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(54) **Apparatus for controlling the temperature of fuel supplied to an engine**

Vorrichtung zur Regelung der Temperatur des einer Brennkraftmaschine zugeführten Kraftstoffs

Appareil pour le contrôle de la température du combustible fourni à un moteur

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Description

[0001] The present invention relates to an apparatus for controlling the temperature of fuel supplied to an internal combustion engine such as a diesel engine.

[0002] Maintaining fuel within a suitable temperature range enhances engine performance, especially in cold start conditions. Fuel temperature is generally controlled using electrically powered heaters or a switching valve as shown in DE 3 427 396 A1.

[0003] According to a first aspect of the present invention there is provided an apparatus for controlling the temperature of fuel supplied to an engine, the apparatus Comprising:

a first inlet for receiving fuel from a fuel tank;
a second inlet for receiving fuel returned from an engine;
a first outlet for passing fuel to an engine;
a second outlet for passing fuel to a fuel tank; and
a valve for directing fuel received back from the engine via the second inlet to one or both of the first and second outlets wherein the valve is operable to divide a continuously variable proportion of the fuel received from the second inlet between the first and second outlets, and wherein the proportioning of flow is controlled by the combined fuel temperatures of the fuel from the first and second inlets.

[0004] The ability to vary the proportion of relatively hot fuel received from an engine to be directed back to the engine via the first outlet enables the temperature of fuel supplied to an engine to be controlled within limits and thus the engine performance may be enhanced.

[0005] The proportion of fuel directed back to the engine and/or the fuel tank is preferably varied dependent upon fuel temperature. The proportion of fuel directed back to the engine and/or the fuel tank may be varied dependent upon the temperature of the fuel in the apparatus, the temperature of the fuel at the first inlet and/or the temperature of the fluid at the second inlet.

[0006] When the fuel is relatively cold, the valve in the apparatus allows a relatively large amount of relatively hot fuel received from an engine via the second inlet to be directed back to the engine via the first outlet. When the fuel is relatively hot, the valve in the apparatus allows a relatively large amount or all of the relatively hot fuel received from an engine via the second inlet to be directed to a fuel tank via the second outlet. The valve is preferably arranged to gradually vary the proportion of fuel returned from an engine via the second inlet to the first and second outlets.

[0007] The apparatus preferably has a shut off valve arranged to pass all of the fuel received from the engine via the second inlet to the fuel tank via the second outlet regardless of the position of the variable valve. The shut off valve may be manually actuatable. The shut off valve ensures that air from the fuel system during a priming phase is directed back to a fuel tank and not back to an engine resulting in the permanent recirculation of air. The apparatus is preferably arranged such that the shut off valve cannot be engaged when not in the priming condition.

[0008] According to a second aspect of the present invention there is provided a fuel filter assembly including the apparatus according to the first aspect of the present invention.

[0009] According to a third aspect of the present invention there is provided an internal combustion engine including the apparatus according to the first aspect of the present invention or the fuel filter assembly according to the second aspect of the present invention.

[0010] A method of controlling the temperature of fuel delivered to an engine, the method comprising:

receiving fuel from a fuel tank from a first inlet;
receiving fuel returned from an engine from a second inlet;
directing fuel received from an engine to one or both of a first outlet for passing fuel back to the engine and a second outlet for passing fuel to a fuel tank using a variable valve operable to divide a continuously variable proportion of the fuel received from the second inlet between the first and second outlets, and wherein the proportioning of flow is controlled by the combined fuel temperatures of the fuel from the first and second inlets.

[0011] Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a schematic view of an embodiment of an apparatus for controlling fuel temperature in an engine;
Figure 2 shows an apparatus for controlling fuel temperature installed in a fuel system of an internal combustion engine running under relatively cold conditions;
Figure 3 shows the fuel system of Figure 2 with an internal combustion engine running under relatively hot conditions;
Figures 4 and 5 show the fuel systems of Figures 2 and 3 with a manual shut off valve engaged during priming conditions in cold and hot conditions;
Figure 6 shows an assembled and exploded view of an example of a valve to be provided within the control apparatus;
Figure 7 shows a cross-section through the assembled valve;
Figure 8 shows a partially cut away perspective view of the outside of the apparatus;
Figure 9 is another perspective view of the outside of the apparatus showing the inlets and outlets;
Figures 10a, 10b and 10c show the position of the valve within the control apparatus when running at

different temperatures;

Figure 11 shows a cross-section through the control apparatus during cold running and

Figure 12 shows a cross-section through the control apparatus during hot running conditions or when the valve is shut off during priming at any temperature.

[0012] Figure 1 shows a schematic view of an embodiment of an apparatus 10 for controlling the temperature of fuel supplied to an engine. The apparatus 10 has a first inlet 20 for receiving fuel from a fuel tank (not shown), a second inlet 30 for receiving fuel returned from an engine (not shown), a first outlet 40 for passing fuel to an engine and a second outlet 50 for passing fuel to a fuel tank. Within the apparatus 10 is a valve for directing fuel received from the second inlet 30 to one or both of the first and second outlets 40, 50. The position of the valve is adjustable to vary the proportion of relatively hot fuel received from the second inlet 30 to be directed back to the engine via the first outlet 40 and / or to the fuel tank via the second outlet 50. The variable valve which is adjustable to vary the proportion of relatively hot fuel received from the engine via the second input 30 to be directed back to the engine enables the temperature of fuel supplied to the engine to be controlled to enhance the engine's performance. The valve determines the proportion of fuel received from the second input 30 to be returned to the engine dependent upon the fuel temperature as will be described in more detail later. The apparatus 10 includes an integrated manually operable shut off valve 60 to facilitate priming of a fuel circuit. The shut off valve 60 allows manual actuation of the variable valve such that all fuel received from the engine via the second inlet 30 is returned to a fuel tank via the second outlet 50 regardless of the fuel temperature and the variable valve position. The purpose of the shut off valve 60 is to ensure all the returned air from the engine during the priming phase is diverted back to the fuel tank and not back to the engine resulting in the permanent re-circulation of air. The variable valve is also designed in such a way that the shut off mode cannot be engaged when the priming pump function is closed off.

[0013] Figure 2 shows the apparatus 10 installed in a fuel filter assembly 100 which forms part of a fuel system 200 for an internal combustion engine. The illustrated fuel system 200 comprises a number of components making up a circuit.

[0014] Fuel is drawn from a fuel tank 210 and passes through an inlet (port 1) of the fuel filter assembly 100 to the first inlet 20 of the control apparatus 10. Fuel leaving the apparatus 10 via the first outlet 40 is then drawn through a one way valve 220 and a primer pump 230 to a primary filter media 240. Fuel is then drawn out of the fuel filter assembly 100 through Port 2 and is drawn by a supply pump 250, is passed through a cooling plate 260 to the main filter 270. After the main filter 270, a pressure sensor 280 is provided to monitor the pressure in the fuel line. The fuel is then passed to a fuel control unit 290 which passes the fuel via a high pressure pump 300 to fuel injectors in a fuel rail or head gallery in an engine's cylinder head 310 and/or through a by-pass/overflow line from the fuel control unit 290 to the exit from the cylinder head 310 to be returned to the fuel filter assembly 100 via Port 3 to the second inlet 30 of the control apparatus 10. The control apparatus 10 then determines the proportion of fuel to be re-circulated via outlet 40 and the proportion of fuel to be returned to the fuel tank 210 via outlet 50. Re-circulated fuel generally mixes with fuel from the fuel tank 210 when leaving the control apparatus 10 via outlet 40.

[0015] Figure 2 illustrates an engine which is running relatively cold. In this situation the control apparatus 10 directs the majority of the relatively hot fuel received from the engine via inlet 30 back to the engine via outlet 40 with only a minority or none of the relatively hot fuel received from the engine via inlet 30 being returned to the fuel tank 210 via outlet 50. In the example of Figure 2, 90% of the relatively hot fuel received from the engine via inlet 30 is directed back to the engine via outlet 40 and the remaining 10% is returned to the fuel tank 210 via outlet 50. The variable valve in the control apparatus is arranged to be able to direct any proportion of fuel to the outlets 40, 50.

