FIXED FLOW REGULATOR

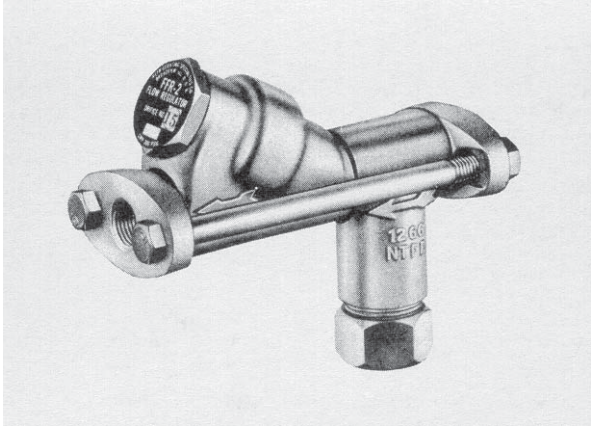
Type FFR-2

FOR LIQUID RECIRCULATION SYSTEMS (LIQUID OVERFEED)

FEATURES

- **Eliminates System Balancing**
- **Overcomes Flow Fluctuations**
- **Compact**
- **Rugged**
- **Simple: One Moving Part**
- **Nine Capacities**
- **Cleanable in Line**
- **Flanged Ends**
- **U.S. Pat. No. 3,741,242**
- **Design Pressure (MRP): 27.6 bar (400 psig)**

BULLETIN 41-15B
Type FFR-2



October 2006
Installation, Service and Parts Information

Description

This precision built, heavy duty, Fixed Flow Regulator is used as a liquid flow control device for Liquid Recirculation Systems. The Regulator establishes and maintains a constant flow rate determined only by the selected orifice number and independent of initial pressure drop or changes in the inlet or outlet pressure.

Selection

By proper orifice selection an appropriate Fixed Flow Regulator can be chosen to maintain constant liquid flow at any one of nine different levels, from 0.24 gpm to 4.8 gpm of ammonia at pressure drops from 5 psi to 50 psi. This is equivalent to a refrigeration effect range from 5.0 tons to 80 tons at a recirculation rate of 1:1 (no overfeed) or 1.7 tons to 27 tons at a recirculation rate of 3:1 (200% overfeed).

To select the proper orifice multiply the evaporator load by the recirculation rate desired and choose the orifice with the rating closest to the calculated rating. Choosing an orifice with a lower number will decrease the recirculation rate, one with a higher number will increase it. For example: 7 tons evaporator with recirculation rate of 4 equals 4x7 or 28 tons. Choose orifice No. 30 (nominal 30 tons).

Two or more FFR-2 Regulators may be installed in parallel to obtain capacities greater than available from one. The total capacity delivered will be equal to the sum of capacities of each regulator. For example: 25 ton load and 3 times recirculation equals 3x25 or 75 tons. A regulator with No. 60 orifice and another in parallel with No. 15 orifice would have a combined capacity of 60 + 15 or 75 tons.

The table also allows selections of orifices based on volumetric flow. Determine the liters/min (gpm) required and select the orifice number closest to the requirements.

Solenoid valves, hand valves or strainers placed upstream of the FFR-2 Regulators must be properly sized to give a low pressure drop that will not cause flashing. The FFR regulators must have 100% subcooled liquid refrigerant at the inlet with no flash gas present in order to give proper liquid flow control.

Capacity

These regulators will control within about plus or minus 5% of the capacity shown when the pressure drop is 0.7 bar (10 psi). At lower pressure drops the actual capacity will be slightly lower than shown; at higher pressure drops, the actual capacity will be slightly higher than shown. This difference is less for larger orifice numbers than for smaller. The maximum deviation could be as much as 20%. Except for small orifice numbers or higher pressure drops, the difference between actual flow and rating is likely to be less than 10%. For the evaporators of most recirculation systems, the accuracy of this device is more than adequate to provide outstanding performance.

FFR-2 regulators have the following nominal flow capacities for pressure drops from .35 to 3.5 bar (5 to 50 psi).

CAPACITY TABLE

Orifice Number	gpm	l/min.	Equiv. Tons R-717	Equiv. KW
4	0.24	0.9	4	14.0
6	0.36	1.4	6	21.0
10	0.6	2.3	10	34.9
15	0.9	3.4	15	52.4
20	1.2	4.5	20	69.9
30	1.8	6.8	30	105
40	2.4	9.0	40	140
60	3.6	13.6	60	210
80	4.8	18.0	80	279

*For R-717 liquid density of 42 lb./ft.^{3} or 0.70 gr/cc. To convert flow capacities to R-12, 22 or 502, multiply KW (tons) for R-717 by these factors: R-12 = 0.18, R-22 = 0.23, R-502 = 0.18

The precision of control required for typical systems makes corrections for density at other temperatures unnecessary.

