Sept. 26, 1967 L. J. KMIECIK 3,344,247

FLUID RESPONSIVE FLOW SWITCH

Filed May 13, 1965 2 Sheets-Sheet 1

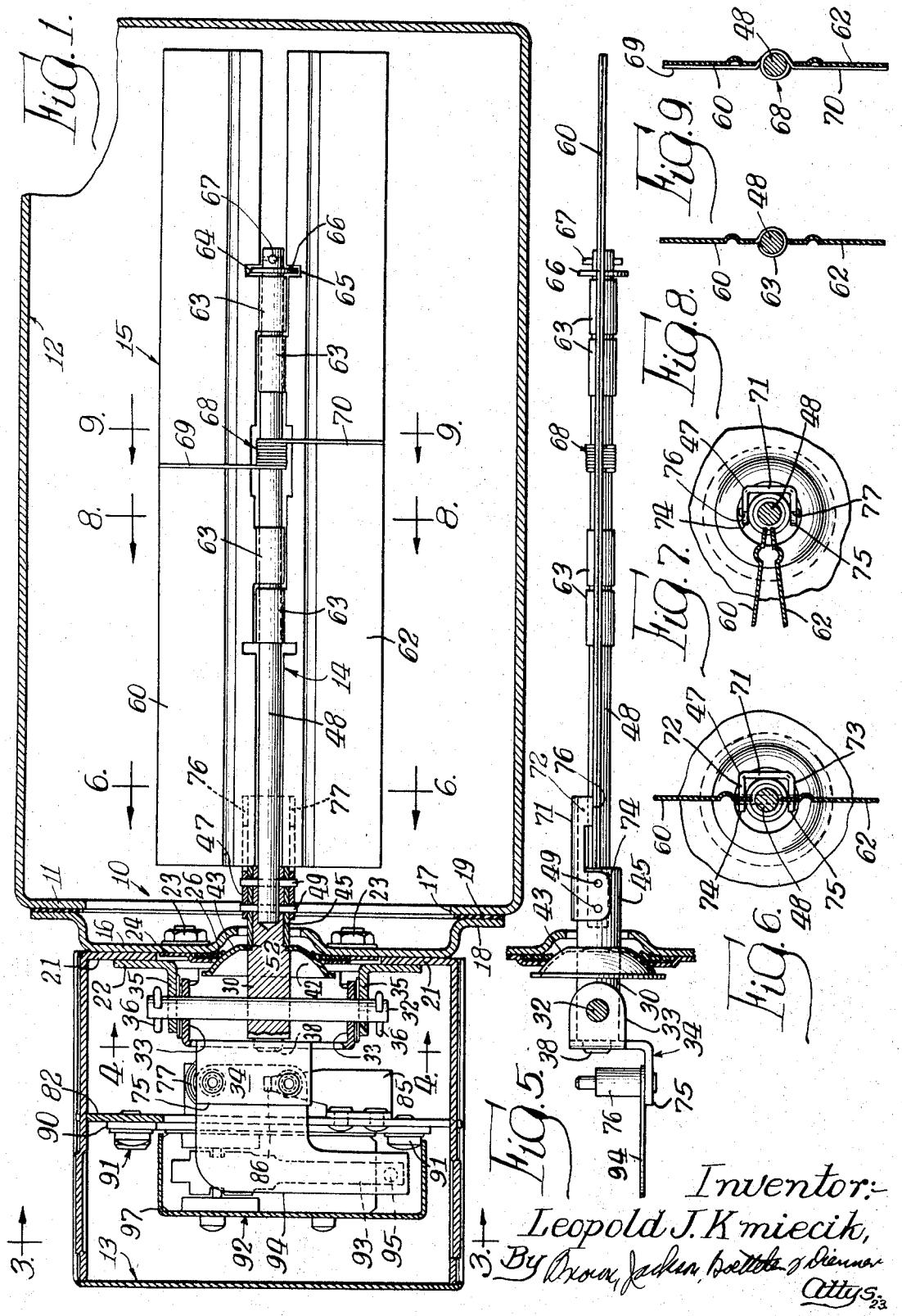

Fig. 1.

Fig. 9.

Fig. 8.

