

Oct. 1, 1963

R. G. RUPPERT
PUMP CONSTRUCTION

3,105,447

Filed Aug. 28, 1961

2 Sheets-Sheet 1

FIG. 1

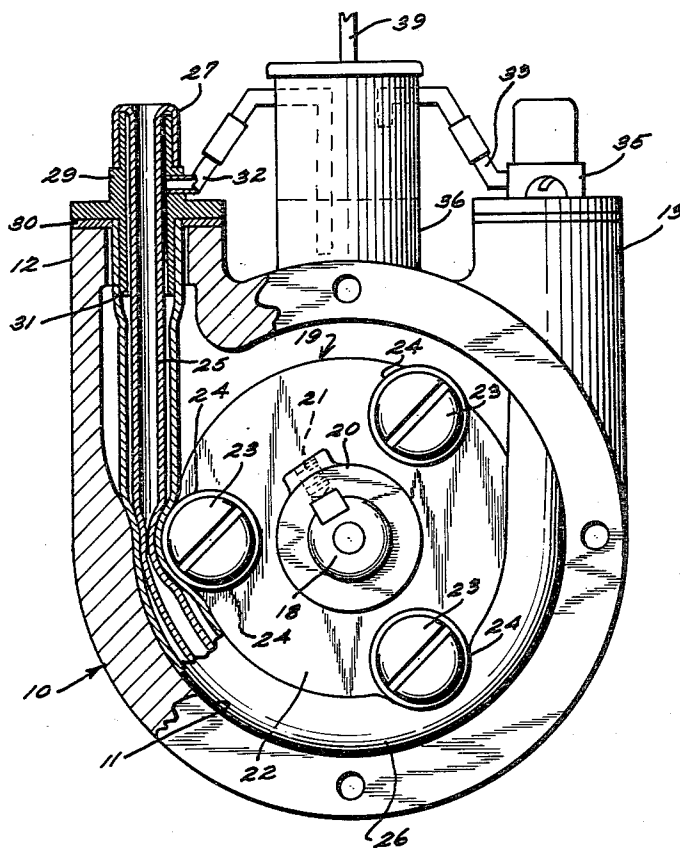


FIG. 3

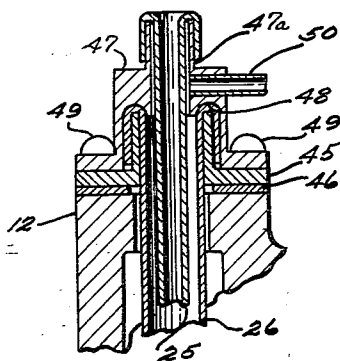
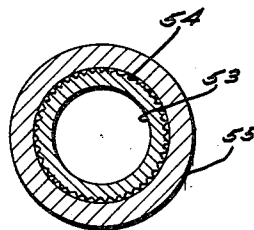