FFR-2 Regulators are available with 1/2" or 3/4" size FPT, socket weld, or weld neck connections. 3/4" is standard, specify flange style and whether the optional close-coupled strainer is desired.

Principles of Operation

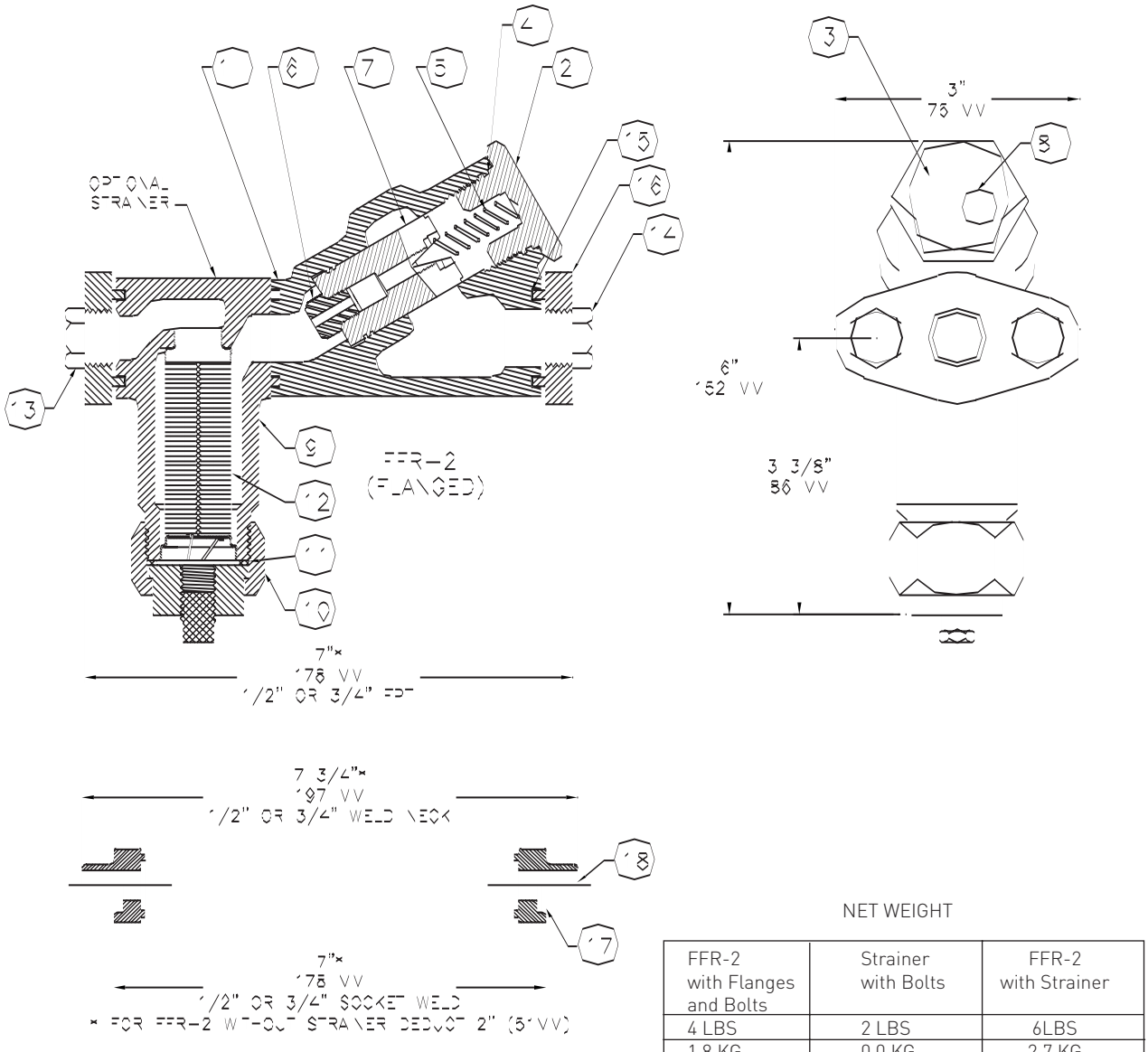
These are fixed flow regulators. Once a regulator with a given orifice number is installed, it will maintain its rated ammonia liquid flow nearly constant, despite fluctuations in the liquid line (inlet) or evaporator (outlet) pressures.

