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(54) **METHOD FOR THE CIRCULATION OF AN OIL QUANTITY AND AN OIL CIRCUIT FOR THE PERFORMANCE OF THE METHOD**

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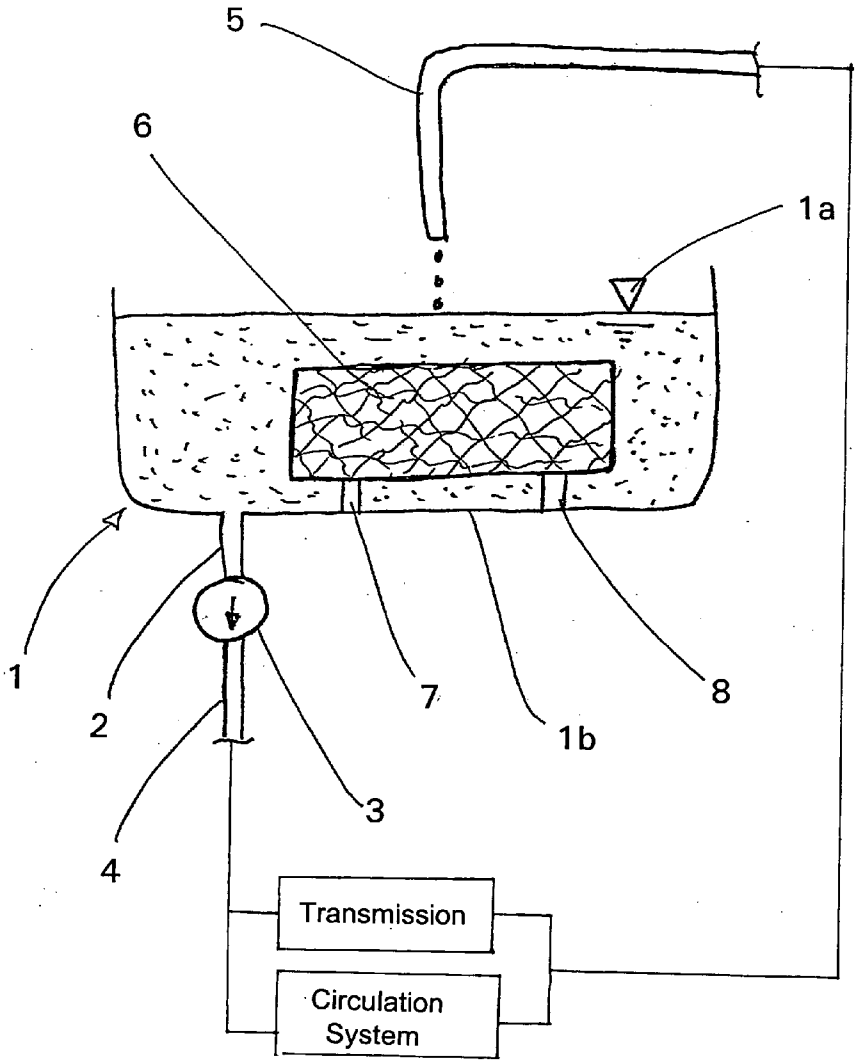
(57) **ABSTRACT**

A procedure for the circulation of a quantity of oil in an oil circulation system of a transmission of a motor vehicle and also concerns an oil circulation system. A portion of the quantity of the oil, which oil is at a lower temperature and a higher viscosity, is retained in a stationary, porous storage medium, from which, upon increasing oil temperature and lessening viscosity, the oil may be removed and entrained in the existing circulating oil quantity. Preferably, the storage medium is placed within an oil pan.



