

SPECIFICATION

Clutch with coolant flow control

5 This invention relates to a clutch with new and improved coolant flow control means to provide no coolant flow when the clutch is disengaged and to provide coolant flow on clutch engagement.

The clutch disclosed herein may be used in a jet engine start system and is used to transmit variable power in the starting cycle depending upon a control pressure applied to the clutch for controlling the degree of engagement of the clutch plates. This mode of operation involves slippage which creates heat due to friction and, therefore, the clutch is constructed to have a substantial flow of coolant through the clutch. An initial step in the cycle is to start certain components by driving of a motor from an accumulator and in previously disclosed clutches 10 it has been found that a time delay in operation is caused by coolant flow through the clutch which provides too much drag torque. In order to reduce the drag torque, the invention disclosed herein provides for shutting off the coolant flow during the initial step of the cycle when the clutch engagement control pressure is of a relatively low value and initiating coolant flow when the control pressure is at a higher value.

It is known in the prior art to have clutches with 30 coolant flow and with the flow of the coolant controlled by means responsive to a control pressure for controlling clutch engagement. The prior art does not show a structure of the type disclosed herein wherein components are structurally related to provide the desired results with a minimum 35 number of parts and with the minimal addition of weight which is of particular importance in structure associated with aircraft.

The invention provides a clutch with coolant flow 40 control means comprising clutch members arranged around a clutch drum that has at one end thereof an inlet opening for hydraulic pressure fluid, the clutch members being movable into clutching engagement with one another in response to a predetermined 45 hydraulic control pressure of the hydraulic pressure fluid acting on an actuating member, and a coolant flow path longitudinally through a central hollow portion of the clutch drum from an inlet opening at the other end thereof and outwardly through one or 50 more passages in the drum to the clutch members, wherein a control valve is provided in the central hollow portion of the clutch drum and has a valve member located on the axis of the drum and biased by a spring to a piston blocking coolant flow to the 55 one or more passages, a piston located on the axis of the drum and exposed to the hydraulic control pressure of the hydraulic pressure fluid and an axial rod between the piston and the control valve for moving the control valve against the bias of the spring to permit coolant flow through the one or 60 more passages to the clutch members.

The clutch preferably has an outer drum around the above (inner) drum and the clutch members, and advantageously the invention provides such a clutch 65 with coolant flow control means wherein the inner

clutch drum has a surrounding clutch chamber housing the interengageable clutch members.

The invention is illustrated by the drawing which is a central vertical section of a preferred clutch 70 according to the invention.

The clutch structure includes an inner clutch drum, indicated generally at 10, and an outer clutch drum, indicated generally at 11, which are concentrically arranged and with the outer clutch drum 11 being 75 mounted for rotation relative to the inner clutch drum by a pair of bearings 15 and 16. The inner clutch drum 10 is driven from a drive train including an input gear 17 secured thereto and the clutch output is from a gear 18 integral with the outer clutch drum 11. A generally annular space between the 80 inner and outer clutch drums defines a clutch chamber with a series of interfitted clutch members in the form of clutch plates 20 positioned within the chamber. Alternate clutch plates 20 are attached to the inner clutch drum 10 by fitting on keys 21 85 extending longitudinally of the inner clutch drum and the remaining clutch plates 20 are fitted to keys 22 carried on the inner surface of the outer clutch drum 11.

The engagement of the clutch plates 20 is under 90 the control of a piston 25 which is slidably mounted on a central tubular hollow section 26 of the inner clutch drum. The piston 25 may move to the right, as viewed in the Figure, to engage an end plate 27 95 which is keyed to the inner clutch drum keys 21 to compress the clutch plates. A control pressure for clutch engagement is delivered through an opening 30 in the tubular section 26, with flow passages 31 delivering control pressure into a chamber defined 100 by a housing 32 in which the piston 25 moves and which is sealed thereto by an O-ring. The clutch plates are disengaged by a disengagement spring 25 surrounding the central tubular section 26 and acting on the piston 25 in a direction to move the piston 105 toward the left when the control pressure is reduced. The flow of coolant for cooling the clutch plates 20 is through an inlet 40 at one end of the central tubular section of the inner clutch drum and through radial passages 41 in the wall of the section. The foregoing 110 structure is generally known in the art.

