

March 18, 1952

S. O. STAGEBERG

2,589,449

MOVABLE VANE PUMP

Filed Oct. 15, 1943

3 Sheets-Sheet 1

Fig. 1

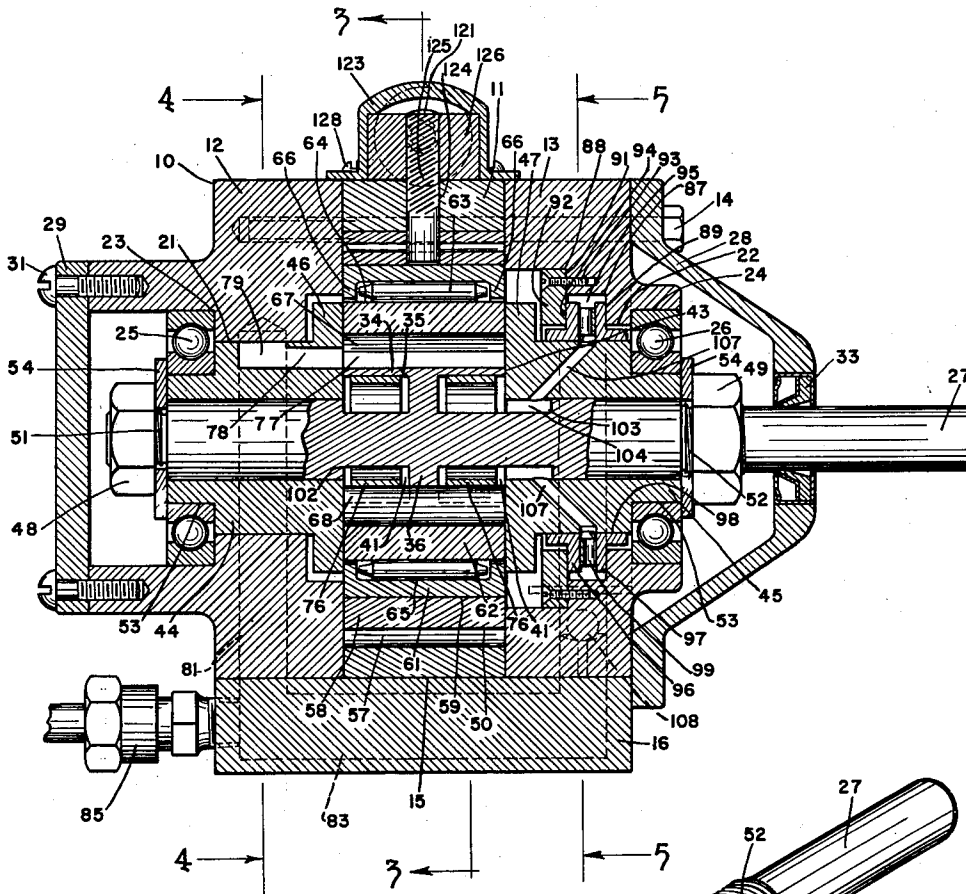
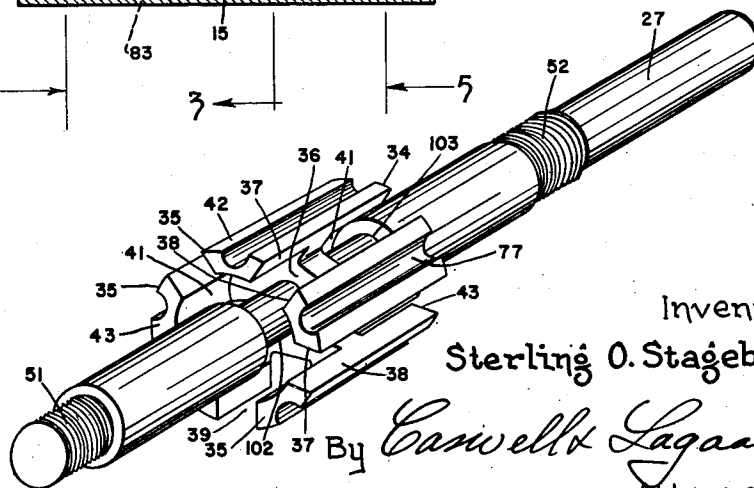


