

Fig. 1

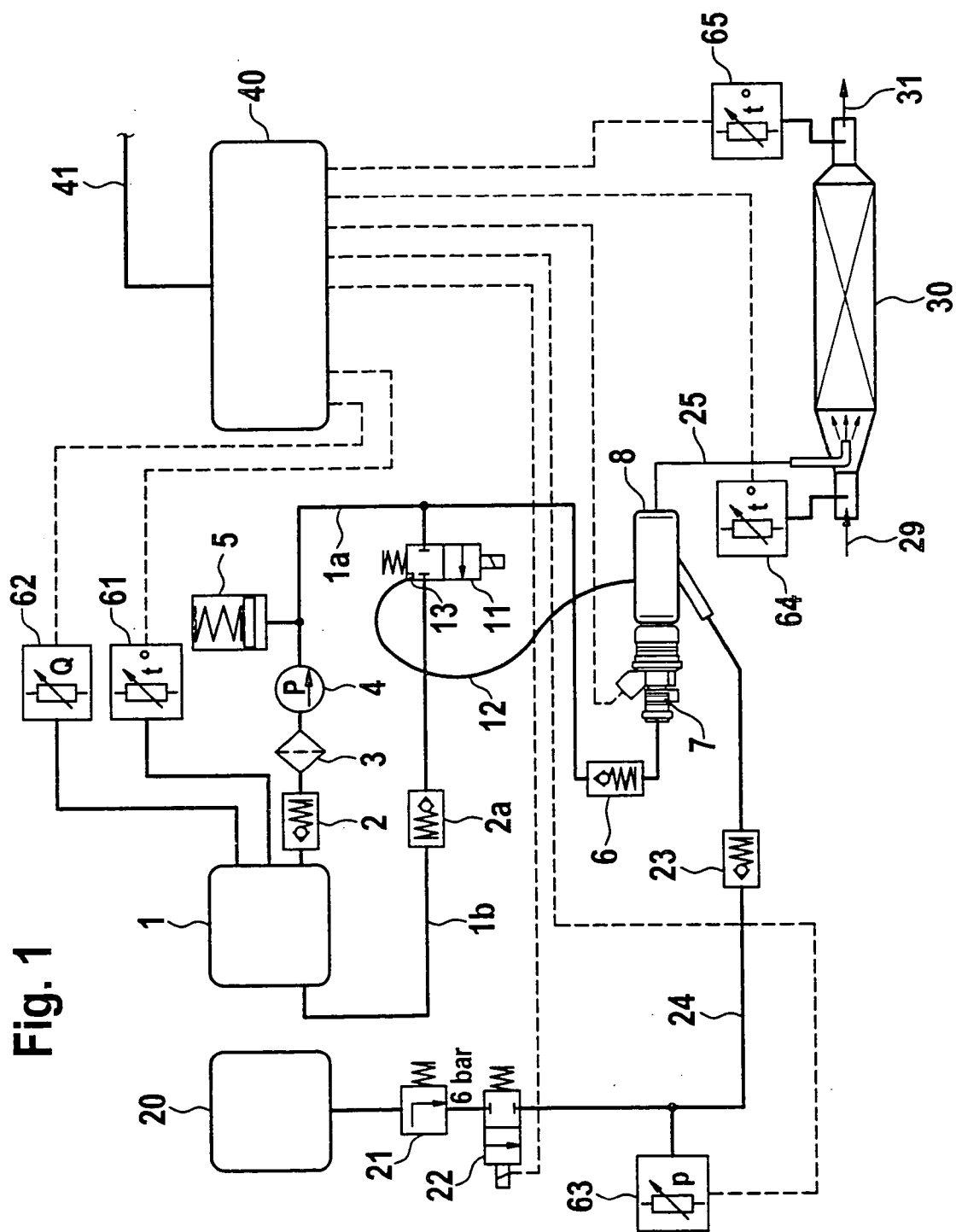


