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54 **Horizontal shaft compressor with lubricating pump.**

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73 Proprietor: **TECUMSEH PRODUCTS COMPANY**  
**100 East Patterson Street**  
**Tecumseh Michigan 49286 (US)**

72 Inventor: **Wood, Mark W.**  
**6762 Ridge Highway**  
**Britton Michigan 49229 (US)**

7A Representative: **Bayliss, Geoffrey Cyril et al**  
**BOULT, WADE & TENNANT 27 Farnival Street**  
**London EC4A 1PQ (GB)**

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## Description

This invention pertains to an oil pump, and more particularly to an oil pump for use in a horizontal rotary compressor.

In some compressors, the crankshaft is vertically disposed in the compressor housing and has its lower end portion submerged in an oil sump. A helical groove is provided in the crankshaft, and upon rotation of the crankshaft by the motor, oil is delivered upwardly through the groove along the crankshaft for lubricating bearings and other moving parts. Generally, some type of impeller means is also provided at the lower end of the crankshaft to assist in urging oil upwardly through the helical groove.

In contrast to the above compressors wherein oil is delivered upwardly by a helical groove in the vertically mounted crankshaft, the crankshaft in a horizontal piston or rotary compressor cannot directly elevate the oil upwardly through a helical groove in the crankshaft. This has posed numerous problems in properly lubricating bearings and other moving parts in a horizontally disposed compressor. The fact that such horizontal compressors are presently in use indicated that some means have been provided in the prior to deliver lubricant to a rotating horizontal crankshaft, however, problems continue to exist in adequately lubricating bearings and moving parts, as well as an inability to adequately self-prime the oil pump during start-up.

DE—A—2010747 comprises the combined features of the preamble of claim 1 defining this invention and discloses an arrangement for delivering lubricant upwardly to a rotating horizontal crankshaft using a disc or plate attached to the crankshaft to rotate therewith and which has its lower portion disposed in the oil sump. A circular groove is provided in the flat surfaces of the disc, and upon rotation of the crankshaft, the disc rotates through the oil sump and carries lubricant in the grooves upwardly to a cavity or chamber adjacent the crankshaft. The lubricant is then delivered from the chamber by means of a series of passages to the crankshaft for lubricating bearings. Several drawbacks exist with this type of oil pump, one of the drawbacks being the inability to deliver a desired amount of lubricant to the crankshaft and associated bearings. Other drawbacks include additional expense in materials and labor in providing the grooved disc and a chamber in the crankcase with oil passages leading to the crankshaft and bearings.

Another type of oil pump for use with horizontal motor-compressor units utilizes a wick device disposed in the oil sump and in contact along several axial points of the crankshaft. The wick device delivers oil upwardly from the oil sump and through the wick to the crankshaft for further delivery along the crankshaft and bearings. An obvious drawback with this type of oiling device is that the wick may shrink down away from the crankshaft during prolonged use, thereby preventing proper lubrication of the crankshaft and

bearings. Moreover, small pieces of the wick may eventually break off and clog oil passages or lodge between moving parts preventing proper movement.

In yet another type of horizontal compressor, a portion of the crankcase is submerged in the oil sump and has a passageway leading from the oil sump upwardly to a chamber provided between an eccentric reduced portion of the crankshaft and crankcase. Rotation of the crankshaft causes oil to be drawn upwardly through the crankcase passageway into the chamber and through an axially extending passage in the crankshaft. One of the problems associated with this particular type of oil is that the axially extending passage in communication with the chamber does not fully utilize the centrifugal force of the rotation crankshaft to deliver efficiently desired amounts of lubrication along the crankshaft for lubricating bearings.

In still another type of oil pump system for a rotating horizontal shaft, the center portion of the shaft is enlarged and tapers radially inwardly toward the remote ends. A pair of oppositely angularly disposed helical grooves are provided on the respective tapering surfaces of the enlarged center portion and have their axially outermost ends in communication with an oil supply. Upon rotation of the shaft and helical grooves therein, oil is delivered axially inwardly along the grooves to the center of the shaft for lubrication thereof. One of the undesired features with this type of oil pump is that the oil supply is required to be disposed at the same height as the ends of the rotating horizontal shaft. In virtually all horizontal rotary compressors, the crankshaft is disposed above the surface of the oil sump in the compressor housing.

