This invention relates to an alarm for a vacuum cleaner, and more particularly to an alarm which provides a continuous visual signal to indicate a partially clogged condition of a vacuum cleaner filter and a combined visual and audible signal to indicate a substantially fully clogged condition of the filter.

One of the problems incident to the operation of suction type cleaners is knowing when to clean or replace the filter in order to renew cleaning efficiency. With the development of the tank-type vacuum cleaner wherein the filter is completely enclosed in a casing and thus may not be readily observed or manipulated, determination of the extent of clogging of the filter is even more difficult than in upright-type cleaners. It is important to know when the filter of a tank-type vacuum cleaner is clogged, not only from an efficiency standpoint but also to prevent damage to the cleaner motor because the motors employed in this type of cleaner usually depend upon the air flow through the filter for cooling purposes.

Various types of warning devices have been suggested as a solution to this problem, many of which sense and utilize the back pressure in the filter to indicate the extent of clogging of the filter. However, few if any such devices have been used commercially, presumably because of erratic or unreliable operation, complexity of construction, or high manufacturing cost.

Accordingly, it is a general object of the present invention to provide a novel and improved alarm device for indicating the extent of clogging of a vacuum cleaner filter.

Another object is to provide a novel alarm device of the foregoing character which provides both a visual and audible signal to indicate a substantially fully clogged condition of a vacuum cleaner filter.

A further object is to provide a novel alarm device of the foregoing character which provides a continuous visual signal to indicate the degree of clogging of the filter and an additional audible signal to indicate a substantially fully clogged condition of the filter.

Still another object is to provide a novel alarm device for indicating a clogged condition of a vacuum cleaner filter wherein the alarm device provides a cooling air flow path through the casing of the cleaner and around the filter to prevent excessive heating of the cleaner motor if the cleaner is operated when the filter is substantially fully clogged.

A further object is to provide a novel alarm device of the character described which is simple in construction, reliable in operation, and economical to manufacture.

Other objects and advantages of the invention will become apparent from the following detailed description and accompanying sheets of drawings in which:

FIG. 1 is a side elevational view, with portions broken away to show internal structural details, of a tank-type vacuum cleaner incorporating an alarm device embodying the features of the present invention;

FIG. 2 is an enlarged fragmentary top plan view of a portion of the cleaner illustrated in FIG. 1 and showing the location of the alarm device in the cleaner;

FIG. 3 is an enlarged fragmentary sectional view taken substantially on the line 3--3 of FIG. 2;

FIG. 4 is a longitudinal sectional view taken along the line 4--4 of FIG. 3;

FIG. 5 is a sectional view taken substantially along the line 5--5 of FIG. 4;

FIG. 6 is a horizontal sectional view taken substantially along the line 6--6 of FIG. 4;

FIG. 7 is a bottom plan view of another alarm device embodying the features of the present invention and adapted for use with the cleaner illustrated in FIG. 1;

FIG. 8 is a longitudinal sectional view showing the alarm device illustrated in FIG. 7 as it would appear when mounted in the cleaner of FIG. 1; and

FIGS. 9, 10, and 11 are transverse sectional views taken along the lines 9--9, 10--10, and 11--11, respectively, of FIG. 8.

Briefly described, the present invention contemplates an alarm generally adapted for use with an airflow producing device which employs some form of suction or reduced pressure generating means for inducing an airflow through the device and has a filter interposed in the airflow for trapping dirt or other foreign particles carried into the device with the airflow, the alarm being operable to provide a continuous visual signal to indicate the degree of clogging of the filter and an audible signal to indicate a substantially fully clogged condition of the filter. While the alarm device of the present invention may be utilized in various applications, it will be described in detail hereinafter in conjunction with tank or canister-type vacuum cleaner having a rigid casing which encloses a suction or reduced pressure generating means, such as a motor-fan unit, and a filter interposed in the airflow through the cleaner for trapping dirt or other foreign particles drawn into the cleaner through an air inlet opening in the casing.

