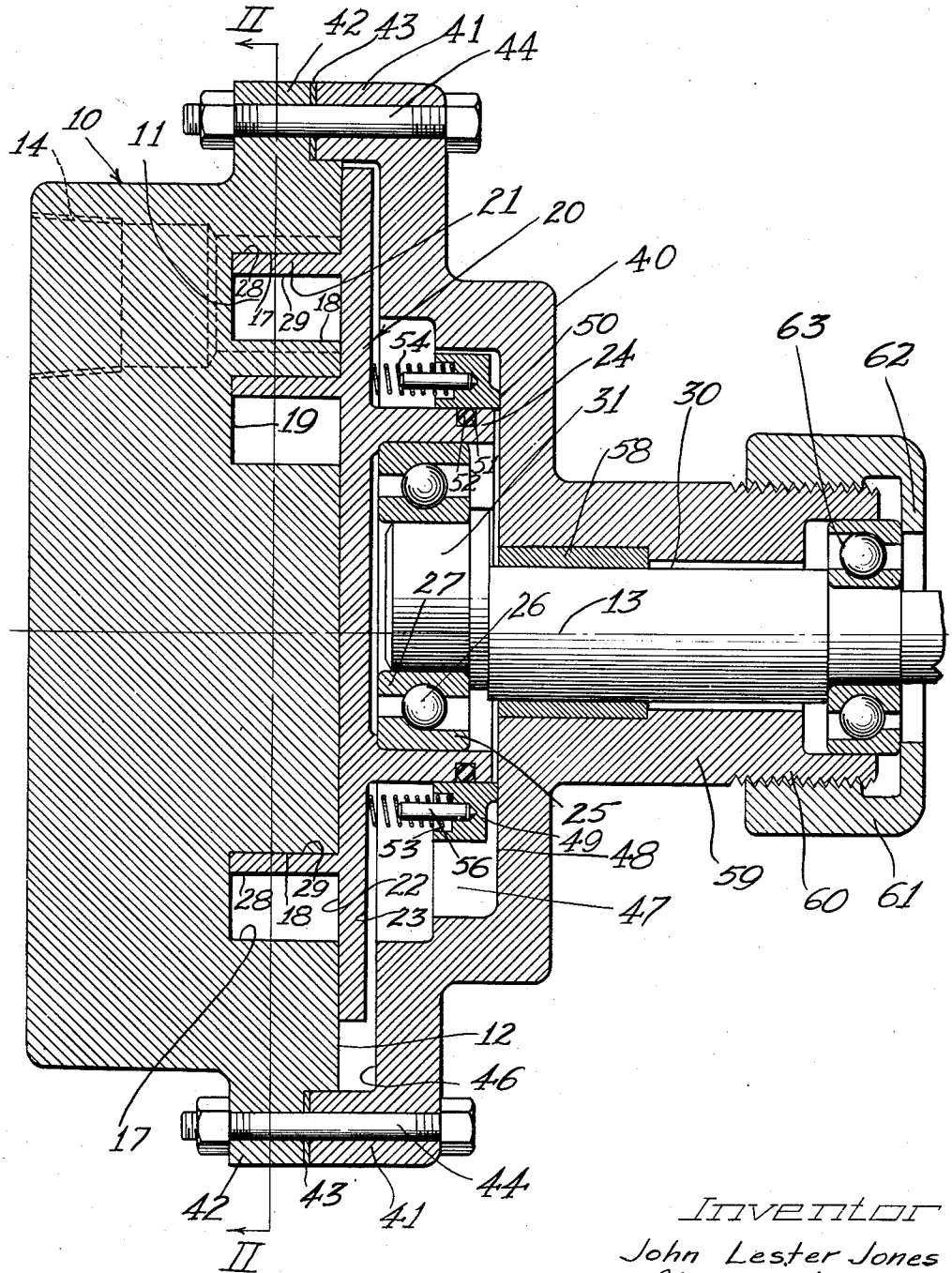
July 1, 1958 J. L. JONES 2,841,089

SCROLL PUMP

Filed May 29, 1953 3 Sheets-Sheet 1

Fig 1



Inventor

John Lester Jones

By Hill Sherman Meroni Gross & Simpson