Fig. 2



Inventor

Sterling O. Stageberg

By *Carwell Lagaard*
Attorneys

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Fig. 3

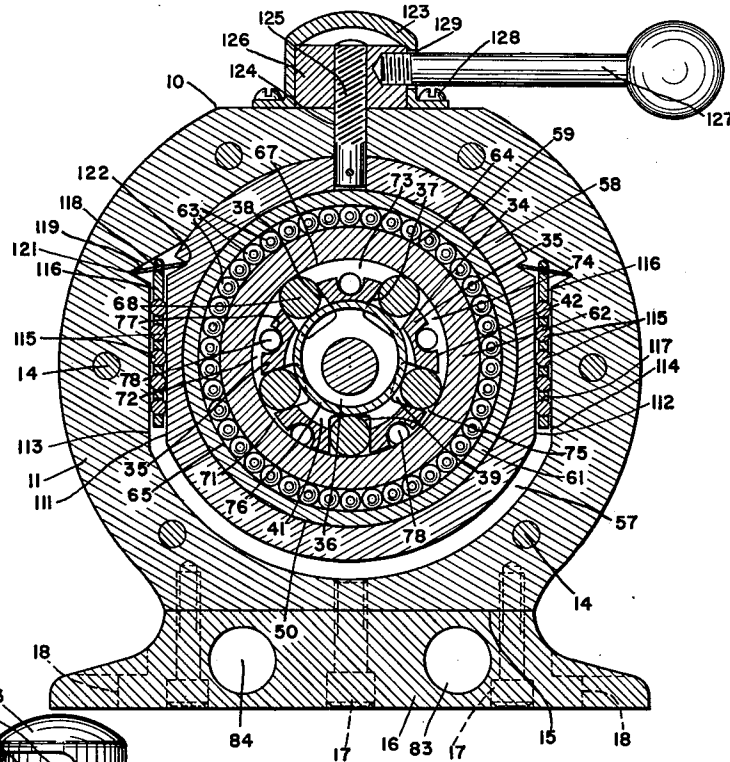
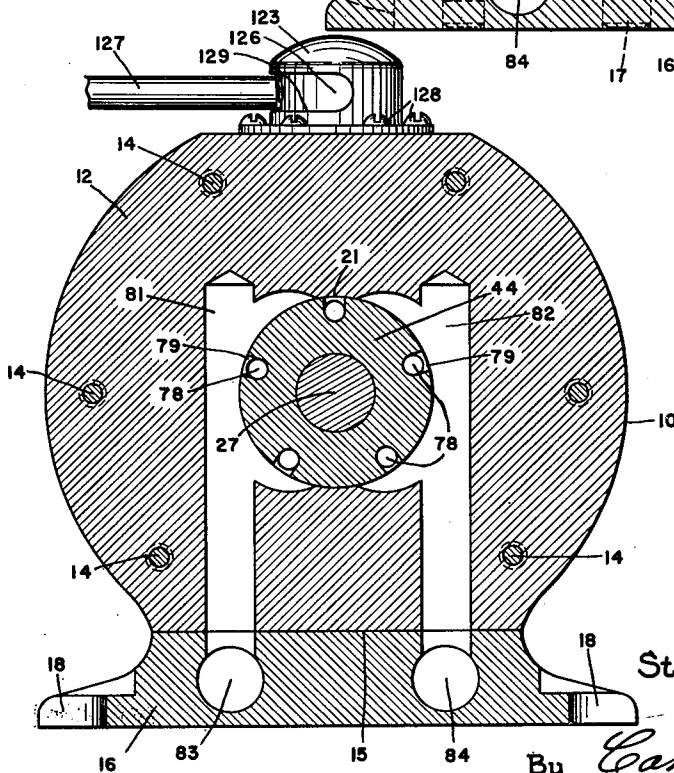


