CHAPTER 1

DESCRIPTION

OPERATION

1. GENERAL ASPECTS

1.1 OVERALL PRESENTATION

In accordance with specifications, the SIDES AIRPORT FIRE VEHICLE Type VMA 112 is intended for use by airfield fire-fighting and rescue services and for use outside the airfield in order to carry out the following missions:

Principal missions:
- Fighting aircraft fires on the airfield and in the vicinity of the aerodrome
- Fighting hydrocarbon fuel depot fires

Secondary missions:
- Fighting fires in facilities housing aviation equipment, transport equipment and in the surrounding areas
- Fighting fires in infrastructure facilities.

The uniformity of design of the vehicle enables it to travel at high speed on roads or concrete tracks and to manoeuvre in complete safety on all pathways and uneven ground and on sandy or heavy, vegetation-covered soil.

The fire-fighting equipment enables both water and foam to be projected. It allows all types of water (fresh or sea water) and foam compounds for fuel fires to be used.
Water/foam production is provided by means of a single-stage centrifugal pump making it possible to use all of the fire fighting equipment at their maximum output simultaneously.
The pump is driven by the vehicle engine via a power take off, on the transmission.

This device makes it possible to perform pump and roll operations.

1.2 CHARACTERISTICS

Physical, technical and performance figures are given in the data sheets inserted at the beginning of the manual.

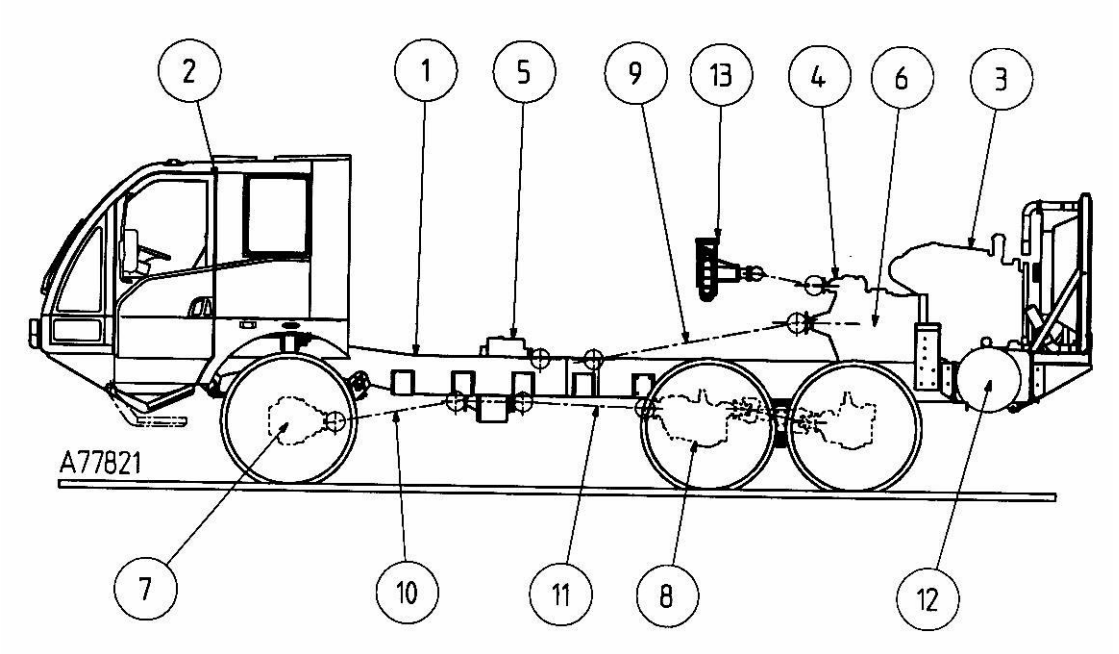
2. VEHICLE SPECIFICATIONS

2.1 GENERAL

The AIRPORT FIRE VEHICLE includes :

- **a cab-chassis**
- **a fire-fighting superstructure** with :
  - the tank
  - the pumping and proportioning unit
  - the fire-fighting equipment, including :
    - the manualy controlled foam monitor
    - two restricted sidelines
    - two unrestricted sidelines
    - a self-protection system under the vehicle
    - a 75 kg dry chemical system with discharge nozzle
    - a 75 kg BCF system with discharge nozzle
- **a bodywork** with :
  - six side lockers built-in the water tank, three each side of the vehicle,
  - rear engine compartment
  - pumping and proportioning unit compartment
- **electrical equipment**
- **a set of accessories**

2.2 CHASSIS-CABIN



CHASSIS (1)

The chassis, made of a special high elastic limit steel, has been specially designed for airport fire-fighting vehicles. The engine, situated at the rear of the chassis, leaves the front part totally free and therefore makes it possible:

- to lower the cabin and thus make access easier;
- to provide a flat floor over the whole of the cabin,
- to house a crew of 5 firemen.

CABIN (2)

This is of an advanced type, with flat floor over the whole area. The cabin is made of GRP on steel framework and is fixed to the chassis by means of flexible mounts, which absorb vibrations.
The cabin basically consists of:

- a wide-angle windscreen,
- two doors fitted with windows, which slide down under electric control, ,
- a wide-opening, sliding rear door, giving direct access to the foam monitor platform,
- two fixed side windows,
- five seats, the driver's one having pneumatic suspension,
- a driving position with adjustable steering column,
- a control panel for driving the vehicle,
- a control panel for operating the fire-fighting equipment,
- a system for defrosting the rear-view mirrors,
- an air ventilation system,
- an air conditioning system
- a heating/defrosting system.

ENGINE / TRANSMISSION

The engine / transmission assembly consist of :

- the engine (3)
- the gearbox (6) fitted with a fire pump power take off (4)
- the transfer case (5)
- the front axle (7)
- the rear axles (8)
- the transmission shafts (9, 10, 11)
- the fuel tank (12)
- the water pump (13)

2.3 FIRE-FIGHTING EQUIPMENT

The fire-fighting equipment includes :

- A two compartment tank, one for water and one for foam compound ;
- A hydraulic pumping–metering unit ;
- Fire fighting equipment including :
  - a foam monitor,
  - four side deliveries,
  - a vehicle self-protection system,
  - a dry chemical set with a portable powder gun,
  - a BCF set with a portable BCF nozzle.

2.3.1 TANK ASSEMBLY

Both water and foam concentrate reserves are contained in a single piece, two-compartment tank entirely constructed of high-strength, glass reinforced polyester. This type of construction makes it possible to transport any type of water (including drinking water) and foam concentrate ; in addition, it removes the risk of corrosion and requires only minimum maintenance.

The tank is fixed to the chassis by rubber mountings which absorb the deformation the chassis is subject to when moving over all types of terrain. In addition, this method of fixing allows the tank to be removed easily.

The upper part of the tank is arranged to provide a platform for the foam monitor, and the hydraulic unit compartment. It is fitted with guard walls built into the sides of the tank. The platform has a non-slip material built-in the walking area.

Water compartment

With a capacity of 11,000 litres this is divided up by anti-roll baffles :

- A manhole 450 mm in diameter with quick-release-cover,
- An overflow device and vent to the open air,
- An electrical level gauge coupled to an indicator,
- A drain tray with strainer and drain valve,
- Two drain orifices on the tank,
- Draining pipework on the outside,
- Two inlets for filling the tank under pressure from an external source.

Foam compound compartment

With an 1,320 litres capacity and built into the water tank, this comprises :

- A manhole 450 mm in diameter with a 5 mm stainless steel mesh funnel strainer and a quick-release cover,
- An overflow and venting system,
- An electrical level gauge coupled to an indicator,
- A drain tray coupled to a metering system,
- Draining pipework with strainer,
- Pipework for filling the tank from an external source.

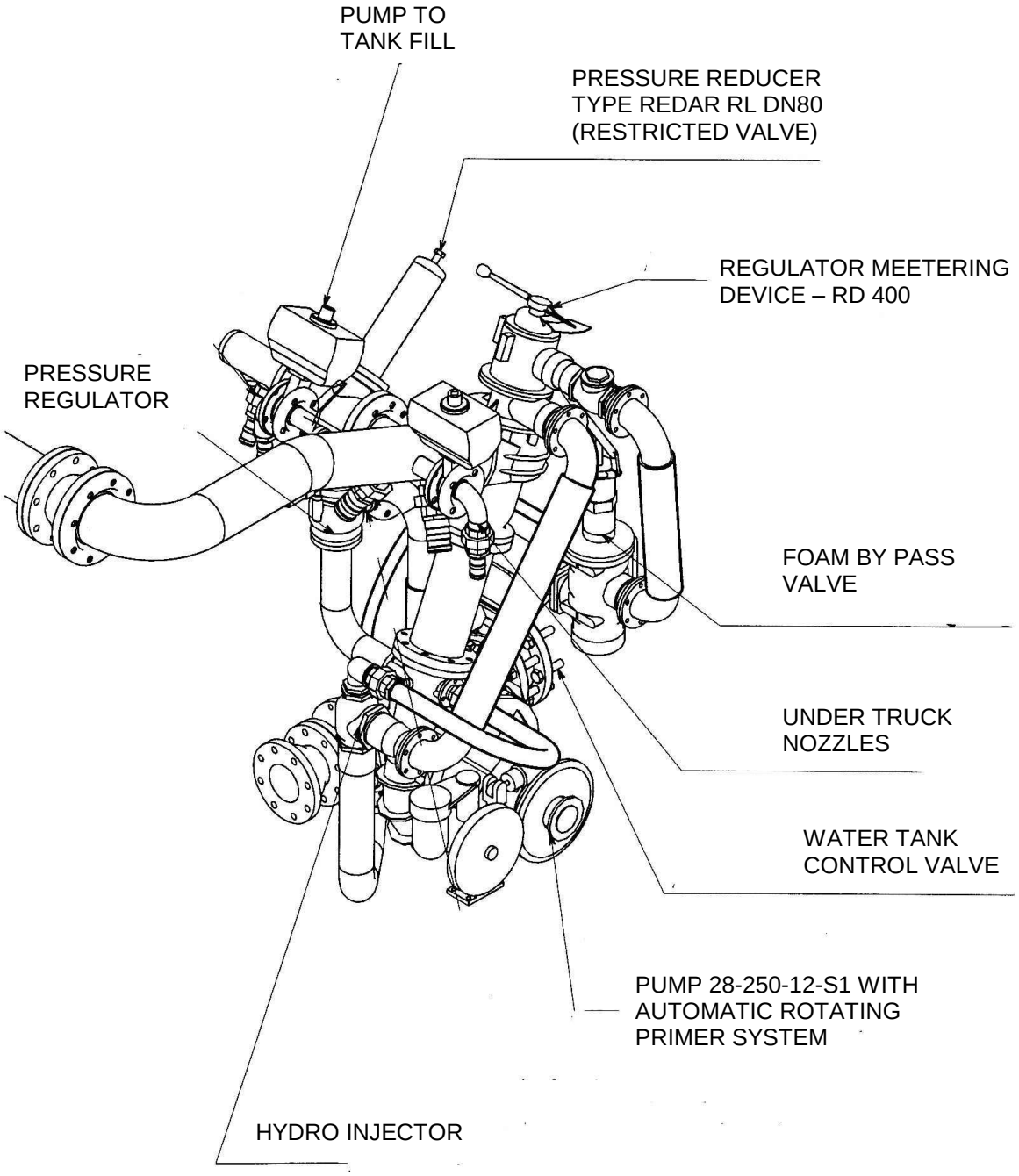
2.3.2 PUMPING AND PROPORTIONING UNIT

The pumping and proportioning unit is located in a compartment built-in the back part of the tank.

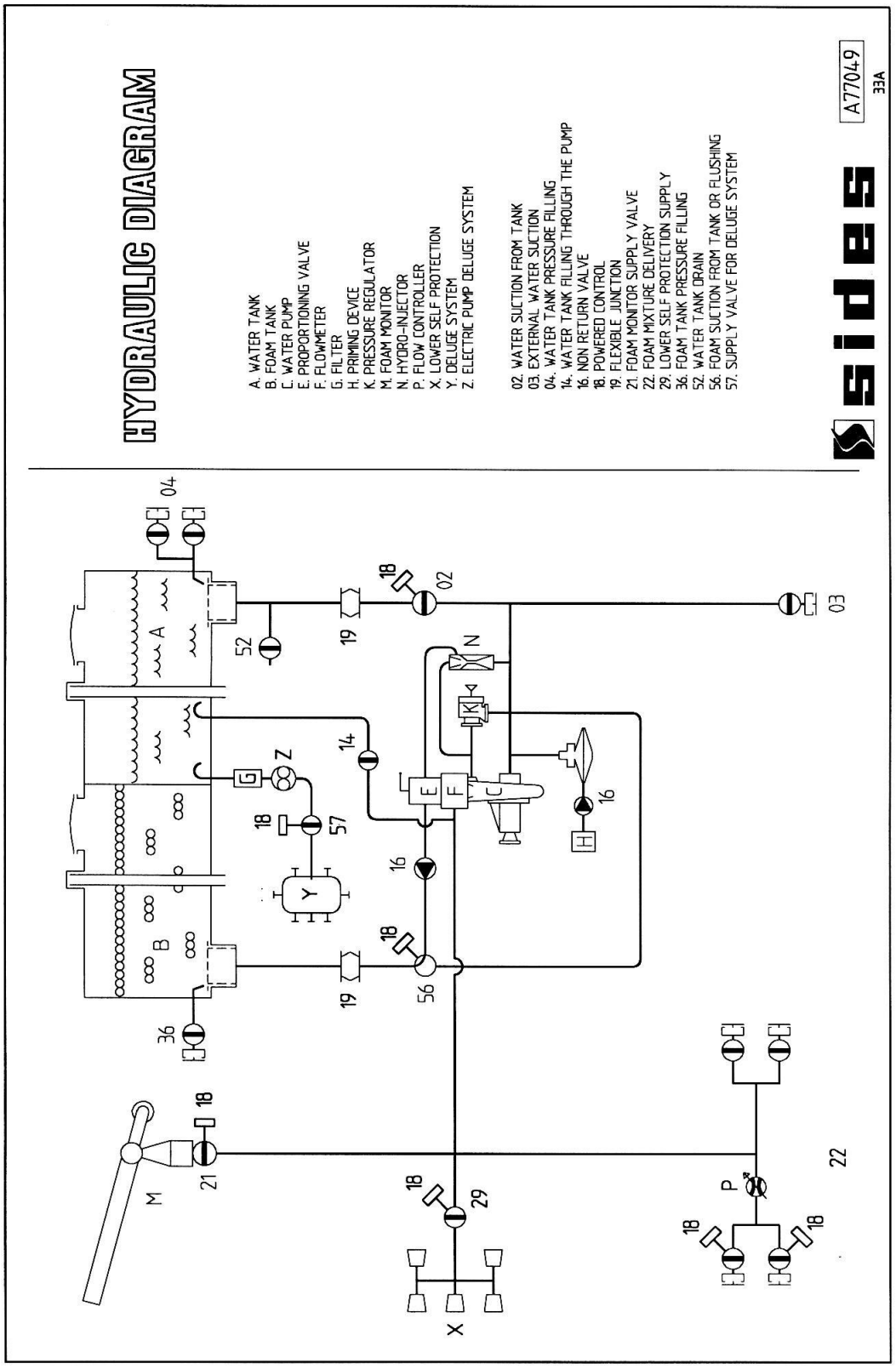
Its purpose is to pump the water, regulate the water pressure, and mix water and foam at a preset ratio.

