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(54) APPARATUS TO PRESSURISE MAINS WATER SUPPLY

VORRICHTUNG ZUR DRUCKBEAUFSCHLAGUNG DER HAUPTWASSERVERSORGUNG

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Description

[0001] The present invention relates to an apparatus to pressurise mains water supply.

[0002] In an attempt to reduce the number of leaks some water suppliers have reduced the pressure of mains water supply. New developments where the water is delivered in series with existing dwellings or businesses may cause the pressure of the mains water supply to be even lower. Accordingly the pressure flow at which water is delivered to many end users is unacceptably low.

[0003] US 7077160 discloses an apparatus for boosting residential water pressure. To attain this, a conduit receives water supplied to a residence and routes the water through an inlet on/off valve and a first check valve to a pump, where said pump provides water to the residence as well as to a throttling conduit back to the input of the pump.

[0004] GB 2031502 discloses a water pressure booster system having a control device which regulates the pressure in the distribution system via a closely balanced piston valve. Flow into the system from a pump is controlled by a throttling valve which is actuated by a pressure differential between the system pressure and a constant pressure acting on a closely balanced piston. Flow from the system back into the pump is prevented by a flow control/check valve within the throttling valve.

[0005] A need exists for an improved fail-safe means of simply, reliably and cost-effectively increasing the flow rate at which water reaches the end user. It is a further object of the invention to provide a means of evening out fluctuations in the mains pressure so that a reliable, consistent flow rate and pressure reaches the end user.

[0006] The invention relates to an apparatus for increasing the flow rate of water supplied to a water delivery pipe system above the flow rate achieved using mains water alone comprising:

- a) a water inlet for connection to a mains water supply;
- b) a water outlet for connection to a water delivery pipe system;
- c) a first non return valve and a pressure limiting valve in series between the water inlet and the water outlet; and
- d) a loop for pressurising the water comprising:

- i) a loop inlet connected between the water inlet and the first non return valve ;
- ii) a loop outlet connected on the downstream side of the first return valve;
- iii) a second non return valve connected in series to a pump ; whereby in use water at the mains pressure enters the water inlet, the water is pressurised by the pump and a positive pressure develops in the water delivery pipe system, the pressurized water being delivered to the water outlet at a flow rate which exceeds the flow rate

achieved using the mains water supply pressure, the apparatus characterised in that a pressure limiting valve is installed in series to the first non return valve at the downstream side of where the loop outlet is connected; and an expansion vessel being provided in series to the pump.

[0007] By using a pressure limiting valve on the downstream side of the loop allows to produce an "over-pressure" in the expansion vessel whereas a pressure exceeding a critical pressure is avoided in the water delivery pipe system.

[0008] In a second aspect the invention relates to apparatus wherein the first non return valve allows water to flow from the water inlet to the water outlet through the pressure limiting valve directly if the loop for pressurizing the water fails.

[0009] In a further aspect the invention relates to apparatus wherein a pressure sensor senses the pressure of the water in the expansion vessel and turns the pump on when the pressure falls below a first lower value and turns the pump off when the pressure reaches a second upper value.

[0010] In a further aspect the invention relates to apparatus wherein the upper value is between 8 and 10 Bar.

[0011] In a further aspect the invention relates to apparatus wherein the upper value is selected to deliver water to the outlet at a flow rate of more than 10 lit/min.

[0012] In a further aspect the invention relates to apparatus wherein the upper value is selected to deliver water to the outlet at a flow rate which exceeds the inlet flow rate.

[0013] In a further aspect the invention relates to apparatus wherein the lower value is 3.8 Bar

[0014] In a further aspect the invention relates to apparatus wherein the pressure sensor senses the pressure of the water downstream of the pump.

[0015] In a further aspect the invention relates to apparatus wherein an air vent is provided upstream of the pump for removing air to prevent cavitation in the pump.

[0016] In a further aspect the invention relates to apparatus wherein the pump is driven by a linear motor.

[0017] In a further aspect the invention relates to apparatus wherein the pump is a rotary vane pump.

[0018] In a further aspect the invention relates to apparatus wherein the loop for pressurising the water further comprises a pump temperature sensor and a pump controller to turn the pump off if the pump temperature rises above a pre-determined level.

