June 7, 1960 A. F. GRAF VON SODEN 2,939,403

ROTARY UNIT FOR VACUUM, AIR PRESSURES AND FLUID CIRCULATION

Filed Jan. 17, 1958

Fig. 3.

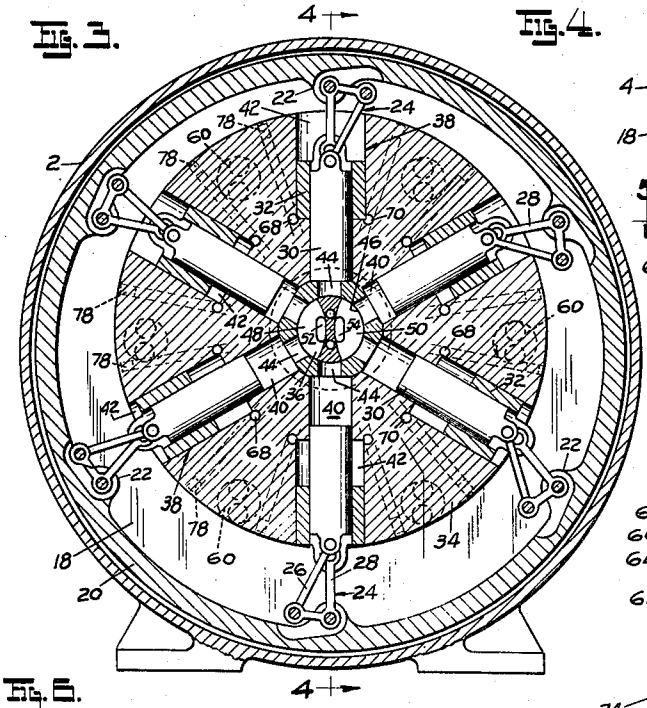


Fig. 4.

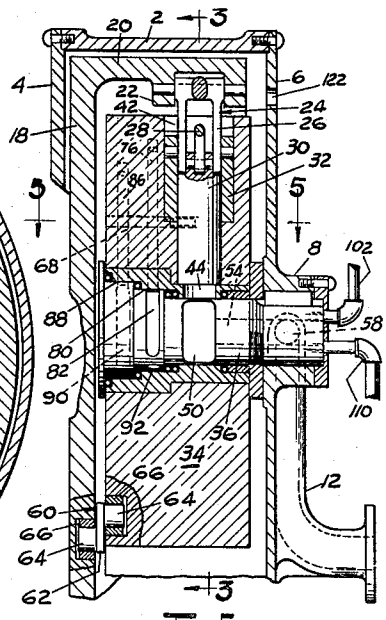


Fig. 5.

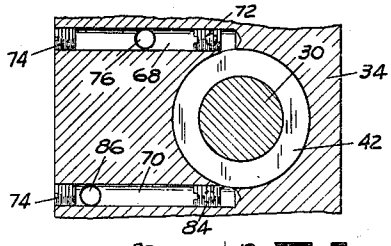


Fig. 6.

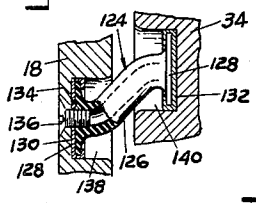


Fig. 7.

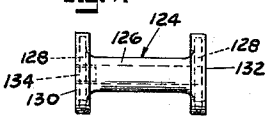


Fig. 8.

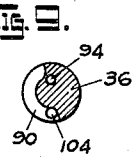


Fig. 10.

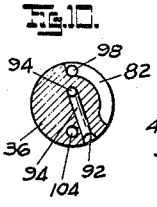


Fig. 11.

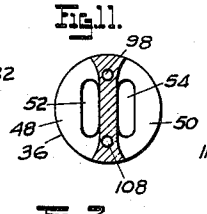


Fig. 9.

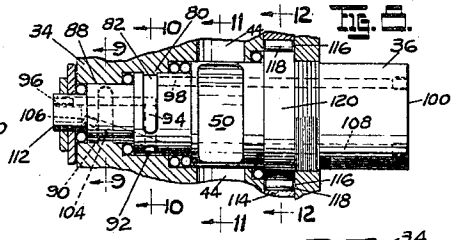


Fig. 1.