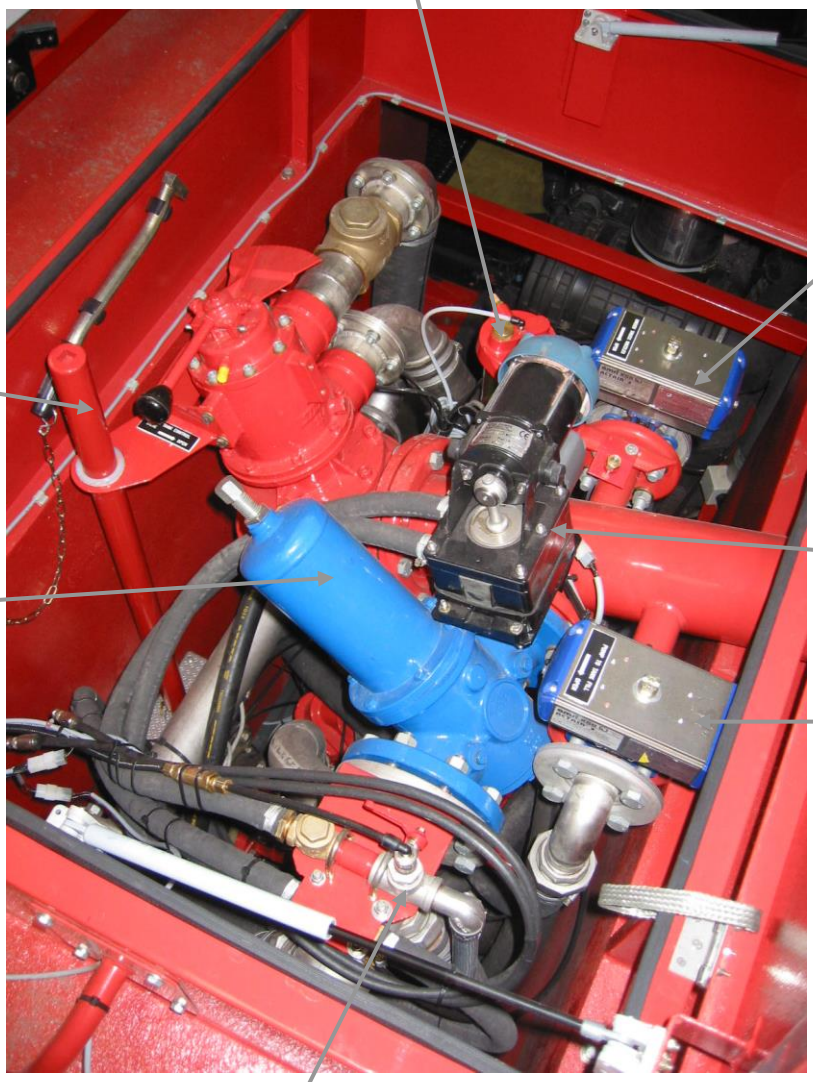
It includes :

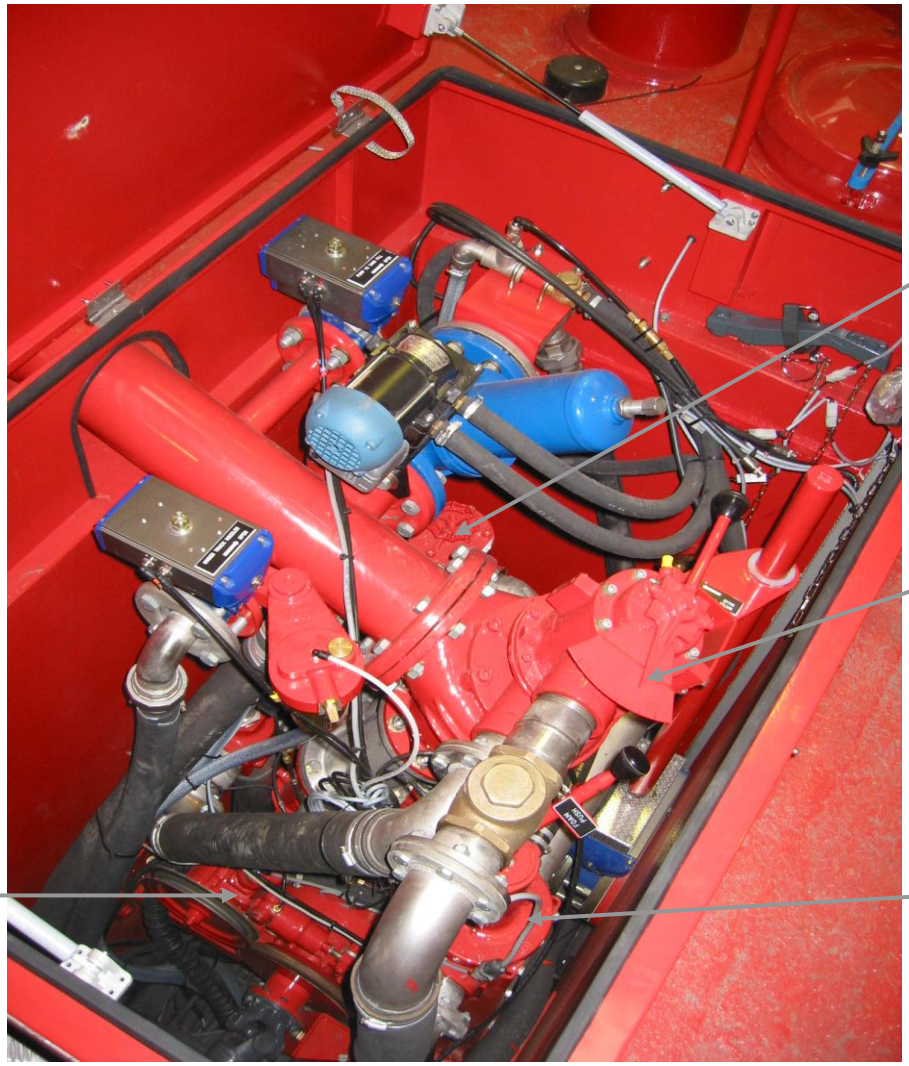
- a water pump, driven by the vehicle engine through a power-take-off located on the gear-box
- a butterfly valve on the tank-to-pump suction pipe
- a primer, of vacuum rotary pump type
- a remote-controlled priming valve
- one pressure regulator : set at 13.5 bar
- an automatic foam-proportioner, including :
    - a water flowmeter with a foam concentrate proportioning valve and a non-return valve
    - an hydro-injector
    - a water/foam selection valve
- a set of remote-controlled powered valves supplying the :
    - foam monitor
    - right hand-line
    - left hand-line
    - water tank valve
    - water tank filling valve by the water pump
    - self protection system


PUMP TO
TANK FILL
PRESSURE REDUCER
TYPE REDAR RL DN80
(RESTRICTED VALVE)
REGULATOR MEETERING
DEVICE – RD 400
PRESSURE
REGULATOR
FOAM BY PASS
VALVE
UNDER TRUCK
NOZZLES
WATER TANK
CONTROL VALVE
PUMP 28-250-12-S1 WITH
AUTOMATIC ROTATING
PRIMER SYSTEM
HYDRO INJECTOR

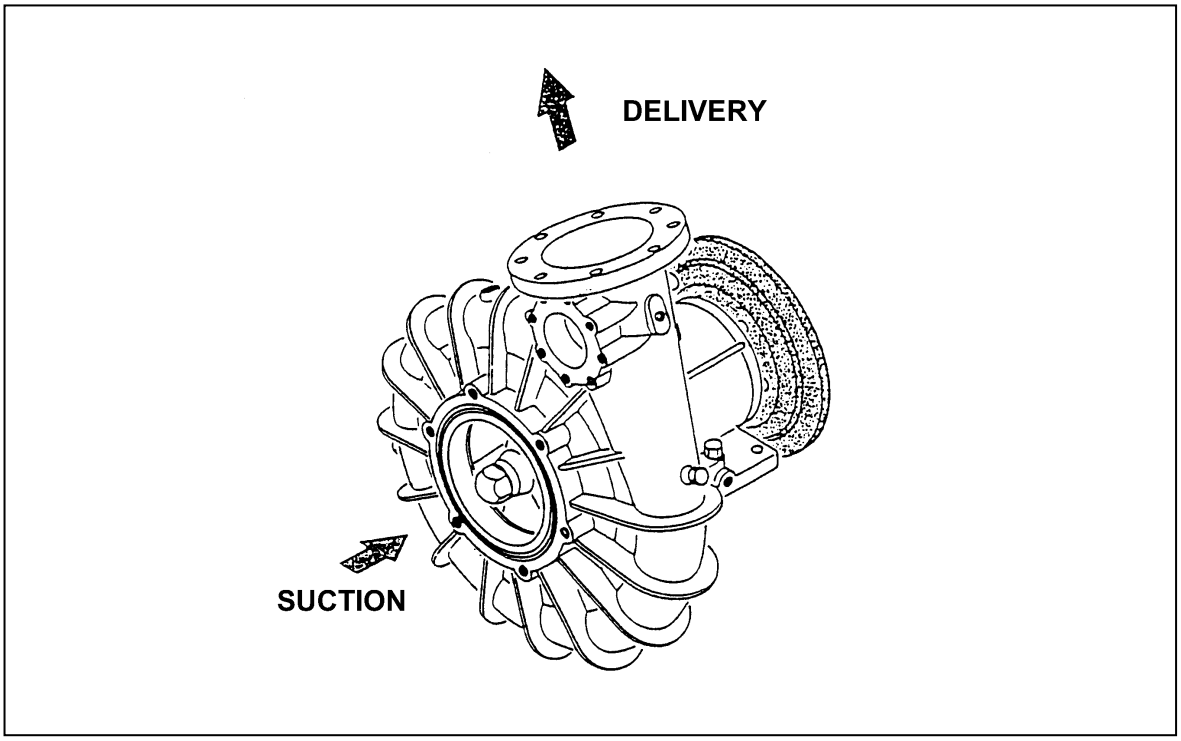
HYDRAULIC DIAGRAM




OIL TANK FOR PRIMER SYSTEM
UNDER TRUCK NOZZLES
WATER TANK CONTROL VALVE
WASH SYSTEM FOR WINDSCREEN
PRESSURE REDUCER (restricted valve)
PUMP TO TANK FILL
FROST PRECAUTION VALVE FOR WASH SYSTEM


PRESSURE REGULATOR
REGULATOR MEETERING DEVICE
AUTOMATIC ROTATING PRIMER SYSTEM WITH CONTROLLED PRIMING VALVE
BY PASS VALVE WITH MANUAL LEVER

Water pump



The water pump is of the single-stage centrifugal type with horizontal shaft. Driven by the power take-off situated on the Gearbox, it draws in water at its centre and delivers under pressure at its periphery. Its maximum output, which is 5,400 l/min at 13.5 bar.

Construction:

- Body diffuser and impeller in bronze,
- Stainless steel shaft supported by two double-row ball bearings,
- Shaft sealing provided by mechanical packing,
- Internal sealing by wear bushes in bronze.

Automatic rotating primer system

The aim of the automatic rotating primer system is to prime the water pump during its start-up phase.

It consists of three parts:

- The primer (1), consisting of a rotating vane suction pump, is mounted on a hinged support. It is driven by the water pump via a friction wheel.

It contains:

- A bronze body,
- a stainless steel rotor,
- a stainless steel shaft supported by "lifetime lubricated" bearings,
- four sealing vanes in Celoron,
- An oil tank (3) for lubrication in transparent plastic,
- A cylinder in bronze with stainless steel shaft (5), controlled by the water pressure taken off the water pump outlet, ensures the primer is disconnected once the pump is primed.

Controlled priming valve

The controlled priming valve is fixed to the water pump suction pipe and is connected to the primer by a flexible pipeline.

This valve ensures that there is communication between the rotating primer and the suction of the water pump such that the latter is no longer primed, and the primer is switched off, once priming has been achieved.

