A diaphragm pumping device includes a housing having a partition to form two chambers and two ports communicating with the respective chambers for receiving a fluid, one or more bladders attached to the housing and communicating with the chambers of the housing respectively, and an actuating device for actuating the bladder to force the fluid to flow between the chambers of the housing via the bladders. One or more check valves may be disposed between the bladder and the chambers of the housing to control the flowing direction of the fluid. The housing and the bladders may be acted as a silencer for reducing the noises that may be generated by various pumping devices.
DIAPHRAGM PUMPING DEVICE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a diaphragm pumping device, and more particularly to a diaphragm pumping device for vacuuming or air pumping purposes, and having one or more silencers for reducing noises that may be generated by the pumping device.

[0003] 2. Description of the Prior Art

[0004] Typical air pumping devices or air compressors comprise a piston slidably received and engaged in a cylinder housing, and a motor driving device coupled to a piston rod for moving or driving the piston to move in reciprocating action within the cylinder housing, in order to generate and to supply a pressurized air to inflate various objects.

[0005] For example, U.S. Pat. No. 5,215,447 to Wen discloses one of the typical mini-type air compressors comprising a motor having a driving axle connected with a driving gear, for coupling to and for moving or driving the piston to move in reciprocating action within the cylinder housing via an eccentric member. However, a great noise will be generated when the piston is moved in a great speed relative to the cylinder housing.

[0006] U.S. Pat. No. 5,358,385 to Wang discloses a typical dual diaphragm pump with adjustable discharge side pressure trip switch comprising a dual piston device coupled to a motor driving device via an eccentric transmission device for generating and supplying a pressurized air to inflate various objects. However, the movement and thus pumping operation of the disk shaped suction disk is limited.

[0007] U.S. Pat. No. 6,413,056 to Chou discloses another typical air compressor comprising a motor coupled to a fan device for moving or driving the fan device to pump the air and to generate and supply a pressurized air to various objects. However, similarly, a great noise will also be generated by the fan device when the fan device is operated or driven by the motor.

[0008] The present invention has arisen to mitigate and/or obviate the afore-described disadvantages of the conventional diaphragm pumping devices.

SUMMARY OF THE INVENTION

[0009] The primary objective of the present invention is to provide a diaphragm pumping device for being actuated or operated by electric actuating device, and for vacuuming or air pumping purposes.

[0010] The other objective of the present invention is to provide a diaphragm pumping device including one or more silencers or silencing devices for reducing noises that may be generated by the pumping device.

[0011] In accordance with one aspect of the invention, there is provided a diaphragm pumping device includes a housing including a partition provided therein, to separate an inner portion of the housing into a first chamber and a second chamber, the housing including at least one first port provided thereon and communicating with the first chamber thereof, and including a second port provided thereon and communicating with the second chamber thereof, for receiving a fluid, at least one bladder attached to the housing, and communicating with the first chamber and the second chamber of the housing, and an actuating device for actuating the bladder to force the fluid into or out of the second chamber of the housing via the second port, and then into or out of the first chamber of the housing, and to flow into or out through the first port of the housing.

[0012] The housing includes a first check valve attached thereto and disposed between the bladder and the first chamber of the housing, and arranged to allow the fluid to flow from the bladder into the first chamber of the housing only, and to prevent the fluid from flowing backward from the first chamber of the housing into the bladder, and includes a second check valve attached thereto and disposed between the bladder and the second chamber of the housing, and arranged to allow the fluid to flow from the second chamber of the housing into the bladder only, and to prevent the fluid from flowing backward from the bladder into the second chamber of the housing.

[0013] The housing includes a first cavity and a second cavity formed therein and communicating with the first and the second chambers of the housing respectively, the first and the second check valves each includes a shank extended therefrom, for engaging through the housing, and each includes a ratchet catch provided on the shank for engaging with the housing, to anchor and secure the first and the second check valves to the housing, and each includes a blade provided on the shank for engaging with the housing, and for selectively blocking the first and the second cavities of the housing respectively.

[0014] The housing includes two annular depressions formed therein and communicating with the first and the second cavities of the housing respectively, to form two peripheral bulges which are located around the first and the second cavities of the housing respectively, and provided for engaging with the blades of the first and the second check valves respectively.

[0015] The actuating device includes an arm attached to the bladder, and device for operating the arm to depress and to expand the bladder, in order to force the fluid to flow to or from the second port of the housing toward the first port of the housing.

