

SCROLL-TYPE MACHINEBACKGROUND AND SUMMARY

The present invention relates to fluid displacement apparatus and more particularly to an improved scroll-type machine especially adapted for compressing gaseous fluids, and to a method of manufacture thereof.

A class of machines exists in the art generally known as "scroll" apparatus for the displacement of various types of fluids. Such apparatus may be configured as an expander, a displacement engine, a pump, a compressor, etc., and many features of the present invention are applicable to any one of these machines. For purposes of illustration, however, the disclosed embodiments are in the form of a hermetic refrigerant compressor.

Generally speaking, a scroll apparatus comprises two spiral scroll wraps of similar configuration each mounted on a separate end plate to define a scroll member. The two scroll members are interfitted together with one of the scroll wraps being rotationally displaced 180 degrees from the other. The apparatus operates by orbiting one scroll member (the "orbiting scroll") with respect to the other scroll member (the "fixed scroll" or "non-orbiting scroll") to make moving line contacts between the flanks of the respective wraps, defining moving

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isolated crescent-shaped pockets of fluid. The spirals are commonly formed as involutes of a circle, and ideally there is no relative rotation between the scroll members during operation, i.e., the motion is purely curvilinear translation (i.e. no rotation of any line in the body). The fluid pockets carry the fluid to be handled from a first zone in the scroll apparatus where a fluid inlet is provided, to a second zone in the apparatus where a fluid outlet is provided. The volume of a sealed pocket changes as it moves from the first zone to the second zone. At any one instant in time there will be at least one pair of sealed pockets, and when there are several pairs of sealed pockets at one time, each pair will have different volumes. In a compressor the second zone is at a higher pressure than the first zone and is physically located centrally in the apparatus, the first zone being located at the outer periphery of the apparatus.

Two types of contacts define the fluid pockets formed between the scroll members: axially extending tangential line contacts between the spiral faces or flanks of the wraps caused by radial forces ("flank sealing"), and area contacts caused by axial forces between the plane edge surfaces (the "tips") of each wrap and the opposite end plate ("tip sealing"). For high efficiency, good sealing must be achieved for both types of contacts, however, the present invention is primarily concerned with tip sealing.

The concept of a scroll-type apparatus has thus been known for some time and has been recognized as having distinct advantages. For example, scroll machines have high isentropic and volumetric efficiency, and hence are relatively small and lightweight for a given capacity. They are quieter and more vibration free than many compressors because

they do not use large reciprocating parts (e.g. pistons, connecting rods, etc.), and because all fluid flow is in one direction with simultaneous compression in plural opposed pockets there are less pressure-created vibrations. Such machines also tend to have high reliability and durability because of the relative few moving parts utilized, the relative low velocity of movement between the scrolls, and an inherent forgiveness to fluid contamination.

One of the difficult areas of design in a scroll-type machine concerns the technique used to achieve tip sealing under all operating conditions, and also speeds in a variable speed machine. Conventionally this has been accomplished by (1) using extremely accurate and very expensive machining techniques, (2) providing the wrap tips with spiral tip seals, which unfortunately are hard to assemble and often unreliable, or (3) applying an axial restoring force by axial biasing the orbiting scroll toward the non-orbiting scroll using compressed working fluid. The latter technique has some advantages but also presents problems; namely, in addition to providing a restoring force to balance the axial separating force, it is also necessary to balance the tipping movement on the scroll member due to pressure-generated radial forces, as well as the inertial loads resulting from its orbital motion, both of which are speed dependent. Thus, the axial balancing force must be relatively high, and will be optimal at only one speed.

One of the more important features of applicant's invention concerns the provision of a design for overcoming these problems. It resides in the discovery of a unique axially compliant suspension system for the non-orbiting scroll which fully balances all significant tipping movements. This permits pressure biasing of the non-orbiting scroll

(which has no inertial load problems), the amount of such pressure biasing required being limited to the minimum amount necessary to deal solely with axial separating forces, thus significantly and beneficially reducing the amount of restoring force required. While pressure biasing of the non-orbiting scroll member has been broadly suggested in the art (see U.S. patent No. 3,874,827), such systems suffer the same disadvantages as those which bias the orbiting scroll member insofar as dealing with tipping movements is concerned. Furthermore, applicants' arrangement provides a control over non-axial movement of the non-orbiting scroll member which is greatly superior to that of prior art devices. Several different embodiments of applicants' invention are disclosed, using different suspension means and different sources of pressure.

One of the more popular approaches for preventing relative angular movement between the scrolls as they orbit with respect to one another resides in the use of an Oldham coupling operative between the orbiting scroll and a fixed portion of the apparatus. An Oldham coupling typically comprises a circular Oldham ring having two sets of keys, one set of keys slides in one direction on a surface of the orbiting scroll while the other set of keys slides at right angles thereto on a surface of the machine housing. The Oldham ring is generally disposed around the outside of the thrust bearing which supports the orbital scroll member with respect to the housing. Another feature of applicant's invention resides in the provision of an improved non-circular Oldham ring which permits the use of a larger thrust bearing, or a reduced diameter outer shell for a given size thrust bearing.

The machine as later described also embodies an improved directed suction baffle for a refrigerant compressor which prevents mixing of the suction gas with oil dispersed throughout the interior of the compressor shell, which functions as an oil separator to remove already entrained oil, and which prevents the transmission of motor heat to the suction gas, thereby significantly improving overall efficiency.

The described machine also incorporates an improved lubrication system to ensure that adequate lubricating oil is delivered to the driving connection between the crankshaft and orbiting scroll member.

Another feature of the present disclosure concerns the provision of a unique manufacturing technique, and wrap tip and end plate profile, which compensate for thermal growth near the centre of the machine. This facilitates the use of relatively fast machining operations for fabrication and yields a compressor which will reach its maximum performance in a much shorter break-in time period than conventional scroll machines.

Attention is drawn to our copending divisional application, No 90 04927.1, Serial No 2 229 226, in which we claim a scroll-type machine comprising: a first scroll member having a spiral wrap thereon; a second scroll member having a spiral wrap thereon; support means for mounting said scroll members for relative orbital movement with said spiral wraps intermeshing with one another whereby said orbital movement will cause said wraps to define fluid pockets moving between a relatively low suction pressure region and a relatively high discharge pressure region, said first scroll member being mounted for non-orbital movement with respect to said support means and said second scroll member being mounted for orbital movement with respect to said support means; and biasing means for biasing said first scroll member toward said second scroll

member, said biasing means comprising means defining a first chamber containing fluid at a first pressure; and means defining a second chamber containing fluid at a second pressure said first and second pressures being greater than the said low pressure; said first and second chambers being positioned such that said fluid at said first pressure and said fluid at said second pressure cooperate to exert a biasing force on said first scroll member to urge it in a direction towards said second scroll member and generally parallel to the axis of said orbital movement thereby to enhance sealing between said scroll members.