[0019] In a further aspect the invention relates to apparatus wherein the water inlet, water outlet, first non return valve pressure limiting valve, and the loop for pressurising the water are connected by pipes formed in a common housing or manifold.

Description of the Drawings

[0020] An embodiment of the invention will now be described with reference to the accompanying drawings in which:

Figure 1 shows a schematic circuit diagram and
Figure 2 shows a cross section view of a manifold.

[0021] Referring to Figure 1 there is shown a schematic circuit of an apparatus 1 to pressurise mains water and to supply it at a consistent flow rate which exceeds that provided by the mains supply to a water delivery pipe system, e.g. the cold mains water pipe system in a building.

[0022] A water inlet 2 is provided for connection to a mains water supply with isolation valve 2A, as is a water outlet 3 for connection to a water delivery pipe system with an isolation valve 3A.

[0023] A first non return valve 4 and pressure limiting valve 5 are provided in series between the water inlet 2 and the water outlet 3.

[0024] A loop 10 for pressurising the water has a loop inlet 10A connected between the water inlet 2 and first non return valve 4, and a loop outlet 10B connected between the first non return valve 4 and the pressure limiting valve 5. The loop 10 has a second non return valve 11 connected in series to a pressurising pump 12, with isolation valves 12A, 12B being provided for the pump 12. An automatic air vent 13 is provided upstream of the pump 12 and a pressure sensor 14 is provided downstream of the pump 12.

[0025] One or more expansion vessel 15 is connected on a branch pipe 15A between the pressurising pump 12 and pressure limiting valve 5. An isolation valve 15B is provided in branch pipe 15A.

[0026] A pump controller 16 is connected to pressure sensor 14 and pump 12.

[0027] In use mains water enters via inlet 2 and isolation valve 2A. Water passes through second non return valve 11 to pump 12 which pressurises the water from the available mains water pressure to around 8 Bar and fills and pressurises the expansion vessel 15 to maintain a positive pressure across the pressure limiting valve 5 at a pressure above the mains water supply pressure. Any air in the water is removed by the automatic air vent 13 to prevent cavitation in pump 12.

[0028] Pressure sensor 14 senses the water pressure downstream of the pump and, with controller 16, turns the pump 12 on when the pressure falls below a first lower value (e.g. around 3.8 Bar) which is the desired service pressure, and turns the pump off when the pressure exceeds a second upper value (e.g. around 8-10 Bar) which is the desired maximum pressure.

[0029] The pressure limiting valve controls the flow rate of water which is delivered to the water delivery pipe system. The outlet pressure, ie the pressure of water which is delivered to the water delivery pipe system, is lower

than the upper value.

[0030] The invention ensures that a consistent flow rate of water which exceeds that available from the mains is delivered to the water delivery pipe system.

[0031] Preferably the pressure in the expansion vessel is more than 1Bar and delivers water to the water delivery pipe system at a flow rate of more than 10lit/min. More preferably the pressure in the expansion vessel is more than 3.5Bar and delivers water to the delivery pipe system at flow rates of between 36 and 300 lit/min depending on the application and the size of the delivery pipe.

[0032] More preferably the pressure in the expansion vessel is between 7.8 and 8 Bar which compresses the air in the expansion vessel and increases the volume of water which can be stored in the expansion vessel to between 70-90% of the expansion vessel's volume.

[0033] Preferably the pump is a peripheral pump or more preferably a rotary vane pump in which all parts are floating and self lubricating.

[0034] Preferably the pump motor is a conventional electric motor or more preferably a linear motor which has no moving parts as they are quiet and very efficient.

[0035] In an especially preferred embodiment the pump is a rotary vane pump and the motor is a linear motor.

[0036] In the event that the pump 12 or expansion vessel 15 should fail, the first non return valve 4 allows water to flow directly from the water inlet to the water outlet through the first pressure limiting valve 5 to the water delivery pipe system, albeit only at mains water pressure. Thus providing a fail-safe system.

[0037] It will be appreciated that, when pressure in expansion vessel 15 is higher than mains pressure, first non return valve 4 prevents flow of pressurised water back to the mains supply.

[0038] A pump temperature sensor 17 is connected to the controller 16 to turn off the pump if the pump temperature rises above a predetermined level. This might occur in the event of no water flowing through the pump, e.g. due to a closed valve or there being no water available.

