(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
14 April 2005 (14.04.2005)

PCT

(10) International Publication Number
WO 2005/033506 A2

(51) International Patent Classification[7]: F04B

(21) International Application Number: PCT/US2004/031921

(22) International Filing Date: 29 September 2004 (29.09.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/506158 29 September 2003 (29.09.2003) US

(71) Applicant and
(72) Inventor: **SANTA ANA, Roland, C.** [US/US]; 224 N. Van Buren St., Rockville, MD 20850 (US).

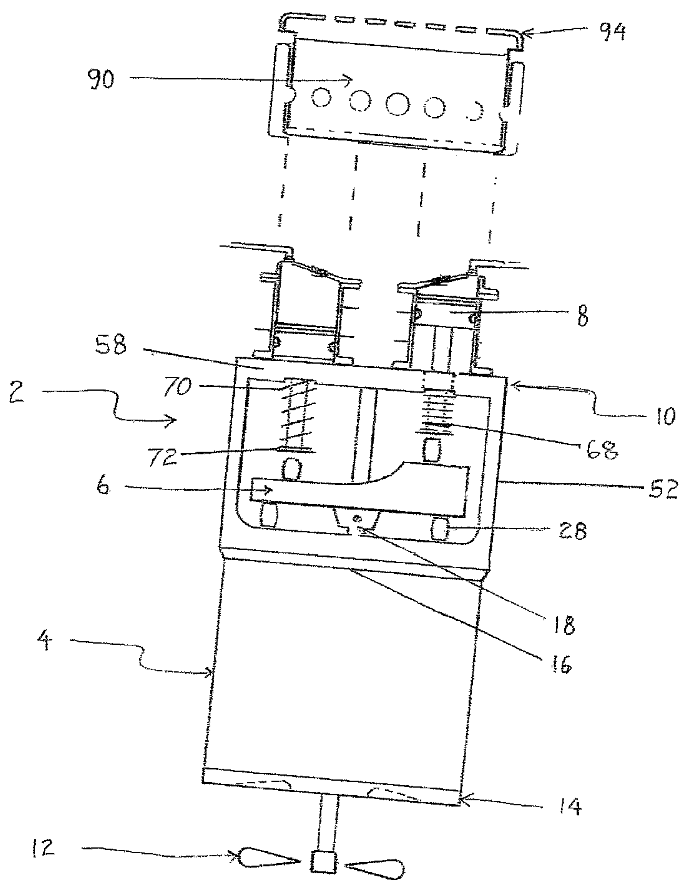
(74) Agent: **HUFF, Richard, Huff, L.**; 19304 Olney Mill Road, Olney, MD 20832 (US).

(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: GAS COMPRESSOR



(57) Abstract: A gas compressor device (2)comprising a motor having a rotatable motor shaft (18), a rotating disk (6) attached to the motor shaft (18), and a compressor (10) comprising pistons (8), piston rods (62), cylinders (50), and the rotating disk (6) has a top contour such that, as the disk (6) turns, a piston rod (62) having a roller (78) which is in moveable contact with the top contour of the disk (6) will start at a low elevation (42), pass gradually to a higher elevation (44), reach a peak (46), and pass rapidly back to the low elevation (42).

WO 2005/033506 A2

Declaration under Rule 4.17:

— *of inventorship (Rule 4.17(iv)) for US only*

Published:

— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

TECHNICAL FIELD

1) Field of the invention

[0001] This invention is directed to gas compressors. More specifically, the invention is directed to gas compressors wherein the compression is carried out by the action of pistons in cylinders and the pistons are made to reciprocate by being contact with a revolving contoured disk.

BACKGROUND ART

The prior art is replete with disclosures of compressors wherein pistons reciprocate in cylinders and the cause of the reciprocation is the pistons' contact with the surface of a revolving oblique disk, generally called a swash plate. Samples of recent US patents having such disclosures are: 6,224,349 issued to Iwanami et al 5/1/2001; 6,302,658 issued to Seipel et al 10/16/2001; 6,312,231 issued to Kuhne et al 11/6/2001; 6,318,502 issued to Unger 11/20/2001; 6,368,073 issued to Kanai 4/9/2002; 6,390,787 issued to Herder 5/21/2002, and 6,406,271 issued to Valentin 6/18/2002. These compressors share the common features of a rotating motor shaft which rotates a swash plate which has a surface oblique to the axis of the motor shaft. The outer edges of the swash plate are connected to one or more pistons. As the swash plate rotates, the pistons are forced to reciprocate in the pistons and the reciprocal movement of the pistons operates the compressor in a known manner.

Such compressors are prolific in the literature, but not in commerce. These compressors require lubrication, which is undesirable when the compressed gas is to be breathed by a human subject. There is a problem in many of these devices which causes the pistons to be out of line with the cylinders. The rate of speed of the piston in the expansion phase is the same as the rate of speed of the piston in the compression phase. It has been discovered that following compression, it is desirable for the piston to exit the cylinder as quickly as possible. The existing swash plate type compressors do not make provision for the difference in reciprocating speeds.

DISCLOSURE OF INVENTION

This invention relates to gas compressors. Gas compressors find a variety of utilities, such as in refrigerators, running pneumatic tools, and supplying air pressure to fill tires and other air-filled devices. The gas compressors of the present invention are run by motors which provide rotary motion. These are preferably electrical motors. The motor shaft is connected to a rotatable disk.

The side of the disk facing the motor is flat and the side of the disk facing away from the motor contains a ramp. This side contains a low area. The height of the disk gradually increases to a peak and then rapidly decreases to the height of the low area. The portion of the disk which is of increased height is hollow so as to maintain a uniform weight throughout the disk.

The air compressor is situated on the opposite side of the motor from the disk and a frame mount connects the motor and the compressor. For the purpose of this description, the motor will be "down" and the compressor will be "up" although any arrangement is possible. Preferably, the compressor contains at least two cylinders and a piston fits into each cylinder. Each piston is attached to a piston rod. The lower end of each piston rod is attached to a roller. Each roller rolls freely along the turning disk and rises and falls as it passes over the ramp on the disk.

The rising and falling motion of the rollers causes alternating up and down motion of the pistons. When the pistons rise, gas in the cylinder is compressed and expelled from the piston. When the pistons fall, a new supply of gas enters the cylinder.

The piston rod passes through a spring. The upper end of the spring attaches to the lower end of the piston and the lower end of the spring attaches to the frame mount. The spring biases the piston rod, causing the piston to be biased toward the lower part of the cylinder.