Brief Description of the Drawing Figures

Figure 1 is a vertical sectional view, with certain parts broken away, of a scroll compressor embodying the principles of the present invention, with the section being taken generally along line 1-1 in Figure 3 but having certain parts slightly rotated;

Figure 2 is a similar sectional view taken generally along line 2-2 in Figure 3 but with certain parts slightly rotated;

Figure 3 is a top plan view of the compressor of Figures 1 and 2 with part of the top removed;

Figure 4 is a view similar to that of Figure 3 but with the entire upper assembly of the compressor removed;

Figures 5, 6 and 7 are fragmentary views similar to the right hand portion of Figure 4 with successive parts removed to more clearly show the details of construction thereof;

Figure 8 is a fragmentary section view taken generally along line 8-8 in Figure 4;

Figure 9 is a fragmentary section view taken generally along line 9-9 in Figure 4;

Figure 10 is a sectional view taken generally along line 10-10 in Figure 1;

Figures 11A and 11B are developed spiral vertical sectional views taken generally along lines 11A-11A and 11B-11B, respectively, in Figure 10, with the profile shown being foreshortened and greatly exaggerated;

Figure 12 is a developed sectional view taken generally along line 12-12 in Figure 4;

Figure 13 is a top plan view of an improved Oldham ring forming part of the present invention;

Figure 14 is a side elevational view of the Oldham ring of Figure 13;

Figure 15 is a fragmentary sectional view taken substantially along line 15-15 in Figure 10 showing several of the lubrication passageways;

Figure 16 is a sectional view taken substantially along line 16-16 in Figure 15;

Figure 17 is a horizontal sectional view taken substantially along line 17-17 in Figure 2;

Figure 18 is an enlarged fragmentary vertical sectional view illustrating another embodiment of the present invention;

Figure 19 is a view similar to Figure 18 showing a further embodiment;

Figure 20 is a fragmentary somewhat diagrammatic horizontal sectional view illustrating a different technique for mounting the non-orbiting scroll for limited axial compliance;

Figure 21 is a sectional view taken substantially along line 21-21 in Figure 20;

Figure 22 is a sectional view similar to Figure 21, but showing a further technique for mounting the non-orbiting scroll for limited axial compliance;

Figure 23 is a view similar to Figure 20, but illustrating a another technique for mounting the non-orbiting scroll for limited axial compliance;

Figure 24 is a sectional view taken substantially along line 24-24 in Figure 23;

Figure 25 is similar to Figure 20 and illustrates yet a further technique for mounting the non-orbiting scroll for limited axial compliance;

Figure 26 is a sectional view taken substantially along line 26-26 in Figure 25;

Figure 27 is similar to Figure 20 and illustrates yet another technique for mounting the non-orbiting scroll for limited axial compliance;

Figure 28 is a sectional view taken substantially along line 28-28 in Figure 27;

Figure 29 is similar to Figure 20 and illustrates yet a further technique for mounting the non-orbiting scroll for limited axial compliance;

Figure 30 is a sectional view taken substantially along line 30-30 in Figure 29;

Figures 31 and 32 are views similar to Figure 21, illustrating two additional somewhat similar techniques for mounting the non-orbiting scroll for limited axial compliance; and

Figure 33 is a view similar to Figure 21 illustrating diagrammatically yet another technique for mounting the non-orbiting scroll for limited axial compliance.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Although the principles of the present invention may be applied to many different types of scroll-type machines, they are described herein for exemplary purposes embodied in a hermetic scroll-type compressor, and particularly one which has been found to have specific utility in the compression of refrigerant for air conditioning and refrigeration systems.

With reference to Figures 1-3, the machine comprises three major overall units, i.e. a central assembly 10 housed within a circular cylindrical steel shell 12, a top and bottom assemblies 14 and 16 welded to the upper and lower ends of shell 12, respectively, to close and seal same. Shell 12 houses the major components of the machine, generally including an electric motor 18 having a stator 20 (with conventional

windings 22 and protector 23) press fit within shell 12, motor rotor 24 (with conventional lugs 26) heat shrunk on a crankshaft 28, a compressor body 30 preferably welded to shell 12 at a plurality of circumferentially spaced locations, as at 32, and supporting an orbiting scroll member 34 having a scroll wrap 35 of a standard desired flank profile and a tip surface 33, an upper crankshaft bearing 39 of conventional two-piece bearing construction, a non-orbiting axially compliant scroll member 36 having a scroll wrap 37 of a standard desired flank profile (preferably the same as that of scroll wrap 35) meshing with wrap 35 in the usual manner and a tip surface 31, a discharge port 41 in scroll member 36, an Oldham ring 38 disposed between scroll member 34 and body 30 to prevent rotation of scroll member 34, a suction inlet fitting 40 soldered or welded to shell 12, a directed suction assembly 42 for directing suction gas to the compressor inlet, and a lower bearing support bracket 44 welded at each end to shell 10, as at 46, and supporting a lower crankshaft bearing 48 in which is journaled the lower end of crankshaft 28. The lower end of the compressor constitutes a sump filled with lubricating oil 49.

Lower assembly 16 comprises a simple steel stamping 50 having a plurality of feet 52 and apertured mounting flanges 54. Stamping 50 is welded to shell 12, as at 56, to close and seal the lower end thereof.

Upper assembly 14 is a discharge muffler comprising a lower stamped steel closure member 58 welded to the upper end of shell 10, as at 60, to close and seal same. Closure member 58 has an upstanding peripheral flange 62 from which projects an apertured holding lug 64 (Figure 3), and in its central area defines an axially disposed circular cylinder chamber 66 having a plurality of openings 68 in the wall

thereof. To increase its stiffness member 58 is provided with a plurality of embossed or ridged areas 70. An annular gas discharge chamber 72 is defined above member 58 by means of an annular muffler member 74 which is welded at its outer periphery to flange 62, as at 76, and at its inner periphery to the outside wall of cylinder chamber 66, as at 78. Compressed gas from discharge port 41 passes through openings 68 into chamber 72 from which it is normally discharged via a discharge fitting 80 soldered or brazed into the wall of member 74. A conventional internal pressure relief valve assembly 82 may be mounted in a suitable opening in closure member 58 to vent discharge gas into shell 12 in excessive pressure situations.

Considering in greater detail the major parts of the compressor, crankshaft 28, which is rotationally driven by motor 18, has at its lower end a reduced diameter bearing surface 84 journaled in bearing 48 and supported on the shoulder above surface 84 by a thrust washer 85 (Figures 1, 2 and 17). The lower end of bearing 48 has an oil inlet passage 86 and a debris removal passage 88. Bracket 44 is formed in the shape shown and is provided with upstanding side flanges 90 to increase the strength and stiffness thereof. Bearing 48 is lubricated by immersion in oil 49 and oil is pumped to the remainder of the compressor by a conventional centrifugal crankshaft pump comprising a central oil passage 92 and an eccentric, outwardly inclined, oil feed passage 94 communicating therewith and extending to the top of the crankshaft. A transverse passage 96 extends from passage 94 to a circumferential groove 98 in bearing 39 to lubricate the latter. A lower counterweight 97 and an upper counterweight 100 are affixed to crankshaft 28 in any suitable manner, such as by staking to projections on lugs 26 in the

usual manner (not shown). These counterweights are of conventional design for a scroll-type machine.