JP—A—58133495 discloses an oil feeder for a rotary vane compressor in which a horizontal rotor has spiral grooves formed in bearing sections of the rotor shaft on both sides of the rotor which are fed with a highly viscous oil from an oil sump below the rotor. The spiral grooves perform a pumping function that advances the oil along the bearing sections to the rotor.

This invention provides a hermetic motor compressor including; a housing having an inlet, an outlet, and an oil sump in the bottom thereof, and a motor-compressor unit mounted in said housing and including a crankcase, a rotatable crankshaft rotatably mounted in two bearings, a cylinder, and means connected to said crankshaft for compressing refrigerant, said crankshaft being generally horizontally disposed and rotatably received in said crankcase, and having a reduced diameter portion between said two bearings forming between said crankshaft and said crankcase an annular chamber; wherein said crankshaft has a helical groove arranged within one of said bearings forming between said crankshaft and said crankcase a helical passage between said annular chamber and said compressing means, a generally vertically disposed oil passageway directly connecting said oil sump

with said annular chamber whereby the pressure in said oil sump when said crankshaft is rotated, said helical groove constituting the only moving means for drawing lubricant upwardly through said oil passage and into said annular chamber, and said helical passage in said rotating crankshaft delivering lubricant from said annular chamber along said crankshaft to lubricate said one bearing.

The horizontal shaft oil pump of the present invention overcomes the general inability of many of the prior art oil pumps to efficiently supply a requisite amount of lubricant along the horizontal crankshaft for lubricating bearings and moving parts. This inability is overcome in a particular advantageous manner by providing a pair of oppositely oriented helical grooves on opposite sides of the annular chamber and which form between the crankshaft and crankcase a pair of oppositely oriented helical passages in communication with and leading away from the annular chamber. The helical passages are oppositely disposed to deliver oil in opposite directions from the annular chamber. Upon rotation of the horizontal crankshaft, the low pressure area created in the annular chamber draws lubricant from the oil sump upwardly through the crankcase passageway into the annular chamber. Lubricant is then delivered by the respective helical passages along the crankshaft for lubricating bearings and other moving parts.

The dimensions of each helical groove are such as to provide adequate oil flow for sufficient lubrication of bearings and to enable self-priming of the pump upon start-up.

In one form of the invention there is provided a compressor comprising a housing having an inlet, outlet, and an oil sump in the bottom thereof. A motor-compressor unit is mounted in the housing and includes a crankcase with a generally vertically disposed passageway in communication with the oil sump, rotatable crankshaft, and means for compressing refrigerant. The crankshaft is generally horizontally disposed and rotatably received in the crankcase, and has a reduced diameter portion forming between the crankshaft and crankcase an annular chamber in communication with the crankcase passageway. The crankshaft further includes a helical groove forming between the crankshaft and crankcase a helical passage between the annular chamber and compressing means. Upon rotation of the crankshaft, a low pressure area is created in the annular chamber to draw lubricant upwardly through the crankcase passageway and into the annular chamber, from which oil is delivered by the helical passage axially along the crankshaft for lubricating the crankshaft bearings.

It will be appreciated that the shaft oil pump of the compression according to the present invention self-priming. It will also be appreciated that its horizontal shaft oil pump is inexpensive to manufacture and easily assembled.

The above mentioned and other features and objects of this invention and the manner of

attaining them, will become more apparent and the invention itself will be better understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a longitudinal cross-sectional view of a preferred embodiment of the present invention;

Figure 2 is a partially broken-away end elevation view of the embodiment in Figure 1;

Figure 3 is an elevational view of the crankshaft in the embodiment of Figure 1;

Figure 4 is a top plan view of the crankshaft of Figure 3;

Figure 5 is an end elevational view of the crankshaft in Figure 4;

Figure 6 is a partially broken-away cross-sectional view of a helical groove in the crankshaft of Figure 3 and

Figure 7 is a partially broken-away exploded view of the embodiment in Figure 1 illustrating the flow of lubricant.

