

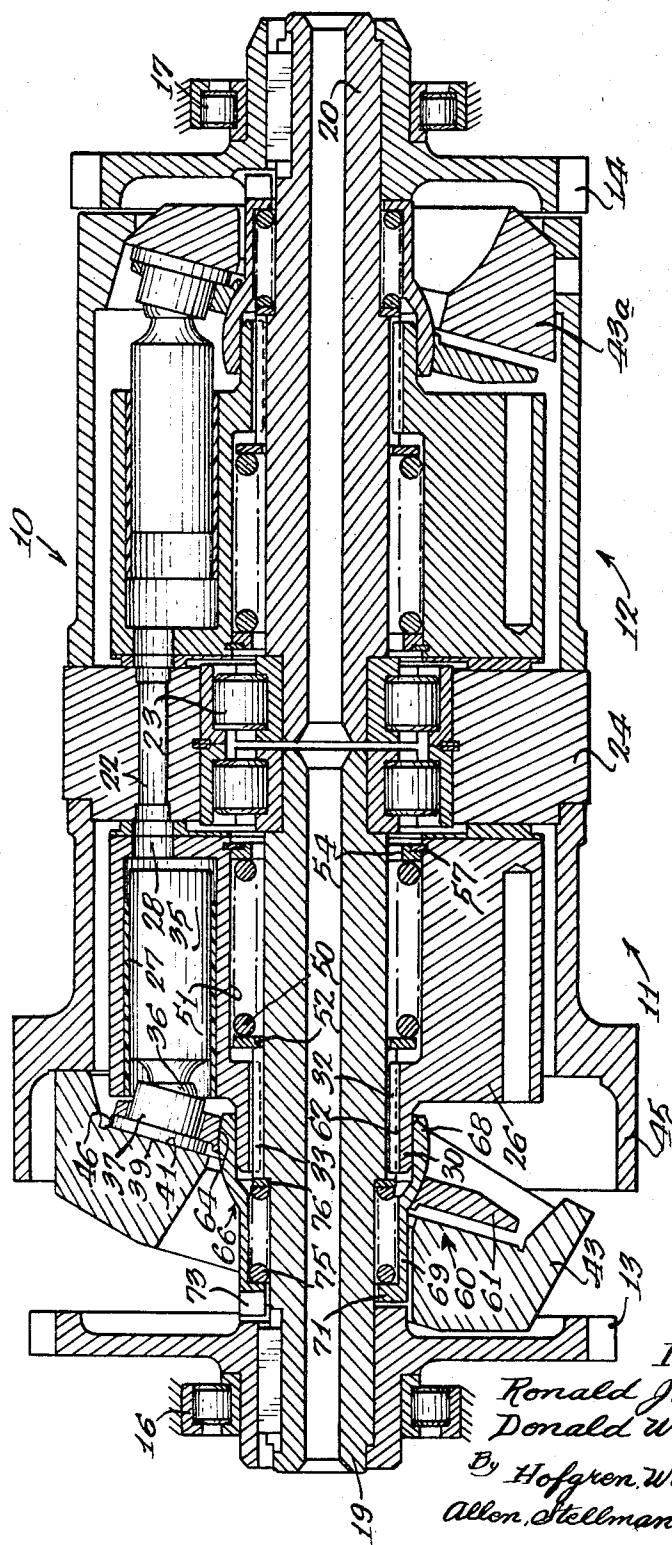
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R. J. KUBINSKI ET AL

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PISTON RETURN MECHANISM

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Inventors:

Ronald J. Kubinski
Donald W. Hagemann

By Hofgren, Wegner,
Allon, Stillman & McCord
Attys

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PISTON RETURN MECHANISM

Ronald J. Kubinski, Pecatonica, and Donald W. Hagemann, Rockford, Ill., assignors to Sundstrand Corporation, a corporation of Delaware

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ABSTRACT OF THE DISCLOSURE

A piston return mechanism for an axial piston pump or motor including a spherical retainer member slidably received on a cylinder block projection internally splined to the drive shaft, with the spherical retainer being resiliently biased by a coiled compression spring seated within an integral rearwardly projecting sleeve on the spherical retainer.

This invention relates generally to a hydraulic fluid energy translating device of the reciprocating piston type, and more particularly to a piston return mechanism for maintaining a contact between relatively rotating members in such devices.

Hydraulic units of the axial piston type are well known in the art and are conventionally capable of use as either pumps or motors. These devices consist of a drive shaft with a torque transmitting relationship with a rotatable cylinder block having cylinders formed therein generally parallel to the axis of rotation of the cylinder block. This type of unit is referred to as an axial piston hydraulic unit. Pistons are reciprocable in the cylinders and have slippers or bearing means on the ends thereof in engagement with an inclined camming member which transmits forces to the pistons to cause reciprocation thereof within the cylinders as the cylinder block rotates relative to the camming member. One end of the cylinder block engages a valve member having inlet and outlet ports which serially communicate with the cylinders as the block rotates, and in this manner fluid is delivered to and from the hydraulic unit.

