



US 20080121483A1

(19) **United States**

(12) **Patent Application Publication**

Sasse et al.

(10) **Pub. No.: US 2008/0121483 A1**

(43) **Pub. Date: May 29, 2008**

(54) **HYDRODYNAMIC TORQUE CONVERTER**

**Publication Classification**

(75) Inventors: **Christoph Sasse**, Schweinfurt (DE); **Bernd Reinhardt**, Schonungen (DE)

(51) **Int. Cl.**  
**F16H 45/00** (2006.01)

(52) **U.S. Cl.** ..... **192/3.3**

(57) **ABSTRACT**

Correspondence Address:

**COHEN, PONTANI, LIEBERMAN & PAVANE**  
**551 FIFTH AVENUE, SUITE 1210**  
**NEW YORK, NY 10176**

A hydrodynamic torque converter includes a housing with an interior space and a pump wheel; a turbine wheel installed in the interior space and rotatable about an axis with respect to the housing; and a bridging clutch including a first friction formation connected essentially nonrotatably to the converter housing, and a second friction surface formation connected essentially nonrotatably to the turbine wheel. A piston element divides the interior space into a first space containing the turbine wheel and a second space facing away from the first space, wherein a pressure increase in the second space brings the first and second friction formations into frictional engagement to connect the housing to the turbine wheel for rotation in common. Fluid flow openings in the piston element connect the second space to the first space in the radial area of the friction surface formations.

(73) Assignee: **ZF Friedrichshafen AG**, Friedrichshafen (DE)