Orbiting scroll member 34 comprises an end plate 102 having generally flat parallel upper and lower surfaces 104 and 106, respectively, the latter slidably engaging a flat circular thrust bearing surface 108 on body 30. Thrust bearing surface 108 is lubricated by an annular groove 110 which receives oil from passage 94 in crankshaft 28 via passage 96 and groove 98, the latter communicating with another groove 112 in bearing 39 which feeds oil to intersecting passages 114 and 116 in body 30 (Figure 15). The tips 31 of scroll wrap 37 sealingly engage surface 104, and the tips 33 of scroll wrap 35 in turn sealingly engage a generally flat and parallel surface 117 on scroll member 36.

Integrally depending from scroll member 34 is a hub 118 having an axial bore 120 therein which has rotatively journaled therein a circular cylindrical unloading drive bushing 122 having an axial bore 124 in which is drivingly disposed an eccentric crank pin 126 integrally formed at the upper end of crankshaft 28. The drive is radially compliant, with crank pin 126 driving bushing 122 via a flat surface 128 on pin 126 which slidably engages a flat bearing insert 130 disposed in the wall of bore 124. Rotation of crankshaft 28 causes bushing 126 to rotate about the crankshaft axis, which in turn causes scroll member 34 to move in a circular orbital path. The angle of the flat driving surface is chosen so that the drive introduces a slight centrifugal force component to the orbiting scroll, in order to enhance flank sealing. Bore 124 is cylindrical, but is also slightly oval in cross-sectional shape to permit limited relative sliding movement between the pin and bushing, which

will in turn permit automatic separation and hence unloading of the meshing scroll flanks when liquids or solids are ingested into the compressor.

The radially compliant orbital drive of the present invention is lubricated utilizing an improved oil feeding system. Oil is pumped by pump passage 92 to the top of passage 94 from which it is thrown radially outwardly by centrifugal force, as indicated by dotted line 125. The oil is collected in a recess in the form of a radial groove 131 located in the top of bushing 122 along path 125. From here it flows downwardly into the clearance space between pin 126 and bore 124, and between bore 120 and a flat surface 133 on bushing 122 which is aligned with groove 131 (Figure 16). Excess oil then drains to the oil sump 49 via a passage 135 in body 30.

Rotation of scroll member 34 relative to body 30 and scroll member 36 is prevented by an Oldham coupling, comprising ring 38 (Figures 13 and 14) which has two downwardly projecting diametrically opposed integral keys 134 slidably disposed in diametrically opposed radial slots 136 in body 30, and at 90 degrees therefrom two upwardly projecting diametrically opposed integral keys 138 slidably disposed in diametrically opposed radial slots 140 in scroll member 34 (one of which is shown in Figure 1).

Ring 38 is of a unique configuration whereby it permits the use of a maximum size thrust bearing for a given overall machine size (in transverse cross-section), or a minimum size machine for a given size thrust bearing. This is accomplished by taking advantage of the fact that the Oldham ring moves in a straight line with respect to the compressor body, and thus configuring the ring with a generally oval or

"racetrack" shape of minimum inside dimension to clear the peripheral edge of the thrust bearing. The inside peripheral wall of ring 38, the controlling shape in the present invention, comprises one end 142 of a radius R taken from center x and an opposite end 144 of the same radius R taken from an outer y (Figure 13), with the intermediate wall portions being substantially straight, as at 146 and 148. Center points x and y are spaced apart a distance equal to twice the orbital radius of scroll member 34 and are located on a line passing through the centers of keys 134 and radial slots 136, and radius R is equal to the radius of thrust bearing surface 108 plus a predetermined minimal clearance. Except for the shape of ring 38, the Oldham coupling functions in the conventional manner.

One of the more significant aspects of the present invention resides in the unique suspension by which upper non-orbiting scroll member is mounted for limited axial movement, while being restrained from any radial or rotational movement, in order to permit axial pressure biasing for tip sealing. The preferred technique for accomplishing this is best shown in Figures 4-7, 9 and 12. Figure 4 shows the top of the compressor with top assembly 14 removed, and Figures 5-7 show a progressive removal of parts. On each side of compressor body 30 there are a pair of axially projecting posts 150 having flat upper surfaces lying in a common transverse plane. Scroll member 36 has a peripheral flange 152 having a transversely disposed planar upper surface, which is recessed at 154 to accommodate posts 150 (Figures 6 and 7). Posts 150 have axially extending threaded holes 156, and flange 152 has corresponding holes 158 equally spaced from holes 156.

Disposed on top of posts 150 is a flat soft metal gasket 160 of the shape shown in Figure 6, on top of gasket 160 is a flat spring steel leaf spring 162 of the shape shown in Figure 5, and on top of that is a retainer 164, all of these parts being clamped together by threaded fasteners 166 threadably disposed in holes 156. The outer ends of spring 162 are affixed to flange 152 by threaded fasteners 168 disposed in holes 158. The opposite side of scroll member 36 is identically supported. As can thus be visualized, scroll member 36 can move slightly in the axial direction by flexing and stretching (within the elastic limit) springs 162, but cannot rotate or move in the radial direction.

Maximum axial movement of the scroll members in a separating direction is limited by a mechanical stop, i.e. the engagement of flange 152 (see portion 170 in Figures 6, 7 and 12) against the lower surface of spring 162, which is backed-up by retainer 164, and in the opposite direction by engagement of the scroll wrap tips on the end plate of the opposite scroll member. This mechanical stop operates to cause the compressor to still compress in the rare situation in which the axial separating force is greater than the axial restoring force, as is the case on start-up. The maximum tip clearance permitted by the stop can be relatively small, e.g. in the order of less than .005" (0.13 mm) for a scroll to 3-4" (7.6-10.2 cms) diameter and 1-2" (2.5-5.1 cms) in wrap height.

Prior to final assembly scroll member 36 is properly aligned with respect to body 30 by means of a fixture (not shown) having pins insertable within locating holes 172 on body 30 and locating holes 174 on flange 152. Posts 150 and gasket 160 are provided with substantially aligned edges 176 disposed generally perpendicular to the portion of

spring 162 extending thereover, for the purpose of reducing stresses thereon. Gasket 160 also helps to distribute the clamping load on spring 162. As shown, spring 162 is in its unstressed condition when the scroll member is at its maximum tip clearance condition (i.e. against retainer 164), for ease of manufacture. Because the stress in spring 162 is so low for the full range of axial movement, however, the initial unstressed axial design position of spring 162 is not believed to be critical.

