June 18, 1968 J. C. WHITING 3,388,682

VACUUM RESPONSIVE DEVICE

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FIG. 1.

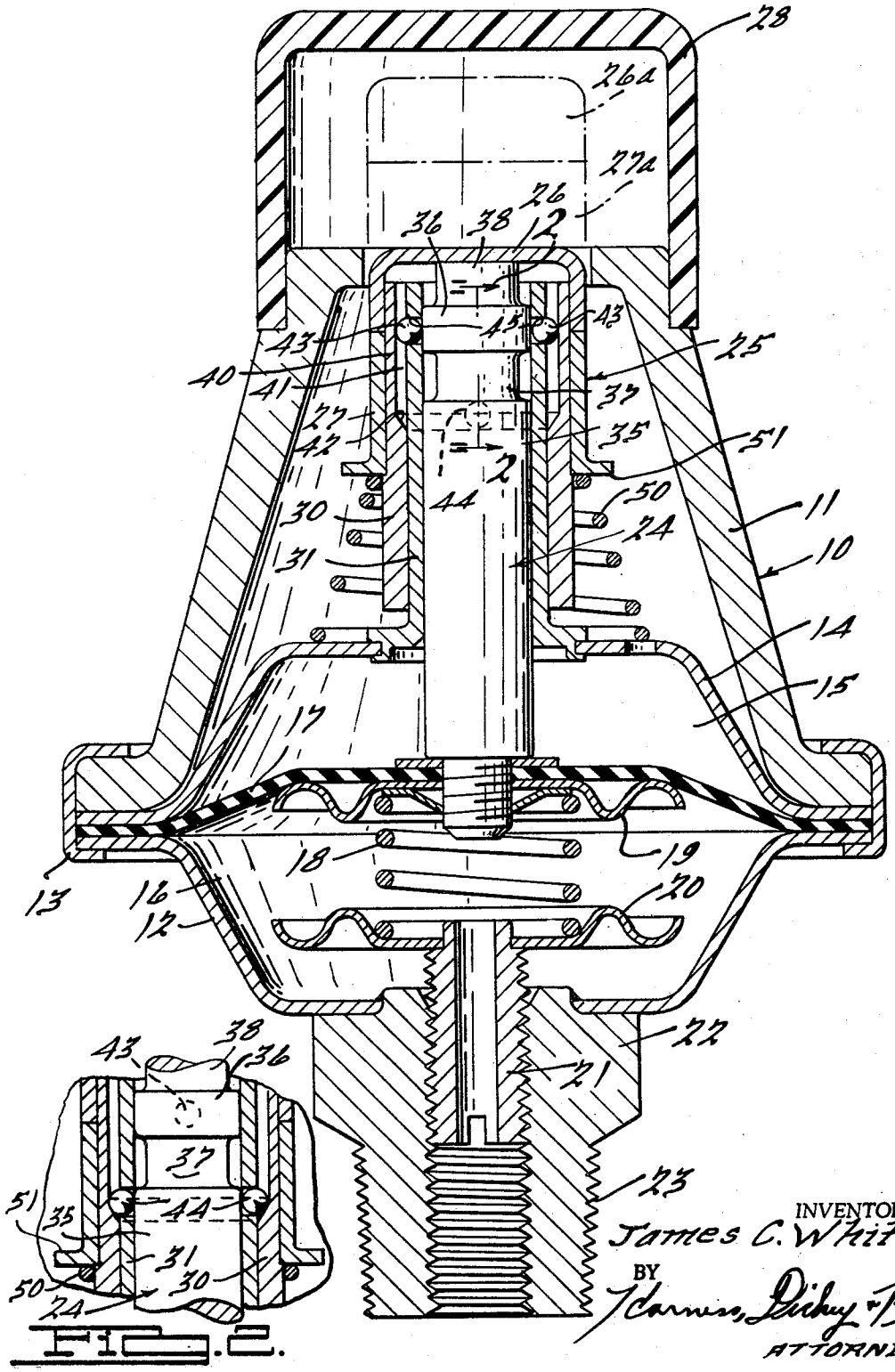


FIG. 2.