[0016] The control apparatus 10, which may comprise a thermostatic return valve, is shown schematically in Figure 2 and includes a thermostatic bulb 11 which is arranged to vary the size of a passageway from second inlet 30 to first outlet 40 depending upon the temperature of fuel passed over the thermostatic bulb 11. In this example the thermostatic bulb 11 has a pin 12 which is arranged to retract as shown in Figure 2 to pull a valve body 13 away from a valve seat 14 to open a passageway from the second inlet 30 to the first outlet 40 when the fuel is relatively cold. Conversely, when the fuel is warmer the pin 12 of the thermostatic bulb 11 extends to position the valve body 13 closer to or on the valve seat 14 to reduce the size of or close the passageway from the second inlet 30 to the first outlet 40. Such a condition is shown in Figure 3 in which none of the relatively hot fuel received from the engine via inlet 30 is re-circulated back to the engine via first outlet 40 and 100% of the relatively hot fuel is returned to the fuel tank 210. The control apparatus 10 is arranged to be adjustable to direct any proportion of fuel to first outlet 40 or second outlet 50. This enables the temperature of fuel supplied to the engine to be controlled within specified limits.

[0017] In Figures 2 and 3 the manual shut off valve 60 is not engaged. However, in Figures 4 and 5 the fuel system is shown with the manual shut off valve 60 engaged to facilitate priming of the circuit. Figure 4 shows the system priming in cold conditions and Figure 5 shows the system priming in hot conditions. However, as can be seen, in both conditions all fuel received via inlet 30 is returned to the fuel tank 210 regardless of fuel temperature and the position of the thermostatic bulb 11 and shaft 12. Use of the shut off valve 60 ensures that all the

returned air from the fuel system during the priming phase is diverted back to the fuel tank 210 and not the engine which could result in the permanent re-circulation of air and possible subsequent starting problems.

[0018] Figure 6 shows an assembled and exploded view of an example of a valve which may be provided within the control apparatus 10 and Figure 7 shows a cross-section through the assembled valve.

[0019] The valve comprises a thermal bulb 500 (equivalent to the thermostatic bulb 11 shown in Figures 2 to 5) housed and supported in a cartridge end cap 510. A spool 520 is inserted onto a thermal bulb pin and retained by return spring 530 in a housing of the fuel filter assembly 100. A seal 540 fits and seals onto a spool shaft by means of an inner lip and is retained by a spring 550 against a spool stop shoulder 560. The spool 520 with seal 540 retained by springs 530 and 550 can move inside the assembly of the cage 570 and cartridge end cap 510 depending upon the position of thermal bulb pin. The amount of relatively hot fuel returned back to the fuel tank 210 via the second outlet 50 (Figures 1 to 5) is determined by the valve stroke distance between the sealing face of lip seal 580 and cage orifice 590 (see Figures 6 and 7).

[0020] Thermal bulb 500 contains wax which expands and contracts depending upon the temperature of fuel. As the thermal bulb 500 expands due to a temperature increase, the thermal bulb pin 600 will extend and move spool 520 causing movement of seal 540 until it comes into contact with cage orifice 590. At this point the sealing contact between the sealing face 580 of lip seal 540 and the cage orifice 590 is reached. Sealing pressure is provided by the load of spring 550 and the compression of lip 610 over spool shaft 620. In this hot running condition as shown in Figure 3 the second inlet 30 (Port 3) becomes sealed from the first outlet 40 (Port 2) and the first inlet 20 (Port 1) and all of the relatively hot re-circulated fuel from second inlet 30 (Port 3) is returned to the fuel tank 210 via second outlet 50 (Port 4). The valve is designed in such a way as to be able to accommodate further temperature expansion of the thermal bulb 500 and extension of the thermal bulb pin 600 and movement of spool 520.

[0021] When the wax in the thermal bulb 500 cools and contracts, the spool 520 and thermal bulb pin 600 are retracted by the spring force from return spring 530. The load from return spring 530 is exerted onto the sealing face 580 of lip seal 540 causing lip seal 540 to lift away from the cage orifice 590 and open a passageway from second inlet 30 (Port 3) to first outlet 40 (Port 2) and first inlet 20 (Port 1) as shown in Figure 2.

[0022] Figure 8 shows a partially cut-away perspective view of the outside of apparatus 10 and Figure 9 is another perspective view of the outside of apparatus 10 showing the inlets and outlets.

[0023] Figures 10a, 10b and 10c show the position of the variable valve within apparatus 10 at various fuel temperatures with the shut off valve disengaged.

[0024] Figure 10a shows the apparatus 10 during cold running with fuel at less than +15°c. In this condition the valve is fully open with 90% of the relatively hot fuel received at the second inlet 30 (Port 3) returned to the engine via the first outlet 40 (Port 2) and the other 10% returned to the fuel tank via second outlet 50 (Port 4). Directing the majority of the relatively hot fuel back to the engine enables it to warm up more quickly enhancing its performance.

[0025] Figure 10b shows the apparatus 10 during hot running with fuel between +15 and +30°c. In this condition a smaller proportion of relatively hot fuel received at the second inlet 30 (Port 3) is returned to the engine via the first outlet 40 (Port 2).

[0026] Figure 10c shows the apparatus 10 during hot running with fuel above 30°c. In this condition all of the relatively hot fuel received at the second inlet 30 (Port 3) is returned to the fuel tank via the second outlet 50 (Port 4).

[0027] Figure 11 shows a cross-section through the control apparatus 10 during cold running at below +15°c. In this condition there is a gap 700 for 90% of the fuel returning from the engine via inlet 30 (Port 3) to be returned to the engine via outlet 40 (Port 2). The remaining 10% of the fuel is returned to the fuel tank.

[0028] Figure 12 shows the same cross-section as Figure 11 except with the fuel at more than +30°c. In this condition a valve body is in contact with a valve seat so that none of the fuel returning from the engine via inlet 30 (Port 30) is returned to the engine. Instead, it is all returned to the fuel tank.

[0029] The shut off valve works by manually creating the same situation as with hot fuel. The handle of the shut off valve 60 is rotated and translated forward until it contacts the thermal bulb 500. This then forces a valve body into contact with a valve seat preventing fuel received from the engine via second inlet 30 (Port 3) from being re-circulated back to the engine via first outlet 40 (Port 2). Instead, all of the fuel from second inlet 30 (Port 3) is returned to the fuel tank.

[0030] Many modifications may be made to the examples described above whilst still falling within the scope of the invention. For example, the apparatus 10 may include a temperature sensor to determine the temperature of the fuel and a control means such as a microprocessor to adjust the position of the valve and thus the proportion of the fuel directed to the first and second outlets dependent upon the measured temperature. Furthermore, any suitable type of valve may be provided as either the variable valve or shut-off valve or both.

Claims

1. An apparatus (10) for controlling the temperature of fuel supplied to an engine, the apparatus comprising:

   a first inlet (20) for receiving fuel from a fuel tank;
   a second inlet (30) for receiving fuel returned

from an engine;
a first outlet (40) for passing fuel to an engine;
a second outlet (50) for passing fuel to a fuel tank; and
a valve (13,14) for directing fuel received back from the engine via the second inlet (30) to one or both of the first (40) and second (50) outlets wherein the valve (13, 14) is operable to divide a continuously variable proportion of the fuel received from the second inlet (30) between the first (40) and second (50) outlets, and wherein the proportioning of flow is controlled by the combined fuel temperatures of the fuel from the first (20) and second (30) inlets.

2. An apparatus according to claim 1, wherein the valve (13,14) directs more of the fuel received from the second inlet (30) to the first outlet (40) when the fuel is below a predetermined temperature.

3. An apparatus according to claim 1 or claim 2, wherein the valve (13,14) directs less of the fuel received from the second inlet (30) to the first outlet (40) when the fuel is above a predetermined temperature.

4. An apparatus according to any one of the preceding claims, additionally including a shut off valve (60) to facilitate priming of a fuel circuit by passing all of the fuel and/or air received from the second inlet (30) to the fuel tank via the second outlet (50).

5. An apparatus according to claim 4, wherein the shut off valve (60) is operable to pass all of the fuel and/or air received from the second inlet (30) to the fuel tank via the second outlet (50) regardless of the position of the variable valve (13,14).

6. An apparatus according to claim 5, wherein the shut off valve (60) is operable to actuate the variable valve (13,14) to pass all of the fuel and/or air received from the second inlet (30) to the fuel tank via the second outlet (50) regardless of the position of the variable valve (13,14).

7. An apparatus according to claim 6, wherein a portion of the shut off valve (60) is translatable to force a valve body (13) of the variable valve into contact with a valve seat (14) of the variable valve.

8. An apparatus according to any one of claims 4 to 7, wherein the shut off valve (60) is manually operable.

9. An apparatus according to any one of claims 4 to 8, wherein the shut off valve (60) cannot be engaged when the apparatus is not in a priming condition.

10. A fuel filter assembly including the apparatus according to any one of the preceding claims.

11. An internal combustion engine including the apparatus according to any one of claims 1 to 9 or the fuel filter assembly according to claim 10.