The compressor contains a self-operated blower which helps to pre-pressurize air entering the pistons. This blower and an optional fan below the motor serve to keep the compressor from overheating.

DISCRIPTION OF DRAWINGS

Fig. 1 is an exploded elevational perspective cut-away view of the rotary pump of the present invention showing one view of the rotating disk.

Fig. 2 is an exploded elevational perspective cut-away view of another rotary pump of the present invention showing one view of the rotating disk.

Fig. 3 is an exploded elevational perspective cut-away view of the rotary pump of the present invention showing another view of the rotating disk.

Fig. 4 is an exploded elevational perspective enlarged view showing the gearing mechanism, the disk and the motor mount in detail.

Fig. 5 is an elevational view of one angle of the rotating disk.

Fig.6 is a side elevational view in cut-away showing the slope of the rotating disk and the relationship of the gears to each other.

Fig. 7 is a side cross-sectional view showing the relationship between the rotating disk and more than one piston rod.

Fig. 8 is a side cross-sectional view showing the relationship between the rotating disk and a single piston rod.

Fig. 9 is an elevational perspective cut-away view of the rotary pump of the present invention showing one view of the rotating disk. This Figure is similar to Fig. 1, but does not show the lower fan or the turbine.

BEST MODE FOR CARRYING OUT THE INVENTION

The invention will now be described in detail with reference to the above drawings wherein like identifying numerals refer to like features throughout the description.

The device **2** of the present invention is made up of a motor (not shown) in a motor housing **4**, a rotatable disk **6** to drive pistons **8**, and a compressor **10** which uses the pistons **8** to compress gas. In the preferred embodiment, the motor housing **4** contains a fan **12** located at the lower surface **14** of the motor housing **4**, which fan **12** is useful in lowering the temperature of the motor and the compressor **10** and preventing overheating. Any conventional motor is suitable, although an electric motor is preferred. The motor fits within a motor housing **4** which is preferably cylindrical in shape and has a flat top surface **16**.

The relationship between the motor and the rotatable disk **6** is better understood with reference to Figs. 1, 4, and 6. The rotatable motor shaft **18** protrudes from the center of the top surface **16** of the motor housing **4**.

The relationship between the gears and the motor shaft is better understood with reference to Fig. 6. The rotatable motor shaft **18** is centrally located in and is fixedly connected to a first, central gear **20**. The first gear **20** meshes with a second, transfer gear **22** as shown in Figs. 4 and 6. The second gear **22** meshes with a third, disk drive gear **24** shown in Fig. 6, but omitted from Fig. 4 for clarity. The third gear **24** is fixedly located in the lower section **26** of a rotating disk **6**. The purpose of the gears **20, 22, 24** is to transfer a fast rotational speed of the motor shaft **18** to a slower rotational speed of the disk **6**.

In one embodiment, as shown in Figs. 1 and 2, support rollers **28** are fixedly attached to the top surface **16** of the motor housing **4**. These rollers **28** abut with the lower surface **30** of the rotatable disk **6** and support the rotatable disk **6** while giving it complete freedom to rotate.

In another embodiment, as shown in Fig.6, the rotatable disk **6** is attached to the inner surface **32** of the device wall **34** and is supported by two sets of collars **36** which contain bracelet bearings **38**. This allows the disk **6** to be firmly supported by the wall **34**, yet given complete freedom to rotate freely.

The top contour **40** of the rotating disk **6** is such that, as the disk **6** turns, an object which is in moveable contact with the disk **6** will start at a low elevation **42**, pass gradually to a higher elevation **44**, reach a peak **46**, and pass rapidly down a steep incline **48** to the low elevation **42**. This configuration allows for the rapid passage of the cylinder **50** into the expansion phase.

A frame mount **52**, best shown in Fig. 4, is connected to the motor housing **4**. The lower end **54** of the frame mount **52** is attached to the motor housing **4** by any mechanical means, preferably bolts. The upper end **56** of the frame mount **52** has a horizontal member **58** which serves as an attachment base for the cylinders **50** of the gas compressor **10**. The horizontal member **58** contains an opening **60** for each piston rod **62**.

The disk **6** contains a lower face **30** and an upper contour **40**. The surface of the lower face **30** is preferably flat. The disk **6** is supported by rotatable supports **28**. The rotatable supports **28** are attached to, and supported by, the frame mount **52**. The surface of the upper contour **40** is curved as described above. It can readily be seen that as the motor shaft **18** causes the disk **6** to rotate, a fixed point over the disk **6** will be subjected to alternating up and down motion. The disk **6** is hollow as shown in Fig. 7 so that the weight of the disk **6** is uniformly distributed throughout its area.

The gas compressor **10** contains at least one cylinder **50**. Each cylinder **50** contains a piston **8**. Each piston **8** contains an upper surface **64** and a lower surface **66**. In the device of the present invention, the user may change the number of pistons and cylinders to fit his or her needs at the time. A change in gearing may be necessary so that the same motor (gasoline or electric) may be used. The change in gearing allows the device to compensate for the increased load put on the motor by providing a slow disk rotation with increased torque or a rapid disk rotation with decreased torque.

In a first embodiment as shown in Fig. 1, a spring **68** contains an upper end **70** and a lower end **72**. The upper end **70** of the spring **68** is connected to the horizontal member **58** of the frame mount **52** and the lower end **72** of the spring **68** is connected to the piston rod **62**. The spring **68** biases the piston rod **62** downwardly to draw the piston **8** out of the compressing position in the cylinder **50**.

In a second embodiment as shown in Fig. 2, a spring **68** contains an upper end **70** and a lower end **72**. The upper end **70** is fixedly connected to the lower surface **66** of the piston **8** and the lower end **72** is fixedly connected to the horizontal member **58** of the frame mount **52**. This spring **68** stretches as the piston **8** is pushed upwardly when the piston rod **62** is pushed upwardly by an area of the disk **6** having a high elevation **44**. The spring **68** contracts when this upward force is removed and this contraction forces the piston rod **62** downwardly.

Each piston **8** is connected to a piston rod **62**. The piston rod **62** passes through an aperture **60** in an insert **74** which has reduced friction in the horizontal member **58** of the frame mount **52**. This insert **74** having reduced friction is preferably made of Teflon®. The lower end **76** of the piston rod **62** is connected to a roller **78** by means of an axle **80** passing through the roller **78** and attaching to the lower end **76** of the piston rod **62**. The roller **78** is so directed that it will revolve as the disk **6** rotates. The cross-section of the piston rods **62** are non-circular in shape and the aperture **60** in the insert **74** in the frame mount **52** is of a similar shape. Square is a preferable shape. The non-circular shape prevents turning of the piston rod **62** and thus keeps the rollers **78** in proper alignment.