FIG. 5



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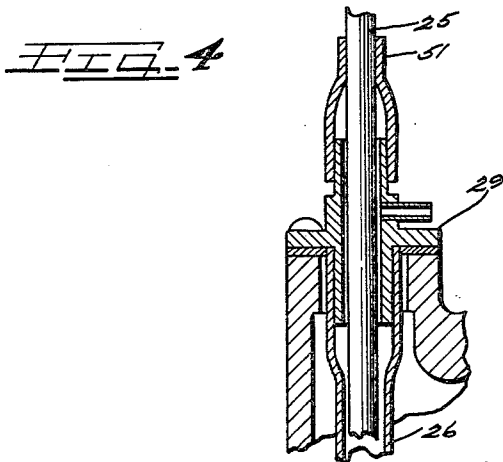
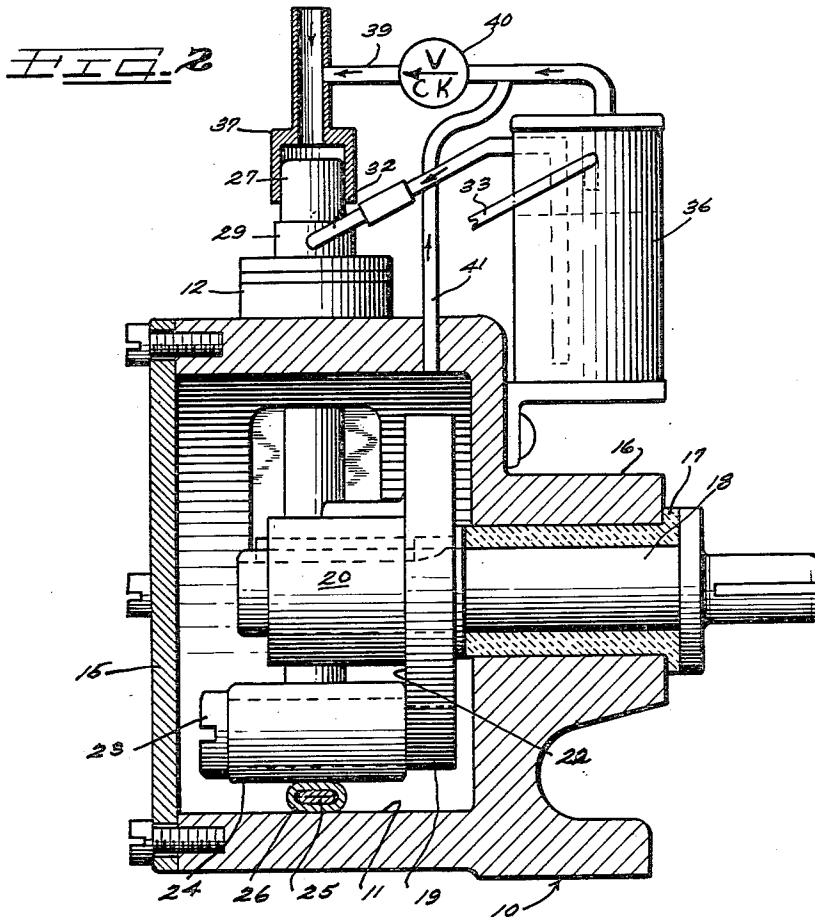
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PUMP CONSTRUCTION

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11 Claims. (Cl. 103—149)

This invention relates to improvements in pumps and more particularly relates to an improved form of pump of the type wherein liquid is propelled through an elastic tube by progressively compressing the tube from one end to the other.

Heretofore, pumps operating on the principle of progressively compressing a tube to propel liquid along the tube have necessarily been small capacity pumps, driven at slow operating speeds to avoid excessive heating of the tube, with a resultant and shortened life thereof. It further has been necessary to use a relatively thick walled elastic tube to provide the high suction and discharge pressures required to efficiently pump the liquid, and the tube frequently ruptures, due to the continued progressive compression thereof.

A principal object of my invention is to remedy the foregoing disadvantage by providing a simplified form of lubricating system for a progressively compressed tube, lubricating the tube and maintaining the tube cool.

A further object of the invention is to provide an improved form of pump wherein liquid is passed through a tube under pressure from the inlet to the outlet end of the tube by progressively compressing the tube, in which the tube is subjected to vacuum to return the tube to its tubular shape after compression thereof, and in which vacuum is attained by the suction at the inlet end of the tube, drawing liquid into and along the tube.

Still another object of the invention is to provide an improved form of pump in which liquid is passed along a tube from the inlet to the outlet end thereof by progressively compressing the tube from its inlet towards its outlet end, and in which the tube is surrounded by a concentric tube spaced therefrom and pumping lubricant in the space between the tubes by compression of the tubes.

A still further object of the invention is to provide an improved form of pump of the elastic tube type in which liquid is passed along a tube by progressively compressing the tube from the inlet to the outlet end thereof, in which the capacity of the pump is increased and the power to drive the pump is reduced by lubricating and cooling the tube and returning the tube to its tubular form by vacuum after compression thereof, and thereby making it possible to use a tube of minimum wall thickness.

