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2,283,831

BAG PRESSURE INDICATOR FOR SUCTION CLEANERS

Filed July 8, 1939

2 Sheets-Sheet 1

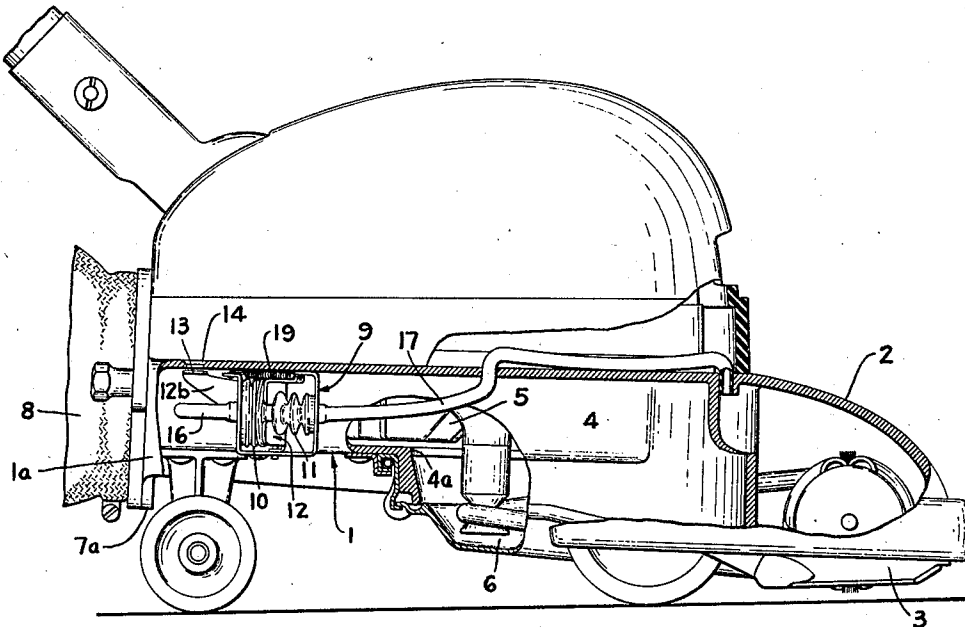


Fig. 1

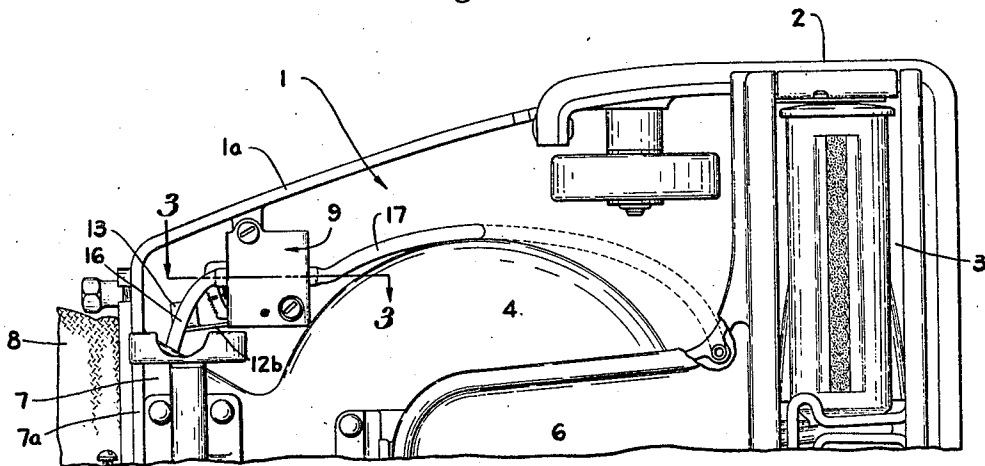


Fig. 2

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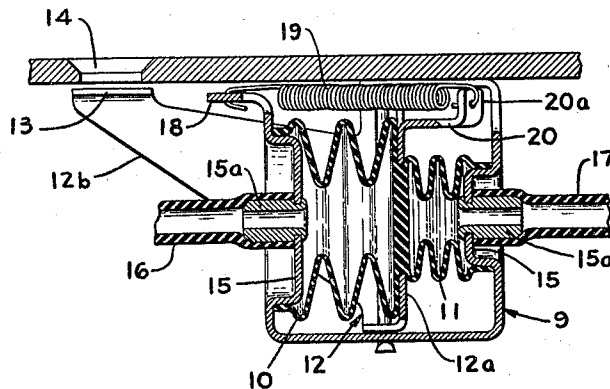