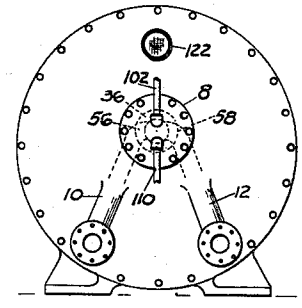


Fig. 2.

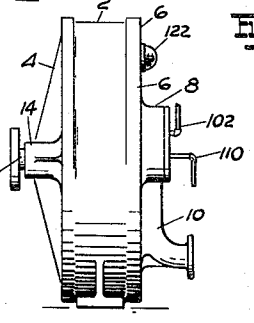
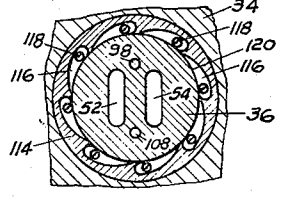


Fig. 12.



INVENTOR.

Adolph F. Graf von Soden

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ROTARY UNIT FOR VACUUM, AIR PRESSURES AND FLUID CIRCULATION

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6 Claims. (Cl. 103—161)

This invention relates to apparatus, such as piston type rotary pumps and power units, and in particular to devices having means for providing elastic fluid circulation, also for providing air pressures and for simultaneously removing air from vacuum chambers or the like, in a continuous operation and without fluid pulsations, during the operation of said apparatus.

Manifestly, an object of the invention is to provide a rotary type unit or apparatus, said apparatus having a suitable housing wherein a balancing member and a multi-piston and cylinder unit are rotatably mounted, said cylinder unit being held in a suitable off center position for providing reciprocal piston action in their respective cylinder chambers, said chambers having fluid passages provided therein for maintaining a continuous circulation of fluid, air, including for drawing vacuum, during each action of each piston unit and when the apparatus is in operation.

A further object of the invention is to provide said cylinder chambers of the apparatus with means for securing a simultaneous circulation of the fluid and for drawing vacuum, each operation or action of the respective piston being independent of the other piston or pistons, at full capacity and volumetric volume of each piston, and without interfering with the respective actions of the piston actions.

Another object of the invention is to provide each cylinder chamber with a combination of a piston and plunger member, each of which actuating independently of the other and each having means for directing the fluid and the elastic fluid in and out of the respective piston and plunger chambers, and specifically for creating vacuum, air pressure and fluid circulation without interfering with any of the respective actions of said pistons or plungers, and without impeding the flow of fluids during the operation of said apparatus.

A further object of the invention is to provide said apparatus with means, whereby a measurable amount or volume of the elastic fluid may be drawn from a vacuum tank, duct or the like, also, whereby a measurable amount or volume of elastic fluid may be drawn, circulated and compressed in a tank or reservoir, and whereby a measurable amount or volume of liquid fluid may be drawn and circulated to and from a source of supply, and within each single action of the piston and plunger, during the operation of the apparatus.

Another object of the invention is to provide said apparatus with suitable counter-action means, for preventing a counter revolution of the cylinder unit in respect to the revolution of the balancing member.

A further object of the invention is to provide said apparatus with means for preventing a counter revolution of the cylinder unit with respect to the required revolution of the balancing member thereof, and for maintaining a relative revolution of the respective members in one direction, or in any direction when so desired.

Another object of the invention is to provide said apparatus with a combined piston and plunger member, of which said plunger member being slidably mounted and passing through said piston member, having means for actuating said plunger and piston members independently of the other, and having means for holding both, the plunger and the piston members in a singular pivotal and reciprocal position, during the operation of said apparatus.

The invention also has for its objects to provide such means that are positive in operation, convenient in use, easily installed in a working position and easily disconnected therefrom, economical in manufacture, relatively simple, and of general superiority and serviceability.

The invention also comprises novel details of construction and novel combinations and arrangements of parts, which will more fully appear in the course of the following description.

Reference is had to the accompanying drawings in which the similar reference characters denote the same parts.

In the drawing;

Fig. 1 shows a front elevational view of the elastic fluid flow control unit.

Fig. 2 shows the side elevational view thereof, taken from the left of Fig. 1.