A further object of the invention is to provide an improved form of pump of the elastic tube type in which at least two concentric elastic tubes are utilized to pump liquid from the inlet to the outlet end of the pump by progressively compressing the tubes, and in which compression of the outer tube draws lubricant in the space between the tubes and compression of the inner tube draws liquid through the tube and supplies the vacuum to place the outer surfaces of the tubes under vacuum.

These and other objects of the invention will appear from time to time as the following specification proceeds and with reference to the accompanying drawings wherein:

FIGURE 1 is a end view of a pump constructed in accordance with the invention with the end cover of the pump removed and the inlet portion of the pump shown in vertical section;

FIGURE 2 is a transverse sectional view taken through the pump shown in FIGURE 1, showing the rotor progressively compressing the collapsible tubes;

FIGURE 3 is an enlarged sectional view of the inlet

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end of the pump illustrating the seal for the inlet ends of the concentric tubes;

FIGURE 4 is a sectional view showing a modified form of sealing arrangement in which the inside tube can be pulled through the pump to expose a new section of tubing after use of the pump; and

FIGURE 5 is a cross sectional view taken through a modified form of concentric tubing, showing the inner tube grooved along its outside.

In the embodiment of the invention illustrated in the drawings, I have shown in FIGURES 1 and 2, a pump housing 10 having a generally cylindrical inner wall 11 and having an inlet boss 12 at one side of said housing and an outlet boss 13 at the opposite side of said housing. The pump housing is closed by a detachable end cover 15 sealed to the end of said housing in a suitable manner (not shown), to maintain the interior of said housing air tight and thereby enable the interior of said housing to be placed under vacuum.

The housing 10 has a boss 16 extending from one end thereof having a bearing 17 carried therein, forming a bearing for a drive shaft 18 for a pump rotor 19. The pump rotor 19 has a hub 20 keyed or otherwise secured to the drive shaft 18, and retained to said drive shaft as by a set screw 21. The drive shaft 18 may be driven from a suitable motor (not shown) in a conventional manner. Sealing means (not shown) may be provided between the shaft 18 and the bearing 17 and between the bearing 17 and the hub 16, to enable the interior of the housing to be placed under vacuum.

The rotor 19 has an inner face 22 having three bearing support pins 23 threaded therein and suitably secured thereto, and forming bearing support means for compression rollers 24, progressively compressing two concentric inner and outer tubes 25 and 26 respectively, during rotation of said rotor and creating suction in said tubes to pass liquid therealong. The bearing for the roller may be lubricated by lubricant contained in the bottom of the housing 10, by the splash system.

The tubes 25 and 26 may both be relatively thin-walled tubes made from an elastic material, such as rubber, an elastomer or one of the well known substitutes for rubber.

The inner tube 25 is shown as having an inlet end portion 27 stretched backwardly over the inlet end of a flanged adapter 29. The flanged portion of the flanged adapter 29 abuts the outer end of the inlet boss 12 and is sealed thereto as by an annular sealing member 30. The outer tube 26 is shown as being stretched about a depending sleeve portion 31 of the flanged adapter 29. An inlet pipe 32 leads through the wall of the adapter 29 upstream of the flanged portion thereof in communication with the space between said adapter and the outside of the inner tube 25, to accommodate lubricant to be pumped into the space between the tubes 25 and 26 by progressive compression of the two tubes, and to enable the outer periphery of the inner tube 25 to be placed under sufficient vacuum to return said inner tube to its tubular form after compression thereof.

The tubes 25 and 26 extend along the cylindrical wall 11 of the housing 10, and upwardly through the outlet or discharge boss 13, and are sealed to a flanged adapter 35, mounted on the outlet boss 13 in the same manner they are sealed to the inlet boss 12. A return pipe 33 leads from the adapter 35 to a lubricant storage reservoir 36 to return lubricant thereto.

