KONTRON INSTRUMENTS

OPERATING MANUAL

HPLC PUMP 422 MASTER

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2. INSTRUMENT DESCRIPTION

2.1. OVERVIEW OF THE HPLC ENVIRONMENT

The HPLC 422 pump Master is only one component within an HPLC system. A basic HPLC system consists of three basic building blocks:

a pump system,

the sample injector system

and corresponding detector.

System also generally require some form of data acquisition and processing which is often combined into a centralised system controller, e.g. the KONTRON INSTRUMENTS Data System 450.

Furthermore, this new pump features built-in control and management electronics for either a HPLC pump 420 or a HPLC pump 422 slave, as a second pumping unit to allow binary high pressure gradients to be run.

2.1.1. System Configurations

Using this new pump it will be possible to realise the following HPLC system:

1. A single HPLC 422 pump Master for normal isocratic operation either in stand-alone (local) or remote control mode. This is the so-called basic unit upon which all extensions are based.
2. The addition of either a HPLC pump 420 or a HPLC pump 422 Slave. Control of this slave unit is possible in local mode for running gradient programs.
3. The addition of a mixer to configure a binary high pressure gradient system. Control of this high pressure gradient system will be possible in both local and remote modes.
4. It is possible to operate a combination of the pump 422 Master with a Gradient Former 425 as a ternary low pressure gradient system. This HPLC system must be managed by a centralised system controller, e.g. the KONTRON INSTRUMENTS Data System 450.

System extension can be carried out et any time to convert between any of the above listed options.

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2.1.2. Internal System Communication

The four different system configurations described above are all capable of an appropriate level of communication both internally and with other modules within the HPLC system. In some cases a single centralised input or output will be adequate for a complete system, i.e. complete intelligence is not necessary for each individual module or accessory. The individual requirements for each system are discussed below followed by possible consequences for the system as a whole.

2.1.3. Basic Pump Module Communication

This module requires a minimum of intelligence since no synchronization processes are required. This module is however capable of communication via a full RS232 control of all parameters.
The following possibilities aree provided for the basic module:

1. RS232 input and output.
2. An "Alarm output" (TTL level) used to activate an external alarm input on another unit, e.g. the HPLC 360/460/465 autosampler.
3. A "Stop" input activated via an external potential-free contact closure.
4. An "Injection input" (or "ext. run") used for starting a gradient run through a HPLC 360/460/465 autosampler.

2.1.4. Gradient Options Communication

Gradient systems require synchronization of the gradient program with the autosampler. Both the low and high pressure gradient options will synchronize the time of starting the gradient with the time of sample injection.

For a high pressure gradient this is simply the time of starting the gradient run in the appropriate control program.

For low pressure gradients the situation is somewhat more complex since the actual starting time for a gradient is defined by the start of the suction phase immediately following a program instruction and not by the actual execution time of the instruction itself. It is therefore necessary to synchronize program execution not only with the sample injection but also internally with the suction phase of the pump.

This can be achieved only by a suitable program running on a centralised system controller, e.g. the KONTRON INSTRUMENTS Data System 450.

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2.2. INSTRUMENT OVERVIEW

The HPLC PUMP 422 (see figure 2-1) is a high performance two-piston pump. It produces flow rates up to 20 ml/min and working pressure up to 600 bar depending on the installed pump head. The pump has an extremely constant flow with almost no pulsation.
The highly precise mechanics of the pump head with the miniature ball valves reduce the dead volume to an absolute minimum.

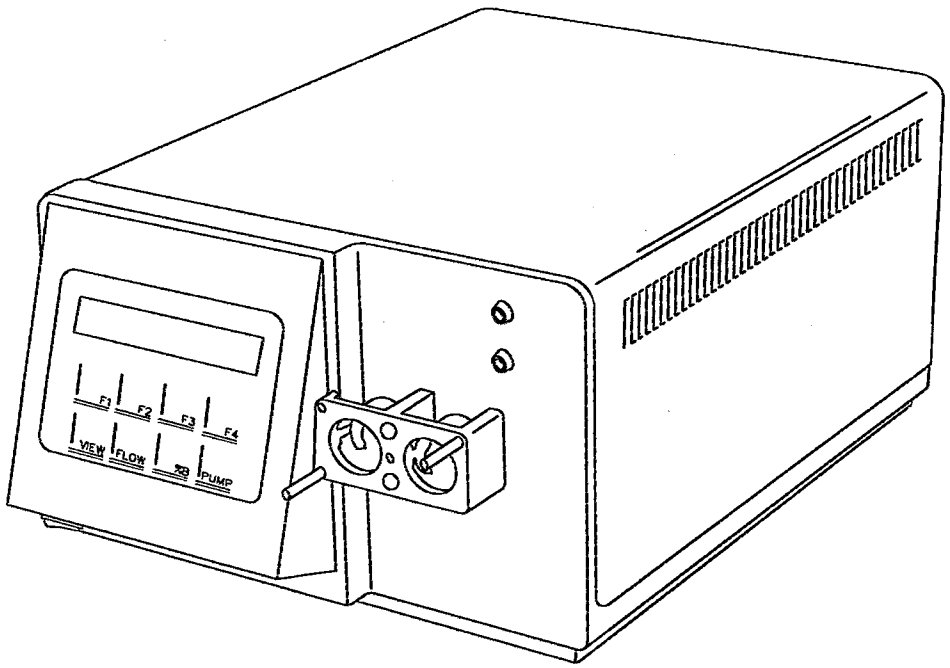


Fig. 2-1

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Development of the HPLC pump 422 Master has been carried out with emphasis on the following main points:

1. The ability to combine two HPLC pump 422 Master (or a 422 Master plus either a 422 slave or a 420 pump) with autosampler to form a system with built-in intelligence for gradient control, syncronization etc.
2. Remote control compatibility with all components of the HPLC system 400, in particular with the Data System 450 as far as possible.

The main components within the system are described briefly below:

Pumphead

The heads supplied allow a flowrate ranging from 0.01 to 20.00 ml/min.

Pressure Measurement

The pump is fitted with a sensor for optimum speed of response and accuracy. The pressure display units can be selected between bar, psi and MPa (by an internal switch selection).

Motor/Gearbox Assembly

The drive unit for the pump is a DC-motor with built-in gearbox and encoder.

The transmission between motor and cam shaft is realised using a oil lubricated gearbox.

Motor Control

The motor speed is controlled using analog and digital loop techniques and a motor encoder. The cam position is defined by a camflag signal which ellows synchronisation of motor speed with the current position of the cam itselft.

Column Shock Protection

Column Shock Protection in the HPLC 422 pump is designed to protect your HPLC column from damage caused by pressure surges when starting up the system. CSP is essentially a time-controlled flow ramp which prevents the system pressure from rising rapidly in the start-up phase.

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2.3. SPECIFICATIONS

Pump head	Flow range	Pressure range
KP91-00503 (S)	.01 - 2 ml/min	up to 600 bar
KP91-00659 (M)	.05 - 10 ml/min	up to 400 bar
KP91-00505 (L)	.1 - 20 ml/min	up to 200 bar

Flow rate accuracy :	≤ 1 % (S:0.6 ml/min. 45 bar, methanol) (M:1.5 ml/min. 95 bar, methanol)
Flow rate precision :	≤ 0.3 % (S:0.6 ml/min. 45 bar, methanol)
Linearity:	$r^2 \leq 0.998$ (s: 0.2 - 1.2 ml/min. rel $_{sa} \geq 0.4$ % constant pressure, methanol)
Drift:	≤ 1 % / 10h (S: 0.6 ml/min. 100 bar, methanol)
Upper pressure limit :	Selectable in steps of 10 bar over the entire pressure range
Lower pressure limit :	Selectable in steps of 10 bar over the entire pressure range
Pressure sensor :	Bourdon tube
Materials in contact with mobile phase :	Sapphire, Ruby, PTFE, Ceramic, Stainless Steel (DIN 1.4435)
Permitted ambient temperature range :	10 °C - 35 °C, noncorrosive, noncondensing atmosphere
Interfaces :	- RS-232 (reduced) - Alarm (pressure, Error detection) - Pressure signal (analog) - Autosampler synchronization (AUX connector)
Mains inlet :	100, 120, 220, 240 VAC; 50/60Hz; 140 VA
Dimensions :	170 mm high, 255 mm wide, 360 mm deep
Weight :	12 kg

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2.4. USER INTERFACE

The menu-driven dialogue between the pump and the user allows the selection and/or setting of both pump and flow generation parameters.
Some menus have more than one level and each level displays a different set of menu items.
The user going through the menus can:

- Configure the pump for both isocratic and gradient flows.
- Manage the flow generation through the use of files.
- Computer controlled operation.

2.4.1. Looking at the 422 M user interface

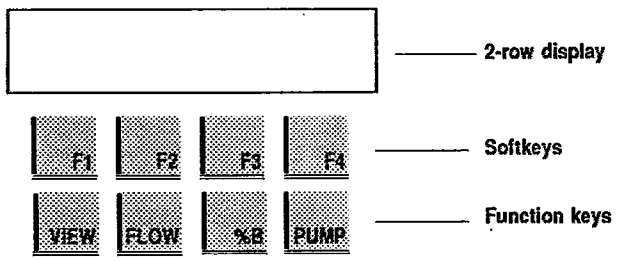


Fig. 2-2.

An alphanumeric LCD display rows of 24 character each is used (see figure 2-2).
On the upper row some messages and measures are displayed.
On the lower display row, the meanings of the menu item functions assigned to the softkeys are displayed.
The LCD display is provided with a back illuminations; the level of light is adjustable via software using one soft key (see para.4.2.2.).

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2.4.2. Softkeys

The pump user interface is based on a multilevel hierarchy of menus selectable via the softkeys, which meaning and function changes according with the menu level active at that moment.
The operation of the softkeys is indicated, using capital letters, on the lower display row immediately above the corresponding key.

2.4.2.1. Hidden function of softkeys

The softkeys have also an "hidden" function.

SOFTKEY	HIDDEN FUNCTION	ACTION
«F3»	**Reset**	Pressing *«F3»* during power up cancels the stored setup values and the pump starts with default values.
«F3» + «%B»	**Reset files**	Pressing *«F3»* and *«%B»* keys during power up causes all the stored files to be cleared.
«F1»	**Autozero**	Pressing «F1»/or more that two seconds, when the pump is stopped, starts the autozero procedure.

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2.4.3. Function keys

FUNCTION KEY	ACTION
«VIEW»	It is used to change the values displayed on the upper display row when the pump is operating the key is active also in remote operation.
«FLOW»	When enabled, allows to change the preset flow.
«%B»	It is enabled only when the pump is configured as master in a binary gradient; it is used to set the percentage of the flow delivered by the slave pump.
«PUMP»	Starts or stops the pump; when the pump is stopped, the upper display row shows "pump stopped", when the pump is active, the flow and the pressure are displayed. The key is not active during remote operation.

2.4.4. Keyboard lock

Pressing *«F4»* + *«VIEW»* at the same time the keyboard becomes locked and only the key *«VIEW»* is enabled.
The display shows

XXX	XXX	XXX	XXX
	KEYBOARD LOCKED		

and the upper line remains uncharged.
Pressing *«VIEW»* it is possible to see values and measures.
All the other keys are disabled. To unlock the keyboard the user must press the two keys *«F4»* + *«VIEW»* as seen above.
The lower line of the display changes to indicate the softkeys active.

2.5. COMPRESSION FEATURE

Due to extreme conditions of pressure and compressibility a pressure breakdown may occour on a specific cam position, this consequently would influence the flow.
To prevent pulsations, a compression function has been built-in; it can be set ON/OFF by the lever switch located on the rear panel (1, Figure 2-3).

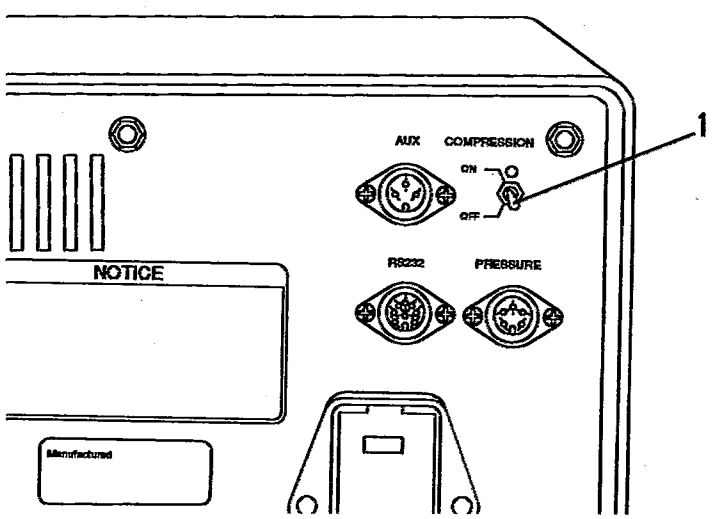


Fig. 2-3.

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3. INSTALLATION

3.1. UNPACKING

Compare the consignment with the delivery note. If parts are missing or damaged please inform your local KONTRON INSTRUMENTS representative immediately.
Transport the instrument only in its original packing box.

3.2. CHECKING THE INSTRUMENTS SERIAL NUMBER

The plate with the serial number is mounted on the rear side of the instrument (1, figure 3-1).
This number must be identical with the serial number on the delivery note.