Fig. 3

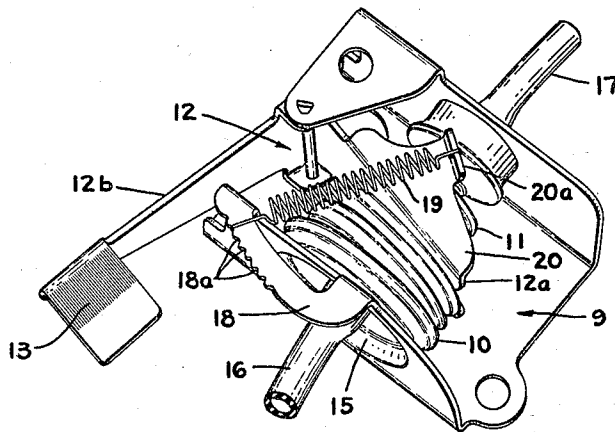


Fig. 4

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BAG PRESSURE INDICATOR FOR SUCTION
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This invention relates to improvements in bag pressure indicators for suction cleaners and more particularly to pressure-responsive signalling devices serving to warn the operator that it is time to empty the dirt bag.

Inasmuch as the dirt bag acts as a filter, it follows that as it becomes filled with dirt, the effective filtering area of the bag material becomes so reduced as to create a considerable back pressure, thus reducing materially the efficiency of the suction fan and consequently affecting the performance of the cleaner.

Heretofore, an indicator consisting of a suitable pressure-responsive element operatively connected with a visual signal member and responsive either to the suction or to the pressure produced by the fan has been considered adequate.

But experience in the operation of cleaners equipped with such indicators has led to the discovery that under certain conditions of operation, the indicator does not reflect the true condition of the bag, that is to say, the warning signal will be displayed even though the bag be comparatively empty. This is likely to occur, for example, when the cleaner is moved from a carpet of average texture onto a bare floor, or perhaps onto a very thin and porous floor covering and the operator, thinking that the bag should be emptied, proceeds to do so only to find that the indicator has given a false signal.

And the reason for this improper functioning of the ordinary pressure-responsive indicator may be explained as follows: So long as the cleaner is being operated on the same carpet, the suction at the nozzle and the pressure at the fan chamber exhaust outlet remain substantially constant because the volume of air being handled is practically constant. But immediately the contact between the nozzle and the carpet is broken, as occurs when the cleaner is moved onto a bare floor, the air flow is greatly increased and the suction decreases in proportion. This sudden increase in the volume of air handled by the fan also results in an increased pressure at the exhaust outlet, to which the indicator responds, although, as previously stated, the bag may be quite empty.

Hence, the object of the present invention is to provide an improved indicator and one that is proof against registering falsely the actual conditions within the bag. Briefly, this desirable result is obtained by designing the indicator so that it is responsive to the combined effect of the pressure at the exhaust outlet and the suction at the nozzle. In other words, the indi-

cator is provided with two pressure-responsive elements instead of one and these pressure-responsive elements are responsive to the added forces of suction and pressure although varying somewhat in magnitude to the end that upon the occurrence of any change in operating conditions which would otherwise result in an increase in pressure due to causes other than a clogged condition of a dirt bag, the action of one pressure-responsive element is counteracted by that of the other and thereby compensating for the effect of the increased air flow.

Thus it may be said that the improved bag pressure indicator of the present disclosure responds to the sum of the pressures at the exhaust outlet and at the nozzle, or perhaps more accurately, responds to the pressure at the exhaust outlet minus a function of the pressure at the nozzle because, as will be presently pointed out, the force acting through the suction-responsive element is somewhat less than that applied by the pressure-responsive element.