12. A method of controlling the temperature of fuel delivered to an engine, the method comprising:

receiving fuel from a fuel tank from a first inlet (20);
receiving fuel returned from an engine from a second inlet (30);
directing fuel received from an engine to one or both of a first outlet (40) for passing fuel back to the engine and a second outlet (50) for passing fuel to a fuel tank using a variable valve (13,14) operable to divide a continuously variable proportion of the fuel received from the second inlet (30) between the first (40) and second (50) outlets, and wherein the proportioning of flow is controlled by the combined fuel temperatures of the fuel from the first (20) and second (30) inlets.

13. A method according to claim 12, the method comprising using a shut off valve (60) to facilitate priming of a fuel circuit by passing all of the fuel and/or air received from the second inlet (30) to the fuel tank via the second outlet (50).

14. A method according to claim 13, wherein the shut off valve (60) passes all of the fuel and/or air received from the second inlet (30) to the fuel tank via the second outlet (50) regardless of the position of the variable valve (13,14).

15. A method according to claim 14, comprising using the shut off valve (60) to actuate the variable valve (13,14) to pass all of the fuel and/or air received from the second inlet (30) to the fuel tank via the second outlet (50) regardless of the position of the variable valve (13,14).

16. A method according to claim 15, wherein said actuating comprises translating a portion of the shut off valve (60) to force a valve body (13) of the variable valve into contact with a valve seat (14) of the variable valve.

17. A method according to any one of claims 12 to 16, comprising manually operating the shut off valve (60).

18. A method according to any one of claims 12 to 17, comprising engaging the shut off valve (60) only when the apparatus is in a priming condition.

Patentansprüche

1. Vorrichtung (10) zum Steuern der Temperatur von Brennstoff, der an einen Motor bereitgestellt wird, wobei die Vorrichtung aufweist:

   einen ersten Einlass (20) zum Aufnehmen von Brennstoff aus einem Brennstofftank,
   einen zweiten Einlass (30) zum Aufnehmen von Brennstoff, der von einem Motor zurückgegeben wird,
   einen ersten Auslass (40) zum Durchlassen von Brennstoff an einen Motor,
   einen zweiten Auslass (50) zum Durchlassen von Brennstoff an einen Brennstofftank und ein Ventil (13, 14) zum Leiten von Brennstoff, der von dem Motor zurückerhalten wurde über den zweiten Einlass (30) an einen oder beide der ersten (40) und zweiten (50) Auslässe, wobei das Ventil (13, 14) so betreibbar ist, dass es einen kontinuierlich einstellbaren Teil des von dem zweiten Einlass (30) aufgenommenen Brennstoffs zwischen den ersten (40) und zweiten (50) Auslässen aufteilt und wobei das Aufteilen des Flusses von den kombinierten Brennstofftemperaturen des Brennstoffs von den ersten (20) und zweiten (30) Einläsen gesteuert wird.

2. Vorrichtung nach Anspruch 1, wobei das Ventil (13, 14) mehr des von dem zweiten Einlass (30) aufgenommenen Brennstoff an den ersten Auslass (40) leitet, wenn der Brennstoff unter einer vorbestimmten Temperatur liegt.

3. Vorrichtung nach Anspruch 1 oder 2, wobei das Ventil (13, 14) weniger des von dem zweiten Einlass (30) erhaltenen Brennstoffs an den ersten Auslass (40) leitet, wenn der Brennstoff über einer vorbestimmten Temperatur liegt.

4. Vorrichtung nach einem der vorhergehenden Ansprüche, darüber hinaus mit einem Absperrventil (60), um ein Einspritzen einer Brennstoffleitung zu ermöglichen durch Durchlassen des gesamten Brennstoffs und/oder von dem zweiten Einlass (30) aufgenommener Luft über den zweiten Auslass (50) an den Brennstofftank.

5. Vorrichtung nach Anspruch 4, wobei das Absperrventil (60) so betreibbar ist, dass es den gesamten Brennstoff und/oder von dem zweiten Einlass (30) aufgenommene Luft über den zweiten Auslass (50) an den Brennstofftank durchlässt, unabhängig von der Position des einstellbaren Ventils (13, 14).

6. Vorrichtung nach Anspruch 5, wobei das Absperrventil (60) so betreibbar ist, dass es das einstellbare Ventil (13, 14) so betätigt, dass der gesamte Brennstoff und/oder von dem zweiten Einlass (30) aufgenommene Luft über den zweiten Auslass (50) an den Brennstofftank durchgelassen wird unabhängig von der Position des einstellbaren Ventils (13, 14).

7. Vorrichtung nach Anspruch 6, wobei ein Teil des Absperrventils (60) übersetzbar ist, um einen Ventilkörper (13) des einstellbaren Ventils in Kontakt mit einem Ventilsitz (14) des einstellbaren Ventils zu bringen.

8. Vorrichtung nach einem der Ansprüche 4 bis 7, wobei das Absperrventil (60) manuell betreibbar ist.

9. Vorrichtung nach einem der Ansprüche 4 bis 8, wobei das Absperrventil (60) nicht gestellt werden kann, wenn die Vorrichtung nicht in einer Einspritzstellung ist.

10. Brennstofffilteranordnung mit der Vorrichtung nach einem der vorhergehenden Ansprüche.

11. Brennkraftmaschine mit der Vorrichtung nach einem der Ansprüche 1 bis 9 oder der Brennstofffilteranordnung nach Anspruch 10.

12. Verfahren zum Steuern der Temperatur von an einen Motor bereitgestelltem Brennstoff, wobei das Verfahren aufweist:

    Aufnehmen von Brennstoff aus einen Brennstofftank von einem ersten Einlass (20),
    Aufnehmen von von einem Motor zurückgegebenen Brennstoff von einem zweiten Einlass (30),
    Leiten von von einem Motor aufgenommenen Brennstoff an einen oder beide eines ersten Auslasses (40) zum Durchlassen von Brennstoff zurück in den Motor und eines zweiten Auslasses (50) zum Durchlassen von Brennstoff in einen Brennstofftank, wobei ein einstellbares Ventil (13, 14) verwendet wird, das so betreibbar ist, dass es einen kontinuierlich einstellbaren Teil des von dem zweiten Einlass (30) erhaltenen Brennstoffs zwischen den ersten (40) und den zweiten (50) Auslässen aufteilt und wobei der Teil des Flusses durch die kombinierten Brennstofftemperaturen des Brennstoffs von den ersten (20) und zweiten (30) Einlässen gesteuert wird.

13. Verfahren nach Anspruch 12, wobei das Verfahren aufweist ein Verwenden eines Absperrventils (60), um ein Einspritzen einer Brennstoffleitung zu ermöglichen durch Durchlassen des gesamten Brennstoffs und/oder von dem zweiten Einlass (30) aufgenommener Luft an den Brennstofftank über den zweiten

Auslass (50).

14. Verfahren nach Anspruch 13, wobei das Absperrventil (60) den gesamten Brennstoff und/oder von dem zweiten Einlass (30) erhaltene Luft über den zweiten Auslass (50) an den Brennstofftank durchlässt unabhängig von der Position des einstellbaren Ventils (13, 14).

15. Verfahren nach Anspruch 14 mit Verwenden des Absperrventils (60), um das einstellbare Ventil (13, 14) zu betätigen, so dass der gesamte Brennstoff und/oder von dem zweiten Einlass (30) aufgenommene Luft über den zweiten Auslass (50) an den Brennstofftank durchgelassen wird unabhängig von der Position des einstellbaren Ventils (13, 14).

16. Verfahren nach Anspruch 15, wobei das Betätigen ein Übersetzen eines Teils des Absperrventils (60) umfasst, so dass ein Ventilkörper (13) des einstellbaren Ventils in Kontakt mit einem Ventilsitz (14) des einstellbaren Ventils gebracht wird.

17. Verfahren nach einem der Ansprüche 12 bis 16 mit manuellem Betreiben des Absperrventils (60).

18. Verfahren nach einem der Ansprüche 12 bis 17 mit Stellen des Absperrventils (60) nur wenn die Vorrichtung in einer Einspritzstellung ist.

Revendications

1. Appareil (10) pour contrôler la température d'un carburant fourni à un moteur, l'appareil comprenant :

une première entrée (20) pour recevoir un carburant provenant d'un réservoir de carburant ;
une deuxième entrée (30) pour recevoir un carburant retourné depuis un moteur ;
une première sortie (40) pour laisser passer un carburant vers un moteur ;
une deuxième sortie (50) pour laisser passer un carburant vers un réservoir de carburant ; et
une soupape (13, 14) pour diriger un carburant revenant du moteur par l'intermédiaire de la deuxième entrée (30) vers l'une des première (40) et deuxième (50) sorties ou vers la première sortie (40) et la deuxième sortie (50), dans lequel la soupape (13, 14) peut être commandée pour diviser une proportion variable en continu du carburant reçu depuis la deuxième entrée (30) entre les première (40) et deuxième (50) sorties, et dans lequel la répartition proportionnelle du débit est contrôlée par les températures combinées du carburant provenant des première (20) et deuxième (30) entrées.

