United States Patent

Grise

[15] **3,635,607**

[45] **Jan. 18, 1972**

[54] VACUUM PUMP

[72] Inventor: **Frederick G. J. Grise**, North Brookfield, Mass.

[73] Assignee: **Novelty Tool Co., Inc.**, Spencer, Mass.

[22] Filed: **Apr. 20, 1970**

[21] Appl. No.: **29,989**

[52] **U.S. Cl.**.....**417/394**

[51] **Int. Cl.**.....**F04b 43/10**, F04b 45/00

[58] **Field of Search**.....417/394, 395

[56] **References Cited**

UNITED STATES PATENTS

1,268,780	6/1918	Jay	417/395
1,627,257	5/1927	Stevens	417/395
2,738,731	3/1956	Browne	417/394

Primary Examiner—Robert M. Walker

Attorney—Charles R. Fay

[57] **ABSTRACT**

A vacuum pump comprising a closed housing, an elastometric diaphragm in the form of a cup therein, said diaphragm having a rim, said rim being sealed into the wall of the housing, said diaphragm dividing the housing into two chambers one including the interior of the diaphragm and the other being at the exterior thereof, a constant vacuum outlet for the latter chamber and a pair of check valves which are substantially the same but reversed for the chamber at the interior of the diaphragm.

3 Claims, 4 Drawing Figures

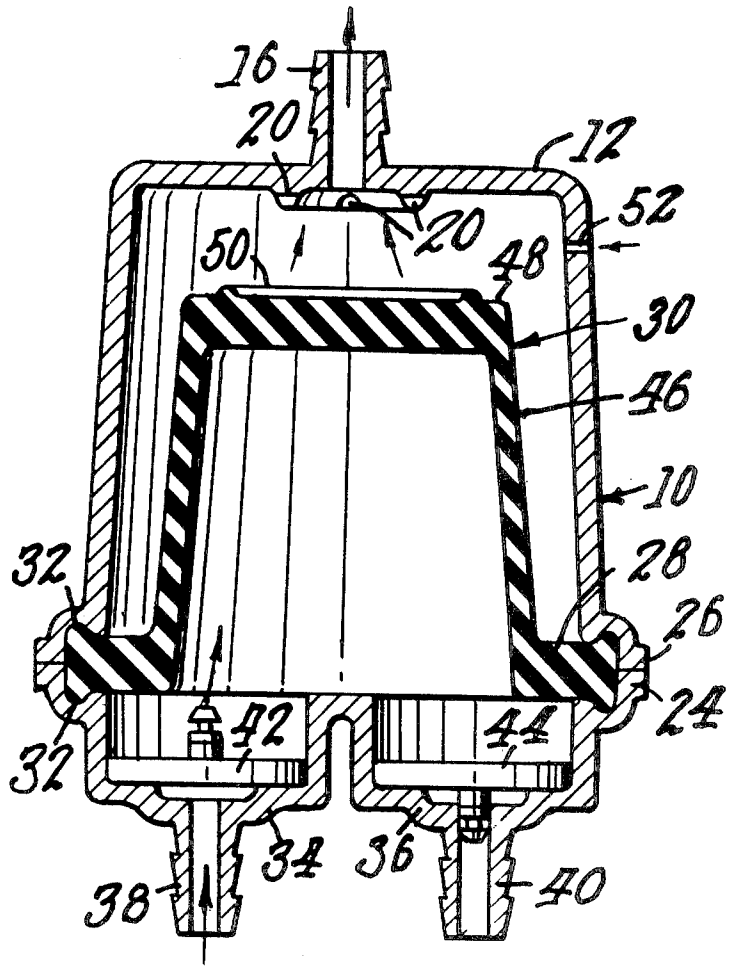


Fig. 1

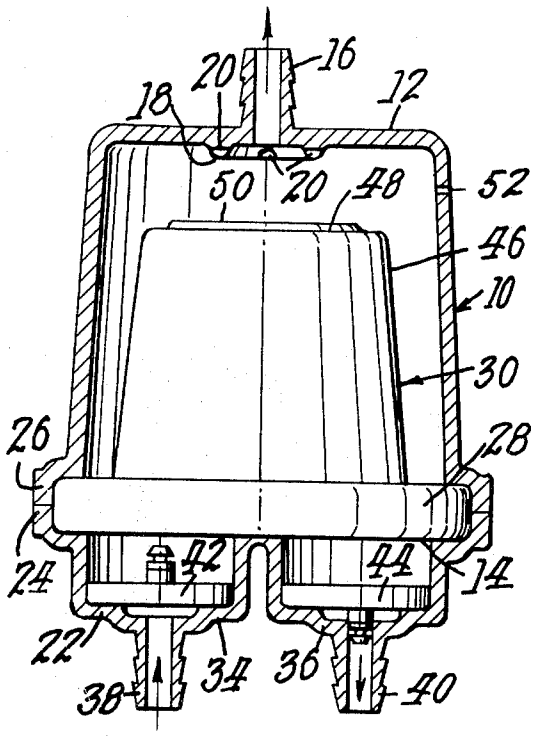


Fig. 2

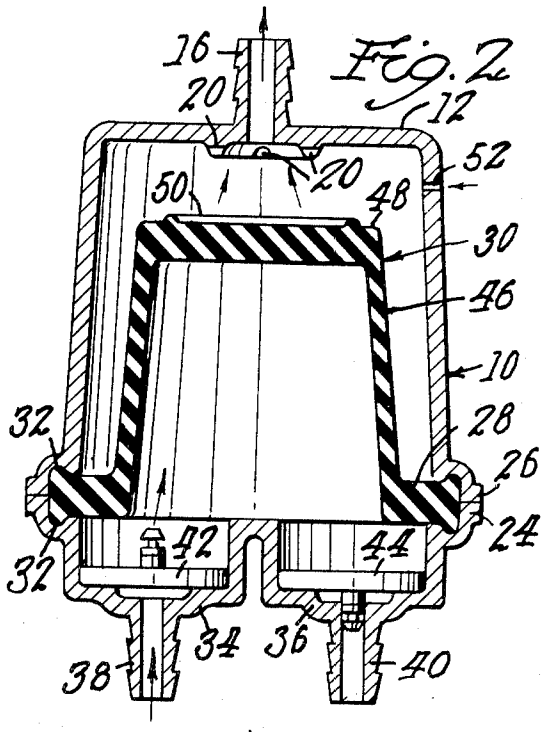


Fig. 3

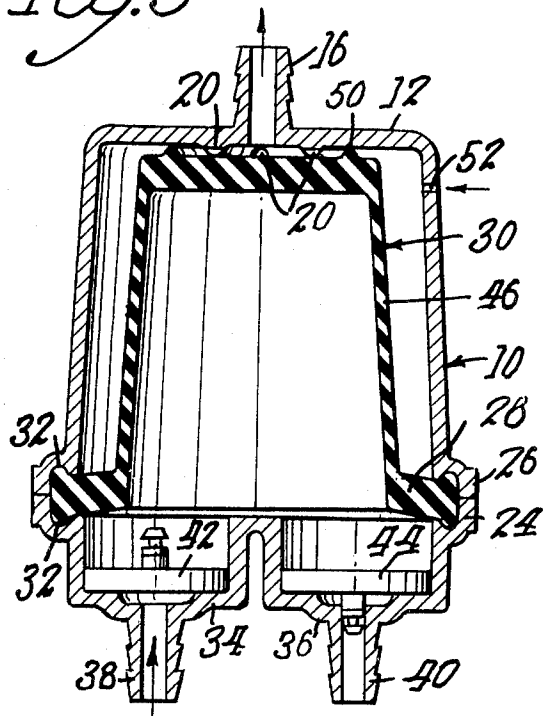
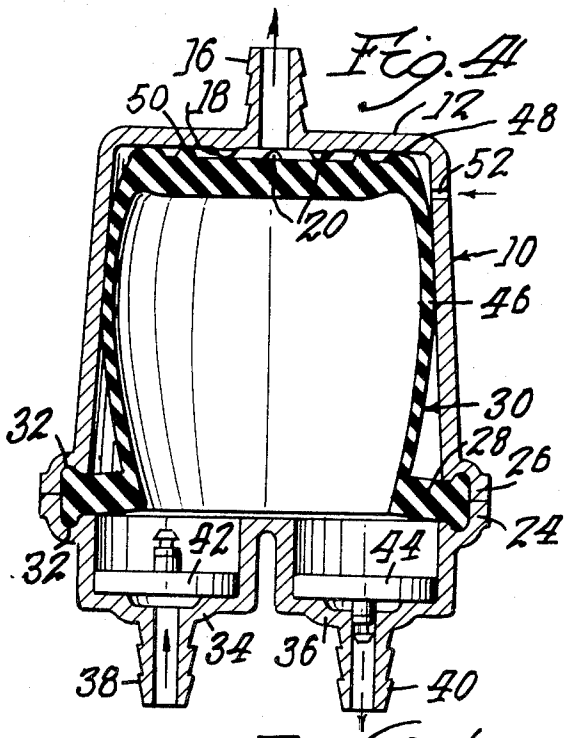