The application of the compensating feature to the otherwise well-known pressure-responsive type of bag pressure indicator will now be disclosed, and in connection with the accompanying drawings, in which:

Figure 1 is a general view in side elevation of a suction cleaner of standard design with parts broken away to show the application of the improved indicator thereto;

Figure 2 is a fragmentary bottom plan view of the cleaner showing the mounting of the indicator on the underside thereof and its connection with the suction and pressure sides of the fan;

Figure 3 is an enlarged view in vertical section through the indicator as taken on line 3—3 of Figure 2; and

Figure 4 is a perspective view of the indicator unit removed from the cleaner.

A bag pressure indicator of the compensating type may be applied to any suction cleaner of standard design comprising generally, a wheeled casing 1 made up of a nozzle 2 provided with the usual downwardly facing suction mouth 3 and a fan chamber 4 in which is a motor-driven fan 5, the fan chamber communicating with the nozzle through an inlet passage 6 and an inlet opening 4a in its bottom wall. Extending rearwardly from the fan chamber is an exhaust outlet passage 7 having a flanged connection 7a to which is attached one end of a dirt bag 8 made of a suitable porous material such as a special woven fabric.

The indicator is preferably mounted on the

underside of the main casing 1 at one side of the fan chamber 4 and concealed from view by a skirt 1a extending along the side margins of the casing.

A frame 9 supports the operating parts of the indicator and is preferably a piece of sheet metal bent in U-shape with open ends. The open top side of the frame bears flush against the underside of the casing 1, and is suitably anchored thereto.

The exact form of the supporting frame 9 is not important, except that it supports two bellows members 10 and 11 and a signal member 12 rotative about a vertical axis located just inwardly from one end of the frame. The signal member 12 is essentially an L-shaped lever having one arm 12a in the form of a flat blade extending between and fastened to the abutting ends of the bellows members and transversely of the supporting frame substantially midway between its side walls. The other arm 12b of the signal member extends rearwardly at right angles some distance beyond the supporting frame and tapering toward its extremity is provided at its end with a horizontally disposed rectangular flag or target 13 lying directly beneath a rectangular opening or aperture 14 in the top wall of the casing 1 at a point near its rear end and offset to one side. The top surface of this target is visible through the opening and one-half of its area is preferably painted white and the other half red so that as the signal member is swung through a small arc of angular adjustment, the visual signal will change from white to red, or vice versa, in accordance with the changes in pressure conditions within the suction system.

The pressure-responsive bellows 10 and 11 are preferably rubber, cup-shaped members with annular corrugations capable of axial extension or contraction under varying pressures communicated to the interiors thereof. One end of each of the bellows members is open and the marginal portion thereof is fitted over and suitably fastened to an annular shoulder formed by an inwardly depressed annular segment 15 in each of the opposing side walls of the supporting frame 9. The two bellows members are thus arranged in axial alignment with each other with their free ends abutting end to end on opposite sides of the transversely disposed arm 12a of the signal member 12.

It will be noticed particularly that the rear-most bellows member 10 is substantially twice the diameter of the forwardly disposed bellows member 11 and somewhat shorter, although both have the same number of corrugations.

The interior of each bellows member is connected with a length of rubber tubing through a nipple 15a projecting outwardly from the center of its base 15. The tube 16 communicating with the rearmost and larger bellows member 10 leads to the exhaust passage 7 from the fan chamber, being suitably fitted within a cored hole in the side wall of the exhaust passage. The other tube 17, connected with the smaller bellows member 11, leads forwardly and communicates at its forward end with the nozzle chamber 2, the end of the tube being fitted into a hole cored in the top wall of the nozzle chamber immediately forward of its rear wall.

Thus, the pressures existing in the nozzle chamber and in the exhaust passage are communicated to the bellows members and they in turn act on the signal member by the contraction of one and the expansion of the other. But

in order to make the indicator positive in its action, the signal member does not respond directly to the combined action of the two bellows members, but rather to the action of a spring, the tension of which normally resists any movement of the signal member except under pressure conditions which would normally call for the display of the warning or "time to empty" signal.