2. Appareil selon la revendication 1, dans lequel la soupape (13, 14) dirige une plus grande quantité de carburant reçu depuis la deuxième entrée (30) vers la première sortie (40) lorsque le carburant est en dessous d'une température prédéterminée.

3. Appareil selon la revendication 1 ou 2, dans lequel la soupape (13, 14) dirige une plus petite quantité de carburant depuis la deuxième entrée (30) vers la première sortie (40) lorsque le carburant est au-dessus d'une température prédéterminée.

4. Appareil selon l'une quelconque des revendications précédentes, comprenant en outre une soupape d'arrêt (60) pour faciliter l'amorçage d'un circuit de carburant en faisant passer la totalité du carburant et/ou de l'air reçus depuis la deuxième entrée (30) vers le réservoir de carburant par l'intermédiaire de la deuxième sortie (50).

5. Appareil selon la revendication 4, dans lequel la soupape d'arrêt (60) peut être commandée pour faire passer la totalité du carburant et/ou de l'air reçus depuis la deuxième entrée (30) vers le réservoir de carburant par l'intermédiaire de la deuxième sortie (50) quelle que soit la position de la soupape variable (13, 14).

6. Appareil selon la revendication 5, dans lequel la soupape d'arrêt (60) peut être commandée pour actionner la soupape variable (13, 14) pour faire passer la totalité du carburant et/ou de l'air reçus depuis la deuxième entrée (30) vers le réservoir de carburant par l'intermédiaire de la deuxième sortie (50) quelle que soit la position de la soupape variable (13, 14).

7. Appareil selon la revendication 6, dans lequel une portion de la soupape d'arrêt (60) est déplacée pour obliger un corps de soupape (13) de la soupape variable à entrer en contact avec un siège de soupape (14) de la soupape variable.

8. Appareil selon l'une quelconque des revendications 4 à 7, dans lequel la soupape d'arrêt (60) peut être commandée manuellement.

9. Appareil selon l'une quelconque des revendications 4 à 8, dans lequel la soupape d'arrêt (60) ne peut pas être accouplée quand l'appareil n'est pas dans une condition d'amorçage.

10. Ensemble de filtre à carburant incluant l'appareil selon l'une quelconque des revendications précédentes.

11. Moteur à combustion interne incluant l'appareil selon l'une quelconque des revendications 1 à 9 ou l'ensemble de filtre à carburant selon la revendication

10.

12. Procédé de contrôle de la température d'un carburant fourni à un moteur, l'appareil comprenant les étapes consistant à :

recevoir un carburant provenant d'un recevoir un carburant depuis une première entrée (20) ; recevoir un carburant retourné depuis un moteur depuis une deuxième entrée (30) ;
diriger un carburant reçu depuis un moteur vers une première sortie (40) destinée à laisser passer le carburant revenant du moteur et vers une deuxième sortie (50) destinée à laisser passer le carburant vers un réservoir de carburant ou uniquement vers l'une de ces sorties en utilisant une soupape variable (13, 14) pouvant être commandée pour diviser une proportion variable en continu du carburant reçu depuis la deuxième entrée (30) entre les première (40) et deuxième (50) sorties, et dans lequel la répartition proportionnelle du débit est contrôlée par les températures combinées du carburant provenant des première (20) et deuxième (30) entrées.

13. Procédé selon la revendication 12, le procédé comprenant l'utilisation d'une soupape d'arrêt (60) pour faciliter l'amorçage d'un circuit de carburant en faisant passer la totalité du carburant et/ou de l'air reçus depuis la deuxième entrée (30) vers le réservoir de carburant par l'intermédiaire de la deuxième sortie (50).

14. Procédé selon la revendication 13, dans lequel la soupape d'arrêt (60) fait passer la totalité du carburant et/ou de l'air reçus depuis la deuxième entrée (30) vers le réservoir de carburant par l'intermédiaire de la deuxième sortie (50) quelle que soit la position de la soupape variable (13, 14).

15. Procédé selon la revendication 14, comprenant l'utilisation de la soupape d'arrêt (60) pour actionner la soupape variable (13, 14) pour faire passer la totalité du carburant et/ou de l'air reçus depuis la deuxième entrée (30) vers le réservoir de carburant par l'intermédiaire de la deuxième sortie (50) quelle que soit la position de la soupape variable (13, 14).

16. Procédé selon la revendication 15, dans lequel ledit actionnement comprend le déplacement d'une portion de la soupape d'arrêt (60) pour obliger un corps de soupape (13) de la soupape variable à entrer en contact avec un siège de soupape (14) de la soupape variable.

17. Procédé l'une quelconque des revendications 12 à 16, comprenant l'actionnement manuel de la soupape d'arrêt (60).

18. Procédé l'une quelconque des revendications 12 à 17, comprenant l'accouplement de la soupape d'arrêt (60) uniquement quand l'appareil est dans une condition d'amorçage.