Attys

July 1, 1958 J. L. JONES 2,841,089

SCROLL PUMP

Filed May 29, 1953 3 Sheets-Sheet 2

Fig 2

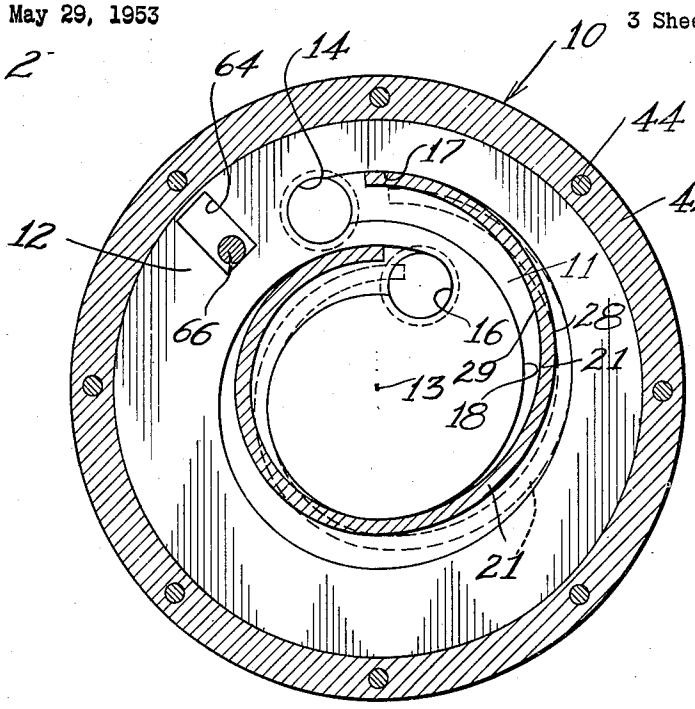
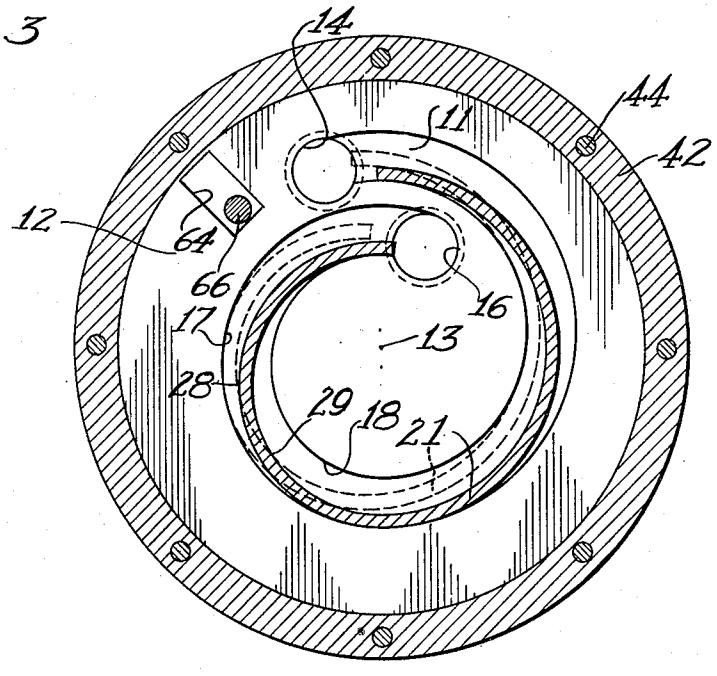