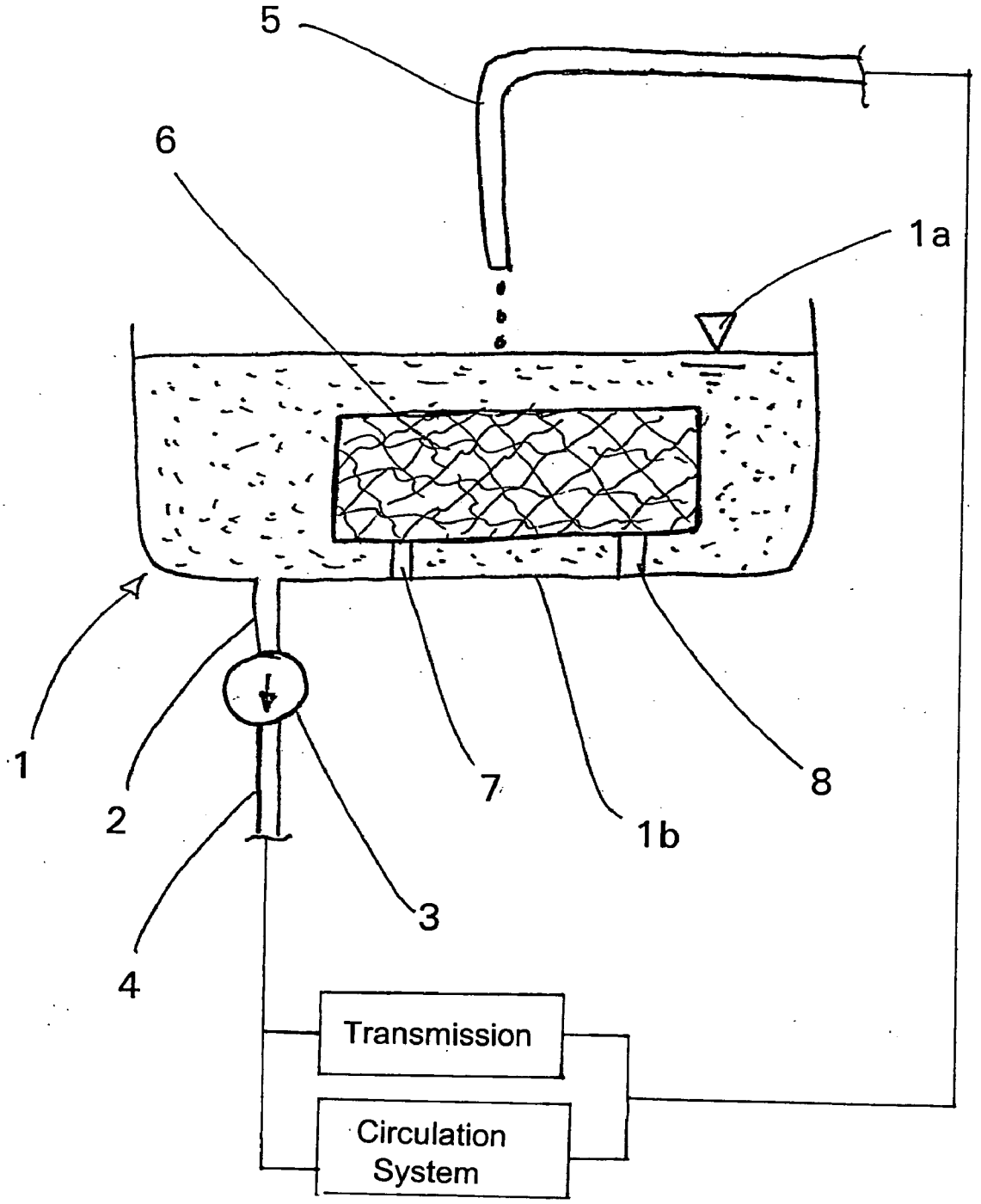


Fig. 1

METHOD FOR THE CIRCULATION OF AN OIL QUANTITY AND AN OIL CIRCUIT FOR THE PERFORMANCE OF THE METHOD

[0001] The invention concerns first a procedure for the circulation of a quantity of oil in accord with the generic concept of patent claim **1** and second an oil circuit for a transmission in accord with the generic concept of claim **2**.

[0002] Oil, which is in circulation in a motor vehicle transmission, exhibits temperature related viscosities, wherein a high viscosity at low temperatures leads to increased friction in the gear train, increased power consumption by the pump and a degradation of the efficiency of the drive action of the motor vehicle while the warm-up phase lasts. The proposition has already been made to warm the oil more rapidly in an oil circulation system, in order the shorten the heating phase and to reach a more favorable efficiency.

[0003] In DE 199 12 327 A1 the applicant proposes, that the oil pan in a lubricating oil circuit of a motor vehicle transmission be divided into two chambers, wherein the heating phase takes oil out of only one chamber and thus leaves only a partial quantity circulating in the lubricating oil for the purpose of more rapid preliminary heating. When this is done, returning, now heated oil yields a part of its heat to the retained oil in the second chamber. This mixed oil is then successively mixed with the oil in the first chamber by a connection thereto. This solution, definitely brings about a quicker heating of the oil, but yet has the potential for improvement and a further reduction of the warm-up period of the oil.