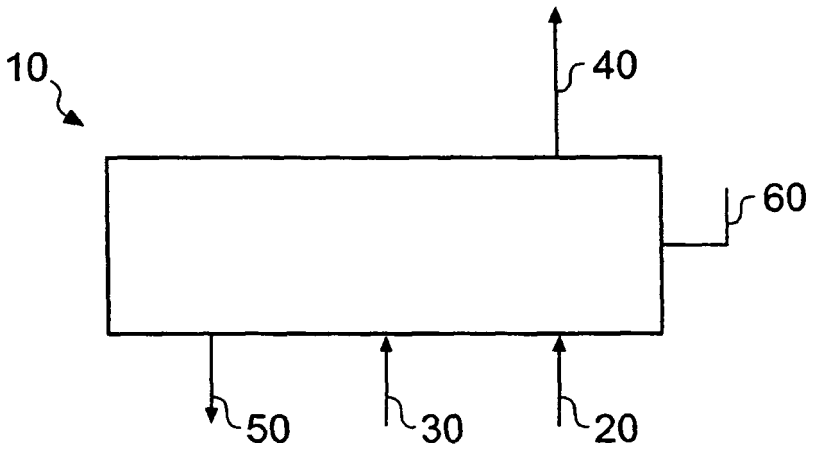


Fig. 1

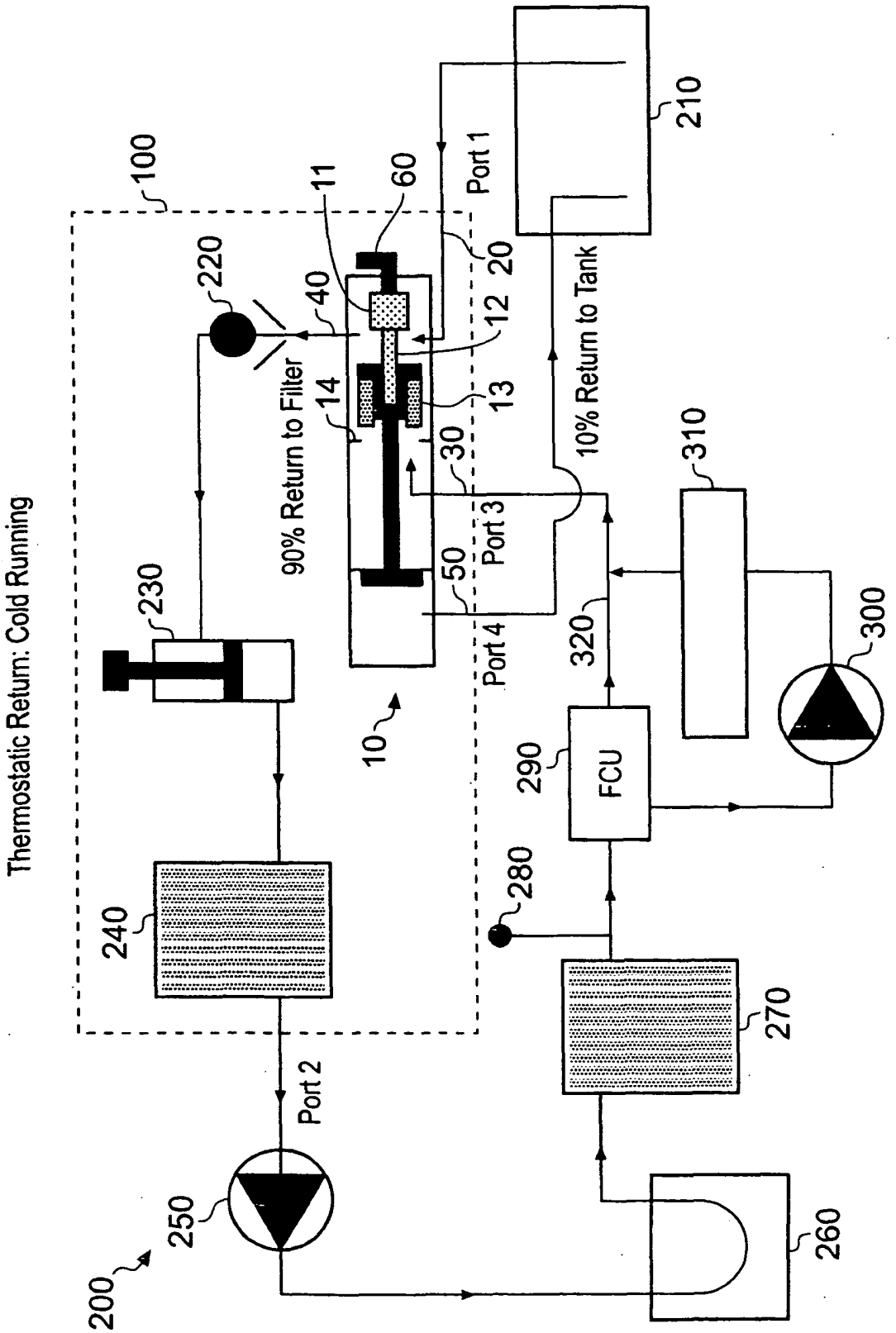

Thermostatic Return: Cold Running
100
210
Port 1
11
60
220
40
12
20
90% Return to Filter
14
13
30
10% Return to Tank
310
Port 3
50
230
320
300
Port 4
10
290
FCU
280
240
270
Port 2
250
260
200

Fig. 2

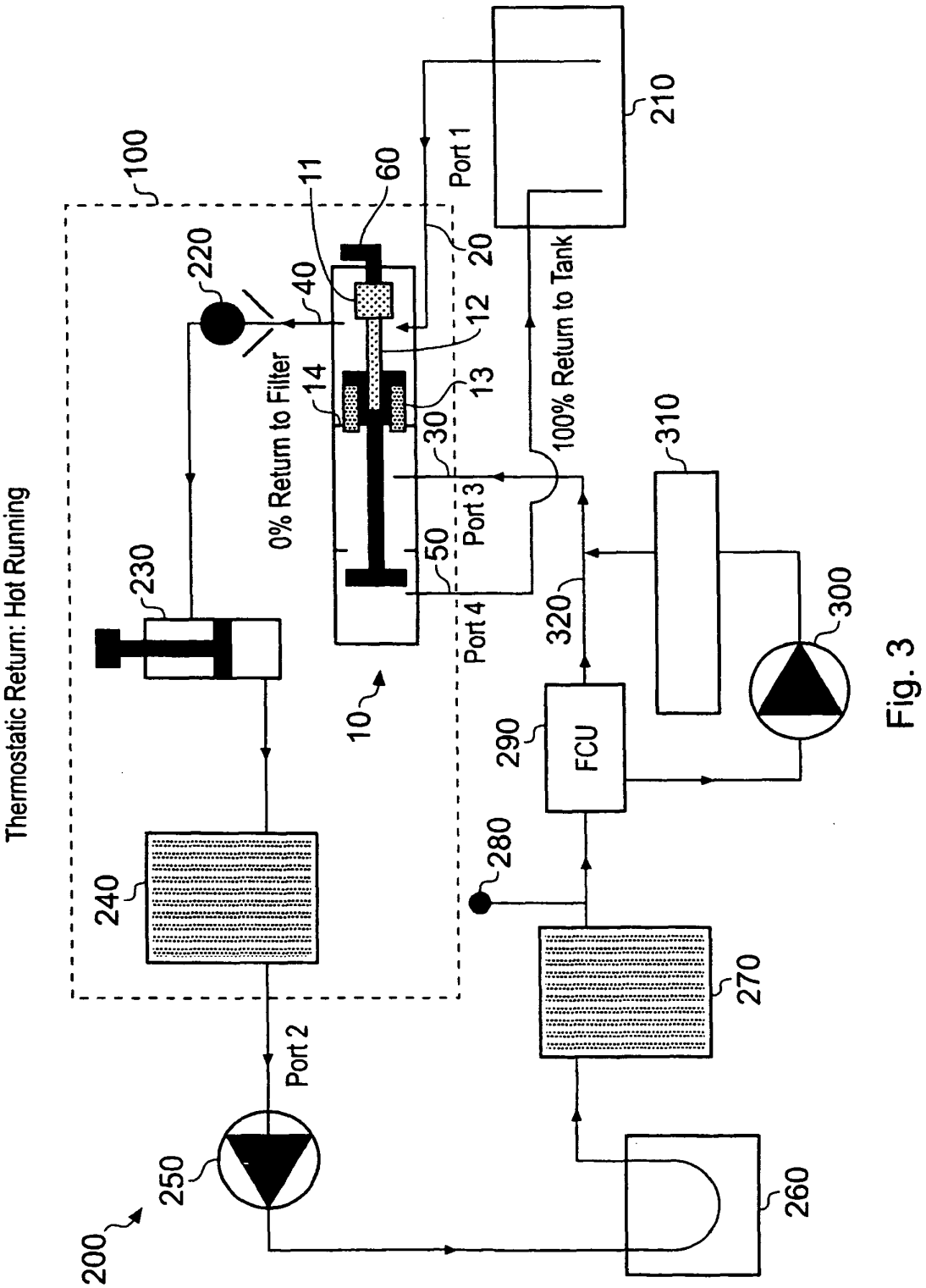

Thermostatic Return: Hot Running
100
210
Port 1
20
60
11
40
220
12
13
14
0% Return to Filter
30
100% Return to Tank
310
Port 3
50
Port 4
230
320
300
10
290
FCU
280
240
270
Port 2
250
260
200

Fig. 3

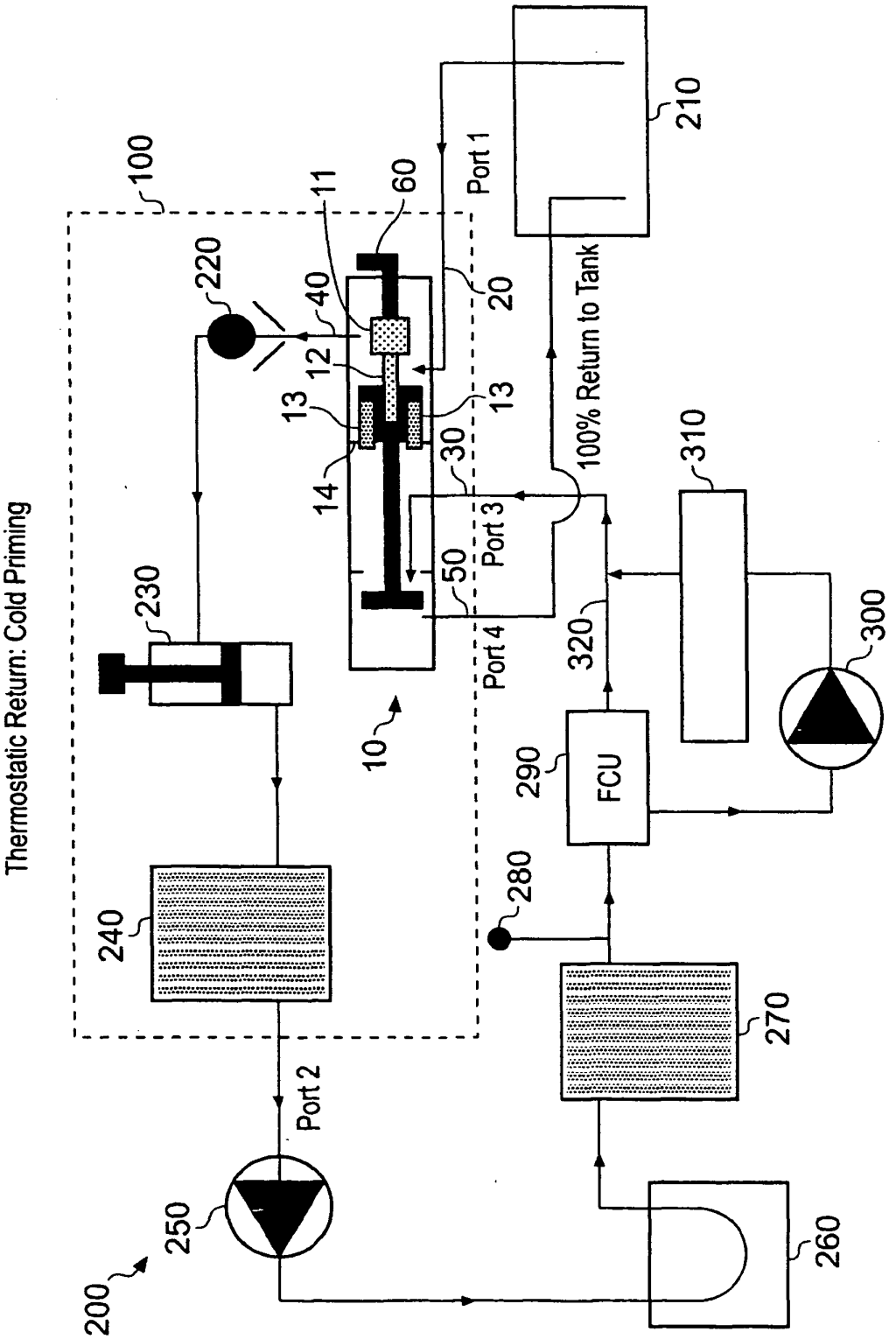

Thermostatic Return: Cold Priming
100
210
Port 1
60
11
220
40
20
12
13
13
100% Return to Tank
310
30
14
Port 3
230
50
320
300
Port 4
10
290
FCU
280
240
270
Port 2
250
260
200

