(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
31 July 2008 (31.07.2008)

(51) International Patent Classification:
F24D 19/00 (2006.01) F24D 3/10 (2006.01)

(21) International Application Number:
PCT/IT2008/000029

(22) International Filing Date: 21 January 2008 (21.01.2008)

(25) Filing Language: Italian

(26) Publication Language: English

(30) Priority Data:
MI2007A 000088 22 January 2007 (22.01.2007) IT

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(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, [Continued on next page]

(54) Title: AUTOMATIC FILLING UNIT FOR HYDRAULIC SYSTEMS WITH A CLOSED CIRCUIT LIKE HEATING SYSTEMS AND SIMILAR

(57) Abstract: An automatic filling unit (T) for hydraulic systems with a closed circuit, such as heating systems and the like, comprising an automatic filling valve (1) with an automatic opening/closing system (21a) with spring (21) that is antagonist to the pressure downstream housed in the body (20) of the valve (1), and comprising a direct path (2) of the water flow between the inlet fitting (23) and the outlet fitting (24) of the automatic filling valve (1) and a bypass conduit (11) interposed between said inlet fitting (23) and said outlet fitting (24) and housing an on-off valve (12), in which automatic filling unit (T) said bypass conduit (11) is obtained within the automatic filling unit (T), i.e. within the body (20) of the automatic filling valve (1).
NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:
— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(U))
— as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(Ui))
— of inventorship (Rule 4.17(iv))

Published:
— without international search report and to be republished upon receipt of that report
"Automatic filling unit for hydraulic systems with a closed circuit like heating systems and similar"

**Description of the Invention**

**Technical Field**
The present invention relates to an automatic filling unit for hydraulic systems with a closed circuits, like heating systems and similar, according to the preamble to claim 1.

**Background of the invention**
As is well known, closed circuit hydraulic systems, such as heating systems, air conditioning systems, heating/cooling systems, and the like, after their installation require to be filled with the necessary quantity of operating circulation water, whereas such filling is also necessary after any total or partial emptying of said systems, e.g. because the radiators are vented or the systems are modified. In the present application, the collective definition of "heating system(s)" means the various executions of closed circuit hydraulic systems, in order to avoid repetitions.

The automatic filling of heating systems occurs by means of known automatic filling valve units in various embodiments and constructed conceptually as shown schematically in figure 1, in which the automatic filling valve 1 of the valve unit T is inserted in a pipeline 2 connected at one side, through an upstream on-off valve 3, to a water inlet pipeline 4 and, at the other side, through a downstream on-off valve 5, to an inlet
pipeline 6 of the heating system, not shown. The valve 1 is provided with a calibration valve, which can generally be set, not shown herein, able to be controlled through a hand wheel 7 to select the predetermined filling pressure, which can be read on the pressure gauge 8. Said calibration spring, operatively associated to a on-off valve, not shown, forms an automatic system for opening/closing the direct path of the flow. The valve unit 1 also comprises a manual valve 9 as well as a filter, not shown, for retaining the impurities present in the passing flow of water. There is also a check valve, not shown, which prevents a reversal of the flow in case of a sudden pressure drop upstream.

The prior art also provides an external bypass conduit 11 comprising its own on-off valve 12, for a manual charging of the system in much shorter times. Moreover, a cock 13 is generally provided, which serves the purpose of reducing operating pressure or emptying the system.

From the outline description of the known automatic filling valve units, shown schematically in figure 1, it is apparent that they comprise the external bypass conduit 11 with its on-off valve, which therefore increase the size of the valve unit and thus require more construction/installation space.

**Summary of the Invention**

At the basis of the present invention is the task of providing an automatic filling valve unit that is free of the disadvantages of prior art automatic filling valve units.
This task is accomplished, according to the invention, by means of an automatic filling unit for heating systems, which has the features of claim 1. Additional advantageous developments of the invention are the subject of the dependent claims.