In axial piston hydraulic units of this general character it is desirable to maintain contact between the reciprocating pistons and the inclined camming member. In the past it has been proposed that a spring be provided reacting between the cylinder block and the piston slippers for this purpose. However, this construction in some instances has been found undesirable due to the fact that the spring also biases the cylinder block into engagement with the valving member. While it is desirable to bias the cylinder block into engagement with the valving member, the force required for this purpose frequently differs from the force required to hold the piston in contact with the camming member. For this reason, the present piston return mechanism is designed so that it reacts not against the cylinder block but against the drive shaft and separate independent spring biasing means are provided for urging the cylinder block into engagement with the valving member.

Furthermore, the prior art forms of piston return mechanisms have involved complicated spring arrangements which require special machining of the cylinder block. In accordance with the present invention, the piston return spring is removed from the cylinder block and surrounds the drive shaft at a point within the camming member providing an improved, simplified and more compact arrangement.

It is, therefore, a primary object of the present invention to provide a new and improved piston return mechanism for a hydraulic energy translating device.

It is a more specific object of the present invention to

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provide a new and improved piston return mechanism for an axial piston hydraulic unit of the type having slippers pivotally mounted on the ends of the pistons in which there is provided a retaining plate generally parallel to the camming surface of the camming member and engaging the slippers to hold them against the camming surface, and a generally spherical ball mounted on a rearwardly extending projection on the cylinder block and engaging the retainer, with the ball having a rearwardly extending cylindrical portion defining with the drive shaft a recess which receives a coiled compression spring acting against the shaft to urge the ball rearwardly, thereby maintaining the piston slippers in continuous engagement with the cam surface of the camming member.

A still more specific object of the present invention is to provide a new and improved piston return mechanism for a hydraulic energy translating device of the type described immediately above in which interengaging splines are provided on the cylinder block projection and the drive shaft with the piston return spring having one end thereof engaging a shoulder on the drive shaft defined by the splines and with the other end of the spring engaging a radially inwardly directed flange on the cylindrical projection of the spherical ball.

Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawing wherein a hydraulic transmission is shown incorporating the principles of the present invention.

While this invention is susceptible of embodiment in many different forms, there is shown in the drawing and will herein be described in detail an embodiment of the invention with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated. The scope of the invention will be pointed out in the appended claims.

In more detail, the drawing illustrates a hydraulic drive 10 particularly suitable for use in a constant speed drive for aircraft such as that disclosed in the copending Gantzer application Ser. No. 421,483, filed Dec. 28, 1964, and assigned to the same assignee as the present invention.

The hydraulic drive 10 consists generally of a variable displacement hydraulic unit 11 and a fixed displacement hydraulic unit 12 either of which may operate as a pump or a motor depending upon control conditions with the associated constant speed drive. Gears 13 and 14 operate either as input or output gears depending upon displacement of hydraulic unit 11 and the torque transfer in a mechanical differential (not shown) conventionally provided in constant speed drives.

Gears 13 and 14 are rotatably mounted in roller bearings 16 and 17 seated within a housing of a type similar to that disclosed in the above noted Gantzer application. These bearings support the hydraulic drive 10 within the housing member. Keyed within gears 13 and 14 are shafts 19 and 20 which deliver torque to and from the respective hydraulic units 11 and 12. The drive shafts 19 and 20 are supported at their adjacent ends in roller bearings 22 and 23 seated within a common valve member 24. The valve member 24 has generally arcuate inlet and discharge passages (only one of which is shown in the drawing) for delivering fluid in closed circuit fashion, between the hydraulic units 11 and 12.

While the present piston return mechanism is incorporated in each of the hydraulic units 11 and 12, the differences between these units form no part of the present invention so that it will suffice to discuss the details of the piston return mechanisms with respect to the variable displacement hydraulic unit 11. Hydraulic unit 11 includes a rotary cylinder block 26 with a plurality of axially dis-

posed cylinders 27 therein formed in annular array around the axis of shaft 19. Cylinders 27 communicate with the inlet and outlet ports in valve member 24 through passages 28 at the forward end of the cylinders. Formed at the other end of the cylinder block is a central axial annular projection 30 extending rearwardly therefrom and having a splined bore 32 therein interengaging splines 33 on drive shaft 19 so that the cylinder block rotates with the shaft and torque may be transmitted therebetween.

A piston 35 reciprocally mounted within each of the cylinders 27 has a spherical projecting end 36 carrying a slipper 37. Each of the slippers 37 has a spherical socket which receives the spherical piston projection 36 to permit pivotal movement therebetween. Each slipper has a bearing surface 39 slidably engaging a cam surface 41 on a cam or swashplate member 43. The slippers also have flanges 46 for a purpose hereinafter described.

The cam 43, which produces reciprocating motion of the pistons 35, is pivotally mounted by trunnions (not shown) in a "cam" 45 which is a partial housing surrounding the unit 11 and mounted on the valve member 24. The pivotal axis of adjustment of the cam 43 may be displaced somewhat toward the cylinder block from the plane defined by the pivotal interconnections of the pistons 35 and the slippers 37, and may be displaced from the axis of shaft 19.