Fig. 4

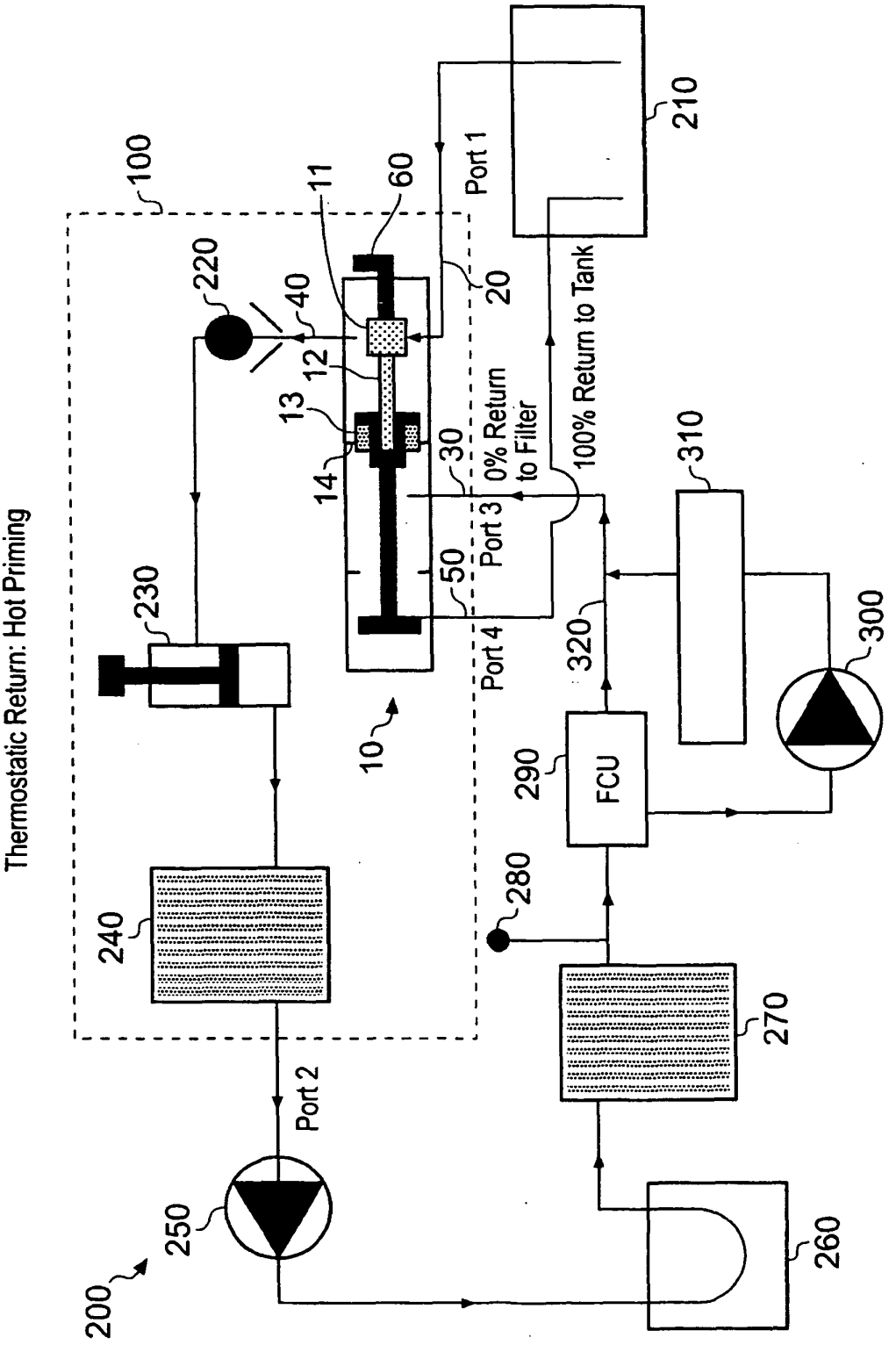

Thermostatic Return: Hot Priming
100
210
Port 1
60
11
220
40
20
12
13
14
30
0% Return to Filter
100% Return to Tank
310
Port 3
50
Port 4
230
320
300
10
290
FCU
280
240
270
Port 2
250
260
200