It consists of three parts:

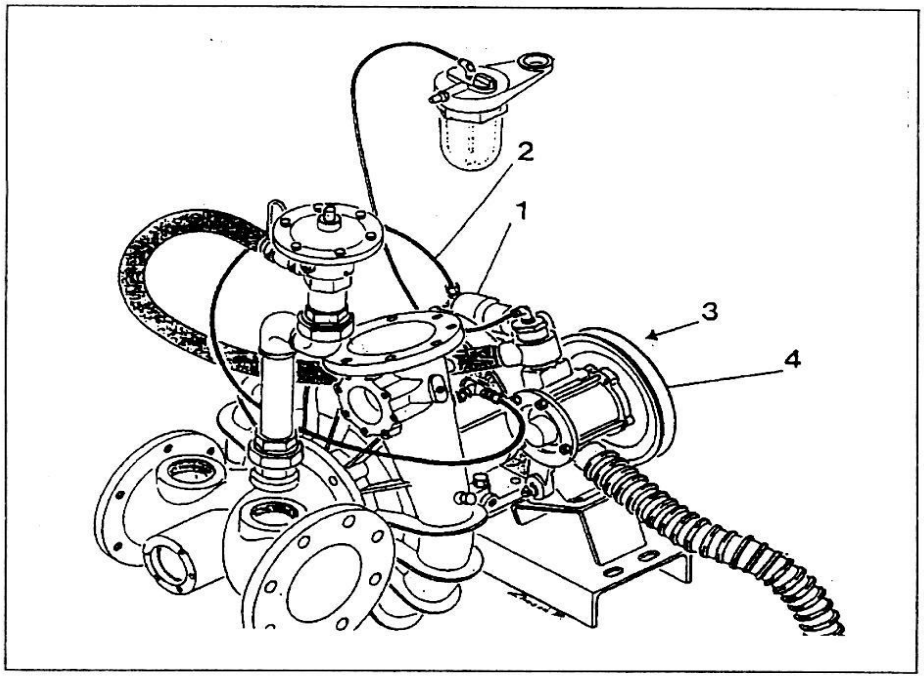
- A valve body (1) made of brass with a stainless steel shaft, with its delivery coupling
- fitted with a non-return valve (2).
- A regulator body (3) made in light alloy and cadmium plated steel.
- A venting system protected by a Poral filter (4).

Pressure regulator

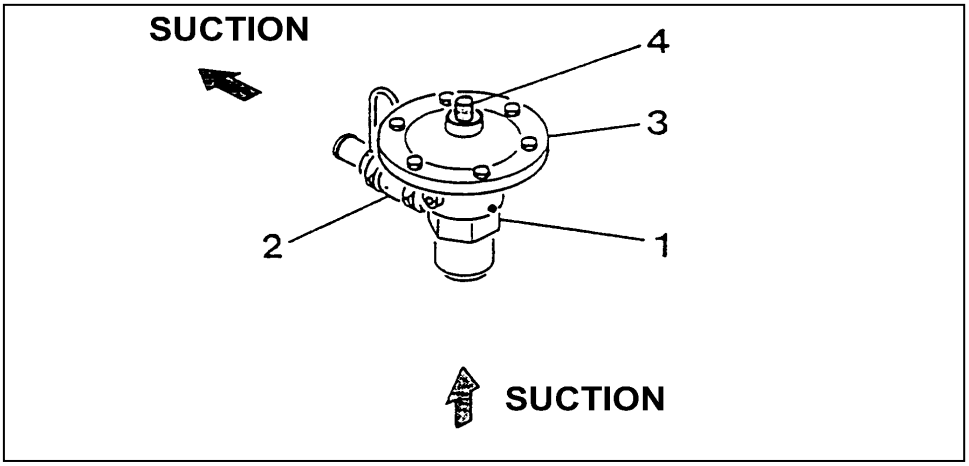
The pressure regulator, mounted in a by-pass circuit between the water pump suction and delivery, makes it possible to return to the suction side any excess flow caused by the closure of one or more fire fighting equipment and, in this way, preventing any overpressure in the delivery circuit which might be damaging to the fire-fighting equipment.

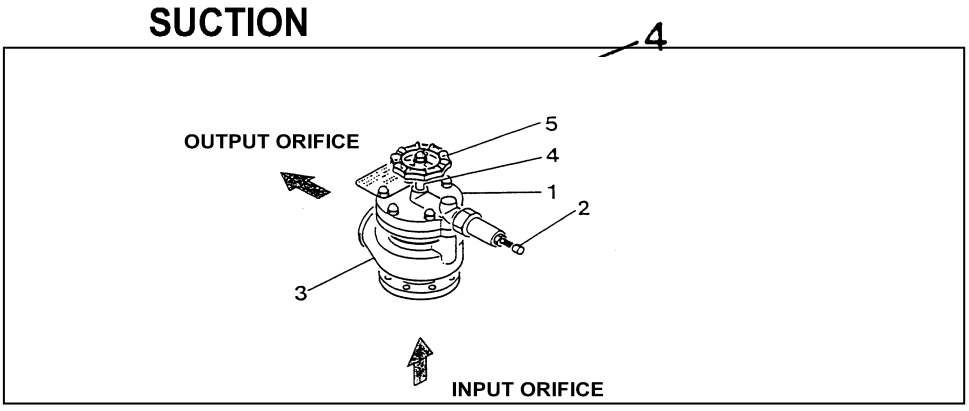
Essentially made of bronze and stainless steel, it is composed of the following elements :

- A cover (1) in which is housed a valve whose setting can be modified by releasing or compressing the spring, using adjusting screw (2) secured by a lock-nut;
- A body (3) fitted with two orifices, one input and one output, within which there is a moving piston held against its seating by a return spring;
- An inhibiting spindle (4) fitted with a wheel (5). This spindle, screwed into the cover, enables the piston to be blocked thus closing the circuit.
- Sealing is provided by a series of O-rings.



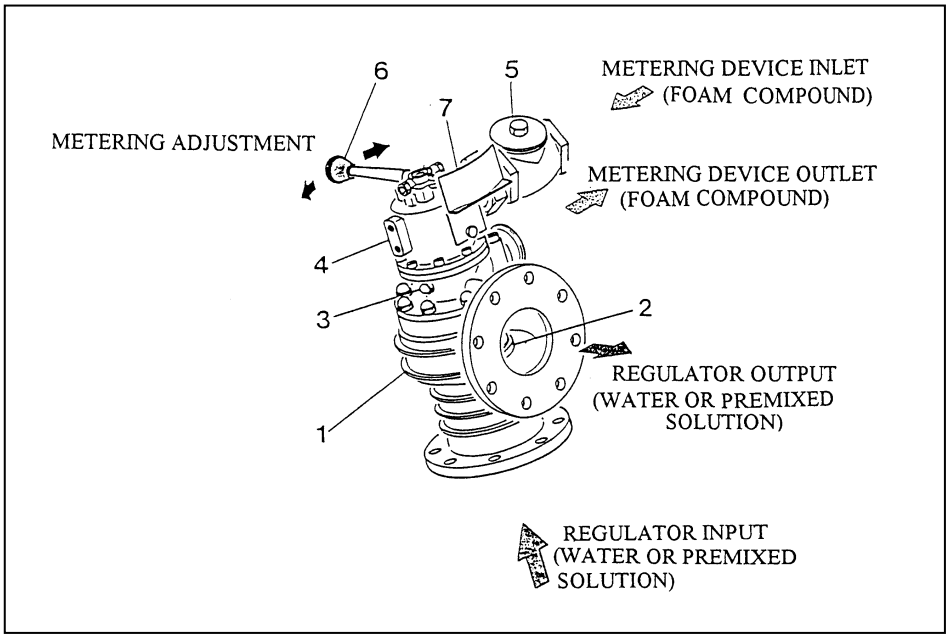
Rotary self contained primer





SUCTION

Regulator–metering device



The role of the regulator–metering device is as follows:

- Regulation of variations in output as a function of the fire fighting equipment used;
- Automatic and constant metering of the foam compound as a function of the output
- from the water pump and of the dose rate required (between 3 and 6%);

Principally made of bronze and stainless steel, each regulator–metering device divides into two parts;

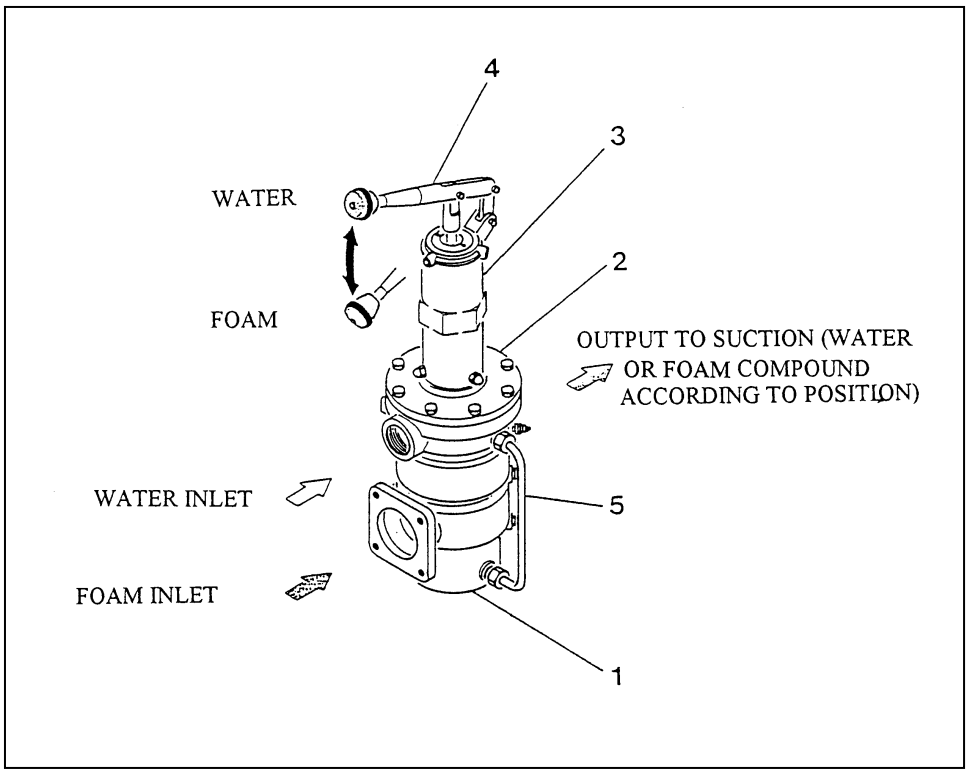
- In the lower part: the output regulator comprising:
- a body (1) fitted with two orifices, one input and one output, in which there is a moving valve (2),
- a valve (2) held on its seating by a compression spring.

The pin–piston is restrained to move within a bore open to atmospheric pressure,

- a bush for limiting travel. This bush, centred by two equalizer springs, prevents the valve having too large a travel which would only be detrimental to the operation of the metering section;
- In the upper part: the metering device comprising:
- an output manifold for the foam compound (3) centred on the regulator body and with its top closed by the metering device body (4) fitted with an input orifice in which there is a non-return valve (5).
- a cylinder provided with apertures, restrained from rotational or translation movement, in which there slides a piston which is firmly attached to the regulator valve by a control spindle. The cylinder is topped by a dome which also has apertures in it. This dome, restrained from moving in translation, is rotated by a lever (6) fitted with a marker pointing to a graduated scale (7).

The assembly is sealed with a series of O-rings.

By-pass valve



The by-pass valve is a three-way valve situated in the foam compound suction pipework upstream of the metering system of the pre-mixing assembly.

It has two functions:

- Supplying the metering system with foam compound in foam operation,
- Supplying the metering system with water in water operation or when rinsing the system after use.

Its design is such that quick selection of one of the two positions is possible without any risk of one liquid coming into contact with the other.

Constructed principally in bronze, the by-pass valve is composed of :

- A body having (1) : - a water inlet orifice
  - an emulsion inlet orifice,
  - a suction orifice,
- A cap (2) fitted with a pneumatic cylinder (3) and emergency manual control (4);
- A piston with two rows of apertures providing the cross-sectional area for passage through into the interior of the body;
- A system for equalizing the forces to move the piston (5).

The assembly is sealed with a series of O-rings.

2.3.3 FIRE FIGHTING EQUIPMENT

Foam monitor

Constructed of light alloy with anti-corrosion treatment, the foam monitor is controllable manually from the vehicle platform.

The monitor can project either water or low-expansion foam.

For functional characteristics refer to the technical characteristics given in the data sheets inserted at the beginning of the manual.

The foam monitor is composed of the following elements :

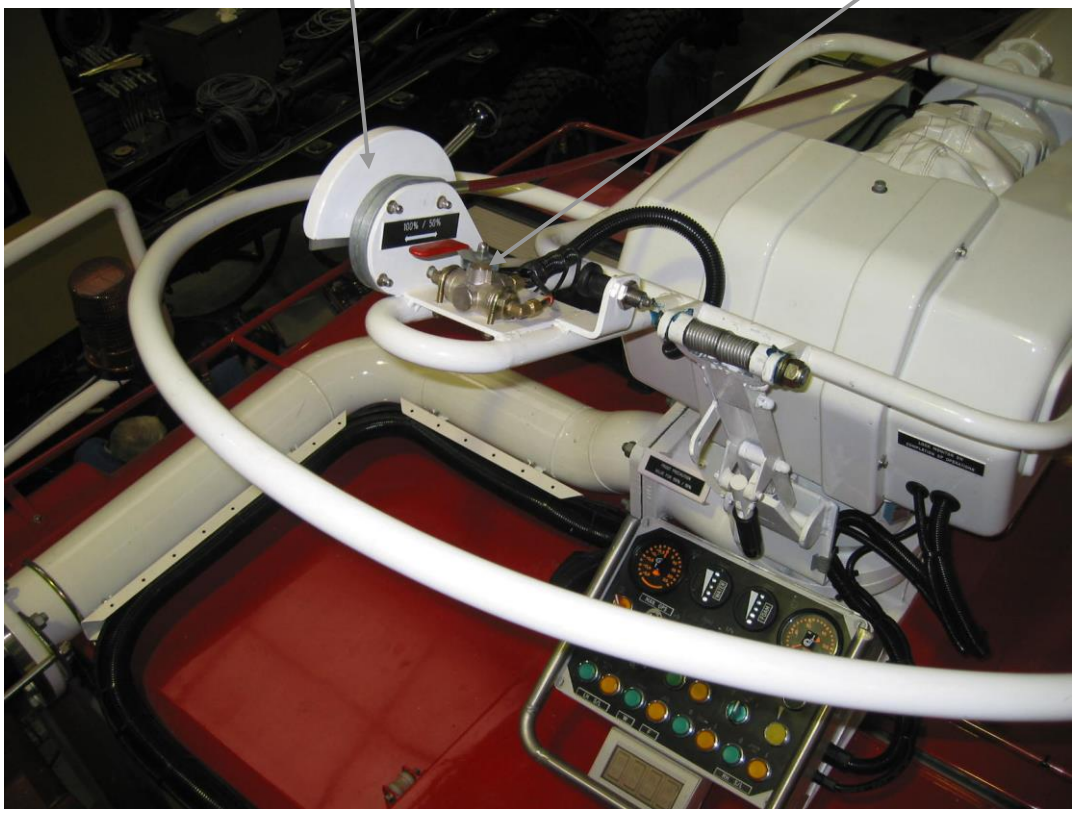
- A turret which enables the nozzle to be oriented in vertical and horizontal positions by means of two pivots mounted on ball bearings which are intended to absorb the hydraulic thrust and the masses; sealing is ensured by a combination of lip seals and O-ring seals. This mounting does not cause any appreciable stiffening due to pressure during use under manual control.

