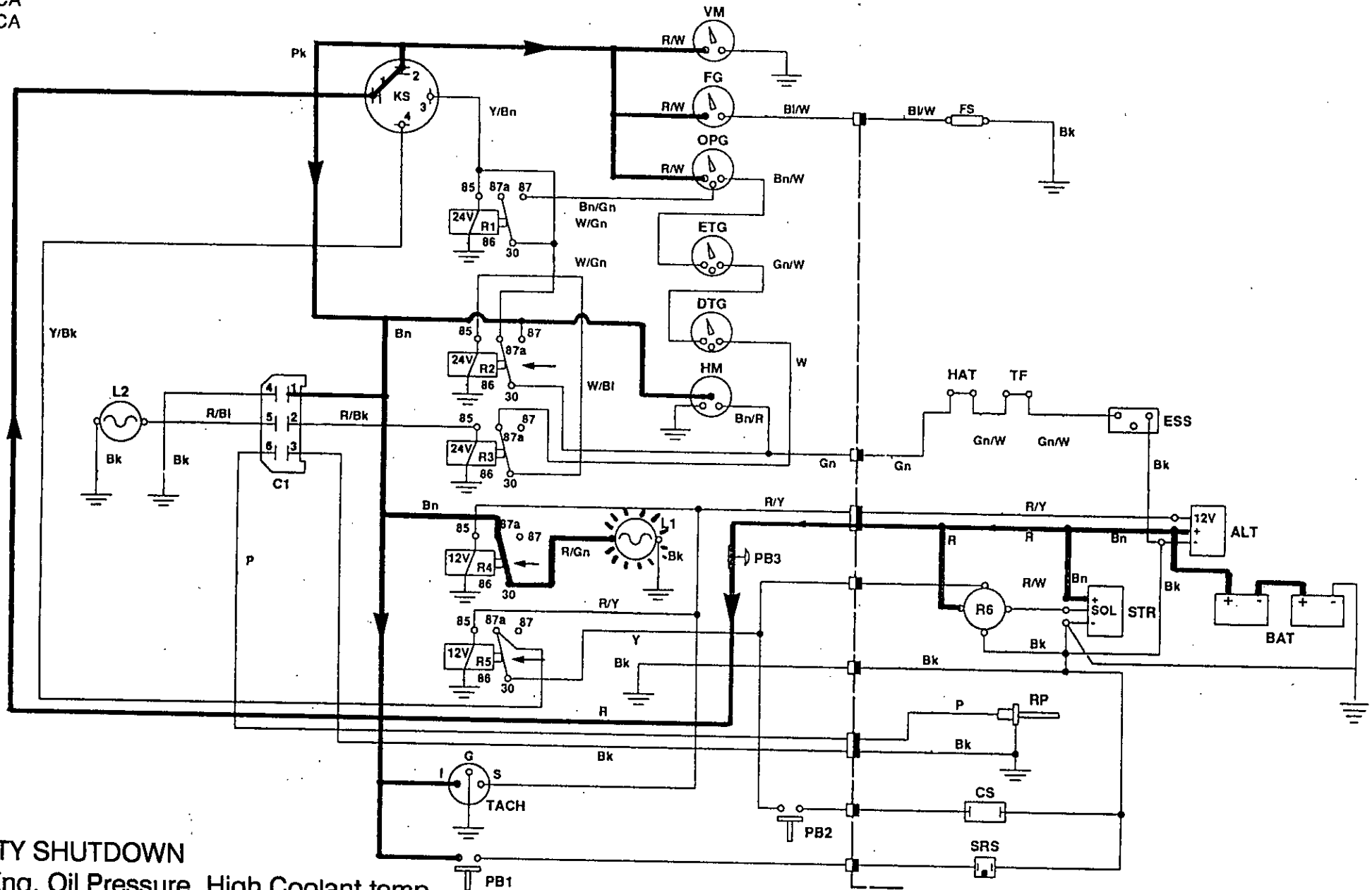
4 MACHINE RUNNING

5. Safety Shutdown

For example, a high engine coolant temperature occurs (above 100 deg C).
ETG switches to its open position.
Consequently, R2 de–energises, which in turn de–energises ESS.
The machine stops immediately.
The operator is provided with a visible indication of whichever shutdown condition may have occured (low oil pressure, high coolant temperature, high discharge air temperature, low coolant level) by checking the gauges (OPG,ETG,DTG) and Radolarm lamp (L2) on the instrument panel.

Note: The cause of a safety shutdown must be remedied before attempting to re–start the machine.