Fig. 7.

Fig. 6.

Fig. 5.

Inventor:
Leopold J. Kmiecik,
By Brown, Jackson, Boettcher & Dienner
Attys.

Sept. 26, 1967 L. J. KMIECIK 3,344,247

FLUID RESPONSIVE FLOW SWITCH

Filed May 13, 1965 2 Sheets-Sheet 2

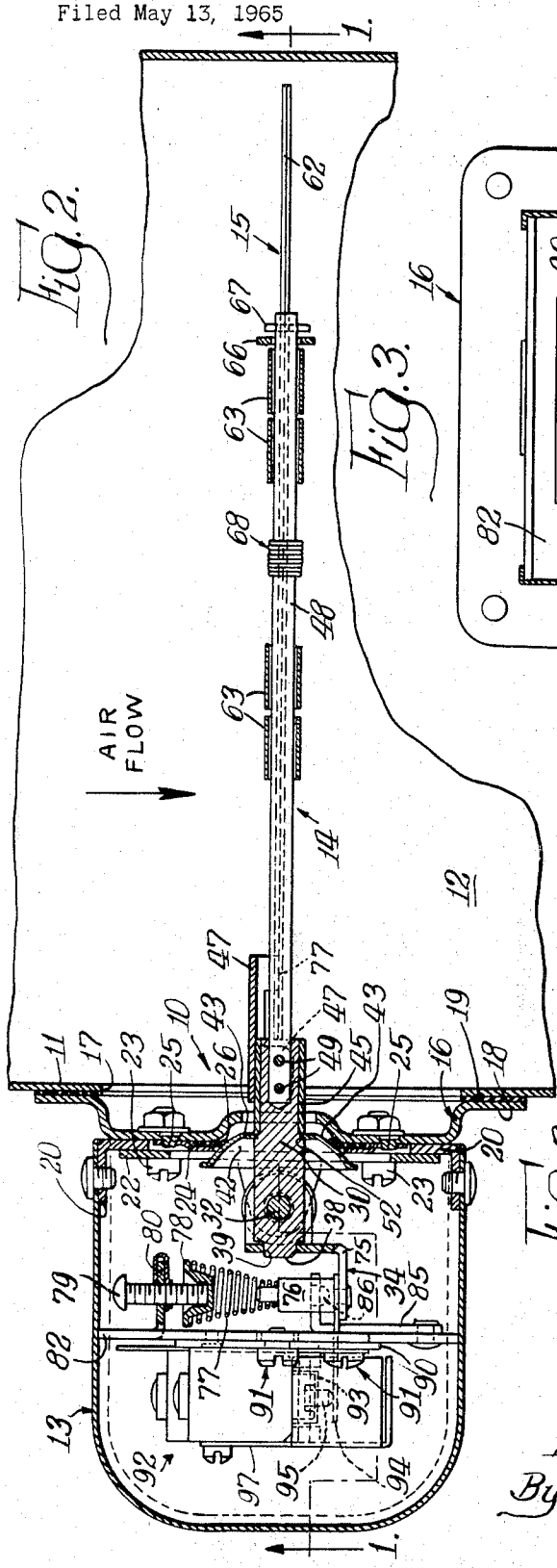

FIG. 2.

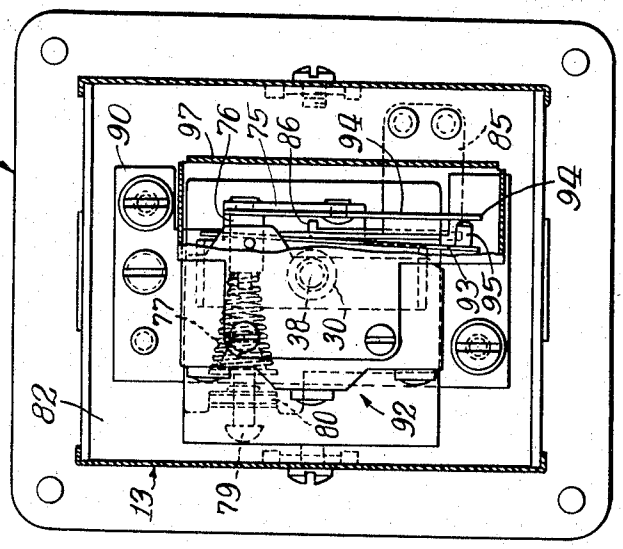

FIG. 3.