Fig. 4



Inventor
Sterling O. Stageberg

By *Canwell & Lagaard*
Attorneys

March 18, 1952

S. O. STAGEBERG

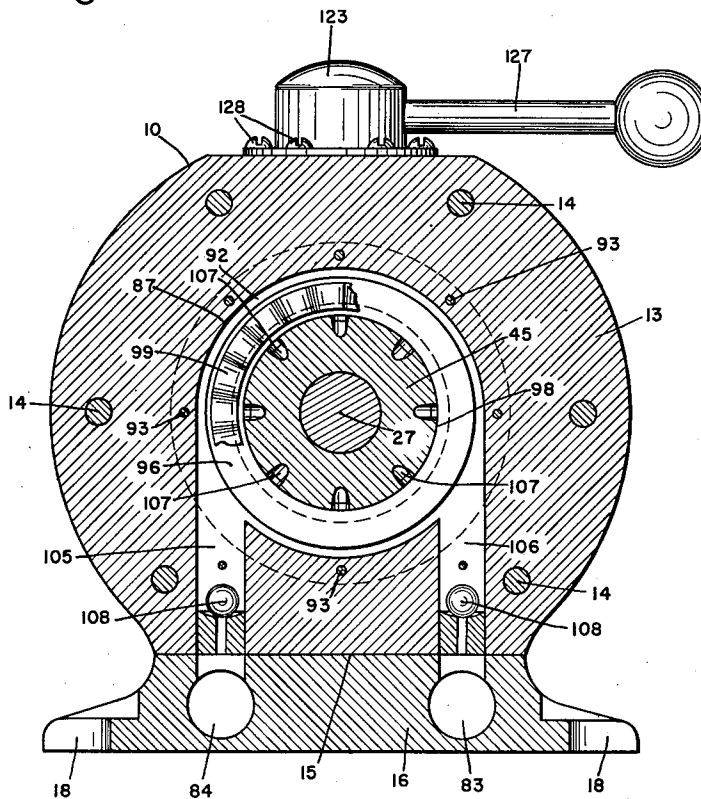
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Fig. 5



Inventor
Sterling O. Stageberg

By Caswell & Laguard
Attorneys

UNITED STATES PATENT OFFICE

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MOVABLE VANE PUMP

Sterling O. Stageberg, Minneapolis, Minn.

Application October 15, 1943, Serial No. 506,325

2 Claims. (Cl. 103—136)

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My invention relates to pumps, and particularly to variable capacity pumps, and has for an object to provide a positive and practical construction in which the volume of the pump may be easily and accurately controlled during operation of the pump.

Another object of the invention resides in providing a pump in which the volume of the pump may be controlled by the movement of a single lever from one position to another.

Another object of the invention resides in constructing the pump with a rotor having longitudinally extending slots therein and in further providing an annulus encircling the rotor and rollers mounted in said slots and cooperating with the annulus.

A feature of the invention resides in providing adjusting means for varying the eccentricity between the annulus and the rotor to vary the output of the pump.

A still further object of the invention resides in providing supporting rings associated with the rotor and engaging the rollers and holding the same in position adjacent the annulus.

Another object of the invention resides in supporting the annulus for rotation within a mounting arranged for transverse movement relative to the axis of the rotor.

A feature of the invention resides in providing antifriction guiding members for said annulus and in the manner of supporting the anti-friction members for movement.

Another object of the invention resides in providing means for conducting a fluid under pressure in back of the rollers to force the rollers into engagement with the annulus.

A feature of the invention resides in the specific construction of the rotor and associated parts.

Another object of the invention resides in providing a construction for overcoming leakage produced by flexure of the rotor shaft.

Another object of the invention resides in the construction for conducting fluid to and from the expansible chambers of the invention.

Other objects of the invention reside in the novel combination and arrangement of parts and in the details of construction hereinafter illustrated and/or described.

In the drawings:

Fig. 1 is a longitudinal elevational sectional view of a pump illustrating an embodiment of my invention.

Fig. 2 is a perspective view of the rotor of my invention.

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Fig. 3 is an elevational sectional view taken on line 3—3 of Fig. 1.

Fig. 4 is a view similar to Fig. 3 taken on line 4—4 of Fig. 1.

Fig. 5 is a view similar to Fig. 4 taken on line 5—5 of Fig. 1.

While my invention is primarily intended as a pump for pumping liquids, such as oil and similar liquids, the device can also be used as a fluid motor and for any other purpose where a device having movable elements arranged to provide valved expansible chambers is desired. It is hence to be understood that this application for patent, while specifically describing a pump, also embraces such other devices and uses.