[0039] In an alternative embodiment a pressure sensor which is able to detect pressures below zero is provided on the inlet side of the pump which turns the pump off if the pressure falls below a preset level to protect the pump in the event of a failure in the water inlet.

[0040] Preferably the system automatically resets once water pressure is restored.

[0041] In an alternative embodiment a mechanical sensor is provided which turns the pump off if the pressure exceeds a preset level to protect the system from becoming over-pressurised.

[0042] If any one of the temperature or pressure sensors is activated a manual re-setting operation may be required.

[0043] A visual pressure gauge 18 is provided between the first non return valve 4 and pressure limiting valve 5. This may also be a digital device displayed on controller 16.

[0044] The digital device may also have means to indicate when one or more of the following

- a) System on and functioning
- b) The pump is running
- c) Manual Reset required eg. because of overpressure failure

[0045] Preferably the water inlet 2, water outlet 3, first non return valve 4 and pressure limiting valve 5, and the bypass loop for pressurising the water comprising the second non return valve 11 and the pressurising pump 12, and an expansion vessel 15 are connected by pipes formed in a common housing or manifold. A schematic cross-section of such a manifold is shown in Figure 2.

[0046] In Figure 2 a manifold is formed from three joined blocks 20A, 20B, 20C. The blocks create a network of pipes with apertures connected to the various components as shown. Water flow direction is shown by the dotted arrows. First and second non return valves 4, and 11 may be integrated with the pipe work as shown. The air vent 13, pressure sensor 14 and pressure gauge 18, and pressure limiting valve 5 may be screwed into threaded apertures on the block 20A, 20B, 20C.

[0047] It is envisaged that a manifold would be sold containing the first and second non return valves 4, 11, the air vent 13, the pressure sensor 14, the pressure gauge 18, and the pressure limiting valve 5. The end user would connect the pump and expansion vessel to the manifold at the point of installation. More commonly the pump, controller and manifold arrangement are sold as a single pre-assembled unit, optionally incorporated in a sound insulated housing, for the user to connect to the inlet, outlet and expansion vessel or vessels.

Claims

1. An apparatus for increasing the flow rate of water supplied to a water delivery pipe system above the flow rate achieved using mains water alone comprising:

- a) a water inlet (2) for connection to a mains water supply;
- b) a water outlet (3) for connection to a water delivery pipe system;
- c) a first non-return valve (4) between the water inlet (2) and the water outlet (3); and
- d) a loop (10) for pressurising the water comprising:

- i) a loop inlet (10A) connected between the water inlet (2) and the first non- return valve (4);
- ii) a loop outlet (10B) connected on the downstream side of the first non-return valve (4);

iii) a second non return valve (11) connected in series to a pump (12); whereby in use water at the mains pressure enters the water inlet (2), the water is pressurised by the pump (12) and a positive pressure develops in the water delivery pipe system, the pressurised water being delivered to the water outlet (3) at a flow rate which exceeds the flow rate achieved using the mains water supply pressure, the apparatus **characterised in that** a pressure limiting valve (5) is installed in series to the first non return valve (4) at the downstream side of where the loop outlet (10B) is connected; and an expansion vessel (15) being provided in series to the pump (12).

2. An apparatus as claimed in claim 1 wherein the first non return valve (4) allows water to flow from the water inlet (2) to the water outlet (3) through the pressure limiting valve (5) directly if the loop (10) for pressurising the water fails.
3. An apparatus as claimed in claim 1 or claim 2 wherein a pressure sensor (14) senses the , pressure of the water in the expansion vessel (15) and turns the pump (12) on when the pressure falls below a first lower value and turns the pump (12) off when the pressure reaches a second upper value.
4. An apparatus as claimed in claim 3 wherein the upper value is between 8 and 10 Bar.
5. An apparatus as claimed in claim 3 or claim 4 wherein the upper value is selected to deliver water to the outlet at a flow rate of more than 10 lit/min.
6. An apparatus as claimed in any one of claims 3 to 5 wherein the upper value is selected to deliver water to the outlet at a flow rate which exceeds the inlet flow rate.
7. An apparatus as claimed in claim 3, 4 or 5 wherein the lower value is 3.8 Bar.
8. An apparatus as claimed in any one of claims 3 to 7 wherein the pressure sensor (14) senses the pressure of the water downstream of the pump (12).
9. An apparatus as claimed in any preceding claim wherein an air vent (13) is provided upstream of the pump (12) for removing air to prevent cavitation in the pump (12).
10. An apparatus as claimed in any preceding claim wherein the pump (12) is driven by a linear motor.
11. An apparatus as claimed in any preceding claim

wherein the pump (12) is a rotary vane pump.