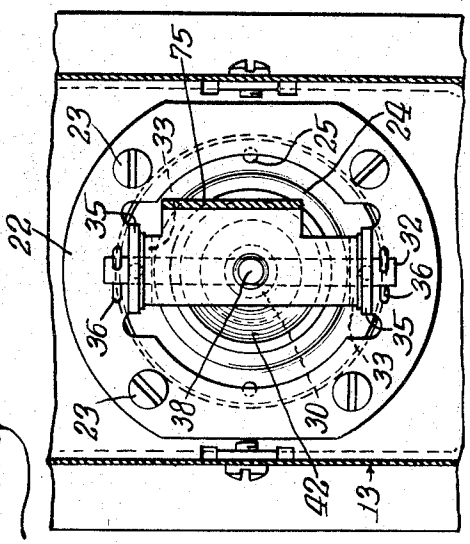

FIG. 4.

Inventor:-
Leopold J. Kmiecik,
By Brown, Jackson, Boettcher & Dienner
Attys.

United States Patent Office 3,344,247
Patented Sept. 26, 1967

3,344,247

FLUID RESPONSIVE FLOW SWITCH

Leopold J. Kmiecik, Lincolnwood, Ill., assignor to McDonnell & Miller, Inc., Chicago, Ill., a corporation of Delaware

Filed May 13, 1965, Ser. No. 455,498
11 Claims. (Cl. 200—81.9)

The present invention relates to fluid flow switches and more particularly to switches responsive to flow of fluid such as air in an air duct.

It is desirable in systems embodying air conducting ducts to provide flow switches sensitive to the flow or lack of flow of air in the air ducts, in which said flow switches may be associated with suitable electrical circuits embodying signalling devices located, for example, at a control panel with energization of such signalling devices being controlled in response to opening and closing of the flow switches.

The flow switch of the present invention has particular utility for use with air ducts for sensing flow of air therein. In most air conducting systems, the air flow will frequently pulsate which, with conventional known air flow switches will cause undesirable opening and closing or fluttering of the switches.

Accordingly, it is an object of the present invention to provide an air flow switch which will not open and close over a predetermined range of pulsating of fluid in a fluid conducting duct.

Also, known air flow switches embody a paddle or vane for positioning in an air duct and which paddle or vane effects opening or closing of an associated switch by movement or lack of movement of air in the air duct. In such known systems and especially at high velocity of air flow in an air duct, the paddles or vanes offer substantial resistance to air flow and impede the efficiency of movement of air through an air duct, and additionally, cause fluttering or undesirable off and on actuation of switch means of such known air switches.

It is a further object of the present invention to provide an air flow switch embodying novel paddle means the effective cross-sectional area of which lessens, especially at high velocity air flows, through an air duct so as to not impede or unduly restrict air flow through the duct, and additionally, to prevent erratic operation of switch means of the air flow switch.

A further object of the present invention is to provide an airflow switch having pivoted paddle rod means supported and being movable about its pivot by movement of the aforementioned paddle means to control operation of switch means of the air flow switch.

A further object is to provide an air flow switch as last noted embodying paddle rod spring means associated with the aforementioned paddle rod means to yieldingly resist movement of the paddle means in the direction thereof caused by air flow in an air duct.

A further object is to provide an air flow switch as last noted embodying paddle rod stop means for preventing pivotal movement of the paddle rod means beyond a predetermined end position in the direction thereof caused by air flow in an air duct.

A further object of the invention is to provide an air flow switch embodying switch means adapted to be actuated by movement of the paddle rod means before the latter is disposed in its aforementioned predetermined end position so as to prevent fluttering of the switch means by pulsing of air in an air duct with which the air flow switch is associated.

A further object is to provide an air flow switch having novel sealing means for preventing air in the duct from entering the air flow switch housing.

The above and other objects and advantages of my invention will appear from the following detailed description of a preferred embodiment of the invention.