A nozzle including :

- an air inlet
- a barrel for foam production
- a foam stream regulator
- a jet nozzle
- a “blabber mouth” fully variable and lockable at all selections between jet and spray
- a full/half output control system.

BLABBER MOUTH CONTROL

MONITOR OUTPUT CONTROL 100% / 50 %



LOCKING DEVICE

SWITCH FOR ROAD POSITION

FROST PRECAUTION VALVE FOR HIGH OUTPUT AND LOW OUTPUT

Foam monitor

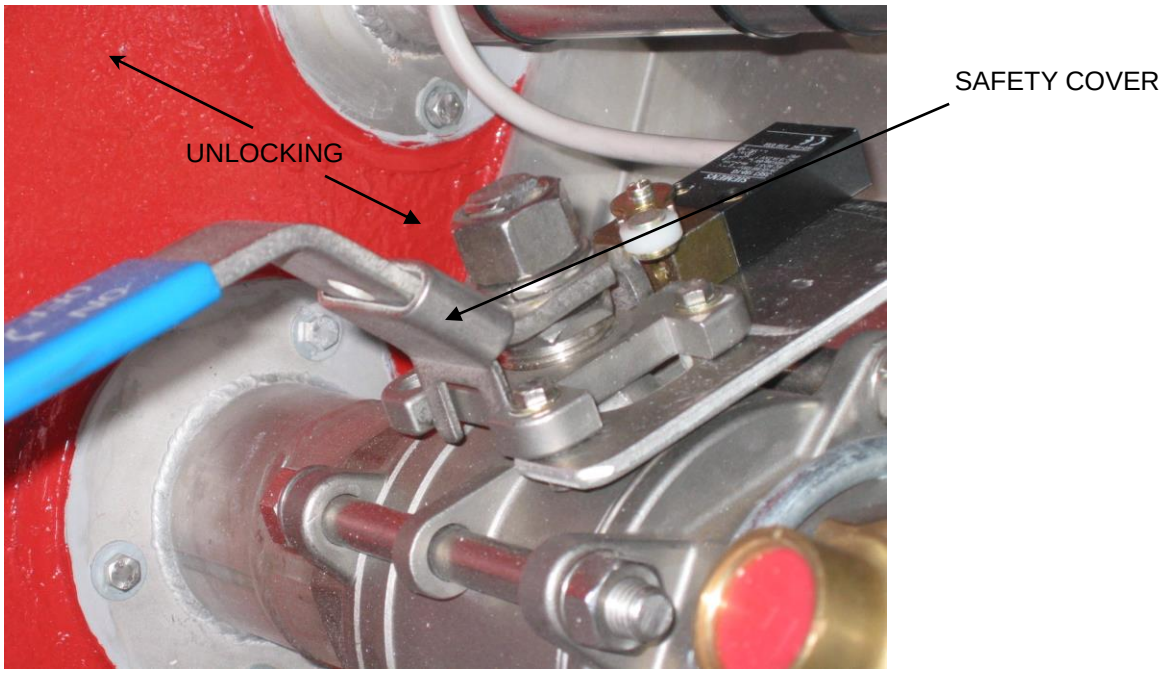
Restricted sidelines

One restricted water / foam sidelines is fitted in each locker, with a 2″ 1/2 INST F coupling.

Each delivery is supplied through a 7 bar pressure reducer and an on / off valve.

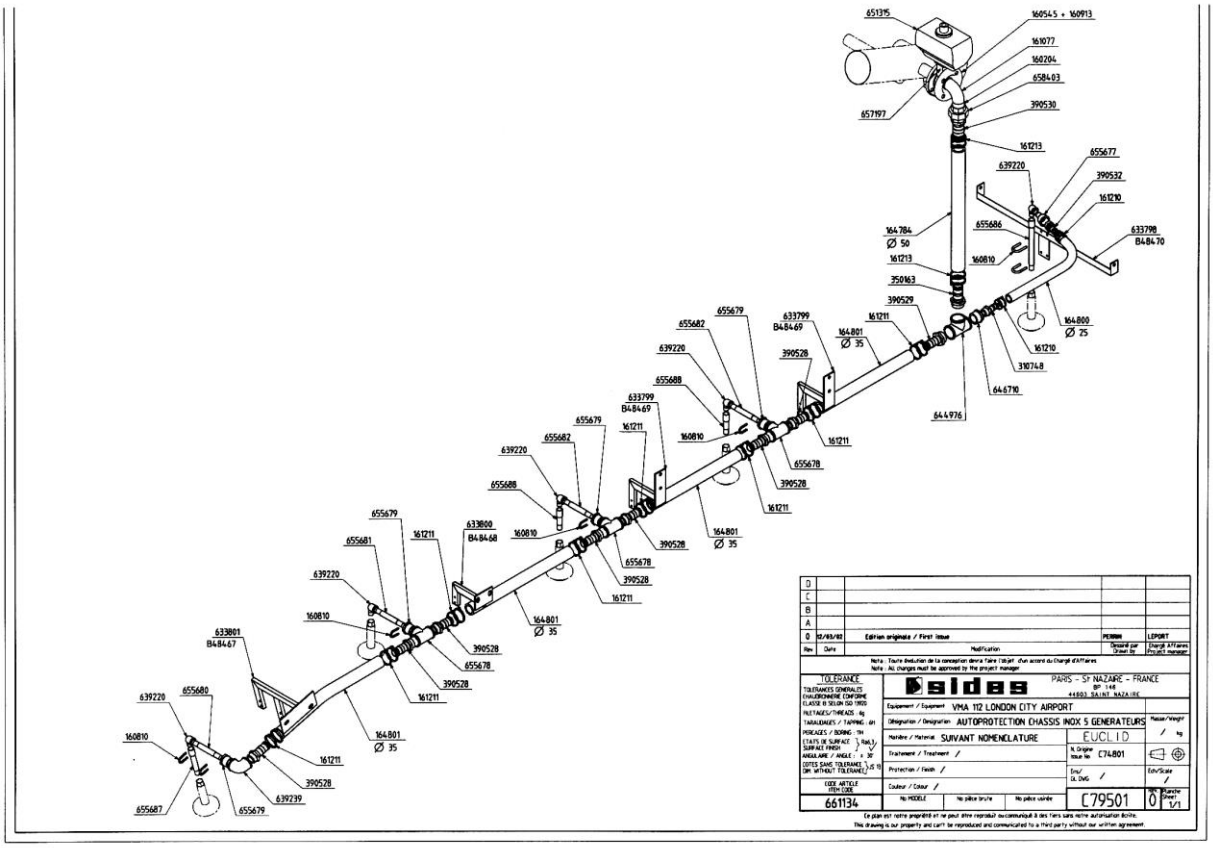
The supply is remotely operated from the control panel in the cab, and from monitor platform controls.

Unrestricted valve



One unrestricted water / foam sideline is fitted in each locker ; with a 2″ 1/2 INST F coupling. Handle is protected by a safety cover.

Vehicle self-protection



The vehicle is protected against pools of fire by five foam generators distributed along the underneath of the vehicle and covering the whole area.

Setting the self-protection system into operation is controlled by a switch situated on the cabin control panel.

2.3.4 BODYWORK

The bodywork is composed of :

- A rear engine compartment assembly,
- A hydraulic unit compartment,
- Six side lockers, three each side of the vehicle, integrated to the tank.

Rear engine compartment

Made of aluminium sheet folded and welded together, the rear engine compartment, reinforced by a framework of welded steel sections, is designed to protect the engine and its surroundings (fuel tank, batteries.....).

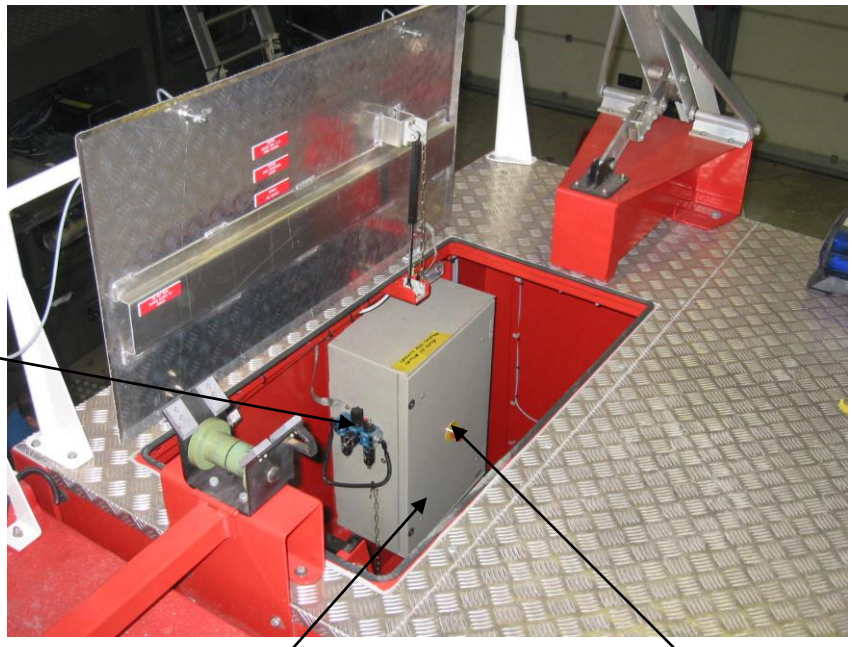
At the rear, this engine compartment is fitted with a grille for the fan to blow engine warm air. On the right-hand side a door opening from rear to front and held in place by a gas-filled strut, gives access to the batteries installed on a tray with telescopic slides; on the left-hand side, a hatch enables the fuel tank to be refilled.

On the upper part, the roof is fitted with two large hinged hatches opening sidewards to give access to the engine and surrounding equipment for easy maintenance.

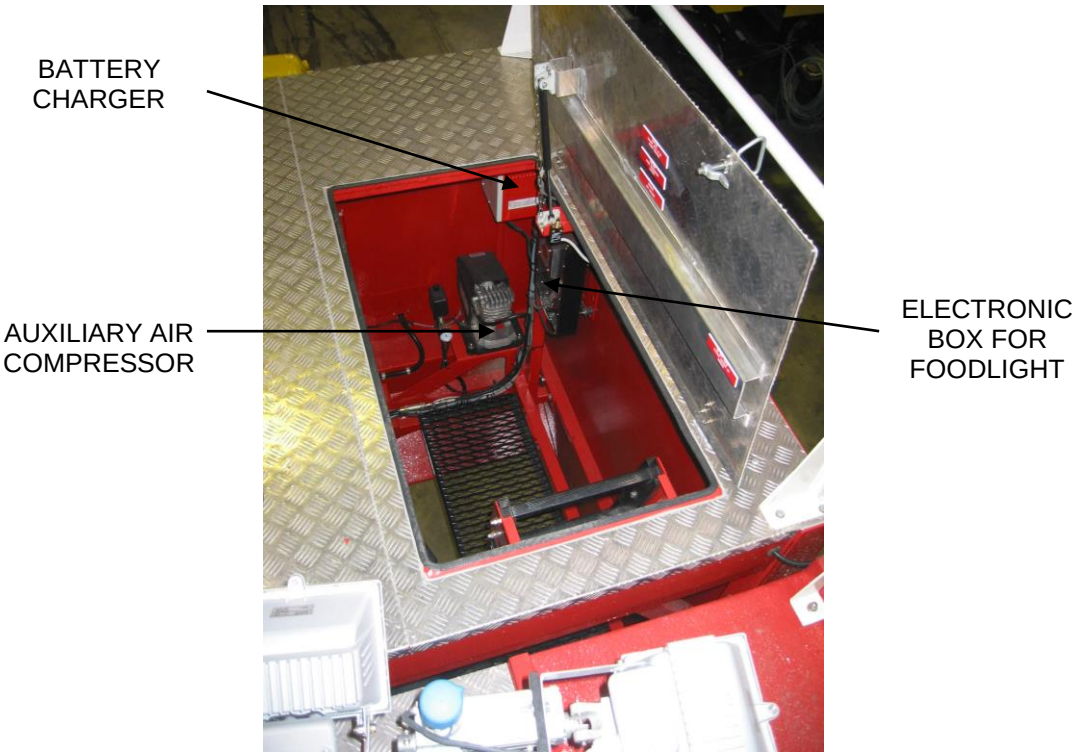
The interior of the engine compartment, with lighting controlled from the cabin, is fitted out to install the electrical and pneumatic, power assistance cabinets on the right, the battery charger, the vehicle mounted electrical air compressor and 220 volts alternator system on the left.

Access into the engine compartment, for inspection and servicing, is facilitated by the presence of two ladders and two retracting footboards.

OFFSIDE HINGED HATCH



NEARSIDE HINGED HATCH



Hydraulic unit locker

With metal parts made of aluminium sheet folded and welded, the locker is fitted into the rear part of the tank.