Fig. 4



Inventor
Frederick G. J. Grise'

By Charles R. Jay.
Attorney

VACUUM PUMP

BACKGROUND OF THE INVENTION

Many vacuum pumps have been provided in the prior art but in most cases they are essentially relatively complicated and require cycling mechanisms, and it is the object of the present invention to provide a vacuum pump which is extremely simple and inexpensive to make and requires no cycling mechanism.

SUMMARY OF THE INVENTION

A housing is provided, said housing being generally cylindrical and having at one end a connection for a vacuum line and at its opposite end two connections, each of the latter being provided with a check valve one of which allows intake of fluid into the housing, the other allowing fluid to be ejected from the housing under pressure. There is a cup-shaped elastometric diaphragm having a bottom extending in relatively close association with respect to the vacuum line connection and at its open end having a rim which is substantially permanently sealed into the wall of the housing adjacent the two check valves. There is a notched rim surrounding the vacuum line connection within the housing facing a projecting continuous seal on the exterior of the bottom of the cuplike elastometric diaphragm. The diaphragm divides the housing into two chambers, one at the exterior of the cup-shaped diaphragm and the other at the interior thereof, the vacuum connection being for the exterior chamber and the check valves being in the interior chamber.

There is also a small bleed hole to the atmosphere in the housing for allowing the atmosphere to enter into the housing between the exterior surface of said cuplike diaphragm and the vacuum line connection, i.e., into the exterior chamber.

The vacuum may be constant and gradually causes the diaphragm to stretch and the bottom of the diaphragm to approach the vacuum connection. When the bottom of the cuplike diaphragm reaches the notched rim circumjacent to the vacuum connection, the latter partially cuts off the vacuum connection from the exterior chamber of the housing, between the cuplike diaphragm and the inside wall of the housing. Of course atmospheric pressure has been constantly leaking into the exterior chamber in the housing through the bleed hole, but as yet the pressure does not equal the degree of vacuum. The bottom of the diaphragm is thus stopped, and the effect is that the sidewall of the diaphragm bulges until it contacts the wall of the housing about the notched rim. The bulging of the diaphragm increases the intake of fluid into the interior chamber through the intake check valve until the contact just described, which causes a definite, instant cut off of the vacuum from the housing. The pressure increases very suddenly and this has the effect of collapsing the diaphragm to its normal position, thus forcing the fluid out of the exit check valve in a spurt and under considerable pressure. The action then repeats and does so as long as the vacuum is in effect.

This action is completely continuous and the size of the bleed hole to the atmosphere and the degree of vacuum determines the actual cycling of operation of the valve and the degree of pressure with which the fluid spurts out.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in elevation illustrating the valve;

FIG. 2 is a section illustrating the valve in normal condition of the diaphragm;

FIG. 3 is a similar view illustrating the action of the diaphragm, and

FIG. 4 shows the diaphragm in its maximum stretched condition.

PREFERRED EMBODIMENT OF THE INVENTION

A main-housing part generally indicated at **10** has a closed end **12** and in the case illustrated an open end at **14**. In the closed end there is a central connection **16** for attachment to a vacuum line and surrounding this connection at the inside of the end **12** there is an annular projecting rim **18** having a series of notches **20** therein. This part of the housing is conveniently molded of clear plastic so that the action, to be described, is clearly visible.

A housing part generally indicated at **22** is provided with a rim **24** corresponding to rim **26** at the open end **14** of the housing part **10** for the purpose of substantially permanently sealing therein the outstanding rim **28** of an elastometric cup-shaped diaphragm generally indicated at **30**. The rim **28** is provided with extension ridges **32, 32** which fit into corresponding recesses in the rims **24** and **26** for the purpose of solidly gripping the rim **28** so that it cannot creep out under any circumstances. The diaphragm divides the housing into two chambers, one exterior of the diaphragm and the other exterior thereof.