[0016] The operating device includes a magnetic member attached to the arm, and an electromagnetic device to actuate the magnetic member to operate the arm. The housing includes a retainer provided thereon, and the arm includes a first end pivotally coupled to the retainer of the housing, and a second end having the magnetic member attached thereto.

[0017] An outer receptacle may further be provided, and a container may further be provided and disposed in the outer receptacle, to support the housing in the outer receptacle. The container includes at least one cushioning member disposed between the container and the outer receptacle, to cushion the container.

[0018] The housing and the bladder may also be used or acted as a silencer for coupling to various pumping devices and for reducing or decreasing the noises that may be generated by the pumping devices.

[0019] Further objectives and advantages of the present invention will become apparent from a careful reading of the
detailed description provided hereinbelow, with appropriate reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] FIG. 1 is a partial exploded view of an air compressing assembly having a diaphragm pumping device in accordance with the present invention;

[0021] FIG. 2 is another partial exploded view illustrating the diaphragm pumping device;

[0022] FIG. 3 is a further partial exploded view of the diaphragm pumping device;

[0023] FIG. 4 is a still further partial exploded view of the diaphragm pumping device;

[0024] FIG. 5 is a still further partial exploded view of the diaphragm pumping device;

[0025] FIG. 6 is a partial perspective view of the diaphragm pumping device;

[0026] FIG. 7 is a cross sectional view of the diaphragm pumping device, taken along lines 7-7 of FIG. 6;

[0027] FIG. 8 is a cross sectional view similar to FIG. 7, illustrating the other operation of the diaphragm pumping device which is acted as a silencer;

[0028] FIGS. 9, 10 are cross sectional view similar to FIGS. 7 and 8, illustrating the operation of the diaphragm pumping device as an air pumping device; and

[0029] FIGS. 11, 12, 13-are partial perspective views similar to FIG. 6, illustrating other arrangements of the diaphragm pumping device.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0030] Referring to the drawings, and initially to FIG. 1, an air compressing assembly 10 in accordance with the present invention comprises an outer receptacle 11 including such as two members 12, 13 or a base member 12 and an upper member 13 to be secured together with fasteners (not shown), or by welding processes, and including a plug 14 for coupling to an electric energy source and for receiving an electric energy to energize the air compressing assembly 10.

[0031] Referring next to FIGS. 2-4, and again to FIG. 1, the air compressing assembly 10 further includes a container 20 disposed in the outer receptacle 11 for receiving a diaphragm pumping device 30 therein. It is preferable that the outer receptacle 11 includes a number of pads or cushioning legs or members 21 (FIG. 2) disposed between the container 20 and the outer receptacle 11 for cushioning the container 20 and the diaphragm pumping device 30 and for reducing a vibration of the container 20 and the diaphragm pumping device 30 relative to the outer receptacle 11.

[0032] As shown in FIGS. 1 and 3-4, the container 20 may include a large chamber 22 formed therein for receiving the diaphragm pumping device 30 therein, and a cover 23 attached or secured onto the container 20 for enclosing the chamber 22 of the container 20. Alternatively, as shown in FIG. 2, the chamber 22 of the container 20 may include a relatively smaller volume and enclosed with a larger hous-
partment 62 formed therein (FIGS. 5, 7-10) and arranged or located between the bladders 60 and the casings 50 respectively, and the bladders 60 are deformable or compressible and expandable to force air or water or fluid or liquid through the cavities 55 of the housing 4 (FIGS. 7-10), which will be discussed hereinafter. Two arms 63 are further provided and attached or coupled to the bladders 60 respectively (FIG. 2), for depressing or compressing and expanding the bladders 60 respectively.

[0039] For example, the housing 4 further includes two hooks or retainers 49 provided thereon, such as extended from the housing members 40 respectively (FIG. 2), and located close to the outlet ports 47. The arms 63 each includes a middle portion attached or coupled to the bladders 60 respectively, and one end 64 hooked or pivotally coupled to the housing 4 with the retainers 49 (FIG. 2), and the other end or the free end having a magnet or magnetic member 65 attached thereto.

[0040] An electromagnetic device 66 is attached to the housing 4, and disposed close to or beside the magnetic members 65 of the arms 63, for generating electromagnetic field or force to force or to move the magnetic member 65 toward each other, and/or away from each other, in order to actuate the arms 63 to depress or compress and expand the bladders 60 respectively, and thus to force the air or water or fluid or liquid to flow between the compartments 62 of the bladders 60 and the chambers 44, 45, of the housing 4 and/or of the casings 50. It is preferable that the electromagnetic device 66 is disposed or supported in the chamber 22 of the container 20.