Thus, as the pump rotor 20 is rotatably driven and the tube 27 is connected to a source of liquid, the three rollers 24 will progressively compress the respective inner and outer tubes 25 and 26 and draw liquid into the inner tube and lubricant into the space between the two tubes, and discharge the liquid through the outlet end of the inner

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tube and return the lubricant to the storage reservoir 36 through the lubricant return pipe 33.

A means is provided to create vacuum in the interior of the housing 11 to tend to return the tube 26 to its tubular form as it has been compressed and to create vacuum in the storage reservoir 36 in the space above the lubricant therein to place the same amount of vacuum in the space between the concentric tubes that is on the suction end of the pump, to thereby increase the elastic ability of the two tubes to overcome the suction lift of the pump and increase the lifting ability of the pump.

As shown in FIGURE 2, a suction connector 37 is placed over a backwardly turned inlet end 27 of the inner tube 25 and is suitably secured thereto. The connector 37 has a suction line 39 leading thereinto from the inside of the storage reservoir 36 above the level of lubricant therein. A check valve 40 is provided in the suction line 39. A second tube 41 leads from the inside of the housing 11 and is connected to the tube 39 upstream of the check valve 40.

The suction created by progressively compressing the tube 25 to draw in liquid through the suction connector 37 and inlet end 27 of the tube 25 will, therefore, draw air from the inside of the housing 11 and maintain the inside of said housing under vacuum, and will also draw air from the inside of the reservoir 36 and maintain said reservoir and the return pipe 33 under vacuum. The return pipe 33 being under suction, therefore provides suction in the space between the tubes 25 and 26 in addition to that required to draw lubricant through the lubricant and coolant inlet 32.

It should here be understood that the lubricant in the space between the tubes 25 and 26 may be of a type which is also a coolant and that the reservoir 36 may serve to cool the lubricant. In addition the lubricant may be cooled by a heat exchanger (not shown) where desirable or necessary. The reservoir 36 may be omitted under conditions where the lubricant affords ample cooling of the tubes. In cases where the reservoir 36 is omitted the lubricant suction tube can be connected to a low point in the pump chamber, and the lubricant discharge tube can lead into the pump chamber from the top thereof.

It should further be understood that since the coolant and lubricant does not come into contact with the pump bearings, rollers, etc., it is possible to use a large range of lubricants and coolants without danger of damaging the pump bearings.

It should still further be understood that with the concentric tubes herein shown, the pump is particularly adapted for pumping corrosive or hazardous fluids and that in cases where the inside tube may rupture, while the fluid may contaminate the lubricant and coolant, it will not contaminate the other parts of the pump. Also, if the outside tube should fail before the inside tube, the coolant will only escape into the pump body, which conditions can readily be detected.

It should still further be understood that by utilizing concentric tubes, the inside tube transferring the liquid pumped, may readily be cleaned, and contamination of the liquid being pumped is avoided as long as the lubricant or coolant in the space between the tubes 25 and 26 is of a type which is not harmful to the fluid pumped in case the inside tube should rupture.

In FIGURE 3, I have shown a modified form of a seal in which a flanged sleeve 45 abuts an annular seal 46 extending along the top of the inlet boss 12. The flanged sleeve 45 has the outer tube 26 extending therealong and turned backwardly over the end of the sleeve along the outer periphery thereof.

A flanged adapter 47 has an annular inner surface 48 generally conforming to the form of the backwardly turned portion of the tube 26 and pressed into engagement with said backwardly turned portion, as by machine screws 49. The tube 25 is turned over a sleeve portion

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47a of the adapter 47 as in the form of the invention shown in FIGURE 1.

With this form of the invention, a more positive seal is provided for the end of the outer tube 26. A lubricant or coolant pipe 50 enters the adapter to admit lubricant in the space between the tubes 25 and 26.

In the modified form of seal shown in FIGURE 4, I have shown a sealing arrangement accommodating the inner tube 25 to be pulled through the outer tube 26 to expose a new section of tubing to the action of the rollers 24 as the tube becomes worn and to thereby increase the life of the inner tube and avoid the possibilities of leakage thereof.