My invention comprises a case indicated in its entirety by the reference numeral 10. This case is constructed with an intermediate section 11 and two end sections 12 and 13. These various sections are secured to one another by means of cap screws 14 which pass through the sections 11 and 13 and are threaded into the section 12. The case 10 is flat on the bottom, as designated at 15 in Figs. 3, 4 and 5 and the various sections thereof are secured to a base 16 by means of screws 17 which extend through the base 16 and are threaded into the intermediate section 11. Slots 18 at the edges of the base 16 serve to receive bolts or other fastening means, whereby the pump may be secured to a suitable support, not shown.

The two end sections 12 and 13 of the case 10 have bores 21 and 22 extending through the same, which bores are recessed at 23 and 24 at their outer ends to receive ball bearings 25 and 26. A shaft 27 extends through the bores 21 and 22 and is journaled in the ball bearings 25 and 26 in a manner to be more fully described. A cap 28 encloses the ball bearing 26 and the outboard end of the shaft 27 and is secured to the end section 13 of case 10 by means of the cap screws 14, previously referred to. An oil seal 33 is mounted in the cap 28 and engages the shaft 27 to form an oil-tight connection between the said shaft and case 10. The recess 23, in the end section 12 of case 10, is covered by means of a cover plate 29 which is secured to said end section by means of screws 31 which pass through said cover plate and are threaded into the end section.

The shaft 27 carries a rotor indicated in its entirety by the reference numeral 34. This rotor may be constructed from solid material which is cut out to provide a number of longi-

itudinally extending bars 35 which are attached to and supported intermediate their ends by means of a web 36. The said bars are spaced from each other and have parallel facing surfaces 37 and 38 which form radially and longitudinally extending slots 39 therebetween. This construction also provides annular recesses 41 in the ends of the rotor which are defined by the shaft 27, the inner surfaces of the bars 35 and the web 36. The outer surfaces 42 of the bars 35 are cylindrical and concentric with the axis of the shaft 27, while the end surfaces 43 of said bars are coplanar and at right angles to the axis of the shaft 27 and form the end surfaces of the rotor 34.

Adjacent the rotor 34 on each end thereof are mounted bushings or end members 44 and 45 which are constructed at their inner ends with flanges 46 and 47 which engage the end surfaces 43 of the rotor 34. These bushings are urged into engagement with the rotor by means of nuts 48 and 49 which are screwed upon threaded portions 51 and 52 of the shaft 27. These bushings have recesses 53 formed therein which receive the ball bearings 25 and 26 and which support the said shaft for rotational movement within the case 10. Washers 54 on the shaft 27 adjacent the ends of the bushings 44 and 45 engage the innermost races of the said ball bearings and securely clamp the same in position, so that end play of the rotor is prevented.

The intermediate section 11 of case 10 is formed with a compartment 57 within the same substantially cylindrical in form. In this compartment is mounted a stator indicated in its entirety by the reference numeral 50. This stator includes a mounting 58 which is annular in form and which is of smaller dimensions than those of the compartment 57, whereby said mounting may be moved toward and from the axis of the shaft 27. The mounting 58 has a bore 59 in which is received a race 61. Within this race is disposed an annulus 62 which is guided for rotational movement within the race 57 by means of a plurality of rollers 63 which engage the outer surface 64 of the annulus 62 and the bore 65 of the race 61. The race 61 is constructed with inwardly turned flanges 66, best shown in Fig. 1, which engage the ends of the rollers 63 and retain said rollers in proper position with respect to the annulus 62.

The annulus 62 is constructed with a bore 67 which is considerably larger than the diameter of the rotor 34 and which receives said rotor. This bore is, during the operation of the pump, eccentrically disposed relative to the shaft 27 and the eccentricity thereof may be varied by moving the mounting 58 in a radial direction within the compartment 57 of case 10. Mounted in the slots 39 of the rotor 34 are a number of rollers 68 which fit snugly against the surfaces 37 and 38 of the bars 35 to afford a fluid-tight connection therebetween. These rollers also are arranged to engage the bore 67 of the annulus 62. By means of this construction, a number of chambers 71, 72, 73, 74 and 75 are formed between the various rollers, the rotor 34, and the annulus 62. As the rotor rotates, the rollers move radially towards and from the axis of the shaft 27 in engagement with the surface 67 of the annulus 62 to successively increase and decrease the volume of said chamber, whereby a pumping action is procured.