Fig. 5

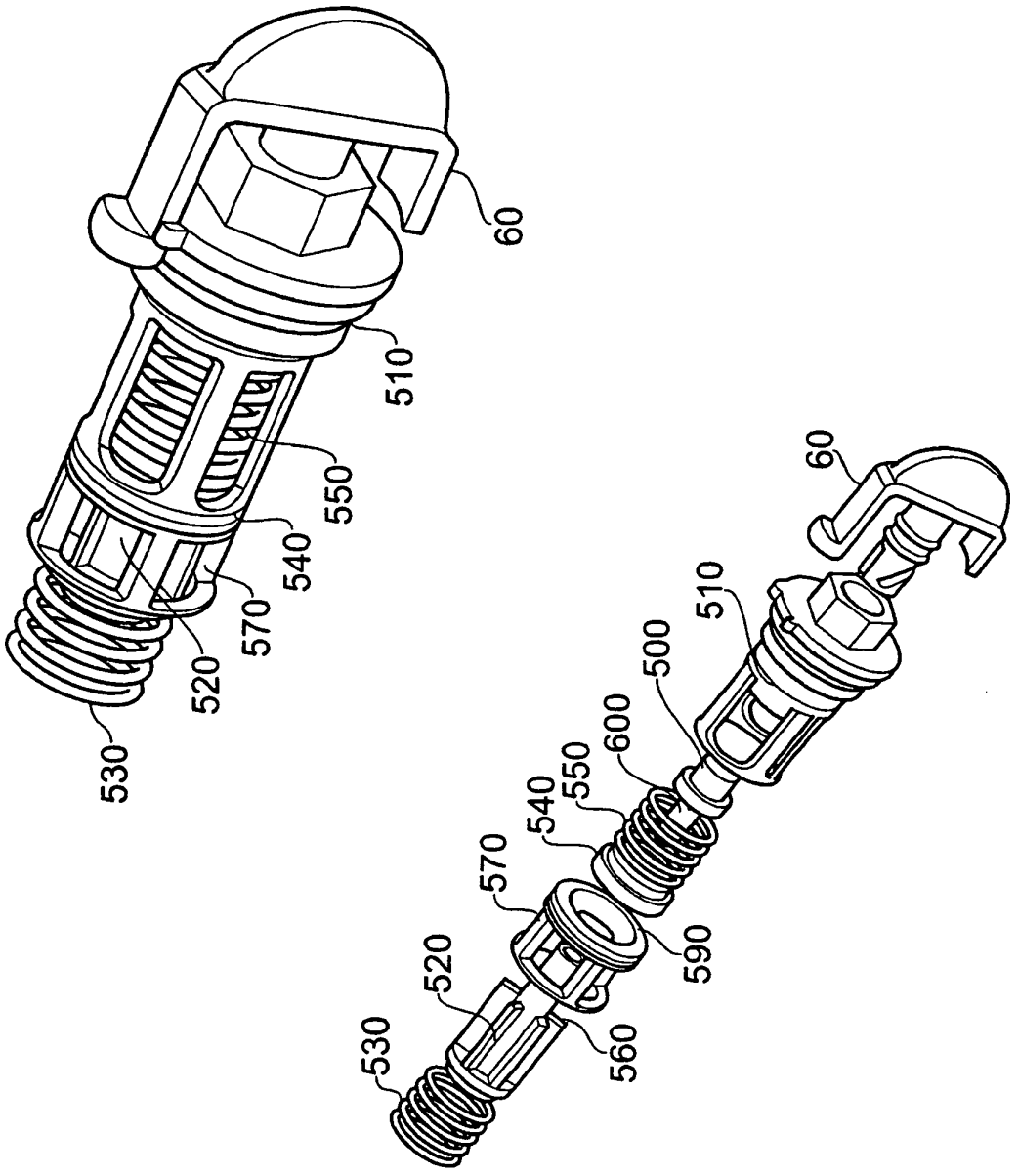

60
510
550
540
570
520
530
60
510
500
600
550
540
570
590
520
530
560

Fig. 6

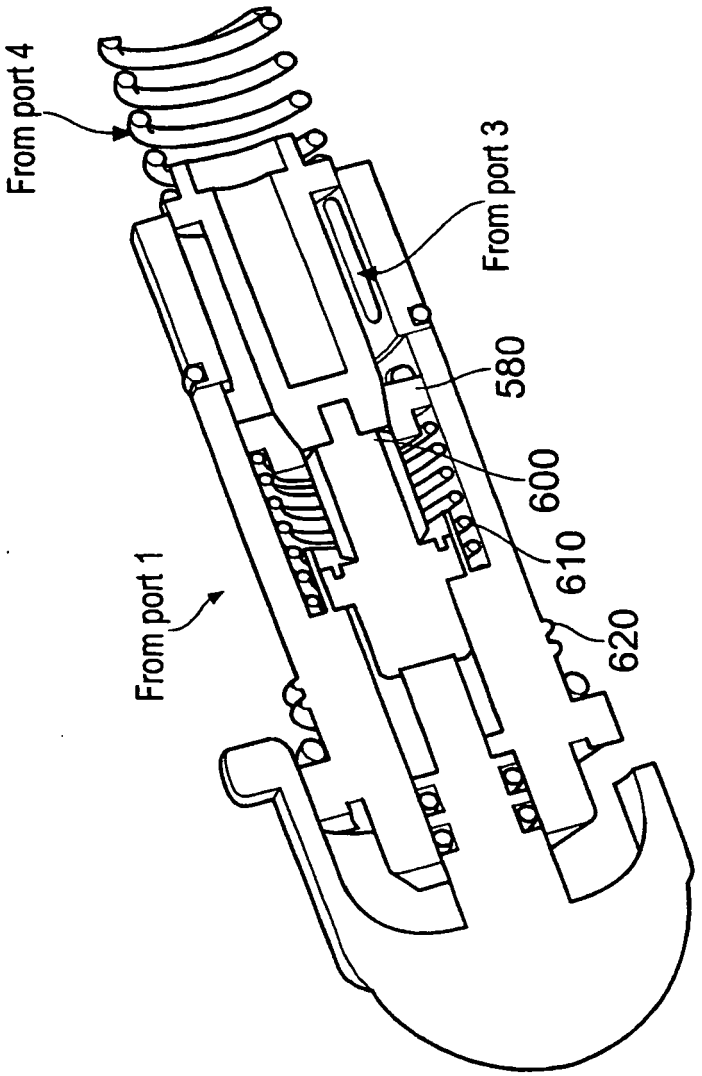


Fig. 7

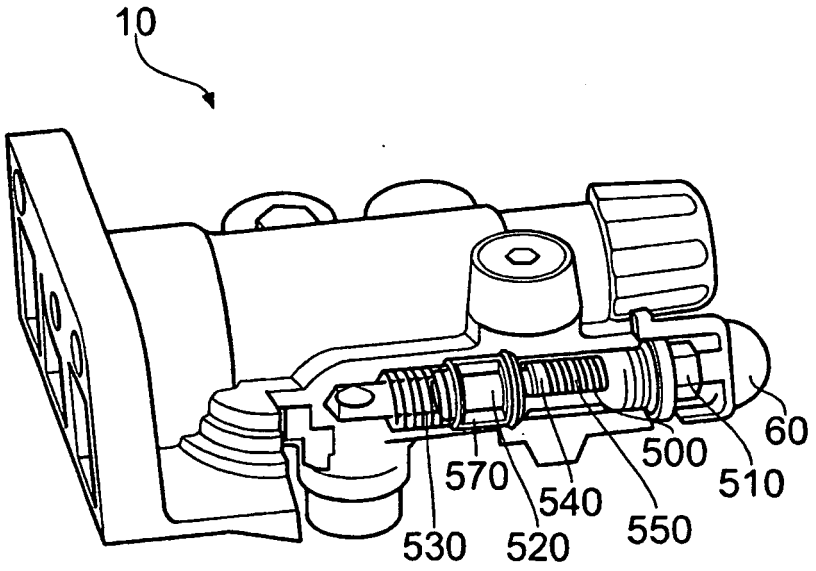


Fig. 8

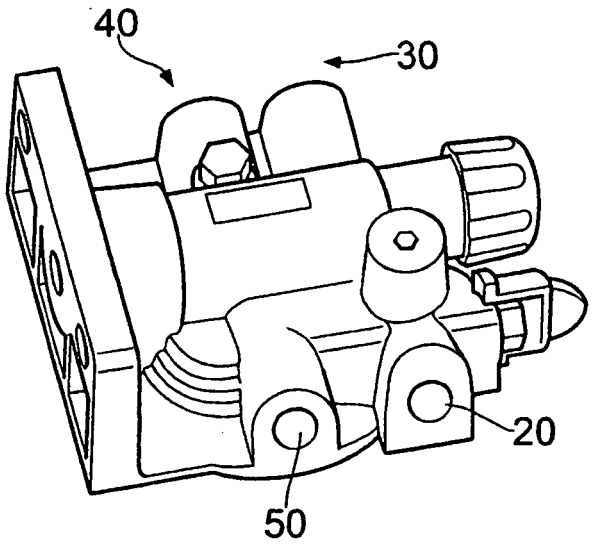
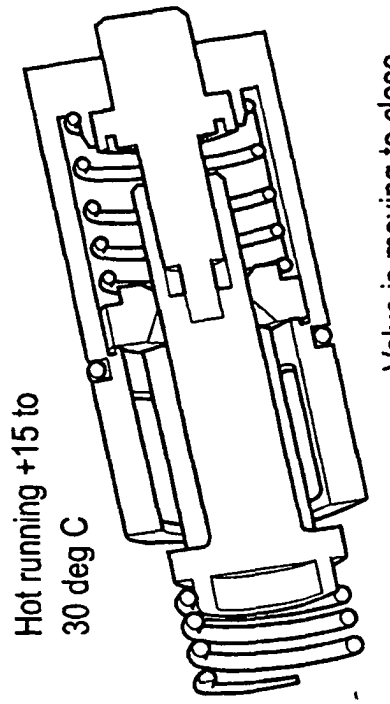