12. An apparatus as claimed in any preceding claim wherein the loop (10) for pressurising the water further comprises a pump temperature sensor (17) and a pump controller (16) to turn the pump (12) off if the pump temperature rises above a pre-determined level.
13. An apparatus as claimed in any preceding claim wherein the water inlet (2), water outlet (3), first non return valve (4) pressure limiting valve (5), and the loop (10) for pressurising the water are connected by pipes formed in a common housing or manifold.

Patentansprüche

1. Vorrichtung zur Erhöhung der Strömungsrate von Wasser, das einem Wasserversorgungsrohrleitungssystem oberhalb der Strömungsrate zugeführt wird, die mit Hilfe des Leitungswassers allein erreicht wird, wobei die Vorrichtung Folgendes umfasst:

- a) einen Wassereinlass (2) zum Anschluss an eine Leitungswasserzufuhr;
- b) einen Wasserauslass (3) zum Anschluss an ein Wasserzufuhrrohrleitungssystem;
- c) ein erstes Rückschlagventil (4) zwischen dem Wassereinlass (2) und dem Wasserauslass (3) und
- d) eine Schleife (10) zum Unterdrucksetzen des Wassers, die Folgendes umfasst:

- i) einen Schleifeneinlass (10A), der zwischen dem Wassereinlass (2) und dem ersten Rückschlagventil (4) angeschlossen ist;
- ii) einen Schleifenauslass (10B), der an der stromabwärtigen Seite des ersten Rückschlagventils (4) angeschlossen ist;
- iii) ein zweites Rückschlagventil (11), das mit einer Pumpe (12) in Reihe angeschlossen ist; wodurch Wasser bei Gebrauch mit Leitungswasserdruck in den Wassereinlass (2) eintritt, das Wasser durch die Pumpe (12) unter Druck gesetzt wird und sich ein positiver Druck in dem Wasserzufuhrrohrleitungssystem entwickelt, wobei das unter Druck stehende Wasser zu dem Wasserauslass (3) mit einer Strömungsrate geleitet wird, die die Strömungsrate überschreitet, die mit dem Leitungswasserzufuhrdruck erreicht wird, wobei die Vorrichtung **dadurch gekennzeichnet ist, dass** ein Druckbegrenzungsventil (5) in Reihe mit dem ersten Rückschlagventil (4) an der stromabwärtigen Seite der Stelle installiert ist, an der der Schleifenauslass (10B) angeschlossen ist;

und ein Ausdehnungsbehälter (15) in Reihe mit der Pumpe (12) bereitgestellt ist.