Now in order to acquaint those skilled in the art with the manner of constructing and utilizing an air flow switch in accordance with the principles of the present invention, there is described below in connection with the accompanying drawings, a preferred embodiment of the invention.

In the drawings:

FIGURE 1 is a vertical cross-sectional view of an air flow switch of the present invention shown mounted on the side wall of an air duct with the view being taken substantially along the line 1—1 of FIGURE 2 looking in the direction indicated by the arrows, and with certain parts shown in elevation.

FIGURE 2 is a horizontal cross-sectional view of the air flow switch and duct of FIGURE 1 with certain parts shown in elevation;

FIGURE 3 is a detail vertical cross-sectional view taken substantially along the line 3—3 of FIGURE 1 looking in the direction indicated by the arrows;

FIGURE 4 is a detail vertical cross-sectional view taken substantially along the line 4—4 of FIGURE 1 looking in the direction indicated by the arrows;

FIGURE 5 is a plan view of the paddle rod means and air sealing means embodied in the air flow switch of FIGURES 1 and 2;

FIGURE 6 is a detail vertical sectional view taken substantially along the line 6—6 of FIGURE 1 looking in the direction indicated by the arrows showing the paddle means of the air flow switch of FIGURES 1 and 2 in normal position and in absence of air flow in the air duct;

FIGURE 7 is a view corresponding to FIGURE 6 showing the paddle means in one position as caused by predetermined flow of air in the air duct;

FIGURE 8 is a detail vertical sectional view taken substantially along the line 8—8 of FIGURE 1 looking in the direction indicated by the arrows; and

FIGURE 9 is a detail vertical sectional view taken substantially along the line 9—9 of FIGURE 1 looking in the direction indicated by the arrows.

Referring now to FIGURES 1 and 2 of the drawings there is shown an air flow switch **10** of the present invention which typically may be mounted on one vertical side wall **11** of a conventional air duct **12**. The air flow switch **10** comprises an enclosing housing, indicated generally at **13**, from which paddle rod means **14** extends through the side wall **11** of and for supporting paddle means **15** within the duct **12**.

The housing **13** comprises a base mounting plate **16** providing for the support of air flow switch **10** at opening **17** in the side wall **11** of the duct as by securing of the peripheral flange **18** of the supporting base plate in any suitable manner adjacent the outer surface of the wall **11** around opening **17**. If desired, a gasket **19** may be interposed between the inner surface of the flange **18** and the adjacent outer surface of wall **11**. Flanges **20** and **21** at the base end of housing **13** are secured between the supporting base **16** and a fulcrum plate member **22** by a plurality of nuts and bolts **23**. A sealing ring retainer **24** is secured to base **16** as by staking as indicated at **25**. An annual sealing ring **26** preferably of material of low frictional characteristics, such as nylon or Teflon, is clamped about its periphery between sealing ring **26** and the opposed surface of supporting base **16**.

The paddle rod means **14** comprises a rod **30** at the inner end thereof within housing **13** through which a pivot pin **32** extends with the opposite ends of the pivot pin projecting through ears **33** of a switch actuator **34** and through spaced apart ears **35** of fulcrum plate member **22**.

Cotter pins 36 may be provided at opposite ends of the pivot pin 32 to retain the latter in position. The outer end of rod 30 is formed with a projection 38 fitting or keyed in the conformably shaped opening 39 of switch actuator 34. A seal member 42 having a seat 43 conforming to a portion of a surface of a sphere is mounted on rod 30 with the seat 43 in sliding sealing engagement with the inner edge of annular sealing ring 26. A sleeve 45, paddle stop means indicated at 47, and a paddle extension rod 48 are secured to rod 30 by a pair of pins 49 passing through these several components. The sleeve 45 thus securely holds the seal member 42 in position against shoulder 52 of rod 30.