Referring to Figures 1 and 2, a rotary compressor is indicated at 10 incorporating horizontal shaft oil pump 11 of the present invention. Although the present invention will be described in terms of rotary compressor 10, horizontal shaft oil pump 11 of can also be incorporated with other types of compressors requiring lubrication of rotating horizontal shafts.

The motor-compressor unit 8 of rotary compressor 10 comprises motor 13 having rotor 15 and stator 14 with windings 16, and cylindrical housing 12 shrunk down on stator 14. The opposite ends of housing 12 are closed by end plates 18, 20 welded thereto. End plate 18 includes terminal pin assembly 22 and discharge outlet 24 having discharge tube 26 connected thereto by connector 28. End plate 20 includes opening 30 through which is received suction inlet tube 32 indicated in dashed lines. A pair of mounting brackets 34 are welded to the opposite ends of housing 12, and each includes a pair of support members, such as resilient grommets 36, 38.

Mounted within interior 40 of housing 12 is crankcase 42 including main bearing block 44 having oil passageway 46 generally vertically disposed therein. Housing 12 includes oil sump 48, and the lower portion of main bearing block 44 is submerged therein to provide communication between oil passageway 46 and horizontally disposed bore 50 in crankcase 42. For purposes of the present application, the term "vertically disposed" as it applies to passageway 46 is to be construed broadly and means that oil must flow upwardly therein from sump 48 against the force of gravity.

Crankshaft 52 is horizontally rotatably received in bore 50, and rotor 15 is shrunk down on portion 54 of crankshaft 52 to rotate crankshaft 52 upon application of electrical current to motor 13 through terminal pin assembly 22.

The opposite end portion of crankshaft 52 includes eccentric 58 having slot 59 and is received in cylinder plate 60, which is connected to main bearing block 44 by screws 66. Roller 62 is

rotatably received about eccentric 58 in cylinder 59, and valve plate or back plate 64 is attached to cylinder 60 by means of screws 66. Discharge muffler 68 is attached to back plate 64 by screws 66, and back plate 64 includes hole 70 in axial alignment with crankshaft 52 and opening 72 in muffler 68. Vane 63 is slidably received in slot 67 in cylinder plate 60 and is biased against roller 62 by C-shaped spring 65, which is secured to cylinder plate 60. Cylinder plate 60 has inlet 69 with which suction inlet tube 32 communicates.

A valve assembly 74 permits compressed refrigerant to flow from cylinder 59 through back plate 64 and into discharge muffler 68. Valve assembly 74 includes opening 76 in back plate 64 which communicates between cylinder 59 and muffler 68. A leaf valve 78 is secured in place over opening 76 by valve retainer 80 and screw 82 (Figure 2) received through valve retainer 80, valve 78, and threadedly secured in back plate 64.

Referring now to Figures 1, 3—6, crankshaft 52 has a reduced diameter center portion 84 which forms annular chamber 86 between crankshaft 52 and crankcase 42, annular chamber 86 communicating with oil passageway 46. Disposed in crankshaft 52 are a pair of helical grooves 88, 90 on opposite sides of and in communication with annular chamber 86.

Referring particularly to Figures 3 and 4, it can be seen that grooves 88 and 90 are oppositely oriented in crankshaft 52 to deliver lubricant from annular chamber 86 in opposite directions along crankshaft 52. The radial dimension or depth and the axial dimension or length of each groove 88, 90 is predetermined as a function of several variables, among which are the diameter and length of the crankshaft, the vertical height of the crankshaft above the oil sump, and the like. Grooves 88, 90 are machined in crankshaft 52 to provide sufficient bearing surface between ridges 92 and the inner surface of crankcase bore 50, while at the same time efficiently supplying a desired amount of lubricant along crankshaft 52. In the disclosed embodiment, each groove 88, 90 has a bottom surface 94 with upwardly extending sides 96, 98 which diverge radially outwardly from bottom surface 94 to ridges 92 for ease of machining.