- 2. Vorrichtung nach Anspruch 1, wobei das erste Rückschlagventil (4) ermöglicht, dass Wasser von dem Wassereinlass (2) zu dem Wasserauslass (3) direkt durch das Druckbegrenzungsventil (5) fließt, wenn die Schleife (10) zum Unterdrucksetzen des Wassers ausfällt.
- 3. Vorrichtung nach Anspruch 1 oder Anspruch 2, wobei ein Drucksensor (14) den Druck des Wassers in dem Ausdehnungsbehälter (15) erfasst und die Pumpe (12) einschaltet, wenn der Druck unter einen ersten unteren Wert sinkt, und die Pumpe (12) ausschaltet, wenn der Druck einen zweiten oberen Wert erreicht.
- 4. Vorrichtung nach Anspruch 3, wobei der obere Wert zwischen 8 und 10 Bar liegt.
- 5. Vorrichtung nach Anspruch 3 oder Anspruch 4, wobei der obere Wert so ausgewählt wird, dass Wasser zu dem Auslass mit einer Strömungsrate von mehr als 10 l/min geleitet wird.
- 6. Vorrichtung nach einem der Ansprüche 3 bis 5, wobei der obere Wert so ausgewählt wird, dass Wasser zu dem Auslass mit einer Strömungsrate geleitet wird, die die Einlassströmungsrate übersteigt.
- 7. Vorrichtung nach Anspruch 3, 4 oder 5, wobei der untere Wert 3,8 Bar beträgt.
- 8. Vorrichtung nach einem der Ansprüche 3 bis 7, wobei der Drucksensor (14) den Druck des Wassers stromabwärts der Pumpe (12) erfasst.
- 9. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei eine Entlüftung (13) stromaufwärts der Pumpe (12) zum Entfernen von Luft vorgesehen ist, um Kavitation in der Pumpe (12) zu verhindern.
- 10. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die Pumpe (12) von einem Linear-motor angetrieben wird.
- 11. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die Pumpe (12) eine Drehschieberpumpe ist.
- 12. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die Schleife (10) zum Unterdrucksetzen des Wassers ferner Folgendes umfasst: einen Pumpentempersensor (17) und eine Pumpensteuerung (16) zum Ausschalten der Pumpe (12), wenn die Pumpentemperatur über einem vorbestimmten Pegel ansteigt.

13. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei der Wassereinlass (2), der Wasserauslass (3), das erste Rückschlagventil (4), das Druckbegrenzungsventil (5) und die Schleife (10) zum Unterdrucksetzen des Wassers durch Rohre verbunden werden, die in einem gemeinsamen Gehäuse oder Verteiler gebildet sind.

Revendications

1. Appareil pour accroître le débit de l'eau, fournie à un système tubulaire de distribution d'eau, au-delà du débit obtenu avec la seule eau de la canalisation principale, comprenant :

- a) un orifice d'admission d'eau (2) destiné à être raccordé à une alimentation de la canalisation principale d'eau ;
- b) un orifice de sortie d'eau (3) destiné à être raccordé à un système tubulaire de distribution d'eau ;
- c) un premier clapet de non retour (4) entre l'orifice d'admission d'eau (2) et l'orifice de sortie d'eau (3) ; et
- d) une boucle (10) pour pressuriser l'eau, comprenant :

- i) un orifice d'entrée de boucle (10A) lequel est raccordé entre l'orifice d'admission d'eau (2) et le premier clapet de non retour (4) ;

- ii) un orifice de sortie de boucle (10B) lequel est raccordé sur le côté aval du premier clapet de non retour (4) ;

- iii) un deuxième clapet de non retour (11) lequel est raccordé en série à une pompe (12) ; de ce fait, en utilisation, de l'eau à la pression de la canalisation principale pénètre dans l'orifice d'admission d'eau (2), l'eau est pressurisée par la pompe (12) et une pression positive se crée dans le système tubulaire de distribution d'eau, l'eau pressurisée étant délivrée à l'orifice de sortie d'eau (3) à un débit qui dépasse le débit obtenu grâce à l'utilisation de la pression d'alimentation de la canalisation principale d'eau, l'appareil étant **caractérisé en ce qu'un** clapet de limitation de pression (5) est installé en série sur le premier clapet de non retour (4) au niveau du côté aval de l'endroit où est raccordé l'orifice de sortie de boucle (10B) ; et un réservoir d'expansion (15) étant prévu en série sur la pompe (12).

2. Appareil selon la revendication 1, le premier clapet de non retour (4) permettant à l'eau de couler à partir

de l'orifice d'admission d'eau (2) vers l'orifice de sortie d'eau (3) par l'intermédiaire du clapet de limitation de pression (5) directement si la boucle (10) servant à pressuriser l'eau a une défaillance.

3. Appareil selon la revendication 1 ou la revendication 2, un capteur de pression (14) détectant la pression de l'eau dans le réservoir d'expansion (15) et activant la pompe (12) lorsque la pression descend en dessous d'une première valeur plus faible, et désactivant la pompe (12) lorsque la pression atteint une deuxième valeur plus élevée.

4. Appareil selon la revendication 3, la valeur supérieure se situant entre 8 et 10 bars.

5. Appareil selon la revendication 3 ou la revendication 4, la valeur supérieure étant sélectionnée de façon à délivrer de l'eau à l'orifice de sortie à un débit de plus de 10 litres/minute.

