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Powertrain System HANT

Hydraulic Pump/Motor

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MASTER

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Hydraulic Pump/Motor

Development

The development of the new Hydraulic Pump/Motor is the main part of the Powertrain-System HANT. Several Engineering Models of the same design have been tested to prove that the new concept is effective. The important ranges: Maximum pressure and rpm and low power (low pressure, rpm, swashplate angle) were tested successfully. The efficiencies in all areas have already shown the same or better data than those of the best products on the market. The tests have been conducted in Switzerland (maximum power) in 1987 and at the UWM-Madison, Wisconsin (low power efficiency) in 1988.

Based on these data and several new useful design features the Engineering Model has been updated. In addition, the reduction of unnecessary safety factor, new materials and mass-production like manufacturing methods, has lead to an significantly improved Prototype Design. The updated version and its expected improved technical data are shown on the following pages.

Technical Information

Hydraulic Pumps/Motors – Axial–piston Type are currently used for heavy equipment (e.g. caterpillar), industrial applications and other equipment where continuous variable transmission (CVT) or high power density is needed.

The table below shows the disadvantages of present pump/motors. The data are for units with a displacement of approximately 6 cuin/rev:

– Small adjustment range (swashplate angle)	2.5 : 1
– Low speed ranges	500–3500 rpm
– Medium to poor efficiency	70–93%
– High noise level	75–95 dBA
– Heavy and expensive	125 lbs

The new Hydraulic Pump/Motor shows significant improvements in all areas and should eliminate the disadvantages almost entirely. The (expected) improvements are:

+ Adjustment range	+100%	5 : 1
+ Revolutions	+70%	500 – 6000 rpm
+ Efficiency, losses	(–50%)	84–96%
+ Noise	(–50%)	70–85 dBA
+ Weight and size	–66%	42 lbs

Range of Application

The advanced technical data of the new Hydraulic Pump/Motor broadens the range of application noticeably and simplifies present arrangements. The main factors are an improved efficiency and power to weight ratio, but most noticeably a drastically increased Transformation Ratio:

<u>Ratio Factor</u>	Present		New		Factor Increase
	Range	Factor	Range	Factor	
Adjustment Angle (°)	8–18°	2.3	7–32°	4.6	2.0
Revolution (rpm)	500–3200	6.4	500–6000	12	1.9
Pressure (psi)	1500–6000	4	1500–8000	5.3	1.3
Transformation Ratio		59		293	
Sum: Factor Increase	5.0				

Rexroth A4

Engineering
Model

HANT

Prototype

15°

25°

32°

5

Scale 1:1

COMPARISON OF SIZE

Rotational Parts

Pump/Motor (reversible)

Max. Output: 245 hp (180 KW)

COMPARISON OF TECHNICAL DATA

Technical Data	Producer Dimension	SAUER-SUNDSTRAND			REXROTH		LINDE		HANT	
		EATON							Engineering Model	Prototype
Displacement	cu.in./rev	6.0	5.5	6.1	5.5	6.1	5.5	6.1	5.5	6.1
Pressure	psi	6900	6000	6000	6000	6000	6000	6000	6000	8000
Revolution	rpm	3600	2900	2800	2900	2800	3800	6000	3800	6000
Adjustment Angle	°	18	15	18	15	18	25	32 ²	25	32 ²
Secondary Drive	%	50	<30	<30	<30	<30	100	100	100	100
Power	hp	397	245	263	245	263	321	750	321	750
Weight ¹	lbs	150	112	125	112	125	63	42	63	42
Power/Weight Ratio	hp/lbs	2.7	2.2	2.1	2.2	2.1	5.0	18	5.0	18
Transformation Ratio	-	63	44	51	44	51	95	293	95	293

- 1) Pump (reversible), Booster Pump, Valves, Pilot.
- 2) Industrial Application.

HYDRAULIC PUMP
Size: 6.1 cu.inch/rev. (100 cm³)
Reversible, 8000 psi, 6000 rpm
Max. Output: 750 hp (550 KW)

Scale: 1:1

COMPARISON OF SIZE

Industrial Application
 Pump/Motor (reversible)
 Max. Output: 245 hp (180 KW)

Arrangement: Back to Back
(100% Drive-Trough Torque)

The Pump/Motor are structurally identical. Their design is based on the following new features:

NEW CYLINDER GEOMETRY

SPHERICAL SWASHPLATE

8-PISTON DESIGN

OFF-CENTER ADJUSTMENT

The new design has been patented in the following countries:

United States of America

Germany (East, West)

Canada, Spain, Taiwan

Sweden, France, Italy

Belgium, Netherlands, Luxembourg

Austria, Brazil

Mexico, Russia

This patent has been applied for in an additional ten major industrialized countries.

Additional patents have been applied for.

United States Patent [19]
Valentin

[11] **Patent Number:** **4,615,257**
[45] **Date of Patent:** **Oct. 7, 1986**

[54] **SWASHPLATE TYPE AXIAL-PISTON PUMP**

[76] **Inventor:** Ingo Valentin, 15000 W. Cleveland Ave., New Berlin, Wis. 53151

[21] **Appl. No.:** 746,240

[22] **Filed:** Jun. 18, 1985

[30] **Foreign Application Priority Data**

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[51] **Int. Cl.⁴** F01B 13/04

[52] **U.S. Cl.** 91/499; 91/487;
91/505

[58] **Field of Search** 91/484-487,
91/499, 504-506

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[57] **ABSTRACT**

An axial-piston pump includes a rotatable cylinder barrel having pistons extending from cylinder bores formed at one end thereof. A swashplate is positioned adjacent the cylinder barrel and includes an inclined surface for engaging and reciprocating the pistons upon rotation of the cylinder barrel relative thereto. The cylinder barrel is rotatably supported by a bearing spaced from the swashplate in a direction toward the cylinder barrel. The location and orientation of the bearing results in the development of bearing forces which operate on the same equivalent force point as the contact forces developed between the pistons and swashplate. Since the forces thus developed all operate on the same equivalent force point, pitching or cocking moments on the cylinder barrel are substantially eliminated.

20 Claims, 4 Drawing Figures

**DATE
FILMED**

9 / 14 / 93

END