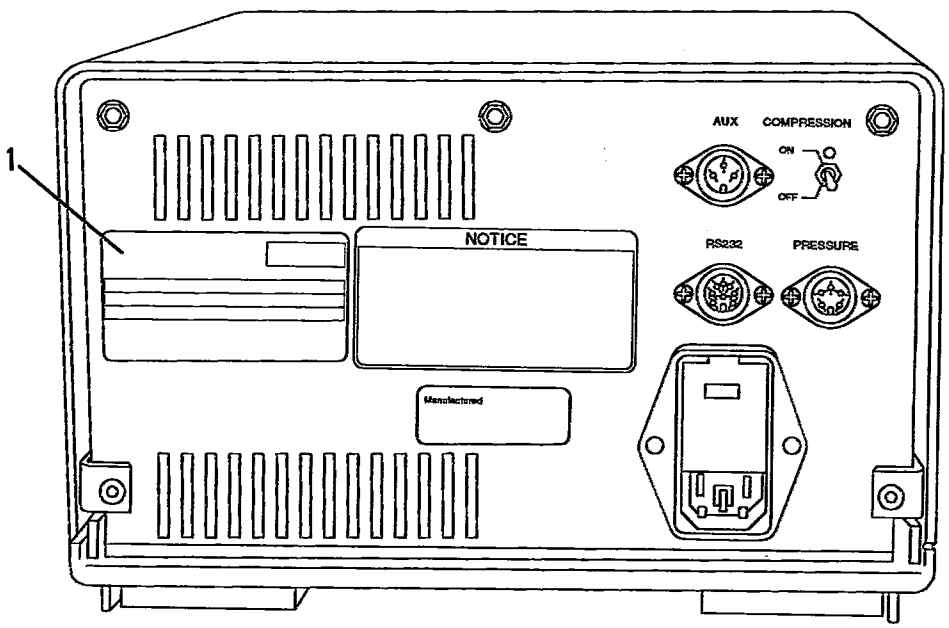


Fig. 3-1

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3.3. CHECKING THE ACCESSORIES

The following standard accessories are included in PN KP91-91056:

Part no.	Description	Q.ty
KP 07-86020	Tubing, sir L=1,68 m	1
KP 15-62252	Recessed hex screw M6x50	2
KP 30-35015	T-piece, dia.3	2
KP 40-00044	Box with Lid	1
KP 40-30013	Open-ended spanner, 1/4"x5/16"	1
KP 40-30018	Allen key 3 mm	1
KP 40-30019	Allen key 5 mm	1
KP 40-30020	Open-ended spanner 15 mm	1
KP 55-65601	Cable power main cord (EU)	1
KP 62-13002	Fuse 2A slo-blo 5x20	2
KP 62-13015	Fuse 4A slo-blo 5x20	2
KP 91-00508	Outlet pipe	1
KP 91-00509	Solvent feed pipe	1
KP 91-00524	Conn. capillary assy	1
KP 98-00029	PVC bag	1
KP 93-90061	Master-slave RS232 cable	1

The pump head, if ordered, is packed separately.
Please check if it is the correct one.

Description	Flow range
Pump head S(mall)	.01 - 2 ml/min
Pump head M(edium)	.05 - 10 ml/min
Pump head L(arge)	.1 - 20 ml/min

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3.4. CHECKING THE MAINS SUPPLY

The HPLC PUMP 422 is factory set for 220V 50/60Hz. For operation with other mains voltages, the correct voltage must be set on the voltage selector (see figure 3-2).

Possible voltages: 100, 120, 220 and 240 VAC.

The main switch (1) is located on the lower left side of the front panel.

The fuses on the voltage selector (2) have to be adjusted according to the mains supply.

Frequency adjustment for 50/60Hz is not necessary.

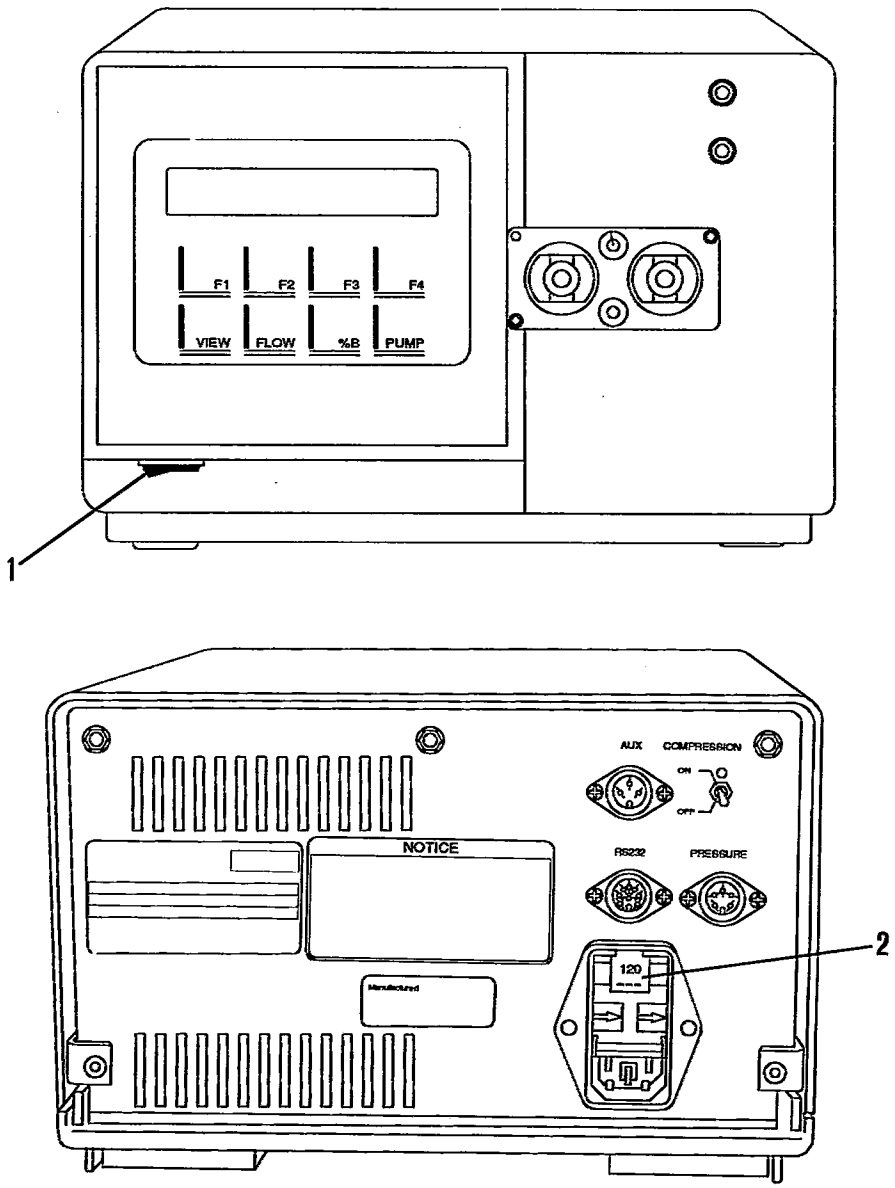


Fig. 3-2

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3.4.1. Voltage selector

For the voltage selection proceed as follows (see figure 3-3)

- Unplug mains cable
- Open the snap-cover (1) using a screwdriver at the top
- Pull marker wheel (2) and turn it to the required position
- Push (2) back into position
- Pull out fuse holders (3) and insert the correct fuse
- Push holders (3) back into position, obey arrows
- Close snap-cover (1)
- Check if the correct voltage is displayed

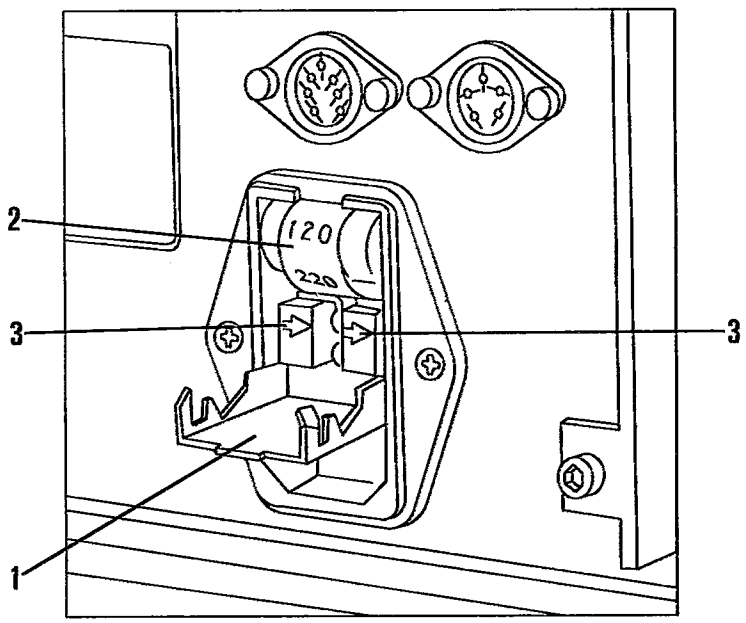


Fig. 3-3

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3.5. INSTALLATION

The installation site of the instrument should be such that it is not exposed to dust or corrosive vapors.
The ambient temperature should be between 10 °C and 35 °C.
Allow 1 cm space around the instrument for sufficient cooling.

3.5.1. Installation of a pump head

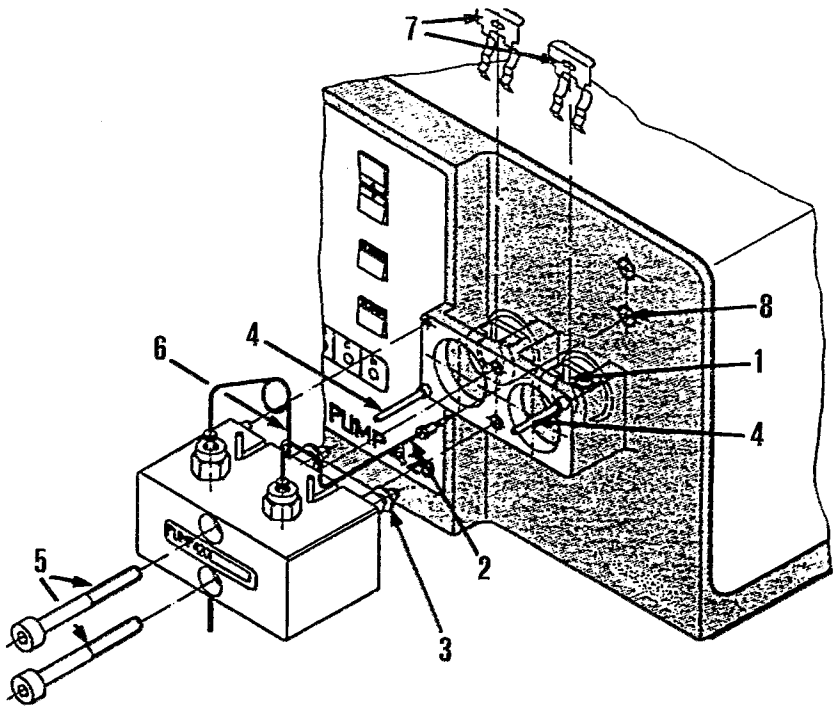


Fig. 3-4

- Before starting installation, switch on the pump and wait for "Pump head missing" to be displayed. Both piston couplings (**1**, figure 3-4) are in the correct position for head installation position.
- Take the capillary (**2**) from the pump head accessories, slide tube nut and ferrule over it and mount it to the pump head.
- Wet both sapphire pistons (**3**) with methanol and push them, with slight rotation, into the pump head all the way to the stop. Then pull both pistons back 5 mm.
- Slide tube nut and ferrule over the free end of the capillary.
- Set the pump head on the guide pins (**4**) and slide it carefully in. Make sure the capillary (**6**) is in the groove.
- Mount the pump head with the screws (**5**).

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- Mount the retaining springs (**7**), set them on the piston shaft, push slightly against the pump and press down. We recommend greasing the springs lightly before mounting, especially on the S-type head.
- On the capillary (**2**), slide tube nut and ferrule over and mount it to the pressure sensor input (**8**) on the pump.
- Using a syringe flush the pump head with an organic solution like: Methanol, IPA, THF etc.
- Disassembly basically takes place in reverse order.
- The description for purge tube connection, replacing the piston seal, and replacing the valves is in chapter 5 of this operating manual.

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3.5.2. Start up of the pump

To gain familiarity with the key functions, read chapter 3.

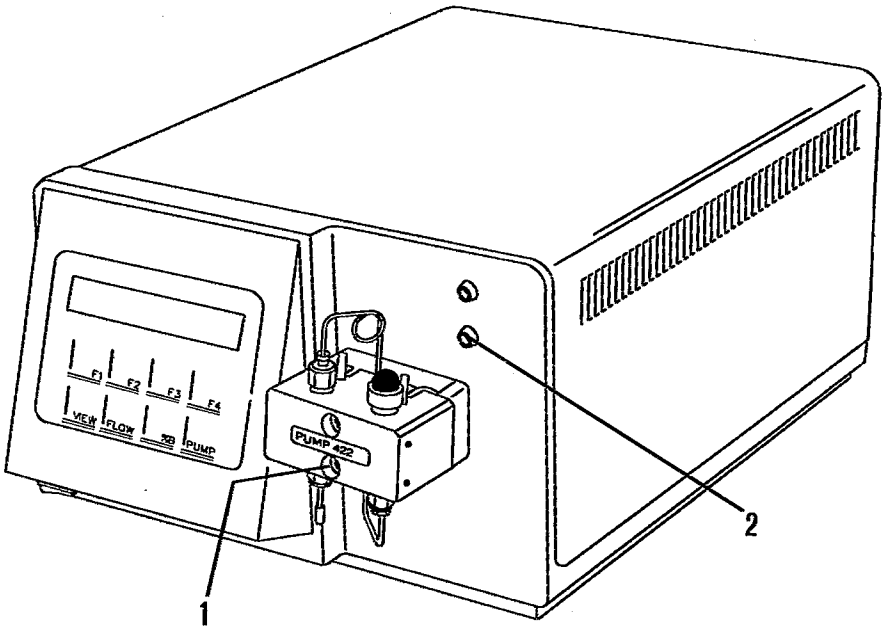


Fig. 3-5

The pump head has been tested with isopropyl alcohol (IPA).
Therefore, for the first run use liquids which are compatible with IPA.
The flush inlets allow wetting and rinsing of piston guide bushings and the piston seals. This will increase the lifetime of the seals.