In FIG. 1, a tank-type vacuum cleaner 10 is illustrated, the latter being exemplary of one type of vacuum cleaner with which the alarm device of the present invention is adapted for use. The cleaner 10, in the present instance, comprises a generally rectangular casing 11 having top and bottom walls 12 and 13, respectively, and left and right end walls 14 and 15, respectively, as viewed in FIG. 1. The casing 11 is preferably formed in two parts, namely a lower portion or shelf 16 and an upper portion or shelf 17 hinged to the lower portion 16 at the right end 15 of the casing. The lower casing portion 16 may be provided with wheels 18 to facilitate movement, and laterally extending support bars or feet 22 may be provided on the right end 15 of the casing for supporting the latter in an upright position. A carrying handle 23 may be provided on the upper casing portion 17.

Mounted within the casing 11 is suction generating means in the form of a motor-fan unit 30. The unit 30, in the present instance, comprises an upper motor portion 32 having an electric motor (not shown) mounted therein and a lower fan portion 33 driven by the motor in the portion 32. The fan portion 33 includes a fan (also not shown) and a plurality of annularly arranged, circumferentially spaced outlet ports 34 through which air from the fan discharges. Air from the interior of the cleaner casing 11 is drawn into the upper end, indicated at 36, of the motor-fan unit 30 and then flows downwardly through the motor portion 32 to cool the motor therein before entering the fan portion 33. The motor-fan unit 30 is enclosed in a housing 37 which isolates the fan portion 33 from the interior of the casing 11 and which has an opening 38 in its upper end through which air from the interior of the casing 11 enters.

Air containing dirt or other foreign particles enters the casing 11 through an inlet opening 40 in the upper casing portion 17 and then flows into a filter which, in the present instance, comprises an elongated, porous paper bag 41 having an opening 42 therein defined by an annular mounting flange 43 on the bag. The flange 43 is adapted to engage a support assembly which holds the flange 43 in pressure sealed relation with the casing inlet.
The inlet 40 is adapted to receive a connector fitting (not shown) secured to one end of a flexible hose (also not shown), the other end of the hose having a similar connector fitting to which various accessory cleaning tools may be connected.

After the dirt-laden air enters the filter 41, which substantially fills the interior of the casing 11 when expanded, the dirt and other foreign particles are retained by the filter so that substantially clean air discharges outwardly through the walls of the filter to the interior of the casing. This cleaned and conditioned air enters the opening 38 in the upper end of the housing 37, flows through the motor-fan unit 30, and is subsequently discharged through the discharge ports 34 in the fan portion 33 into a chamber 44 in the housing 37 surrounding the fan portion 33. The end wall 15 of the lower casing portion 16 is provided with a plurality of openings or ports 45 providing an outlet in the casing 11 communicating with the chamber 44 and through which the cleaned air is discharged.

The flow of air into the casing inlet 40, through the filter 41 and motor-fan unit 30, and out of the discharge ports 45 is indicated by arrows in FIG. 1.

A control lever or treadle 46 may be provided to control current flow to the motor of unit 30, and a motor speed control 47 (FIG. 2) and vacuum control 48 may be mounted on the top wall 12 of the casing 11 and enclosed by a cover plate 49.

With the foregoing construction, it will be apparent that as the filter 41 becomes clogged with dirt and other foreign particles, less air will pass through the filter. Consequently, the vacuum within the cleaner casing 11 on the outside or downstream side of the filter 41 will increase. Since a reduction in the flow of clean air through the filter 41 also results in a similar reduction in the flow of air entering the inlet 40 of the cleaner, the efficiency of the cleaner falls off. In addition, a reduction in the flow of air through the filter 41 would normally result in an increase in the operating temperature of the motor of the unit 30, which increase could possibly raise the temperature of the motor to a point such that the end wall 64 of the piston 62 clears the lower end of the port 82 and leaves the latter open and unobstructed when the piston 62 is at the extreme right-hand end of its travel as shown in full lines in FIG. 4. The lower end of the port 82 is also located opposite the left-hand ends of the passages 68 adjacent the transition portion 69 for the purpose hereinafter described.

The upper end of the opening 82 registers with a chamber or space 83 thereabove defined by a generally rectangular, hollow cap member 84 having laterally spaced side walls 86, a left end wall 87 as viewed in FIG. 4, and a top wall 88 which includes a projecting portion 89 (FIG. 4). The cap member 84 also includes a pair of laterally outwardly extending lugs 90 (FIGS. 5 and 6) which seat in complementarily shaped depressions 91 in the plate portion 53. Screws 92 extend upwardly through the depressions 91 and are threaded into the lugs 90 to secure the cap members 84 to the housing 52.