Mounted within the recesses 41 of the rotor 34

are two rings 76. These rings engage the rollers 68, while in their slots and hold said rollers substantially in engagement with the bore 67 of annulus 62. Endwise movement of these rings is limited by means of the web 36 of rotor 34 and the flanges 46 and 47 of the end members 44 and 45. To cause the rings 76 to clear the shaft 27 when the mounting 58 is at the extreme end of its path of movement, the said shaft is undercut, as indicated at 102 and 103.

The length of the intermediate section 11 of case 10 and of the rotor 34 are equal. The end members 12 and 13 are rigidly clamped to the intermediate section 11 to prevent relative movement therebetween and the end members 44 and 45 are clamped against the ends of the rotor 34 to similarly prevent relative movement therebetween. The stator 50, consisting of the mounting 58, the race 61, the annulus 62, as well as the rollers 68, are all of the same length and slightly less in length than that of said section 11 and the rotor 34, so that these parts may move freely between the flanges 46 and 47 and the adjoining surfaces of the end sections 12 and 13 and yet form substantially fluid-tight connections therebetween.

In each of the bars 35 of the rotor 34 is provided a groove 77 which runs throughout the length of said bar and communicates at one end with a corresponding hole 78 drilled in the bushing 44. This hole terminates in an outwardly facing port 79 which is adapted to alternately communicate respectively with two manifolds 81 and 82 formed in the end member 12, (Fig. 4). The manifolds 81 and 82 communicate respectively with passageways 83 and 84 in the base 16 which passageways communicate with tubular fittings 85 and to which suitable tubes or pipes, leading to and from the pump, may be connected. When the rotor 34 operates in a clockwise direction, and the eccentricity is as shown in Figs. 3 and 5, a fluid contained within the chambers 73, 74 and 75 is forced out of said chambers and into the manifold 81. As rotation occurs, the chambers 71 and 72 increase in capacity and the fluid is drawn into these chambers through the manifold 82. Manifold 82 hence serves as an inlet for the pump and the manifold 81 as an outlet for the pump.

For the purpose of maintaining the rollers 63 in fluid-tight contact with the bore 67 of annulus 62, the following construction is employed. Within the interior of the end section 13 of case 10 is formed a recess 87 which has an offset 88. This construction provides two shoulders 89 and 91 which both face inwardly. A collar 92 is secured to the shoulder 91 by means of screws 93. This collar has a surface 94 which corresponds with and faces the surface formed by the shoulder 89. By means of this construction, an annular groove 95 is provided encircling the bushing 45. In this groove are mounted two sleeves 96 and 97 which snugly engage the outer surface 98 of the bushing 45 to form a fluid-tight connection therebetween. The facing ends of these sleeves are normally spaced and said sleeves are urged into contact with the shoulders 94 and 89 by means of a crinkled spring 99 which extends between said sleeves throughout the circumferential extent thereof. The undercut 103 in the shaft 27 extends within the bushing 45 to form an annular passageway 104 which communicates with the recess 41. The annular groove 95 communicates with the passageway 104 through a number of drilled holes 107 which extend diagonally

through the bushing 45. In the end section 13, as shown in Fig. 5, two passageways 105 and 106 are provided, which are connected to the passageways 84 and 83, respectively. Check valves 108 are provided in each of the passageways 105 and 106, so that the liquid under pressure may enter the groove 95 through either passageway. When the shaft 27 is turned in one direction and with the eccentricity in a certain direction, the passageway 84 contains fluid under pressure which opens the valve 108 in passageway 105 and discharges through the groove 95, the passageways 107 and 104 and into the recesses 41. Pressure in these recesses forces the rollers 68 outwardly and against the bore 67 of the annulus 62. In such case, there would be a suction in the passageway 83 and the check valve 108 in the passageway 106 would prevent flow of fluid into the passageway 83. When the shaft 27 rotates in the opposite direction or the eccentricity is reversed, fluid under pressure is conducted through the passageway 106 and into the recesses 41 and the check valve 108 in the passageway 105 would block the flow of fluid through this passageway.