Fill the reservoir with clean, degassed solvent which is compatible with IPA. Take the suction tube and the inlet filter from the pump accessory, fill it with the solvent and plug the tube over the capillary (**1**, figure 3-5) on the inlet valve. Then connect the outlet tube on the pressure sensor outlet (**2**).

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- Switch power on to the pump, by the mains switch (**1**, figure 3-6) located below the front panel.
- Software version is displayed.
- Self test and initial program is running.
- The indication "pump stopped" is displayed.
- Place the outlet capillary into an empty glass.

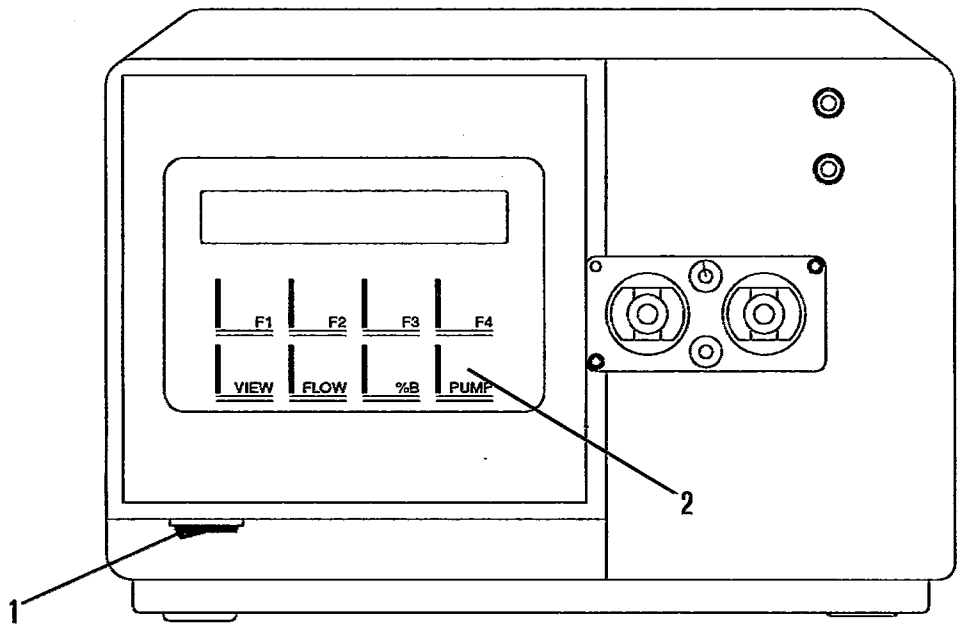


Fig. 3-6

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- Start the pump by pushing the function key "***PUMP***" (2).
- The pump starts running slowly and accelerates to the initial value within 10 sec (Column Shock Protection); the display indicates the flow and the measured pressure.
- After all air bubbles have been removed, stop the pump by pushing the function key "***PUMP***" (2).
- Flush the pump head as described in chapter 5.1.1 respectively 5.1.2.
- Connect the outlet capillary to the operating system.
- Set the pressure limits for optimal system protection.
- Set the desired flow rate.
- The HPLC pump 422 is ready to use.

3.5.3. Connection of accessories

The PUMP 422 can be operated by a computer via a reduced RS232-interface (**1**, figure 3-7).
In addition an Y/t recorder can be connected to record the system pressure.
On the same connector, an alarm signal is available.

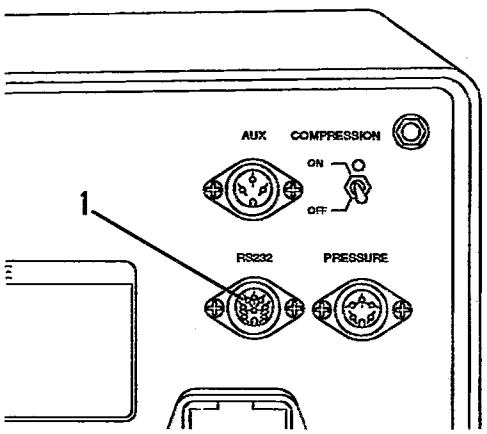
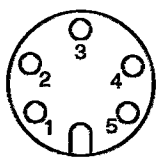


Fig. 3-7

3.5.3.1. Pin assignment for analog and alarm connection

5 way (240°)



1. - /Alarm output (TTL level)
2. - Pressure signal output
3. - Ground A
4. - /Stop
5. - No connection

VIEW: as seen on
the rear panel

Alarm out is set in case of:

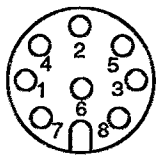
- transgression of either upper or lower limit
- occurrence of error 25 (software regulation)
- occurrence of error 26 (RPM measurement)

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Pressure signal output: R_i approx. 50 kOhm
100 bar corresponds to 750 mV (±10%).

3.5.3.2. Pin assignment for RS-232 connection

8 way (262 °)

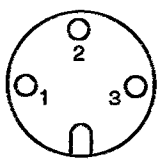


1. - CTS
2. - Ground D
3. - /RXD
4. - RTS
5. - /TXD
6. - /Cam
7. - Ground D
8. - /DSK

VIEW: as seen on
the rear panel

For more details see chapter 4.6, Operation via RS-232-Interface.

3 way (180 °)



1. - Injection input
2. - GND
3. - /Alarm output (TTL level)

VIEW: as seen on
the rear panel

3.5.3.3. Pin assignment for auxiliary connection

Alarm output is set in case of:

- transgression of pressure limits
- occurrence of error 25
- occurrence of error 26

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4. OPERATING INSTRUCTIONS

4.1. INITIALIZATION AND START-UP

NOTE: Before starting operation make sure that the pump is installed according to the instructions in Section 3.
If you are not familiar with the functions on the pump it might be helpful to read Section 2 first.

After switching power on the initialization program will start. It proceeds as follows:

- Display of Software-Version
- Initializing the system
- Self test of program and data memory
- Check of the mains frequency and setting of the frequence dependent parameters
- Pressure adjustment of the sensor
- Pressure head identification and setting of the dependent parameters.

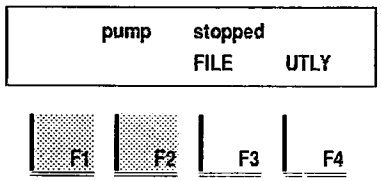
The display shows:

```
PU422    STARTUP TESTS
SOFTWARE V x.xx-yyyy
```

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4.1.1. Run menu

After the initialization program has been completed, the display shows the run menu with the indication of the possible options and the status of the pump.



«F3» and *«F4»* are the active soft keys.

4.2. PUMP CONFIGURATION

The 422-M pump can be configurated to operate both in isocratic (SINGLE CONFIGURATION) and linear binary gradient systems (MASTER CONFIGURATION).
According to the configuration set, the following eluent mixtures can be generated:

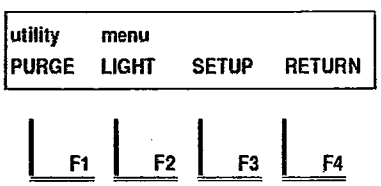
1. 1-eluent mixture with constant flow (isocratic operation).
2. 1-eluent mixture with variable flow (flow gradient operation) in both cases the pump can be configurated either for single or for master operation (in this case the slave pump is disabled).
3. 2-eluent mixture with constant flow and variable eluents composition (parameter *«%B»*) (linear binary gradient operation).
4. 2-eluent mixture with constant eluents composition and variable mixture flow (linear binary gradient operation). In both cases the pump can be configurated only as a master pump.

4.2.1. How to change the pump configuration

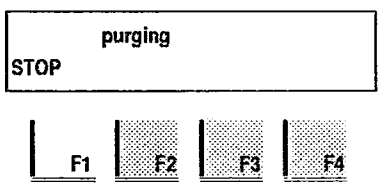
The pump is factory set for single operation.
After both initialization and startup steps (see previous par.s), the pump configuration can be changed by choosing the utility menu via the soft key *«F4»*.

4.2.2. Utility menu

After heaving enabled the utility menu, the relating menu items appear:



PURGING
Pressing *«F1»* the key the purge operation occurs, during the purging the display becomes.



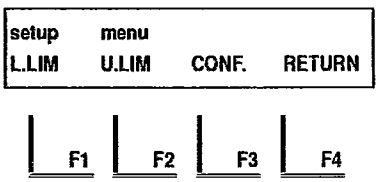
STOP
Pressing the key *«F1»* key the display returns to the previous menu level, and the pump stops.

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LIGHT ADJUSTMENT
Pressing the *«F2»* key the back illumination of the display changes (8 levels from Ø to maximum). *«F4»* Key RETURNS to initial display.

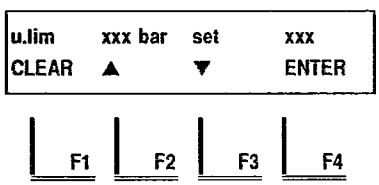
4.2.3. Setup menu

Pressing the *«F3»* key the display shows the setup menu:



The two keys *«F2» (U.LIM)* and *«F1» (L.LIM)* set the values of pressure limits (upper and lower).

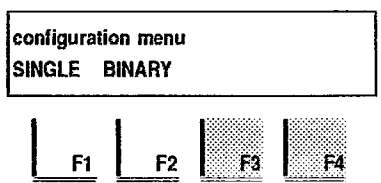
Pressing *«F2» (U.LIM)* for example the display becomes:



The upper row indicates the set value and the modified value.
«F2» (▲) and *«F3»* (▼) keys modify the actual values.
«F4» (ENTER) accepts the modified value and exits.
The same occurs for *«F1» (L.LIM)* key.

4.2.3.1. Pump configuration menu

Pressing *«F3» (CONF)* the display shows the configuration menu:



«F1» (SINGLE) configures the pump as SINGLE pump
«F2» (BINARY) configures the pump as master pump for binary gradient runs.
The configuration is kept in permanent memory.
After configuration the setup menu will reappear, press *«F4» (RETURN)* to return to the run menu.

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4.3. FLOW GENERATION FILES

With the pump 422-M the user can set up to four types of flow generation files which are stored in the RAM: Each file can be composed of up to 20 lines, each of which allows the pump to produce a flow with almost one flow parameter (time, flowrate or «%B») changing.
If the pump operates in isocratic mode (i.e. 1-eluent flow at constant flow rate) the file will be composed of only two lines.
In any case the total flow generation time must not exceed 999 min.

4.3.1. Types of flow generation file.

According to the pump configuration as four types of eluent-mixture flows can be produced as four types of flow generation files can be created.

4.3.2. MASTER flow generation file

A fifth type of file can be generated, it is manual Master file and it can be seen as a sequence of isocratic and/or gradient runs.
A maximum of 8 lines can be written in this file, each of which recall one of the three different flow generation files stored in the RAM.
Furthermore each flow generation file recalled can be repeated up to 99 times.

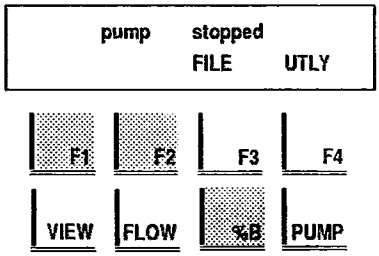
PUMP CONFIGURATION	TYPE OF OPERATION	TYPE OF FILE	NOTE
SINGLE	ISOCRATIC	1st	MASTER FILE FOR SINGLE CONFIG.
	FLOW GRADIENT	2nd	
MASTER	AS FOR SINGLE CONF.		MASTER FILE FOR MASTER CONFIG.
	WITH TOTAL FLOW CONSTANT AND ELEENTS COMPOSITION VARIABLE («%B» GRADIENT) (BINARY GRADIENT)	3rd	
	WITH CONSTANTS ELEMENTS COMPOSITION «%B» AND FLOW GRADIENT (BINARY GRADIENT)	4th	

Table 4-1. Types of flow generation files

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4.4. OPERATION IN SINGLE CONFIGURATION

If the pump is configured in single mode, after power on and initialization the display shows the run menu:



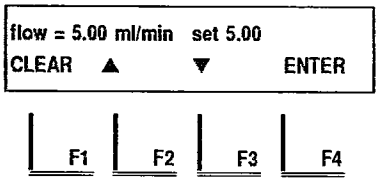
the following function and soft keys are active:

FUNCTION KEYS	SOFT KEYS	
	KEY	FUNCTION ASSIGNED
	«F3»	FILE: goes to FILE menu
	«F4»	UTLY: goes to UTILITY menu
«VIEW»		Display limits
«FLOW»		Edit the flow rate
«PUMP»		Starts/stop the pump

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4.4.1. Flow rate edit

Pressing the function key *«FLOW»* the user can change the preset flow:

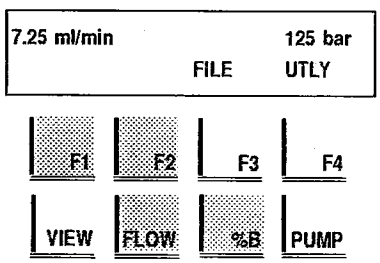


The following soft keys are active:

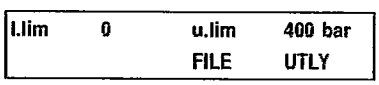
SOFT KEYS		
	FUNCTION	**ACTION**
«F1»	**CLEAR**	Resets modifications entered to preset flow rate
«F2»	**UP (▲)**	Increases flow rate
«F3»	**DOWN (▼)**	Decreases flow rate
«F4»	**RESET**	Accepts and stores flow rate modifications entered

4.4.2. Operation at fixed flow (isocratic run)

Pressing the function key *«PUMP»* from start display (see par. 4.4.) the pump operates at the preset flow.