Starting with no flow Piston #7 V port is held wide open by Spring #5. When the flow starts, a pressure drop is established across orifice #6 and creates a larger pressure difference across Piston #7 from Port "P" to Port "R". The Piston is moved upward which causes a reduction in opening of the "V-Port" part of the piston. This opening size is automatically varied to balance the Spring #5 force on top of the Piston, which results in constant pressure drop from Port "P" to Space "R". Thus the orifice area and the pressure drop across the orifice is constant, thereby providing constant flow of liquid to the evaporator. This flow is determined only by the orifice number (size).

Selecting a Constant Flow Regulator FFR-2 or AFR-3 Which Type?

The FFR-2 Fixed Flow Regulator provides an economical means of maintaining constant flow by the selection of an orifice number. The flow rate of the regulator is determined by the orifice number and can be changed only by changing the orifice. The AFR-3 Automatic Flow Regulator (see Bulletin 41 -10A) provides for external adjustment of the flow rate and should be used where the desired flow rate cannot be predetermined, or where it is desired to have all Flow Regulators identical so it is not necessary to use a specific capacity flow regulator for each location.

The FFR-2 does not provide a check valve feature and will permit flow in the opposite direction; therefore, for hot gas defrost applications, or any other application where the pressure in the evaporator may occasionally exceed the pressure in the low pressure liquid line, a check valve must be installed upstream of the FFR-2. The AFR-3 has such a check valve built in.



NET WEIGHT

FFR-2 with Flanges and Bolts	Strainer with Bolts	FFR-2 with Strainer
4 LBS	2 LBS	6LBS
1.8 KG	0.0 KG	2.7 KG

Replacement Parts Kits

	Item No.		Description and Contents		
FFR-2	All		Plug Kit, Metering		201185
		7	Plug, Metering	1	
		5	Spring, Comp	1	
		4	O-Ring	1	
FFR-2	4		Plug Kit, Orifice		201186
		6	Plug, Orifice	1	
		4	O-Ring	1	
FFR-2	6		Plug Kit,Orifice		201187
		6	Plug, Orifice	1	
		4	O-Ring	1	
FFR-2	10		Plug Kit, Orifice		201188
		6	Plug, Orifice	1	
		4	O-Ring	1	
FFR-2	15		Plug Kit, Orifice		201189
		6	Plug, Orifice	1	
		4	O-Ring	1	
FFR-2	20		Plug Kit, Orifice		201190
		6	Plug, Orifice	1	
		4	O-Ring	1	
FFR-2	30		Plug Kit, Orifice		201191
		6	Plug, Orifice	1	
		4	O-Ring	1	
FFR-2	40		Plug Kit, Orifice		201192
		6	Plug, Orifice	1	
		4	O-Ring	1	
FFR-2	60		Plug Kit, Orifice		201193
		6	Plug, Orifice	1	
		4	O-Ring	1	
FFR-2	All	15	Gasket, Flange	12	202078

Installation

Be sure that. the correct FFR regulator with the proper orifice number as shown on the nameplate has been chosen for the particular evaporator. Check the piping drawings or evaporator flow regulator schedule for this information.

Protect the inside of the regulator from dirt and chips during installation. Do not remove the protective coverings from inlet and outlet connections until the regulator is ready to be installed. Normally the regulator should be installed.in a horizontal line, with the cap upward. The arrow on the body must always point in the direction of flow for the regulator to function properly. It is advisable to install companion strainer ahead of the FFR-2 as a protection against dirt and chips.

NOTE: Allow at least 2-1/2" of clearance above the #2 valve body cap for removal of Cap and internal parts without having to remove the regulator from the line. Where a RSF companion strainer is used, allow at least 3" below the strainer for removal of the screen.