For the purpose of guiding the mounting 58 for movement in an axial direction to vary the output of the pump, a construction best shown in Fig. 3 is employed. The mounting 58 is constructed with two oppositely facing parallel surfaces 111 and 112. Adjacent these surfaces, the intermediate case member 11 is constructed with two surfaces 113, 114 spaced from the surfaces 111 and 112 and parallel therewith. Between these surfaces are mounted rollers 115 which are held in cages 116 and 117 which permit rolling movement of the rollers with respect to the surface which they contact, but which hold the rollers in proper position. Both the cages 116 and 117 are supported in the same manner and only the construction for supporting the cage 116 will be described. This cage has at its upper end an opening 118 in the same through which a lever 119 extends. The said lever extends into a notch 121 in the section 11 of case 10 and into a corresponding notch 122 in the mounting 58. The said notches and the opening 118 are of such construction that the cage 116 will move vertically, traveling one-half the distance of the mounting 58. In this manner, the rollers 115 which engage both the surfaces 113 and 111 are guided for movement and slippage is prevented. It will readily be comprehended that the mounting 58, by means of the rollers 115 is guided for up and down movement, so that the axis of the annulus 62 may be moved toward and from the axis of the rotor 34.

For the purpose of moving the mounting 58, the same is provided with a stud 121 which extends upwardly therefrom and through a hole 124 in the section 11 of case 10. This stud has an extremely coarse thread 125 which is engaged by a nut 126. A handle 127, secured to this nut, serves to rotate the same and to cause vertical movement of the mounting 58. This nut is contained within a housing 123 on the uppermost portion of the section 11 of case 10, which is secured thereto by means of screws 128. The handle 127 operates through a slot 129 in the housing 123.

The advantages of the invention are manifest. The pump may be constructed extremely rigid, so that high pressures may be procured. My improved pump is balanced so that pulsations are eliminated, thereby permitting the pump to be operated at high speeds. Due to the mounting

of the annulus in a roller bearing, pressure on the displacement rollers procures a fluid-tight connection between these rollers and the annulus, without causing the rollers to wear flat. By means of the supporting rings for the rollers, the rollers are at all times maintained in proper position for immediate action. The pump therefore picks up pressure immediately without having to rely solely on centrifugal force to bring the rollers into action. By means of the spaced sleeves used in conjunction with the rotor on the outboard end of the rotor shaft, a fluid-tight connection is procured which will operate even though the shaft be slightly sprung, as frequently occurs when a pump is heavily loaded. My improved pump can be adjusted in capacity while the same is operating and the simple movement of a single lever causes change from zero volume to maximum capacity. My improved pump is compact and sturdy and is extremely efficient for its type.

Changes in the specific form of my invention, as herein described, may be made within the scope of what is claimed without departing from the spirit of my invention.

Having described my invention, what I claim as new and desire to protect by Letters Patent is:

1. In combination, a rotor, a shaft therefor, said rotor having a surface concentric with the axis of the shaft, and being formed with spaced annular recesses, said rotor having longitudinally extending bars spaced from one another to form slots therebetween extending through said surface and into said recesses and bringing said recesses into communication, an annulus encircling said rotor and having a bore eccentric with reference to the axis of said rotor shaft, rollers disposed in said slots and engaging the bore of said annulus, bushings mounted on said shaft and having flanges disposed adjacent the ends of said rotor, said annulus being disposed between said flanges, said bars having grooves extending longitudinally thereof, one of the flanges having passageways therein communicating with said grooves and means forming inlet and outlet chambers adapted to successively communicate with said passageways.

2. In combination, a stator having a bore therein, a rotor within said bore having an axis eccentric with respect to the axis of said bore and having a plurality of slots therein, members in said slots forming in conjunction with said rotor and stator a plurality of expansible chambers, means forming in conjunction with said stator a bore and an annular groove extending outwardly from said bore and having two radially facing surfaces, a revoluble member on said rotor disposed within said bore, spaced sleeves on said revoluble member slidable along the same and having portions extending into said groove and provided with surfaces thereon engaging the surfaces of the stator at said groove, resilient means acting between said sleeves to urge the surfaces thereof into engagement with the surfaces of said stator, said revoluble member having passageways therein leading from behind the members in said slots to the space between said sleeves, and means for conducting fluid under pressure into the space between the sleeves.

STERLING O. STAGEBERG.

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