What is very significant, however, is that the transverse plane in which spring 162 is disposed, as well as the surfaces on the body and non-orbiting scroll member to which it is attached, are disposed substantially in an imaginary transverse plane passing through the mid-point of the meshing scroll wraps, i.e. approximately mid-way between surfaces 104 and 117. This enables the mounting means for the axially compliant scroll member to minimize the tipping moment on the scroll member caused by the compressed fluid acting in a radial direction, i.e. the pressure of the compressed gas acting radially against the flanks of the spiral wraps. Failure to balance this tipping moment could result in unseating of scroll member 36. This technique for balancing this force is greatly superior to the use of the axial pressure biasing because it reduces the possibility of over-biasing the scroll members together and because it also makes tip seal biasing substantially independent of compressor speed. There may remain a small tipping movement due to the fact that the axial separating force does not act exactly on the center of the crankshaft, however it is relatively insignificant compared to the separating and restoring forces normally encountered. There is therefore a distinct advantage in

axially biasing the non-orbiting scroll member, as compared to the orbiting scroll member, in that in the case of the latter it is necessary to compensate for tipping movements due to radial separating forces, as well as those due to inertial forces, which are a function of speed, and this can result in excessive balancing forces, particularly at low speeds.

The mounting of scroll member 36 for axial compliance in the present manner permits the use of a very simple pressure biasing arrangement to augment tip sealing. With the present invention this is accomplished using pumped fluid at discharge pressure, or at an intermediate pressure, or at a pressure reflecting a combination of both. In its simpler and presently preferred form, axial biasing in a tip sealing or restoring direction is achieved using discharge pressure. As best seen in Figures 1-3, the top of scroll member 36 is provided with a cylindrical wall 178 surrounding discharge port 41 and defining a piston slidably disposed in cylinder chamber 66, an elastomeric seal 180 being provided to enhance sealing. Scroll member 36 is thus biased in a restoring direction by compressed fluid at discharge pressure acting on the area of the top of scroll member 36 defined by piston 178 (less the area of the discharge port).

Because the axial separating force is a function of the discharge pressure of the machine (among other things), it is possible to choose a piston area which will yield excellent tip sealing under most operating conditions. Preferably, the area is chosen so that there is no significant separation of the scroll members at any time in the cycle during normal operating conditions. Furthermore, optimally in a maximum

pressure situation (maximum separating force) there would be a minimum net axial balancing force, and of course no significant separation.

With respect to tip sealing, it has also been discovered that significant performance improvements with a minimum break-in period can be achieved by slightly altering the configuration of end plate surfaces 104 and 117, as well as scroll wrap tip surfaces 31 and 33. It has been learned that it is much preferred to form each of the end plate surfaces 104 and 117 so that they are very slightly concave, and if wrap tip surfaces 31 and 33 are similarly configured (i.e. surface 31 is generally parallel to surface 117, and surface 33 is generally parallel to surface 104). This may be contrary to what might be predicted because it results in an initial distinct axial clearance between the scroll members in the central area of the machine, which is the highest pressure area; however it has been found that because the central area is also the hottest, there is more thermal growth in the axial direction in this area which would otherwise result in excessive efficiency robbing frictional rubbing in the central area of the compressor. By providing this initial extra clearance the compressor reaches a maximum tip sealing condition as it reaches operating temperature.

Although a theoretically smooth concave surface may be better, it has been discovered that the surface can be formed having a stepped spiral configuration, which is much easier to machine. As can best be seen in grossly exaggerated form in Figures 11A and 11B, with reference to Figure 10, surface 104, while being generally flat, is actually formed of spiral stepped surfaces 182, 184, 186 and 188. Tip surface 33 is similarly configured with spiral steps 190, 192, 194 and 196. The individual steps should be as small as possible, with a total

displacement from flat being a function of scroll wrap height and the thermal coefficient of expansion of the material used. For example, it has been found that in a three-wrap machine with cast iron scroll members, the ratio of wrap or vane height to total axial surface displacement can range from 3000:1 to 9000:1, with a preferred ratio of approximately 6000:1. Preferably both scroll members will have the same end plate and tip surface configurations, although it is believed possible to put all of the axial surface displacement on one scroll member, if desired. It is not critical where the steps are located because they are so small (they cannot even be seen with the naked eye), and because they are so small the surfaces in question are referred to as "generally flat". This stepped surface is very different from that disclosed in assignee's prior copending application Serial No. 516,770, filed July 25, 1983, entitled Scroll-Type Machine in which relatively large steps (with step sealing between the mated scroll members) are provided for increasing the pressure ratio of the machine.

In operation, a cold machine on start-up will have tip sealing at the outer periphery, but an axial clearance in the center area. As the machine reaches operating temperature the axial thermal growth of the central wraps will reduce the axial clearance until good tip sealing is achieved, such sealing being enhanced by pressure biasing as described above. In the absence of such initial axial surface displacement, thermal growth in the center of the machine will cause the outer wraps to axially separate, with loss of a good tip seal.

The compressor of the present invention is also provided with improved means for directing suction gas entering the shell directly to the inlet of the compressor itself. This advantageously facilitates the

separation of oil from inlet suction fluid, as well as prevents inlet suction fluid from picking up oil dispersed within the shell interior. It also prevents the suction gas from picking up unnecessary heat from the motor, which would cause reduction in volumetric efficiency.

The directed suction assembly 42 comprises a lower baffle element 200 formed of sheet metal and having circumferentially spaced vertical flanges 202 welded to the inside surface of shell 12 (Figures 1, 4, 8 and 10). Baffle 200 is positioned directly over the inlet from suction fitting 40 and is provided with an open bottom portion 204 so that oil carried in the entering suction gas will impinge upon the baffle and then drain into compressor sump 49. The assembly further comprises a molded plastic element 206 having a downwardly depending integrally formed arcuate shaped channel section 208 extending into a space between the top of baffle 200 and the wall of shell 12, as best seen in Figure 1. The upper portion of element 206 is generally tubular in configuration (diverging radially inwardly) for communicating gas flowing up channel 208 radially inwardly into the peripheral inlet of the meshed scroll members. Element 208 is retained in place in a circumferential direction by means of a notch 210 which straddles one of the fasteners 168, and axially by means of an integrally formed tab 212 which is stressed against the lower surface of closure member 58, as best shown in Figure 1. Tab 212 operates to resiliently bias element 206 axially downwardly into the position shown. The radially outer extent of the directed suction inlet passageway is defined by the inner wall surface of shell 12.

Power is supplied to the compressor motor in the normal manner using a conventional terminal block, protected by a suitable cover 214.