With the automatic filling unit according to the invention, several important advantageous are achieved. In the first place, the external bypass conduit with the related on-off valve present therein is eliminated. Indeed, the external bypass conduit, necessary for a rapid filling of the heating system, is advantageously provided inside the valve body of the filling unit, so that the known external bypass conduit is eliminated altogether, the size of the filling unit is reduced and the installation of the proposed filling unit is facilitated and made faster. The filling unit according to the invention also facilitates the stocking of the necessary installation components, because the union components and tubular sectors necessary for the construction of the known external bypass conduit are eliminated altogether.

With the incorporation of the bypass conduit within the body of the automatic filling valve, said body is enlarged by a negligible amount and said bypass conduit is obtained from the automatic shaving removal machining, slightly increased with respect to the machining already required to obtain the valve body, and with a wholly negligible lengthening of the machining time, so that, on one hand, production costs are obtained that are substantially similar to those expected for the production of the bodies of known automatic filling valves and, on the other hand, with the
elimination of the external bypass conduit, a considerable saving in material is obtained along with reduced installation times.

Brief description of the drawings
Additional advantages, details and characteristics of the automatic filling unit and valve according to the invention shall become more readily apparent from the following description of a preferred embodiment of an automatic filling unit and valve according to the invention described by way of example hereafter and illustrated in the drawings, in which:

figure 1 shows a front outline view of the automatic filling units of the prior art;
figure 2 shows a perspective view of the unit with automatic filling valve according to the invention, with separate filter cartridge-check valve; and
figures 3, 4 and 5 show, each, a longitudinal section of the assembled unit with automatic filling valve of figure 2, more specifically respectively during the manual loading operation (figure 3), during the automatic loading operation (figure 4), and while reaching the set pressure (figure 5).

Description of the preferred embodiment
With a prior art automatic filling unit and valve, shown in figure 1, the disadvantages mentioned in the introductory part are encountered.
Reference is now made to the unit T with automatic filling valve according to the invention, illustrated in figures 2 through 5, in which for parts shared with the known unit with automatic filling valve of figure 1, the same reference numbers are maintained.
More in detail, the automatic filling unit T comprises an automatic filling valve with a valve body 20, which houses a known opening/closing system
21a, which comprises a calibration spring 21, that is antagonist to the pressure $P$ downstream of the valve 1 and that acts on the membrane 22. The valve body 20 comprises an inlet fitting 23 and an outlet fitting 24 able to be connected, the first with the water inlet pipeline, not shown, through an on-off valve 25, and the second is connected, through an on-off valve 26, to the pipeline, not shown, for entering the heating system, not shown. The arrow F indicates the direction of the flow of the water into the heating system. In the valve body 20, between the unions 23 and 24 is housed a filter 27 for retaining impurities, as well as a check valve 28, to prevent reverse flow phenomena in the case of a sudden pressure drop upstream of the valve 1.

According to the invention, moreover, in the body 20 of the automatic filling valve 1 is provided an internal bypass path 11 derived from the inlet fitting 23 and ending in the outlet fitting 24, whereas on the inlet side of said bypass 11 is provided an on/off valve 12, whose shutter 29 is able to close the shut-off port 30 of said bypass conduit 11 on the inlet side. The hand-wheel for controlling the shutter 29 is designated with the reference number 31.

Figures 3-5 also show that the shutter 32 of the on-off valve co-operating with the calibration spring 21 and forming therewith the known opening/closing system 21a is able to close the seat 33 of said opening/closing system. In the valve body 20 is also housed, in known fashion, a gauge 8 for reading the downstream pressure $P$. 
Lastly, the valve body 20 has a union 34 with internal thread for housing the coupling thread 35 of a cartridge 36 housing, preferably coaxially, said filter 27 and said check valve 28 mentioned above. With the automatic filling unit T according to the invention, a rapid calibration of the filling pressure is advantageously possible and the presence of the known manual valve 9 of figure 1 is practically made superfluous. Moreover, it is easy to verify whether the calibration of the operating pressure, set by the manufacturer, is maintained, by means of the seal 7a positioned on the adjusting hand-wheel 7. Alternatively, it is possible to use valves that can be calibrated manually by acting on the related hand-wheel 7.