Fig 3



Inventor

John Lester Jones

By Hill Sherman Meroni Gross & Simpson

Attys

July 1, 1958 J. L. JONES 2,841,089

SCROLL PUMP

Filed May 29, 1953 3 Sheets-Sheet 3

Fig 4

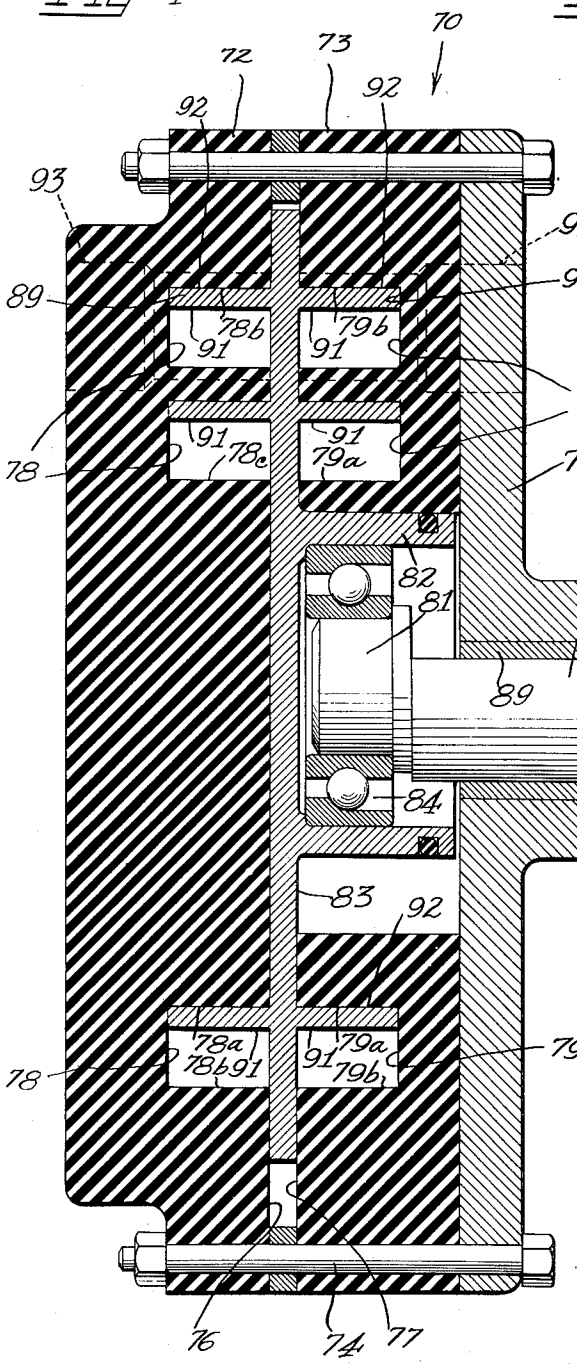
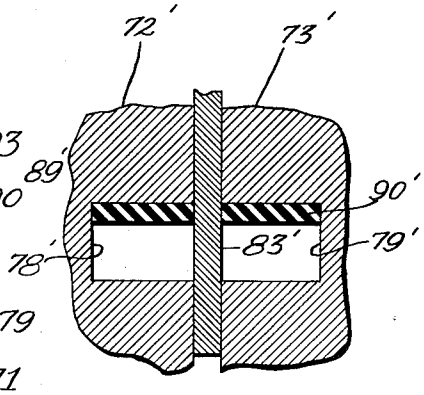


Fig 5



Inventor

John Lester Jones

By Hill Sherman Meroni Gross & Simpson

Attys

United States Patent Office 2,841,089 Patented July 1, 1958

2,841,089

SCROLL PUMP

John Lester Jones, Cleveland, Ohio, assignor, by mesne assignments, to Rand Development Corporation, Cleveland, Ohio, a corporation of Ohio

Application May 29, 1953, Serial No. 358,473

7 Claims. (Cl. 103—131)

This invention relates generally to pumps and more particularly relates to a pump having male and female spirally-shaped fluid displacement means which are relatively oscillatable about a fixed axis, the male and female fluid displacement means operable to provide alternately converging and diverging pumping spaces on both sides of the male impeller member for effecting a substantially continuous flow between inlet and outlet openings spaced apart radially of the axis.