[0004] Thus it is the purpose of the present invention, to shorten and improve a procedure of the generic kind described in the opening passages for the initial heating period for the oil. Further, it is also the purpose of the present invention, to make available an oil circulation system, which permits a rapid heating of the oil and is simple to install.

[0005] This purpose is achieved in both parts by the features of the patent claims **1** and **2**. In accord with claim **1**, the proposal is, that cold oil with a high viscosity is retained in a porous storage medium, removed therefrom upon increasing temperature and reduced viscosity and mixed with the already circulating oil. Thereby, upon a cold start of the motor, a small quantity of oil is already in circulation, which warms itself relatively quickly and yields its heat in the reflux flow directly to the retained oil in the storage medium, now of higher viscosity. In accord with claim **2**, an oil circulation in a motor vehicle transmission is proposed, which is especially applicable for the carrying out of the invented procedure. In accord with the invention, provision has been made, that the said porous medium can be optionally placed in the course of the circulation, but most favorably within the transmission housing and/or in the oil pan. The advantage arises in connection with the invented storage medium, that an optionally given amount of cold oil is held out of circulation, until it has reached a sufficient temperature. For the placement of the storage medium, no extensive installation operation, nor any valves, partition walls or interception walls are necessary. The porous storage mass can be in an optional shape, for example, placed in the oil pan on the bottom or on the sides and in that place fulfill its temporary, temperature conditioned, storage and retention functions for the oil. The size of the pores is so selected, that the storage medium can accept "thick" oil easily. "Thinner" oil, i.e., heated oil, will be released from said porosity of the storage medium without significant resistance. With this arrangement, the advantage of a quick heating of the oil and an increase of the transmission efficiency is obtained.

[0006] An advantageous embodiment of the invention can be found in the subordinate claims. In accord therewith, the storage medium can be made of various materials, which exhibit specific porosity or permeate retention. These materials could be, for example, foamed metal, or woven stranded metal, or a feltlike substance. Ceramic and plastic substances are also possible, directly as porous materials or again woven. Advantageously, the storage medium can have an elevated hollow space portion, wherewith the advantage of a small internal reservoir, i.e., additional storage space is available.

[0007] In a further advantageous formation of the invention, the storage medium can undertake additional functions, namely those of an oil filter, heat insulation or body noise abatement. The latter can especially be achieved, in that the oil pan and/or parts of the transmission housing can be internally lined with the said storage medium. With such a lining, the advantage of loss of heat during the heating-up phase and the emission of noise is still retained.

[0008] One embodiment of the invention is presented in the drawing and is described in greater detail in the following.

[0009] **FIG. 1** exhibits an exemplary, partial component of a complete oil circulation system, the complete system not being shown. Depicted is an oil pan **1**, this being a supply tank for refluxed oil. The part of the complete system can be for an automatic transmission with a circulation system for oil serving both lubrication and hydraulic pressure purposes. In the oil pan **1**, the oil is shown at an oil level **1***a*. The oil pan possesses a bottom **1***b* and an oil exit line **2** extending therefrom. The oil is removed from the exit line **2** by a pump **3** and injected into the additional circulation system **4** (not shown). After completing its function in an entire circulation system **4**, the oil is returned from a transmission exit through an oil return line **5**, thereby regaining its storage in the oil pan **1**. Within the oil volume in the oil pan **1**, which is limited by "oil level 1a", a solid body made of a porous storage medium **6** is found in place, this being generally a foamed metal, which has a high effective space portion and is thus in a position to accept and store the incoming oil. The storage medium **6** is here, as an example, depicted as a somewhat rectangular sided block and supports itself on two feet, namely **7**, **8**, on the bottom **1***b* of the oil pan **1**. The storage medium **6** lies, thus not directly on the bottom **1***b*, but is available for oil contact on all sides, even with oil flowing therebeneath. Another arrangement of the storage medium **6** could be considered, wherein an inner cladding of the oil pan **1** with a layer of the storage medium **6** material. Thereby, it is possible that both heat insulation of the oil pan **1** is acquired and noise radiation is prevented.