A sleeve 45 is fitted within the hollow interior of the inner clutch drum and defines a pair of chambers 46 and 48 with a connecting passage 51. The chamber 48 has a series of radial passages 50 115 adjacent one end thereof for directing coolant flow from the chamber 48 to the clutch chamber with flow through the radial passages 41. A control valve having a valve member 55 is located within the chamber 48 and urged to the position shown by a spring 47 whereby the valve member blocks the radial passages 50 to prevent coolant flow from the inlet 40 to the clutch chamber. 120

The chamber 46 has an actuating member in the form of a piston 60 movable therein and subject to 125 control pressure by means of a passage 61 which connects with the previously mentioned opening 30. The actuator piston 60 and the valve member 55 are mechanically interconnected by a rod 62 disposed in the passage 51 whereby control pressure acting on 130 the piston 60 controls the position of the valve

member 55 subject to the force of the spring 47.

When the control pressure is of a relatively low value, the force generated thereby on the piston 60 is not sufficient to overcome the force of the spring 47 and the valve member 55 remains in the position shown. Thus, there is no coolant flow to the clutch chamber and no drag torque resulting from the coolant flow. When the control pressure increases to a value sufficient to overcome the force of the spring 47, the piston 60 and the valve member 55 move to the right to have the valve member uncover the radial passages 50 whereby coolant can flow to the clutch chamber. This coolant flow is through a series of longitudinally-extending passages 65 in the valve member 55. These passages permit coolant to always be present at both sides of the valve member to equalize the forces on the valve member from pressure of the coolant. Once the valve member is shifted to the right to open the radial passages 50, coolant flows through the passages 65 of the valve member and through the radial passages 50 to the clutch chamber. Subsequently, when the control pressure drops to a value sufficient to let the spring 47 move the valve member back to the position shown in the Figure, the coolant flow is cut off from the clutch chamber. The chamber 46 has ports 69 to permit connection of the chamber behind the piston 60 to case pressure. The outer clutch drum 11 has a plurality of openings 70 in the wall thereof to permit coolant to leave the clutch chamber.

In operation of the system using the clutch disclosed herein, clutch control pressure is low during acceleration of a starter turbine and, thus, coolant flow is not delivered to the clutch chamber to avoid drag torque. When the starter turbine reaches operating speed and the clutch is to operate, the control pressure increases to operate the clutch and immediately thereafter the loading of the spring 47 is overcome to shift the valve member 55 and permit coolant flow to the clutch chamber.

CLAIMS

1. A clutch with coolant flow control means, comprising clutch members arranged around a clutch drum that has at one end thereof an inlet opening for hydraulic pressure fluid, the clutch members being movable into clutching engagement with one another in response to a predetermined hydraulic control pressure of the hydraulic pressure fluid acting on an actuating member, and a coolant flow path longitudinally through a central hollow portion of the clutch drum from an inlet opening at the other end thereof and outwardly through one or more passages in the drum to the clutch members, wherein a control valve is provided in the central hollow portion of the clutch drum and has a valve member located on the axis of the drum and biased by a spring to a position blocking coolant flow to the one or more passages, a piston located on the axis of the drum and exposed to the hydraulic control pressure of the hydraulic pressure fluid and an axial rod between the piston and the control valve for moving the control valve against the bias of the spring to permit coolant flow through the one or

more passages of the clutch members.

2. A clutch according to claim 1, wherein the clutch members are clutch plates.

3. A clutch according to claim 2, wherein the clutch drum is an inner drum of a pair of relatively rotatable drums, and the inner and outer clutch drums are keyed to different ones of the clutch members so as together to form drive and driven members of the clutch.

4. A clutch according to any preceding claim, wherein the valve member has one or more coolant flow passages therethrough to balance fluid pressure forces acting thereon due to coolant pressure.

5. A clutch according to any preceding claim, wherein the spring bias on the valve member is provided by a compression spring.

6. A clutch according to any preceding claim, wherein one end of the piston is exposed to the hydraulic control pressure and the other end is exposed to the coolant pressure.

7. A clutch according to any preceding claim, wherein the hydraulic control pressure necessary to move the piston and valve member against the bias is more than the predetermined hydraulic control pressure.

8. A clutch with coolant flow control means, substantially as described herein with reference to the drawings.

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