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VACUUM RESPONSIVE DEVICE

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ABSTRACT OF THE DISCLOSURE

A vacuum responsive device of the type in which a diaphragm is exposed to atmospheric pressure on one side thereof and subatmospheric pressure on its other side. The diaphragm carries a slidable stem that serves as a latch for ball detents. The ball detents lock a spring biased signal member. When the diaphragm has moved a given amount in response to a first level of subatmospheric pressure, the stem will permit movement of a first pair of ball detents out of alignment with a shoulder on the signal member so that the signal member can be moved by its spring to a first indicating position. Further movement of the diaphragm will unlatch a second pair of ball detents to permit the signal member to be biased to a second indicating position. The two indicating positions may be indicative of an incipient clog filter conditon and a completely clogged condition, respectively.

This invention relates to vacuum responsive devices of the type in which a diaphragm exposed to a subatmospheric pressure actuates a signal to indicate when the vacuum has exceeded a predetermined level.

One of the principal objects of this invention is to provide a device of this type which has a two-stage signalling function and in which two signalling media are successively presented in response to movement of a diaphragm. The movement of the signal is controlled by detents or ball-like members which are, in turn, actuated by the diaphragm.

While the commercial uses to which the present invention is adaptable are numerous and widespread, it finds particular utility in connection with the hydraulic power systems of machine tools and the like. The device may be connected between the filter of a fluid reservoir and the pump. With such an arrangement, the device will indicate if the filter or fluid supply line has become clogged up or the flow of fluid is impeded so that a correction should be made. Broadly stated, the device is useful in any vacuum or suction line where an excessive vacuum condition is to be avoided.

The various objects of this invention are attained by a vacuum device comprising a vacuum actuated diaphragm having a movable stem attached thereto which stem is adapted to control a plurality of detents. These detents control movement of the signal device in such a manner that the initial movement of the stem releases a first signal and the further movement of the stem, due to a greater vacuum, releases the second signal.

It is an important object of this invention to provide a device of this type which is so reduced in the number and character of its component parts as to approach the ultimate in structural simplicity and which creates an economy in its manufacture, installation and maintenance costs.

The various objects and advantages, and the novel details of construction of one commercially practical embodiment of the invention, will become more apparent as this description proceeds, especially when considered in connection with the accompanying drawings, in which:

FIGURE 1 is a vertical section through the device with the signal shown in operative position by dot and dash lines; and

FIGURE 2 is a detail sectional view taken substantially on the plane indicated by line 2—2 in FIGURE 1.

The device of this invention comprises a housing which is divided by a rubber diaphragm into upper and lower chambers. The upper chamber is open to atomspheric pressure and the lower chamber is placed in communication with the fluid medium on which surveillance is to be maintained. The object is to activate a two-stage signal as the level in the vacuum drops. The vacuum (subatmospheric pressure) in the lower chamber, together with the atmospheric pressure in the upper chamber, provides a differential pressure condition across the diaphragm which tends to move the diaphragm downwardly. This action is opposed by a coil spring, the tension of which is adjustable. When the spring yields, the diaphragm will move downwardly and carry with it a stem-like member which controls the signal.

The device comprises a housing **10** which consists of an upper housing member **11** and a lower housing member **12** which may be joined together in any suitable manner as, for instance, by means of a ring-like clamping member **13**. Also secured at the union between the housing members **11** and **12** is a supporting bracket-like member **14**.

The chamber indicated by the reference character **15** is open to atmospheric pressure. The reference character **16** indicates a vacuum chamber.

Located between the chambers **15** and **16** is a diaphragm **17** made of some flexible material such, for instance, as rubber. The periphery of this diaphragm is clamped between the edges of the housing members **11** and **12**, as shown.

An upward force on the diaphragm **17** is exerted by a spring **18** mounted between washers **19** and **20**, and magnitude of the force offered by the spring **18** may be adjusted in any suitable manner as, for instance, by an adjustable screw member **21** threaded into a nipple member **22** provided with threads **23** adapted to be threaded into the conduit for the fluid medium on which surveillance is to be maintained.