Each cylinder **50** contains conventional one-way inlet **84** and outlet valves **86** to permit the intake of gas and the outlet of pressurized gas.

The upper end **88** of the compressor **10** contains a blower fan **90** as shown in Fig. 3 having its own energy source. The blower fan or turbine **90** is preferably within a housing container **92**. The purpose of the fan or turbine **90** is to enable gas entering the cylinders **50** to have a pressure which is greater than ambient pressure. This pressure build-up takes place in a holding container **92** between the fan or turbine **90** and the cylinders **50**. The housing cap **94** also contains a filter **96** for the gas. The turbine may be replace with any similar device which forces air at a rate of more than 150 liters per minute, preferably 450 liters per minute.

In operation, as best shown in Figs. 4 and 6, the motor rotates a motor shaft **18** and causes the disk **6** to rotate around the shaft **18** through a series of speed transmission gears **20, 22, 24**. The disk **6** is supported by support rollers **28** or by attachment to the device wall **34**. The upper face **96** of the disk **6** rises and falls in relation to any given point above the disk **6** as the disk **6** rotates. As shown in Fig. 9, the rollers **78** of the piston rods **62** remain in a fixed position relative to the rotating disk **6** and rise and fall as they move with the changing height of the disk **6**. The piston rods **62** and pistons **8** follow the rising and falling of the rollers **78**. As a piston **8** rises, it compresses gas in its cylinder **50**. As a piston **8** falls with the help of the spring **68**, the gas enters the cylinder **50** under higher than ambient pressure because of the blower fan **90** in the housing cap **92**. The repeated up and down movement of the pistons **8** causes a continuous flow of pressurized gas from the compressor **10**.

INDUSTRIAL APPLICABILITY

The gas compressor of the present invention may be used for the compressing of gas for a variety of applications. It may be used to compress coolants for refrigerators and air conditioners. It may be used as a compressor in air pumps for a wide variety of inflatable objects.

Although the invention has been described and illustrated in detail, it is to be clearly understood that the same is by way of illustration and example, and is not to be taken by way of limitation. The spirit and scope of the present invention are to be limited only by the terms of the appended claims.

CLAIMS

1. In a gas compressor device comprising a motor having a rotatable motor shaft, a rotating disk attached to the motor shaft, and a compressor comprising a piston, the piston having a lower end, and a piston rod, and a cylinder, the improvement wherein the rotating disk has a lower section, a lower surface, and a top contour such that, as the disk turns, an object which is in moveable contact with the top contour of the disk will start at a low elevation, pass gradually to a higher elevation, reach a peak, and pass rapidly back to the low elevation.

2. The gas compressor device of claim 1, wherein there is at least one piston and at least one cylinder.

3. The gas compressor device of claim 2, wherein each piston is attached to a piston rod, which piston rod has upper and lower ends, the upper end of the piston rod being attached to the piston and the lower end of the piston rod being attached to rollers which are in contact with the top contour of the rotating disk.

4. The gas compressor device of claim 2, wherein the motor is within a motor housing having a top surface and a lower end and a frame mount is connected to the motor housing, which frame mount has a lower end and an upper end.

5. The gas compressor device of claim 4, wherein the lower end of the frame mount is attached to the motor housing, the upper end of the frame mount has a horizontal member which serves as an attachment base for the at least one cylinder of the gas compressor, and the horizontal member contains an opening for each piston rod.

6. The gas compressor device of claim 5, wherein the openings of the horizontal members contain inserts having reduced friction.

7. The gas compressor device of claim 6, wherein the cross-section of the piston rods and the openings of the horizontal members are non-circular in shape.

8. The gas compressor device of claim 5, wherein each piston rod passes through a spring containing an upper end and a lower end, the upper end being fixedly connected to the lower surface of the piston and the lower end being fixedly connected to the horizontal member of the frame mount.

9. The gas compressor device of claim 1, wherein the lower end of the motor housing has a fan attached thereto.

10. The gas compressor device of claim 3, wherein support rollers are fixedly attached to the top surface of the motor housing which rollers abut with the lower surface of the rotatable disk and support the rotatable disk.

11. The gas compressor device of claim 1, wherein the rotatable motor shaft is centrally located in and is fixedly connected to a first, central gear, the first gear meshes with a second, transfer gear, the second gear meshes with a third, disk drive gear, and the third gear is fixedly located in the lower section of the rotating disk.

12. The gas compressor device of claim 4, wherein the device has a wall having an inner surface, the rotatable disk is attached to the inner surface of the device wall, and the rotatable disk is supported by two sets of collars which contain bracelet bearings.

13. The gas compressor device of claim 1, wherein the compressor has an upper end, which upper end contains a turbine or blower fan within a housing container.

14. The gas compressor device of claim 13, wherein the turbine or blower fan forces air at the rate of at least 450 liters per minute.