According to the principles of the present invention, a pump casing has a face extending radially outwardly of a fixed axis particularly characterized by the provision of a spirally-shaped recess which winds or coils or circles around the center or pole prescribed by the fixed axis and gradually recedes or approaches such center.

Suitable openings providing a pump inlet and a pump outlet are provided in the casing and are spaced apart from one another radially outwardly of the fixed axis.

The spirally-shaped recess is essentially a groove having side walls parallel to one another and to the fixed axis. A male scroll or male impeller oscillates in the recess or groove and consists of a spirally-shaped band of considerably smaller width than the width of the recess or groove. There is provided by the male scroll, therefore, an outside surface which confronts one of the side walls of the recess or groove and an inside surface confronting the other of the side walls. At one position of alignment, the outside surface of the male scroll contacts one of the side walls at two points while the inside surface of the male scroll contacts the other of the side walls at only one point.

A cover is provided for the pump which engages the casing and rotatably journals a shaft having an eccentric on one end thereof operatively connected to the male scroll to produce relative oscillation between the casing and the male scroll.

Upon oscillation of the male scroll, the points of contact between the male scroll and the casing will be continually varied along a spiral path thereby providing alternately converging and diverging spirally-shaped pumping spaces on both sides of the male scroll for effecting a substantially continuous flow between the pump inlet and the pump outlet.

According to one form of the invention a housing is utilized which provides opposed elongated spirally-spaced grooves curved through an arc of at least 360°. A rotatable shaft is journaled in the housing and has an oscillatable impeller providing opposed elongated spirally-shaped male parts curved through an arc of at least 360° received in the grooves for oscillation with respect to the housing. Since the male parts provide inner and outer fluid impelling surfaces and since the inner and outer fluid impelling surfaces engage the walls of each corresponding groove at no less than two points between the opposite ends of the groove, substantially continuous flow is established between a pump inlet and a pump outlet located in the housing and communicating with opposite ends of the grooves.

It is contemplated in accordance with the principles of the present invention to make one or the other, or both, of the male and female parts of the fluid displacement means of an elastic and resilient material such as rubber or a rubber substitute. Other plastic materials such as polymers could also be employed if desired.

Through the utilization of any elastic and resilient material such as rubber or a rubber substitute on one of the parts, a tighter seal is provided and the resulting pumping structure is also capable of handling solid materials.

It is an object of the present invention to provide an extremely simple form of pump requiring a reduced number of parts which are convenient and economical to manufacture and which may be effectively maintained with a minimum of expense and effort.

Another object of the present invention is to provide a pump structure which can be powered by a rotary motor and in which torque requirements are minimized.

Yet another object of the present invention is to provide a pump wherein comparative relatively high vacuums can be maintained with a minimum amount of lubrication.

Yet another object of the present invention is to provide a pump which will effectively pump fluids but which is capable of impelling appreciable quantities of solids.

Many other features, advantages and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detail description which follows and the accompanying sheets of drawings in which a preferred structural embodiment of the present invention is shown by way of illustrative example.

On the drawings:

Figure 1 is a cross-sectional view with parts shown in elevation showing a pump provided in accordance with the principles of the present invention;

Figure 2 is a somewhat reduced cross-sectional view taken substantially on the line II—II of Figure 1;

Figure 3 is a view similar to Figure 2 but showing the fluid displacement means in a different relative physical position;

Figure 4 is a view similar to Figure 1 but showing an alternative embodiment of the present invention wherein a multiple pump utilizing a rubber housing portion is provided; and

Figure 5 is a fragmentary cross-sectional view showing an alternative embodiment wherein the male part of the oscillatable fluid displacement means is made of rubber.

As shown on the drawings:

The pump of the present invention consists of four primary members, namely, the body or casing **10** containing what shall be sometimes herein referred to as a female scroll **11**, an impeller **20** carrying what shall sometimes be referred to herein as a male scroll **21**, a shaft **30** having an eccentric **31** on one end thereof and a cover **40**.