Fig. 3 shows an enlarged vertical sectional view of the apparatus, disclosing the component parts thereof, taken on the line 3—3 of Fig. 4.

Fig. 4 shows a vertical sectional view of the apparatus, taken on the line 4—4 of Fig. 3.

Fig. 5 shows a fragmentary and horizontally sectional view of the plunger and piston combination, disclosing the cylinder chamber, and disclosing the inlet and outlet controlling valves for vacuum and fluid pressure, taken on the line 5—5 of Fig. 4.

Fig. 6 shows a vertical and a fragmentary sectional view of the rotation control and stabilizing unit, slightly enlarged and taken in the same position as shown in Fig. 4 showing the same in a modified form.

Fig. 7 shows the elevational view of the rotation control and stabilizing unit, when in normal position.

Fig. 8 shows a fragmentary and elevational view of the cylinder unit mounting bar, showing same in a modified form.

Fig. 9 shows a vertically sectional view of the fluid pressure passages, disposed in cylinder unit mounting bar, taken on lines 9—9 of Fig. 8.

Fig. 10 shows a vertically sectional view of the cylinder unit mounting bar, disclosing the vacuum passages, and taken on lines 10—10 of Fig. 8.

Fig. 11 shows a vertically sectional view of the cylinder unit mounting bar, disclosing the fluid circulating passages, taken on lines 11—11 of Fig. 8.

Fig. 12 shows a fragmentary vertically sectional view of the cylinder unit counter rotation control member, showing same in modified form and taken on lines 12—12 of Fig. 8.

Describing the invention more in detail, in its broader aspects, said invention comprises a housing 2 forming a shell, having a front end cover section 4 and a rear cover member 6 mounted thereon.

Said rear cover member 6 is provided with a mounting hub 8 which is disposed in an off center position, also having a pair of fluid passages 10 and 12 adapted for fluid circulation, each passage extending outwardly from said hub 8 and extends downwardly, as shown in Figs. 1 and 2, and terminating with pipe mounting flanges, while said passages 10 and 12, which may be used for either fluid inlet or outlet purposes, are merging internally in said hub 8, the purpose of which will be presently described.

A main bearing 14 is provided in said front end cover section 4 wherein a main shaft 16 is rotatably mounted, said shaft having a balancing member 18 at one end which extends to said housing 2. Said balancing member having a rim section 20 extending transversely, as shown in Fig. 4, which is provided with a plurality of uniformly spaced boss members 22, each of which having a connecting crank rod unit 24 pivotally connected thereto, each crank rod unit extending centripetally from its pivoted position.

Each of said connecting crank rod units 24 being pro-

vided with a suitable plunger and piston connecting members 26 and 28, to which a suitable plunger member 30 and a piston member 32, respectively, are pivotally connected, as shown in Fig. 3.

Within said housing 2 and beneath said balancing member rim section 20, a cylinder unit 34 is held in place and revolubly mounted upon a cylinder mounting bar member 36. Said cylinder unit is provided with a plurality of chambers 38, the number of which corresponds to the number of said crank rod units 24, each chamber 38 comprises a plunger chamber 40 and a piston chamber 42. Each of said plunger chambers 40 is provided with a passage 44 terminating at the cylinder unit center opening 46, which is adapted for receiving said cylinder mounting bar member 36 and on which said cylinder unit 34 is rotatably mounted.

Said mounting bar 36 is provided with a pair of suitable side outlets 48 and 50, each having a connecting passage 52 and 54 which extend to and terminate at the fluid passages 56 and 58 disposed in said mounting hub 8 and interconnecting said fluid passages 10 and 12, respectively.

It may be noted, that each of said plunger members 30 is slidably mounted within the respective piston member 32, also, that each is pivotally connected to the respective connecting members 26 and 28 of said crank rod units 24, and that each of said plunger members 30 and said piston member 32 is slidably mounted within said plunger chamber 40 and said piston chamber 42 respectively.