The diaphragm **17** is provided with a stem **24** rigidly secured thereto and adapted to move therewith. This stem **24** is adapted to control a signal device **25**. The signal device **25** is in the form of a button-like member formed in two parts **26** and **27**. In order that the extent of the movement of the diaphargm may be visually readily determined, the parts **26** and **27** of the signal device may be of different colors. For instnace, the section **26** may be formed of some yellow material and the section **27** formed of some red material. When the signal is in its operative position, illustrated in FIGURE 1, it is clearly visible through a cover **28** formed of clear plastic or some other suitable material which has a snap-on engagement with the top of the housing portion **11**.

The signal device is fixed to a sleeve **30** so that the parts **25** and **30** move together. Rigidly secured to the bracket **14** is a locking sleeve or retainer **31**. Thus, the locking sleeve **31** is fixed against vertical movement. The signal device **25–30** is slidably mounted on this locking sleeve **31** for vertical movement relative thereto, as viewed in FIGURE 1. The stem **24** connected to the diaphragm **17** slides within the locking sleeve **31** to control the movement of the signal device **25** in a manner yet to be described.

The stem **24** is provided with a main circular portion **35** which is of substantially the same diameter as the inner diameter of the locking sleeve **31** and with an annular portion **36** of substantially the same diameter. Between the portions **35** and **36**, the stem **24** is provided

with a recessed or reduced diameter portion **37** and the upper end of the stem **24** has a recessed portion of reduced diameter, as indicated at **38**.

The sleeve **30** of the signal device is provided with an enlarged inner diameter portion **40** forming an annular space or recess **41**. The lower end of the reduced portion **40** terminates in an annular shoulder **42** which is normally positioned immediately below the reduced diameter sleeve portion **37**.

The signal device **25** is controlled by two pairs **43** and **44** of ball shaped detents or locking members. The detents of each pair are disposed diametrically opposite one another and the two pairs are rotated 90° from one another. These detents **43** and **44** lie in openings **45** in the locking sleeve **31** and are normally caused to project into the recess **41** by the portions **35** and **36** of the stem **24**. This is the position of the parts shown in FIGURES 1 and 2.

When, however, the stem **24** is shifted relative to the locking sleeve **31**, one or both of reduced portions **37** and **38** is brought radially opposite to or in registration with the detents **43** or **44** so as to release the signal device **25**. The reduced portions **37** and **38** are spaced apart axially a slightly greater distance than the detents **43** and **44** so that the detents **44** will move radially inwadrly out of the recess **41** first and thereafter, upon further movement of the stem **24**, the detents **43** will move radially inwardly out of the recess **41**. The radially inward movement of the detents **43** and **44** is caused by the shoulder **42**, the inclined attitude of the shoulder **42** producing a camming action on the balls **43** or **44** as it contacts them.

The signal device **25** is normally biased in an upward direction by means of a spring **50** which is seated on the bracket **14** and engages a flange **51** on the lower end of the signal device. Thus, when the detents **43** and **44** are freed for radially inward movement, the spring **50** will move the signal device upwardly to the positions **27***a* and **26***a*, respectively, shown in FIGURE 1.

Upon the initial downward movement of the stem **24**, the reduced diameter stem portion **37** is first brought into registration with the lower of said detents **44**. This occurs while the stem portion **36** still lies adjacent the detents **43** and keeps the detents **43** projecting into the recess **41** and prior to the time that the reduced diameter stem portion **38** comes into registration with the detents **43**. At this point, the inclined shoulder **42** is able to cam the detents **44** transversely or radially inwardly clear of the shoulder **42**, freeing the members **25** and **30** for upward movement under the influence of the spring **50** until the shoulder **42** contacts the detents **43**. At this point, the signal part **26** will lie above the housing member **11** and assumes a position indicated in broken lines at **27***a* in FIGURE 1. The spring is calibrated so that this first stage of indicator movement will occur at a point slightly prior to the excessive vacuum condition which it is desired to avoid. Thus, a machine attendant observing the preliminary warning given by the section **26** can take the necessary corrective action to remedy the condition producing the vacuum. Such corrective action would normally consist of changing or cleaning a clogged filter. However, if such corrective action is not taken and the condition becomes worse, a higher level of vacuum of a predetermined degree will result in the diaphragm **17** and stem **24** moving downwardly still further until the reduced diameter stem portion **38** is brought into registration with the detents **43**. At this point, the ball detents **43** are freed for transverse or radially inward movement by the camming force of the inclined shoulder **42**, thereby permitting the signal member **25** to move axially upwardly until the flange **51** contacts the upper end of housing member **11**. At this point, the lower signal part **27** will be exposed and will assume the position shown in broken lines at **27***a* in FIGURE 1. The upper signal part **26** will now have been moved to the position shown at **26***a* in FIGURE 1.