Referring further to the drawings, it will be noted that the body or casing **10** provides a face **12** which extends radially outwardly of a fixed axis indicated at **13**.

The face **12** is particularly characterized by the provision of an opening **14** forming a pump inlet and a second opening **16** forming a pump outlet.

The inlet **14** and the outlet **16** extend generally parallel to the axis **13** and are spaced apart from one another radially and outwardly of the axis **13**.

The inlet **14** and the outlet **16** are communicated with one another by the female scroll **11** which more particularly comprises a recess or groove which circles around the axis **13** and gradually approaches the axis **13**, as the

recess or groove circles or coils or winds from the inlet 14 toward the outlet 16.

As shown in the drawings, the female scroll 11 provided by the recess or groove has side walls which are parallel to one another and which extend in parallel relation with respect to the axis 13. There is thus provided an outside side wall indicated at 17 and an inside side wall indicated at 18 separated from one another by a distance equal to the width of the recess or groove, a dimension which is also commensurate with the bottom 19 of the female scroll 11.

As shown on the drawings, the impeller 20 is a plate form member providing a sealing face 22 which extends radially outwardly of the axis 13 and sealingly engages the face 12 provided by the casing or body 10. An oppositely disposed face 23 on the impeller 20 is particularly characterized by the provision of a hub flange 24 seating on the inside thereof a ball race 25 which in turn cooperates with a plurality of shiftable members or ball bearings 26 enclosed within an inner ball race 27 seated on the bearing surface provided by the eccentric 31 on the end of the shaft 30.

The male scroll 21 is provided by a spirally-shaped band which extends normal to the face 22 and which is shaped in a spiral configuration with respect to the axis 13 so as to be complemental to the female scroll 11.

The cover 40 has a flange 41 which abuts against a corresponding flange 42 on the body or casing 10. A gasket 43 is interposed therebetween and the cover 40 and the body or casing 10 are retained in firm assembly with one another by a plurality of circumferentially spaced fasteners, indicated at 44.

A counterbore 46 is formed in the cover to provide space for accommodating the oscillatory movement of the impeller 20. An additional counterbored space 47 is provided in the cover 40 adjacent a radially extending face 48 to accommodate the hub 24. A bearing ring 49 has a bearing surface 50 which slidingly engages the face 48. The ring 49 encircles the hub 24 and an annular groove 51 seating an O-ring 52 is provided in the hub 24 for establishing a seal between the hub 24 and the ring 49.

One or more recesses 53 are provided in the ring 49 to seat one end of a corresponding coil spring 54, the other end of each coil spring 54 engaging the face 23 of the impeller 20.

A retainer pin 56 for each recess 53 is carried by the ring 49 and extends through a portion of each respective coil spring 54. There is thus provided a continuous biasing force between the cover 40 and the impeller 20 tending to load the faces 22 and 12 into sealing engagement with one another.

A bearing ring 58 is carried by the cover 40 and provides a journal surface for the shaft 30.

The cover 40 has a reduced neck 59 threaded as at 60 to threadedly receive a nut 61 having a radially inwardly extending flange 62 retaining a bearing assembly 63 against axial displacement. The bearing assembly 63 provides further journal support for the shaft 30 in the cover 40.

The body or casing 10 may also be provided with a recess 64 confining a pin 66 which extends axially away from the face 22 of the impeller 20 so as to prevent relative rotation between the impeller 20 and the body or casing 10. The recess 64 and the pin 66 are preferably proportioned to accommodate relative oscillatory movement between the body or casing 10 and the impeller 20.

As will be noted upon making reference to the drawings, the male scroll 21 has a pair of oppositely disposed faces which extend generally parallel to the axis 13 and normal to the face 22 including an outside face 28 which confronts the side wall 17 of the female scroll 11 and an inside face 29 which confronts the side wall 18 of the female scroll 11.