The housing part **22** is provided with two annular valve holding portions **34** and **36**, each of which is provided with a connection for a tube as at **38** and **40**. Each of the annular portions **34** and **36** is provided with a check valve of conventional design, these being indicated at **42, 44**. One check valve allows only pressure inwardly through its connection into the interior of the cuplike diaphragm **30** and the other check valve allows only ejection of fluid material from the cuplike diaphragm **30**.

The cuplike diaphragm **30** has an upstanding wall **46** and a closed end portion **48** at the exterior of which there is an upstanding continuous ring **50**.

With the parts as shown in FIG. **2** and assuming a vacuum line connected at **16**, the exterior chamber between the housing **10** and the elastometric diaphragm **30** will begin to be exhausted even though a slight amount of atmospheric air leaks in through a small hole **52**. The bottom **48** of diaphragm **30** is pulled upwardly toward the source of vacuum, the diaphragm stretching, see for instance FIG. **3**, and eventually the exterior surface of the diaphragm bottom **48** contacts the rim **18**. When this happens, it is more difficult for the vacuum to extract air as this air can only pass through notches **20** inwardly from the interior of housing **10** to the connection **16**. Nevertheless the vacuum still acts on the diaphragm and since the center portion of the bottom **48** thereof cannot proceed any further upwardly, the elastometric wall **46** bulges, see FIG. **4**, until the ring **50** contacts the inside surface of the bottom **12** of the housing part **10**. At this instant, the diaphragm is substantially full of fluid.

At this instant, all of the vacuum action is cut off from the exterior chamber, i.e., between the interior wall of housing part **10** and the bulged out exterior wall **46** of diaphragm **30**, so that the atmospheric leak through the hole **52** sharply causes a relatively high pressure between the housing and the diaphragm which causes the latter to actually snap from the FIG. **4** position back to the original FIG. **2** position.

When this snap off occurs, the wall of the diaphragm as well as the bottom thereof quickly snap inwardly from FIG. **4** to FIG. **2** position, and since check valve **38** will not allow any return, some fluid in the diaphragm is expelled in a spurt or jet through the valve **44** and connection **40**.

It will therefore be seen that a pulsating action is provided for supplying fluid in seriatim jets and this action will last as long as there is a reservoir of fluid connected to connection **38** and a vacuum to connection **16**. The sealing arrangement of the rims **24** and **26** together with rim **28** prevents any dislodgment of the parts and the only moving parts are the diaphragm itself and the check valves at **42** and **44**.

Increased vacuum will cause a faster action, and varying the size of hole **52** will also affect the action, but otherwise it will be seen that an extremely simple pulsating fluid pump is provided and this pump will operate as long as the vacuum is applied and the fluid reservoir is in operation.

I claim:

1. A vacuum pump comprising a housing, a connection for admitting vacuum to said housing in one area thereof and a pair of check valves in a different area thereof, said check valves operating independently and oppositely to each other,

an elastometric diaphragm in said housing, said diaphragm being in the form of a cup having a rim, a continuous sidewall, and a closed bottom, means securing the rim of said diaphragm to said housing continuously, dividing the same into a pair of chambers, a first chamber outside the cup including the vacuum connection and a second and separate chamber inside the cup including the check valves, a small hole to the atmosphere in a wall of said housing into the first chamber,

said housing including a sidewall greater in diameter then the diameter of the cup, providing an annular space between the walls, said space being at least a part of the first chamber,

vacuum from the vacuum connection acting upon said diaphragm to cause the same to stretch toward it and the cup walls to expand toward the housing wall reducing the volume of the first chamber and thereby causing fluid material to enter into the second chamber, the bottom of the cup being constructed and arranged to substantially cutoff the vacuum relative to said first chamber to provide that the pressure entering from the atmosphere overcomes the vacuum action and causes the diaphragm to snap back from its stretched condition expelling fluid in a jet through one of the check valves.

2. The vacuum pump of claim 1 including means initially partially shutting off the vacuum and causing the bottom of the diaphragm cup to bend into contact with the housing about the vacuum connection and wholly shutting off the vacuum substantially simultaneously with the expansion of the sidewall of the cup.

3. The vacuum pump of claim 1 including a rim about the vacuum connection at the interior of the housing, the bottom of the cup coming in contact with the rim and stopping further elongation of the cup at a certain point in the stretch of the cup.

* * * * *