The chamber or space 83 communicates with the exterior of the casing 11 by means of a pair of laterally spaced, longitudinally extending passages 93 (FIGS. 3 and 5) defined by the side walls 86 of the cap member 84 and an upraised, elongated plate portion 94 extending into chamber 83. As best seen in FIG. 4, the cap member 84 and the housing portion 94 extend upwardly through the opening 51 in the top wall 12. The cross-sectional area of the passages 93 is increased somewhat by a pair of longitudinally extending recesses 96 (FIGS. 3–6) in the upper surface of the plate portion 53. The outer ends of the passages 93 communicate with a space 85 between the top wall 12 and the cover plate 49 and thence with the exterior of the casing 11 through an elongated recess 97 (FIGS. 1, 3, 4, and 6). An elongated, cup-shaped piston 62 having a cylindrical side wall 63 and end wall 64 at the left end of the piston, as viewed in FIG. 4, is loosely mounted in the bore 60. The bore 60 is circular in cross section for a minor portion of its length at the left end of the housing 52, as best seen in FIGS. 3 and 5. Such vertical elongation is provided by a downwardly displaced wall portion 65 joined to the left-hand circular cross-section portion of the bore 60 by means of a horizontal wall portion 69. The wall portion 65 includes an upstanding central rib 66 (FIGS. 3, 4 and 5) having its upper edge 67 linearly aligned with the bottom of the bore 60 to support the piston 62 during movement thereof toward the right end 61 of the housing 52. The displaced wall portion 65 and rib 66 define two elongated parallel passages 68 (FIGS. 3 and 5) in the housing 52 which extend from the transition portion 69 to the open end 61 of the bore 60 thereby communicating with the low pressure zone in the cleaner casing on the downstream side of the filter 41 when the inlet port 30 is in operation.

A coil spring 72 is mounted in the bore 60 with its left end engaging the inner face, indicated at 73, of the end wall 64 of the piston 62, and the right end of the spring 72 engages a generally cup-shaped abutment or retainer 74 disposed in the bore 60 adjacent the right end 61 of the housing 52. For the purposes hereinafter described, the housing 52 is preferably made of a transparent thermoplastic material, such as a polystyrene plastic, so that the abutment 74 can be secured in the housing bore 60 by thermally deforming the material of the housing 52 at opposite sides of the abutment 74, such deformation extending substantially to the upper circumferential half of the abutment 74, as indicated at 76 in FIGS. 4 and 6. The housing 52 also includes air passage means extending through the housing and intersecting the bore 60, the passage means communicating at its ends with the exterior and interior of the casing for applying a force on the piston 62 in response to clogging of the filter 41 and in opposition to the force exerted by the spring 72. To this end, the housing 52 includes a vertically extending, oval-shaped opening or port 82, the lower end of which intersects the bore 60 at a point such that the end wall 64 of the piston 62 clears the lower end of the port 82 and leaves the latter open and unobstructed when the piston 62 is at the extreme right-hand end of its travel as shown in full lines in FIG. 4. The lower end of the port 82 is also located opposite the left-hand ends of the passages 68 adjacent the transition portion 69 for the purpose hereinafter described.

The upper end of the opening 82 registers with a chamber or space 83 thereabove defined by a generally rectangular, hollow cap member 84 having laterally spaced side walls 86, a left end wall 87 as viewed in FIG. 4, and a top wall 88 which includes a projecting portion 89 (FIG. 4). The cap member 84 also includes a pair of laterally outwardly extending lugs 90 (FIGS. 5 and 6) which seat in complementarily shaped depressions 91 in the plate portion 53. Screws 92 extend upwardly through the depressions 91 and are threaded into the lugs 90 to secure the cap members 84 to the housing 52.