Given in the following are dimensions of a typical working embodiment of crankshaft 52 in the present invention, and are exemplary only and do not limit the scope of the invention:

Compressor power:

186 W (1/4 horsepower)

Crankcase bore ID:

12.7356 mm to 12.743 mm (.5014—.5017")

Crankshaft OD:

12.7203 mm to 12.729 mm (.5508—.5511")

Crankshaft axial length excluding eccentric 58:

85.852 mm to 85.979 mm (3.380—3.385")

Reduced diameter center portion 84 OD:

11.4554 mm to 11.7094 (.451—.461")

Groove radial depth:

0.1270 mm to 0.1778 mm (.005—.007")

Bottom surface 94 axial width:

0.889 mm to 1.143 mm (.034—.045")

Angular inclination of sides 96, 98:

0.75 radians to 0.820 radians (43°—47°)

Grooves 88, 90 are machined in crankshaft 52 at four threads per 2.54 cms (=1 inch), and as illustrated in Figure 1, form between crankshaft 52 and crankcase 44 helical passages 100, 102, respectively, in communication with annular chamber 86. Passage 102 also communicates with slot 59 in eccentric 58 (Figure 4).

In operation, electrical current is supplied to terminal pin assembly 22 to rotate rotor 15 and crankshaft 52, and refrigerant is supplied through suction inlet tube 32 and inlet 69 into cylinder 59. As crankshaft 52 rotates, eccentric 58 rotates roller 62 in cylinder 60 to compress the supplied refrigerant. Compressed refrigerant is discharged through valve assembly 74 into muffler 68, and then through an opening (not shown) in muffler 68 into the interior 40 of housing 12. The compressed refrigerant passes over motor 13 to cool motor 13 and is then discharged through outlet 24 into discharge tube 26.

Referring to Figures 1, 4 and 7, lubrication is provided as soon as crankshaft 52 is rotated. The rotation of crankshaft 52 creates a partial vacuum or low pressure area in annular chamber 86 which draws lubricant upwardly from oil sump 48 through oil passageway 46 into chamber 86. From annular chamber 86, lubricant is delivered in opposite directions by helical passages 100, 102. Lubricant is discharged from helical passage 100 on to rotor 56, which will throw the lubricant outwardly against the inner surface of housing 12 for cooling and return to oil sump 48.

Lubricant delivered by helical passage 102 lubricates bore 50 of crankcase 42, and exits passageway 102 through slot 59 in eccentric 58. Lubricant delivered to slot 59 lubricates the mutually engaging surfaces of eccentric 58 and roller 62. From slot 59, lubricant is then delivered through hole 70 in back plate 64 and opening 72 in discharge muffler 68 for return to oil sump 48.

If desired, an outboard bearing (not shown) may be provided with eccentric 58 to rotate within bore 70 in back plate 64. Any such outboard bearing may include an oil passage in communication with slot 59 in eccentric 58 to deliver lubricant through the outboard bearing and to oil sump 48.

## Claims

1. A hermetic motor compressor including;  
a housing (12) having an inlet (30), an outlet (24), and an oil sump (48) in the bottom thereof, and a motor-compressor unit (8) mounted in said housing and including a crankcase (42), a rotatable crankshaft (52) rotatably mounted in two bearings, a cylinder (60), and means (58) connected to said crankshaft for compressing refrigerant, said crankshaft (52) being generally horizontally disposed and rotatably received in said crankcase (42), and having a reduced diameter portion (84) between said two bearings forming

between said crankshaft (52) and said crankcase an annular chamber (86),

said crankshaft including a helical groove (90) arranged within one of said bearings forming between said crankshaft (52) and said crankcase (42), a helical passage (102) extending between said annular chamber (86) and said compressing means (58), and characterized in that a generally vertically disposed oil passageway (46) directly connects said oil sump (48) with said annular chamber (86), whereby the pressure in said chamber (86) is lower than the pressure in said oil sump (48) when said crankshaft (52) is rotated, said helical groove (90) constituting the only moving means for drawing lubricant upwardly through said oil passage (46) and into said annular chamber (86) and said helical passage (102) in said rotating crankshaft (52) delivering lubricant from said annular chamber (86) along said crankshaft (52) to lubricate said one bearing.