Pressing *«PUMP»* again the pump stops.
Pressing *«VIEW»* the upper line of the display changes to show the pressure limits.

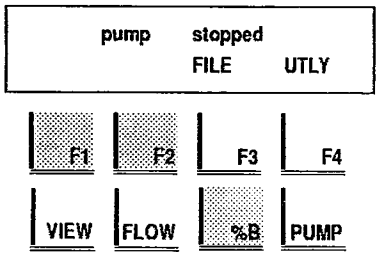


Pressing *«VIEW»* again the display returns to the previous window showing the flow rate and pressure.

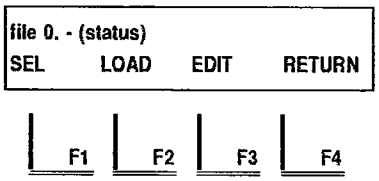
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4.4.3. Flow generation file edit

When the pump is configured as single it is possible to perform a flow gradient.



Pressing *«F3» (FILE)* the display changes to:

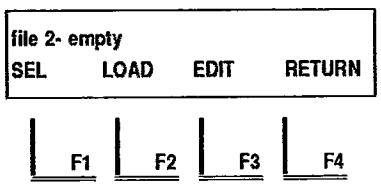


SOFT KEYS		
	FUNCTION	**ACTION**
«F1»	**SEL**	Scrolls the files selecting from 0 to 8 in the upper row, near the file number, the file status is indicated by one of the following message: *<empty>* : new file *<present>* : old file *<loaded>* : file loaded for run *<running>* : file running *<stopped>* : if holding
«F2»	**LOAD**	Loads a file in the run area
«F3»	**EDIT**	To edit the selected file
«F4»	**RETURN**	Returns to initial menu

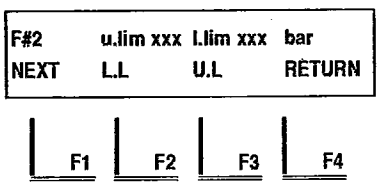
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4.4.3.1. Edit of a new file

Press *«F1» (SEL)* to select an empty file (different from Ø-zero- which is the master file):

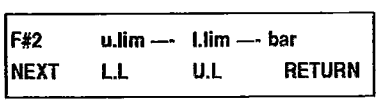


Pressing *«F3» (EDIT)* the display becomes:



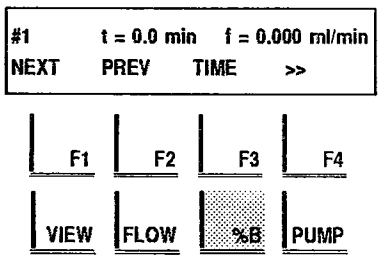
SOFT KEYS		
	FUNCTION	**ACTION**
«F1»	**NEXT**	Passes to the next display
«F2»	**U.L.**	To edit pressure limits
«F3»	**L.L.**	To edit pressure limits
«F4»	**RETURN**	Exit the EDIT section

The file header may contain two pressure limits that can superimpose the pump limits when the file is loaded.
The two limits, using the two ***L.LIM*** and ***U.LIM*** keys can be disabled.
When the limits are disabled the display becomes:



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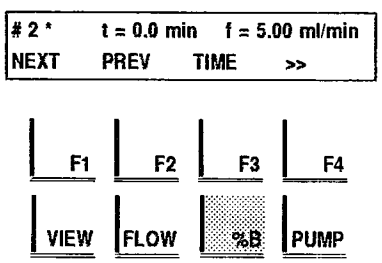
If the limits of the file are disabled, the pump limits are used as default.
Pressing *«F1» (NEXT)* after the limits have been set, the display passes to the first line of the new file:



SOFT KEYS		
	FUNCTION	**ACTION**
«F1»	**NEXT**	To go to the following line
«F2»	**PREV**	To go to the previous line
«F3»	**TIME**	To changed flow data
«F4»	**>>**	End-of-file marker and displays the edit exit menu.

Pressing *«F3» (TIME)* and the function key *«FLOW»* it is possible to edit the two values of the line.
In the first line time **must** be **zero** and cannot be changed.

Press *«F1» (NEXT)* to display the second line:



This line is equal to the previous one, and it's marked with "*" to indicate the user has not yet changed it.
In this condition (line not modified) it's not possible to go to the line # 3 if the user doesn't not change at least one of *(TIME)* or *(FLOW)* value.
To mark the end of file is necessary to press *«F4» (>>)* to display the Edit exit menu and then press *«F3»* (**END**).

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NOTE: CHECK THAT THE ACTIVE LINE IS NOT THE FIRST LINE, BECAUSE IN THIS CASE THE USE OF THE ***«F3» (END)*** KEY WILL DELETE THE FILE.

Before pressing ***«F3» (END)*** the user can change the time value (on this last line) only in order to keep the last flow for a certain period of time.
But if the user tries to change also the flow (on this last line) the software will discard this new value and keeps the flow of the line immediately before the last one. So the result, after pressing ***(END)***, will be for example:

```
# 12      t = 20.00 min      - end
NEXT      PREV      TIME      >>
```

To exit EDIT mode press ***«F4» (>>)*** and the exit menu will appear:

```
# 12      t = 20.0 min - end
INS       DEL       END       RETURN
```

F1 F2 F3 F4

Press ***«F4» (RETURN)***

```
exit      edit      mode      ?
YES       NO
```

F1 F2 F3 F4

if the user presses ***«F2» (NO)***, the display returns to edit mode in the same line before the pressing of ***«>>»***.
If the user presses ***«F1» (YES)*** the file edited is stored in his protected area; the display becomes.

```
file 2 - present
SEL       LOAD      EDIT      RETURN
```

F1 F2 F3 F4

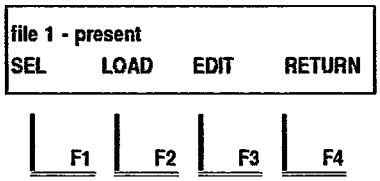
VIEW FLOW %B PUMP

When the file is existing the user can decide to load it for run, or to edit it again to perform modifications (see the following paragraph).

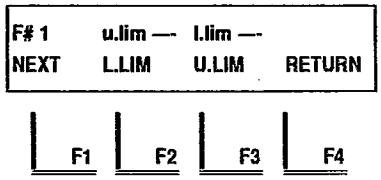
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4.4.3.2. Edit of an existing file

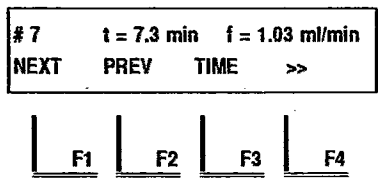
Select an existing file using *«F1» (SEL)*:



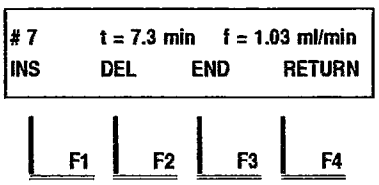
Press *«F3» (EDIT)* to display the header file:



Suppose to delete line # 7 and to add a line before the line # 9.
Press *«F1» (NEXT)* until line # 7 is displayed:



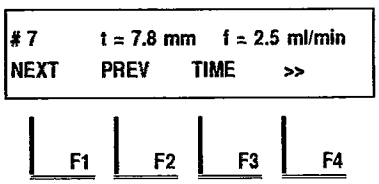
Press *«F4» (>>)* to display the exit menu:



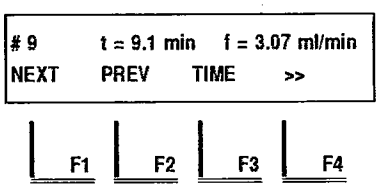
SOFT KEYS		
	FUNCTION	**ACTION**
«F1»	**INS**	To insert a new line before the actual one
«F2»	**DEL**	To deleted the actual file line
«F3»	**END**	To delete a file, only if the active line is the line # 1
«F4»	**RETURN**	To exit the edit mode

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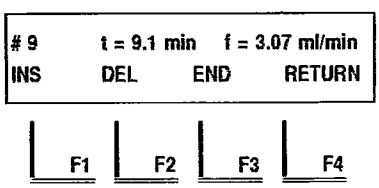
Press *«F2» (DEL)* to delete the line # 7 and the display returns to:



Where line # 7 is the old line # 8 and all following lines are renumbered.
Press *«F1» (NEXT)* again up to reach line # 9:

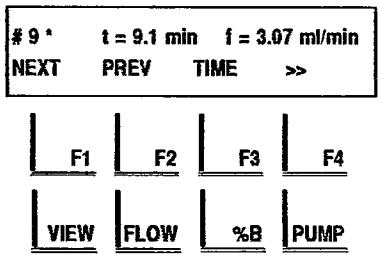


Press *«F4» (>>)*:

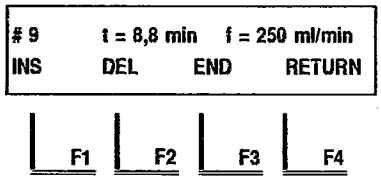


Press *«F1» (INS)* and the actual line # 9 becomes line # 10 (the new line is inserted before the line displayed) and all the following lines are renumbered. The new line # 9 contains a copy of the old line and it is marked with a «*».

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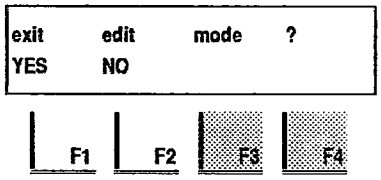


using *«F3» (TIME)* key and the function key *«FLOW»* the user changes the value of the new line:



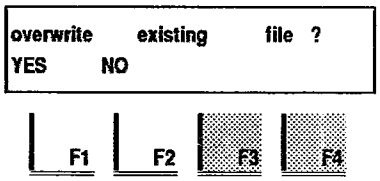
The user cannot insert more than one line a time, the cannot insert another line without changing the actual inserted line by using the function key *«FLOW»*.
To exit from edit the will use *«F4» (>>)* and *«F4» (RETURN)*.

As seen the display will become:



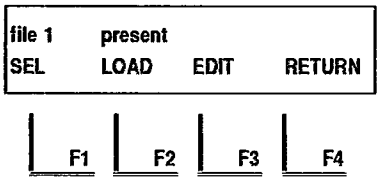
If *«F2» (NO)* is pressed the display will gone back to the last edited line.

If *«F1» (YES)* is pressed, and the user changed something in the file the display becomes:



If *«F1» (YES)* is pressed and the file was not changed the display will be:

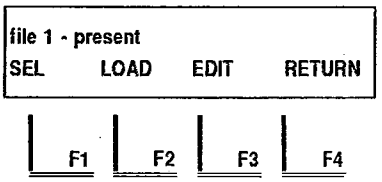
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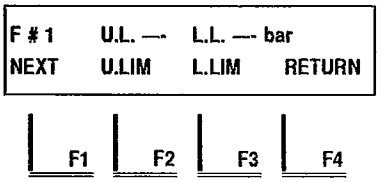
And the modifications are stored permanently.
If *«F2» (NO)* is pressed the modifications are discarded.

4.4.3.3. Delete of a file

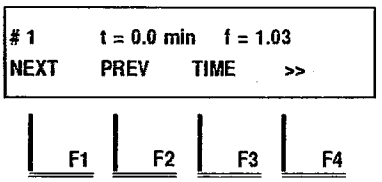
A file present (i.e. stored) can be deleted by entering in the edit mode and pressing *(END)* when the first line is present:



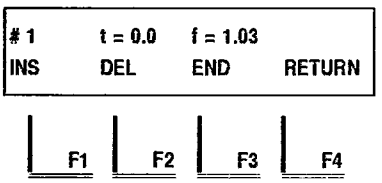
press *«F3» (EDIT)*:



press *«F1» (NEXT)*:



press *«F4» (>>)*:

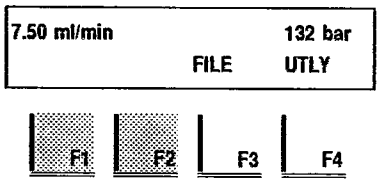


press *«F3» (END)*. The display the user first to exit the edit mode and overwrite existing file. If the answer is *«YES»* to both questions then to file will be deleted.