[0041] Four check valves 70, 71, 72, 73 each includes a shank 74 extended therefrom, for engaging through the holes 51, 52, 53, 54 of the casings 50 respectively, and each further includes a ratchet catch 75 provided on the shank 74, for engaging through the holes 51, 52, 53, 54 of the casings 50 respectively, and for engaging with the casings 50, for anchoring or securing the check valves 70-73 to the casings 50 and between the bladders 60 and the chambers 44, 45, of the housing 4 and/or of the casings 50 respectively.

[0042] Each of the check valves 70, 71, 72, 73 includes a resilient blade 76 formed or provided on one end of the shank 74, for engaging with the peripheral bulges 57, 58 of the casings 50 respectively, and for selectively blocking or opening the cavities 55 of the housing 4 respectively, best shown in FIGS. 9, 10, in order to form the check valves 70, 71, 72, 73, and so as to control the flowing of the air or water or fluid or liquid between the compartments 62 of the bladders 60 and the chambers 44, 45, of the housing 4 and/or of the casings 50.

[0043] For example, when the magnetic member 65 is forced or moved away from each other by the electromagnetic device 66, or when the bladders 60 are expanded by the arms 63, the check valves 70, 72 may be opened by the bladders 60, to allow the air or water or fluid or liquid to flow between the bladders 60 and the chambers 44, 45, of the housing 4 and/or of the casings 50 toward the compartments 62 of the bladders 60 (FIG. 9), and thus to allow the air or water or fluid or liquid to be drawn into the chamber(s) 44 of the housing 4 and/or of the casings 50 via the ports 47 of the housing 4.

[0044] At this moment, the other check valves 71, 73 will be forced to enclose the chamber(s) 45 of the housing 4 and/or of the casings 50 by the bladders 60, to prevent the air or water or fluid or liquid from flowing backward form the chamber(s) 45 of the housing 4 and/or of the casings 50 toward the compartments 62 of the bladders 60, and thus to allow the air or water or fluid or liquid to be drawn from the chamber(s) 44 of the housing 4 and/or of the casings 50 into the compartments 62 of the bladders 60 only.

[0045] On the contrary, as shown in FIG. 10, the check valves 70, 71, 72, 73 may be disposed or arranged in the position different from that shown in FIG. 9, for allowing the check valves 70, 72 to be opened by the bladders 60 and to allow the air or water or fluid or liquid to be forced to flow form the compartments 62 of the bladders 60 toward the chamber(s) 44 of the housing 4 and/or of the casings 50 and then to allow the air or water or fluid or liquid to flow out of the housing 4 via the ports 47 of the housing 4 when the magnetic member 65 are forced or moved toward each other by the electromagnetic device 66 and when the bladders 60 are compressed by the arms 63.

[0046] At this moment, the other check valves 71, 73 will be forced to be forced to enclose the chamber(s) 45 of the housing 4 and/or of the casings 50 by the depressing or compressing or pumping force of the bladders 60, to prevent the air or water or fluid or liquid from flowing backward form the compartments 62 of the bladders 60 toward the chamber(s) 45 of the housing 4 and/or of the casings 50, and thus to prevent the air or water or fluid or liquid from being forced to flow backwardly into the chamber(s) 45 of the housing 4 and/or of the casings 50.

[0047] In operation, the air or water or fluid or liquid may be drawn to flow into the chamber(s) 45 of the housing 4 and/or of the casings 50 via the inlet port 48 of the housing 4 (FIG. 10), and then to flow form the chamber(s) 45 of the housing 4 and/or of the casings 50 toward the compartments 62 of the bladders 60 when the bladders 60 are expanded in the configuration or arrangement as shown in FIG. 10. The air or water or fluid or liquid may then be forced to flow form the compartments 62 of the bladders 60 toward the chamber(s) 44 of the housing 4 and/or of the casings 50, and then to flow out through the ports 47 of the housing 4 when the bladders 60 are depressed or compressed, such that the air or water or fluid or liquid may be pumped to flow form the inlet port 48 of the housing 4 to the outlet ports 47 of the housing 4 by the bladders 60 step by step.