The chamber or space 83 communicates with the exterior of the casing 11 by means of a pair of laterally spaced, longitudinally extending passages 93 (FIGS. 3 and 5) defined by the side walls 86 of the cap member 84 and an upraised, elongated plate portion 94 extending into chamber 83. As best seen in FIG. 4, the cap member 84 and the housing portion 94 extend upwardly through the opening 51 in the top wall 12. The cross-sectional area of the passages 93 is increased somewhat by a pair of longitudinally extending recesses 96 (FIGS. 3–6) in the upper surface of the plate portion 53. The outer ends of the passages 93 communicate with a space 85 between the top wall 12 and the cover plate 49 and thence with the exterior of the casing 11 through an elongated recess 97 (FIGS. 1, 4).
Thus, the passages 93, the space 83, and the opening 82, permit air at substantially atmospheric pressure to enter the bore 60. At the point of intersection of the opening 82 with the bore 60, the air passage means through the housing 52 in effect divides into two portions. The first portion extends through the clearance space between the tip of the piston 63 and its bore, 60, over the end face, indicated at 98, of the piston, and through the clearance space between the bottom of the piston 62 and its bore 60. The second portion extends generally transversely across the housing bore 60 and around the outer periphery of the side wall 63 of the piston 62. The first and second portions of the passage means unite at the transition portion 69, and there join with the passages 68.

Thus, the first portion of the passage means provides a path through which air at substantially atmospheric pressure may flow around the exterior of the loose-fitting piston 62 to the outer face 98 of the piston end wall 64, while the inner face 73 of the piston end wall 64 is exposed to a reduced pressure communicated thereto through the bore 60 and the passages 68 at the open end 61 of the bore 60. Consequently, the piston 62 is subjected to a differential pressure force tending to shift the piston toward the right end 61 of the housing 52, the magnitude of such force being dependent upon the degree of clogging of the filter 41. Assuming that a clean filter 41 has been installed in the cleaner 10, the piston 62 may not immediately begin to shift toward the right end 61 of the housing 52 as the filter begins to clog because of a pre-load in the spring 72, as determined by the position of the abutment 74. Preferably, the abutment 74 is positioned to preload the spring 72 so that the piston 62 will not shift beyond the lower end of the opening 82 until the filter 41 is substantially fully clogged. Such positioning of the abutment 74 is effected at the factory by adjusting the abutment 74 portions both on the lower end of the opening 82 is uncovered at a predetermined suction level at which point the abutment 74 is then heat sealed in permanent position, as at 76.

In order to permit observation of the position of the piston 62 from the exterior of the casing 11, the plate 49 includes an opening or window portion 101 and also overlying the left portion of the housing 52 which is transparent. The opening 99 may be closed by a piece of transparent plastic material 100 having a convex configuration to provide a degree of magnification. To further facilitate observation of the position of the piston 62, the latter is provided in the area 103 and locating the reed 102 in close proximity to the upper edge of the flange 104. As will be apparent from FIGS. 3 and 4, the upper edge of the flange 104 is disposed closely adjacent the undersurface of the top of the cover plate 49 for a major portion of its length and then tapers downw ardly away from the outer end, indicated at 108, of the reed. The outer end 108 of the reed is thus free to vibrate, and the reed 102 and flange 104 together define an elongated space 112 between which communicates with the space 83 at the left end of the cap member 84.

Thus, the space 112 comprises one branch of the passage means through the housing 52, which communicates air at substantially atmospheric pressure to the outer side 98 of the piston end wall 64.

When the filter 41 becomes substantially fully clogged so that the pressure on the inner end face 73 of the piston end wall 64 is reduced to a value sufficient to shift the piston to its full line position illustrated in FIG. 4, the lower end of the opening 82 is no longer restricted by the piston and consequently the flow of air through the opening 82 to the interior of the casing 11 is substantially increased. Such increased flow is readily accommodated by the combined areas of the space 112 and passages 93. Because the cross sectional area of the passages 93, which comprise another branch of the passage means through the housing 52, is substantially greater than that of the space 112, the passages 93 serve as a bypass around the space 112 for a portion of the air entering the opening 82.

Thus, as viewed in FIG. 4, air now flows inwardly through the passages 93 and space 112 in the cap 84, downwardly through the opening 82 into the bore 60, thence into the end of the passages 68 at the transition section 69, and longitudinally through the passages 68 into the interior of the casing 11. Consequently, when the lower end of the opening 82 is no longer restricted by the piston 62, not only will the quantity of air flowing through the passages 93 increase, but also there is a substantial increase in the flow through the space 112. Such flow increase through the space 112 and around the outer end 108 of the reed 102 causes the reed to vibrate and emit an audible signal in the form of a whistle. When this occurs, even though a user may have neglected to observe the visual signal provided by the position of the piston 62, the audible signal is normally sufficient to bring attention to the fact that the filter bag 41 is clogged and in need of replacement. Consequently, the user will normally shut off the cleaner at this time and change the bag.