(21) Appl. No.: **11/986,182**

(22) Filed: **Nov. 20, 2007**

(30) **Foreign Application Priority Data**

Nov. 23, 2006 (DE) ..... 10 2006 055 271.7

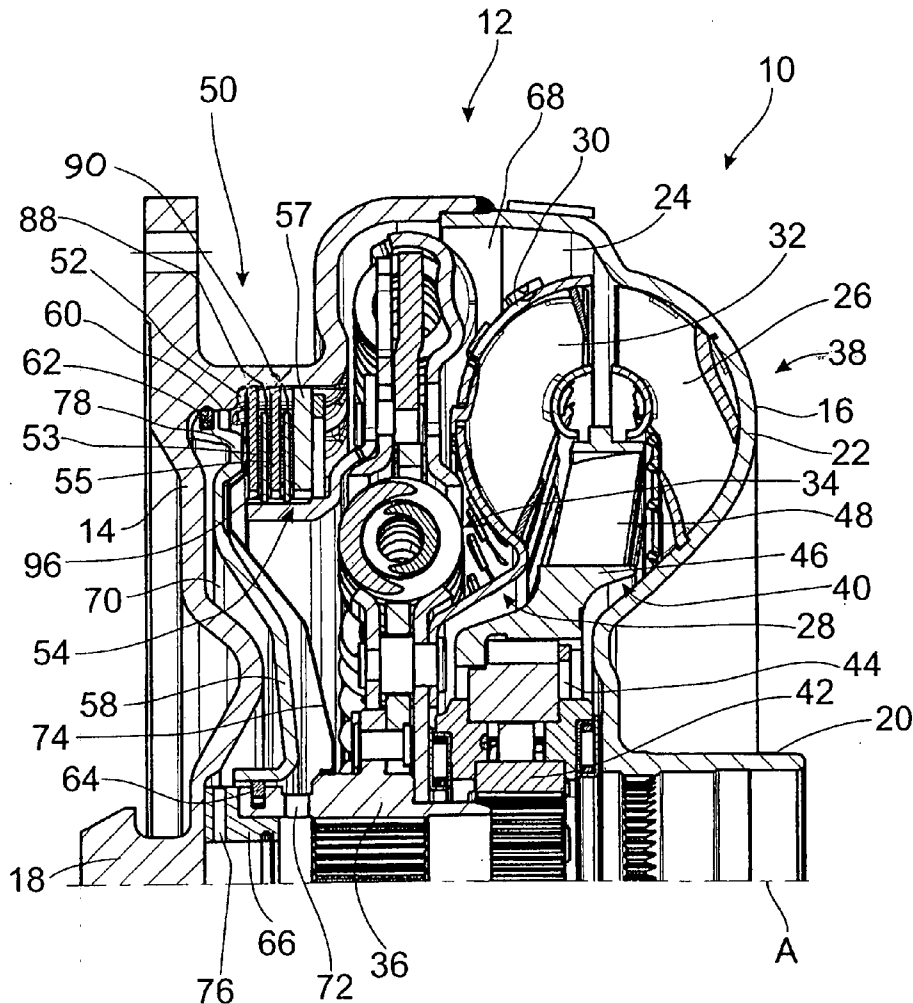


Fig. 1

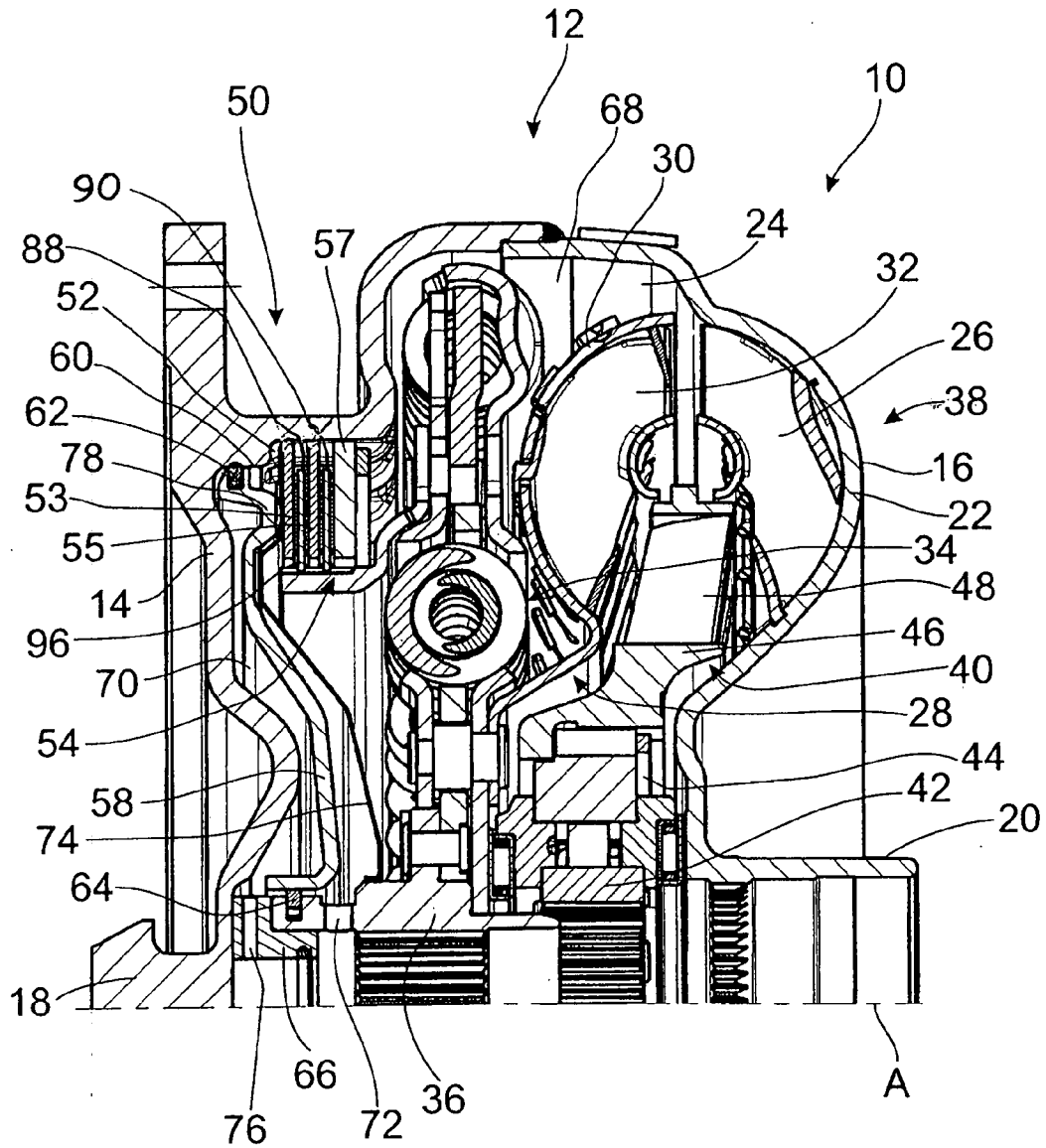


Fig. 2

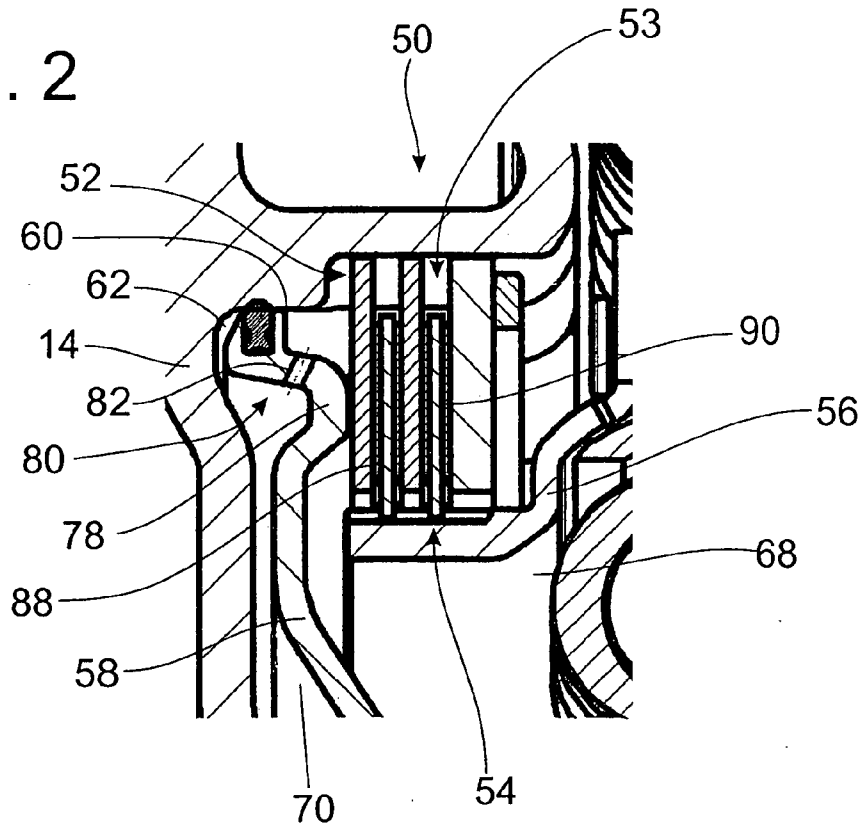