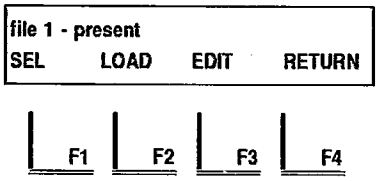
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4.4.4. Operation at variable flow (flow gradient run)

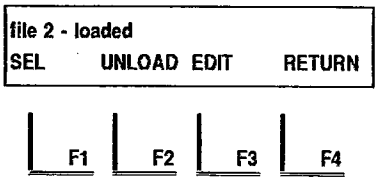
Starting from initial display of the pump running the procedure is:



press *«F3» (FILE)*:



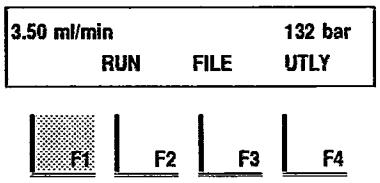
suppose to run file 2; press *«F1» (SEL)* and then *«LF2» (LOAD)* the loading menu will appear:



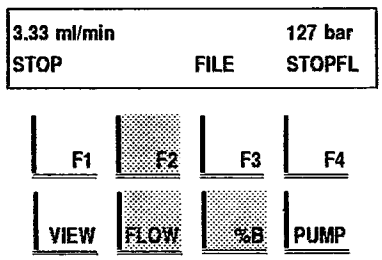
SOFT KEYS		
	FUNCTION	**ACTION**
«F1»	**SEL**	To scroll the files
«F2»	**UNLOAD**	To discarge the actual loaded file
«F3»	**EDIT**	To enter the edit mode
«F4»	**RETURN**	Return to the startup menu

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press *«F4» (RETURN)*.
When a *«F3» (FILE)* is loaded in the run area the main display becomes:



the *«F2» (RUN)* option appears to indicate that a file is loaded, the pump is running and it is waiting either for a manual start of the file or an external signal from an autosampler.
The status of the values remain constant the user presses or the *«F2» (RUN)* autosampler sends an injection signal.
When this event occurs the program starts and gradient running menu appears on the display:



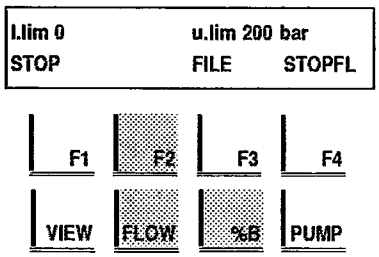
	SOFT KEYS	
	FUNCTION	**ACTION**
«F1»	**STOP**	Suspension of the gradient in progress
«F3»	**FILE**	To edit another file while another one is running
«F4»	**STOPFL**	Stop of the gradient in progress with flow reduced to zero

The upper line indicates the values of actual flow and actual pressure changing during the gradient.

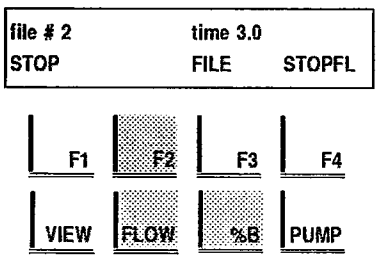
The function key *«PUMP»* is active, pressing it the pump stops (emergency).

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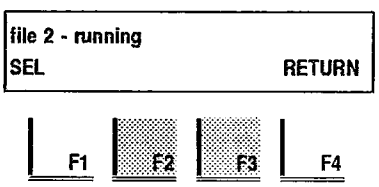
Pressing ***«VIEW»*** the display changes to:



«VIEW» pressing it again:



using ***«VIEW»*** it is possible to scroll the three displays.
Using ***«F3» (FILE)*** it is possible to EDIT a file **different from the file that is running**. In fact, if the user presses ***«F3» (FILE)***, the display becomes:

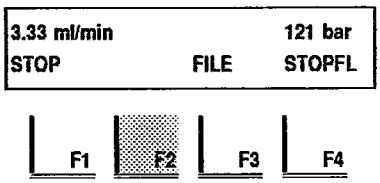


the softkeys ***(LOAD)*** and ***(EDIT)*** are disabled.

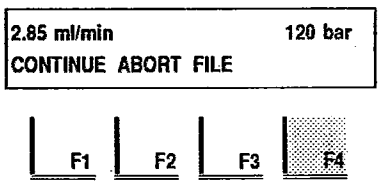
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4.4.4.1. Hold of the gradient

While a gradient is running the display is:



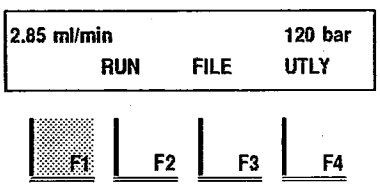
Pressing *«F1» (STOP)* the gradient is suspended and the display shows the gradient holding menu:



Pressing *«F1» (CONTINUE)* the gradient file continues and the display returns to the previous.
Pressing *«F2» (ABORT)* it the file run is terminated and the pump remains in the conditions determined by the hold.

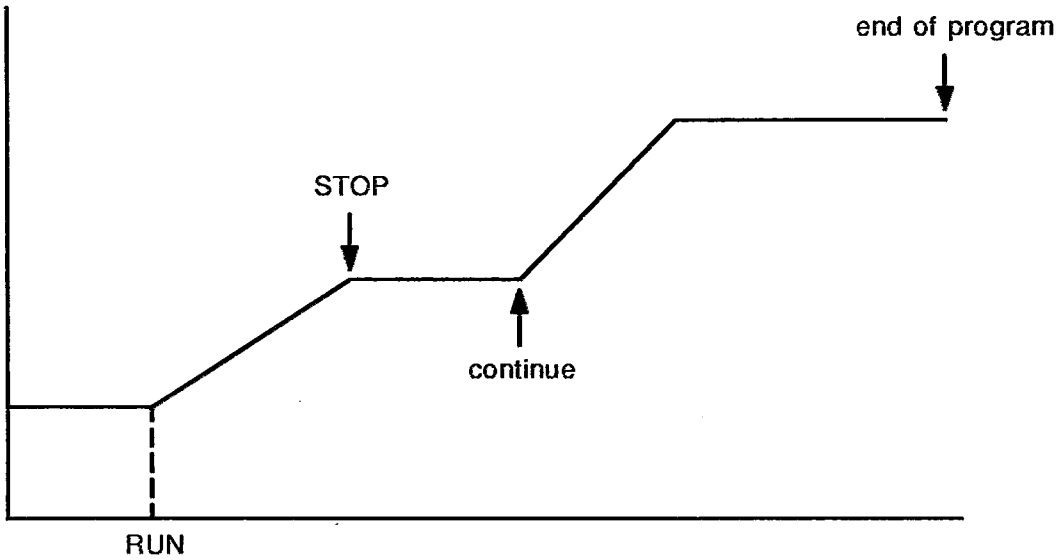
The display return to the initial, with the file loaded but not running and waiting for a start (manual or via autosampler).

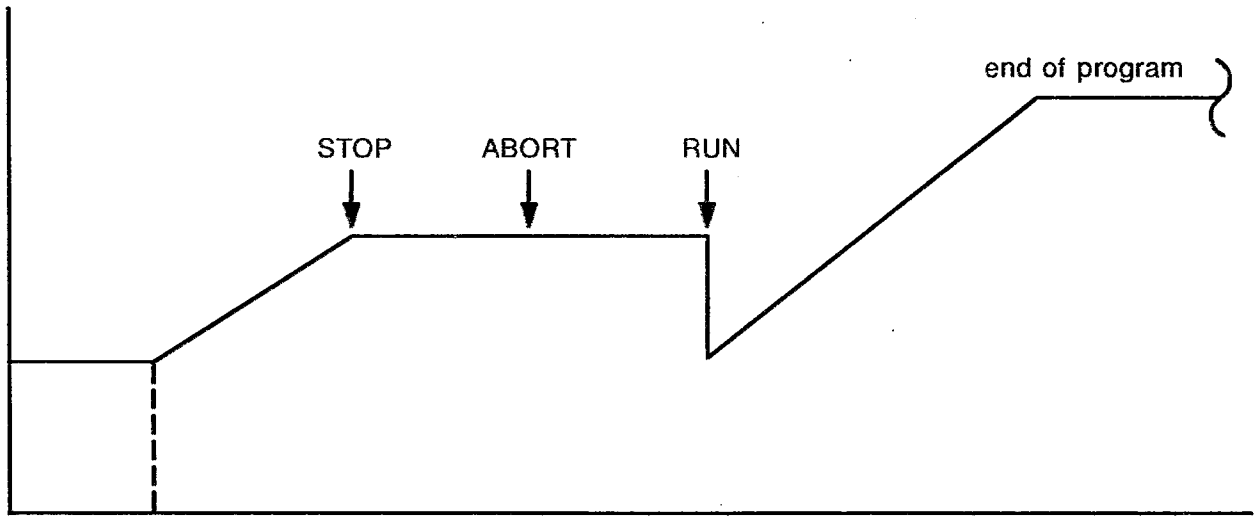
The display is:



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the operation is illustrated in the following diagrams:



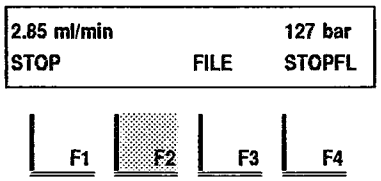


Pressing *«F4» (STOPFL)* the operation is the same, except that the flow is reduced to zero during the pause.

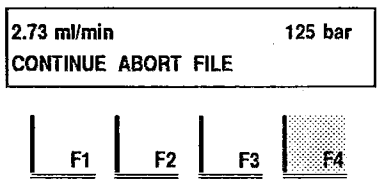
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4.4.4.2. Edit during the run

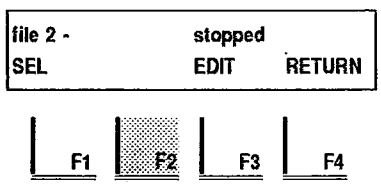
The running file has to be edited only during the hold phase.



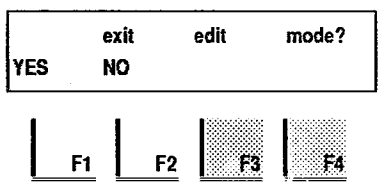
Press *«F1» (STOP):*



Press *«F3» (FILE)* and the running file edit manu will appear:

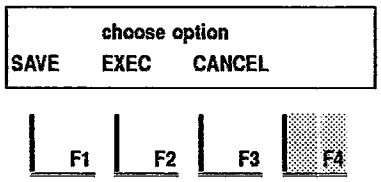


Press *«F3» (EDIT)* and perform file modification as detailed before.
At the end of editing phase the following display occurs.

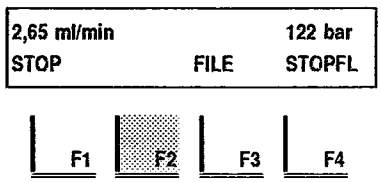


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Press *«F1» (YES):*



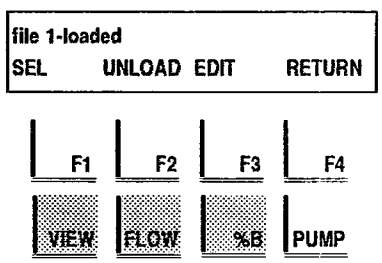
Pressing *«F1» (SAVE)* the file is stored permanently in the memory (i.e. the file is overwritten) and the gradient goes on.
Pressing *«F2» (EXEC)* the file modified is executed without saving the modifications permanentely.
Pressing *«F3» (CANCEL)* the modifications are rejected and the file continues unchanged.
In all the cases the display returns to:



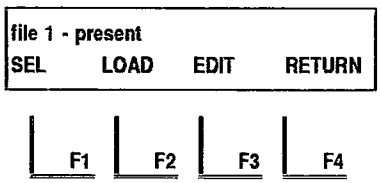
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4.4.4.3. Unloading a file

If a file is LOADED it remains permanently in the run area of the pump; in this condition, pressing *«PUMP»*, the first line of the file loaded will be executed.
The flow modifications introduced when the pump is stopped will be lost.
To overcome this problem it is possible to UNLOAD the loaded file pressing the corresponding key *«F2» (UNLOAD)* in the file menu.



Pressing *«F2» (UNLOAD)* the file is discharged; the pump operates without file and the display becomes:



Now it is possible to load again the file, when necessary.

4.4.5. How to create a master file

The user can edit and execute a sequence file (master file) that allows to run a sequence of files for a variable number of repetitions (1 to 99) with synchronized start or one run without synchronization.
It is possible to have a master file composed by 8 lines (max).

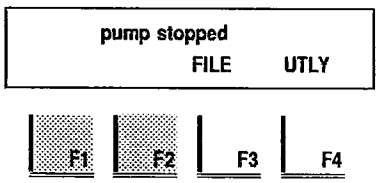
Example

line # 1	file # 3	repetitions 22
line # 2	file # 1	repetitions 12
line # 3	file # 2	repetitions 4
line # 4	file # 1	repetitions 25
line # 5	—	—
line # 6	—	—
line # 7	—	—
line # 8	—	—

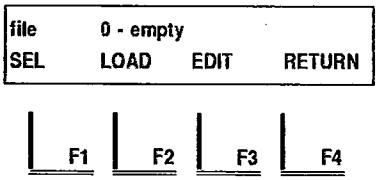
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4.4.5.1. Master file edit

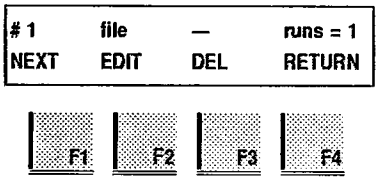
The procedure to edit master file is:
starting from one of the menus containing the FILE softkey.



Press *«F3» (FILE)*



Pressing *«F1» (SEL)* select the file #∅ master file and press *«F3» (EDIT)*. It is not possible to edit master file only if in the system there is no other file present.
The master file edit menu will appear on the display:

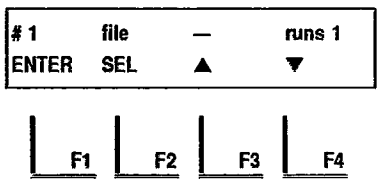


SOFT KEYS		
	FUNCTION	**ACTION**
«F1»	**NEXT**	To scroll the file line
«F2»	**EDIT**	To modify the actual line
«F3»	**DEL**	To delete the actual line
«F4»	**RETURN**	To store the edited line; and to exit the edit mode

At the beginning all the lines are empty; pressing *«F1» (NEXT)* appears always the first line; press *«F2» (EDIT)* to modify the first line.