2. The compressor of Claim 1 wherein said crankshaft includes a second helical groove (88) forming between said crankshaft and said crankcase a second helical passage (100) in communication with and leading from said annular chamber in a direction opposite from said first-mentioned helical passage, said second helical groove being oppositely oriented in said crankshaft relative to said first-mentioned groove to deliver lubricant from said chamber in a direction opposite to the first mentioned groove to lubricate other bearings.

3. The compressor of Claim 2 wherein the facing opposite sides (96, 98) of each said groove diverge radially outwardly.

4. The compressor of Claim 2 or Claim 3 wherein each said groove has a radial dimension less than its axial dimension.

5. The compressor of any of Claims 1 to 4 wherein said compressing means is a rotary compressing means comprising an eccentric (68) with an annular-shaped roller member (62) rotatably received thereabout, said eccentric having an axially extending slot (59) in its radially outer surface in communication with said helical passage to deliver lubricant between said eccentric and said roller member.

#### Patentansprüche

1. Hermetischer Motor-Verdichter mit einem Gehäuse (12), das einen Einlaß (30), einen Auslaß (24) sowie im Bodenbereich einen Ölsumpf (48) aufweist, mit einer Motor-Verdichter-Einheit (8), die im Gehäuse angeordnet ist und ein Kurbelwellengehäuse (42) umfaßt, mit einer Kurbelwelle (52), die in zwei Lagern drehbar gelagert ist, einem Zylinder (60), einem Aggregat (58), das an die Kurbelwelle angeschlossen ist, und das Kältemittel verdichtet, wobei die Kurbelwelle (52) im wesentlichen horizontal angeordnet und drehbar im Kurbelwellengehäuse (42) aufgenommen ist und zwischen den genannten beiden Lagern einen Bereich (84) verringerten Durchmessers aufweist, der zwischen der Kurbelwelle (52) und

dem Kurbelwellengehäuse eine Ringkammer (86) beläßt, wobei die Kurbelwelle eine schraubenlinienförmige Nut (90) aufweist, die innerhalb eines der Lager angeordnet ist und zwischen der Kurbelwelle (52) und dem Kurbelwellengehäuse (42) einen schraubenlinienförmigen Kanal (102) bildet, der sich zwischen der Ringkammer (86) und dem Aggregat (58) erstreckt, dadurch gekennzeichnet, daß ein im wesentlichen vertikal angeordneter Ölkanal (46) den Ölsumpf (48) unmittelbar mit der Ringkammer (86) verbindet, wodurch der Druck in der Kammer (86) dann geringer als der Druck im Ölsumpf (48) ist, wenn die Kurbelwelle (52) umläuft, daß die schraubenlinienförmige Nut (90) das einzige Antriebsmittel zum Fördern von Schmiermittel durch den Ölkanal (46) in die Ringkammer (86) nach oben darstellt, und daß der schraubenlinienförmige Kanal (102) in der umlaufenden Kurbelwelle (52) Schmiermittel aus der Ringkammer (86) entlang der Kurbelwelle (52) liefert, um das genannte eine Lager zu schmieren.

2. Verdichternach Anspruch 1, dadurch gekennzeichnet, daß die Kurbelwelle eine zweite schraubenlinienförmige Nut (88) aufweist, die zwischen der Kurbelwelle und dem Kurbelwellengehäuse einen zweiten schraubenlinienförmigen Kanal (100) bildet, der mit der Ringkammer in leitender Verbindung steht und aus dieser herausführt in einer Richtung entgegen jener aus dem ersten schraubenlinienförmigen Kanal, und daß die zweite schraubenlinienförmige Nut in der Kurbelwelle in Bezug auf die erste Nut entgegengerichtet ist, um Schmiermittel aus der Kammer in einer Richtung entgegen der erstgenannten Nut zu liefern, um die anderen Lager zu schmieren.