During the rotation of said cylinder unit 36, for example in a clockwise direction and caused by means of fluid flow or air pressure supplied to and through said fluid passage 10, the pressure or force impressed upon the respective plunger members 30 while flowing through said side outlet 48, passes into said passage 44 and against the respective plunger members 30 into said chambers 40, and because said cylinder unit 36 is held in an off center position, the plunger action causes said cylinder unit 36 to turn to the right, allowing said passages 44 to pass over the opposite side of the side outlet 50, the downward action of the respective plungers cause each plunger chamber 40 to empty its contents through said passages 44 and said side outlet 50, flowing through the connecting passage 54 and the passage 58, then discharging into and through said passage 12.

In the manner above described, when applying fluid flow or pressures into said passage 12, the cylinder unit 34 will assume an opposite reaction, and the revolution thereof will be in an anti-clockwise direction.

It may then be noted, that when using fluid flow or air pressure as the source of supply, the apparatus will function as a prime mover or a motor.

When however, a motive power, such as electric motor or the like is connected to said main shaft 16, for actuating the component parts of the apparatus, the fluidal passage and circulation being identical as herein before described, then the apparatus will function as a pumping unit.

In order to prevent a counter action or counter rotation of said cylinder unit 34 with respect to the rotation of said balancing member 18, and for providing stability therebetween, a plurality of stabilizing members 60 are provided, as shown in Figs. 3 and 4.

Said stabilizing member 60 comprises a crank member 62 which is disposed in close proximity to the inner surfaces of said balancing member 18 and said cylinder unit 34, each crank member 62 having an oppositely positioned crank pin 64 at each side, each crank pin being rotatably mounted within a suitable bushing 66, and each bushing being secured within their respective recesses, as shown.

In best practices, the number of stabilizing members 60 correspond to the number of cylinder chambers 38 in said cylinder unit 34.

Said bushings 66 may, if so desired, be made of suitable material for preventing excessive friction, or, said bushings may be made out of suitable elastic material such as hard rubber or resilient compound, so that the diametrically opposite and dimensional discrepancies need not be too accurate or precise, and thereby facilitating the process of manufacture.

Since each plunger member 30 is slidably mounted in each piston member 32, and each performing independently of the other in their respective plunger chambers 40 and said piston chambers 42, and although the crank action of said crank rod unit 24 provides a longer stroke for each plunger member 30, nevertheless, said plunger chambers 40 are entirely insulated and do not interfere with the performances or functions of the piston members 32 and the respective piston chambers 42.

The lowermost section of each piston chamber 42 is provided with a suitable inlet and outlet passages 68 and 70, respectively, each of said passages inter-connecting said chambers and each being suitably disposed in a diametrically opposite position of each other, as shown in Fig. 5.

Said passage 68 is provided with a suitable flow control check valve 72, which in its preferred position being located in close proximity to the chamber bottom section, also, said passage 68 having a suitable closure member 74 such as a plug or the like, and having a connecting passage 76 which inter-connects said passage 68, as shown in Fig. 5, the upper end of said passage 76 being enclosed by means of a suitable plug member 78, see Fig. 3, while the lowermost end or opening of said passage 76 terminating at the intake section 80, which is disposed at the junction of said mounting bar 36 and disposed in a position for inter-connecting with the intake groove 82.

Further, the outlet passage 70 of said chamber 42 is provided with an exhaust flow control check valve 84, which is mounted in close proximity to the bottom section of said chamber, also, said passage 70 having a closure member 74, as shown in Fig. 5.

Said passage 70 having a connecting passage 86, the upper end of which is enclosed by means of a plug member 78, while the lowermost end and opening of said passage 86 terminates at the exhaust section 88 disposed at said mounting bar 36 and inter-connecting a suitable exhaust groove 90, as shown.

The intake section 80 of said mounting bar 36, having said intake groove 82, is also provided with a suitable relief passage 92, see Figs. 4 and 8, which interconnects with an auxiliary passage 94 extending to the inner end of said mounting bar 36 and wherein a suitable auxiliary intake check valve 96 is mounted, the purpose and operation of which will be presently described.

Said groove 82 is provided with suitable intake passage 98 extending through said bar 36 to the outwardly extending bar end 100, having a pipe connection 102 mounted in place, as shown in Figs. 1, 2 and 4, designated by numeral 102.