It is entirely insulated in order to protect the hydraulic unit from intemperate weather conditions. Its upper part is raised and fitted with a hatch permitting easy access to the various controls of the pumping/metering hydraulic unit; two gas-filled struts help in handling the hatch and hold it in the open or closed position.

In addition, the locker is fitted with lighting controlled from the cab when the sidelight is on.

Side lockers

The side lockers are built-in the glass reinforced polyester tank and, therefore, made of the same material. They are fitted, with roller shutter door.

The doors can be locked by key.

The insides of the lockers, which are ventilated and proof against inclement weather, are fitted with brackets needed for the stowage of equipment for fire-fighting action. In addition, the locker is fitted with lighting controlled from the cab.

AUX. EQPT.
DRY SUITS
MEGAPHONE
PUMP OPS

DCP UNIT
RESCUE EQPT.
BA CYLINDERS
EXTINGUISHERS

SUCTION HOSES
HOSES DELIVERIES

WATER TANK
FILL

T.I.C. OXY UNIT
FIRST AID KIT
TORCH

HOSES
DELIVERIES
HYDRANT KIT
BA CYLINDERS
GP LINE
SUCTION HOSES
EXTINGUISHERS

BCF UNIT
RESCUE EQPT.
CUTTING EQPT .
TOOL BOX

2.3.5 ELECTRICAL EQUIPMENT

Lighting and signalling are in accordance with the International Traffic Regulations.

Besides, following equipment is also provided :

- Cab interior dome lights
- Lighting of engine compartment, lockers, and monitor area
- 4 blue repeater flashing lights (2 at front, 2 at rear)
- Lighting of all instruments panels
- 2 reverse lights with automatic switch and buzzer
- 3 blue rotating lightbars (2 at front, 1 at rear)
- 1 orange rotating obstruction light
- 4 area suround lights
- a pneumatic extendable lighting mast with 4x500 W lights
- 4 halogen head ligths
- 2 white front fog lights
- 2 red rear fog lights
- 1 clearance warning siren with public-address system
- 2 floodlights mounted on the foam monitor
- 1 map reading light in cab
- Interference suppression for VHF radio
- 1 battery charger
- 1 electric, air compressor
- 1 heating system of the engine
- 1 rear quick - disconnect socket for battery charger, electric air compressor and heating of the engine

Energizing the vehicle from an external voltage supply

Located at the rear of the vehicle, a single-phase 220 V socket, disconnected automatically on the vehicle going powers the following equipment:

- Battery charger
- Electric compressor
- Heating of the engine

A circuit breaker in the engine compartment protects the 220 V supply.

AT VEHICLE BACK LEFT SIDE

Battery charger

The vehicle is equipped with a “Floating” battery charger located in the engine compartment.

This charger is connected directly to the batteries for permanent charging - even when the battery main switch is open.

It has full electronic control, short-circuit and overheating protection. It should also be noted that this charger can remain switched on when the engine is running.

INSIDE THE ENGINE COMPARTMENT LEFT SIDE

Electric compressor

Stored at the rear left-hand side of the tender behind the fuel tank, this electric compressor keeps the braking air reservoirs pressurized. This means that the parking brake can be released for an instant pull-away.

It is activated automatically when the air pressure falls below 5.5 bar.

It will cut out at a regulating pressure of 8 bar.

INSIDE THE ENGINE COMPARTMENT LEFT SIDE

2.3.6 PNEUMATIC CIRCUIT

Pneumatic circuit

The air necessary for the operation of this circuit is taken from the "services" air bottle of the braking system of the chassis/cabin assembly.

It basically consists of :

- A rotary control switch for inhibiting the circuit on the control panel in the cabin, in case of emergency control.
- A regulator/lubricator filter, (set-up in factory at 7 bar), located in a cubicle at rear right of the engine compartment.
- A set of pneumatic interfaces controlled by switches situated on the control panel in the cabin, or near the appliance to be controlled.

INSIDE THE ENGINE COMPARTMENT RIGHT SIDE

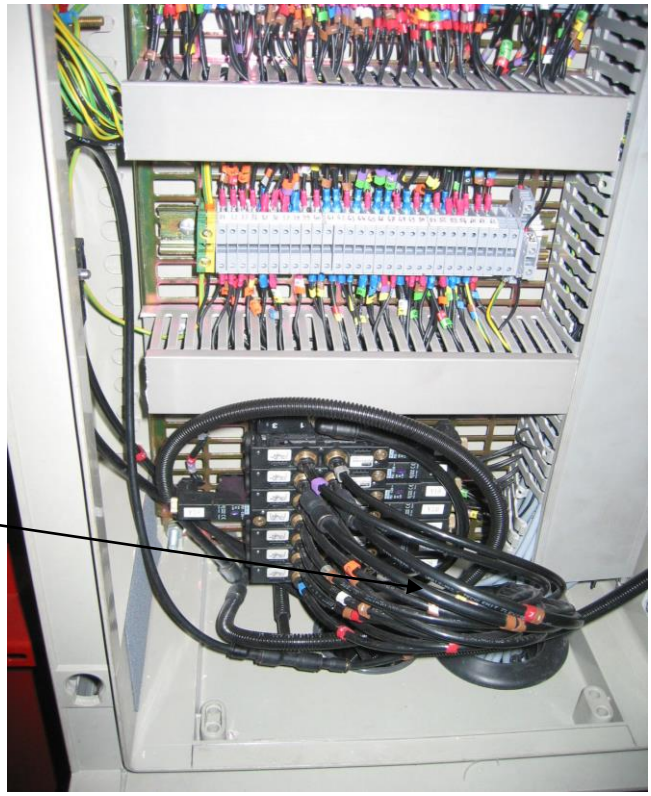
RELAY

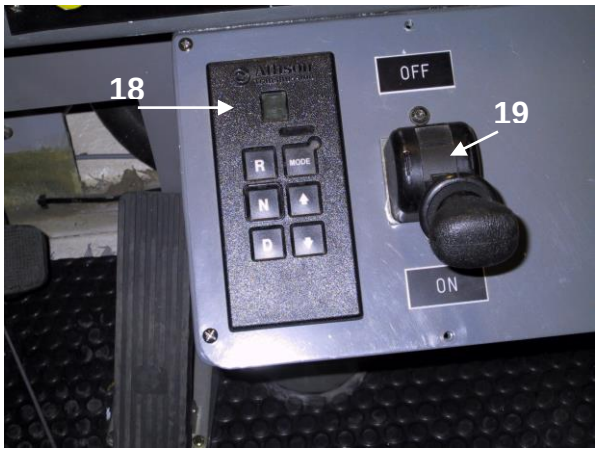
FOAM
SELECTION
PRESSOSTAT

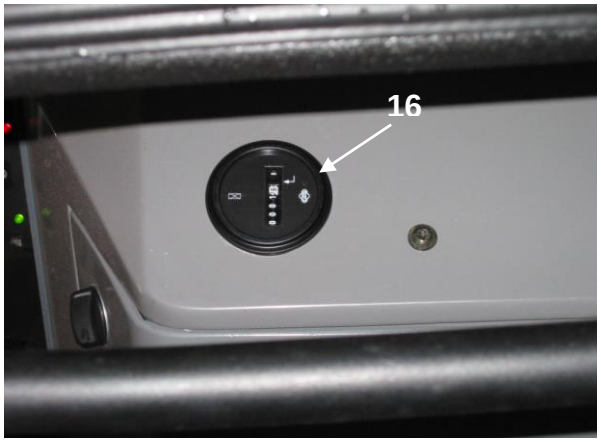
FORWARD/REARWARD
FACING
FLASHING LIGHTS
ELECTRONIC BOX

INSIDE THE ENGINE COMPARTMENT RIGHT SIDE

PNEUMATIC
REMOTE
CONTROL



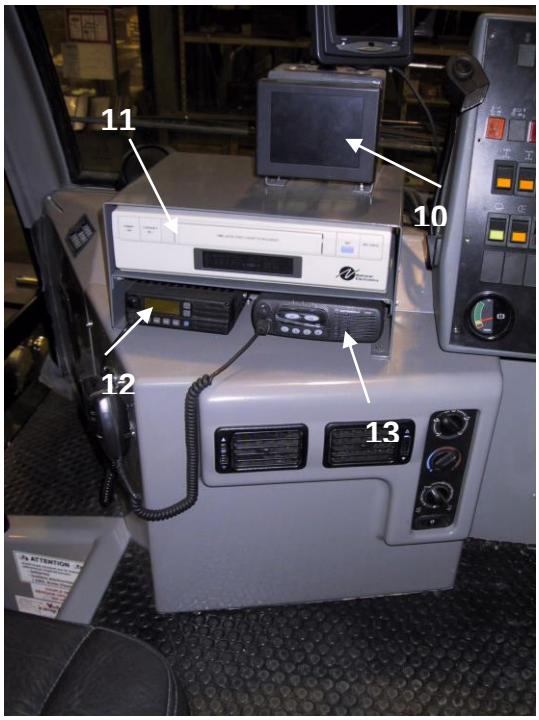

18
19
OFF
ON


16


1
20
3
4
2
L/H RANGE
PTO
WATER
OFF


14
15


5
17
8
6
7
9


11
10
12
13

1. Generator driven by the main engine.
2. Manual throttle.
3. Tranfer box low / high speed control.
4. Pneumatic control.
5. Battery isolation.
6. Door opening lamp.
7. Mast up indicator.
8. Monitor azimuth position lamp.
9. Air pressure manometer.
10. Monitor for reversing camera.
11. Video recorder for colour camera on bumper.
12. Radio (customer).
13. Radio (customer).
14. Intercommunication system.
15. Siren and public address system.
16. Engine hours clock.
17. Audible warning for mast up.
18. Gear box selector.
19. Hand brake control.
20. Power take off switch.

2.3.7 ON-BOARD KIT

An on-board kit is delivered with the vehicle :

This on-board kit consists of :

- 1 wheel spanner ;
- 1 hydraulic jack with actuation lever ;
- 1 spare wheel ;
- 1 tool set for chassis, including :
  - 1 adjustable pliers,
  - 2 bent wrench,
  - 1 adjustable wrench,
  - 1 screw driver with 3 interchangeable blades.
- 1 inflation nozzle with hose and pressure gauge ;
- 1 set of rings for towing (from front or back) ;
- 1 signalling triangle ;
- 1 box of electrical bulbs;
- 1 tyre inflation kit.

2.3.8 VEHICLE TREATMENT AND PROTECTION

The procedure for painting the various bodywork components is as follows :

- Preparation of the various surfaces :

- After shot-blasting parts which show traces of rust, steel parts undergo degreasing and a phosphating process of a type which is amorphous to iron, with small-sized pieces having chrome passivation in addition. Prior to drying all parts in a drying booth or kiln, the joins between sheets are blasted with filtered compressed air.

- Aluminium parts are scuffed with a sander and then subjected to degreasing and acid pickling followed by pressurised water rinsing: small-sized pieces having chrome passivation in addition.

- Resin parts are sanded.

- Application of sandable polyester mastic on all areas that need it.

- Application of two cross-laid coats of corrosion-inhibiting epoxy primer.

- Application of bituminous products :

- The interior of the bodywork receives a polyurethane texture acrylic lacquer which wrinkles on hardening to present a "leather grain" type of finish.

- The bottom areas of the bodywork receive a bitumen-based product giving corrosion-inhibiting and sound-deadening protection to the underneath of the body.

- Joins between metal sheets all receive an application from a polyurethane mastic cartridge in order to inhibit any corrosion forming.

- Careful sanding of all prepared surfaces of the bodywork prior to receiving the finishing coats.

- Application of polyurethane finishing coats in several cross-laid layers.
  Drying is carried out in a booth with continuous control of temperature and humidity.

- Corrosion-inhibiting treatment by spraying a microwax-based product into all parts inaccessible to painting, fastenings, beneath the vehicle and in all of the body cavities.

3. OPERATION

3.1 TRANSMISSION

The Airport Fire Vehicle's transmission system presents two possible vehicle operating configurations :

- NORMAL mode : in this mode, the vehicle can be driven without using the fire-fighting equipment ;
- PUMP-AND-ROLL : this mode allows the fire-fighting equipment to be used while the vehicle is either being driven or at a standstill.

Pump and roll mode
(Effects on transmission / PTO)

This function is selected after driving the vehicle in "normal mode" to the scene of the fire.

To move around the fire while putting it out, the "Pump-and-Roll" position must be selected on the control panel.

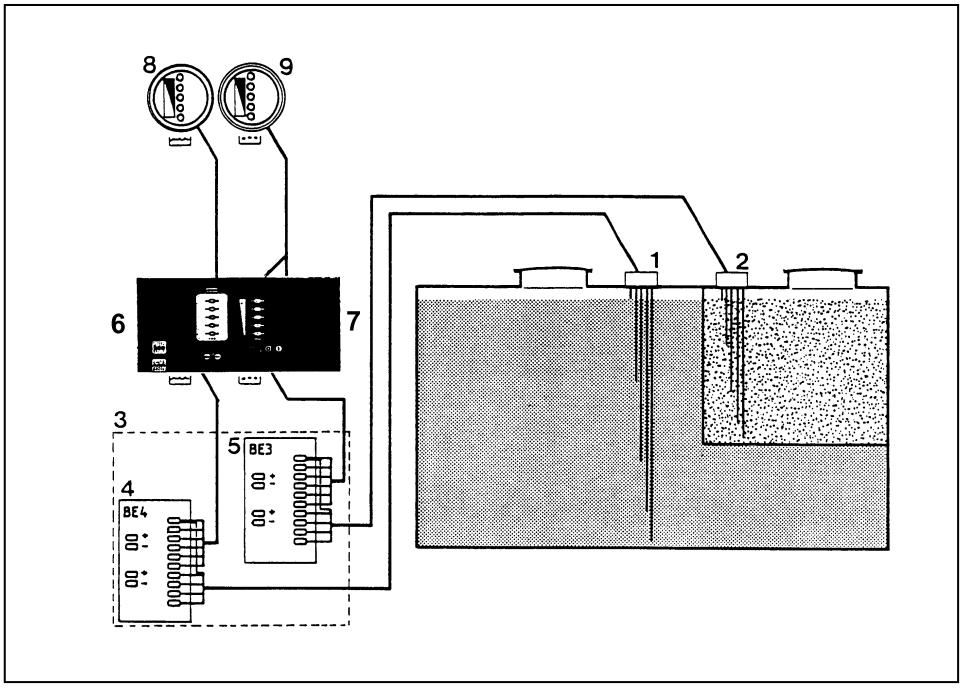
This action:
- deactivates the accelerator pedal,
- restricts the engine speed to 1,900 rpm maximum,
- prevents lock-up,
- engages the PTO driving the fire pump.