3. Verdichter nach Anspruch 2, dadurch gekennzeichnet, daß die einander zugewandten entgegengesetzten Seiten (96, 98) einer jeden Nut radial nach außen divergieren.

4. Verdichter nach Anspruch 2 oder 3, dadurch gekennzeichnet, daß jede Nut eine radiale Erstreckung aufweist, die geringer als ihre axiale Erstreckung ist.

5. Verdichter nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß das Verdichtungsaggregat ein drehbares Verdichtungsaggregat ist, das einen Exzenter (58) mit einem diesen umschließenden, ringförmig gestalteten drehbaren Rollkörper ist, und daß der Exzenter einen sich axial erstreckenden Schlitz (59) in seiner äußeren Fläche aufweist, der in leitender Verbindung mit dem schraubenförmigen Kanal steht, um Schmiermittel zwischen dem Exzenter und dem Rollkörper zu fördern.

#### Revendications

1. Compresseur à moteur hermétique comprenant un boîtier (12) muni d'un orifice d'entrée (30), d'un orifice de sortie (24), et d'un carter d'huile (48) dans le fond de celui-ci, et un bloc de compresseur à moteur (8) monté dans le boîtier et comprenant un carter (42), un vilebrequin rotatif (52) monté en rotation dans deux paliers, un cylindre (60), et des moyens (58) reliés au vilebre-

quin pour comprimer le réfrigérant, ce vilebrequin (52) étant disposé généralement horizontalement et venant se loger en rotation dans le carter (42), ce vilebrequin présentant également une partie de diamètre réduit (84) entre les deux paliers pour former entre le vilebrequin (52) et le carter une chambre annulaire (86) ce vilebrequin comprenant une rainure en hélice (90) disposée à l'intérieur de l'un des paliers pour former entre le vilebrequin (52) et le carter (42) un passage en hélice (102) s'étendant entre la chambre annulaire (86) et les moyens de compression (58), et caractérisé en ce qu'un passage d'huile disposé généralement verticalement (46) relie directement le carter d'huile (48) à la chambre annulaire (86), de sorte que la pression régnant dans la chambre (86) est inférieure à la pression régnant dans le carter d'huile (48) lorsque le vilebrequin (52) est entraîné en rotation, la rainure en hélice (90) constituant le seul moyen mobile pour entraîner le lubrifiant vers le haut dans le passage d'huile (46) de façon qu'il pénètre dans la chambre annulaire (86), et le passage en hélice (102) du vilebrequin tournant (52) délivrant le lubrifiant de la chambre annulaire (86) le long du vilebrequin (52) pour lubrifier le palier ci-dessus.

2. Compresseur selon la revendication 1, caractérisé en ce que le vilebrequin comprend une seconde rainure en hélice (88) formant entre le vilebrequin et le carter un second passage en

hélice (100) en communication avec la chambre annulaire et sortant de cette chambre annulaire dans une direction opposée à celle du premier passage en hélice ci-dessus, la seconde rainure en hélice étant orientée à l'opposé du vilebrequin par rapport à la première rainure ci-dessus pour délivrer le lubrifiant provenant de la chambre dans une direction opposée à celle de la première rainure ci-dessus, de manière à lubrifier d'autre paliers.

3. Compresseur selon la revendication 2, caractérisé en ce que les côtés opposés se faisant face (96, 98) de chacune des rainures divergent radialement vers l'extérieur.

4. Compresseur selon l'une quelconque des revendications 2 et 3, caractérisé en ce que chaque rainure présente une dimension radiale inférieure à sa dimension axiale.

5. Compresseur selon l'une quelconque des revendications 1 à 4, caractérisé en ce que les moyens de compression sont constitués par un dispositif de compression rotatif comprenant un excentrique (58) muni d'un élément de rouleau de forme annulaire (62) venant se loger en rotation autour de celui-ci, cet excentrique comportant dans sa surface radialement extérieure une fente axiale (59) en communication avec le passage en hélice pour délivrer le lubrifiant entre l'excentrique et l'élément de rouleau.