As the cylinder block 26 rotates with respect to the cam 43, fluid enters the cylinders associated with the pistons moving down the cam surface 41 from one of the ports in valve member 24 and fluid is expelled from the cylinders associated with the pistons moving up the cam surface 41 to the other port in the valve member 24. The fluid entering or leaving the cylinders may be either high or low pressure fluid depending on whether the hydraulic unit 11 is operating as a pump or as a motor.

A coiled compression spring 50 is provided for resiliently biasing the cylinder block 26 into engagement with the valve member 24 to maintain an effective sliding seal therebetween. Spring 50 surrounds the drive shaft 19 and is received within a central recess 51 in the cylinder block 26. One end of the spring 50 engages a spring seat washer 52 which in turn is restrained against axial movement by a shoulder defined by the inner end of splines 33 on the drive shaft 19. In this manner the spring reacts against the drive shaft 19 and through bearing 16 to the drive housing. The other end of the spring 50 engages annular spring seat 54 axially fixed with respect to the cylinder block by a suitable snap ring 57 in bore 51. In this manner, the spring 50 resiliently urges the cylinder block 26 into engagement with the valve member 24.

Piston return assembly 60 is provided for urging the slippers 37 into engagement with the cam surface 41 independently of the cylinder block biasing spring 50. The assembly 60 includes a generally annular retainer plate 61 having suitable openings 62 therein which loosely receive the reduced portion of each of the slippers 37. Retaining plate 61 engages the flanges 46 on the slippers and is adapted through the biasing arrangement herein described to urge the slippers toward the cam surface 41. A central spherical opening 64 is formed in the retainer plate 61.

A retainer sleeve 66 is provided for urging the retainer plate 61 toward the cam surface 41. Sleeve 66 includes a generally spherical portion 68 mounted on the rear axial projection 30 on cylinder block 26. Extending rearwardly from the spherical portion 68 is a cylindrical portion 69 which terminates in an inwardly directed flange 71. Flange 71 is loosely received around shaft 19. A tang 73, on sleeve 66, interconnects the gear 13 with the sleeve 66 so that the sleeve rotates with the shaft 19.

The sleeve 66 including the flange 71 define an annular recess around shaft 19 adjacent the splines 33 in which a coiled compression piston return spring 75 is mounted. Spring 75 surrounds shaft 19 and reacts at one end against

a spring seat ring 76 which in turn abuts a shoulder defined by the adjacent end of the splines 33. The other end of the spring 75 engages flange 71 and thereby biases the sleeve 66 away from the cylinder block 26.

The retainer plate 61 is mounted on the spherical portion 68 of the sleeve 66 and the spherical surface 64 on the retainer interengaging the spherical portion 68 of the sleeve permits a relative pivotal movement therebetween which occurs as the displacement of the hydraulic unit 11 is varied. Spring 75 thus urges the sleeve 66 and the retainer plate 61 as an assembly rearwardly toward the cam member 43 so that the slippers 37 are resiliently biased into engagement with the cam surface 41.

In the fixed displacement unit 12, the construction is similar except that swashplate 43a is not adjustably mounted.

With the above described construction there is provided a piston return mechanism which acts independently of the cylinder block biasing mechanism. Additionally, the unique construction of the sleeve 66 which permits the piston return spring 75 to be completely separate from the cylinder block simplifies the construction of hydraulic units of this type and eliminates the necessity of special machining of the cylinder block to accommodate the piston return spring.

We claim:

1. A hydraulic energy translating device, comprising: a drive shaft, a cylinder block surrounding said drive shaft and having a plurality of cylinders therein, said cylinder block having a central projection extending from one end thereof, interengaging drive means on said cylinder block and said shaft adjacent said projection, cam means adjacent said cylinder block, pistons reciprocable in said cylinders and having bearing means on the ends thereof engaging said cam means, retainer means for urging said bearing means toward said cam means, a spherical member adjacent said cam means having a portion in engagement with said retainer means, said cylinder block projection slidably receiving said spherical member, an extension on said spherical member projecting rearwardly from said cylinder block projection, a coiled compression spring surrounding said shaft within said extension for resiliently urging the spherical member in a direction to urge the bearing means toward said cam means, said coiled compression spring being located rearwardly of said cylinder block projection, and shoulder means on said shaft rearwardly of said cylinder block projection against which one end of said spring reacts.

2. A hydraulic energy translating device as defined in claim 1 and further including valve means having ports therein serially communicable with the cylinder block cylinders during relative rotation of the cylinder block and valve means, spring means for urging said cylinder block into engagement with said valve means, one end of said spring means being grounded on said drive shaft and the other end of said spring means being connected to urge said cylinder block.

3. A hydraulic energy translating device as defined in claim 1 and further including means for transmitting torque between said drive shaft and said extension including drive means on the end of said extension opposite the cylinder block.

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WILLIAM L. FREEH, *Primary Examiner.*