As clearly shown in Figure 4, there is provided along the rear top edge of the supporting frame 9 an integral sector 18 having series of notches 18a cut in its outer edge, these notches forming the mounting for one end of a light coil spring 19 extending in a general forward direction and attached at its forward end to an upturned ear 20a at the edge of a flange 20 bent forwardly at right angles from the upper edge of the operating arm 12a of the signal member 12. As thus arranged, the spring acts continually to prevent the signal member from being rotated in a direction to change the signal from white to red or, in other words, to yieldably retain the signal member in the normal or "clean bag" position.

And in connection with the mounting of the spring 19 it may be explained that the curved sector 18 with the notched edge forms an adjustable anchorage for the fixed end of the spring in that the notches are offset in the direction of the axis of the spring and hence by shifting the point of anchorage from one notch to the other, permits the spring to be adjusted for tension.

Referring now to the manner in which the indicator functions, it should be first pointed out that with one of the bellows members responsive to the pressure at the exhaust outlet and the other responsive to the suction in the nozzle chamber, it follows that one will expand as the other contracts and, since they are mounted on opposite sides of the signal operating lever, the forces exerted by the bellows combine to actuate the signal member. However, the suction at the nozzle and the pressure at the exhaust outlet do not act through their respective bellows members with equal force, but in the proportion of approximately three to one, or in direct proportion to the diameter of the bellows members. Thus, the force exerted upon the signal member is always the sum of the pressure in the bag, multiplied by three, and the suction at the nozzle, this ratio being considered as the most satisfactory for all conditions. In short, the signal member is responsive primarily to variations in bag pressure but subject to the compensating effect of the suction at the nozzle under abnormal conditions.

For example, if the cleaner is being operated upon carpets of average grade and texture, the dirt removed from the carpet will gradually fill the dirt bag and cause a correspondingly increased pressure at the exhaust outlet. Now, this increased pressure will be accompanied by a proportional decrease in the suction at the nozzle because, under constant operating conditions, the pressures on opposite sides of the fan vary inversely to the air flow. In other words, as the resistance to the passage of air through the filter bag increases, the amount of air which can be handled by the fan decreases in proportion and this necessarily means a drop in the suction and a reduction in the cleaning effectiveness of the cleaner. And this, incidentally, is the reason for the necessity for periodic cleaning of the bag and why the operator should be warned that the bag should be emptied.

In any case, as the dirt bag becomes filled, the increasing back pressure is transmitted to the larger bellows 10 and, coupled with the suction acting through the smaller bellows member 11, will eventually overcome the tension of the spring 19 and the signal member 12 will shift from the safe position to the warning position, as indicated by the change from the white to the red signal. Under these conditions then, the signal operates in the normal manner and indicates that the bag should be emptied.

But let it be assumed that the bag is quite empty and the cleaner, while being operated on the same kind of carpet, is suddenly wheeled off onto the bare floor or onto a very thin porous carpet or rug. Under these conditions, the volume of air entering the nozzle chamber is suddenly increased and hence the volume of air to be handled by the fan and discharged into the dirt bag is likewise increased. But the dirt bag is unable to filter this increased volume of air and the result is that a back pressure is created which has the same effect as increasing the amount of dirt in the bag.

Now, the ordinary type of pressure-responsive indicator would be very likely to function under this condition and display the warning signal when there is no occasion for such warning. But with the compensating arrangement, the display of the warning signal is prevented, as will be understood from the following: Bearing in mind that the combined pressure in the bag and the suction in the nozzle chamber are required to overcome the tension of the spring 19 and shift the signal member into the warning position, it will now be seen that the decreased suction (negative pressure) in the nozzle chamber will be reflected in a correspondingly reduced force available to overcome the spring tension on the signal member and as long as the force of suction remains below a given value, the combined pressures will not be sufficient to overcome the tension spring 19 and operate the signal member. In other words, the compensating effect of reduced suction at the nozzle makes it impossible for the indicator to function except under a normal increase in back pressure due to excess dirt in the bag.

Inasmuch as the advantages of a bag pressure indicator of the compensating type have been fully set forth in the introductory paragraphs of this specification, further discussion is not considered necessary, except to point out that the application of the invention need not be limited to the specific disclosure herein.