Several alternative ways in which to achieve pressure biasing in an axial direction to enhance tip sealing are illustrated in Figures 18 and 19, where parts having like functions to those of the first embodiment are indicated with the same reference numerals.

In the embodiment of Figure 18 axial biasing is achieved through the use of compressed fluid at an intermediate pressure less than discharge pressure. This is accomplished by providing a piston 300 on the top of scroll member 36 which slides in cylinder chamber 66, but which has a closure element 302 preventing exposure of the top of the piston to discharge pressure. Instead discharge fluid flows from discharge port 39 into a radial passage 304 in piston 300 which connects with an annular groove 306, which is in direct communication with openings 68 and discharge chamber 72. Elastomeric seals 308 and 310 provide the necessary sealing. Compressed fluid under an intermediate pressure is tapped from the desired sealed pocket defined by the wraps via a passage 312 to the top of pistons 300, where it exerts an axial restoring force on the non-orbiting scroll member to enhance tip sealing.

In the embodiment of Figure 19 a combination of discharge and intermediate pressures are utilized for axial tip seal biasing. To accomplish this, closure member 58 is shaped to define two separate coaxial, spaced cylinder chambers 314 and 316, and the top of scroll member 36 is provided with coaxial pistons 318 and 320 slidably disposed in chambers 314 and 316 respectively. Compressed fluid under discharge pressure is applied to the top of piston 320 in exactly the same manner as in the first embodiment, and fluid under an intermediate pressure is applied to annular piston 318 via a passage 322 extending from a

suitably located pressure tap. If desired, piston 320 could be subjected to a second intermediate pressure, rather than discharge pressure. Because the areas of the pistons and the location of the pressure tap can be varied, this embodiment offers the best way to achieve optimum axial balancing for all desired operating conditions.

The pressure taps can be chosen to provide the desired pressure and if desired can be located to see different pressures at different points in the cycle, so that an average desired pressure can be obtained. Pressure passages 312, 322 and the like are preferably relatively small in diameter so that there is a minimum of flow (and hence pumping loss) and a dampening of pressure (and hence force) variations.

In Figures 20 through 33, there are illustrated a number of other suspension systems which have been discovered mounting the non-orbiting scroll member for limited axial movement, while restraining same from a radial and circumferential movement. Each of these embodiments functions to mount the non-orbiting scroll member at its mid-point, as in the first embodiment, so as to balance the tipping moments on the scroll member created by radial fluid pressure forces. In all of these embodiments, the top surface of flange 152 is in the same geometrical position as in the first embodiment.

With reference to Figures 20 and 21, support is maintained by means of a spring steel ring 400 anchored at its outer periphery by means of fasteners 402 to a mounting ring 404 affixed to the inside surface of shell 12, and at its inside periphery to the upper surface of flange 152 on non-orbiting scroll member 36 by means of fasteners 406. Ring 400 is provided with a plurality of angled openings 408 disposed

about the full extent thereof to reduce the stiffness thereof and permit limited axial excursions of the non-orbiting scroll member 36. Because openings 408 are slanted with respect to the radial direction, axial displacement of the inner periphery of the ring with respect to the outer periphery thereof does not require stretching of the ring, but will cause a very slight rotation. This very limited rotational movement is so trivial, however, that it is not believed it causes any significant loss of efficiency.

In the embodiment of Figure 22, non-orbiting scroll 36 is very simply mounted by means of a plurality of L-shaped brackets 410 welded on one leg to the inner surface of shell 12 and having the other leg affixed to the upper surface of flange 152 by means of a suitable fastener 412. Bracket 410 is designed so that it may stretch slightly within its elastic limit to accommodate axial excursions of the non-orbiting scroll.

In the embodiments of Figures 23 and 24, the mounting means comprises a plurality (three shown) of tubular members 414 having a radially inner flange structure 416 affixed to the top surface of flange 152 of the non-orbiting scroll by means of a suitable fastener 418, and a radially outer flange 420 connected by means of a suitable fastener 422 to a bracket 424 welded to the inside surface of shell 12. Radial excursions of the non-orbiting scroll are prevented by virtue of the fact that there are a plurality of tubular members utilized with at least two of them not directly opposing one another.

In the embodiment of Figures 25 and 26, the non-orbiting scroll is supported for limited axial movement by means of leaf springs 426 and 428 which are affixed at their outer ends to a mounting ring 430 welded

to the inside surface of shell 12 by suitable fasteners 432, and to the upper surface of flange 152 in the center thereof by means of a suitable fastener 434. The leaf springs can either be straight, as in the case of spring 426, or arcuate, as in the case of spring 428. Slight axial excursions of scroll member 36 will cause stretching of the leaf springs within their elastic limit.

In the embodiment of Figures 27 and 28 radial and circumferential movement of non-orbiting scroll 36 is prevented by a plurality of spherical balls 436 (one shown) tightly fit within a cylindrical bore defined by a cylindrical surface 437 on the inner peripheral edge of a mounting ring 440 welded to the inside surface of shell 12 and by a cylindrical surface 439 formed in the radially outer peripheral edge of a flange 442 on non-orbiting scroll member 36, the balls 436 lying in a plane disposed midway between the end plate surfaces of the scroll members for the reasons discussed above. The embodiment of Figures 29 and 30 is virtually identical to that of Figures 27 and 28 except instead of balls, there are utilized a plurality of circular cylindrical rollers 444 (one of which is shown) tightly pressed within a rectangular slot defined by surface 446 on ring 440 and surface 448 on flange 442. Preferably ring 440 is sufficiently resilient that it can be stretched over the balls or rollers in order to pre-stress the assembly and eliminate any backlash.

In the embodiment of Figure 31, the non-orbiting scroll 36 is provided with a centrally disposed flange 450 having an axially extending hole 452 extending therethrough. Slidably disposed within hole 452 is a pin 454 tightly affixed at its lower end to body 30. As can be visualized, axial excursions of the non-orbiting scroll are

possible whereas circumferential or radial excursions are prevented. The embodiment of Figure 32 is identical to that of Figure 31 except that pin 454 is adjustable. This is accomplished by providing an enlarged hole 456 in a suitable flange on body 30 and providing pin 454 with a support flange 458 and a threaded lower end projecting through hole 456 and having a threaded nut 460 thereon. Once pin 454 is accurately positioned, nut 460 is tightened to permanently anchor the parts in position.