The vehicle is driven in "Pump-and-Roll" mode in first or reverse gear.
Select driving at low or hight speed
Check the neutral position on the gear box.
Engage the pump.
Select drive position then the first gear.
Accelerate at maximum 1900 rpm.
Open the monitor valve.
The converter acts as a relief valve but converts all the energy retained by the brake into heat energy.
This pump-and-roll function should therefore be used with moderation.
Shift the gear lever to neutral as soon as vehicle motion is no longer necessary.

3.2 FIRE-FIGHTING EQUIPMENT

3.2.1 TANK ASSEMBLY

↳ System for level detection



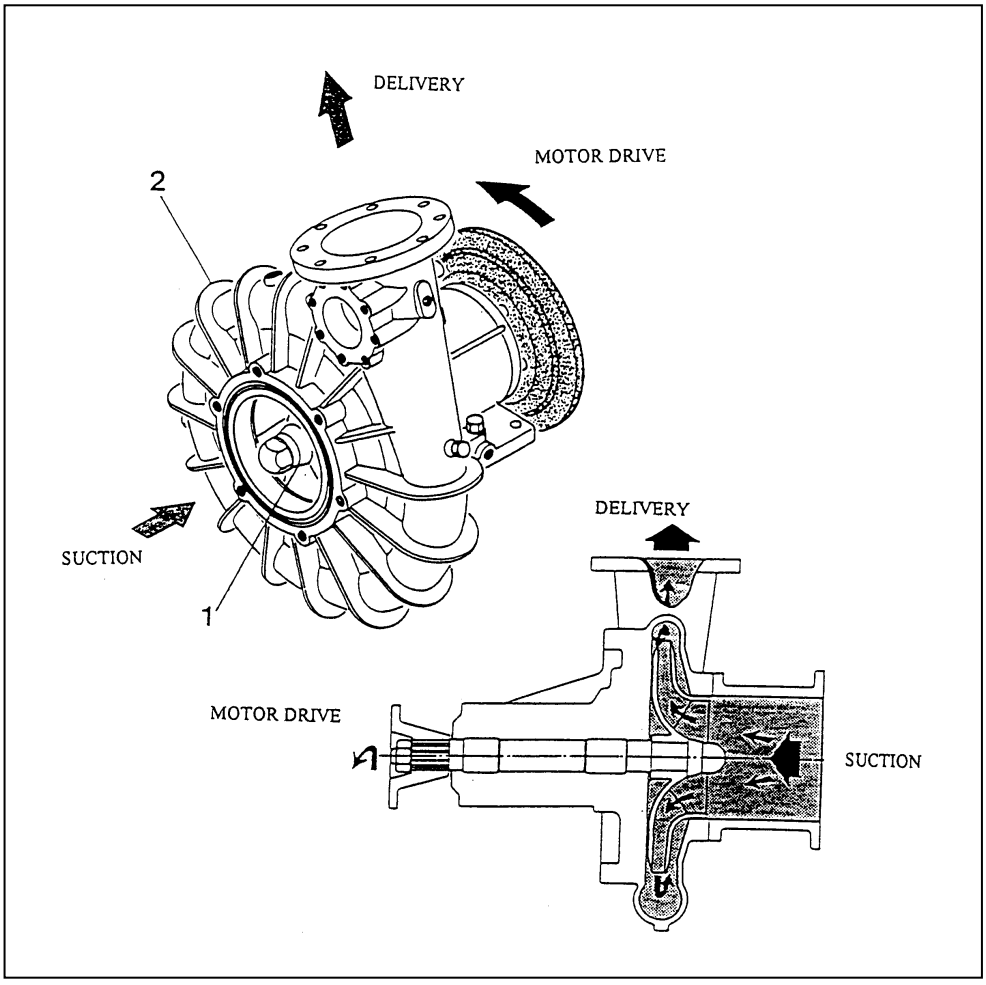
The water and foam compound compartments are both fitted with an identical system containing a sensor composed of five electrodes which measure the level (3/3, 2/3, 1/3, 1/8, and 0).When one electrode is in contact with the liquid to be detected a small alternating current circulates in the product between the sensor electrode and earth and causes a diode to illuminate.
This system breaks down into three parts :

- A five-electrode sensor for each of the water (1) and foam compound (2) compartments; the body of the sensor is made of resin which ensures all connections are water-tight; the electrodes are Rilsan™ coated to avoid any current flow due to the foam which can form at the top of the sensor;
- An electronic unit (3), in the cabin with the fuse panel, fitted with two printed circuits, one for water (4) and the other for foam compound (5); these printed circuits are fixed in a sealed plastic box; glands allow for cable entry and prevent ingress of moisture which might damage the components;
- Two sets of two level receivers; one set for water (6) and foam compound (7), situated on the control panel in the cabin and the other water (8) and foam compound (9) set on the platform control panel, each detector having five diodes of different colours:
  - three green diodes to indicate levels 3/3, 2/3, and 1/3,
  - one orange diode for level 1/8,
  - one red diode for level 0 (empty).

The indications 3/3, 1/3, 1/8 and 0 do not appear on the receiver but are replaced by a self-adhesive strip indicating progress of the level.

3.2.2 HYDRAULIC UNIT

Water pump

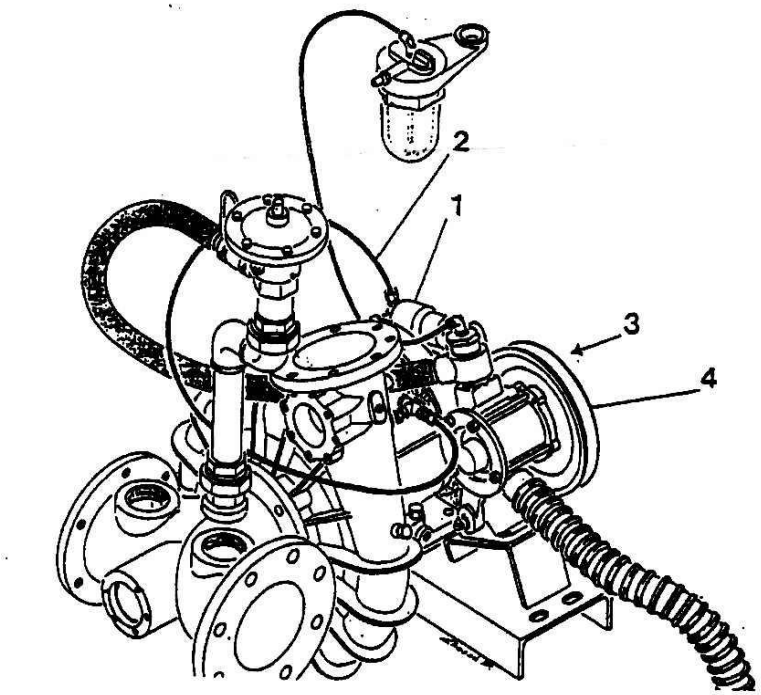


The centrifugal type water pump consists of the following two basic elements :

- The impeller or turbine, (1) which transmits velocity to the liquid which comes in at the centre (centre feed) and throws it to the edge by virtue of the centrifugal force.
- The diffuser or shell, (2) which accepts the moving liquid and transforms the kinetic energy of this mass of liquid into potential energy (pressure and flow).

The liquid which leaves the impeller, with a velocity proportional to the turbine speed of rotation, creates a "vacuum" at its central feed which draws in an equivalent mass of liquid.
This liquid, delivered by the impeller, is collected by the diffuser whose cross-sectional path is increasing in the direction of fluid circulation (spiral shape). This progressive increase in area causes the liquid to slow down and raises the pressure created by the centrifugal force, which is already acting over the whole of the interior surface of the diffuser.

Automatic rotating primer assembly



There are three phases to the operation of this assembly :

A - ***Primer at rest***

When the water pump is not operating the primer wheel (4) is in contact with the pump wheel (3).

B - ***Priming the water pump***

When the water pump starts up, the primer wheel (4), driven by pump wheel (3), turns and drives the rotor and vanes. This device acts as a vane pump and sucks up the air in the pump pipe and creates a vacuum column, which draws in air by depression. When the water reaches the water pump suction pipe, this latter is primed.

C - ***Halting the primer***

The rotation movement pushing the water increases pressure. This intensifying pressure, via the flexible feed pipe (2), connected to the pump outlet, acts on cylinder (1) which moves the primer away, wheels (3 and 4) disengage from each other and the operation of the primer comes to a halt whilst pump operation continues.
Separation pressure : 4 bar approximately.

NOTE : Disengagement of the primer lasts as long as there is sufficient pressure acting on the piston of the cylinder

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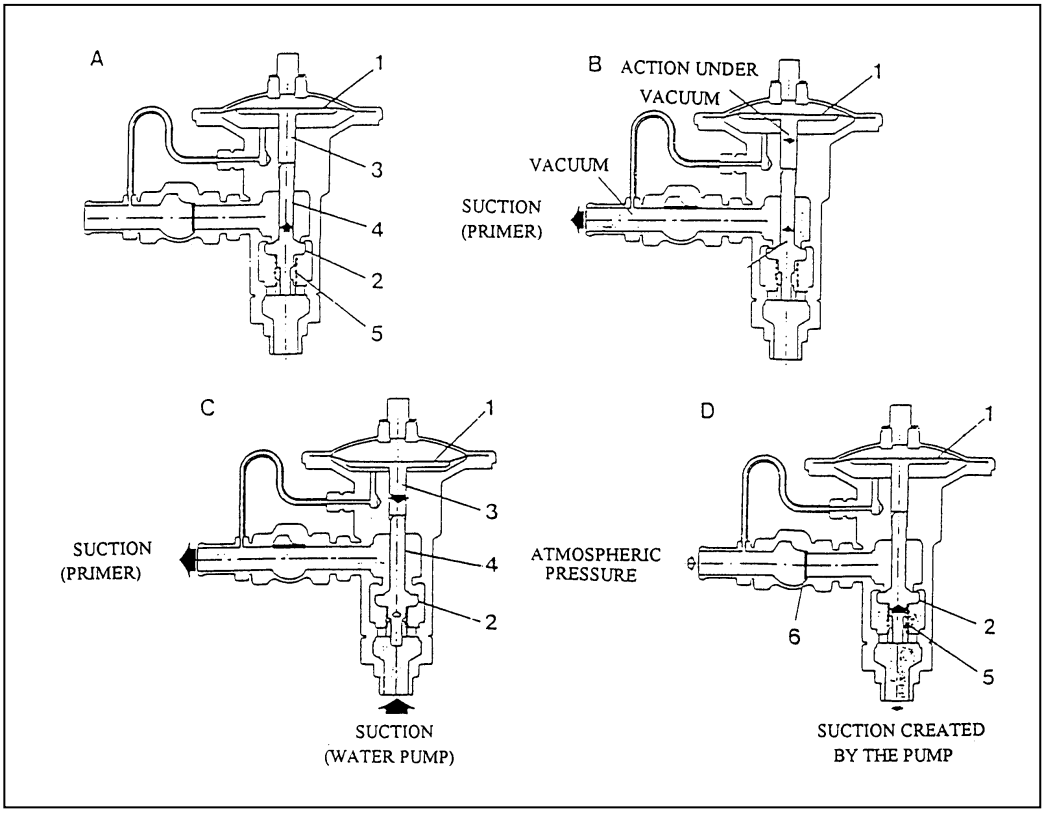
Controlled priming valve



The operation of the controlled priming valve can be summarized over four phases :

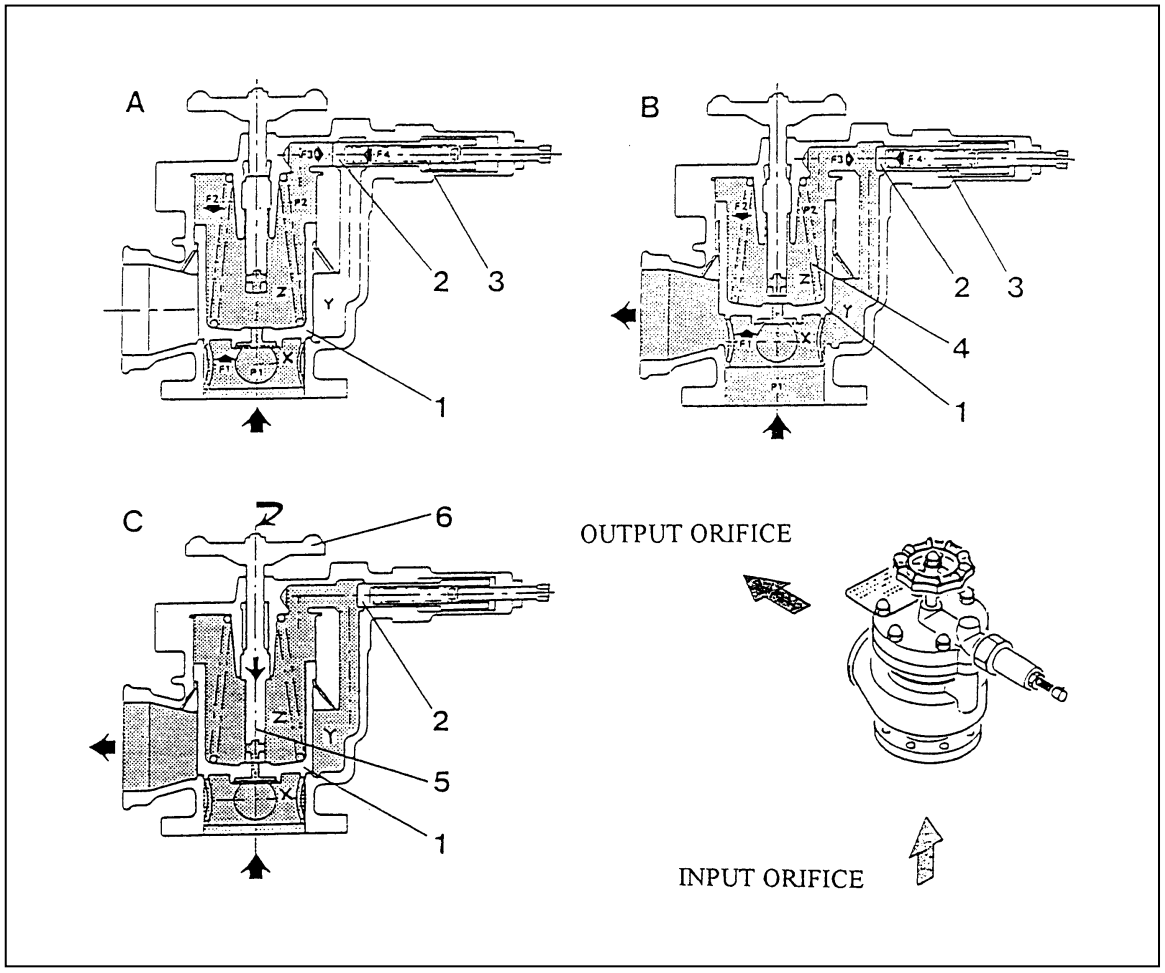
A - ***First phase***
When the valve is not loaded, spring (5) holds flap (2) on its seating and, by means of the control rod (4) and tappet (3), pushes diaphragm (1) upwards.