6. Appareil selon l'une quelconque des revendications 3 à 5, la valeur supérieure étant sélectionnée de façon à délivrer de l'eau à l'orifice de sortie à un débit qui est supérieur au débit de l'orifice d'admission.

7. Appareil selon la revendication 3, 4 ou 5, la valeur inférieure étant de 3,8 bars.

8. Appareil selon l'une quelconque des revendications 3 à 7, le capteur de pression (14) détectant la pression de l'eau en aval de la pompe (12).

9. Appareil selon l'une quelconque des revendications précédentes, un événement d'air (13) étant prévu en amont de la pompe (12) afin d'évacuer l'air pour empêcher tout effet de cavitation dans la pompe (12).

10. Appareil selon l'une quelconque des revendications précédentes, la pompe (12) étant entraînée par un moteur linéaire.

11. Appareil selon l'une quelconque des revendications précédentes, la pompe (12) étant une pompe à palettes rotatives.

12. Appareil selon l'une quelconque des revendications précédentes, la boucle (10) pour pressuriser l'eau comprenant en outre un capteur de température de pompe (17) et un contrôleur de pompe (16) afin de désactiver la pompe (12) si la température de la pompe augmente au-delà d'un niveau prédéterminé.

13. Appareil selon l'une quelconque des revendications précédentes, l'orifice d'admission d'eau (2), l'orifice de sortie d'eau (3), le premier clapet de non retour (4), le clapet de limitation de pression (5) et la boucle (10) pour pressuriser l'eau étant raccordés par des

tubulaires formées dans un collecteur ou un logement commun.

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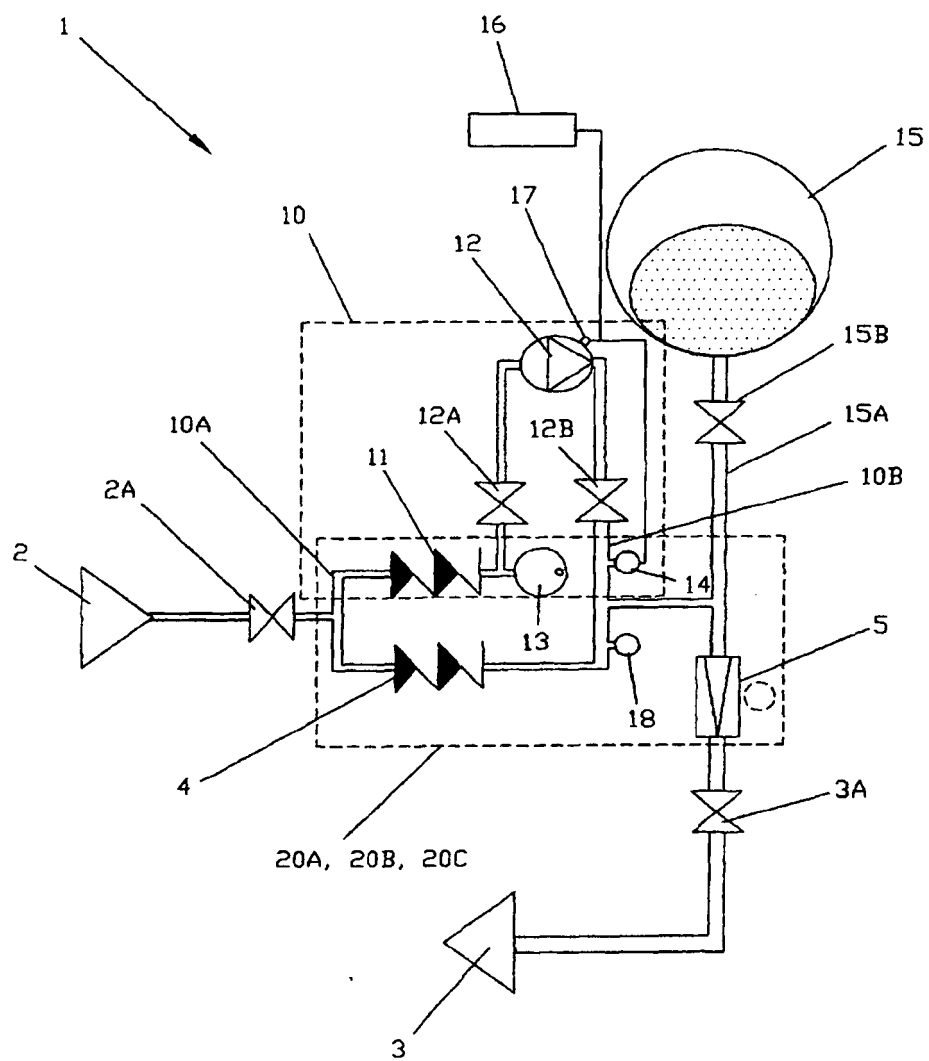