15. The gas compressor device of claim 13, wherein the housing container contains a filter for the gas.

16. The gas compressor device of claim 13, wherein there is a storage container for the compressed gas.

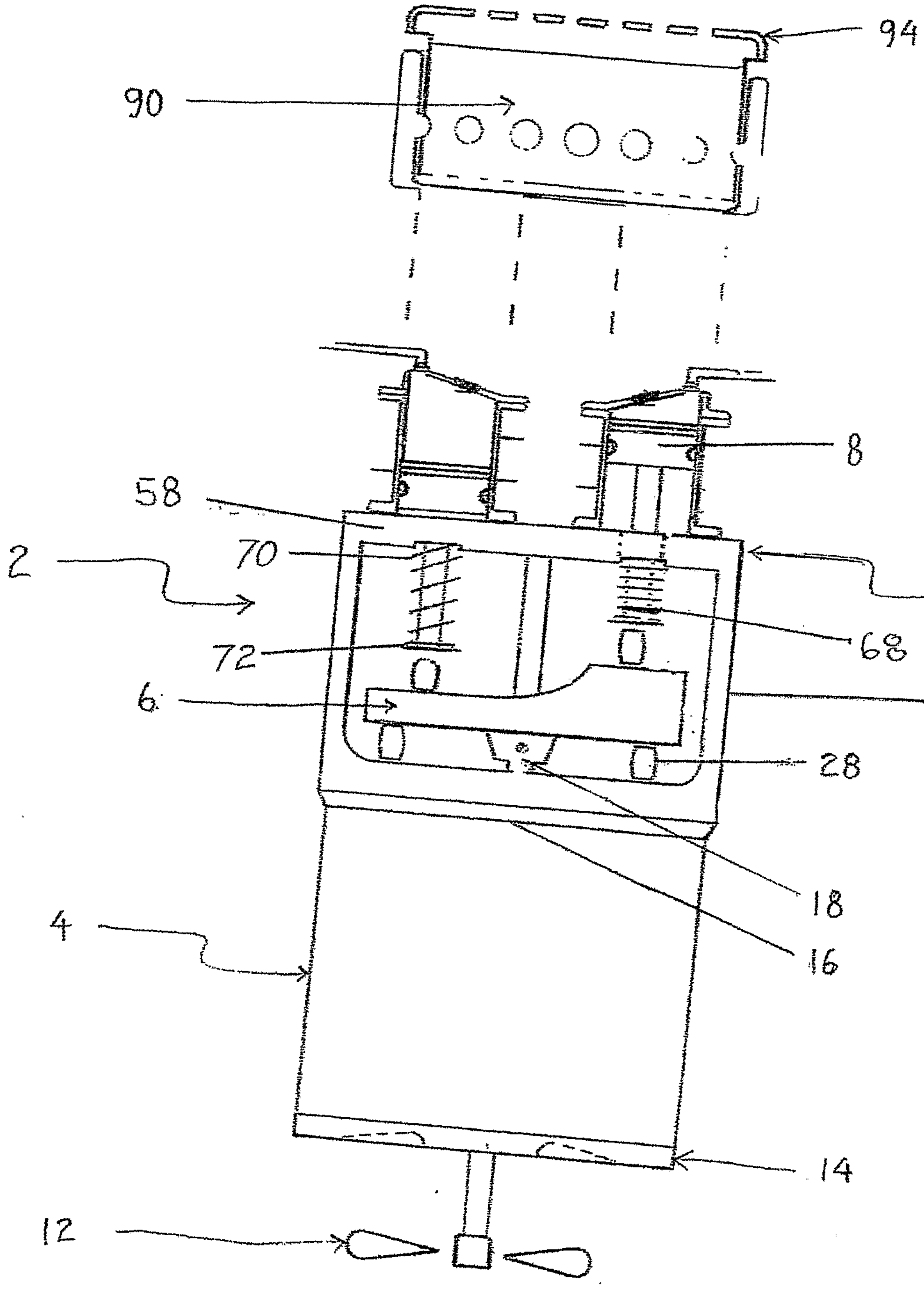


FIG. 1