However, if the user should neglect to heed both the visual and audible signals, damage to the motor of the motor-fan unit 30 due to over-heating is avoided because of the large bypass flow of air through the passages 93, which passes directly into the inlet 36 of the motor-fan unit 30 to cool the motor.

Referring now to FIGS. 7-11, inclusive, another alarm device 120 adapted for use with a vacuum cleaner, such as the cleaner 10, is illustrated. The device 120, which comprises a second embodiment of the invention, employs parts in common with the device 50 and therefore like numerals have been used to identify identical parts.

The alarm device 120 thus comprises a generally elongated, tubular housing 122, similar to the housing 52, and mounted in the interior of the cleaner casing 11 on the underside of the top wall 12 thereof. The housing 122 thus includes an upraised, integral, generally rectangular plate 49. Such a plate 49 is adapted to engage the underside of the top wall 12 of the casing, the plate portion extending openings therethrough for receiving screws 124 which extend upwardly therethrough and which are threaded into the bosses 54 on the underside of the cover plate 49. When so mounted, a portion of the housing 122 underlines a generally rectangular opening 125 in the top wall 12 of the casing 11. A transparent plate member 126, substantially coextensive in area with the plate portion
123 and having an opening 127 therein, is interposed between the plate portion 123 of the housing 122 and the underside of the top wall 12.

The housing 122 is provided with a longitudinal bore 130 which extends from the right end, indicated at 133, of the housing, as viewed in FIG. 8, and an elongated cup-shaped piston 134 having a cylindrical side wall 136 and an end wall 137 at the left end of the piston, as viewed in FIG. 8, is loosely mounted in the bore 132. An elongated spring retainer 138 having a radially enlarged plug portion 139 and a reduced diameter guide portion 143 is tightly mounted in the right end of the bore 132 to provide an abutment for one end of a coil spring 144. The outer diameter of the spring 144 is somewhat less than the inner diameter of the side wall 136 of the piston 134, and the outer diameter of the guide portion 143 is somewhat less than the inner diameter of the spring 144 such that the latter is carried between the guide portion 143 and the cylindrical side wall 136 of the piston in the manner illustrated in FIG. 8.

The inner or left end, indicated at 146, of the guide portion 143 provides an abutment or stop for limiting movement of the piston 134 toward the right end 133 of the housing 122. Movement of the piston 134 toward the left end wall, indicated at 147, of the housing 122 is limited by a transverse rib or stop 148 (FIGS. 8, 10 and 11) which extends across the bore 132. The rib 148 also maintains the outer or left end face 131 of the piston 134 spaced from the inner face of the end wall 147.

As in the previous embodiment, the housing 122 includes a downwardly displaced wall portion 65 which extends from an inclined transition portion 69 of the housing to the right end 133 thereof. The housing bore 132 is thus vertically elongated throughout the portion 65 and the latter includes an upstanding central rib 66 having its upper endge 67 linearly aligned with the bottom of the housing bore 132. The depressed portion 65 of the housing 122 and the central rib 66 thus defines two longitudinally extending passages 68 (FIG. 9) which extend inwardly from the right end 133 of the housing to the transition portion 69. The passages 68 thus communicate with the low pressure zone in the cleaner casing on the downstream side of the filter 41 when the motor unit 30 is in operation.

The housing 122 also includes passage means extending through the housing and intersecting the bore 132, the passage means communicating at its ends with the exterior and interior of the casing 11. Such passage means includes a first portion which communicates air at substantially atmospheric pressure to the outer end face, indicated at 131, of the piston 134, and a second portion which extends generally transversely across the bore 132 of the housing and around the outer periphery of the piston side wall 136. The first and second portions of the passage means unite at the transition portion 69 of the housing 122, and there connect with the passages 68.

In order to provide the first portion of the passage means, the top portion of the housing 122 is provided with an opening in the form of an arcuate slot 152 (FIGS. 8 and 11) adjacent the left end wall 147, the slot 152 communicating with the exterior of the casing 11 through a chamber or space 153 between the cylindrical portion of the housing 122 and the plate member 126, the openings 127 and 125 in the plate member 126 and top wall 12, respectively, and the slot 97 in the rear edge of the cover plate 49.