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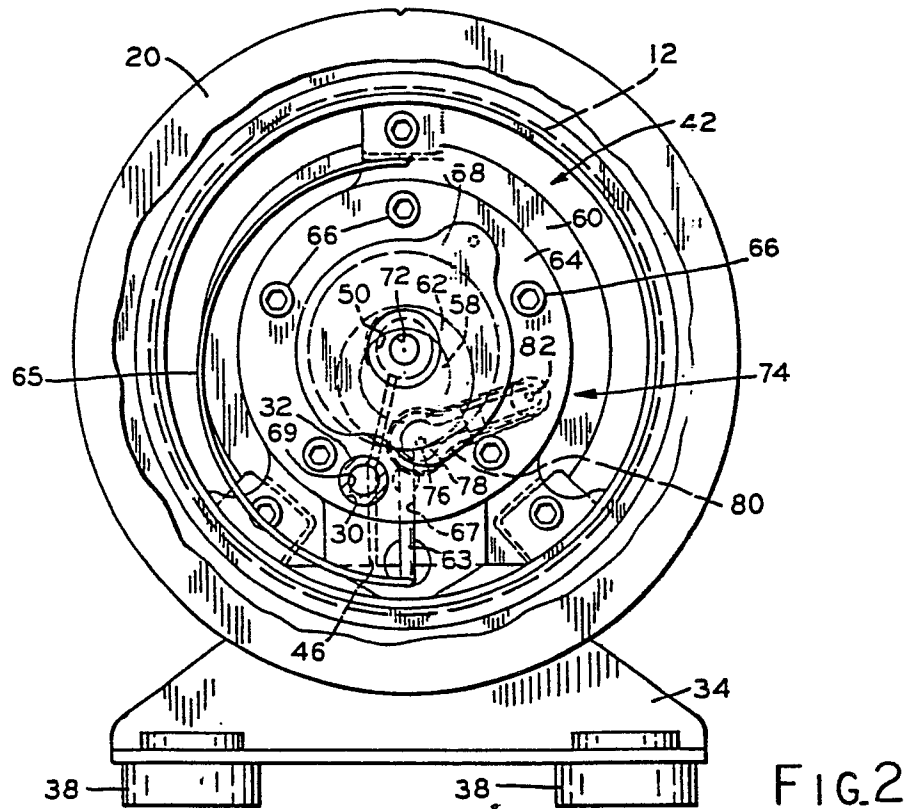
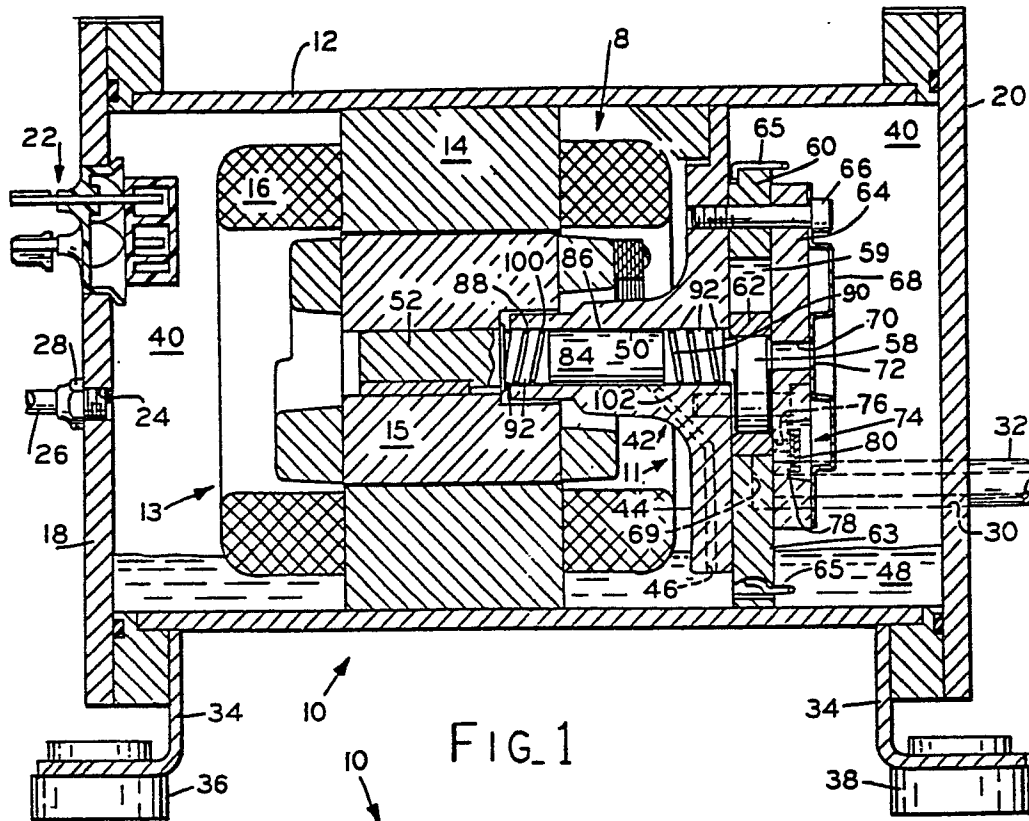
50