Fig. 2

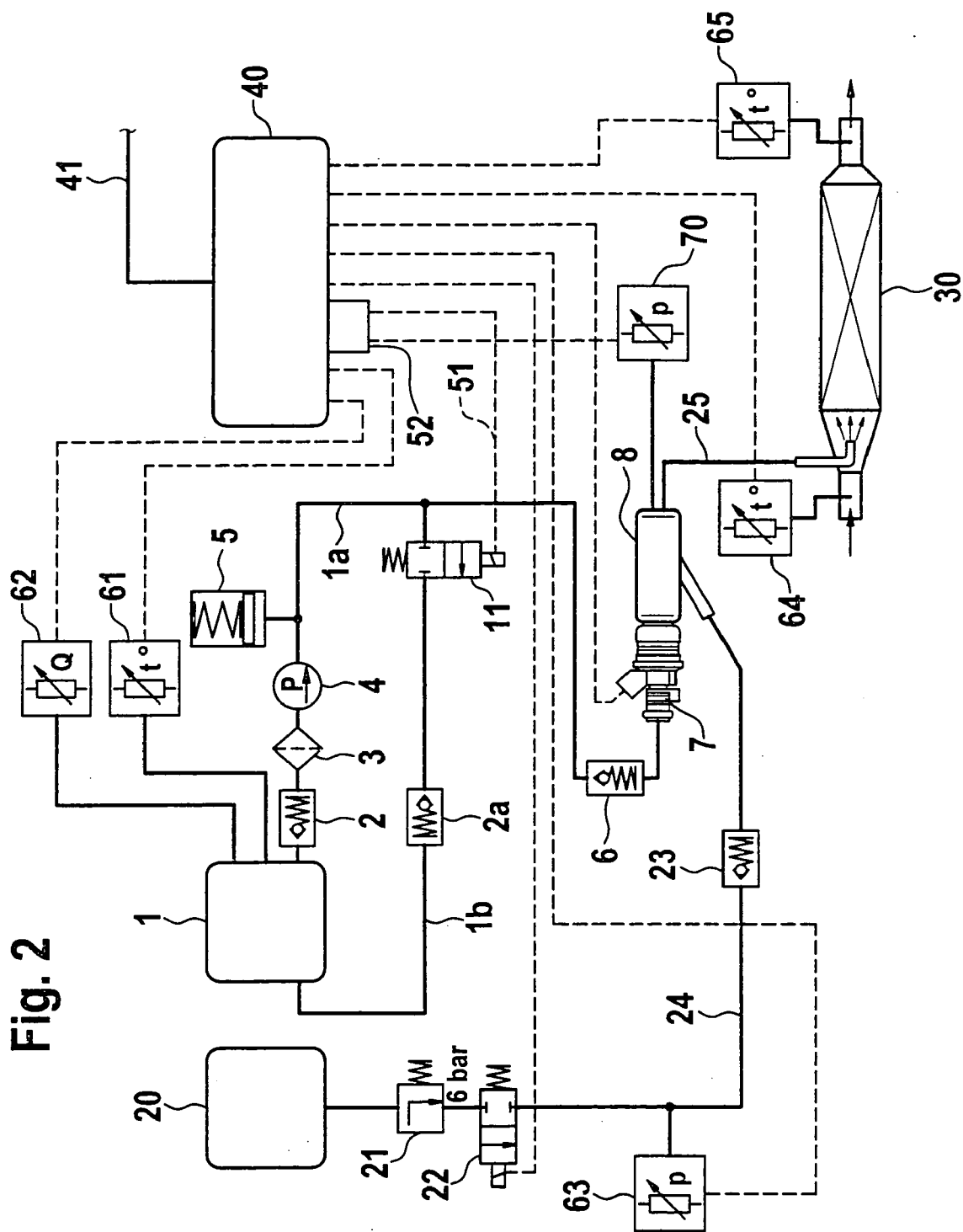