Thus, the slot 152, chamber 153, and opening 127, which comprise the first portion of the passage means through the housing 122, permits air, at substantially atmospheric pressure, to enter the outer face 131 of the piston 134. Since the piston 134 is loosely fitted in the bore 132, a continuous bleed flow of air from the exterior of the casing 11 flows through the first and second portions of the passage means to enter the interior of the casing through the passages 68.

The inner face, indicated at 157, of the piston 134 is exposed to the reduced pressure in the interior of the casing on the downstream side of the filter 41 when the motor-fan unit 30 is in operation, so that the bore 132 is subjected to a differential pressure force tending to shift it toward the right end 133 of the housing 122. Such force is dependent upon the degree of clogging of the filter 41 and is opposed by the force of the spring 144. Consequently, the piston 134 will gradually shift toward the right end 133 of the housing 122 as the housing 122 comes clogged in the manner of the previous embodiment, thereby providing a visual signal to the user that the filter bag should be replaced.

To permit observation of the position of the piston 134 from the exterior of the casing 11, at least the left portion of the housing 122 and the plate member 126 are of transparent material, such as a polystyrene plastic, and the piston 134 is of opaque or translucent material. Preferably, the entire housing 122 is of transparent material. Such movement may be observed from the exterior of the housing 122 through an opening or window 99 in the plate member 49, which is aligned with the opening 125 in the top wall 12. The opening 99 may be covered by a piece of transparent plastic material 100 having a convex configuration for magnification purposes. In addition, a layer of reflective or brightly colored material 101, such as a laminate of transparent plastic material 100, is applied around the left end portion of the housing 122 to further facilitate observation and draw attention to the position of the piston 134.

The alarm device 120 also includes sound generating means for generating an audible signal to indicate a substantially fully clogged condition of the filter 41. Such means preferably comprises an opening 156 in the housing 122 in substantial vertical alignment with the opening 127 in the plate member 126. The opening 156 is spaced from the left end wall 147 by an amount somewhat less than the length of travel of the piston 134 so that the opening 156 is exposed to the compressed air when the latter moves to its limit position toward the right end 133 of the housing 122. Such limit position is illustrated by the full line position of the piston 134 in FIG. 8 and is reached when the inner end face 157 of the piston end wall 137 engages the outer end face 146 of the guide portion 143.

The openings 156, space 153, and opening 127, thus comprise the second portion of the passage means through the housing 122.

Thus, when the piston 134 reaches its full line position illustrated in FIG. 8, a substantial increase in the flow of air through the first and second portions of the passage means through the housing 122 occurs, the combined flow flowing past an annular clearance space 158 (FIGS. 8 and 10) between the piston side wall 136 and its bore 132, at the left end of the piston 134, prior to entering the transition portion 69 of the housing 122 and the passages 68. Because of the high velocity of the air flow through the aligned openings 127 and 156, an audible signal in the form of a whistle is generated. Such signal provides an additional warning to a user that the filter 41 of the cleaner is substantially fully clogged.

The increased flow of air through the housing 122, which occurs when the opening 156 is unobstructed, the piston 134, also serves to cool the motor of the motor-fan unit 30 to prevent damage thereto in the event that the cleaner is operated for any length of time with a substantially fully clogged filter.

While only two embodiments of the invention have been herein illustrated and described, it will be understood that modifications and variations thereof may be effected without departing from the scope of the invention as set forth in the appended claims.

We claim:

1. A combined visual-audible signal device for indicating clogging of a filter contained in a casing through which air is passed for filtering the same, said device comprising a housing adapted to be mounted in said casing, a pres-
3,381,652

5. The signal device of claim 4, further characterized in that said first portion of said passage means comprises a clearance space upstream from the intersection of said passage means with said bore, and said sound generating means is operatively associated with one of said branches.

6. The signal device of claim 3, further characterized in that said passage means includes a pair of branches upstream from the intersection of said passage means with said bore, and said sound generating means is operatively associated with one of said branches.

7. The signal device of claim 9 further characterized in that the other of said branches comprises a bypass around said sound generating means.