In this form of seal, the outer tube 26 is sealed to individual adapters 29 at its inlet and its outlet ends in the same manner as in FIGURES 1 and 2. The individual adapters 29 for the inlet and outlet ends of the housing are the same, so one only need herein be shown and described in detail. The adapter 29 has a sealing sleeve 51 stretched about the sleeve portion thereof and stretched into sealing engagement with the outer surface of the inner tube 25 and accommodating the inner tube 25 to be slipped along the sealing sleeve 51, and also sealing said tube to said sleeve by the resiliency of said sealing sleeve and the vacuum developed in the space between the tubes 25 and 26.

While I have herein shown the inner tube as being movable along the cylindrical wall 11 to expose a new section to the action of the rollers 24 as the tube becomes worn it should be understood that the outer tube 26 may also be adjustably movable if desired.

In FIGURE 5, I have shown a modified form of concentric tube arrangement which may be used in place of the tubes 25 and 26. In this form of tube arrangement an inner tube 53 is provided, which has grooves 54 extending along the periphery thereof, the ridges separating the grooves being shown as being in closely spaced relationship with respect to the inner wall of an outer concentric tube 55.

The grooves 54 extending along the inner tube 53 serve to keep the outer tube 55 from completely closing the lubricant passage between the tubes, should the outside tube collapse due to excess vacuum, and also expose more area of the inside tube to the lubricant or circulating coolant and thereby increase the heat transfer between the inner tube and the coolant.

While I have herein shown and described several forms in which my invention may be embodied, it should be understood that various variations and modifications in the invention may be attained without departing from the spirit and scope of the novel concepts thereof as defined by the claims appended hereto.

I claim as my invention:

1. In a pump of the class described, an inner tube having an inlet end and an outlet end, means for progressively compressing said inner tube between said inlet end and said outlet end and thereby propelling liquid therethrough, and means for lubricating and cooling said inner tube comprising a concentric outer tube extending along said inner tube and spaced from the periphery thereof, means sealing the ends of said concentric outer tube, an inlet into said concentric outer tube adjacent said inlet end of said inner tube, an outlet from said concentric outer tube adjacent the outlet from said inner tube, a coolant storage reservoir, a fluid connection from said coolant storage reservoir to said inlet to said outer tube, and a return connection from said outlet from said outer tube to said coolant storage reservoir, said means for progressively compressing said inner tube from the inlet end thereof to the outlet end thereof also progressively compressing said outer tube from the inlet end thereof to the outlet end thereof and effecting the continuous circulation of coolant within said concentric outer tube from said inlet to said outer tube through said outlet from said outer tube and along the outer side of said inner tube.

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2. In a pump of the class described, a housing having an inner cylindrical wall, an elastic tube extending along said wall having an inner wall forming a lubricant and coolant passageway, an inner elastic tube within said elastic tube and having an inlet end and an outlet end and sealed to said housing adjacent the inlet and outlet ends thereof, means progressively compressing said tubes from the inlet to the outlet ends thereof, means sealing said outer tube to said inner tube at its opposite ends, a lubricant and coolant storage reservoir, an inlet from said storage reservoir to said lubricant and coolant passageway adjacent the inlet end of said inner tube, an outlet from said lubricant and coolant passageway into said storage reservoir adjacent the outlet end of said inner elastic tube, a suction connection from the inlet end of said inner tube to said storage reservoir to maintain said reservoir under inlet vacuum and thereby maintain said lubricant and coolant passage under vacuum, and a fluid connection from the inlet end of said inner tube to the inside of said housing to maintain vacuum therein substantially equal to inlet vacuum of said inner tube.