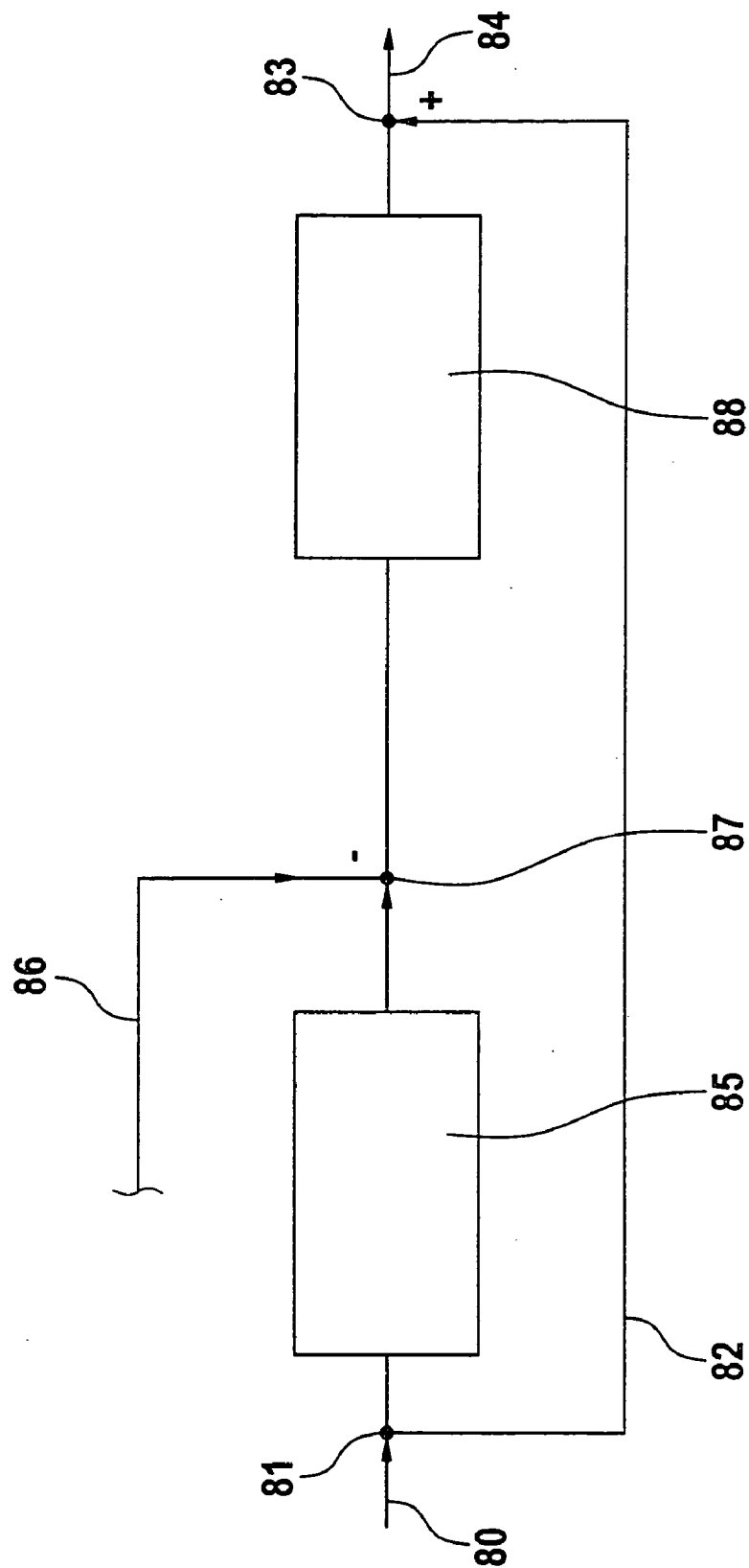