In the embodiment of Figure 33, the inside surface of shell 12 is provided with two bosses 462 and 464 having accurately machined, radially inwardly facing flat surfaces 466 and 468, respectively, disposed at right angles with respect to one another.. Flange 152 on non-orbiting scroll 36 is provided with two corresponding bosses each having radially outwardly facing flat surfaces 470 and 472 located at right angles with respect to one another and engaging surfaces 466 and 468, respectively. These bosses and surfaces are accurately machined so as to properly locate the non-orbiting scroll in the proper radial and rotational position. To maintain it in that position while permitting limited axial movement thereof there is provided a very stiff spring in the form of a Belleville washer or the like 474 acting between a boss 476 on the inner surface of shell 12 and a boss 478 affixed to the outer periphery of flange 152. Spring 474 applies a strong biasing force against the non-orbiting scroll to maintain it in position against surfaces 466 and 468. This force should be slightly greater than the maximum radial and rotational force normally encountered tending to unseat the scroll member. Spring 474 is preferably positioned so that the biasing force it exerts has equal components in the direction of

each of bosses 462 and 464 (i.e., its diametrical force line bisects the two bosses). As in the previous embodiments, the bosses and spring force are disposed substantially midway between the scroll member end plate surfaces, in order to balance tipping moments.

In all of the embodiments of Figures 20 through 33 it should be appreciated that axial movement of the non-orbiting scrolls in a separating direction can be limited by any suitable means, such as the mechanical stop described in the first embodiment. Movement in the opposite direction is, of course, limited by the engagement of the scroll members with one another.

CLAIMS:

1. A scroll-type machine comprising:

(a) a first scroll member including a first end plate having a first sealing surface thereon and a first spiral wrap disposed on said first sealing surface, the center axis of said first wrap being disposed generally perpendicular to said first sealing surface;

(b) a second scroll member including a second end plate having a second sealing surface thereon and a second spiral wrap disposed on said second sealing surface, the center axis of said second wrap being disposed generally perpendicular to said second sealing surface;

(c) a stationary body having means supporting said second scroll member for orbital movement with respect to said first scroll member, said second scroll member being positioned with respect to said first scroll member such that said first and second spiral wraps intermesh with one another so that orbiting of said second scroll member with respect to said first scroll member will cause said wraps to define moving fluid chambers, the edge of said first wrap spaced from said first end plate being in sealing engagement with said second sealing surface, the edge of said second wrap spaced from said second end plate being in sealing engagement with said first sealing surface; ~~and~~ and

(d) axially compliant mounting means supported in a fixed position with respect to said body and connected to said first scroll member to permit axial movement of said first scroll member, said mounting means being connected to said first scroll member at a point disposed generally at the mid-point between the respective planes of said first and second sealing surfaces.



2. A scroll-type machine as claimed in claim 1, wherein said mounting means prevents rotational and radial movement of said first scroll member with respect to the orbital axis of said second scroll member.

3. A scroll-type machine as claimed in claim 1, wherein said mounting means is connected to said first scroll member at a plurality of spaced points, each of said points lying generally in a plane disposed midway between said first and second sealing surfaces.

4. A scroll-type machine as claimed in claim 1, wherein said mounting means comprises a leaf spring which stretches within its elastic limit upon normal axial excursions of said first scroll member.

5. A scroll-type machine as claimed in claim 1, wherein said mounting means comprises slidably engaging abutment surfaces on said body and said first scroll member.

6. A scroll-type machine as claimed in claim 5, wherein one of said abutment surfaces is a pin and the other of said abutment surfaces is a bore slidably receiving said pin.

7. A scroll-type machine as claimed in claim 6, wherein said pin is adjustably mounted.

8. A scroll-type machine as claimed in claim 6, wherein said pin and bore are circular in cross-section.



9. A scroll-type machine as claimed in claim 1, further comprising stop means for positively limiting to a predetermined amount the axial movement of said first scroll member away from said second scroll member.

10. A scroll-type machine as claimed in claim 9, wherein said predetermined amount is small enough to permit said machine to operate ~~[as a compressor]~~ on start-up when at a maximum displacement condition.

11. A scroll-type machine as claimed in claim 1, wherein said mounting means comprises a resilient element having a generally U-shaped configuration in plan, the bight portion of said element being fixed in position with regard to said body, each of the leg portions of said element being connected adjacent their ends to said first scroll member.

12. A scroll-type machine as claimed in claim 11, wherein said element is formed of spring steel.

13. A scroll-type machine as claimed in claim 11, wherein said element is formed of generally flat spring steel.

14. A scroll-type machine as claimed in claim 1, wherein said body is provided with an axially extending post having a generally flat transverse end surface, said mounting means comprising a resilient element affixed to said end surface.



15. A scroll-type machine as claimed in claim 14, wherein said end surface lies substantially in a plane parallel to the planes of said sealing surfaces.
16. A scroll-type machine as claimed in claim 15, wherein said end surface plane is disposed substantially between the planes of said sealing surfaces.
17. A scroll-type machine as claimed in claim 14, wherein said first scroll member is provided with a relatively flat mounting surface, said resilient element having a projecting leg portion affixed to said mounting surface.
18. A scroll-type machine as claimed in claim 17, wherein said mounting surface lies generally in the plane of said end surface.
19. A scroll-type machine as claimed in claim 17, wherein said end surface has an edge disposed generally perpendicular to said leg portion to facilitate flexing of said element with a minimum of stress.
20. A scroll-type machine as claimed in claim 19, further comprising a relatively soft gasket disposed between said end surface and said element.
21. A scroll-type machine as claimed in claim 20, wherein said gasket has an edge substantially coincident with said end surface edge.



22. A scroll-type machine as claimed in claim 21, wherein said gasket is formed of a relatively soft metal.

23. A scroll-type machine as claimed in claim 14, wherein said element is held in position on said end surface by a stop member, said stop member also positively limiting the axial movement of said first scroll member away from said second scroll member to a predetermined amount.

24. A scroll-type machine as claimed in claim 1, wherein said first and second sealing surfaces are slightly concave.

25. A scroll-type machine as claimed in claim 1, wherein said edges of said wraps are slightly concave.

26. A scroll-type machine as claimed in claim 25, wherein said first and second sealing surfaces are slightly concave.

27. A scroll-type machine as claimed in claim 26, wherein said edge of each of said wraps is generally parallel to the sealing surface of the scroll member to which it is attached.

28. A scroll-type machine as claimed in claim 1, wherein said mounting means comprises a resilient annular ring, the outer periphery of said ring being fixed with respect to said body and the inner periphery of said ring being connected to said first scroll member.



* C L M S *

29. A scroll-type machine as claimed in claim 28, wherein said ring is formed of spring steel.

30. A scroll-type machine as claimed in claim 28, wherein said ring has a plurality of apertures therethrough to increase the flexibility thereof.

31. A scroll-type machine as claimed in claim 30, wherein each of said apertures is elongated in plan and is disposed at an angle with respect to a line extending generally radially from said axes.

32. A scroll-type machine as claimed in claim 1, wherein said machine is disposed within a housing, said mounting means comprising a plurality of resilient brackets connected between said housing and said first scroll member.

33. A scroll-type machine as claimed in claim 32, wherein each of said brackets is L-shaped with one leg affixed to said housing and the other leg affixed to said first scroll member.