I claim:

1. A bag pressure indicating device of the compensating type for suction cleaners of the type having a suction-creating system, comprising a signal member mounted on said cleaner and shiftable to and from a position to indicate an excessive bag pressure in the suction system of the cleaner, a pressure-responsive element communicating with the pressure side of said suction system and connected with said signal member tending to shift the same into signaling position under predetermined conditions of increased back pressure on said suction system, and a secondary pressure-responsive element communicating with the suction side of said system and also connected with said signal member to aid in shifting it and to compensate for the effect upon the action of said indicating device of an abnormal increase in the volume of air delivered to said suction system.

2. A bag pressure indicating device of the compensating type for suction cleaners of the type having a suction-creating system, comprising a signal member pivotally mounted on the cleaner for movement to and from a position to signal an excessive bag pressure on the suction system of the cleaner, a bellows communicating with the pressure side of the suction system and mounted on the cleaner for operative connection with said signal member, and a secondary bellows communicating with the suction side of the system and also operatively connected with said signal member whereby the latter functions under the resultant of the pressure and suction created in said system.

3. A bag pressure indicator for suction cleaners of the type having a suction-creating system, comprising a signal member pivotally mounted on the cleaner for movement to and from a position indicating an excessive back pressure on the suction system of the cleaner, tension means acting on said signal member to prevent its movement to signaling position under less than a predetermined back pressure, a bellows mounted on said cleaner and communicating with the pressure side of said suction system, the force exerted by said bellows acting on said signal member in a direction to oppose the action of said tension means, and a secondary bellows communicating with the suction side of said suction system and mounted on said cleaner, the force exerted by said last-mentioned bellows also exerting a force on said signal member in a direction to oppose said tension means, whereby said signal member is capable of functioning upon the resultant of the forces exerted by both of said bellows being greater than the force exerted by said tension means.

4. A compensating bag pressure indicator for suction cleaners of the type having a suction-creating system, comprising a signal member pivotally mounted on the cleaner, a bellows communicating with the pressure side of the suction system of the cleaner and mounted on said cleaner in operative connection with said signal member to tend to shift the same into signaling position under a predetermined excess back pressure on said system, a spring acting on said signal member to oppose its movement into signaling position, the force exerted by said spring being greater than the counter force exerted by said bellows, and a secondary bellows communicating with the suction side of said system and mounted on said cleaner in operative connection with said signal member and acting to exert a force thereon supplementing that of said first-mentioned bellows whereby said signal member is moved to signaling position under pressure conditions within said system wherein the combined forces exerted by said bellows exceed that of said spring.

5. A bag pressure indicator for suction cleaners of the type having a suction-creating system, the combination of a spring-actuated signal member mounted on said cleaner and adapted to be shifted to and from signaling position, a pressure-responsive element mounted on said cleaner adjacent said signal member and operatively connected therewith and subject to variations in air pressure on the pressure side of the suction-creating system of said cleaner and tending under normal increase in bag pressure to shift said signal member into signaling position against the spring action but exerting less force than the spring, and another pressure-respon-

sive element also mounted on said cleaner adjacent said signal member and having operative connection with the same and responsive to the variations in air pressure on the suction side of said suction-creating system and adapted to exert a force to shift said signal member in the same direction as said first-mentioned pressure-responsive element, whereby said signal member functions upon the resultant of the forces exerted by said pressure-responsive elements being sufficient to overcome the opposing tension of said signal member.

6. A bag pressure indicator for suction cleaners of the type having a suction-creating system, comprising a signal member pivotally mounted on the cleaner and adapted to swing to and from a signaling position visible to the operator, tension means acting on said signal member to oppose its movement into signaling position, a pressure-responsive element connected to and subject to variations in pressure on the pressure side of the suction system of said cleaner and acting in response to increased bag pressure on said signal member in a direction tending to shift the same into signaling position, and a secondary pressure-responsive element connected to the suction side of said system also acting on said signal member in the same direction as said first-mentioned element to normally assist in shifting the signal and arranged to be responsive to variations in the pressure on the suction side of said suction system in order at times to prevent the shifting of the signal.