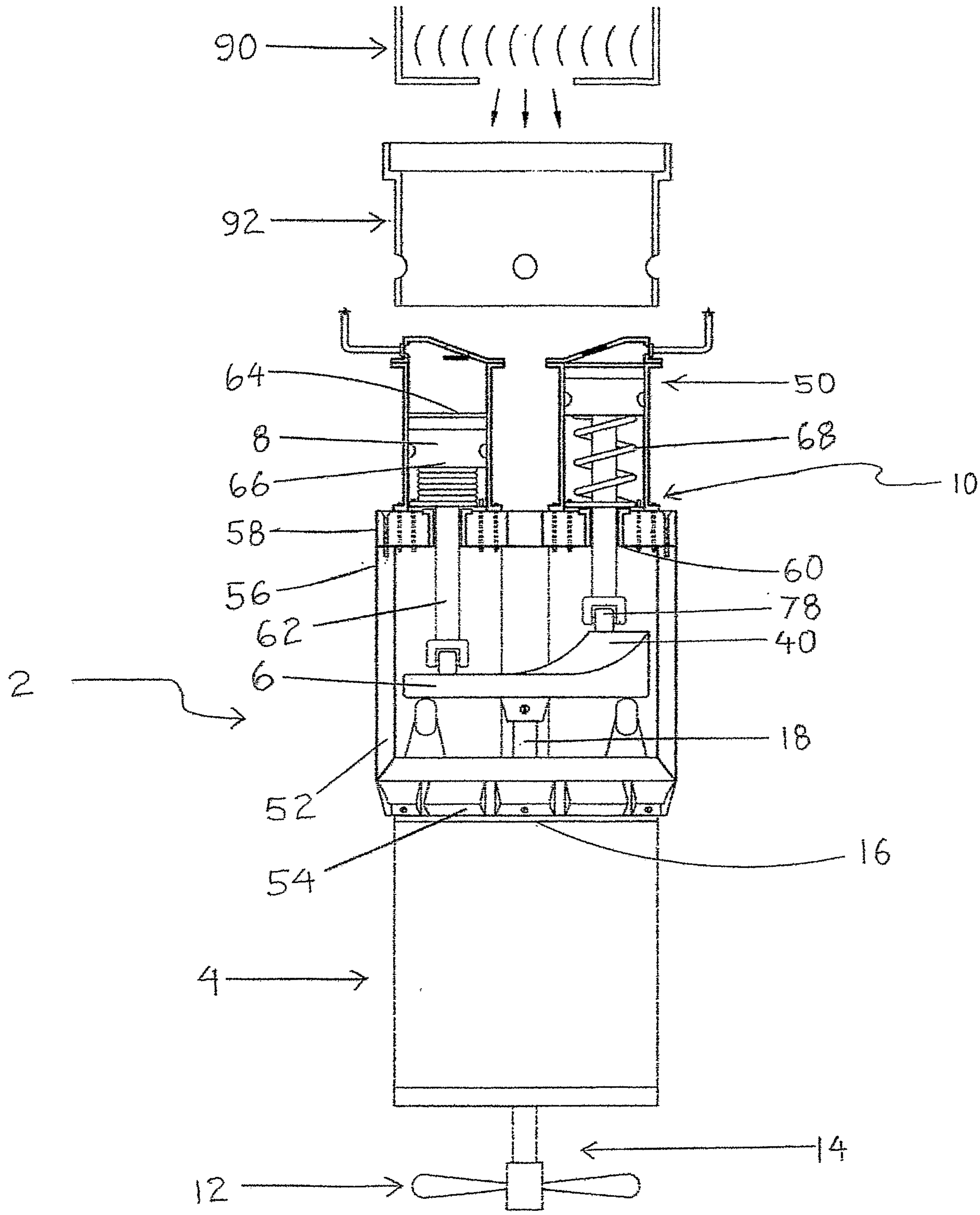


FIG. 2

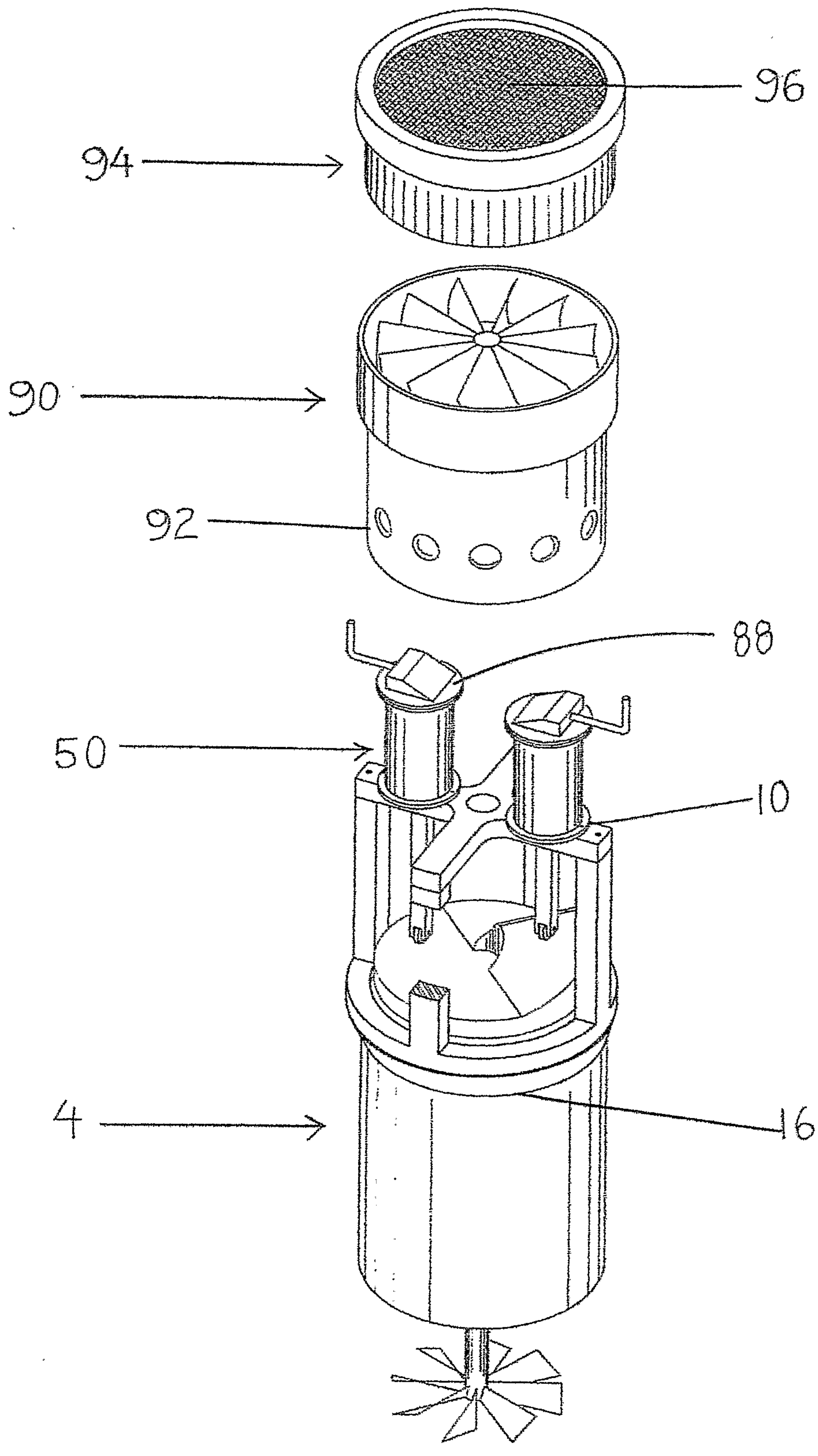


FIG. 3

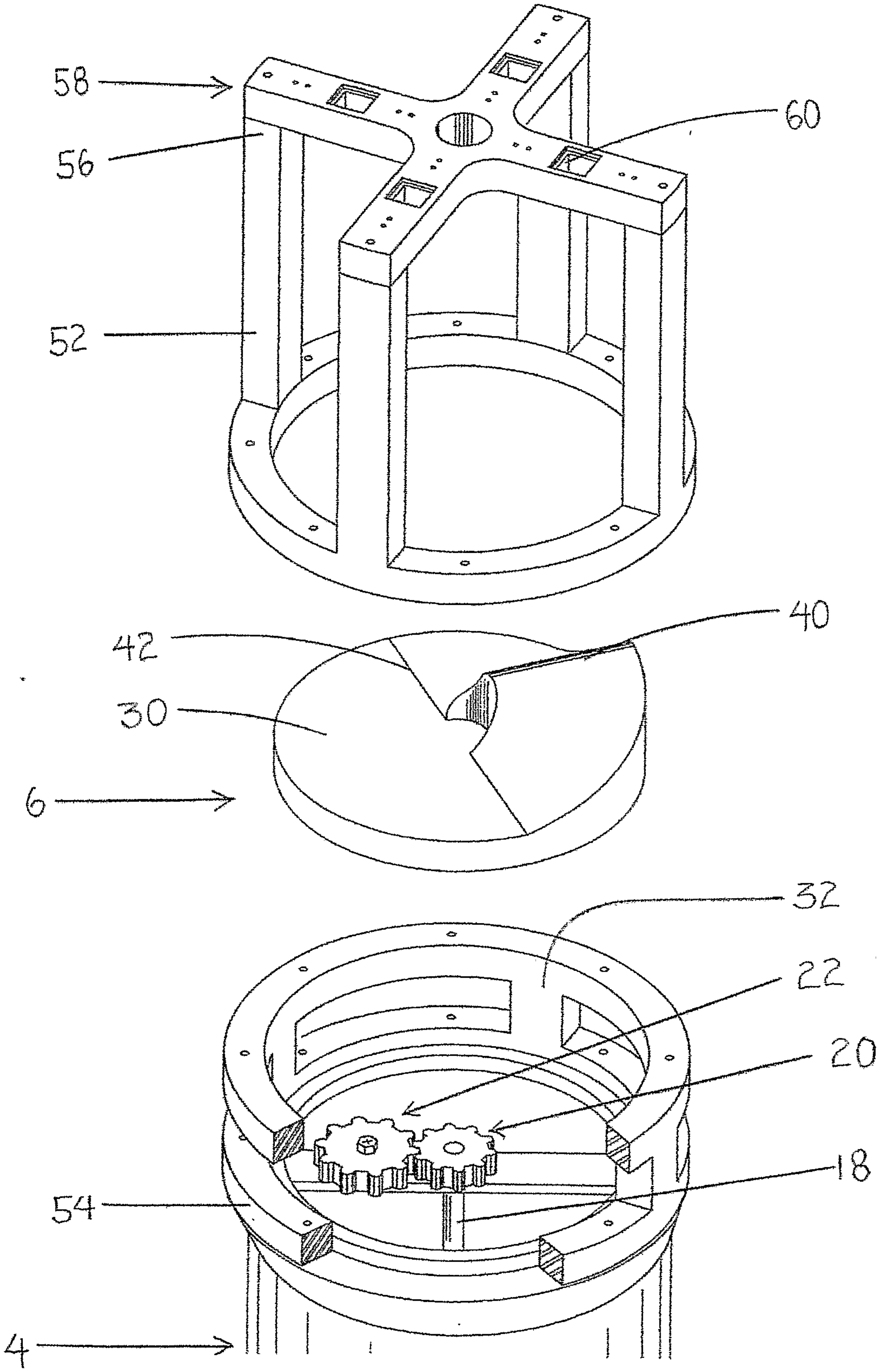


