A method and apparatus for reducing the thermal load on a motor vehicle clutch system. The clutch includes at least a pressure plate, a clutch disk, and a flywheel, by way of which a torque is transmitted. The friction forces that exist on the respective friction surfaces of the clutch disk are unevenly distributed. The clutch is cooled by a flow of cooling air that is led through the clutch bell that encloses the clutch and that defines a housing. The cooling air is conducted from the existing ventilation air inlets of the vehicle, and a jet pump arranged in the exhaust system is disclosed for withdrawing the cooling air from the clutch housing.
Fig. 2
METHOD AND SYSTEM FOR COOLING THE CLUTCH SYSTEM OF A TRANSMISSION

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a method for the reduction of thermal loads and a method for cooling clutch systems, as well as a system therefor.

[0003] 2. Description of the Related Art

[0004] It has been shown that the thermal economy in clutch systems, such as, for example, a dry friction clutch, is problematic, especially at high power input. A thermal overload is especially to be suspected in a load-shift clutch of an uninterruptible transmission (USG).

[0005] The components of the clutch, especially the friction lining, have a limited temperature resistance, and the energy input is very high in relation to the available space, whereby the heat transfer to the environment is too low.

[0006] In addition, the pressure plate, for example, has a smaller heat capacity in contrast to the flywheel of the clutch. Furthermore, the heat flow to the surrounding parts is relatively low and the heat transfer to the surrounding air within the clutch bell housing is also low. Thus, there is a limit relative to the operation of the clutch system as a result of the expected temperature rise in known clutch systems, especially of the pressure plate.

[0007] Therefore, especially in load-shift transmissions, it is a necessity that the temperature load on the clutch be lowered by cooling measures. In the case of a so-called inline transmission, for example for a rear drive motor vehicle, an open type of construction, which of a certain size makes cooling possible (tunnel assembly, water spray, near the exhaust system), can only be realized with limitations.

[0008] The object of the present invention is directed to a method and a system of the above-described type that makes possible the optimal cooling of a clutch system of a power train, so that the operating conditions of the clutch system in particular are improved.

SUMMARY OF THE INVENTION

[0009] The object of the invention is particularly achieved by providing a method for the reduction of the thermal load on a clutch system with which torque is transmitted. The clutch system includes at least a pressure plate, a clutch disk, and a flywheel, whereby the frictional torque that exists at the time on the friction surfaces of the clutch disk is unevenly distributed.

[0010] The frictional load generated in the clutch system is determined by the frictional torque that acts and the relative speed. In known clutch systems an identical speed condition at both friction surfaces of the clutch disk is preferred. A solution can consequently lie in producing uneven frictional torques on the respective friction surfaces. In that way, the pressure plate, for example, can be supplied with a smaller portion of the frictional energy that occurs, so that the thermal load is reduced.

[0011] Within the scope of the invention a further embodiment can be provided in which different friction linings with different coefficients of friction can be utilized at the two friction surfaces of the clutch disk. The frictional load that is produced is thereby introduced unequally to the two friction surfaces by providing different friction parameters at both frictional sides of the clutch disk.

[0012] The frictional torque that is generated depends on the effective friction radius, the contact pressure of the pressure plate, and the coefficient of friction of the respective friction surfaces. Influencing the clutch system coefficient of friction conditions provides the possibility to suitably distribute the thermal load. It is also conceivable that the other influence values could be changed.

[0013] In the method in accordance with the invention several possibilities are provided for influencing the coefficient of friction conditions in the clutch system, which are described below.

[0014] For example, a lower coefficient of friction can be utilized on the pressure-plate-side friction surface of the clutch disk than on the flywheel-side friction surface, so that a lesser amount of frictional energy is introduced on the pressure plate than on the flywheel. In that way, a desired distribution of the frictional load can be realized. Thereby, in an advantageous way, lower thermal loads arise on the pressure plate.

[0015] In accordance with the invention, by the use of different friction linings on the clutch disk it can be provided that the respective friction partners on the flywheel-side are selected in such a way that a higher coefficient of friction arises when the temperature increases. For example, the clutch disk can have different friction linings on its two friction surfaces. The friction partners on the flywheel-side have such a type of temperature dependence that a higher coefficient of friction arises with increasing temperature. If, as expected, a higher temperature arises at the friction point during the operation of the clutch, the coefficient of friction on the pressure plate side decreases, so that the desired coefficient of friction difference is adjusted.