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The display shows the master lines edit menu:



SOFT KEYS		
	FUNCTION	**ACTION**
«F1»	**ENTER**	To store the selected file into the master file
«F2»	**SEL**	To select a flow generation file to be marked into the master file
«F3»		To increase/decrease the repetions of the flow file up to 99
«F4»		

The softkeys allow the user to introduce the parameters in the line.
«F2» (SEL) select the file from 1 to 8.
«F2» (▲) and *«F4» (▼)* Increase/decrease runs from 1 to 99.

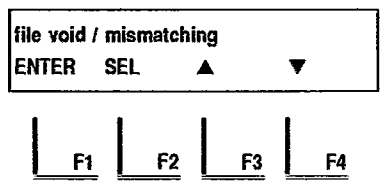
When runs = 1 and the user presses *(▼)* appears the letter 'A' (ansynchronous) to select one free run without the wait for the autosampler start.

Before the store operation it is checked if:

– file number is not empty;

– file number is compatible with configuration.

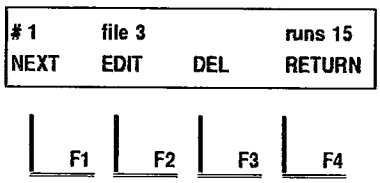
If an error occurrs the display shows the message:



The user must remove the error pressing *«F2» (SEL)* and choosing a write file or no file.

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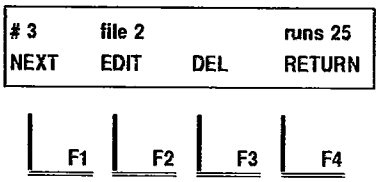
When the line is correct, pressing *«F1» (ENTER)* the display becomes:



Pressing *«F1» (NEXT)* and *«F2» (EDIT)* it is possible to introduce the desired lines in the file.

Delete of a line

Using *«F1» (NEXT)* select a line to display:



Pressing *«F3» (DEL)* the line is deleted, the successive line appears on the display; if the line is the last, a new empty line appears.
When a file is completed pressing *«F1» (NEXT)* it is possible to scroll cyclically the lines, the last line is indicated by an empty line.

Insert of a line

New lines can only be added at the end of a new file.

Delete of the file

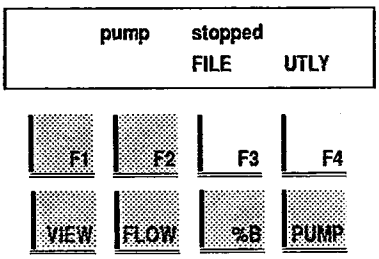
The file can be deleted only using *«F3» (DEL)* on all the lines.

To leave the edit of the master file press *«F4» (RETURN)*.

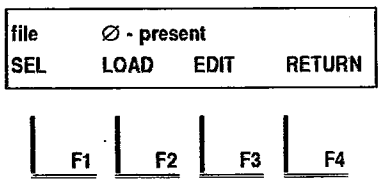
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4.4.5.2. Running of a master file

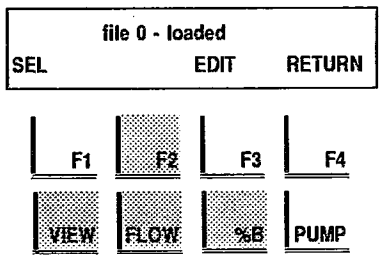
The procedure is similar to that of other files:



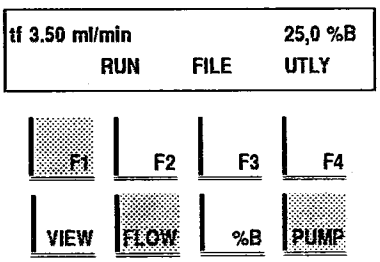
Press *«F3» (FILE)* and select file ∅:



Press *«F2» (LOAD)*:



Press *«F4» (PUMP)* and *«PUMP»*:

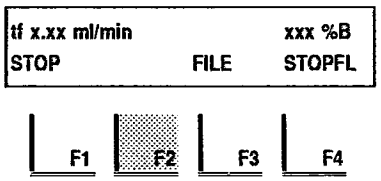


Using *«VIEW»* the user can see:

- total flow and *«%B»* (only in binary gradient);
- lower and upper pressure limits;
- flow of the pump and pressure.

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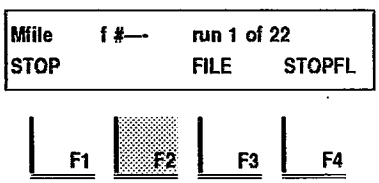
If an external AUTOSAMPLER INPUT occurrs or the user presses ***«F2» (RUN)*** the master file runs the first repetition of the first file.
The display becomes:



Pressing ***«STATUS»***, in addition to the previous displays the following two occurrs.

- master line: with file number and repetitions

This new display is:



where f #— is the number of the file.
If one line has the "A" option in the runs field the corresponding program is executed without the wait for the RUN key or the external AUTOSAMPLER INPUT.

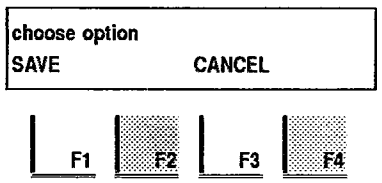
Editing while master file is running

While the master file is running it is possible to edit the files that at the moment are not running, i.e. the files that are not included in the Master file and the files that are in the lines following that in execution.

If the file edited is not included in the master file the editing session is equal to that of the files not running.

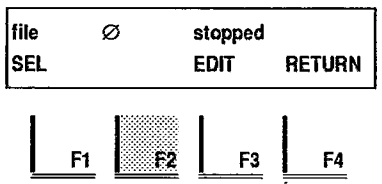
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If the file edited is part of the master file but not running at the moment it can be edited like the previous but, if it becomes active during the operation, when the session ends on the display appear the options:



if the user presses ***«F3» (CANCEL)*** the modification are last, if presses ***«F1» (SAVE)*** the modifications become permanent and the running file includes immediately the modifications.

The master file can be edited only if it is stopped using the key ***«STOP»*** or ***«STOPFL»***.

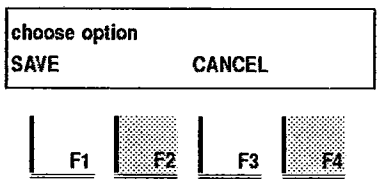


Pressing ***«F3» (EDIT)*** it is possible to change the lines of the master file.

The modifications are immediately stored and executed when the option ***«CONTINUE»*** is selected.

Similar behaviour occurrs when modification of the file that is running is performed.

At the end of edit session the two options are displayed:



Pressing ***«F1» (SAVE)*** the master file continues with the modified file and the modifications become permanent.
pressing ***«F3» (CANCEL)*** the master file continues unchanged and the modifications are discharged.

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4.5. OPERATION IN MASTER CONFIGURATION

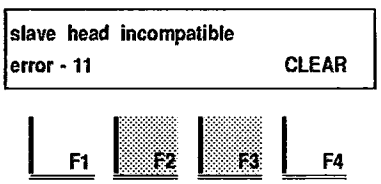
If the pump is configured as master pump it can operate with:

- a pump 422 S (slave)
- a pump 420 (remote)
- a pump 422 (single mode, remote)

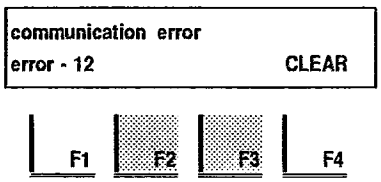
without modifications.

4.5.1. Power up

The slave pump **must be started first**
Switching on the master pump, it executes the test asking to the slave the type of head mounted.
If the head is different or missing or the communication has an error the display indicates.

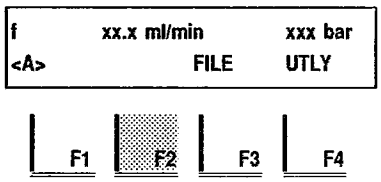


or



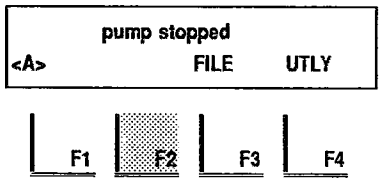
If all is OK, the slave pump passes in remote mode and the master pump starts with the initial display indicating that the pump is the master pump.

If the pump is working.



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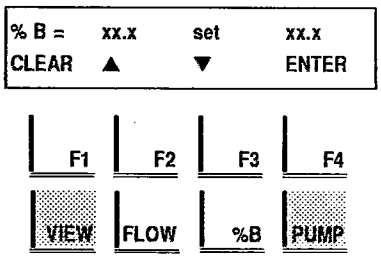
With the softkey *«RUN»* present if there is a file still loaded from the last work.
Or if the pump is not working:



All the configuration operation are the same; also set of flow is equal.
Configured as master pump also the key *«%B»* now is active.

4.5.2. Edit of flow parameters

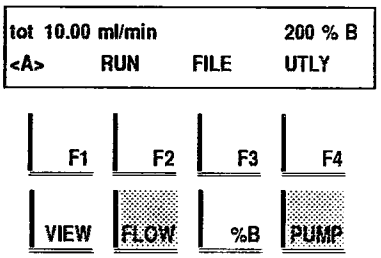
Pressing *«FLOW»* the user can select the total flow of the two pumps.
pressing *«%B»* the percent of organic modifier can be selected.
The display becomes.



The key have the same meaning of other edit modes.

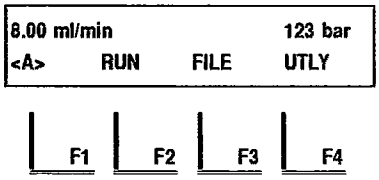
4.5.3. Operation in isocratic mode

Pressing the key pump the two pumps start to operate delivering the flow quantities programmed.
The display of the master pump becomes:

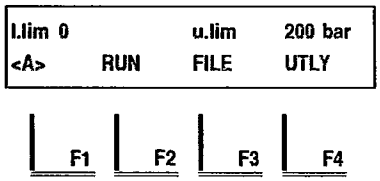


Indicating the *«%B»* and the total flow
«VIEW» pressing it the display changes to the following in sequence:

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where 8.00 ml/min is the actual flow of the master pump



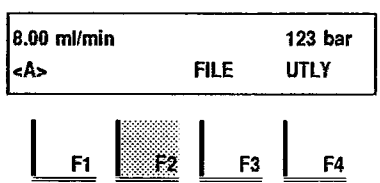
4.5.4. Flow generation file edit

4.5.4.1. File edit

The operation is similar to that of single mode flow, four types of file are possible (see table).

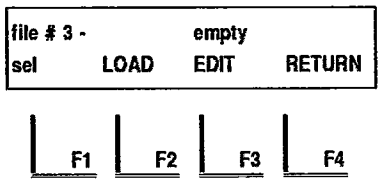
PUMP CONFIGURATION	TYPE OF OPERATION	TYPE OF FILE	NOTE
MASTER	AS FOR SINGLE CONF.		MASTER FILE FOR MASTER CONFIG.
	WITH TOTAL FLOW CONSTANT AND ELEMENTS COMPOSITION VARIABLE (*«%B»* GRADIENT) (BINARY GRADIENT)	3 RD	
	WITH CONSTANTS ELEMENTS COMPOSITION *«%B»* AND FLOW GRADIENT (BINARY GRADIENT)	4 TH	

It is not possible to insert the two types of gradient in a single file.

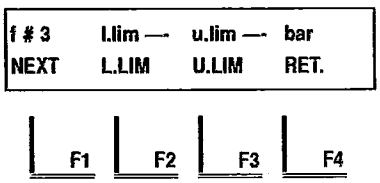


Press *«F3» (FILE)* and select an empty file.

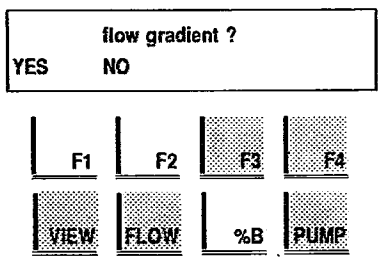
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Press *«F3» (EDIT)*; the header of the file is displayed:

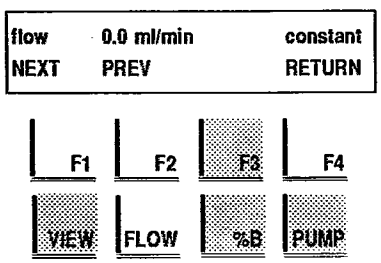


Edit the limits and press *«F1» (NEXT)*
the display asks the type of file to be edited:



If you press *«F1» (YES)* the file contains a flow gradient and the *«%B»* is fixed; if you press *«F2» (NO)* the gradient is in *«%B»* with the flow fixed.

Answering *«NO»* the display changes to:

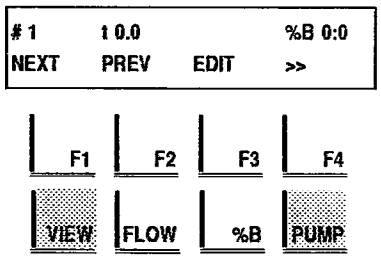


Pressing the key *«FLOW»* the user can give value to the flow; otherwise the flow will be equal to zero.

The key *«%B»* is not active in this picture.