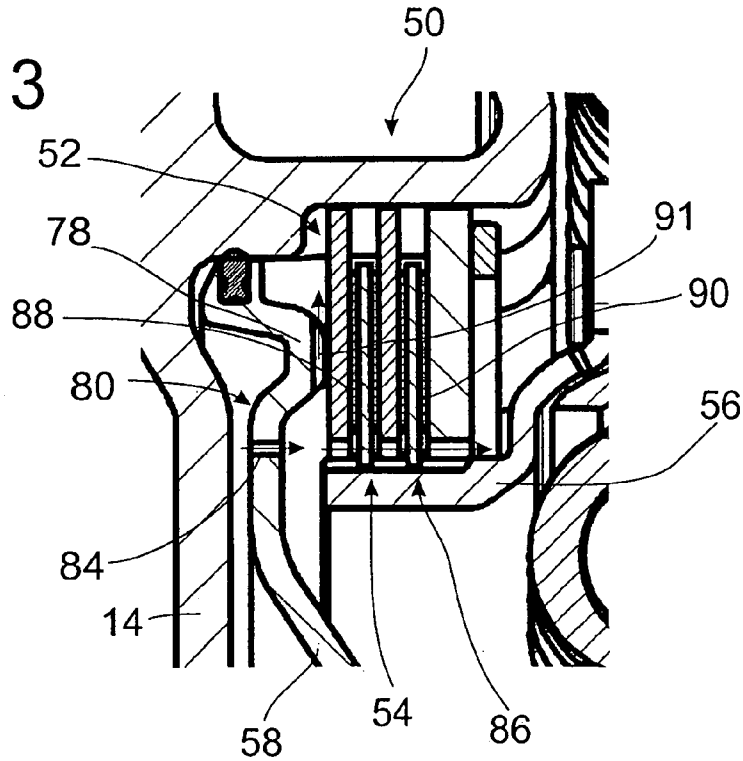
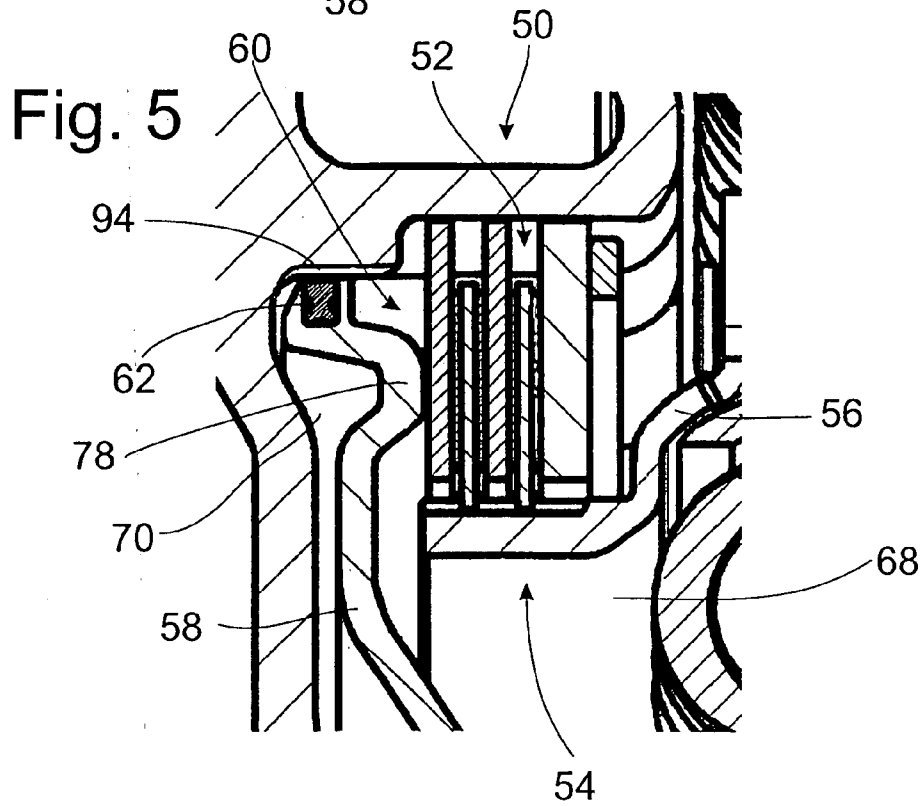
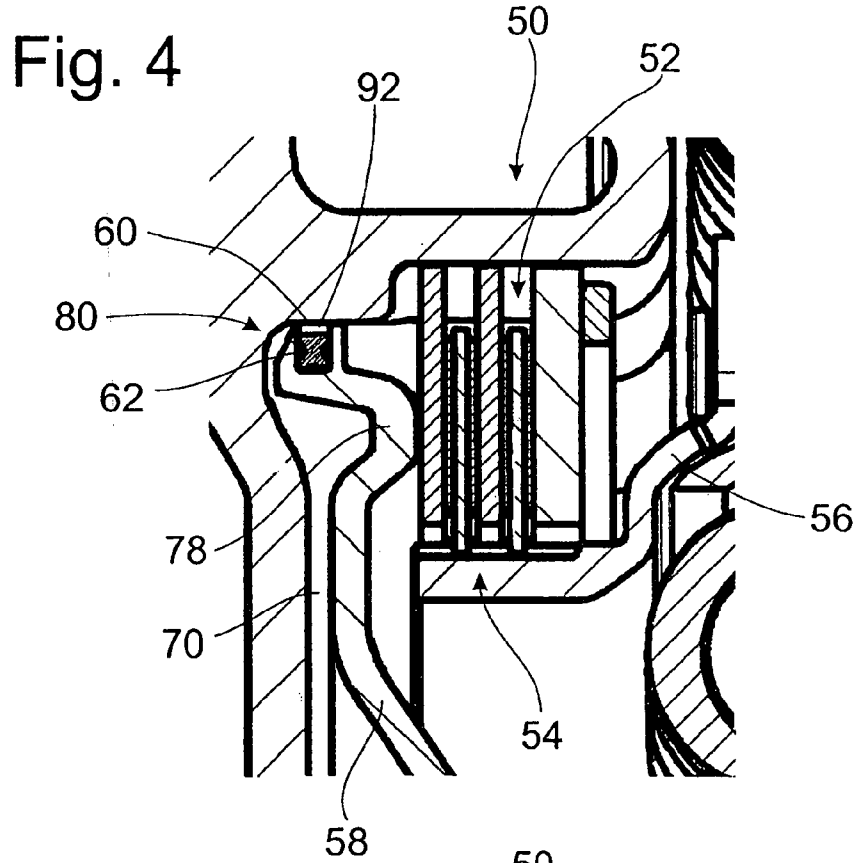