3. In a pump of the class described, a housing having an inner cylindrical wall, an elastic outer tube extending along said wall, an inner tube within said elastic tube and having an inlet end and an outlet end and sealed to said housing adjacent the inlet and outlet ends thereof, means progressively compressing said tubes from the inlet to the outlet ends thereof, means sealing said outer tube to said inner tube and forming a lubricant and coolant passageway within said outer tube, a lubricant and coolant storage reservoir, an inlet from said storage reservoir into said lubricant and coolant passageway adjacent the inlet end of said inner tube, an outlet from said lubricant and coolant passageway adjacent the outlet end of the inner of said tubes and a return connection from said outlet to said storage reservoir, a suction connection from the inlet end of said inner tube to said storage reservoir to maintain said reservoir under inlet vacuum and thereby place said lubricant and coolant passageway under inlet vacuum, a suction connection from the inlet end of said inner tube to the inside of said housing maintaining vacuum therein at substantially inlet vacuum, and a check valve in said inlet end of said inner tube between said storage reservoir and the connection of said suction connection to said inner tube.

4. In a pump of the class described, a housing having an inner cylindrical wall, an inlet into said housing and an outlet therefrom, two concentric tubes extending along said cylindrical wall and sealed to said housing adjacent said inlet and said outlet, the inner of said tubes being open at its opposite ends to accommodate the pumping of fluid therealong, the outer of said tubes having an inner wall defining a lubricant and coolant passageway, a lubricant and coolant inlet into said lubricant and coolant passageway, an outlet from said lubricant and coolant passageway adjacent the outlet from said housing, a rotor having a plurality of rollers rotatable about axes parallel to the axis of rotation of said rotor and progressively compressing said tubes along said cylindrical wall in a direction from said inlet to said housing to said outlet from said housing and pumping fluid into the end of the inner of said tubes adjacent the inlet into said housing and pumping lubricant and coolant into said lubricant and coolant passageway.

5. In a pump of the class described, a housing having an inner cylindrical wall, an inlet into said housing and an outlet therefrom, two concentric tubes extending along said cylindrical wall and sealed to said housing adjacent said inlet into said housing and said outlet from said housing, the inner of said tubes being open at its opposite ends to accommodate the pumping of fluid therethrough, the outer of said tubes having an inner wall defining a lubricant and coolant passageway, a lubricant and coolant inlet into said lubricant and coolant passageway adjacent the inlet into said housing, a lubricant and coolant outlet from said lu-

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bricant and coolant passageway adjacent the outlet from said housing, a rotor having a plurality of rollers thereon rotatable about axes parallel to the axis of rotation of said rotor and engaging and progressively compressing said tubes between said inlet into said housing and said outlet from said housing, and a suction connection from the inlet end of the inner of said tubes to said lubricant and coolant outlet from said lubricant and coolant passageway for maintaining said lubricant and coolant passageway under inlet vacuum.

6. In a pump of the class described, a housing having an inner cylindrical wall, an inlet into said housing and an outlet therefrom, two concentric tubes extending along said cylindrical wall, the inner of said tubes being open at its opposite ends and having an inlet end leading into said inlet into said housing and an outlet end leading through said outlet from said housing, and the outer of said tubes having an interior wall defining a lubricant and coolant passageway and being sealed to the inner of said tubes adjacent said inlet into said housing and said outlet from said housing, a lubricant and coolant inlet into said lubricant and coolant passageway, a lubricant and coolant outlet from said lubricant and coolant passageway, a rotor having at least one roller thereon rotatable about an axis parallel to the axis of rotation of said rotor and progressively compressing said tubes between said inlet and said outlet and pumping fluid into the inlet end of the inner of said tube and lubricant and coolant along said lubricant and coolant passageway, and a vacuum connection from the inlet end of the inner of said tubes to the interior of said housing for placing the interior of said housing under inlet vacuum.

7. In a pump of the class described, a housing having an inner cylindrical wall, an inlet into said housing and an outlet therefrom, at least two concentric tubes extending along said cylindrical wall, the inner of said tubes being open at its ends and extending into said housing through said inlet and out of said housing through said outlet and being sealed to said housing adjacent said inlet and said outlet, the outer of said tubes being sealed to the inner of said tubes adjacent said inlet and said outlet and having an inner wall defining a lubricant and coolant passageway, a lubricant and coolant inlet into said lubricant and coolant passageway adjacent said inlet, a lubricant and coolant outlet leading from said lubricant and coolant passageway adjacent said outlet from said housing, a rotor having a roller thereon rotatable about an axis parallel to the axis of rotation of said rotor and progressively compressing said tubes between said inlet into said housing and said outlet from said housing to effect the pumping of fluid therealong, a lubricant and coolant storage reservoir, a fluid connection from said storage reservoir to said lubricant and coolant inlet, a return connection from said lubricant and coolant outlet to said storage reservoir, and a vacuum connection from the inlet end of the inner of said tubes to said storage reservoir for maintaining said storage reservoir and said lubricant and coolant passageway under vacuum.