As shown in Figure 2, the fluid displacement means provided by the female and male scroll members 11 and 21 contact one another at three places when the male scroll 21 is oscillated to the uppermost position relative to the female scroll 11. In the position of Figure 2 the outside surface 28 of the male scroll 21 engages the side wall 17 at two points of contact and the inside surface 29 of the male scroll 21 engages the side wall 18 of the female scroll 11 at one point of contact.

Upon relative oscillation between the male and female scroll members, these points of contact continually vary in relation to one another along a spiral path so that the fluid displacement means provide alternately converging and diverging pumping spaces on both sides of the male scroll 21 for effecting a substantially continuous flow between the inlet 14 and the outlet 16. In other words, pumping action occurs both inside and outside the male scroll 11 because the female scroll 21 provides a complementally-shaped flow path which confines fluid on opposite sides of the impeller, the confining spaces being concurrently varied to continuously enlarge in size for receiving fluid from the inlet 14 or to continuously decrease in size to expel fluid to the outlet 16. The only limitation on full continuous flow is that limitation imposed by the difference in radii between the outside and the inside of the scroll.

A particularly useful feature of the present invention resides in the low torque required to relatively oscillate the impeller 20 and the means providing the female scroll 11. This is due to the minimal interference between the cross-section faces and between the scroll faces and its mating recess or groove.

The dotted lines shown in Figures 2 and 3 indicate the rolling action effected upon relative oscillation of the impeller 20 and the body or casing member 10, thereby clearly indicating the double pumping action which occurs on both sides of the male scroll 21 because of the formation of alternately diverging and converging pumping spaces. The fluid displacement means provided in accordance with the present invention will not only effectively pump fluids but will accommodate appreciable quantities of solids without adversely effecting the operative efficiency of the pump.

In the embodiment of the invention shown in Figure 4, a pump 70 including multiple fluid displacement means is provided and includes a housing 71 having rubber portions 72 and 73 assembled in firm relationship therewith by means of fastening means 74.

The rubber portion 72 is provided with a radially extending face 76 and the rubber portion 73 is provided with a radially extending face 77, the faces 76 and 77 being substantially coextensive and adapted to face one another.

The rubber portions 72 and 73 are particularly characterized by the provision of opposed elongated spirally-shaped grooves indicated at 78 and 79, respectively, each groove being curved through an arc of at least 360° similar to the female scroll 11 described in connection with the embodiment shown in Figures 1–3. The groove 78 has an inner surface 78*a* and an outer surface 78*b* and the groove 79 has an inner surface 79*a* and an outer surface 79*b*.

Rotatably journaled in the housing 71 is a shaft 80 having an eccentric crank 81 on one end thereof connected to a hub portion 82 of an oscillatable impeller 83 by means of bearing means indicated generally at 84.

The oscillatable impeller 83 preferably comprises a plate-shaped or disk-shaped member which has radially extending faces arranged in opposed and parallel relation so as to facilitate location of the oscillatable impeller 83 between the radial faces 76 and 77 of the rubber portions 72 and 73 of the housing 71.

The hub portion 82 extends from one face of the impeller 83 and comprises a flange receiving the bearing means 84.

A bearing sleeve **89** is provided between the housing **71** and the shaft **80** and bearing means indicated generally at **86** are also provided at the end of the housing **71**, a retainer cap **87** being threaded onto the housing **71** as at **88**.

The impeller **83** is particularly characterized by the provision of opposed elongated spirally-shaped male parts indicated at **89** and **90**, respectively, each of which is curved through an arc of at least 360° similar to the male scroll **21** described in connection with the embodiment of Figures 1–5.

The male parts **89** and **90** take the form of spirally-shaped bands considerably narrower in transverse dimension than the width of the grooves **78** and **79** in which they are respectively received. Moreover, the male parts **89** and **90** extend generally normal to the opposed faces of the oscillatable impeller **83** and provide inner and outer fluid impelling surfaces indicated at **91** and **92**, respectively.