[0048] The arms 63 and the magnetic member 65 and the electromagnetic device 66 may thus be formed as an actuating means or device for depressing or compressing or pumping the bladders 60, to draw the fluid or liquid or air into one of the chambers 45 of the housing 4 and/or of the casings 50 via the inlet port 48 of the housing 4, and then to force the fluid or liquid to flow into the other chamber 44 of the housing 4 and/or of the casings 50, and then to force the fluid or liquid to flow out through the port 47 of the housing 4. The magnetic member 65 and the electromagnetic device 66 may thus be formed as an operating means or device for actuating or operating the arms 63 to depress or compress or pump or to expand the bladders 60, in order to draw and to force the fluid or liquid to flow form the port 48 of the housing 4 to the ports 47 of the housing 4.

[0049] On the contrary, as shown in FIG. 9, when the bladders 60 are depressed or compressed by the arms 63 and the electromagnetic device 66, the fluid or liquid may be
drawn and forced to flow the compartments 62 of the bladders 60 into the chambers 45 of the housing 4 and/or of the casings 50 and then to flow out through the inlet port 48 of the housing 4. The fluid or liquid may be drawn and forced to flow form the chamber 44 of the housing 4 and/or of the casings 50 into the compartments 62 of the bladders 60 when the bladders 60 are expanded by the arms 63 and the electromagnetic device 66, such that the fluid or liquid may also be drawn and forced to flow form the ports 47 of the housing 4 and the port 48 of the housing 4 by the bladders 60 step by step.

[0050] As shown in FIGS. 1-4 and 11-13, the air compressing assembly 10 may further include one or more kinds of silencers 8 having various kinds of ports 47, 48 for coupling to either or both of the ports 47, 48 of the diaphragm pumping device 10 or other kinds of pumping devices. The silencers 8 include a structure or configuration identical to the housing 4 as those shown in FIGS. 5-8, except that the silencers 8 do not include the check valves 70, 71, 72, 73 engaged into the housing members 40. The silencers 8 are provided for allowing the fluid or liquid or air to flow into or out of the ports 47, 48 of the housing 4 with a decreased noise.

[0051] For example, the silencers 8 each may also include two housing members 40 to be anchored or secured together, a partition 43 extended from the housing members 40 to separate the inner portion of the silencer 8 into two chambers 44, 45 (FIGS. 7-8), and preferably includes a narrowed neck portion 46 formed in a middle portion of the chamber 44 thereof, one or more, such as two tubes or ports 47 extended from such as the two housing members 40 and communicating with the chamber 44 thereof, and another tube or port 48 extended from one of the housing members 40, and communicating with the other chamber 45 thereof.

[0052] The silencers 8 each may also include two casings 50 oppositely protruded from the housing members 40 respectively and having the partition 43 extended from the middle portions of the casings 50 respectively, to have the casings 50 communicated with the chambers 44, 45 of the silencer 8, and further includes two holes 51, 52, 53, 54 formed in each of the casings 50, and located in different side of the partition 43, and communicating with the chambers 44, 45 of the silencer 8 respectively, and further includes a number of cavities 55 formed in each of the casings 50 and arranged around the holes 51, 52, 53, 54 of the casings 50 respectively, and also communicating with the chambers 44, 45 of the silencer 8 respectively.

[0053] In operation, as shown in FIGS. 7-8, the air or fluid flowing into or out of either of the ports 47, 48 of the silencer 8 may flow from one of the chambers 44, 45 of the silencer 8 through the compartments 62 of the bladders 60 and then into the other chambers 45, 44, of the silencer 8, such that the silencer 8 may be used to reduce or to decrease the noises that may be generated by various pumping devices. In addition, the flowing speed of the air or fluid flowing out through the narrowed neck portion 46 may be decreased such that the noises may further be reduced or decreased by the silencer 8.

[0054] It is to be noted that the silencers 8 include a structure or configuration identical to the housing 4 as those shown in FIGS. 5-8, such that the housing 4 as shown in FIGS. 5-8 may be used for the pumping purposes as those shown in FIGS. 9 and 10, or for the noise silencing purposes as those shown in FIGS. 1-4 and 11-13. It is only required to engage the check valves 70, 71, 72, 73 into the housing members 40 (FIGS. 9, 10) when the housing 4 is going to be used for the pumping purposes, such that the manufacturing for the silencers 8 and the pumping housing 4 may be simplified.