B - ***Second phase***
When the primer is operating, vacuum is created in the priming pipe and in the upper chamber of the valve body beneath the diaphragm (1).

C - ***Third phase***
Diaphragm (1) which has greater cross-section than the flap (2), and is therefore subject to a preponderant force, allows the control rod (4), by means of tappet (3), to open flap (2). Vacuum can thus become established throughout the water pump suction pipework and priming is achieved.

D - ***Fourth phase***
Having achieved priming, halting the primer causes atmospheric pressure to enter the chamber below the diaphragm (1). The latter loses its preponderant force and flap (2) can close again under the action of spring (5) whose force is greater than the depression created in the lower chamber of the valve body. The priming valve is then again in the rest position.
When the primer halts, non-return valve (6) prevents atmospheric pressure entering the suction pipework and the risk of depriming. It is also a second safety factor in the event of a leakage at flap (2) of the valve.

Pressure regulator



Before looking in detail at the operation of the pressure regulator, it is as well to note that as the diameter of chamber "Z" is greater than that of chamber "X" the area of piston (1) is larger in "Z" than in "X".

A - ***Operation at normal pressure (A)***

The liquid, at pressure "P1", arrives in chamber "X" which communicates with chamber "Z" by the hole in piston (1). Pressures "P1" and "P2" ruling in chambers "X" and "Z" are therefore identical.
As its cross-section is greater on the chamber "Z" side, piston (1) is subjected to a force "F2" higher than the force "F1" acting on it from the "X" chamber side. The differential force which results applies piston (1) to its seating and stops the passage of liquid.
Pressure "P2", applied on the area of the flap (2), subjects the latter to a force "F3" less than or equal to force "F4", delivered by the calibrated spring (3), on flap (2). This preponderance leaves the flap (2) shut.

B - ***Operation when adjusted pressure is exceeded (B)***

When pressure "P1" increases, pressure "P2" increases by the same amount; force "F3" exerted on flap (2) also increases proportionally and then becomes greater than force "F4" exerted by the calibrated spring (3), and the flap opens creating a flow of liquid from chamber "Z" towards chamber "Y".

The flow of liquid to chamber "Y" becoming larger than the flow passing through the hole in piston (1), pressure "P2" reduces, which causes a proportional reduction in force "F2"; so that force "F1" then becomes greater than "F2" and makes piston (1) open to allow the passage of liquid to the water pump suction side.

Piston (1) stabilizes after opening when the forces "F1" and "F2" are equal.

If pressure "P1" falls, pressure "P2" decreases in identical fashion and force "F3" reduces in proportion; when it becomes less than force "F4" exerted by the calibrated spring (3), flap (2) closes and isolates chamber "Z" from chamber "Y". Pressure "P2" becomes equal again to pressure "P1", force "F2" becomes preponderant again over force "F1", and the piston reverts to its initial position, pressed into its seating, and once again opposes the passage of liquid.

A return spring (4) pushes the piston into its seating so as to ensure that it does not remain open when the pumping unit has stopped.

C - ***Putting the pressure regulator out of action (C)***

In this case there is no regulation and the pump may then be used at its maximum pressure.

In order to do this it is sufficient to screw down the inhibiting spindle (5) of the pressure regulator with the aid of wheel (6). This then holds the piston (1) on its seating.

When the pressure regulator is out of service, the orifices made in the end of the inhibiting spindle (5) allow chamber "X" to communicate with chamber "Y" in order to prevent force "F1" being applied at the threads of the inhibiting spindle, which would make it harder to turn the wheel. This link between the two chambers "X" and "Z" causes the calibrated flap (2) to open and a slight flow of liquid to the output orifice.

NOTE: The pressure regulator when out of service can support a maximum pressure of 18 bar.

Premixing system

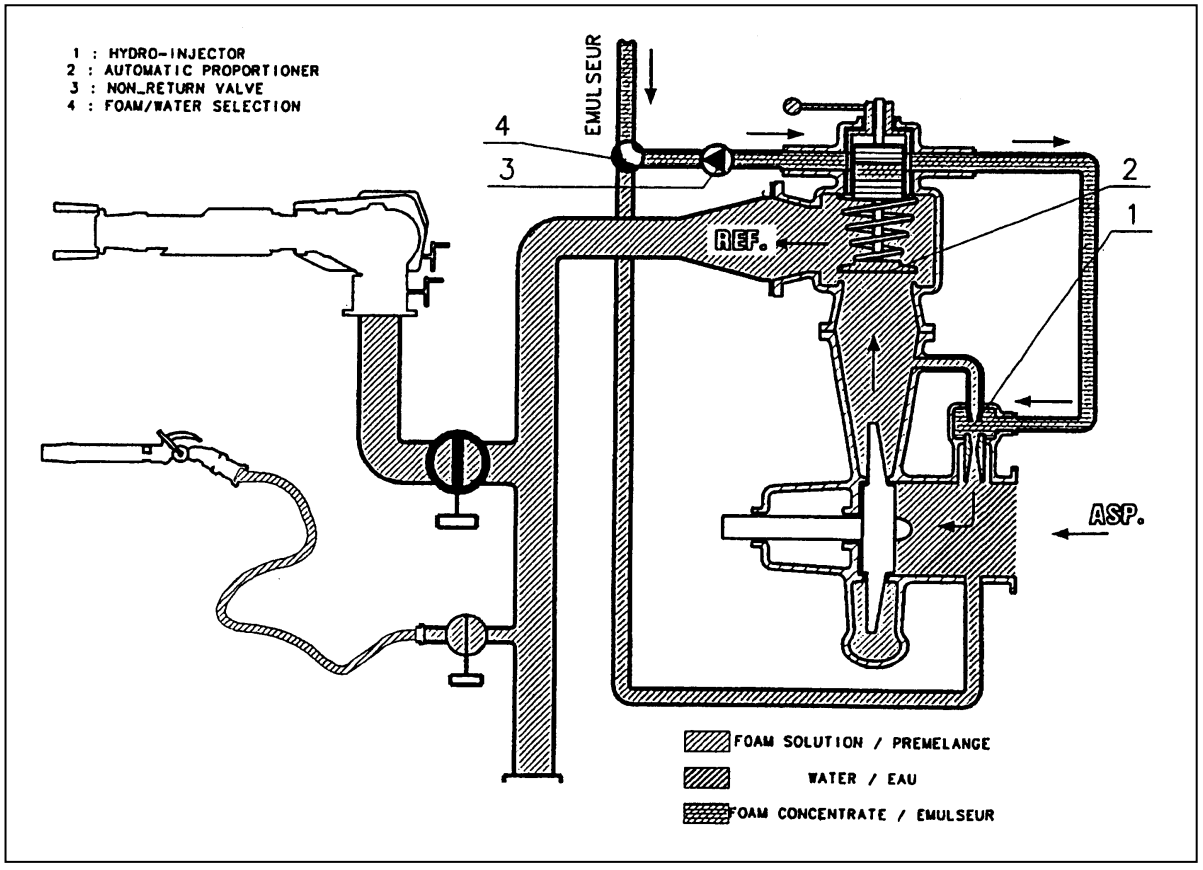
This system for producing premixing contains a regulator–metering device coupled to a hydro-injector. Each system (the foam monitor and the associated fire fighting equipment) can be supplied.

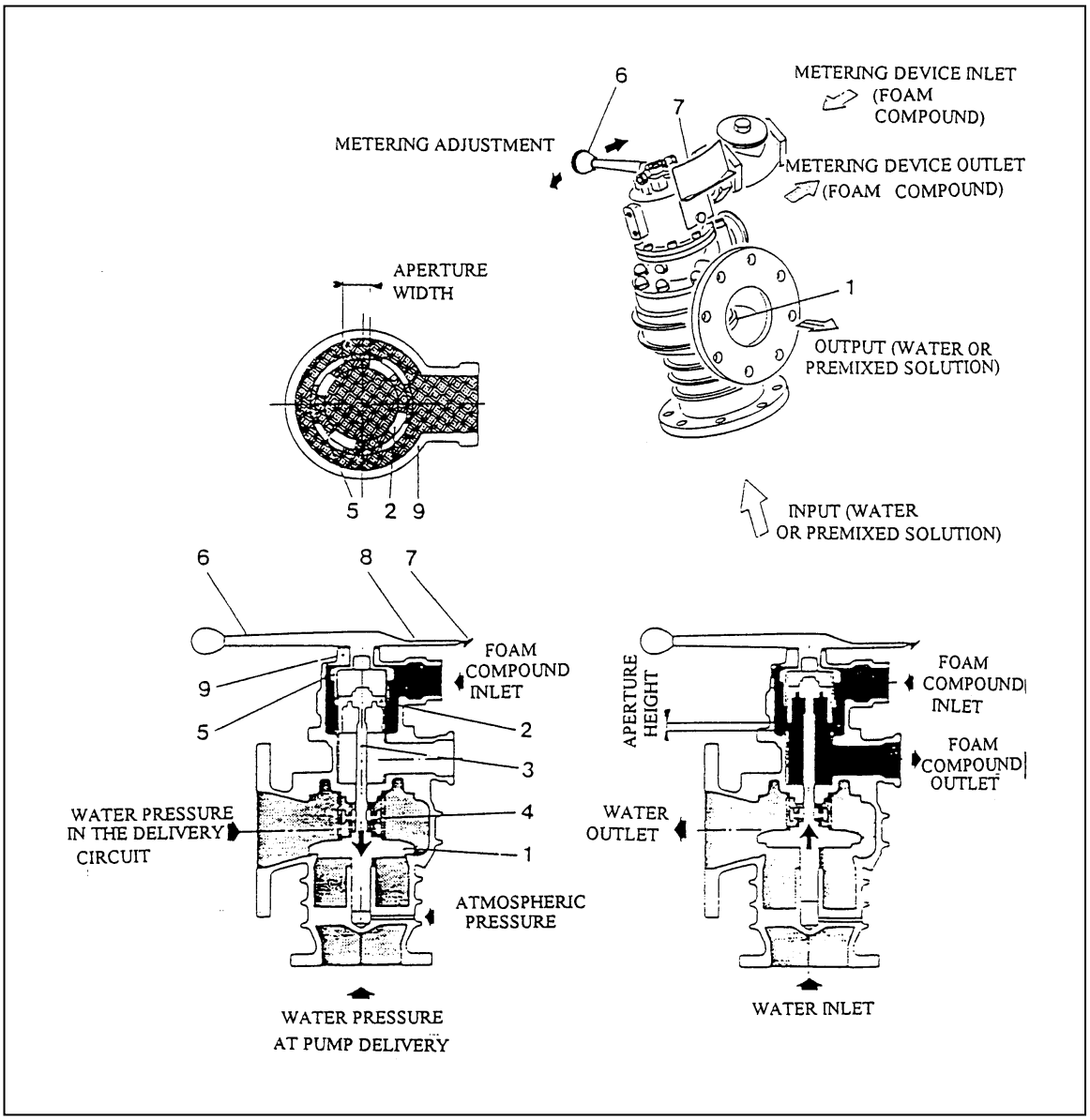
A - ***Overall operation***

Each hydro-injector is installed in a by-pass between pump delivery and suction by means of pipework. Circulation of water under pressure crosses the venturi housed in the body of the hydro-injector (1) and creates there a depression which is used to draw up through a third orifice the foam compound which is delivered by the regulator–metering device to which the hydro-injector is connected.

The regulator–metering (2) device, mounted on the delivery manifold, is traversed by the flow demanded by one or more of the fire fighting equipment in use. The valve fitted in the lower part of the regulator–metering device is arranged such that its lift is proportional to output. A moving piston, fixed to the valve and housed in the rotating metering device, releases the desired quantity of foam compound which is drawn out of this system by the hydro-injector.

Priming of the pump is possible even with the delivery valves open, the valve of the regulator–metering device acting as a shutter. Any return of water to the foam compound reservoir is impossible because of the non-return valve (3) fitted between the regulator–metering device and the by-pass valve (4).





B - ***Operation of the regulator–metering device***

Delivered by the pump, water under pressure arrives beneath the valve (1) which lifts, opening the passage to the delivery circuit. If there is no fire engagement facility which is making flow demand, the delivery circuit becomes pressurised and when this pressure is equal to that supplied by the pump, valve (1) closes.