The paddle means 15, as shown, comprises a pair of components, such as pivotable paddle component means 60 and 62 mounted on paddle extension rod 48 to extend transversely of duct 12 and in the path of air flowing through the duct. The paddle component 60 is preferably fabricated of light gauge sheet metal, and is formed with a pair of integral and spaced apart tubular bearing portions 63 along the lower edge thereof through which extension rod 48 extends. The paddle component 62 is of the same construction as paddle component 60 but is arranged with its tubular bearing portions 63 along the upper edge thereof with such tubular bearing portions 63 of the pair of paddle components in alternate relation along extension rod 48. Cut outs 64 and 65 are formed in paddle components 60 and 62 to provide for the reception of a washer 66 adjacent the outer end of rod 48 which together with cotter pin 67 retain the paddle components 60 and 62 on the rod 48. Paddle spring means 68 in part surrounds rod 48 substantially mid-way between opposite ends of the paddle components 60 and 62, and legs 69 and 70 of spring means 68 engage the surfaces of the paddle components 60 and 62, respectively. The aforementioned paddle stop means 47, as best seen in FIGURES 5, 6 and 7, comprises a U-shaped end portion 71, the upper and lower legs 72 and 73 of which are formed with slots 74 and 75, the inner ends of which provide stops 76 and 77, respectively, for limiting clockwise movement of pivotable paddle component 60 and counter clockwise movement of pivotable paddle component 62 as viewed in FIGURES 6 and 7. The legs 69 and 70 of the aforementioned paddle spring means 68 provide for normally disposing the pivotable paddle components 60 and 62 to the positions shown in FIGURE 6. In this position, the paddle components 60 and 62 provide the maximum effective area of paddle means 15 traversing the duct 12 and opposing air flowing through the duct in the direction of air flow as indicated by the arrow in FIGURE 2. As will be described later in detail, the spring means 68 may be selected to provide any desired loading of the paddle components 60 and 62 and the force of such spring may be overcome by a given predetermined air flow through the duct in the indicated direction so as to effect relative pivotal movement of the paddle components 60 and 62 toward each other and reduce the effective surface area of paddle means 15 and thus provide minimum obstruction to air flow through the duct 12.

Referring to the aforementioned switch actuator 34, it will be seen that it further compirses a flange 75 which has mounted thereon one end of a spring guide member 76 which at its other end provides a seat for paddle rod spring means in the form of a coil spring 77. The other end of coil spring 77 supports a spring seat member 78 and into which a bolt 79 threaded in flange 80 of a switch supporting plate 82 is seated. The bolt 79 provides for adjusting the force of the paddle rod spring means 77. The switch supporting plate 82 extends transversely of and is suitably mounted in fixed relation in housing 13. The switch supporting plate 82 has a switch actuator stop member 85 secured thereto which is formed with a stop projection 86 for engaging and preventing movement of switch actuator 34 in a clockwise direction around the axis of pivot pin 32 as viewed in FIGURE 2. A switch adjusting plate 90 carrying known switch means, as indicated at 92, which switch means may, for example, comprise a conventional snap action switch is mounted on switch supporting plate 82. Suitable conventional adjusting and mounting screw means 91 may be provided for adjusting the plate 90 and switch means carried thereby to provide for the desired positioning of switch actuating blade 93 as desired. The switch actuator 34 as best seen in FIGURES 1 and 2 further comprises a plate member 94 for engaging the abutment 95 of switch blade 93 of the switch means 92 for effecting actuation of the latter. As noted, the switch means 92 is conventional and may be adjusted according to conventional practice of the art and further may also be enclosed in a suitable protected housing as indicated at 97.

In the arrangement of components as above described, and with a predetermined air flow through the duct 12 in the direction indicated by the arrow in FIGURE 2, it will be observed that such air flow in the duct 12 will effect movement of paddle means 15 and control rod means 14 in a clockwise direction relative to pivot pin 32, as viewed in FIGURE 2, effecting movement of switch actuator 34 in a direction for engaging plate 94 thereof with the projection 95 of the switch blade 93 of switch means 92. Actuation of the switch means 92 may as previously indicated provide for the energization of signal means at a control center indicating flow of air through the duct 12. As above mentioned the paddle spring means 68 normally disposes the pivotable paddle components 60 and 62 in position of maximum effective area against air flow through the duct, but such spring means may be selected so that at a predetermined air flow through the duct the paddle components 60 and 62 pivot toward each other and against the force of the spring means 68 to substantially lessen or render completely ineffective, the effective area of paddle means 15 restricting air flow through the duct to thus provide for the efficient movement of air in the duct. By reason of the mode of operation as last described, pulsing of air in the duct 12 in view of the small area of the paddle rod means and paddle components 60 and 62 in the duct serve to prevent on and off actuation of the switch means 92.