Figure 1

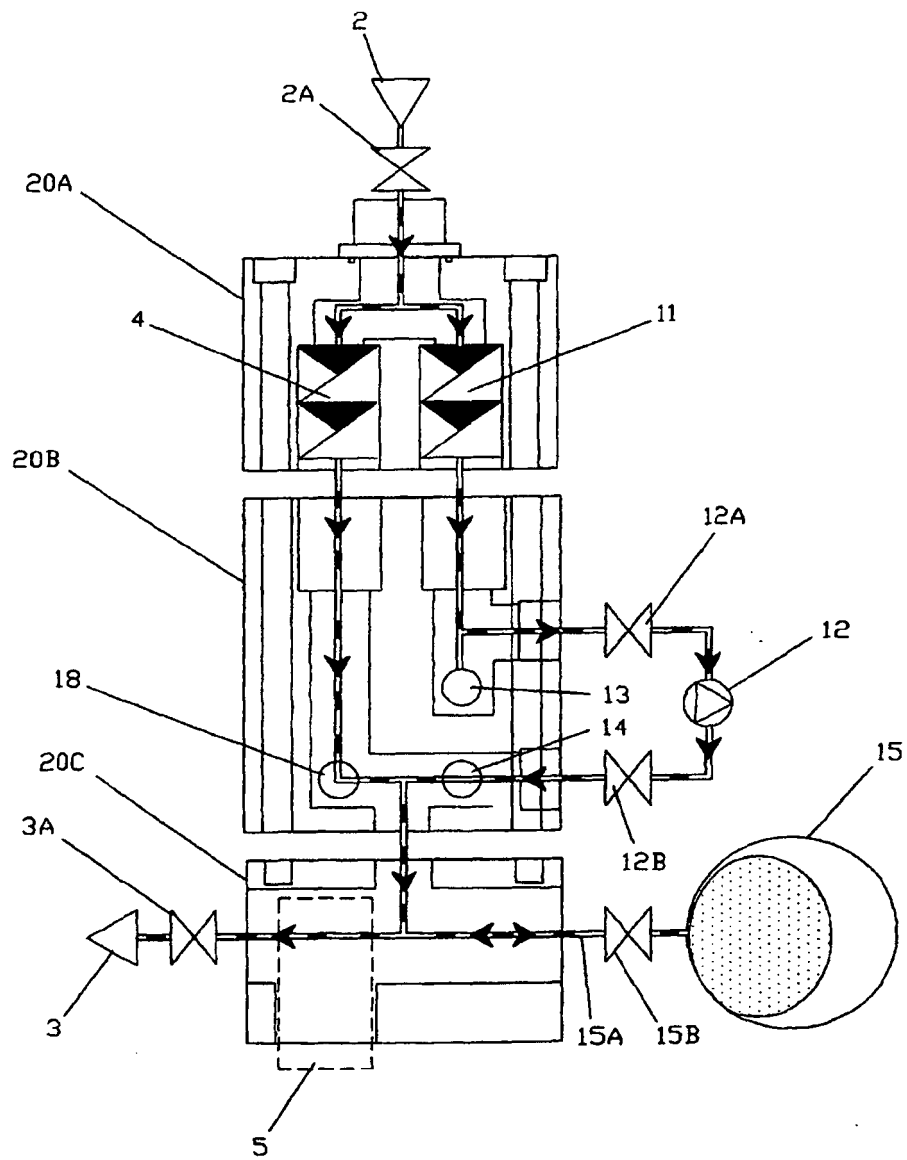


Figure 2

REFERENCES CITED IN THE DESCRIPTION

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