FIG. 4

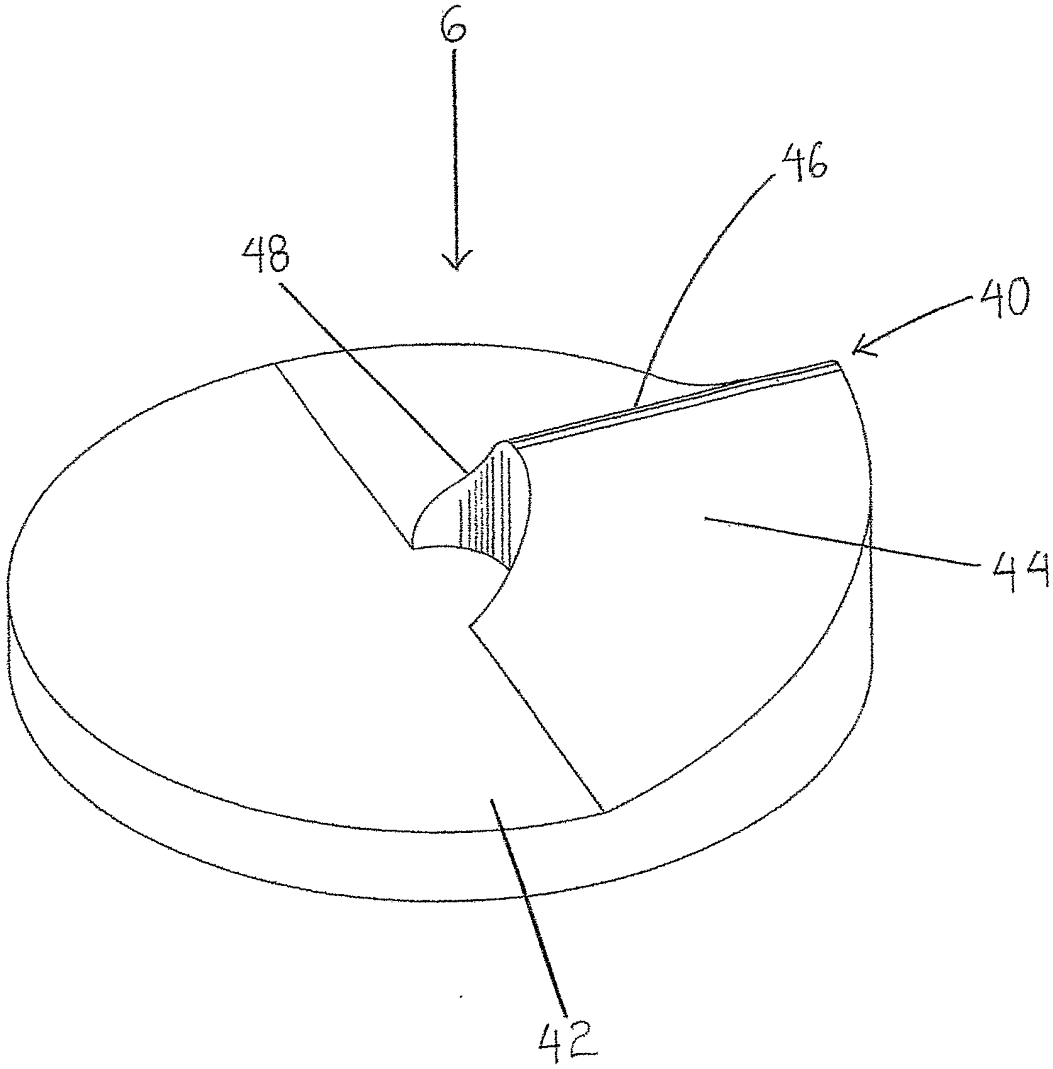


FIG. 5

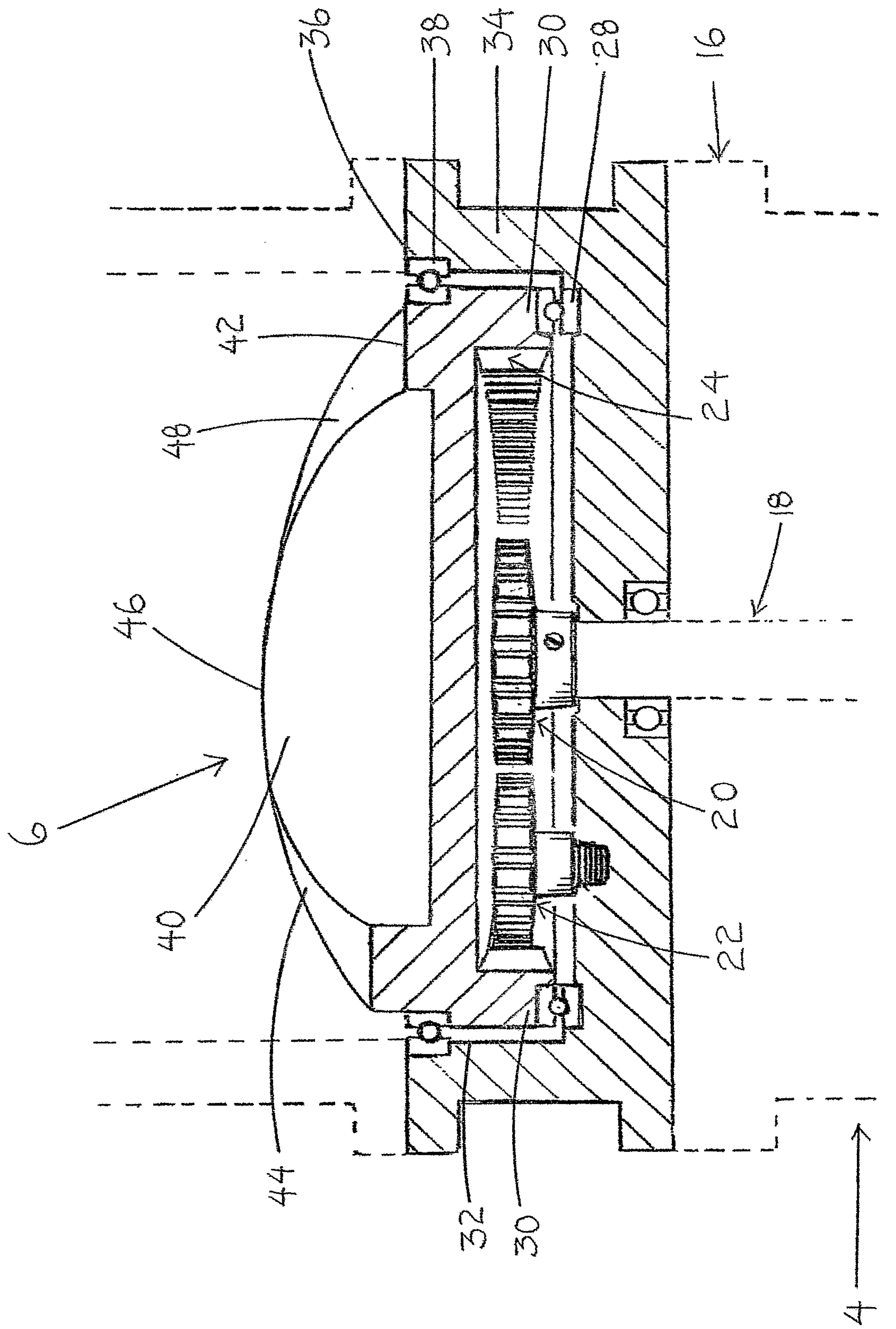


FIG. 6