Specifications

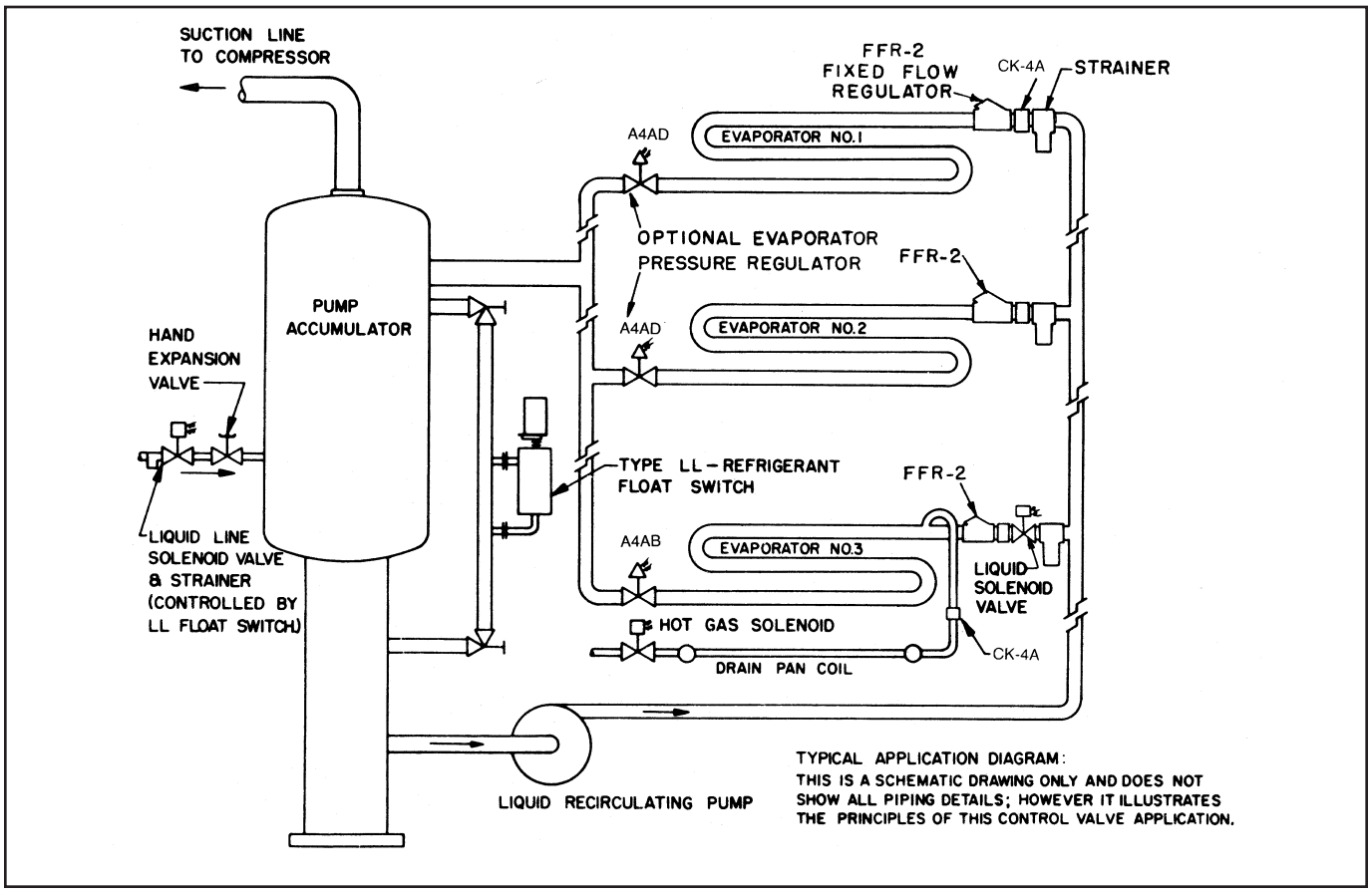
Safe working pressure: 21 bar (300 psi)

Pressure drop range: 0.35 to 3.5 bar (5 to 50 psi)

Higher pressure drops up to 300 psi will not harm the regulator but can cause poor flow control.

Minimum refrigerant temperature: - 40°C (- 40°F)
Maximum refrigerant temperature: 38°C (100°F)

Materials: Body: ASTM 126 Class B cast iron
Piston: stainless steel
Flow Orifice: steel
Spring: stainless steel
Valve Body Cap: steel
"O" Ring: synthetic rubber.



Service Pointers

1. The FFR-2 can be disassembled and serviced by removing the Cap #2. The Spring #5 and Piston #7 together with the orifice # ' 6 can now be removed. To remove a stuck piston turn a 5/16-18 screw into the threaded hole at the V Port end of the piston and pull the piston out. Regulator performance depends on the smooth motion of the Piston. Make sure that both the piston and bore surfaces are smooth and clean before re-assembling. Apply a light film or refrigerant oil on the piston. Make sure that the piston moves freely during assembly. Before replacing the Cap #2 check the "0" ring #4 for any damage, if any nicks or tears show the "0" ring must be replaced. During re-assembly make sure that the Spring #5 is properly seated in the Piston and the Cap.