Further, it will be observed upon predetermined air flow through the duct 12 as above described that the clockwise rotation of control rod means 14 as seen in FIGURE 2 about the pivot pin 32 is yieldingly resisted by compression of paddle rod spring means 77 before movement of switch actuator 34 is arrested by engaging the abutment 86 of the paddle rod stop member 85. It is also an important aspect of the instant invention to provide upon movement of the paddle rod means 14 in the manner described that the actuator member 34 effects tripping of switch means 92 before the actuator member 34 abuts the stop 86 so that pulsing of air flow in the duct 12 will not effect off and on actuation of switch means 92. The paddle rod stop member 85 may thus be positioned to provide for the desired further movement of the paddle rod means 14 and paddle components 60 and 62 in a clockwise direction as viewed in FIGURE 2 such that predetermined movement of such components in a counterclockwise direction about the pivot pin 32 as may be caused by pulsing of air in duct 12 will not effect off and on tripping of the switch means 92 by the switch actuator 34. Thus, the switch means 92 may be closed prior to movement of the switch actuator 34 being arrested by the stop member 85 to thus avoid bouncing or opening and closing of switch 92 due to irregular or pulsing air flow in the duct 12.

In the aforementioned pivotal movement of the control rod means 14 it will be observed that the spherical sealing surface 43 of the seal 42 maintains sealing engagement with the annular sealing ring 24 for preventing

air in the duct from escaping into the housing **13** of the air flow switch means **10**.

While there has been shown and described a preferred embodiment of the air flow switch of the present invention, it will be understood that various modifications and rearrangements may be made therein without departing from the spirit and scope of the invention.

I claim:

1. A flow switch for association with a fluid conducting duct comprising a housing adapted to be mounted on said duct, electrical switch means mounted in said housing, paddle rod means pivotally mounted at one end thereof within said housing and with the other end of said paddle rod means extending into said duct, paddle means carried at said other end of said paddle rod means, said paddle means being movable by fluid flow in said duct to effect movement of said paddle rod means, said paddle means including pivotable paddle components movable around said other end of said paddle rod means and relative to each other from a first position by predetermined flow of air through said duct for decreasing the effective surface area of said paddle components of said paddle means exposed to fluid flow in said duct, spring means in engagement with said pivotable paddle components for normally biasing said paddle components towards said first position, and switch actuator means between said one end of said paddle rod means and said electrical switch means for opening and closing the latter upon predetermined movement of said paddle rod means.

2. A flow switch for association with a fluid conducting duct comprising a housing adapted to be mounted on said duct, electrical switch means mounted in said housing, paddle rod means pivotally mounted at one end thereof in said housing and with the other end of said paddle rod means extending into said duct, paddle means carried at said other end of said paddle rod means, said paddle means being movable by fluid flow in said duct to effect pivotal movement of said paddle rod means, said paddle means comprising pivotable paddle components movable around said other end of said paddle rod means and relative to each other from a first position by predetermined flow of fluid through said duct for decreasing the effective surface area of said paddle components of said paddle means exposed to fluid flowing in said duct, spring means in engagement said pivotable paddle components for normally biasing said paddle components toward said first position, and switch actuator means between said one end of said paddle rod means and said electrical switch means for opening and closing the latter upon predetermined pivotal movement of said paddle rod means.

3. A flow switch for association with a fluid conducting duct comprising a housing adapted to be mounted on said duct, electrical switch means mounted in said housing, paddle rod means pivotally mounted in said housing, paddle means adapted to be disposed in said duct carried by said paddle rod means, spring means connected to said paddle rod means for resisting movement of said paddle rod means, said paddle means being movable by fluid flow in said duct to effect pivotal movement of said paddle rod means against said spring means, said paddle means comprising pivotable paddle components movable relative to each other from a first position by predetermined flow of air through said duct for decreasing the effective surface area of said paddle components of said paddle means exposed to fluid flowing in said duct, spring means between said paddle rod means and said pivotable paddle components normally biasing said paddle components toward said first position, and switch actuator means between said paddle rod means and said electrical switch means for opening and closing the latter upon predetermined pivotal movement of said paddle rod means.