[0016] In addition, in accordance with the invention it can be provided that in the case of identical friction linings on the clutch disk two friction partners with different characteristics are utilized, so that the desired coefficient of friction difference or frictional torque distribution results. For example, the pressure plate and the flywheel can be made from combinations of the materials steel and aluminum.

[0017] Furthermore, in the case of identical friction linings on the clutch disk, it can be provided that the respective friction partners have such a temperature dependence that a lower coefficient of friction arises with increasing temperature, whereby a higher temperature exists on the pressure plate than on the flywheel, so that the desired coefficient of friction difference is realized.

[0018] The previously-described possibilities can also be arbitrarily combined in order to further improve the proposed method.

[0019] Alternatively, in the method in accordance with the invention it can also be provided that a higher coefficient of friction is utilized on the pressure-plate-side friction surface of the clutch disk, for example, than on the flywheel-side friction surface if the pressure plate is suitably cooled. In that way, under certain circumstances, namely when cooling measures are carried out at the pressure plate, a reverse
friction load distribution is also conceivable. Thereby, a higher temperature of the pressure plate, for example, can lead to an altogether better heat elimination at the clutch system by reason of a higher temperature differential. At the same time, it must be noted, however, that a temperature-resistant friction lining must be utilized at each friction surface as the friction lining.

Furthermore, the underlying object of the invention is also especially achieved in that a method is proposed for cooling the clutch in a power train of a motor vehicle, in which a flow of cooling air for the clutch is utilized. Furthermore, particularly for carrying out the method, a system for cooling the clutch of a power train of a motor vehicle is proposed, wherein a flow of cooling air is provided that can be conducted through the clutch bell surrounding the clutch as a housing.

Advantages and additional embodiments of the system and the method in accordance with the invention for cooling the clutch of a power train are described in greater detail below.

In accordance with an advantageous further development of the invention, the already-existing air inlets of the motor vehicle, for example for the ventilation of the interior, can be utilized as a cooling airflow to cool the clutch. Preferably, the flow of cooling air can be guided through the clutch bell that surrounds the clutch as a housing.

For that purpose, the inlets, for example, could be designed and dimensioned accordingly. All together, the advantage of using already-existing air inlets is that, for example, filters, deck pans, water drains, and the like, only have to be provided once in a motor vehicle because of their dual usage. In addition, by means of the air passages provided, acoustic advantages can be realized in contrast with open clutches.

Within the scope of an arrangement of the invention, the exiting cool air flow can be carried off to the environment using the existing exhaust gas system of the motor vehicle. The cool air flow can thus be carried off through the exhaust gas system together with the exhaust gas. Especially in motor vehicles with rear drive, the exhaust system is located near the transmission. In accordance with that arrangement there results the advantage that in that way clutch noises are not considered to be disturbing in the surrounding area because of the muffler.

Preferably, the cool air flow can be provided by a pump device provided in the exhaust gas flow of the exhaust gas system. The cool airflow can thereby be drawn off through the clutch bell. The pump device can especially be a jet pump, or the like, which is preferably provided in the exhaust gas stream. In that way, other necessary (active) cooling measures can be avoided.

It is also possible that the cool airflow is interrupted at least periodically through a shutter device in the exhaust system, so that an independent stationary exhaust gas measurement is made possible. Preferably, at least a flap, or the like, can be utilized as a shutter device.

Preferably, the proposed system and method can be utilized in high performance clutches, especially in a load-shift transmission (USG) and/or a double-clutch transmission (DKG).

BRIEF DESCRIPTION OF THE DRAWINGS

Additional advantages and embodiments follow from the dependent claims and the following description and drawings in which:

FIG. 1 is a schematic view of a system for cooling a clutch with a jet pump; and

FIG. 2 is a graph with the results of a simulation calculation for a method for reducing the thermal load of a clutch.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

There is shown in FIG. 1 one possible embodiment of a system in accordance with the invention to cool a clutch, whereby an engine 101 with a connected exhaust gas system 102, and a transmission 103 with a clutch bell 104, as well as a drive shaft 105, are shown in schematically. In addition, there is shown in FIG. 1 an exemplary existing air inlet 107, for example for the windshield for ventilating the motor vehicle interior, which is utilized additionally for the cooling airflow in accordance with the invention. Other air inlets can also be provided for the cooling airflow.

The cooling airflow can be withdrawn from the clutch bell 104 by means of at least one air outlet 108 through a jet pump 106. The jet pump 106 is located in the exhaust system 102, and which is shown larger in the FIG. 1 enlargement portion.

