

Controller for switching the fuel supply to an internal combustion engine from a first fuel to a second fuel

- 5 The invention relates to a method for switching the fuel supply to an internal combustion engine from a first fuel to a second fuel, the first fuel being stored in a first tank and the second fuel being stored in a second tank, the tanks and the internal combustion engine being connected to each other by means of a control valve and said control valve having a control path where the internal combustion engine is fed only the first fuel from the first tank in a first position, only the second fuel from the second tank in a second position, and a mixture of the first fuel and the second fuel in a plurality of additional positions arranged between the first position and the second position.

- 15 Changing over between the fuel supply from tanks filled with different fuels to an internal combustion engine, for example a ship diesel engine that can be operated selectively with heavy oil (HFO) and marine diesel oil (MGO), usually takes place by means of a 3/2 way control valve that is connected by one line each with the two fuel tanks and via one line to the internal combustion engine.

- 20 The control valve makes it possible (if a certain tolerance is present) that in a first setting of the control valve only fuel from the first tank and in a second setting only fuel from the second tank is conveyed to the internal combustion engine. Between these settings, the control valve exhibits a control path across which the proportion of the first fuel decreases continually and the proportion of the second fuel rises continually until finally the operation of the internal combustion engine is completely changed over from the first fuel to the second fuel.

- 30 Changing over between the types of fuel is extremely time-consuming since the change-over requires at least one fuel to be brought to a specified temperature due to the different viscosities that usually arise and the change-over therefore has to take place rather slowly.

It is therefore the object of the invention to provide a method for changing over the fuel supply to an internal combustion engine from a first fuel to a second fuel, that enables a fast change-over between two types of fuel, for example heavy fuel (HFO) and marine diesel fuel (MGO or MDO).

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The object is achieved by the method having the features of Claim 1. The sub claims specify advantageous embodiments of the invention.

10 During investigations regarding the present application it could be determined that the setting of the control element, for example a hand wheel or an automatically driven wheel, does not necessarily correlate with the control path of the control valve. For example, the control path of a control valve designed as a rotary valve coincides with the rotary range of the valve that the control element, that is to say the rotary valve, sweeps across completely only if the pressure in both tanks is identical and a conveying rate specific for the respective valve is
15 maintained, different conveying rates, for example 500 L/hour compared to 250 L/hour, resulting in small differences between the setting of the control valve and the starting and end position of the control path. Also the centre position of the control path where a 50:50 mixture of both fuels is present is then slightly shifted in the case of different conveying rates.

20 If, however, there is a pressure difference between the two tanks such as is the case for example at a different filling level of the tank, on the one hand it could be found that the length of the control path – that is to say the area in which there really is a change in the fuel composition – is considerably reduced relative to the starting and end position of the control valve, and therefore also the starting and end position of the control path no longer agrees
25 with the starting and end position of the rotary valve.

Expressed differently: if a pressure difference exists between the tanks, rotating the control element from its home position in the direction of its end position does not at first result in any change in the fuel composition fed to the internal combustion engine, since the starting
30 position of the control path is shifted in the direction of the end position of the control element. It is only after rotating the control element further and after reaching the starting

position of the control path that the fuel composition is changed continually, the end position of the control path being reached prior to the end setting of the control element.

For example in the case of a rotary valve, the shortened control path can now be specifically used for a faster change-over between the operation of the internal combustion engine with the first fuel to the operation with the second fuel, since the valve does not have to sweep at a low speed across the entire rotary range. For changing over, only traversing the control path is sufficient, which in the case of pressure differences between the tanks is shorter than the rotary range across which the rotary valve sweeps completely.

According to the invention, the control elements only has to be brought, as a function of the pressure difference between the two tanks, into that setting in which the starting position of the control path is located. This approaching can take place at a high speed since it is known that there is no change in the fuel composition between the starting setting of the valve and the starting position of the control path. Sweeping across this control path is then done (as is customary) in a predetermined time, the end position of the control path then being reached prior to the end setting of the control element. After the end position of the control path has been reached, the control element can then be brought in its end setting at an increased speed, since here, too, it is known that there is no longer a change in the fuel composition between the end position of the control path and the end setting of the control element.

To carry out the method, it is necessary, first of all, to determine the length of the control path for the fuel system that is connected to the internal combustion engine, as a function of different pressure differences between the two tanks and the first position of the control path, that is to say its starting position, and/or the second position of the control path, that is its end position, relative to the setting of the control element.

These values are entered into a table so that the setting of the control valve can be correlated with the control path for a specific pressure ratio between the tanks.

As an alternative, for regulating the system in the case of different pressure ratios of known length of the control path, the determination of the first or second position can be dispensed

with in that during on-going operation the first position, or when rotating the control element in the other direction the second position, is detected by means of a temperature change of the fuel that is conveyed by the control valve to the internal combustion engine. As mentioned above, the fuels must be brought differently to a specified temperature due all differing viscosities so that mixing both fuel types necessarily leads to a temperature change. However, a temperature change (of a predetermined level) marks the start of the control path so that this parameter can be detected in real time.

As an additional correction it is also recommended to determine the length of the control path both as a function of the pressure difference between the first tank and the second tank and also as a function of the conveying of the fuel to the internal combustion engine and to enter it in a table since in this case the control valve can be controlled even more precisely.

The pressure difference between the two tanks can take place in a particularly simple manner if the pressure difference is calculated from the filling level of the first tank and the filling level of the second tank.

Finally, the control valve is preferably designed as a rotary valve.

PATENT CLAIMS

1. A method for switching the fuel supply to an internal combustion engine from a first fuel to a second fuel,

- the first fuel being stored in a first tank and the second fuel being stored in a second tank,
- the tanks and the internal combustion engine being connected to each other by means of a rotary valve and
- the rotary valve having a control path for which the internal combustion engine is fed only the first fuel from the first tank in a first position, only the second fuel from the second tank in a second position, and a mixture of the first fuel and the second fuel in a plurality of additional positions arranged between the first position and the second position,

characterised in that

the setting of the rotary valve is correlated with the control path by means of a table, in which

- the length of the control path is associated with the pressure difference between the first tank and the second tank and the first position and/or the second position is associated with a predetermined setting of the rotary valve,

or

- the length of the control path is associated with the pressure difference between the first tank and the second tank and the first position or the second position is detected by means of a temperature change of the fuel conveyed to the internal combustion engine by the rotary valve.

2. The method according to claim 1, characterised in that the length of the control path is associated with the pressure difference between the first tank and the second tank as a function of the conveying rate of fuel to the internal combustion engine.

3. The method according to one of the preceding claims, characterised in that the length of the control path is traversed in a predetermined time.

4. The method according to one of the preceding claims, characterised in that the pressure difference is calculated from the filling level of the first tank and the filling level of the second tank.
5. The method according to one of the preceding claims, characterised in that the first fuel is heavy oil (HFO) and the second fuel marine diesel oil (MGO).