Within the area of said exhaust section 88, said mounting bar 36 having said exhaust groove 90, is also provided with a suitable connecting hole 104 which connects said groove 90, said hole 104 extends internally and endwardly and the end of which is enclosed by means of a plug 106, while the opposite hole section extends to and inter-connects the exhaust passage 108, which extends to and terminates at the bar end 100 and which is provided with a suitable exhaust pipe connection 110, as shown.

It may be noted, that when said piston member 32 is drawn upwardly, by the rotative action of said balancing member 18 and said cylinder unit 34, a suction action is created in said piston chambers 42, which causes said check valve 84 to close in each chamber, and allowing

the elastic fluid to pass from said pipe connection **102** into said intake passage **98**, then flowing through said intake passages **76** and **68**, and then through said check valve **72** into each piston chamber **42**.

Said check valve **72** provides the exhaust checking action when said piston members **32** are forced downwardly and into their lowermost downward stroke positions.

Also, it may readily be noted, that when said check valves **72** are closed, the downward piston strokes cause the elastic fluid contained in said piston chambers **42** to be forced through the exhaust check valves **84**, and then into said passages **70** and **86**, said fluid flowing into said groove **90** and passing into and through said connecting hole **104** leading into exhaust passage **108**, then into and through said pipe connection **110**.

Said pipe connection **102** may, if so desired, be connected to a suitable vacuum tank or chamber (not shown), from which the elastic fluid may be drawn and directed into the exhaust pipe connection **110**, and then to a suitable pressure tank or accumulator (not shown).

In order to overcome the shortage of elastic fluid when said vacuum chamber reaches the maximum lowest level, during the rotation of the apparatus, that is, when all the air is drawn therefrom and the vacuum producing piston strokes are in operation, the return or downward strokes of said piston members **32** produce a fluid pressure for said passing elastic fluid, while the upward piston strokes are moving in nearly empty or exhausted piston chambers **42**, the downwardly extending openings of said connecting passages **76** are carried over said intake groove **82** and then over said relief passage **92**, shown in Figs. 4, 8 and 10.

The positional movement of said fluid carrying passages **76** over said relief passage **92** causes the intake check valve member **96** to open in said inwardly extending bar end **112**, because of partial vacuum created in the respective cylinder chambers **42**, thus allowing the elastic fluid to be drawn from the interior of said housing **2**, and for allowing said elastic fluid to pass into the auxiliary passage **94**, thereby re-filling the empty space of each of said piston chambers **42**.

By carrying over said intake ports of each of said piston chambers **42** after each chamber is re-filled, the exhaust ports of said connecting passages **86** are directed into said exhaust groove **90**, thus in the downward stroke of said piston members **32** the elastic fluid contained in each piston chamber **42** is forced past the check valve **84** into said connecting passages **86** and then through said connecting hole **104** into said exhaust passage **108**, and through the exhaust pipe connection **110** into the pressure tank or chamber (not shown).

As shown in Fig. 8, including said Figs. 9, 10 and 11, the cycle of operation and flow of the fluids as directed to Figs. 3 and 4 is the same, the structure of said cylinder mounting bar **36** in Fig. 8 is disclosed in modified form as compared with the mounting bar **36** shown in Figs. 3 and 4, in which the inwardly extending bar end **112** is smaller in diameter, retaining however, the identical operational characteristics of the apparatus, as previously described.

Said mounting bar **36** as shown in Fig. 8 in modified form, discloses an outwardly extending bar end **100** provided with a rotation controlling ring section **114**, which is firmly secured in place in said cylinder unit **34**, having a plurality of tapered apertures **116**, as shown in Fig. 12, each of which being provided with a suitable roller member **118** and each of which being independently disposed and rotating freely in each of said apertures and resting upon a bar collar member **120**.

When said cylinder unit **34** is caused to rotate in a clockwise direction, each roller member **118** slides freely within each of said apertures **116**, thus causing said balancing member **18** and said cylinder unit **34** to revolve in unison and in the same direction, and preventing a counter rotation of the respective members of the apparatus.

When using said device, consisting of said rollers **118**, for controlling the counter rotation of the respective members of said apparatus and in the manner herein described, the rotation stabilizing members **60**, as shown in Figs. 3 and 4, and as shown in Figs. 6 and 7, need not be used, because the counter action of rotation of said cylinder unit **34** is prevented when said roller members **118** are wedged in their respective apertures **116**.