Fig. 3



DEVICE AND METHOD FOR METERING A REDUCTANT FOR ELIMINATING NITROGEN OXIDES FROM EXHAUST GASES

BACKGROUND INFORMATION

[0001] The present invention relates to a device and a method for metering a reducing agent, particularly of urea or a urea-water solution within the scope of a catalytic exhaust gas treatment, according to the species defined in the independent claims.

[0002] In order to achieve a reduction in NO_x components in exhaust gases, reduction catalysts were developed, particularly for Diesel engines, which are commonly subdivided into SCR catalysts (selective catalytic reduction) and storage catalysts. The so-called SCR catalysts reduce the nitrogen oxides by the use of a reducing agent, such as urea and/or ammonia, which is added to the exhaust gas, while the so-called storage catalysts are periodically regenerated, preferably using hydrocarbons of the internal combustion engine fuel that is carried along with it, in so-called exhaust gas rich phases.

[0003] From German Patent Application DE 199 47 198 a device is known which meters in urea as the reducing agent, to remove nitrogen oxides in exhaust gases, such as from a Diesel engine. The metering is performed via a valve which releases urea doses, which are determined by the electrical control of the metering valve, its throttling cross section and the pressure difference prevailing at the throttle valve. The pressure prevailing before the valve is measured and held constant within a tolerance range.

SUMMARY OF THE INVENTION

[0004] By contrast, the metering device according to the present invention and the method according to the present invention, having the characterizing features of the independent claims, have the advantage of making possible a compensation of manufacturing tolerances of the metering pipe and the metering line with respect to metering accuracy, of maintaining metering accuracy in the case of metering pipe outlet openings that are wearing and/or being stopped up, and of eliminating the influence of the exhaust gas counterpressure on the metering accuracy. Furthermore, no new plotting of a valve characteristic curve is required in the control unit, independently of the special design of the metering pipe and the metering line, so that time advantages come about in the application of the present invention.

[0005] Advantageous further refinements and improvements of the method and the metering device described in the independent claims are made possible by the measures described in the dependent claims.

[0006] It is particularly advantageous to set a constant pressure difference across the metering agent or rather, the metering valve, so that the difference in the pressure before and after the metering agent remains constant, independent of the metering quantity and independent of changing environmental conditions. Alternatively, in an advantageous manner, a constant pressure ratio across the metering agent or the metering valve can be set, so that the quotient of the reducing agent pressure upstream of the metering agent and the pressure downstream of the metering agent remains constant. This ensures a steady metering accuracy, so that

both an ammonia breakthrough as a result of overmetering and a loss in nitrogen oxide conversion as a result of undermetering are certainly able to be avoided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Exemplary embodiments of the present invention are shown in the drawings and explained in greater detail in the following description. The figures show:

[0008] FIG. 1 a metering system, connected together to a compressed air tank, a urea tank and a catalytic converter system, and

[0009] FIG. 2 a corresponding system having an alternative metering device.

[0010] FIG. 3 shows a control circuit diagram and

[0011] FIG. 4 shows another alternative metering device.

DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0012] In FIG. 1, 1 denotes a urea tank, from which a urea/water solution is conveyed, via a urea line 1a having a check valve 2 and a filter 3 designed as a filtering strainer, sucked in by a metering pump 4 that is controlled by the engine speed, and via a check valve 6 to a metering valve 7 of a mixing chamber 8. A quantity that is conveyed in excess is returned via a relief valve 11 and a return line 1b provided with a check valve 2a to the intake side of the pump. A relief valve is known, for example, from DE 198 05 070 C2. In FIG. 1 of DE 198 05 070 C2, such a valve is furnished with reference numeral 5 and is designated there as a diaphragm valve, since a diaphragm separates a first chamber conveying the fluid, whose pressure is to be controlled, from a second chamber having a spring. This spring presses on the diaphragm against an outlet opening that carries off excess quantities of fluid, which is situated in the first chamber. The second chamber (reference numeral 20 in DE 198 05 070 C2) is also able to have pressure applied to it via lines, so that the pressure that is to be set via the relief valve may be varied. This can be performed hydraulically, as described in DE 198 05 070 C2, or pneumatically. The connection of such a line to the relief valve is denoted in the present Application as pneumatic connection 13. To pneumatic connection 13 is connected a line 12, such as in the form of a hose, whose other end is connected to mixing chamber 8, so that relief valve 11 is able to control the pressure of the urea/water solution in line 1a as a function of the pressure in the mixing chamber. Between relief valve 11 and metering pump 4, a pressure damper or pulsation damper 5 is connected to line 1a. From an air pressure container 20, air pressure is able to be introduced into the mixing chamber via an air pressure line 24 having a pressure limiter 21, a two-way valve 22 and a check valve 23. An aerosol line 25 goes from mixing chamber 8 to catalytic converter 30, which has an exhaust gas supply 29 on one side and an exhaust gas outlet 31 on the other side. Urea tank 1 is provided with a fluid level sensor 62 and a temperature sensor 61. Temperature sensors 64 and 65 measure the temperature of the exhaust gas at the inlet and the outlet of catalytic converter 30. Furthermore, a pressure sensor 63 is provided between two-way valve 22 and check valve 23. A controller 40 is connected electrically both to sensors 61 to 65 and to metering valve 7. Via a CAN data line 41 (CAN is short for

“controlled area network”), controller **40** is connected to the voltage supply and to additional electronic components in the motor vehicle, especially to the engine control unit.