55

60

65

6



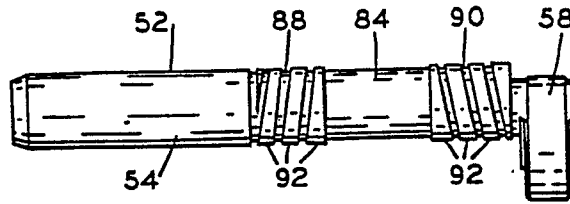


FIG. 3

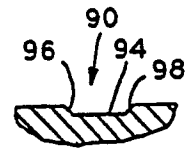


FIG. 6

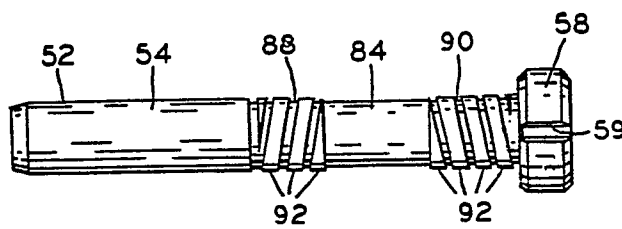


FIG. 4

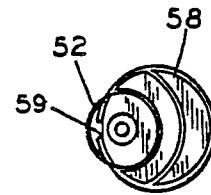


FIG. 5

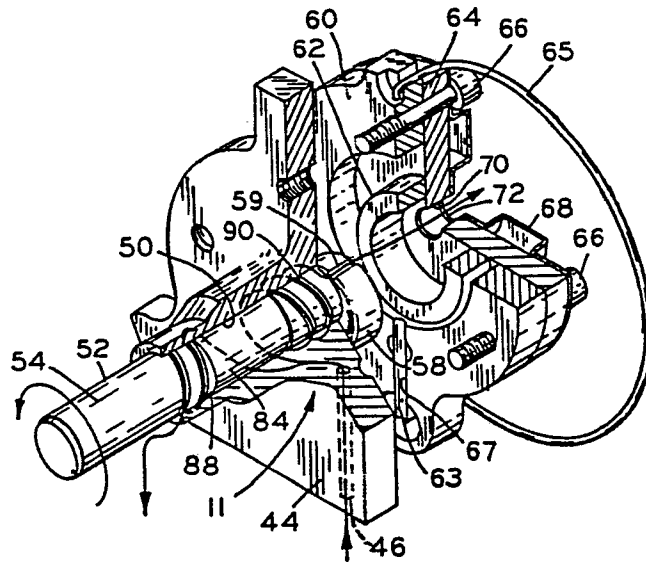


FIG. 7