In this manner the apparatus may operate in one direction, however, suitable arrangements and a second reversibly positioned aperture ring member **114** may be provided in said apparatus, so that the rotation of said balancing member **18** and said cylinder unit **34** may be had, and also, that suitable control therefor may be provided and operable externally of said apparatus, so that the rotation of the respective parts or unit, in either direction, may be secured.

In order to provide sufficient volume of elastic fluid within said housing **2**, when it may be necessary to rely upon outside source of elastic fluid supply, and when the vacuum is drawn to its lowest level by means of said piston members **32**, and when the volume of air in said housing **2** is not sufficient for adequate re-filling said piston chambers **42**, a suitable breather member **122** is provided in said housing, as shown in Figs. 2 and 4, so that a continuous operation of the apparatus at full capacity may be had, and a sufficient air supply for the pressure tank (not shown) may be maintained.

In Figs. 6 and 7 is shown a modification of the stabilizing unit, comprising a resilient spool, generally designated by numeral **124**, having a body member **126** and a pair of flared out end sections **128**, which may be square or round, and which are enclosed within suitable retainers **130** and **132**.

The retainer **130** is provided with a threaded hole **134** which is adapted for receiving a suitable fastening member **136** such as screw or the like, and for holding said retainer together with the respective spool end within a suitable recess **138**, said recess being disposed in said balancing member **18**, as shown in Fig. 6, while the other end of said spool **124** including said retainer member **132** is held in suitable recess **140**, which is disposed within said cylinder unit **34**, as shown.

Obviously it may be noted, that the counter rotation of the respective parts, which are the balancing member **18** and said cylinder unit **34**, may be eliminated when employing said stabilizing unit **124** and when said cylinder unit is held in an off center position, as hereinbefore described and for the purposes intended.

Moreover, when said apparatus is in operation, said plunger chambers **40** and the respective plunger members **30** may be used and operable in and for drawing vacuum from vacuum chambers, and at the same time, said piston chambers **42** and their respective piston members **32** may be used for circulating fluids or other uses.

Also, that the diametrical structure of said pistons and plungers and their respective chambers may be made of suitable dimensions, whereby diversified combinations and proportions of fluid flow and combinations thereof, such as fluid and air, may be had.

While this invention thus described and illustrated is regarded with great particularity it will be clear that the same may be modified throughout a wide range. Accordingly, it is not proposed that this invention be limited to the exact details of construction herein shown and described in the specification, but that a reservation of the right in practice is made for making the necessary changes and modifications therein, which may come within the scope of the appended claims.

Having thus described the invention, what is claimed and desired to secure by Letters Patent is:

1. In the apparatus of the class described, comprising, a housing having open ends, a front end cover section

mounted at one end of said housing having a bearing centrally positioned, a rear cover member mounted at the other end of said housing, a mounting hub in said rear cover member disposed in an off-center position with relation to the centrally positioned bearing of said front end cover section, a balancing member in said housing having a shaft mounted in said centrally positioned bearing of said front end cover section, a rim section in said balancing member and terminating at said rear cover member, a plurality of crank rod units pivotally mounted in said rim section and extending centripetally therefrom, a combined piston and plunger member slidably mounted one within the other and connected to each of said crank rod units; a cylinder mounting bar securely mounted in said mounting hub of said rear cover member and having the end thereof extending into said balancing member rim section, a cylinder unit rotatably mounted on said extended end of said cylinder mounting bar and positioned within said rim section of said balancing member, a plurality of combined piston and plunger chambers in said cylinder unit converging at the diametrical center thereof for receiving said combined piston and plunger members and for holding same in slidable position therein, a passage in each plunger chamber terminating at the cylinder unit center opening section and adjacent to the outer surface section of said cylinder mounting bar, a pair of passages in each piston chamber extending to and connecting grooves at said cylinder mounting bar, a check valve in each of said passages for controlling elastic fluid flow into each of said piston chambers, a pair of oppositely positioned side outlets in said extended end of said cylinder mounting bar for connecting said passages in said plunger chambers, a pair of connecting passages in said cylinder mounting bar extending from said side outlets and terminating at said mounting hub of said rear cover member, a pair of side passages in said mounting hub for inter-connecting said extended connecting passages in said cylinder mounting bar and for connecting the fluid inlet and outlet in said rear cover member, a pair of passages extending through the length of said cylinder mounting bar and connecting said grooves therein for connecting the passages directed to said piston chambers, a pair of pipe connections connecting said last mentioned pair of passages in said cylinder mounting bar and extending through said mounting hub of said rear cover member, an auxiliary passage in said cylinder mounting bar for connecting one of said passages directed to said piston chambers, a check valve in said auxiliary passage for controlling air passage passing therethrough, a breather member in said rear cover for supplying air into said housing and said auxiliary passage, and a plurality of stabilizer members mounted upon the inner sides of said cylinder unit and said balancing member for maintaining a uniform rotating position of said cylinder unit and said balancing member, during the operation of said apparatus and when simultaneously pumping vacuum, providing air pressure and circulating fluid therethrough.