The device of the present invention is believed to be particularly useful in that it provides a warning of an impending excess vacuum condition as well as an indication of an existing excess vacuum condition, thus allowing corrective action to be taken prior to the occurrence of possible damage or machinery malfunction resulting from the excess vacuum condition. It is believed that the device of the present invention provides such a two-stage warning function with a high degree of accuracy and in a highly expeditious manner.

The cover **28** may be of clear plastic or any other suitable material and snapped into place on the housing portion **11**. The portions **26** and **27** of the signal device may conveniently be made of anodized aluminum or colored plastic, or any other suitable material.

It is believed that from the foregoing, the operation and advantages of the device will be readily apparent. As will also be apparent from the foregoing description, the objects and advantages of this invention are attained by a construction which is so reduced in the number and character of its component parts as to approach the ultimate in structural simplicity. The simplicity of the device creates an economy in its manufacture, installation and maintenance costs.

While one commercially practical embodiment of the invention has been described and illustrated herein somewhat in detail, it will be understood that various changes may be made as may come within the purview of the accompanying claims.

What is claimed is:

1. A vacuum indicating device including a housing, a pressure responsive member movably disposed within said housing and forming therewith a closed pressure chamber on one side of said pressure responsive member with the other side thereof exposed to atmospheric pressure, yieldable means biasing said pressure responsive member in a direction opposing the force of atmospheric pressure acting thereon, a stem connected to said pressure responsive member and movable therewith along a given axis, said stem having first and second axially spaced recessed portions, a signal member, means guiding said signal member for axial movement from a retracted position to first and second indicating positions, a spring biasing said signal member from said retracted position toward said indicating positions, shoulder means on said signal device, first and second detent means, a detent retainer surrounding said stem and operable to hold said detent means in axially spaced positions therealong while permitting radial movement of said detent means between positions in and out of axial alignment with said shoulder, said stem being normally operable to hold said detents in axial alignment with said shoulder, the movement of said stem first recessed portion into radial alignment with said first detent means being operable to permit radial movement of said first detent means out of axial alignment with said shoulder whereby said signal member is released for movement by said spring from said retracted position to said first indicating position, and the movement of said second stem recessed portion into alignment with said second detent means being operable to permit radially inward movement of said second detent means out of axial alignment with said shoulder whereby said signal member is freed for movement to said second indicating position.

2. The structure set forth in claim **1** wherein said signal member is of annular configuration and surrounds said stem and wherein the shoulder of said signal member is of annular shape.

3. The structure set forth in claim **1** wherein said retainer has a cylindrical outer peripheral surface and wherein said signal member is provided with a sleeve portion slidably guided on said peripheral surface.

4. The structure set forth in claim **1** wherein said retainer is of sleeve shaped configuration and wherein each of said detent means comprises a plurality of balls movable within openings of said retainer.

5. The structure set forth in claim 1 wherein said signal member shoulder is inclined with respect to the axis of said stem for applying a radially inward force to said detent means to thereby produce radially inward movement of said detent means upon the movement of a stem recessed portion to a position radially opposite thereto.

References Cited

UNITED STATES PATENTS

2,843,077	7/1958	Leefer	116—117
2,954,751	10/1960	Barnes	116—70
3,119,367	1/1964	Barnes et al.	116—70
3,200,787	8/1965	Darnell	116—70
3,216,571	11/1965	Whiting et al.	210—90

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