[0013] Metering valve **7** meters the required urea/water solution into mixing chamber **8**. In the mixing chamber, an aerosol and a wall film are generated by the compressed air being applied to the urea/water solution which are introduced into catalytic converter **30** via aerosol line **25**. In this context, controller **40** records signals which are received by a superordinated engine control unit via CAN data line **39** as well as the signals from pressure, temperature and fluid level sensors **61** to **65**, which are known per se, and are not explained in greater detail here. Valve **22** regulates the pressure in the compressed air line. From the sensor data, controller **40** computes a urea metering quantity that is to be added to an exhaust gas flowing through catalytic converter **30**. To do this, the controller uses data on the engine operating state supplied from the engine control unit via data line **41**, as well as sensor data originating from the metering device and the catalytic converter. Depending on its construction, the pressure in mixing chamber **8** may vary as a function of the selected dimensions of line **25** and of the metering pipe reaching in to the exhaust gas tract, and of the geometry and the number of outlet openings on the metering pipe. In addition, the exhaust gas counterpressure also influences the pressure in the mixing chamber, for example, as a result of a particulate filter situated downstream from catalytic converter **30**. Such influences on the mixing chamber pressure may be dependent upon conditions of manufacturing, the application involved, the wear occurring or the process. Now, hose line **12** ensures that, independently of these influences, the metering quantity provided by the controller is actually injected into the exhaust gas tract: for if an increased mixing chamber pressure is present at the relief valve via the hose line, this regulates the pressure in line **1a** to a higher value and to the extent that the difference of the pressures before and after the metering valve remain constant or that the ratio of the pressures before and after metering valve **7** remains constant.

[0014] Alternatively, the metering device may also be used without the support of compressed air, i.e. without using components **20** to **24** and **63**.

[0015] FIG. 2 shows an additional, alternative specific embodiment, in which the same components as in FIG. 1 are given the same reference numerals. In comparison to FIG. 1, relief valve **11** has no pneumatic connection connected to the mixing chamber via a line. Instead, controller **40** has a regulator **52** that is electrically connected to relief valve **11** via a line **51**, and it is integrated into the controller as software. Furthermore, a pressure sensor **70** detects the pressure in mixing chamber **8** and conducts its pressure signals on to regulator **52**.

[0016] An adjustment of the reducing agent pressure in line **1a** takes place here by electrical control of the relief valve, at increased pressure in the mixing chamber the relief valve first returning an excess quantity of reducing agent into tank **1** via line **1b** at a corresponding increased pressure in line **1a**, so that the pressure difference and the ratio of the pressures before and after metering valve **7** remain constant.

[0017] An adjustment of the metering quantity of urea/water solution can be made alternatively or in combination with electrical control of the relief valve by correction

characteristics maps, stored in regulator **52**, for the variation of the metering valve control. Metering valve **7** is controlled by the control unit as soon as there is a requirement for reducing agent in the exhaust gas tract. In this connection, the metering takes place in pulsed form, so that an on/off ratio can be defined, which is derived from the ratio of the time durations of closed valve states to open valve states during the time of the control. Regulator **52** is able to vary this on/off ratio as a function of the measured pressure prevailing in the mixing chamber. If the pressure in the mixing chamber increases for any reason mentioned before, the proportion of the time of open valve states is increased, so that in spite of the increased counterpressure, the metering valve is able to inject the required metering quantity into the mixing chamber. FIG. 3 shows an exemplary control algorithm for this. According to FIG. 3, regulator **52** processes an on/off ratio value **80** proportional to the T, by a conversion unit **85** determining the setpoint pressure value in the mixing chamber that results from a currently present on/off ratio value (such as via a stored linear function). As is symbolically represented in summation node **87**, from this setpoint pressure value, mixing chamber actual value **86** is subtracted, which is reported to regulator **52** by pressure sensor **70**. The difference value is supplied to a correction value computing unit **88**, which, as a function of the difference value, determines a correction value for the on/off ratio. The stored correction characteristics curve required for this, in a diagram in which the correction values are plotted along the ordinate and the difference values along the abscissa, has, for instance, the shape of a straight line going through the origin and having a negative slope, for difference values that are large in absolute value, the straight line going over into curve sections having a low slope in absolute value or a slope of zero. As symbolized by branching node **81** and line **82**, the correction value is added in summation node **83** to currently set on/off ratio value **80**, so that regulator **52** is able to set, via line **51**, a correcting on/off ratio **84** at relief valve **11**.