XHP660 CA
XHP760 CA



5 SAFETY SHUTDOWN
Low Eng. Oil Pressure, High Coolant temp.,
Low Coolant Level, High Air Disch. Temp.

FAULT FINDING

FAULT	CAUSE	REMEDY
Engine fails to start. (Starter not operating.)	Low battery charge.	Check battery connections and re-charge battery if necessary.
	25 amp Circuit Breaker tripped out.	
Engine fails to start. (Starter Motor operating.)	Loose connection to Stop Solenoid.	Check wiring.
	Fusible Plug (TF) blown.	Check Fusible Plug in top of Separator tank.
	Faulty Stop Solenoid.	Check Stop Solenoid.
	Fuel Starvation.	Use manual fuel pump to prime fuel system.
Engine stops when keyswitch is released.	Low engine oil pressure.	Check oil level and oil filter.
	Low water level.	Check if Radolarm light is on. If radiator water level is correct, check Radolarm circuit for fault.
	Electrical fault.	Test electrical circuits.
	Keyswitch faulty.	Check Keyswitch.
Engine stops.	No fuel.	Check fuel levels in fuel tanks and filters.
	Water in fuel system.	Check water trap and clean if necessary.
	High discharge temperature.	Check Discharge Temperature gauge.
	High water temperature.	Check Water Temperature gauge.
	Low engine oil pressure.	Check engine oil level and oil filter.
	Electrical fault.	Test electrical circuits.
	Faulty relay.	Check relays in sockets and replace if necessary.

Refer also to the Engine Manufacturer's manual.

Machine goes to full pressure when started.	Butterfly Valve set incorrectly.	Reset Butterfly Valve (refer to "Regulation Adjustment")
Machine fails to load when Start–Run button is pressed.	Faulty Start–Run Solenoid.	Check electrical circuit. Feel for movement in Solenoid when button is pressed. Replace Solenoid, if necessary.
Safety Valve operates.	Butterfly Valve set incorrectly. Loose pipe or hose connections. Faulty Safety Valve.	Reset Butterfly Valve (refer to "Regulation Adjustment") Check all connections. Check relieving pressure. Replace if necessary. **Do not attempt to repair.**
Oil blows back into airend air filter at shutdown.	Incorrect stopping procedure. Faulty Discharge Check Valve. Machine stalls when required to idle.	Use correct stopping procedure. Close Service Valve and allow machine to idle before stopping. Dismantle Check Valve from discharge pipe and check operation. Check operation of regulation system. Check and adjust idle speed, if necessary.
High discharge air temperature.	Low oil level. Blocked oil cooler fins. Faulty Oil Temperature Bypass Valve. Reduced cooling air flow from fan.	Check oil level. If necessary, re–fill to top of green sector in sightglass. Clean cooling fins with compressed air or steam with machine stopped. **Use reduced pressure air for cleaning** Check operation of valve. (Refer to Op.Maint. Parts book section "PROTECTIVE SHUTDOWN SYSTEM" in the MAINTENANCE section.) Check fan and belt drive. Check for obstructions inside fan cowl.

High engine coolant temperature.	Low coolant level.	Check and re–fill, if necessary.
	Blocked radiator fins.	Clean cooling fins with air or steam with the machine stopped. **Use reduced pressure air only for cleaning.**
	Reduced cooling air flow from fan.	Check fan and belt drive. Check for obstructions inside fan cowl.
	Faulty engine thermostat.	Check and replace, if necessary.
Low discharge air capacity.	Engine speed too low.	Check engine speed with a tachometer. If necessary. re–set engine speed control cylinder. (Refer to "Regulation Adjustment.")
	Blocked air filter.	Check restriction indicators and replace air filters, if necessary.
	High pressure air escaping	Check for leaks and rectify.
	Regulation system set incorrectly.	Reset. (Refer to "Regulation Adjustment".)
Oil carry–over in discharge air.	Blocked Scavenge Line/Orifice.	Clean and re–assemble.
	Separator Element perforated.	Replace Separator Element.
	Minimum Pressure Valve defective.	Check operation of Minimum Pressure Valve. (Min. pressure should be 10,0 bar 150 psi.)
Engine speed too low.	Blocked air filter.	Check restriction indicators and replace air filter, if necessary.
	Blocked fuel filter or strainer.	Clean strainer and/or replace filter.
	Premature unloading.	Check operation and regulation of Engine Control Cylinder.
	Engine or Airend malfunctioning.	Reduce operating pressure to observe if engine speed is still too low.