**Operation**

Similarly to the automatic filling units of the prior art, with the unit with automatic filling valve according to the invention, three operative steps can be defined, and more specifically:

**Step 1:** The empty heating system must be filled. In this step, the automatic shutter 32 is open, because the pressure \( P \) in the system to be filled is lower than the pressure set by means of the calibration spring 21, whereas to fill the heating system more rapidly, the bypass 11 is opened by opening the shutter 29 of the on-off valve 12. In this way, most of the water flow will pass through the bypass 11 as a result of the reduced head losses of said bypass conduit 11 relative to the head losses of the automatic system, i.e. within the valve 1. In this way, the heating system is filled quickly.

**Step 2:** the heating system is almost completely filled and the pressure in the heating system is close to the set pressure. At this point, acting on the
on-off valve 12, the bypass conduit 11 is closed to prevent the filling pressure from reaching the set pressure, which is reached solely by means of the automatic path that traverses the valve 1.

Step 3: in this step, the downstream pressure, i.e. the pressure in the heating system, becomes equal to the set pressure. After the heating system is filled, the automatic shutter 32 moves to the closed position on the seat 33 because the effect of the pressure P downstream of the valve 1 will overcome the force of the calibration spring 4 (and it will open in the opposite case).

If it is necessary to reduce the operating pressure, or to empty the heating system, this will be obtained in known fashion by opening the drain cock 13. If the system is emptied, for maintenance or modifications to the heating system in operation, or already filled with water, the new filling operation will take place as indicated above.

Housing the filter 27 and the check valve 35 in the cartridge 36 allows to rapidly remove said cartridge 36 and clean the filter, or to replace the check valve 28 even with the automatic filling valve 1 installed, after simply closing the two on-off valves 25 and 26, even with the heating system in operation.

From the above structural and functional description of a filling unit with automatic filling valve according to the invention, it is readily apparent that with said unit and valve, the indicated task is effectively accomplished and the aforementioned advantages are obtained.

Those skilled in the art may introduce modifications and variants with respect, for example, to the illustrated automatic opening/closing system, as
well as to the arrangement of other components, without thereby departing from the scope of protection of the automatic filling unit and valve according to the invention, as it is described, illustrated and claimed in the appended claims.
Claims

1. An automatic filling unit for hydraulic systems with a closed circuit, such as heating systems and the like, comprising an automatic filling valve with an automatic opening/closing system with spring that is antagonist to the pressure downstream, housed in the body of the automatic filling valve, which automatic filling unit has an inlet fitting to be connected to the water distribution pipeline, e.g. by means of an on-off valve, as well as an outlet fitting to be connected, e.g. through an on-off valve, to the inlet of the heating system, and comprising also a filter and a check valve interposed between the inlet fitting and the outlet fitting in a direct path of the flow between the inlet fitting and the outlet fitting, as well as a bypass conduit interposed between said inlet fitting and said outlet fitting and housing an on-off valve, and also with a possible gauge for reading the downstream pressure and drain cock, characterised in that said bypass path is obtained within the automatic filling unit, i.e. of the automatic filling valve body.

2. An automatic filling unit as claimed in claim 1, characterised in that in said bypass conduit the on-pff valve thereof is positioned in the branch of said bypass conduit upstream of the automatic opening/closing system of the automatic filling vale.

3. An automatic filling unit as claimed in claims 1 and 2, characterised in that, with the on-off valve of the bypass conduit closed, the filling flow between the inlet fitting and the outlet fitting takes place through the direct path of the flow provided for the automatic opening/closing system, whilst
with the on-off valve of the bypass conduit open, said filling flow occurs partially through the path of said automatic opening/closing system and, prevalently, through said bypass conduit.

4. Automatic filling unit as claimed in one or more of the claims 1 through 3, **characterised** in that the filter and the check valve provided downstream of the automatic opening/closing system are housed axially above each other in a cartridge that can be removable fastened to the body of the automatic filling valve.

5. An automatic filling unit as claimed in claim 4, **characterised** in that the cartridge, mounted in the body of the automatic filling valve, has an axis coaxial to the axis of the automatic opening/closing system.

6. An automatic filling system for hydraulic systems with a closed circuit, e.g. a heating system, **characterised** in that it comprises an automatic filling unit as claimed in one or more of the claims 1 through 5.