4. A flow switch for association with a fluid conducting duct comprising a housing adapted to be mounted on said duct, electrical switch means mounted in said housing, paddle rod means pivotally mounted in said housing, paddle means adapted to be disposed in said duct carried by said paddle rod means, spring means connected to said paddle rod means for resisting movement of said paddle rod means, means in engagement with said spring means for adjusting the resistance of the latter, said paddle means being movable by fluid flow in said duct to effect pivotal movement of said paddle rod means against said spring means, said paddle means comprising pivotable paddle components movable relative to each other from a first position by predetermined flow of air through said duct for decreasing the effective surface area of said paddle components of said paddle means exposed to fluid flowing in said duct, spring means between said paddle rod means and said pivotable paddle components normally biasing said paddle components toward said first position, and switch actuator means between said paddle rod means and said electrical switch means for opening and closing the latter upon predetermined pivotal movement of said paddle rod means.

5. A flow switch for association with a fluid conducting duct comprising a housing adapted to be mounted on said duct, electrical switch means mounted in said housing, paddle rod means pivotally mounted in said housing, paddle means adapted to be disposed in said duct carried by said paddle rod means, said paddle means being movable by engagement therewith of fluid flowing in said duct to effect pivotal movement of said paddle rod means, paddle rod stop means mounted in said housing for limiting movement of said paddle rod means by fluid flow in said duct against said paddle means, paddle rod spring means connected to said paddle rod means for resisting movement of said paddle rod means before engagement of the latter with said paddle rod stop means, said paddle means comprising pivotable paddle components movable relative to each other from a first position by predetermined flow of fluid through said duct for decreasing the effective surface area of said paddle components of said paddle means exposed to fluid flowing in said duct, spring means between said paddle rod means and said pivotable paddle components normally biasing said paddle components toward said first position, and switch actuator means between said paddle rod means and said electrical switch means for opening and closing the latter upon predetermined pivotal movement of said paddle rod means.

6. A flow switch for association with a fluid conducting duct comprising a housing adapted to be mounted on said duct, electrical switch means mounted in said housing, said electrical switch means comprising a movable switch member, paddle rod means pivotally mounted in said housing, paddle means adapted to be disposed in said duct carried by said paddle rod means, said paddle means being movable in one direction by engagement therewith of fluid flowing in said duct to effect pivotal movement in one direction of said paddle rod means, paddle rod stop means mounted in said housing for limiting movement of said paddle rod means in said one direction of movement thereof, paddle rod spring means connected to said paddle rod means for resisting movement of said paddle rod means in said one direction of movement thereof before engagement of the latter with said paddle rod stop means, said paddle means comprising pivotable paddle components movable relative to each other from a first position by predetermined flow of fluid through said duct for decreasing the effective surface area of said paddle components of said paddle means exposed to fluid flow in said duct, spring means between said paddle rod means and said pivotable paddle components normally biasing said paddle components toward said first position, and switch actuator means between said paddle rod means and said switch member of said electrical switch means for opening and closing the latter upon predetermined pivotal movement of said paddle rod means in said one direction and before engagement of said paddle rod means with said stop means.

7. A flow switch for association with an air conducting duct comprising a housing adapted to be mounted on said duct, electrical switch means mounted in said housing, paddle rod means pivotally mounted adjacent one end thereof in said housing and having an outwardly projecting portion extending through an opening in said housing for positioning in said air duct, paddle means adapted to be disposed in said air duct carried by said outwardly projecting portion of said paddle rod means, an annular sealing ring mounted at said opening of said housing, a seal member mounted on said paddle rod means, said seal member having a surface conforming to a portion of the surface of a sphere engaging said sealing ring for preventing entry of air into said housing from said duct, said paddle means being movable by air flow in said air duct to effect pivotal movement of said paddle rod means, said paddle means comprising pivotable paddle components movable relative to each other by flow of air through said duct for decreasing the effective surface area of said paddle components of said paddle means exposed to air flow in said duct, and switch actuator means between said paddle rod means and said electrical switch means for opening and closing the latter upon predetermined pivotal movement of said paddle rod means.