2. In the apparatus of the class described as disclosed in claim 1, wherein a controlling ring means is mounted upon said cylinder mounting bar for supporting said cylinder unit and for securing one direction rotation of said cylinder unit when said apparatus is in use and operation.

3. In the apparatus of the class described, comprising, a housing having a front and a rear cover attached thereto, a balancing member means having a shaft and revolubly disposed within said housing, a mounting bar means stationarily mounted in said rear cover having one end inwardly extending into said housing and secured in an off center position with respect to the rotationary center of said balancing member, a cylinder unit revolubly mounted upon said inwardly extending mounting bar means and disposed in close proximity to said balancing member, a plurality of plunger and piston chamber means in said cylinder unit, a plurality of connecting crank rod unit means pivotally connected to the rim of said balancing member means and extending centripetally therefrom, a combination of plunger and piston means slidably positioned one within the other and pivotally connected to each of said crank rod unit means and also slidably positioned within the respective plunger and piston chamber means of said cylinder unit, a plurality of fluid inlet and outlet means in said mounting bar means and connecting each of said plunger and piston chamber means, for directing and for controlling the fluid flow into and out of said plunger and piston chamber means and out of said housing, during the operation of said apparatus.

4. In the apparatus of the class described, comprising, a housing having a front cover and a rear cover attached thereto, a balancing member means having a shaft which is revolubly mounted in said front cover and the balancing member being disposed in said housing, a mounting bar means stationarily mounted in said rear cover disposed in an off center position with respect to the center of said balancing member means and extending internally into said housing, a cylinder unit means revolubly mounted upon said internally extending mounting bar means and positioned in close proximity to said balancing member means, a plurality of combination plunger and piston chamber means centripetally positioned in said cylinder unit means, a plurality of connecting crank rod unit means pivotally connecting said balancing member means and extending into each of said combination plunger and piston chamber means, a combined plunger and piston means slidably positioned one within the other also slidably mounted within each of said combination plunger and piston chamber means and pivotally connected to each of the respective connecting crank rod unit means, a fluid passage means in each of said plunger chamber means extending to and terminating at said mounting bar means, a pair of air passages in each of said piston chamber means and extending to said mounting bar means, a check valve in each of said air passages, a plurality of passages in said mounting bar means for connecting said fluid passage means of said plunger chamber means and independently connecting said pair of air passage means, an auxiliary air passage means in said mounting bar means and connecting one of said air passages of said piston chamber means, said fluid and air passage means being for directing the fluid circulation, also air pressures and vacuum through said apparatus and in one single operation, and during the operation thereof.

5. In the apparatus of the class described, as disclosed in claim 4, wherein means are provided in said mounting bar means and directed to one of said air passage means and said auxiliary air passage means, for supplying air flow into each of said piston chamber means and when the vacuum created by the action of said piston means reaches the lowest maximum level, and thereby providing air pressure therein, during the operation of the apparatus.

6. In the apparatus of the class described, as disclosed in claim 4, wherein a plurality of counter rotation stabilizing means are provided in said apparatus for preventing a counter rotation of said cylinder unit means with respect to the rotation of said balancing member means, during the rotation of said apparatus.

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