The inner and outer fluid impelling surfaces **91** and **92** engage the corresponding side wall portions **78***a*, **78***b*, **79***a*, **79***b* of the grooves **78** and **79** and it may be noted that there are never less than two sealing points provided by such inter-engagement between opposite ends of the grooves **78** and **79**. When the oscillatable impeller **83** is at the top position as shown in Figure 4 (like Fig. 2) or when the oscillatable impeller is in the bottom position, for example, as it would be if it were positioned similar to the showing of Figure 3, there are three sealing points provided by the inter-engagement of the contacting surfaces.

As in the embodiment of Figures 1–5, a pump inlet and a pump outlet are provided in the housing and are arranged to communicate with opposite ends of the grooves **78** and **79**.

In the present embodiment, the pump inlet is spaced at the radial innermost end of the grooves **78** and **79** and, as shown in Figure 4, the pump outlet **93** communicates with the radial outermost end portion of the grooves **78** and **79**.

Because fluid is impelled by both the outer and inner fluid impelling surfaces **91** and **92** of the oscillatable impeller **83**, there will be provided virtually continuous flow between the inlet and the outlet.

Moreover, because the female parts are provided by the rubber portion **72** and the rubber portion **73** of the housing **71**, a very good sealing action is afforded between the housing and the oscillatable impeller **83**.

It will be apparent to those versed in the art that either of the male and female parts of the oscillatable fluid displacement means or both of the parts could be made from an elastic and resilient material such as a rubber or a rubber substitute. In the embodiment of Figure 4, the female part is so constructed, however, in the embodiment of Figure 5 the reverse arrangement is illustrated.

In Figure 5 the housing is provided with parts **72'** and **73'** having opposed elongated spirally-shaped grooves **78'** and **79'** which are curved through an arc of at least 360° and which receive opposed elongated spirally-shaped male parts **89'** and **90'** forming a part of an oscillatable impeller **83'**. In the embodiment of Figure 5, each of the male parts **89'** and **90'** is made of elastic and resilient material such as rubber or a rubber substitute.

The use of a resilient and elastic material such as rubber or a rubber substitute for one of the parts not only permits a tighter seal to be maintained but also facilitates the handling of solid materials. Accordingly, the pump of the present invention will displace appreciable quantities of solid material without adversely affecting the operative efficiency of the pump in pumping fluids between the inlet and the outlet.

Although various minor modifications might be suggested by those versed in the art it should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

1. In a pump, a casing member having a planar casing face intersected by a spirally-shaped recess, means in said casing providing openings at the inner and outer ends of said recess to provide inlet and outlet openings for the recess, an end plate providing spaced faces, one of said faces being generally planar and abutting said casing face and having a spirally-shaped rib extending therefrom into said recess, the other face of said end plate having an annular hub extending away therefrom, a second casing member connected to said first casing member and having wall portions spaced from said end plate, bearing means inside of said hub, a rotatable shaft journaled in said second casing member and having an eccentric portion engaging said bearing means to oscillate said end plate, continuous biasing means between the other of said faces on said end plate and said wall portions of said second casing member to load said end plate into sealing engagement with said casing face, and stop means between said first casing member and said end plate precluding relative rotation therebetween.

2. In a pump, means providing an inlet and an outlet spaced apart radially of an axis, a spiral groove circling said axis and providing a female scroll communicating at one end with said inlet only and at its other end with said outlet only, said groove providing side walls parallel to one another and to said axis, a spiral impeller in said groove providing a male scroll having an outside surface confronting one of said side walls and an inside surface confronting the other of said side walls, said outside surface of said male scroll contacting said one of said side walls at two points while said inside surface contacts the other of said side walls at one point, housing means closing the open side of said groove, and actuating means for causing relative oscillation between said male and female scrolls to continually vary said points of contact along a spiral path, thereby to provide alternately converging and diverging pumping spaces on both sides of said male scroll for substantially continuously flowing fluid from said inlet to said outlet.