34. A scroll-type machine as claimed in claim 33, wherein normal axial movement of said first scroll member causes said bracket to stretch within its elastic limit.



35. A scroll-type machine as claimed in claim 1, wherein said mounting means comprises a plurality of tubular elements each having a first flange affixed with respect to said body and a second flange connected to said first scroll member.

36. A scroll-type machine as claimed in claim 35, wherein said flanges are disposed in a generally horizontal transverse plane.

37. A scroll-type machine as claimed in claim 35, wherein said tubular elements are circumferentially spaced around said first scroll member.

38. A scroll-type machine as claimed in claim 37, said tubular elements each include a tubular portion having a center axis disposed generally tangentially with respect to said first scroll member.

39. A scroll-type machine as claimed in claim 38, wherein said tubular elements are arranged so that they are not parallel to one another.

40. A scroll-type machine as claimed in claim 1, wherein said mounting means comprises a leaf spring.

41. A scroll-type machine as claimed in claim 40, wherein said spring is centrally fixed with respect to said body with its ends affixed to said first scroll member.



42. A scroll-type machine as claimed in claim 40, wherein said spring is centrally affixed to said first scroll member with its ends being fixed with respect to said body.

43. A scroll-type machine as claimed in claim 42, wherein said spring is elongated and relatively straight in plan.

44. A scroll-type machine as claimed in claim 42, wherein said spring is elongated and curved in plan.

45. A scroll-type machine as claimed in claim 1, wherein said mounting means includes a plurality of balls each disposed in a pair of opposed axially disposed grooves, one of said grooves being fixed with respect to said body and the other of said grooves being fixed with respect to said first scroll member.

46. A scroll-type machine as claimed in claim 45, wherein said one of said grooves is disposed in a ring member surrounding said first scroll member, said ring member being prestressed in order to load said balls in said grooves.

47. A scroll-type machine as claimed in claim 1, wherein said mounting means includes a plurality of rollers each disposed in a pair of opposed axially disposed grooves, one of said grooves being fixed with respect to said body and the other of said grooves being fixed with respect to said first scroll member.



48. A scroll-type machine as claimed in claim 47, wherein said one of said grooves is disposed in a ring member surrounding said first scroll member, said ring member being prestressed in order to load said rollers in said grooves.

49. A scroll-type machine as claimed in claim 1, wherein said mounting means comprises at least two axially extending guide surfaces fixed with respect to said body, means defining abutting surfaces fixed with respect to said first scroll member and engaging said guide surfaces, respectively, and biasing means urging said abutting surfaces into engagement with said guide surfaces.

50. A scroll-type machine as claimed in claim 49, wherein said guide surfaces are flat and face radially inwardly.

51. A scroll-type machine as claimed in claim 49, wherein said guide surfaces are disposed at positions 90 degrees apart about said axes.

52. A scroll-type machine as claimed in claim 51, wherein said biasing means exerts a force in a direction lying on a line which bisects said guide surfaces.



53. A scroll-type machine as claimed in any preceding claim, wherein a biasing means is provided for axially biasing the ^{first} scroll member towards the second scroll member, said biasing means being operable by fluid under pressure.

54. A scroll-type machine as claimed in ^{claim} 53, wherein said machine is a compressor for pumping a fluid from a relatively low suction pressure to a relatively high discharge pressure.

55. A scroll-type machine as claimed in ^{claim} 54, wherein said biasing means is operable by fluid pressurised by said compressor.

56. A scroll-type machine as claimed in ^{claim} 55, wherein said pressurised fluid is at said relatively high compressor discharge pressure.

57. A scroll-type machine as claimed in ^{claim} 55, wherein said pressurised fluid is at a pressure intermediate said relatively high compressor discharge pressure and said suction pressure.

58. A scroll-type machine as claimed in ^{claim} 55, 56 or 57, further comprising a first cylinder chamber mounted in a fixed position with respect to said body, and a first piston connected to said first scroll member, said first piston being slidably disposed in said first cylinder chamber for movement with respect thereto in a direction substantially parallel to said axis, said biasing means including means for supplying pressurised fluid to said first cylinder chamber.

59. A scroll-type machine as claimed in ^{claim} 58, further comprising a second cylinder chamber mounted in a fixed position with respect to said body, and a second piston connected to said first scroll member, said second piston being slidably disposed in said second cylinder chamber for movement with respect thereto in a direction substantially parallel to said axis, said biasing means



including means for supplying pressurised fluid to said second cylinder chamber.

60. A scroll-type machine as claimed in ^{claim} 59, wherein the pressurised fluid supplied to one of said cylinder chambers is at said relatively high compressor discharge pressure and the pressurised fluid supplied to the other of said cylinder chambers is at a pressure intermediate said relatively high compressor discharge pressure and said suction pressure.

61. A scroll-type machine as claimed in ^{claim} 59, wherein the pressurised fluid supplied to both of said cylinder chambers is at a pressure intermediate said relatively high compressor discharge pressure and said suction pressure.

62. A scroll-type machine as claimed in any one of claims 59 to 61, wherein said cylinder chambers and pistons are generally concentric with respect to one another, said cylinder chambers being defined by a stepped cylinder wall having two different inside diameters, said second piston being defined by an annular shoulder on said first piston, said first piston being surrounded by the smaller diameter portion of said cylinder wall, said second piston being surrounded by the larger diameter portion of said cylinder wall.

63. A scroll-type machine as claimed in ^{claim} 62, when appendant to claim 60, wherein pressurised fluid at said relatively high compressor discharge pressure is supplied to said first cylinder chamber.

64. A scroll-type machine as claimed in claim 1, comprising:

- (a) a motor;
- (b) a crankshaft rotatable by said motor about a substantially vertical axis;
- (c) a source of lubricating oil;



(d) means defining a first circular cylindrical axial bore in said second scroll member;

(e) a drive bushing journaled in said first bore and having a second cylindrical axial bore therethrough;

(f) a crank pin on said crankshaft drivingly disposed in said second bore whereby rotation of said crankshaft will cause said second scroll member to move in an orbital path;

(g) means defining an oil feed passage in said shaft for delivering lubricating oil from said oil source to the top of said crank pin, from which it is thrown outwardly by centrifugal force upon rotation of said crankshaft; and

(h) means defining a recess in the top of said bushing for collecting said thrown lubricating oil so that it can flow into said first and second bores for lubricating purposes.

65. A scroll-type machine as claimed in ^{claim} 64, wherein said bushing has a flat surface on the outside thereof defining an oil flow space between said bushing and first bore, said oil flow space communicating with said recess.

66. A scroll-type machine as claimed in ^{claim} 65, wherein said flat surface extends axially from the bottom to the top of said bushing.

67. A scroll-type machine as claimed in ^{claim} 66, wherein said second bore is non-circular in cross-sectional configuration, whereby an oil flow space is defined between said bushing and crank pin, said last-mentioned space being in communication with said recess.