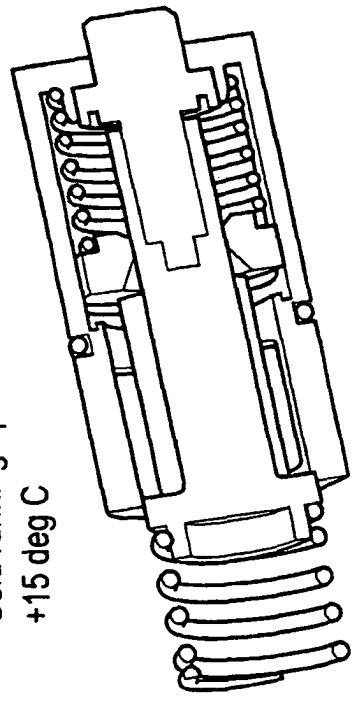
Fig. 9



Hot running +15 to
30 deg C

Valve is moving to close

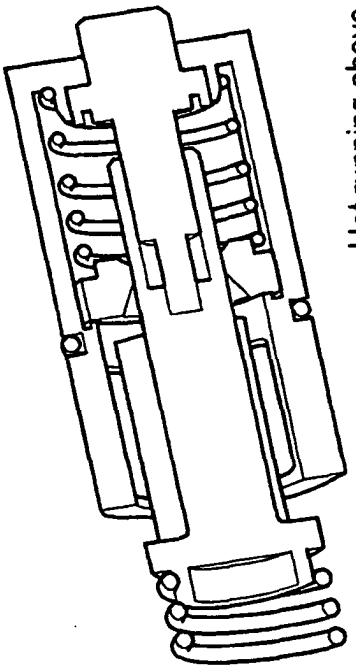
Fig. 10b



Cold running up to
+15 deg C

Valve is fully open:
80% fuel flow returns to filter
20% fuel returns to tank

Fig. 10a



Hot running above
+30 deg C

Fig. 10c

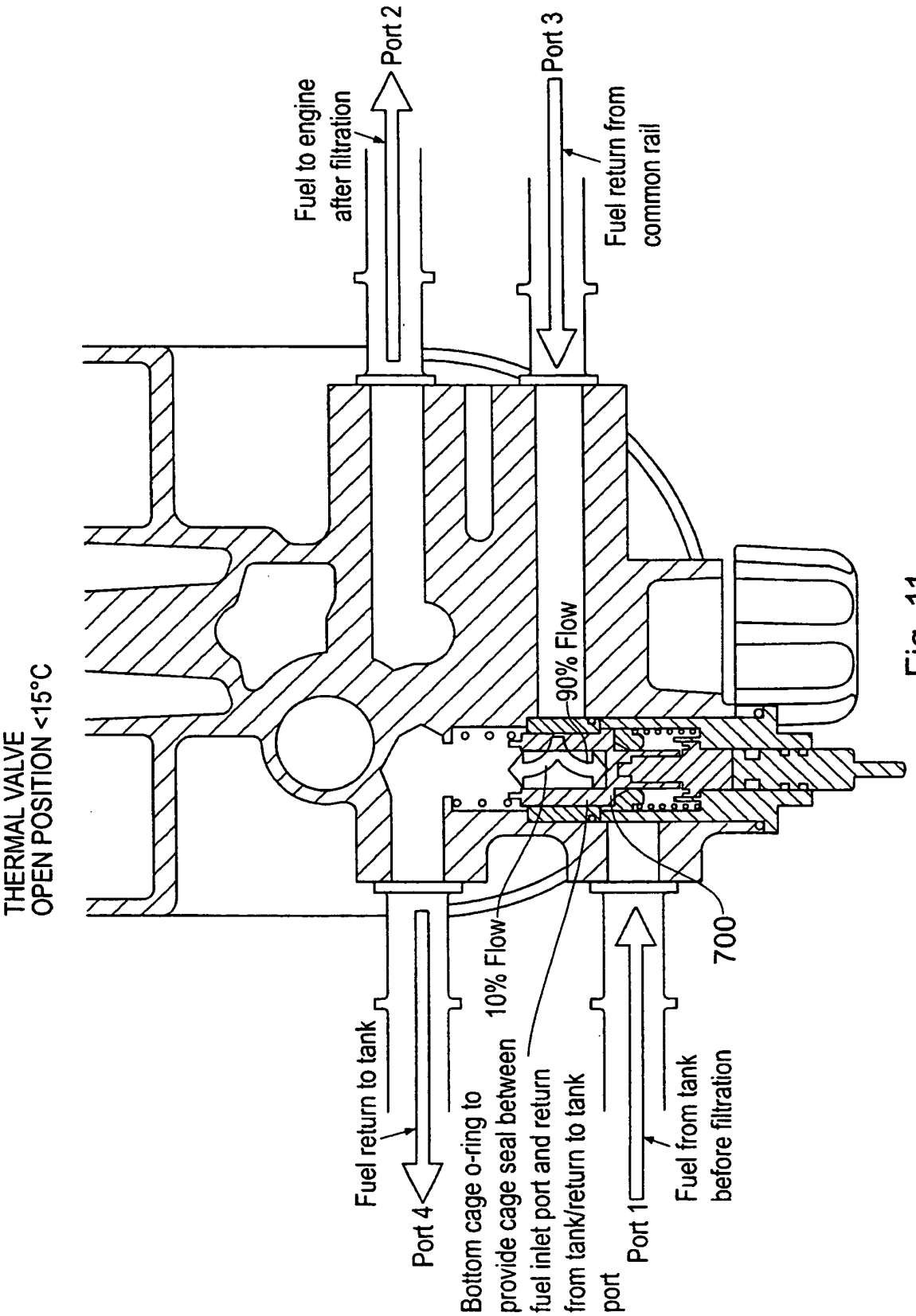

THERMAL VALVE
OPEN POSITION <15°C
Fuel to engine after filtration
Port 2
Port 3
Fuel return from common rail
90% Flow
10% Flow
700
Fuel return to tank
Port 4
Bottom cage o-ring to provide cage seal between fuel inlet port and return from tank/return to tank port
Port 1
Fuel from tank before filtration

Fig. 11

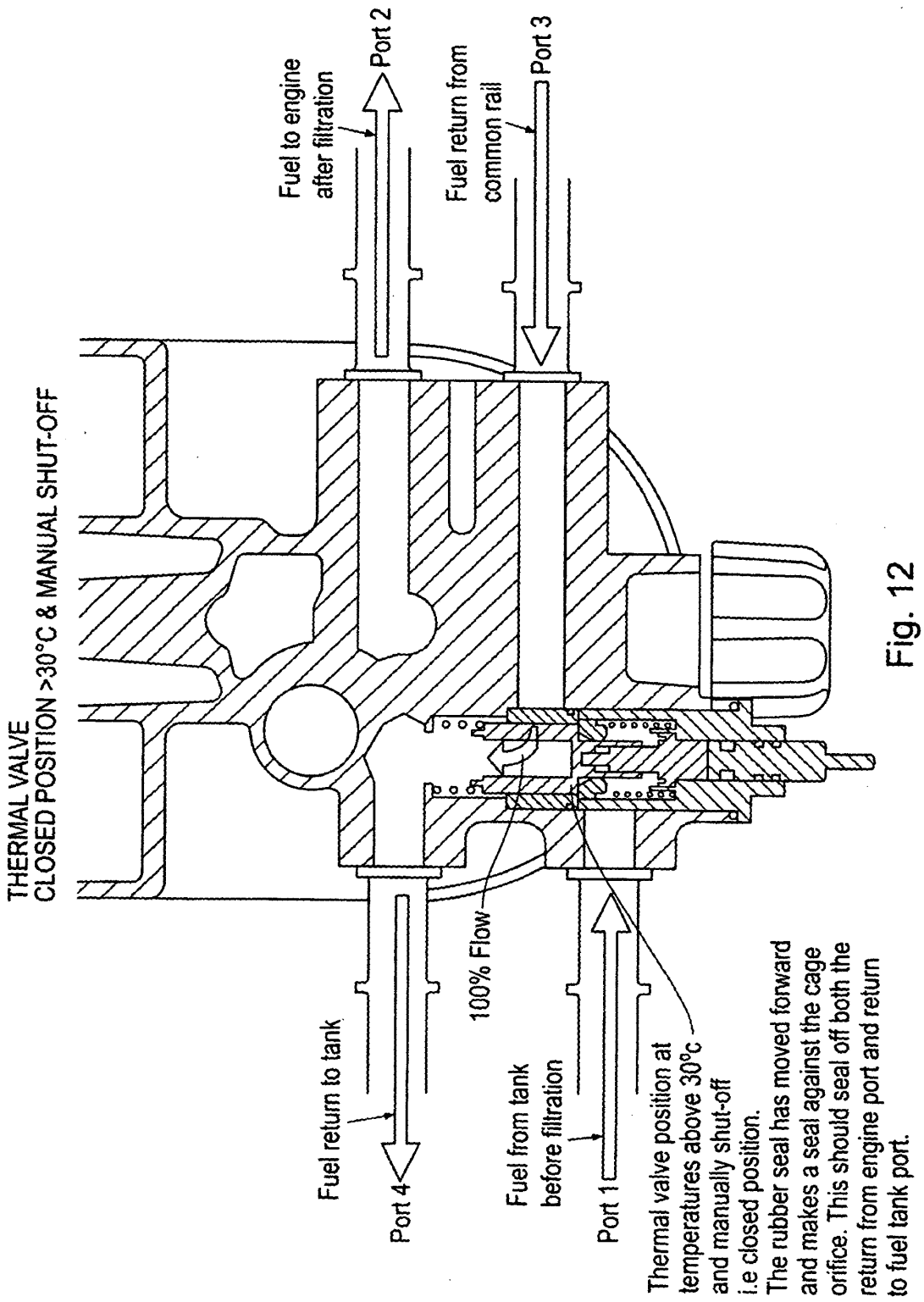

THERMAL VALVE
CLOSED POSITION >30°C & MANUAL SHUT-OFF
Fuel to engine after filtration
Port 2
Fuel return from common rail
Port 3
Fuel return to tank
Port 4
100% Flow
Fuel from tank before filtration
Port 1
Thermal valve position at temperatures above 30°c and manually shut-off i.e closed position.
The rubber seal has moved forward and makes a seal against the cage orifice. This should seal off both the return from engine port and return to fuel tank port.

Fig. 12

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- DE 3427396 A1 **[0002]**