8. A signal device for indicating clogging of a filter contained in a casing through which air is passed for filtering the same, comprising a housing adapted to be mounted in said casing and having a bore therein, a piston in said bore and adapted to move in response to a differential pressure between the inside and outside of said casing, said housing also having passage means therethrough intersecting said bore and adapted to communicate with the exterior of said casing and with a reduced pressure zone within said casing, said passage means thereby being adapted to expose one side of said piston to said reduced pressure zone and the other side of said piston to the pressure at the outside of said casing, said passage means being restricted by said piston until the latter moves beyond a predetermined position in said bore, said housing also including a portion adapted to communicate with the exterior of said casing through an opening therein, a cap member mounted on said housing and overlying said portion of said housing, said housing portion and said cap member defining said one end of said passage means, and sound generating means disposed between said portion of said housing and said cap member for generating an audible signal upon movement of said piston beyond said predetermined position in said bore.

9. The signal device of claim 8, further characterized in that said sound generating means comprises a reed secured to the underside of said cap member and having its free end extending upstream toward said one end of said passage means.

10. The signal device of claim 9, further characterized in that said housing portion is provided with an upward flange engaging a portion of the periphery of said reed and defining a space therebetween, said space comprising a branch of said passage means.

11. A signal device for indicating clogging of a filter contained in a casing having suction means for inducing a flow of air through said casing and said filter, said suction means providing a zone of reduced pressure in said casing downstream of said filter, said device comprising a housing adapted to be mounted within said casing and having a bore therein, said housing also having passage means therethrough intersecting said bore and adapted to communicate with the exterior of said casing and said reduced pressure zone, a piston in said bore having one side thereof adapted to communicate through said passage means with said reduced pressure zone and its other side adapted to communicate through said passage means with the exterior of said casing, whereby said piston is shiftable toward one end of said bore in response to a differential pressure force applied thereto from the exterior of said casing and said zone, spring means urging said piston toward the opposite end of said bore in opposition to said differential pressure force, said piston substantially restricting said passage means during a portion of its travel until said piston moves beyond the intersection of said passage means with said bore, and sound generating means operatively associated with said passage means for emitting an audible signal to indicate a substantially clogged condition of said filter, said sound generating means being actuated upon increased air flow through said passage means when said piston moves beyond the intersection of said second portion of said passage means with said bore.

12. The combination of claim 11, further characterized
3,381,652

in that said housing includes means providing a chamber on the exterior thereof communicating with said other opening, said chamber having an opening therein aligned with and spaced from said other opening in said housing, said chamber opening coacting with said other opening to provide said audible signal when said piston moves beyond said other opening.

13. The combination of claim 12, further characterized in said means providing said chamber comprises an upraised portion of said housing circumscribing said other opening, and a plate member engaging said upraised portion and having an opening therein aligned with said other opening in said housing.

14. In a suction cleaner including a casing having an air inlet, an air outlet, a filter interposed between said inlet and said outlet, and a motor-fan unit within said casing for inducing an airflow into said inlet, through said filter, and out of said outlet, said motor-fan unit providing a zone of reduced pressure in said casing between said filter and said air outlet and including a motor portion adapted to be cooled by at least a portion of the air flowing through said casing, a combined signal and protective device for signalling clogging of said filter and for preventing overheating of the motor portion of said motor-fan unit in the event that said cleaner is operated with a substantially fully clogged filter, said device comprising a housing adapted to be mounted within said casing and having a bore therein, said housing also having air passage means therethrough intersecting said bore and adapted to provide a direct path of communication between the exterior of said casing and said reduced pressure zone, a piston in said bore and adapted to move in response to a differential pressure between said reduced pressure zone and the exterior of said casing, and signal means operatively associated with said air passage means for providing a signal to indicate a substantially fully clogged filter, said signal means being actuated in response to an increased air flow through said passage means upon movement of said piston beyond the intersection of said passage means with said bore, said increased air flow passing directly from the exterior of said casing through said passage means to said motor-fan unit and providing a supplemental flow of cooling air to the motor portion of said unit to prevent overheating in the event that said cleaner is operated with a substantially fully clogged filter.

References Cited

UNITED STATES PATENTS
2,750,915 6/1956 Carlberg 116—65
3,119,369 1/1964 Harland et al. 116—114

LOUIS R. PRINCE, Primary Examiner.
J. W. ROSKOS, Assistant Examiner.