8. In a pump of the class described, a housing having an inner cylindrical wall, an inlet into said housing and an outlet therefrom, two concentric tubes extending along said cylindrical wall, the inner of said tubes entering said housing through said inlet and leaving said housing through said outlet and the outer of said tube having an inner wall defining a lubricant and coolant passageway and being sealed to the inner of said tubes adjacent said inlet and said outlet, a lubricant and coolant inlet into said lubricant and coolant passageway, a lubricant and coolant outlet from said lubricant and coolant passageway adjacent said outlet from said housing, a rotor having at least one roller thereon rotatable about an axis parallel to the axis of rotation of said rotor and progressively compressing said tubes between said inlet into said housing to said outlet from said housing to effect the pumping of liquid therethrough, a lubricant and coolant

storage reservoir, a fluid connection from said storage reservoir to said lubricant and coolant inlet, a return connection from said lubricant and coolant outlet to said storage reservoir, a vacuum connection from the inlet end of the inner of said tubes to said storage reservoir for maintaining a vacuum in said lubricant and coolant passageway, and a check valve in said vacuum connection from the inlet end of the inner of said tubes to said storage reservoir.

9. In a pump of the class described, a housing having an inner cylindrical wall, an inner and an outer concentric tube extending along said inner cylindrical wall, the inner concentric tube extending into and from said housing, the outer concentric tube being sealed to said housing adjacent its opposite ends and having an inner wall defining a lubricant and coolant passageway, a lubricant inlet into said passageway adjacent the inlet end of the inner of said tubes, a lubricant outlet from said passageway adjacent the discharge end of said tubes, means progressively compressing said tubes to effect the flow of fluid therethrough, and the inner of said tubes having a grooved outer wall having spaced grooves extending longitudinally therealong in close relationship with said inner wall of the outer of said tubes and accommodating the flow of lubricant and coolant along said lubricant and coolant passageway.

10. In a pump of the class described, inner and outer concentric tubes, means for progressively compressing said tubes throughout a portion of the length thereof to effect the flow of fluid therealong, the outer of said tubes being sealed at its ends and having an inner wall defining a lubricant and coolant passageway, a lubricant inlet into said passageway, a lubricant outlet from said passageway, and the inner of said tubes being mounted

within the outer of said tubes for adjustable slidable movement along the outer of said tubes to expose a new surface of the inner of said tubes for progressive compression thereof upon wear of said tube.

11. In a pump of the class described, a housing having an inlet and an outlet and an inner cylindrical wall, inner and outer concentric tubes, the outer of said tubes extending along said cylindrical wall from said inlet to said outlet and having an inner wall defining a lubricant and coolant passageway, the inner of said tubes entering said housing through said inlet and leaving said housing through said outlet, means progressively compressing said tubes along said cylindrical wall between said inlet and said outlet, a lubricant and coolant connection into said lubricant and coolant passageway, a lubricant and coolant outlet from said lubricant and coolant passageway, and means sealing opposite ends of said outer tube and accommodating the movement of the inner of said tubes along the outer of said tubes to expose a new surface of the inner of said tubes for progressive compression thereof, comprising an adapter in said inlet, another adapter in said outlet, each adapter having a sleeve portion having the outer of said tubes stretched thereabout and sealed thereto, and an individual elastic seal stretched about each adapter and the inner of said tubes and sealing the inner of said tubes to said adapters and accommodating movement of the inner of said tubes along said adapter.

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