To remove the orifice hold the piston with a glove or piece of cloth and turn the orifice counter clockwise. If the orifice is too tight a piece of wood or plastic may be placed between the "V" to hold the piston. Do not use a wrench or a piece of metal to hold the piston, because the smooth outside diameter of the piston could be damaged. Replace the orifice in the same manner, turning it clockwise.

2. Too much flow:

   (a) DIRT or chips are causing Piston #7 to stick with V Port open. Disassemble and clean the regulator.

   (b) Orifice #6 too large. Check flow requirements. Replace with smaller orifice, if needed. Follow the assembly instructions in paragraph 1.

3. Too little flow:

   (a) Dirt has fouled the regulator causing Piston #7 to stick with V Port closed. See 2 (a) above.

   (b) Strainer screen is plugged. Remove the strainer cap, remove screen, clean and replace. The screen may be washed in a good solvent and dried. If air pressure is used to blow the screen dry, it must be directed into the screen basket, otherwise screen damage may occur. Check for excessive oil; at very low temperatures the oil could stiffen sufficiently to clog the screen.

   (c) Regulator is not receiving 100% liquid ammonia. Regulator must have liquid with no flash gas present at inlet or its capacity will be reduced. Examine the line ahead of regulator for restrictions that may cause excessive pressure drop. If solenoid valve or hand valve is used ahead of FFR-2 Regulator, be sure these are fully open to liquid flow and that strainers are not plugged with dirt or oil. Upstream liquid line and valves should be sized to furnish liquid with adequate subcooling at inlet of FFR-2 Regulator.

   (d) Orifice #6 too small. Check flow requirements. Replace with larger orifice, if needed. Follow assembly instructions in paragraph 1.

4. Erratic flow.

   (a) Dirt has fouled the regulator. See 2 (a) above.

   (b) Piston #2 has become worn or eroded. Replace with new piston. Follow assembly instructions in paragraph 1.

The FFR-2 and its close coupled strainer are easily removed for cleaning or repairing without disturbing threaded or welded joints. To remove the regulator loosen the flange bolts and spread the flanges slightly apart.

Warranty

All Refrigerating Specialties Products are warranted against defect in workmanship and materials for a period of one year from date of shipment from factory. This warranty is in force only when products are properly installed, field assembled, maintained and operated in use and service as specifically stated in Refrigerating Specialties Catalogs or Bulletin for normal refrigeration applications, unless otherwise approved in writing by Refrigerating Specialties Division. Defective products, or parts thereof, returned to the factory with transportation charges prepaid and found to be defective by factory inspection will be replaced or repaired at Refrigerating Specialties' option, free of charge, F.O.B. factory. Warranty does not cover products which have been altered or repaired in the field, damaged in transit, or have suffered accidents, misuse, or abuse. Products disabled by dirt, or other foreign substances will not be considered defective.

THE EXPRESS WARRANTY SET FORTH ABOVE CONSTITUTES THE ONLY WARRANTY APPLICABLE TO REFRIGERATING SPECIALTIES PRODUCTS, AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, WRITTEN OR ORAL, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. No employee, agent, dealer or other person is authorized to give any warranties on behalf of Refrigerating Specialties, nor to assume, for Refrigerating Specialties, any other liability in connection with any of its products.

Safe Operation (See also Bulletin RSBcv)

People doing any work on a refrigeration system must be qualified and completely familiar with the system and the Refrigerating Specialties Division Products involved, or all other precautions will be meaningless. This includes reading and understanding pertinent Refrigerating Specialties Division Product Bulletins, and Safety Bulletin RSB prior to installation or servicing work.

Where cold refrigerant liquid lines are used, it is necessary that certain precautions be taken to avoid damage which could result from liquid expansion. Temperature increase in a piping section full of solid liquid will cause high pressure due to the expanding liquid which can possibly rupture a gasket, pipe or valve. All hand valves isolating such sections should be marked, warning against accidental closing, and must not be closed until the liquid is removed. Check valves must never be installed upstream of solenoid valves, or regulators with electric shut-off, nor should hand valves upstream of solenoid valves or downstream of check valves be closed until the liquid has been removed. It is advisable to properly install relief devices in any section where liquid expansion could take place.

Avoid all piping or control arrangements which might produce thermal or pressure shock.

For the protection of people and products, all refrigerant must be removed from the section to be worked on before a valve, strainer, or other device is opened or removed.

Flanges with ODS connections are not suitable for ammonia service.