[0055] Accordingly, the diaphragm pumping device in accordance with the present invention may be actuated or operated by electric actuating device, and may be used for vacuuming or air pumping purposes, and having one or more silencers for reducing noises that may be generated by the pumping device.

[0056] Although this invention has been described with a certain degree of particularity, it is to be understood that the present disclosure has been made by way of example only and that numerous changes in the detailed construction and the combination and arrangement of parts may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

I claim:
1. A diaphragm pumping device comprising:
   a housing including a partition provided therein, to separate an inner portion of said housing into a first chamber and a second chamber, said housing including at least one first port provided thereon and communicating with said first chamber thereof, and including a second port provided thereon and communicating with said second chamber thereof, for receiving a fluid,
   at least one bladder attached to said housing, and communicating with said first chamber and said second chamber of said housing, and
   means for actuating said at least one bladder to force the fluid into or out of said second chamber of said housing via said second port, and then into or out of said first chamber of said housing, and to flow into or out through said at least one port of said housing.
2. The diaphragm pumping device as claimed in claim 1, wherein said housing includes a first check valve attached thereto and disposed between said at least one bladder and said first chamber of said housing, and arranged to allow the fluid to flow from said at least one bladder into said first chamber of said housing only, and to prevent the fluid from flowing backward from said first chamber of said housing into said at least one bladder, and includes a second check valve attached thereto and disposed between said at least one bladder and said second chamber of said housing, and arranged to allow the fluid to flow from said second chamber of said housing into said at least one bladder only, and to prevent the fluid from flowing backward from said at least one bladder into said second chamber of said housing.
3. The diaphragm pumping device as claimed in claim 2, wherein said housing includes a first cavity and a second cavity formed therein and communicating with said first and said second chambers of said housing respectively, said first and said second check valves each includes a shank extended therefrom, for engaging through said housing, and each includes a ratchet catch provided on said shank for engaging with said housing, to anchor and secure said first and said second check valves to said housing, and each includes a blade provided on said shank for engaging with
said housing, and for selectively blocking said first and said second cavities of said housing respectively.

4. The diaphragm pumping device as claimed in claim 3, wherein said housing includes two annular depressions formed therein and communicating with said first and said second cavities of said housing respectively, to form two peripheral bulges which are located around said first and said second cavities of said housing respectively, and provided for engaging with said blades of said first and said second check valves respectively.

5. The diaphragm pumping device as claimed in claim 1, wherein said actuating means includes an arm attached to said at least one bladder, and means for operating said arm to depress and to expand said at least one bladder, in order to force the fluid to flow to or from said second port of said housing toward said at least one first port of said housing.

6. The diaphragm pumping device as claimed in claim 5, wherein said operating means includes a magnetic member attached to said arm, and an electromagnetic device to actuate said magnetic member to operate said arm.

7. The diaphragm pumping device as claimed in claim 6, wherein said housing includes a retainer provided thereon, and said arm includes a first end pivotally coupled to said retainer of said housing, and a second end having said magnetic member attached thereto.

8. The diaphragm pumping device as claimed in claim 1 further comprising an outer receptacle, and a container disposed in said outer receptacle, to support said housing in said outer receptacle.

9. The diaphragm pumping device as claimed in claim 8, wherein said container includes at least one cushioning member disposed between said container and said outer receptacle, to cushion said container.

10. A silencer comprising:

   a housing including a partition provided therein, to separate an inner portion of said housing into a first chamber and a second chamber, said housing including at least one first port provided thereon and communicating with said first chamber thereof, and including a second port provided thereon and communicating with said second chamber thereof, for receiving a fluid, said housing including a casing, said partition being extended from said casing to have said casing communicated with said first and said second chambers of said housing, and said casing including a first cavity and a second cavity formed therein and communicating with said first and said second chambers of said housing respectively, and

   at least one bladder attached to said casing, and including a compartment formed therein and arranged between said at least one bladder and said casing, and communicating with said first and said second chambers of said housing, for allowing the fluid to flow between said first and said second chambers of said housing, via said compartment of said at least one bladder.

11. The diaphragm pumping device as claimed in claim 10, wherein said casing includes two holes located in different side of said partition and communicating with said first and said second chambers of said housing respectively, and first and said second cavities are arranged around said holes of said casing respectively.

12. The diaphragm pumping device as claimed in claim 10, wherein said housing includes two annular depressions formed therein and communicating with said first and said second cavities of said housing respectively, to form two peripheral bulges which are located around said first and said second cavities of said housing respectively.

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