[0010] The function of the storage medium **6** is as follows: Upon a cold start of the internal combustion motor of the vehicle, cold viscous oil is found in the oil pan **1**, which flows only with difficulty. A part of all the oil, which is intended to be circulated, is found in the storage medium **6**. The pump **3** transfers only that oil which is to be found

outside of the storage medium **6**, that is to say, the pump moves a portion of the oil into the oil circulation system **4**, from which the portion returned, now at an elevated temperature, reenters the oil pan **1** through the return line **5**. In this way, the resident oil in the oil pan **1** is heated. This heat is then immediately transferred by conduction and convection to the oil in the storage medium **6**. The oil in the storage medium **6** then becomes more fluid, which allows it to preferentially leave the storage medium **6** and enter into the supply of oil to the pump **3** to join the general circulation of oil. Thereby, successively, more and more of the oil retained in the storage medium **6** mixes into the circulating oil and is heated. The respective oil, which has been circulating through the transmission thus reaches its operating temperature more rapidly, so that the transmission can operate earlier with a better efficiency.

[**0011**] The storage medium **6** is not only fully surrounded by the oil flow, but to a certain degree is subjected to a through-flow of oil, whereby it provides an oil filtering function simultaneously. That is to say, the contaminate particulate in the oil is retained by the porosity of the storage medium **6**.

[**0012**] Reference Numerals

[**0013**] **1** Oil pan

[**0014**] **1***a* Level of oil in oil pan

[**0015**] **1***b* Bottom of oil pan

[**0016**] **2** Outlet connection for oil from pan

[**0017**] **3** Pump in outlet connection line

[**0018**] **4** Oil circulation system (not shown in its entirety)

[**0019**] **5** Return line from oil circulation system

[**0020**] **6** Storage medium

[**0021**] **7** First support foot for storage medium

[**0022**] **8** Second support foot for storage medium

1-11. (CANCELED)

12. A method of circulating of a quantity of oil in a oil circulation system of a transmission for a motor vehicle, the method comprising the steps of:

upon a cold start, retaining a portion of the quantity of oil at an initial temperature and an initial viscosity in a positionally affixed, porous storage medium; and

upon the portion of the quantity of oil retained by the storage medium increasing in temperature and decreasing in viscosity, due to circulation of general oil circulating within the oil circulation system, gradually discharging oil from the storage medium and combining the discharged oil with the general oil circulating within the oil circulation system.

13. The oil circulation system of a transmission of a motor vehicle, in which the oil circulation system comprises:

a transmission housing;

a plurality of oil lines (**2**, **4**, **5**);

a fluid transport pump (**3**); and

an oil pan (**1**);

wherein a porous storage medium (**6**) is located within the oil circulation system for acceptance of a portion of the circulating oil, upon a cold start, a portion of the quantity of oil at an initial temperature and an initial viscosity is retained in a porous storage medium; and

upon the portion of the quantity of oil retained in the storage medium increasing in temperature and decreasing in viscosity, due to circulation of general oil circulating within the oil circulation system, oil is gradually discharged from the storage medium and combined with the general oil circulating within the oil circulation system.

14. The oil circulation system according to claim 13, wherein the storage medium (**6**) is one of a foamed metal and a metal weave.

15. The oil circulation system according to claim 13, wherein the storage medium (**6**) comprises a felt like, permeable material.

16. The oil circulation system according to claim 13, wherein the storage medium (**6**) is one of a ceramic material and a plastic material.

17. The oil circulation system according to claim 13, wherein the storage medium (**6**) is an elevated hollow space.

18. The oil circulation system according to claim 13, wherein the porosity of the storage medium (**6**) is adaptable to the viscosity of the oil.

19. The oil circulation system according to claim 13, wherein the storage medium (**6**) is placed in, and affixed within the oil circulation system as a rigid body, subjected to flow of oil around and through the storage medium (**6**).

20. The oil circulation system according to claim 13, wherein the storage medium (**6**) is located within least one of the transmission housing and the oil pan (**1**).

21. The oil circulation system according to claim 13, wherein the storage medium (**6**) is used as an oil filter.

22. The oil circulation system according to claim 13, wherein the storage medium (**6**) is used for heat insulation.

23. The oil circulation system according to claim 20, wherein the storage medium (**6**) is used as a body noise damping for one of the transmission housing and the oil pan.

24. An oil circulation system for circulating of a quantity of oil for a motor vehicle, the oil circulation system comprising:

a first portion of the quantity of oil circulating within the circulating system, the first portion of the quantity of oil being at a first temperature and a first viscosity; and

a porous storage medium within the circulation system, the porous storage medium retaining the first portion of the quantity of oil at the first temperature and the first viscosity, and upon the first portion of oil sufficiently increasing in temperature and sufficiently decreasing in viscosity, dispensing the first portion of the quantity of oil and replacing the dispensed oil with oil circulating within the oil circulation system.

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