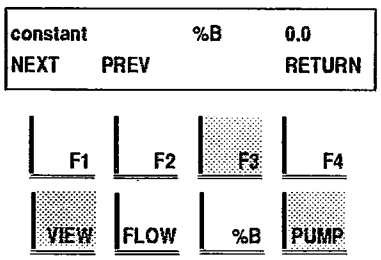
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Pressing *«F2» (PREV)* the user views again the pressure limits;
Pressing *«F1» (NEXT)* the views the first line of the file:



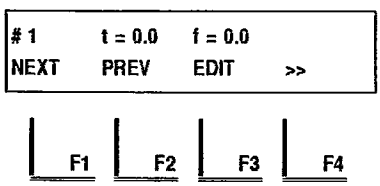
From now on *«%B»* is available while *«FLOW»* is not and the edit is equal to the one already descripted for single mode.

Answering *«YES»* the display will be:

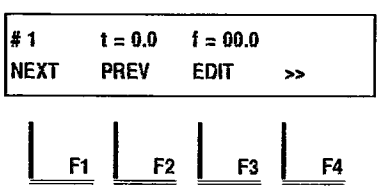


You can change *«%B»* with the key *«%B»* while *«FLOW»* key is not active.

Pressing *«F1» (NEXT)* starts the edit of the lines.



The edit of the line is mode using *«TIME»* and *«FLOW»*.



All other edit operations remain unchanged.

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4.5.5. Gradient run

Similar to single mode.

4.5.6. Edit while file is running

Similar to single mode.

4.6. OPERATION VIA RS-232

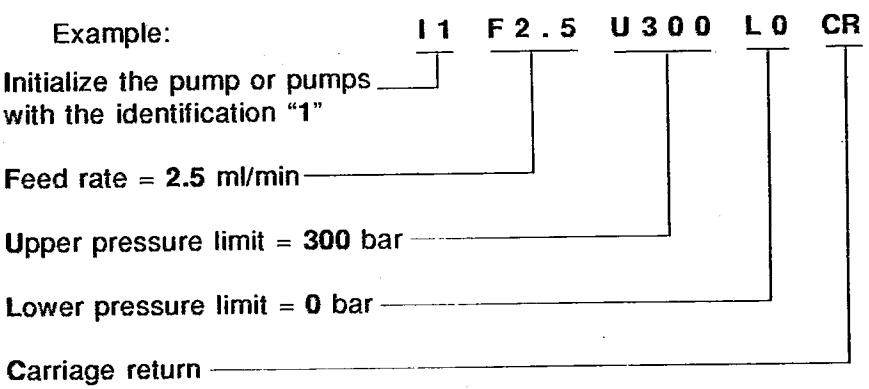
4.6.1. Technical data of RS-232

For signal layout on the connector see chapter 1.5.3.

Baud rate:	4800	Data bits:	7
Parity:	on, even (ANACOMP: odd)	Stop bits:	1

Data string

- A data string consists of maximum 50 characters (ASCII code) and is terminated with a CR (Carriage return).
- The first character always is a letter, it is followed by a number or a question mark when calling the parameter.
- Numbers may include a decimal point (no commas)
- Several parameters can be entered in a string.



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Trasmitting data to the pump

No control signals are necessary since the pump is always ready to receive.
A pause of at least 240 ms is required between two strings (CR to CR).

Transferring data to the computer

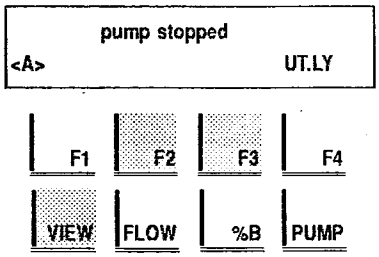
- Errors and error messages are sent directly. On the other hand the computer must call for parameters or status information.
- The pump gives an RTS signal out when it is ready, data output is executed when a CTS i received by the pump.

4.6.2. Initializing the pump stations

If a pump is initialized vis RS-232, then the key ***«FLOW»***, ***«%B»*** and ***«PUMP»*** are inactive.
The communication starts when a pump is initialized with code I1 ... I4.

Code I 0 (zero) sets manual operation.

When the pump receives the instruction to switch in remote operation it disables all the softkeys except ***«F4» (UTLY)*** the display becomes.



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4.6.3. Operating and checking of parameters

Remember that communication starts with an initializing code I1 ... I4.
The parameters are called up with a letter code followed by a question mark.
If an unknown sign or nanollowed data is received then an error message is given by the pump (see chapter 6).

Data acceptance

During standby data is immediately accepted.
During run mode, a new flow rate (F) or ramp (F, T) must be followed by "S1" before becoming effetive.

Instruction set

CODE	STATE, RANGE	DESCRIPTION
I	1,2,3,4	– Initializes pump A, B, C or D – Switches to computer control
I	0	– Switches to manual control
S	1	Starts the pump with the preset flow rate or sets the new flow rate (F) or ramp (F, T)
S	0	Stops the pump
F	* 0.010...20.0	Defines the flow rate in ml/min
T	0...9999	Defines the ramp time in 1/100 min
U	* 0...600	Defines the upper pressure limit in bar
L	* 0...600	Defines the lower pressure limit in bar
B	0	Stops the ramp time and the flow
B	1	Continuation with old parameters
B	2	Stops the ramp time and the flow rate (constant flow)
D	1	Selects display: Pressure, Flow
	2	Selects display: limits
P	0	Pressure zero adjustment (AUTOZERO see section 2)
* These ranges depend on the pump head in use.		

Ready check

If the pump receives the command.

OK?

it performs a check and answers

OK

if no errors are present

(NAK) XX

if an error is present, where XX is the error code.

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4.6.3. Operating and checking of parameters (cont.)

Each of the parameters F, T, U, L and B can be checked for its state or value. Just enter the code followed by a "?" (question mark).
In addition following states can be checked only:

CODE	POSSIBLE ANSWER	DESCRIPTION
P?	P0...600.0	System pressure in bar
H?	H0	No flow head is installed
	H1	Small flow head (micro flow) is installed
	H2	Medium flow head (analytical)is installed
	H3	Large flow head (semi prep.) is installed
R?	R0	Pump is in standby state
	R1	Pump is normal running
	R2	Pump is running a ramp
J	...	Instruction for gradient former
(NAK)		Data string invalid
Y?	Y1	Pump in bar
	Y2	Pump in psi
	Y3	Pump in MPa

4.6.4. Ramp preset for gradient

Example:

- Dual gradient flow rate 2 ml/min
- Gradient in 5 min from 5% A to 20%A.

Presetting:

Pump A runs with 0.1 ml/min (5%)
Pump B runs with 1.9 ml/min (95%).

Ramp programming:

The end value of the flow rate and the time for ramping must be programmed for each pump.

Pump A to 20% in 5 min: **I 1 F. 4 T 5 0 0 CR**

Pump B to 80% in 5 min: **I 2 F 1 . 6 T 5 0 0 CR**

Both pumps are still running with the preset flow rate.

Starting the ramp:

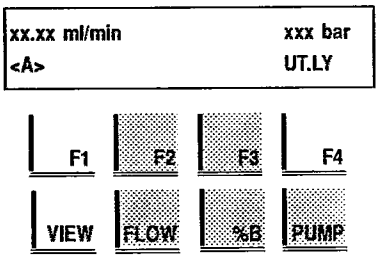
Enter the start instruction: **S 1 CR**

Both pumps A and B will start ramping.
Pump A will reach .4 ml/min, pump B 1.6 ml/min, in 5 min and stay at these flow rates.

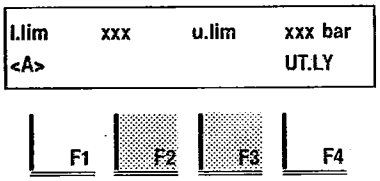
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4.6.5. Display operation during remote

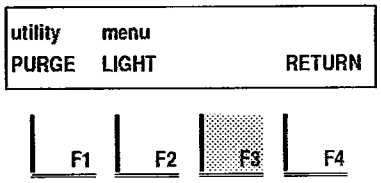
When the pump starts the operation the display switches to:



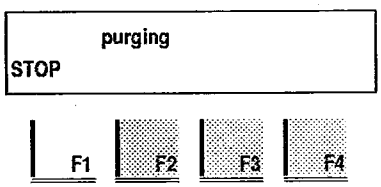
«VIEW», pressing it is possible to scroll the other values:



«F4» (UTLY), pressing it the display changes to



the key *«F1» (PURGE)* is used to purge the pump, pressing *«F1» (PURGE)* the display becomes



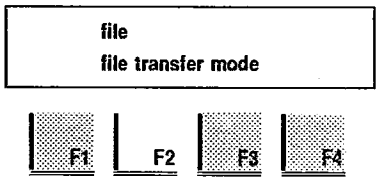
Pressing *«F1» (STOP)* the display returns to the previous pressing *«F2» (LIGHT)* changes the back illumination of LCD;
pressing *«F4» (RETURN)* the display returns to main display.

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4.6.6. File transfer

It is possible to program the files of the pump (except master file) using RS232 commands, at the same time it is possible to read a programmed file and store it in a computer.

If the command "I6" is received by the pump, it passes in the "File transfer mode", the display becomes.



4.6.6.1. Trasmission of a file

After the initialization command the file must be transmitted using a fixed protocol based on the acknowledge character (ACK = hex 06).

The host sends a line, the pump reads it, and if no errors are detected sends back the ACK character so the host can continue with the transmission:

the transmission sequence must be

Sn ↵ (n = number of the file); file number

Cxy - Lnnn - Ummm - Naaa ↵ ; file header

TO Vbbb ↵ ; 1^{RT} line of the file

Tc.c. Vbbb ↵ ; n^{th} line of the file

Tc.c E ↵ ; last line of the file

where X = head type
1. small
2. medium
3. large

where Y = file type
1. flow gradient
2. %B gradient

Lnnn = lower pressure limit (unit of measure of the pump)

Ummm = upper pressure limit (unit of measure of the pump)

Naaa = fixed parameter
(flow for %B gradient file)
(%B for flow gradient file)

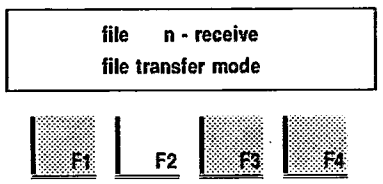
Vbbb = variable parameter of the file
(flow for flow gradient file)
(%B for %B gradient file)

Tc.c time in minutes

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Decimal point position depends on pump unit measure and head type.

During file transmission the display becomes.



4.6.6.2. Extraction of a file

After the initialization command the file is extracted using the:

"Xn" command where n = number of the file

If n is present the pump answers with the header of the file

Cxy Lnnn Ummm Naaa ↵

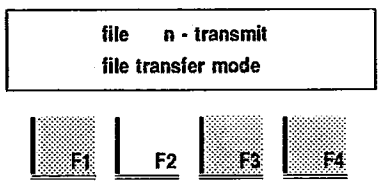
and waits for the acknowledge of the host when the host sends an ACK the pump continues with the first line of the file with the same mechanism:

with the same protocol all the lines of the file are transmitted.

At the end of the file the last line is transmitted
Tc.c. E ↵

when the host sends ACK, and the file is finished, the pump sends back another ACK to indicate the end of transmission.

During file extraction the display becomes.



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5.2. REPLACEMENT OF THE PISTON SEAL

- Disassemble the pump head (see chapter 3.5.1) and place face down. Pull the pistons (**1**, Figure 5-3) straight out without scratching them and place them on a soft towel (slight rotation of the piston rod may be required).
- Unscrew the connections (**2** + **3**) and remove them.
- Unscrew the 3 hex. screws (**5**) and remove the support plate (**4**).
- Hold the piston guide bush (**6**) by the rinse nipples and pull it out.
- Carefully remove the PTFE seal (**7**) using tweezers.
- Fill the ceramic chamber with IPA or methanol, block the inlet and outlet holes with your thumb and forefinger; the old piston seal will pop out by forcing the piston seating tool rod into the chamber.

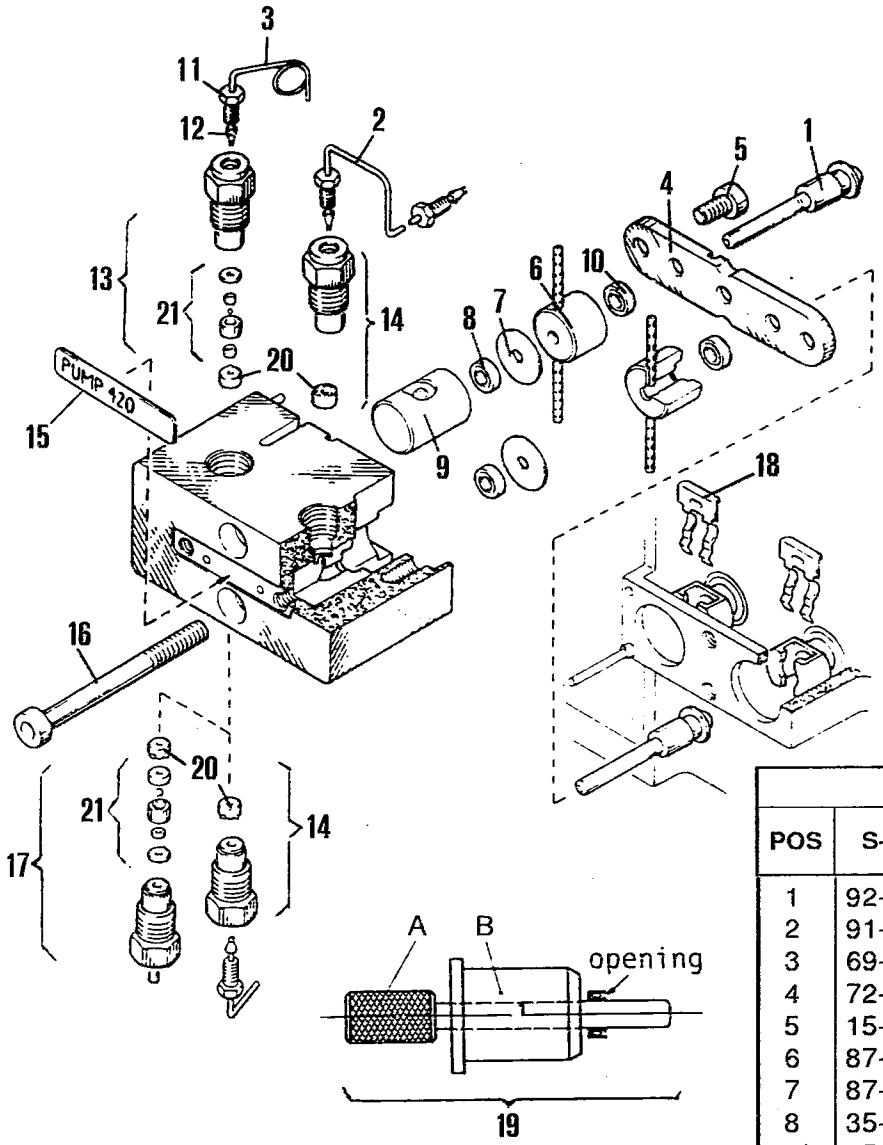
NOTE: THE OLD SEAL IS NOT REUSABLE.