68. A scroll-type machine as claimed in ^{claim} 67, wherein said second bore is generally oval in shape and said crank pin is generally circular in shape.

69. A scroll-type machine as claimed in ^{claim} 68, wherein said second bore and crank pin each have a flat



surface in driving engagement with one another. ^{claim}

70. A scroll-type machine as claimed in ^{claim} 64, wherein said recess is a groove in the top surface of said bushing extending between said second bore and the outer surface thereof.

71. A scroll-type machine as claimed in ^{claim} 64, wherein the angular position of said recess with respect to that of said oil feed passage is slightly lagging in the direction of rotation of said crankshaft.

72. A scroll-type machine as claimed in any one of claims 64 to 71, further comprising an oil pump disposed in the lower portion of said shaft, said oil source being an oil sump in which said pump is disposed, said pump supplying lubrication oil from said sump to said oil feed passage upon rotation of said shaft.

73. A scroll-type machine as claimed in ^{claim} 1, wherein said body has a portion which is generally circular about the machine axis, and further including compact Oldham coupling means for preventing rotational movement of said second scroll member with respect to said body, comprising:

(1) means defining generally diametrically aligned first abutment surfaces on said body,

(2) means defining generally diametrically aligned second abutment surfaces on said second scroll member, arranged at right angles to said first abutment surfaces,

(3) a transversely disposed annular ring member generally surrounding said circular body portion, the inner peripheral surface of said ring member being non-circular in configuration, comprising at opposite ends circular arcs of equal radius, the centres of curvature of said arcs being spaced apart a predetermined distance, and relatively straight portions connecting said arcs,

(4) a first pair of keys on one face of said ring member in linear sliding engagement with said first abutment surfaces, and



(5) a second pair of keys on the opposite face of said ring member in linear sliding engagement with said second abutment surfaces.

74. A scroll-type machine as claimed in ^{claim} 73, wherein said radius is equal to that of said circular body portion plus a predetermined minimal clearance.

75. A scroll-type machine as claimed in ^{claim} 74, wherein said predetermined distance is in a direction generally parallel to the diameter on which said first abutment surfaces are aligned.

76. A scroll-type machine as claimed in ^{claim} 74 or 75, wherein said circular body portion defines a flat transverse thrust bearing surface on said body slidably supporting said second scroll member.

77. A scroll-type machine as claimed in any one of claims 73 to 76, wherein said predetermined distance is equal to twice the orbital radius of said second scroll member.

78. A scroll-type machine as claimed in ^{claim} 73, wherein said first aligned abutment surfaces are a pair of radial slots in said body disposed on diametrically opposite sides of said axis.

79. A scroll-type machine as claimed in claim 73, wherein said second aligned abutment surfaces are a pair of radial slots in said scroll member disposed on diametrically opposite sides of said axis.

80. A scroll-type machine as claimed in claim 1, wherein a portion of said first sealing surface disposed between opposed flanks of said first wrap is axially stepped in configuration to define a slightly concave surface, and a portion of said second sealing surface disposed between opposed flanks of said second wrap is axially stepped in configuration to define a slightly concave surface.



81. A hermetic scroll-type fluid compressor as claimed in claim 1, further comprising:

(a) a hermetic shell having a fluid inlet port through the wall thereof;

(b) means defining a compressor fluid inlet spaced from said inlet port;

(c) a baffle affixed to said shell in overlying relationship to said inlet portion, said baffle defining openings above and below said inlet port, said lower opening acting as a drain for oil entrained in inlet fluid which separates upon impingement with said baffle; and

(d) a plastic member having means at one end defining an axially extending passageway in communication with said upper opening for receiving inlet fluid and means at the opposite end for directing inlet fluid into said compressor inlet.

82. A hermetic scroll-type fluid compressor as claimed in claim 81, wherein said passageway is in part defined by said plastic member and in part by said shell.

83. A hermetic scroll-type fluid compressor as claimed in claim 81, wherein said upper and lower openings are defined between said baffle and said shell.

84. A hermetic scroll-type fluid compressor as claimed in claim 81, further comprising a flexible tab formed on said plastic member and an abutment surface inside said shell, said tab being stressed against said abutment surface to urge said member into proper position.

85. A scroll-type machine as claimed in claim 1, wherein said axially compliant mounting means comprises a flexible resilient strap having a first portion supported in a fixed position with respect to said body and a second portion connected to said first scroll member to permit axial movement of said first scroll member.

86. A scroll-type machine as claimed in claim 85, wherein said strap is connected to said first scroll member



at a point disposed generally at the mid-point between the respective planes of said first and second sealing surfaces.

87. A scroll-type machine as claimed in claim 85, wherein said strap is connected to said first scroll member at a point disposed substantially in the plane of the tipping moment on said first across member.

88. A scroll-type machine as claimed in claim 85, wherein said strap lies substantially in a flat plane disposed perpendicular to the axis of orbital movement of said second scroll member.

89. A scroll-type machine as claimed in claim 85, wherein said mounting means comprises a plurality of said straps.

90. A scroll-type machine as claimed in claim 89, wherein said straps are circumferentially spaced around said first scroll member.

91. A scroll-type machine as claimed in claim 85, wherein said strap stretches within its elastic limit upon normal axial excursions of said first scroll member.

92. A scroll-type machine as claimed in claim 85, wherein said mounting means comprises a pair of said straps disposed on opposite sides of said first scroll member.

93. A scroll-type machine as claimed in claim 1, further including biasing means for axially biasing said first scroll member toward said second scroll member, said biasing means comprising:

- (1) a cylinder chamber,
- (2) a piston slidably disposed in said cylinder chamber for movement with respect thereto in a direction substantially parallel to said axes, one of said piston and cylinder chamber being mounted in a fixed position with respect to said body, the other of said piston and cylinder chamber being connected to said first scroll member, and



(3) means for supplying pressurised fluid to said cylinder chamber to bias said first scroll member towards said second scroll member.

94. A scroll-type machine as claimed in claim 93, wherein said machine is a compressor for pumping a fluid from a relatively low suction pressure to a relatively high discharge pressure.

95. A scroll-type machine as claimed in claim 94, further comprising means defining a generally transversely extending passage through the respective side walls of said piston and cylinder chamber for communicating pumped fluid at discharge pressure from said compressor, and an annular elastomeric seal disposed between said piston and cylinder chamber on axially opposite sides of said chamber.

96. A scroll-type machine as claimed in claim 95, further comprising means for communicating pressurised fluid at a pressure intermediate said discharge pressure and said suction pressure to the head end of said piston to bias said scroll members together.

97. A scroll-type machine as claimed in claim 93, wherein said cylinder chamber is mounted in a fixed position with respect to said body and said piston is connected to said first scroll member.

98. A scroll-type machine constructed and arranged to operate substantially as herein described with reference to and as illustrated in the accompanying drawings.