3. In a pump, a casing having an inlet and an outlet spaced radially of an axis, a spiral groove circling said axis and providing a female scroll communicating at one end with said inlet only and at its other end with said outlet only, said spiral groove providing side walls parallel to one another and to said axis, an oscillatable end plate having a spiral rib extending into said groove and providing a male scroll having an outside surface confronting one of said side walls and an inside surface confronting the other of said side walls, said outside surface of said male scroll contacting said one of said side walls at two points while said inside surface contacts the other of said side walls at one point, a cover connected to said casing, a shaft journaled in said cover, and an eccentric on said shaft operatively connected to said end plate for oscillating said male scroll to continually vary said points of contact along a spiral path thereby to provide alternately converging and diverging pumping spaces on opposite sides of said male scroll for effecting a substantially continuous flow between the inlet and the outlet.

4. In a pump, relatively oscillatable fluid displacement means comprising elongated spirally-shaped male and female parts curved through an arc of at least 360°, said male part being narrower in transverse dimension than said female part, and each part providing confronting inner and outer fluid impelling surfaces engaged at never less than two sealing points between opposite ends of said parts, and means providing an inlet and an outlet at opposite ends of said parts, whereby fluid is displaced upon oscillation of said parts with a substantially continuous flow, one of said male and female parts being made of rubber to improve the seal therebetween.

5. In a pump, a housing having a rubber portion providing opposed elongated spirally-shaped grooves curved through an arc of at least 360°, a rotatable shaft journaled in said housing and having an oscillatable impeller providing opposed elongated spirally-shaped male parts curved through an arc of at least 360° received in said grooves for oscillation with respect to the rubber portion of said housing, each male part providing inner and outer fluid impelling surfaces always resiliently engaging the walls of a corresponding groove at no less than two points between the opposite ends of the groove, and an inlet and an outlet in said housing communicating with opposite ends of said grooves, whereby fluid is displaced upon oscillation of said impeller with a substantially continuous flow.

6. In a pump, a housing providing opposed elongated spirally-shaped grooves curved through an arc of at least 360°, a rotatable shaft journaled in said housing and having an oscillatable impeller providing opposed elongated spirally-shaped rubber male parts curved through an arc of at least 360° and received in said grooves for oscillation with respect to said housing, each rubber male part providing inner and outer fluid impelling surfaces resiliently and elastically engaging the walls of a corresponding groove at no less than two points between the opposite ends of the groove, and an inlet and an outlet in said housing communicating with opposite ends of said grooves, whereby fluid is displaced upon oscillation of said impeller with a substantially continuous flow.

7. In a pump, means providing an inlet and an outlet spaced apart radially of an axis, a spiral groove circling said axis and providing a female scroll communicating at one end with said inlet only and at its other end with said outlet only, said groove providing side walls parallel to one another and to said axis, a spiral impeller in said groove providing a male scroll having an outside surface confronting one of said side walls and an inside surface confronting the other of said side walls, said outside surface of said male scroll contacting said one of said side walls at two points while said inside surface contacts the other of said side walls at one point, housing means closing the open side of said groove, and actuating means for causing relative oscillation between said male and female scrolls to continually vary said points of contact along a spiral path, thereby to provide alternately converging and diverging pumping spaces on both sides of said male scroll for substantially continuously flowing fluid from said inlet to said outlet.

References Cited in the file of this patent

UNITED STATES PATENTS

801,182	Creux	Oct. 3, 1905
1,376,291	Rolkerr	Apr. 26, 1921
2,449,974	Bergman	Sept. 28, 1948
2,462,063	Bergman	Feb. 22, 1949
2,475,247	Mikulasek	July 5, 1949
2,494,100	Mikulasek	Jan. 10, 1950
2,764,101	Rand	Sept. 25, 1956

FOREIGN PATENTS

48,616	France	Jan. 19, 1938
220,296	Great Britain	Jan. 8, 1925
367,086	Great Britain	Feb. 18, 1932
486,192	Great Britain	May 31, 1938
813,559	France	Mar. 1, 1937
825,643	France	Dec. 16, 1937