In fact, as the area of the upper face of the valve is greater than that of the lower face, part of which is subject to atmospheric pressure via the piston rod, the difference in area, for equal pressure, leads to a greater force being applied to the upper face of the valve than is applied to the lower, and, as a result, it closes.

When a fire engagement facility causes a flow to occur, the pressure exerted on the upper face falls and the valve opens under the action of the water pressure, the rise of the valve being proportional to the flow of water needed by this fire engagement facility.

Piston (2) of the metering device follows the movement of valve (1) to which it is firmly attached by means of the control rod (3).

NOTE: The travel limit bush (4) prevents the valve from having too great a travel which would be disadvantageous for the operation of the metering section.

Piston (2) of the metering device moves in a coaxial sleeve (5) fitted with apertures. As it rises, the apertures are exposed creating a passage whose area increases with the rate of flow of water. The quantity of foam compound drawn in through the apertures of the metering device is therefore proportional to the quantity of water crossing the regulator. This ratio is kept constant regardless of the water output.

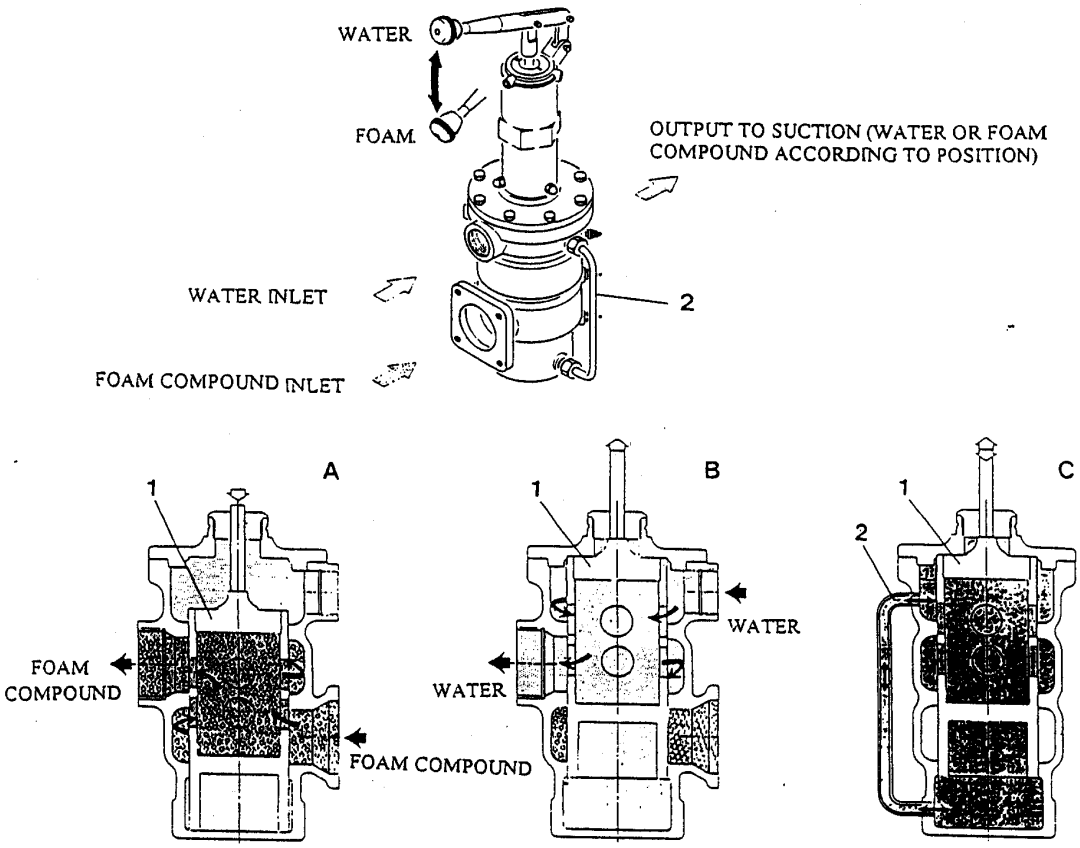
C - ***Adjusting the foam compound content in the premixer***

The proportion (or percentage) of foam compound relative to water may be modified as required between 2 % and 8 %.

Move the metering control lever (6) in order to do this, with the manual control on the dashboard in the cab. The piston being provided with apertures matching those in the sleeve pivots, the piston apertures then uncover or cover up the apertures in the sleeve, thereby modifying the width of the passage and in this way regulating the percentage of foam compound. The value of this percentage is read on the dial (7) in relation to the scale (8).

IN SUMMARY : The percentage is adjusted by acting on the WIDTH of the apertures; The percentage is maintained constant regardless of the flow of water by its action on the HEIGHT of the apertures, this being by means of the valve/piston assembly

By-pass valve

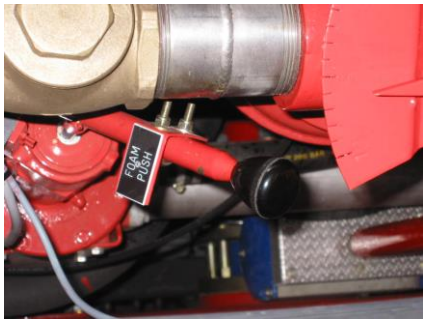


This is a two-position, three-way valve actioned by a double-acting pneumatic cylinder. A manual control enables the valve to be operated in emergency

A - ***FOAM position (A)***
Piston (1) fully withdrawn: the valve allows the foam compound contained in the tank to be sucked into the metering system.

B - ***WATER - RINSING position (B)***
Piston (1) fully withdrawn: the valve allows water to be sucked into the metering system, and thus to rinse the by-pass valve, and operation of the hydraulic unit with water alone.

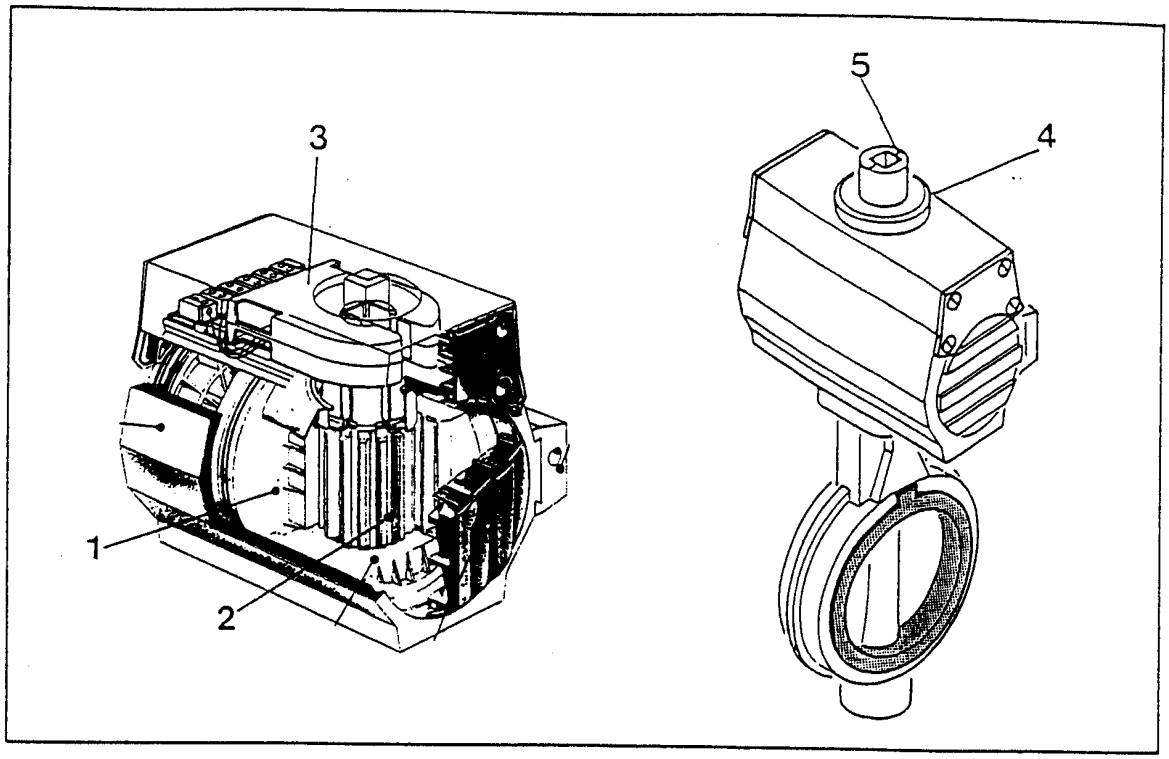
The two cavities at the ends of the piston are connected together by an external equalising pipework (2) which stops there being any risk of different pressures in the two cavities and hence operating difficulties.



Butterfly valve with pneumatic operator

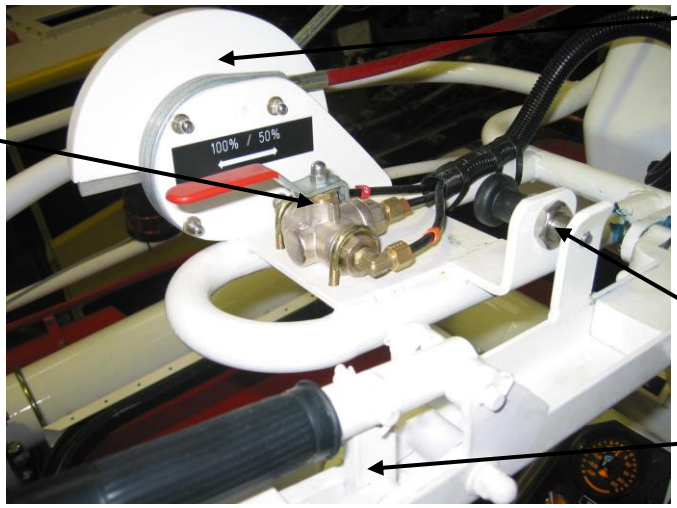
These valves are positioned on the suction pipe, suction side of the tank at the hydraulic unit inlet, and four others, at the output from this unit for delivery to the fire fighting equipment.

According to diameter, their action is controlled by a double-acting, single or double piston–rack (1) which causes rotation of the pinion (2) which is firmly fastened to the quarter-turn butterfly of the valve.



In addition, a double microswitch limit stop (3) built into the operator makes it possible, on the cabin instrument panels, to show the position of the valve (open or closed) with indicator lamps.

NOTE: An emergency manual control (4) allows the valve to be moved after opening the pneumatic operator to atmosphere.
A marker, engraved on the operating quadrant (5), also provides information on the valve position (open or closed).

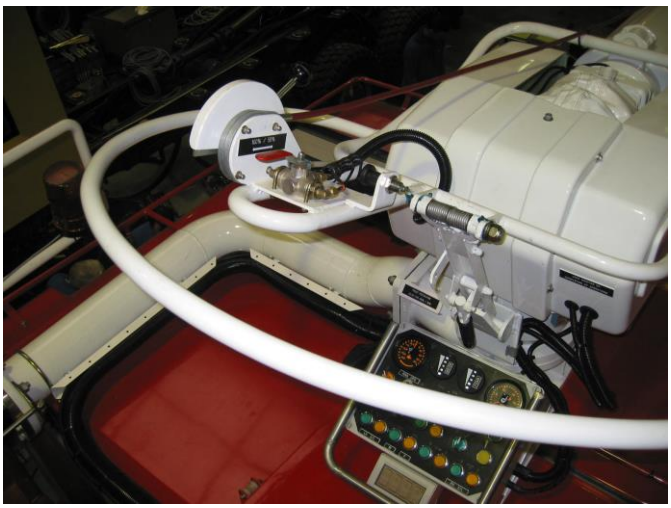


"BLABBER MOUTH" FULLY VARIABLE AND LOCKABLE BETWEEN JET AND SPRAY

FULL AND HALF OUTPUT

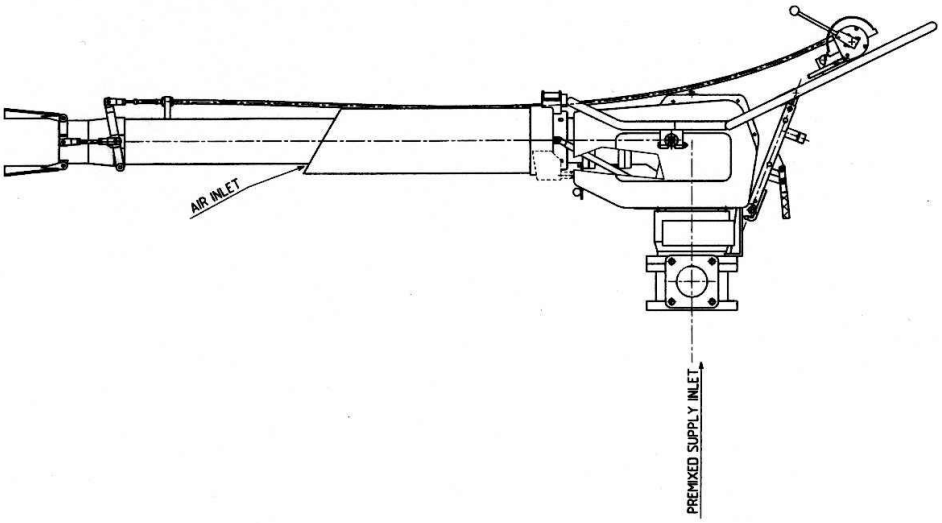
ARM LOCKING

MONITOR LOCKING DEVICE (SHOWED UNLOCKED)



MONITOR POSITIVELY LOCKED BY HAND CONTROLLED MECHANICAL SYSTEM (SHOWED LOCKED)

Foam monitor



The premixed supply, delivered under pressure by the water pump, arrives at the base of the turret and then gains access to the barrel of the nozzle by following a path intended to cancel any unevenness in thrust due to the circulation of the premixed solution.
The premixed solution then travels through the nozzle (6) where it is transformed into foam by the addition, at the inlet to the nozzle (7), of air drawn in across the air intake (8). The foam is then throttled in the tranquilliser (9), regulated by passing through the nose (10) and finally ejected as a full or diffused jet according to the position of diffusers (11).