- Slide the new seal (with the opening outside) over the shaft of the mounting tool.
- Plug the tool with the seal into the ceramic cylinder (**9**).
- Hold plunger (**A**), and with slide ring (**B**) press the seal all the way into the ceramic cylinder (**9**), until it stands only about 1 mm fore.
- Hold slide ring (**B**) and pull the plunger (**A**) out, then remove slide ring (**B**).
- Mount the PTFE seal (**7**), replace it if damaged.
- Insert the piston guide bush, (**6**) but do not push in yet. The flushing seal (**10**) should be visible at the back of the pump head.
- Replace the support piece (**4**) in position so that its groove matches the groove in the pump head.
- Clean and inspect the sapphire pistons (**1**) to make sure they are not faintly scratched.

NOTE: SCRATCHED PISTONS WILL DESTROY THE NEW SEALS.

- Fill the piston holes and wet the piston rod with 100 % methanol. Carefully insert pistons (**1**) with slight rotation until approximately 6 mm of the sapphire shows above the surface of the support plate (**4**).
- Let the pistons and the guide bushes adjust in their seat by moving them up and down, to avoid any possible misalignment.
- Replace the three hex. screws (**5**) and begin to tighten each screw a small amount, alternating between them until fully seated.
- Connect the capillaries (**2** + **3**).
- Mount the pump head (see description in chapter 3.5.1.)

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Part No			
POS	S-HEAD	M-HEAD * (91-00659)	L-HEAD
1	92-00832	92-00833	92-00834
2	91-00524	91-91028	91-00524
3	69-00045	69-90009	69-00045
4	72-00423	72-00424	72-00425
5	15-62202	15-62202	15-62202
6	87-00687	87-00688	87-00689
7	87-00692	87-00692	87-00699
8	35-99003	35-99001	35-99004
8*	35-30023	35-30024	35-30025
9	71-00918	71-00919	71-00920
10	35-30020	35-30016	35-30018
11	30-50048	30-50048	30-50048
12	30-50047	30-50047	30-50047
13	92-90008	92-90008	92-90002
14	92-90009	92.90009	92-90009
15	79-00682	79-00683	79-00684
16	15-62252	15-62252	15-62252
17	92-90007	92-90007	92-90003
18	70-00206	70-00206	70-00206
19	91-00518	91-00519	91-00520
20	87-00704	87-00704	87-00704
21	92-90014	92-90014	92-90012

M-HEAD *:
Part numbers for "Inert pump head" are included in the instruction of the kit.

8 *:
These seals are recommended for mobile phases with a high water compound.
After a seal change first use an organic solution like: Methanol, IPA, THF etc., there after you may use water.

Fig. 5-3

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5.3. REPLACEMENT OF THE VALVE CARTRIDGE

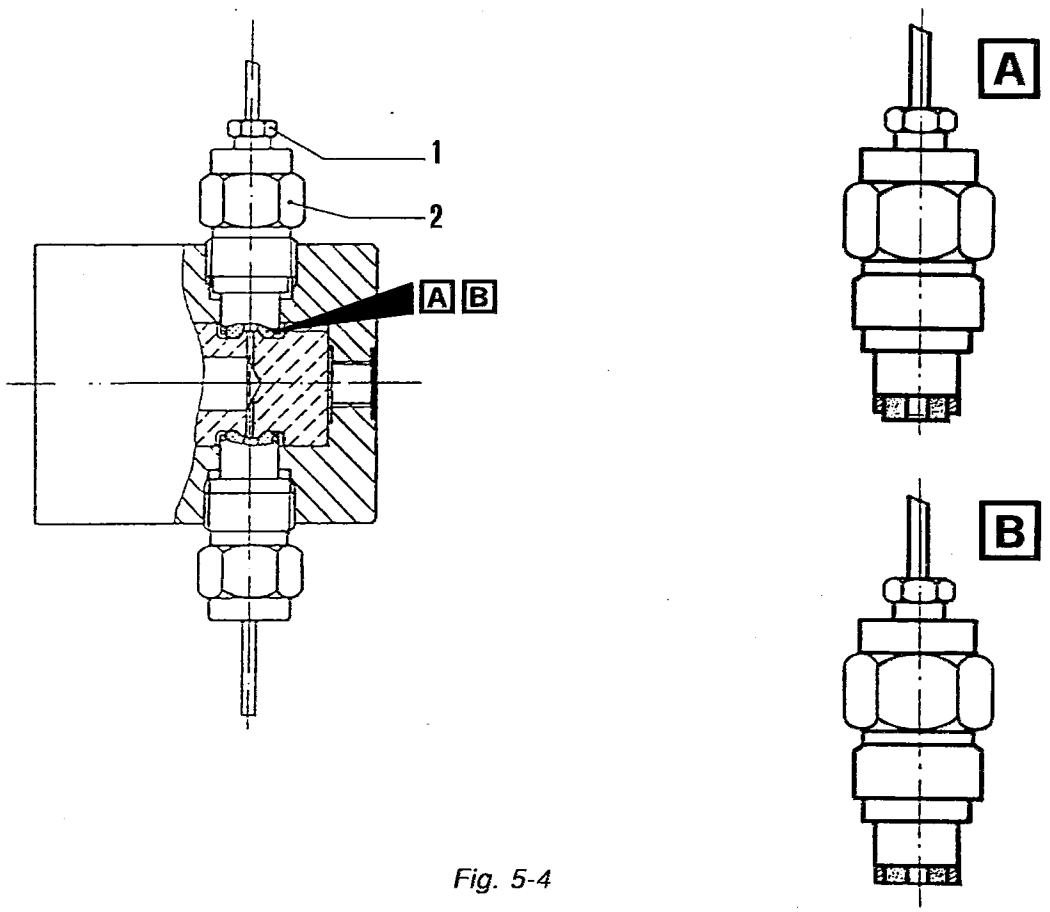


Fig. 5-4

- Switch off the power to the instrument.
- Loosen the capillary tube nut (**1**, figure 5-4).
- Unscrew and remove the valve (**2**).

Mounting of the cartridges:

a. Mounting a **new** cartridge or a cartridge with a **new** seal (detail A)
   - Insert the cartridge into the pump head.
   - Screw in the valve body (**2**) finger-tight.
   - With a spanner add 1-full turn (approx. 80 cmkp).

b. Mounting a cartridge with **used** seal.
   - With the spanner add only 1/4-turn instead of 1 turn, otherwise proceed as above.

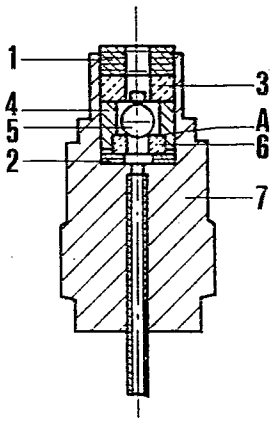
c. A cartridge with a worn out seal (detail B) must be replaced. It can be reworked in the factory.

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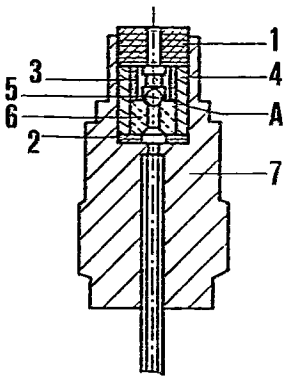
5.4. CLEANING OF THE VALVES

- Rinse dirty valve cartridges with detergent
  Attention: Ultra sonic bath may be used, **but not longer than 1 min,** as it may damage the valve balls and ball seats.
- If a valve cannot be cleaned or is leaking, the cartridge must be replaced or exchanged.

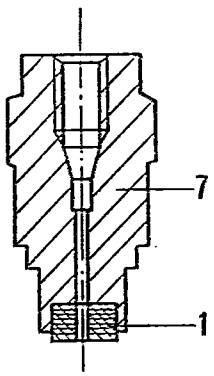
  Valve assemblies (see figure 5-5):



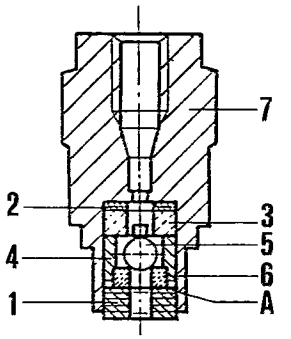
Inlet valve L-head



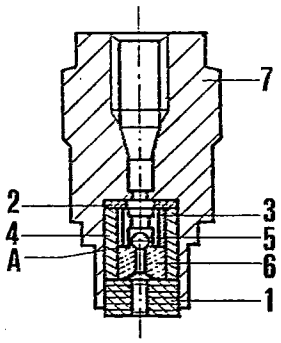
Inlet valve S, M-head



Bind valve
S, M, L-head



Outlet valve



L-head Outlet valve S, M-head

Pos.	Description	
A	Shiny side of seal	
1	Seal Teflon compound (black)	87-00704
2	Seal Teflon compound (black)	87-00700
3	Ball guide	
4	Spacer (steel)	
5	Valve ball	
6	Valve seal	
7	Valve body	

Fig. 5-5

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6. TROUBLESHOOTING

6.1. ERROR MESSAGES

All error messages are, after detection, immediately output to the RS 232-interface and the display.
The following codes are used:

Display	RS-232 "NAK"=(15H)	Trouble area	Action to be taken
EPROM checksum error 01	"NAK"-01	Check sum of EPROMs	Call Service.
Memory error error 02	- 02	RAM test	Call Service.
—	- 03	RS-Data transmission (Parity, Baudrate, Stop bit)	Check configuration on Master.
—	- 04	RS-Data string longer than 50 characters	Shorten the data string.
Short power failure error 05	- 05	Short power fail	Pump keeps running. Reset with "CLEAR"-key (is for information only).
—	- 06	RS-Data not acceptable	Input correct code or range.
—	- 07	Pressure limits wrong	Correct values.
Mains frequency error error 08	- 08	Mains frequency out of range (50/60 Hz)	Check power connections to the unit.
Error XX on slave pump error 10	—	Error on slave pump	Check slave pump.
Slave head incompatible error 11	—	Slave with head type different from master	Change heads.
Communication error error 12	—	Different RS-232 characteristics of slave pump	Check baud rate, connections of pumps.
Press too low xx bar error 21	- 21	Pressure is lower than the programmed limit	Check programmed limit value. Check fluid system. Clear error message with "CLEAR" key.
Press too high xx bar error 22	- 22	Pressure is higher than the programmed limit	Check programmed limit value. Check fluid system, may be clogged. Clear error message with "CLEAR" key.

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Display	RS-232 "NAK"=(15H)	Trouble area	Action to be taken
Pressure adjust failure error 23	- 23	Pressure sensor adjustment not functioning	Release pressure on the sensor completely. Make a new pressure sensor adjustment. If no success, call Service.
Pump head missing error 24	- 24	Pump head missing or detection defective	Mount the pump head and switch on the pump. If no success, call Service.
Motor regulation failure error 25	- 25	Motor speed regulation not functioning (e.g. stalled motor)	Restart pump with the "PUMP" key. If it occurs often, call Service.
Speed measure failed error 26	- 26	Motor speed not measurable	Call Service.
Battery failure error 30	—	Battery discharged	Restart pump. Call Service.
File corrupted error 31	—	Battery discharged	Restart pump. Call Service.

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7. OPTIONS AND ACCESSORIES

7.1. PUMP HEAD S

Flow range: 0.01 ... 2 ml/min

Pressure range: 0 ... 600 bar

Cycle volume: 24 ul (Pump piston)

7.2. PUMP HEAD M

Flow range: 0.05 ... 10 ml/min

Pressure range: 0 ... 400 bar

Cycle volume: 107 ul

7.3. PUMP HEAD L

Flow range: 0.15 ... 20 ml/min

Pressure range: 0 ... 200 bar

Cycle volume: 190 ul

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7.4. PURGE VALVE INSTALLATION KIT

This kit contains the necessary mounting material and capillaries for the installation of a purge valve.

7.5. INERT PUMP KIT

Flow range: 0.05 ... 10 ml/min

Pressure range: 0 ... 400 bar

Cycle volume: 107 ul