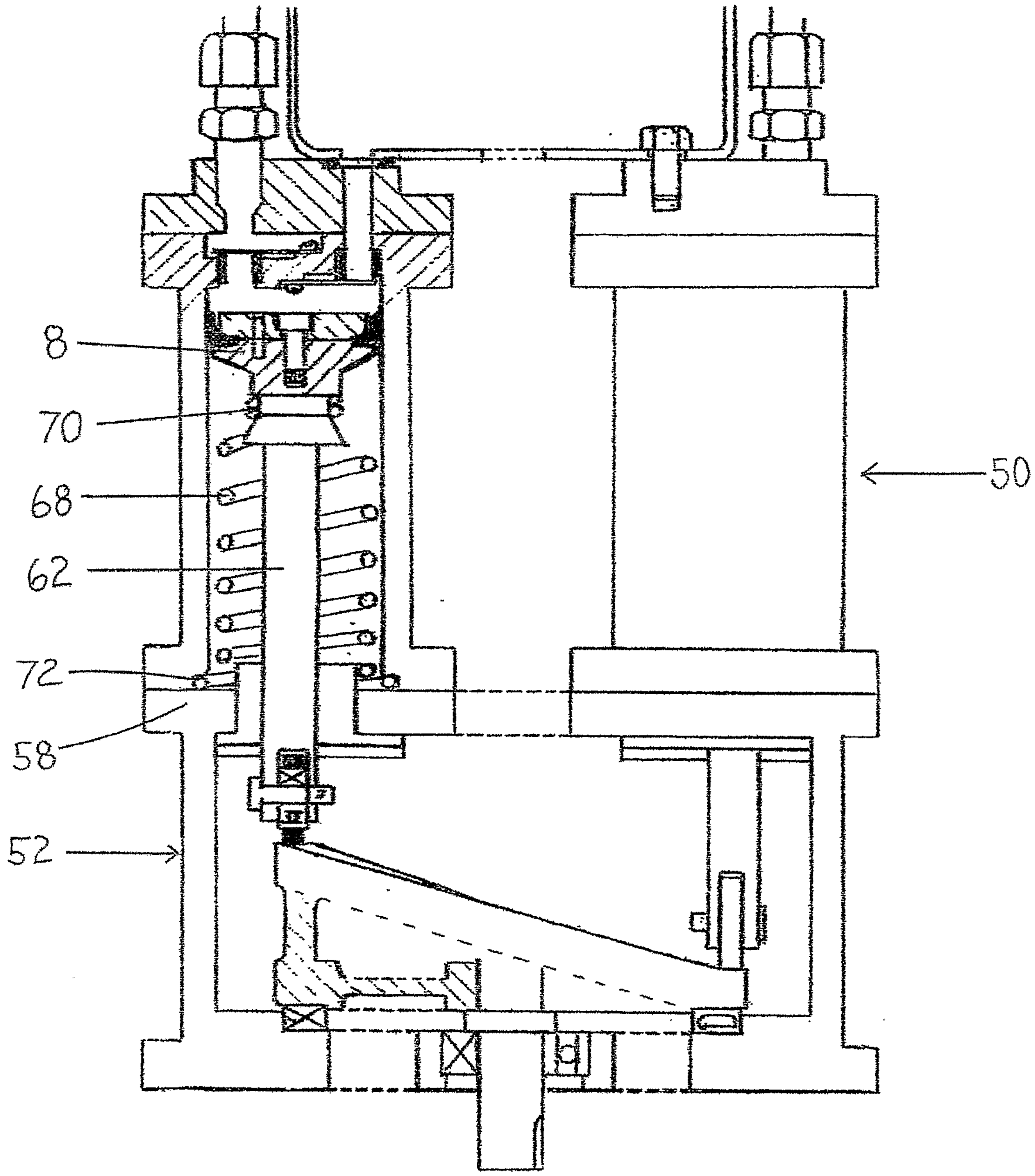


FIG. 7

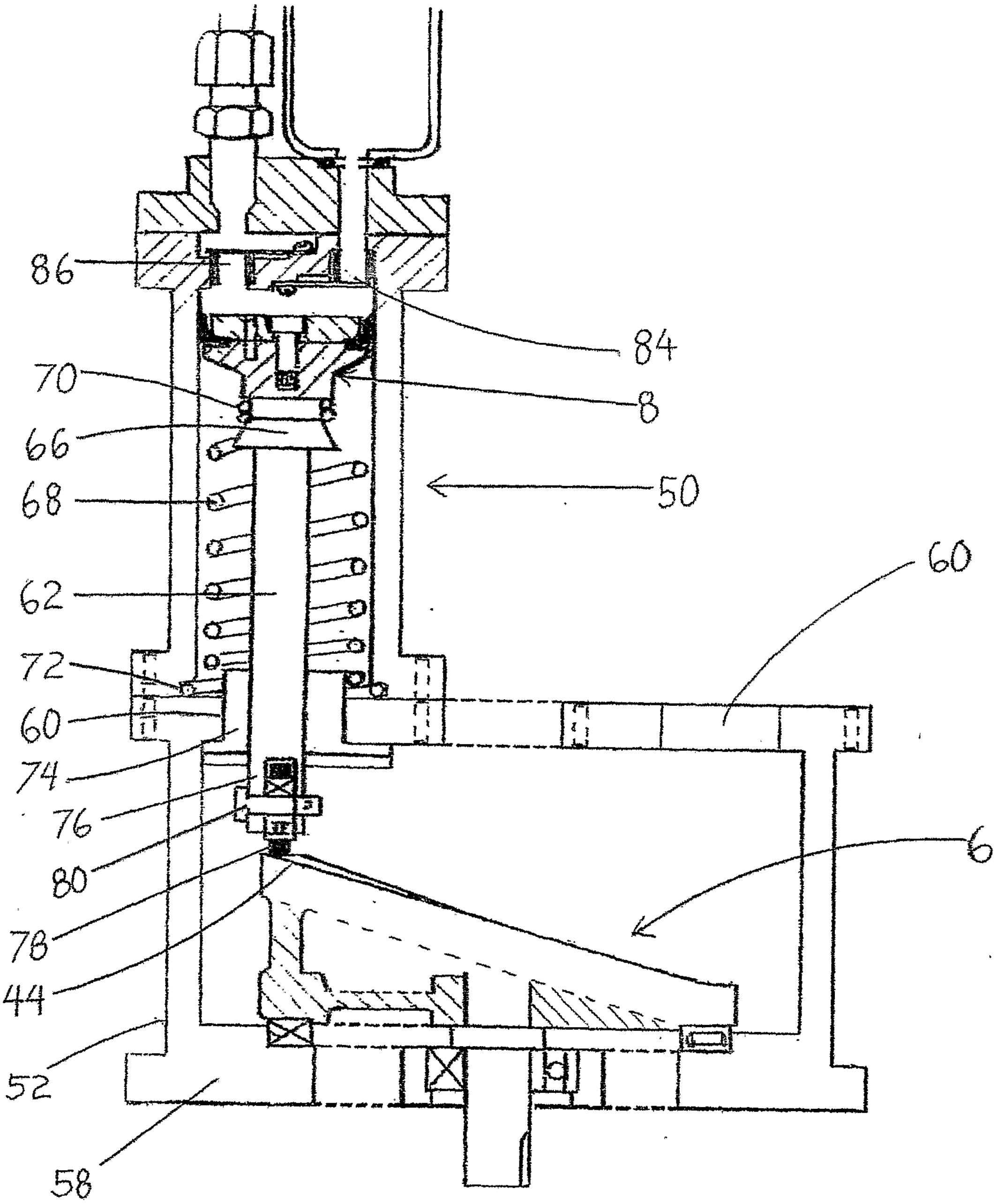


FIG. 8

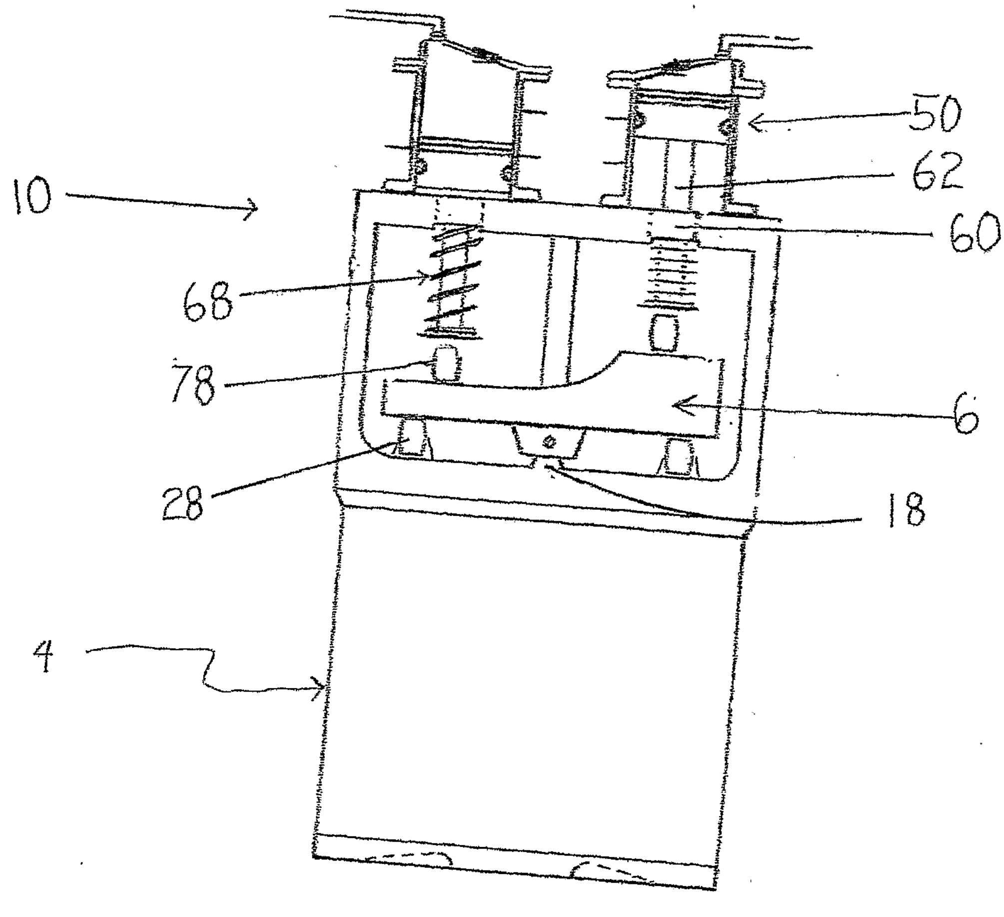


FIG. 9