The system in accordance with the invention, by interconnection with the existing air inlet system and exhaust gas system provided in the motor vehicle, can enable the supply and withdrawal of the cooling airflow in accordance with the invention for the cooling of the clutch.

The system can especially be utilized in connection with a load-shift transmission (USG), a double-clutch transmission (DKG), and all types of high-performance clutches that require (air) cooling.

In FIG. 2 there is shown the result of a simulation calculation for a method for reducing the thermal load on a clutch. There are shown therein different temperature trends over time.

The simulation model was prepared for a load-shift clutch of a USG system. In that way, the effect of the changed coefficients of friction can be shown.

Moreover, the coefficients of friction of the respective friction surfaces are assumed, one time with a constant ratio (1:1) and one time with a ratio of 0.7:1. A plurality of maximum accelerations of the motor vehicle to a speed of 100 km/h were assumed as the loading. The upper curve of the pressure plate temperature TDP signifies the coefficient of friction ratio of 1:1, while the lower curve shows the pressure plate temperature TDP at the coefficient of friction ratio of 0.7:1.

One can clearly appreciate that the pressure plate temperature is lower at a coefficient of friction ratio of 0.7:1. The temperatures of the flywheel Tsr by comparison increased only slightly. That is perceptible in the curve for Tsr.
6. A method in accordance with claim 5, wherein the friction characteristics of at least one of the pressure plate and the flywheel are provided by a combination of steel and aluminum friction surfaces.

7. A method in accordance with claim 1, wherein the clutch disk has identical friction linings on respective sides thereof and each friction exhibits such interface has a temperature dependence in the case of identical to provide a lower coefficient of friction with increasing temperature, whereby a higher temperature occurs at the pressure plate than at the flywheel, so that a desired coefficient of friction difference is realized at the pressure plate and the flywheel sides of the clutch disk.

8. A method in accordance with claim 1, wherein a higher coefficient of friction exists at a friction surface on the pressure-plate side of the clutch disk than at a friction surface on the flywheel side when the pressure plate is cooled.

9. A method in accordance with claim 8, wherein a temperature-resistant friction lining is utilized as the friction lining at each friction surface.

10. A method in accordance with claim 1, including the step of introducing a cooling airflow into a housing that surrounds the clutch.

11. A method in accordance with claim 10, including the step of utilizing at least one existing air inlet for the ventilation of the interior of a motor vehicle as an inlet for the cooling airflow, and conducting the cooling airflow through the clutch housing.

12. A method in accordance with claim 10, wherein cooling airflow is withdrawn from the housing to the environment through an existing exhaust system of the vehicle.

13. A method in accordance with claim 10, wherein the cooling airflow is provided by a pump means positioned in the exhaust gas flow of the exhaust system.

14. A method in accordance with claim 13, wherein the pump means is a jet pump.

15. A method in accordance with claim 10, including the step of Periodically interrupting the cooling airflow by a blocking means to allow a stationary exhaust gas measurement.

16. A method in accordance with claim 15, wherein the blocking means is a shutter.

17. A method in accordance with claim 10, wherein the clutch is included in a power train that includes one of a load-shift transmission and a double-clutch transmission.

18. A system for cooling a clutch in a motor vehicle power train, said system comprising: a flywheel, a clutch disk, and a pressure plate, wherein the flywheel and the pressure plate frictionally engage respective opposed surfaces of the clutch disk, a clutch bell that surrounds at least the clutch disk and the pressure plate as a clutch housing, and means for introducing a cooling airflow into the clutch housing.

19. A system in accordance with claim 18, wherein the means for introducing cooling airflow includes as an air inlet at least one existing air inlet for the ventilation of the interior of the motor vehicle.

20. A system in accordance with claim 18, wherein an existing exhaust system of the motor vehicle is in communication with the clutch housing for withdrawal of cooling airflow from the clutch housing.
21. A system in accordance with one claim 20, including pump device is means in the exhaust gas flow of the exhaust system for producing the cooling airflow.

22. A system in accordance with claim 21, wherein the pump means includes at least one jet pump.

23. A system in accordance with claim 20, including blocking means provided in the exhaust system for blocking flow into an exhaust gas stream of cooling airflow from the clutch housing.

24. A system in accordance with claim 23, wherein the blocking means is a shutter.

25. A system in accordance with claim 18, wherein the system is incorporated into a motor vehicle power train that includes a high-performance clutches clutch and at least one of a load-shift transmission and a double-clutch transmission.

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