8. A flow switch for association with an air conducting duct comprising a housing adapted to be mounted on said duct, electrical switch means mounted in said housing, paddle rod means pivotally mounted adjacent one end thereof in said housing and having an outwardly projecting portion extending through an opening in said housing for positioning in said air duct, paddle means adapted to be disposed in said air duct carried by said outwardly projecting portion of said paddle rod means, said paddle means being movable by air flow in said air duct to effect pivotal movement of said paddle rod means, said paddle means comprising pivotable paddle components normally disposed in a first position presenting a predetermined surface area exposed to air flowing in said duct, spring means between said paddle rod means and said paddle means normally biasing said paddle components toward said first position, and said paddle components being movable toward each other by predetermined flow of air through said duct for decreasing the effective surface area of said paddle components of said paddle means exposed to air flow in said duct, and switch actuator means between said paddle rod means and said electrical switch means for opening and closing the latter upon predetermined pivotal movement of said paddle rod means.

9. A flow switch for association with an air conducting duct comprising a housing adapted to be mounted on said duct, electrical switch means mounted in said housing, paddle rod means pivotally mounted adjacent one end thereof in said housing and having an outwardly projecting portion extending through an opening in said housing for positioning in said air duct, paddle means adapted to be disposed in said air duct carried by said outwardly projecting portion of said paddle rod means, said paddle means being movable by air flow in said air duct to effect pivotal movement of said paddle rod means, paddle stop means carried by said paddle rod means, said paddle means comprising pivotable paddle components movable relative to each other, spring means carried by said paddle rod means for engaging said paddle means for biasing said paddle components toward said paddle stop means for disposing said paddle means in a first position presenting a predetermined surface area exposed to air flowing in said duct, said paddle components being movable toward each other against the force of said spring means by predetermined flow of fluid through said duct for decreasing the effective surface area of said paddle components of said paddle means exposed to air flow in said duct, and switch actuator means between said paddle rod means and said electrical switch means for opening and closing the latter upon predetermined pivotal movement of said paddle rod means.

10. A flow switch for association with a fluid conducting duct comprising a housing adapted to be mounted on said duct, electrical switch means mounted in said housing, paddle rod means pivotally mounted at one end portions thereof in said housing and having its other end portion extending into said duct, paddle means carried by said other end portion of said paddle rod means, said paddle means being movable by fluid flow in said duct to effect movement of said paddle rod means, switch actuator means mounted on said one end portion of said paddle rod means and adjacent said electrical switch means for effecting actuation of the latter upon a first predetermined amount of movement of said paddle rod means in one direction of fluid flow in said duct, and stop means mounted in said housing in position for engaging said switch actuator means to arrest movement of said paddle rod means upon movement of the same a second predetermined amount beyond said first predetermined amount of movement in said one direction of fluid flow.

11. A flow switch for association with a fluid conducting duct comprising a housing adapted to be mounted on said duct, electrical switch means mounted in said housing, paddle rod means pivotally mounted at one end portion thereof in said housing and having its other end portion extending into said duct, paddle means carried by said other end portion of said paddle rod means, said paddle means being movable by fluid flow in said duct to effect movement of said paddle rod means, switch actuator means between said paddle rod means and said electrical switch means for effecting actuation of the latter upon a first predetermined amount of movement of said paddle rod means in one direction of fluid flow in said duct, spring means mounted in said housing and engaging said switch actuator means for resisting movement of said paddle rod means in said one direction of fluid flow in said duct, and stop means mounted in said housing in position for engaging said switch actuator means to arrest movement of said paddle rod means upon movement of the same a second predetermined amount beyond said first predetermined amount of movement in said one direction of fluid flow.

References Cited

UNITED STATES PATENTS

2,038,111	4/1936	Hopkins	200—81.9
2,211,553	9/1940	Bogue	200—81.9
3,126,463	3/1964	Kmiecik	200—81.9
3,147,620	9/1964	Stapler	73—228

BERNARD A. GILHEANY, *Primary Examiner.*

G. MAIER, H. BROOME, *Assistant Examiners.*