7. A bag pressure indicating device for suction cleaners of the type having suction-creating systems, comprising a signal member mounted on the cleaner to move to and from a signaling position visible to the operator, a spring acting on said signal member to oppose its movement into signaling position, a primary bellows member connected with the pressure side of the suction system of the cleaner and adapted to exert a force on said signal member in a direction to tend to shift the same into signaling position, but incapable of shifting the same against the tension of said spring, and a second bellows member acting on said signal member and communicating with the suction side of said suction system, said last-mentioned bellows member responding to a function of the suction existing in said system to aid said first-mentioned bellows member to overcome the tension of said spring and to effect the operation of said signal device only under an excessive bag pressure and when the suction side pressure is normal.

8. A bag pressure indicator for suction cleaners of the type having suction-creating means, comprising a pivoted signal member adapted to swing to a signaling position visible to the operator when the dirt bag is to be emptied, tension means acting on said signal member to oppose its movement into signaling position, a primary bellows member communicating with the pressure side of the suction system of the cleaner and adapted to exert a force on said signal member in a direction tending to shift the same into signaling position, but incapable singly of overcoming the tension of said spring, and a second bellows member acting on said signal member and communicating with the suction side of said suction system, said last-mentioned bellows member having an effective pressure area less than that of said first-mentioned bellows member but acting therewith to overcome the tension of said spring and to effect the operation of said signal

device only above a predetermined ratio of bag pressure to suction pressure existing in said system.

9. In a bag pressure indicator for suction cleaners of the type having a suction-creating system, the combination of a frame, a signal member pivotally mounted on said frame, a spring acting on said signal member to oppose its movement into signaling position under normal operating conditions, and a pair of pressure-responsive elements supported on said frame and together acting on said signal member to at times shift the same into signaling position, one of said elements being connected to and responsive to the pressure on the pressure side of the suction-creating system of the cleaner and the other being connected to and responsive to the pressure on the suction side thereof, whereby the movement of said signal member is effected by the resultant of the forces exerted by said pressure-responsive elements overcoming the opposing tension of said spring.

10. In a bag pressure indicator for suction cleaners of the type having a suction-creating system, the combination of a frame, a spring-pressed signal member mounted on said frame to move to and from a signaling position, a pair of bellows members mounted on said frame and acting on said signal member, one of said bellows members being connected to and responsive to the pressure side of the suction-creating system of the cleaner and the other being connected to and responsive to the suction side of said system to supplement the pressure side bellows, the combined effective pressures acting through said bellows members under normal operating conditions being less and under warning conditions being more than the tension exerted by said spring on said signal member whereby the latter is operated only under a predetermined increased bag pressure and a normal suction in the suction-creating system of the cleaner.

11. In a bag pressure indicator for suction cleaners, the combination of a supporting frame adapted to be mounted on the underside of the cleaner body, a signal member pivotally mounted in said frame and comprising a lever arm, a pair of bellows members mounted in said frame on opposite sides of said lever arm, one of said bellows members being connected with the pressure side of the suction-creating fan and the other bellows member connected with the suction side of said fan, said pressure-responsive bellows member being substantially of greater diameter than said suction-responsive bellows member, and a tension spring acting on said signal member in a direction and under sufficient tension to prevent the shifting of said signal member into signalling position under the combined action of said bellows members under operating conditions in which a substantially increased pressure is created upon both the exhaust side and the inlet side of said fan.

12. A bag pressure indicator for suction cleaners of the type having a suction-creating system, comprising an indicating element movable between clear and warning position, a pressure-controlled element connected to the pressure side of the said system and to said indicating element to exert a force thereon to tend to move said element to warning position, resilient means exerting an opposing force greater than that exerted by said pressure-controlled element under all operating conditions, and a second pressure-controlled element connected to the suction side

of said system and to said indicating element, said pressure responsive elements being connected to said indicating element as to exert complementary moving forces thereon to overcome the force of the resilient means under warning conditions, characterized in that the force of said resilient means exceeds the combined forces of said pressure-controlled elements with the pressures at the suction and pressure sides of said system resulting from the free unhindered flow of air into said suction system.

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