[0018] FIG. 4 illustrates a metering device which, in modification of a system as shown in FIG. 1, has neither means for metering air nor a mixing chamber. The metering valve, here given reference numeral **120**, is mounted directly on exhaust gas pipe **110** that leads to catalytic converter **30**, so that its opening penetrates directly into the exhaust gas tract. Pneumatic connection **13** of relief valve **11** is connected via a hose line **100** to exhaust gas pipe **110**.

[0019] Analogous to the system shown in FIG. 1, relief valve **11** sets the pressure in line **1a** as a function of the pressure prevailing after metering valve **120**, the pressure in exhaust gas pipe **110**.

[0020] Alternatively to hose connection **100**, the solution may also be applied that uses a regulator **52** connected to a pressure sensor corresponding to FIG. 2, the pressure sensor measuring the pressure in exhaust gas pipe **110**. The guiding magnitude in controller **52** is then not the mixing chamber pressure, but rather the exhaust gas counterpressure prevailing in the exhaust gas pipe.

What is claimed is:

1. A device for metering a reducing agent, particularly urea or a urea/water solution, having means for supplying the reducing agent into a catalytic converter system via a line for removing nitrogen oxides from the exhaust gases, espe-

cially of a Diesel engine, a metering means, particularly a metering valve, being situated at the end of the line, having means for regulating the pressure of the reducing agent in the line,

wherein the means for regulating the pressure (**11, 12, 13; 11, 52, 70; 11, 13, 100**) and/or the metering means (**7; 120**) are able to interact with a pressure recording element (**12; 70; 100**) which records pressure changes at the output side of the metering means facing away from the line, so that the pressure changes have an influence on the pressure regulation and the metering.

2. The device as recited in claim 1,

wherein the difference or the quotient of the value of the pressure in the line and the pressure on the output side of the metering means facing away from the line is kept constant.

3. The device as recited in one of the preceding claims, wherein the means for regulating the pressure include a relief valve (**11**).

4. The device as recited in claim 3,

wherein the relief valve has a pneumatic connection (**13**); the pressure recording element has an additional line (**12**) connected to the relief valve;

and the line is connected to the pneumatic connection.

5. The device as recited in one of the preceding claims, wherein the pressure recording element has a pressure sensor (**70**).

6. The device as recited in claim 5,

wherein the pressure sensor is connected to a regulator, especially to a regulator (**52**) integrated into a control

unit (**40**) which is able to control the means for regulating the pressure and/or the metering means as a function of the pressure changes.

7. The device as recited in one of the preceding claims,

wherein the metered reducing agent supply goes into a mixing chamber (**8**) to form an aerosol, so that the aerosol is able to be introduced into the catalytic converter system (**30**) via an aerosol line (**25**).

8. The device as recited in claim 7,

wherein means (**20, 21, 22, 23, 24, 63**) are provided for metering an air supply into the mixing chamber (**8**).

9. The device as recited in one of claims 1 through 6,

wherein the metering means are mounted on an exhaust gas pipe that leads to the catalytic converter system, the output side of the metering means facing away from the line penetrating into the exhaust gas pipe.

10. A method for metering a reducing agent, particularly urea or a urea/water solution, the reducing agent being supplied in a metered manner to a catalytic converter system, while the pressure of the reducing agent is regulated, for the removal of nitrogen oxides from the exhaust gases, especially of a Diesel engine, with the aid of a metering means, particularly a metering valve, wherein the pressure changes are recorded at the side of the metering means facing the catalytic converter system and have an influence on the pressure regulation and/or the control of the metering means.

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