Fig. 3





## HYDRODYNAMIC TORQUE CONVERTER

### BACKGROUND OF THE INVENTION

#### [0001] 1. Field of the Invention

[0002] The present invention pertains to a hydrodynamic torque converter including a converter housing with a pump wheel; a turbine wheel installed in an interior space of the converter housing; and a bridging clutch arrangement with a first friction surface formation, which is connected essentially nonrotatably to the housing, and a second friction surface formation, which is connected essentially nonrotatably to the turbine wheel. The interior space of the housing is divided by a piston element into a first space containing the turbine wheel and a second space separated from the first space in an essentially fluid-tight manner. When the fluid pressure in the second space is increased, the actuating area of the piston element brings the friction surface formations into frictional engagement with each other and thus connects the housing and the turbine wheel together for rotation in common around an axis of rotation.

#### [0003] 2. Description of the Related Art

[0004] A hydrodynamic torque converter of this type is known from U.S. Pat. No. 5,964,329, in which each of the two friction surface formations is formed by several ring-like disk or ring-like plate friction elements. These can be pressed into frictional engagement with each other by the piston element. The radially inner area and the radially central area of the piston element are guided with freedom of axial movement along the housing in a fluid-tight manner. Therefore, the second space is also situated radially in the area between the radially inner seal and the radially central seal. In an area extending over the radially central seal and beyond in the radially outward direction, the piston element extends into the area of the friction surface formations and is able to press these against each other when the pressure in the second space is increased. So that heat can be dissipated more effectively from the area of these frictionally interacting friction surface formations, the piston element has a pass-through opening outside the area in which it forms part of the boundary of the second space to allow the fluid introduced into the first space to flow onto the side of the radially outer area of the piston element facing away from the friction surface formations and thus to allow the fluid introduced into the first space to flow more effectively around the frictionally interacting surface areas.

### SUMMARY OF THE INVENTION

[0005] An object of the present invention is to design a hydrodynamic torque converter in such a way that, in the area of the friction formations to be brought into frictional interaction with each other, a better cooling action can be provided by the fluid to be introduced into the interior of the housing.

[0006] According to the invention, a fluid flow arrangement which connects the second space to the first space is provided in the piston arrangement in the radial area of the friction surface formations.

[0007] In comparison with the previously indicated prior art, the hydrodynamic torque converter of the inventive design offers various advantages. First, the fluid flow opening arrangement establishes a connection between the second space and the first space. Especially when the bridging clutch

with each other, the fluid pressure in the second space is higher than that in the first space, which means that fluid will flow at comparatively high pressure and correspondingly high velocity through the fluid flow opening arrangement. This leads to a significant improvement in the forced flow of fluid around the surfaces areas to be cooled. Because the fluid flow opening arrangement is located in the radial area of the friction surface formations, that is, precisely where the heat is generated by friction and precisely in the area from which the heat must be carried away, optimal use can thus be made of the cooling action which can be achieved.

[0008] The hydrodynamic torque converter can be designed in such a way, for example, that a first fluid supply channel arrangement has a feed channel area leading to the first space and a discharge channel area leading away from the first space, and that a second fluid supply channel arrangement is provided to supply fluid to the second space and to carry it away from that space essentially independently of the first fluid supply channel arrangement. This means that the converter is of the so-called 3-line type; that is, the fluid feed to the first space can occur separately or independently of the fluid feed to the second space.

[0009] It is also possible, for example, for the first friction surface formation to comprise at least one ring-shaped disk element connected essentially nonrotatably to the housing and for the second friction surface formation to comprise at least one ring-shaped disk element connected essentially nonrotatably to a friction element carrier.

[0010] The fluid flow opening arrangement can comprise at least one through-opening formed in the piston element. The minimum of one through-opening in the piston element can extend through the piston element at a radially outward-directed slant from the second space to the first space. As a result of this slanted positioning, that is, at an angle to the axis of rotation and at an angle to a plane perpendicular to the axis of rotation, advantage can be taken of the centrifugal forces acting on the fluid flowing into the second space to promote the flow. As a result of this flow direction, which is already directed radially outward onto the friction surface formations, furthermore, the effect of a jet nozzle is obtained, which provides an even greater boost to the radially outward transport of fluid into the first space.

[0011] Alternatively, it is possible for at least one through-opening in the piston element to proceed essentially in the axial direction. This is especially advantageous in cases where the minimum of one friction element of the second friction surface formation is connected essentially nonrotatably to the carrier by a set of teeth and at least one through-opening leading to the first space is present in the radial area of this set of teeth. In this case, the fluid leaving the second space flows directly into the area in which at least one friction element is connected to the carrier. In the area of the teeth which form this connection, intermediate spaces are usually present, which allow the fluid to pass through in the axial direction and thus promote the distribution of fluid over the entire area of the frictionally interacting surfaces.

[0012] So that effective use can be made of the centrifugal force effects already mentioned, it is also proposed that at least one through-opening be provided radially inside the actuating area of the piston element and that, in the actuating area, at least one through-channel be provided, which bridges the actuating area in the radial direction.

# Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

## Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

## Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

## Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

## API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

## LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

## FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

## E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.