April 14, 1953 B. J. WILSON 2,635,153

FLUID PRESSURE RESPONSIVE DIFFERENTIAL BELLOWS SWITCH DEVICE

Filed June 12, 1950 2 SHEETS—SHEET 1

Fig. 1.

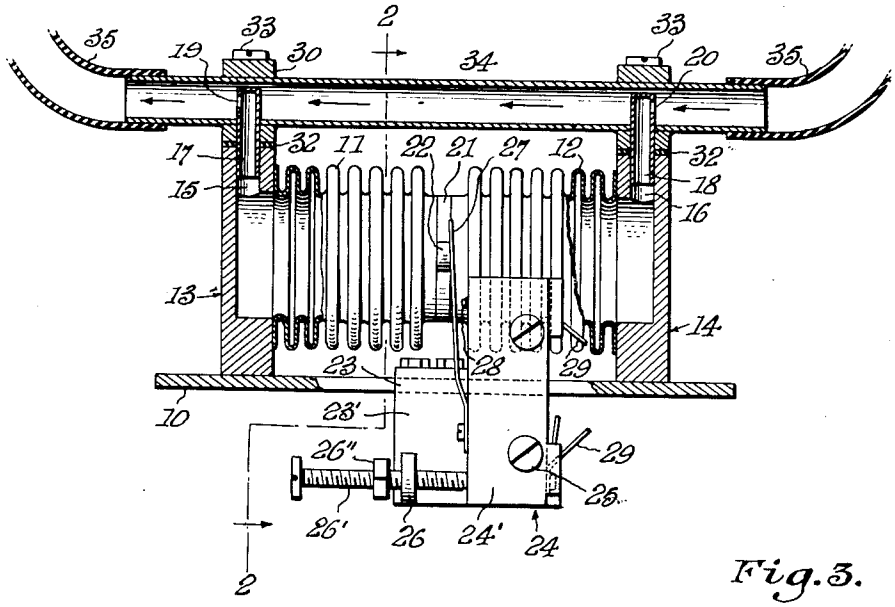


Fig. 3.

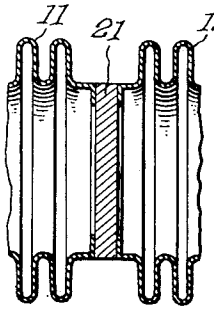
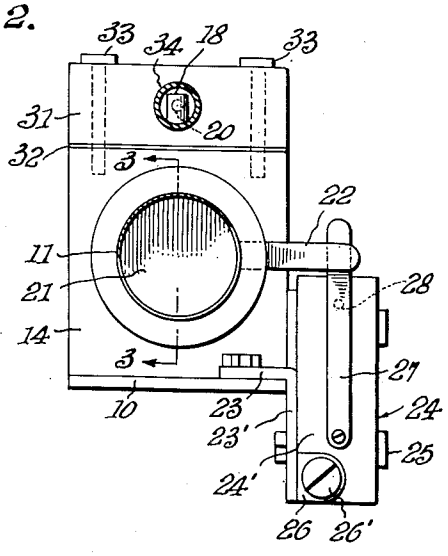


Fig. 2.



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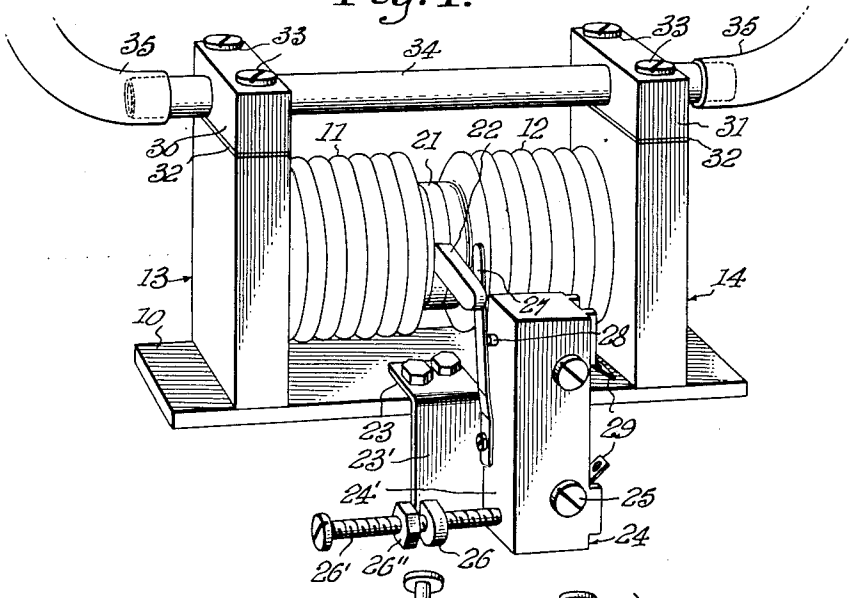
ATTORNEY

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Fig. 4.



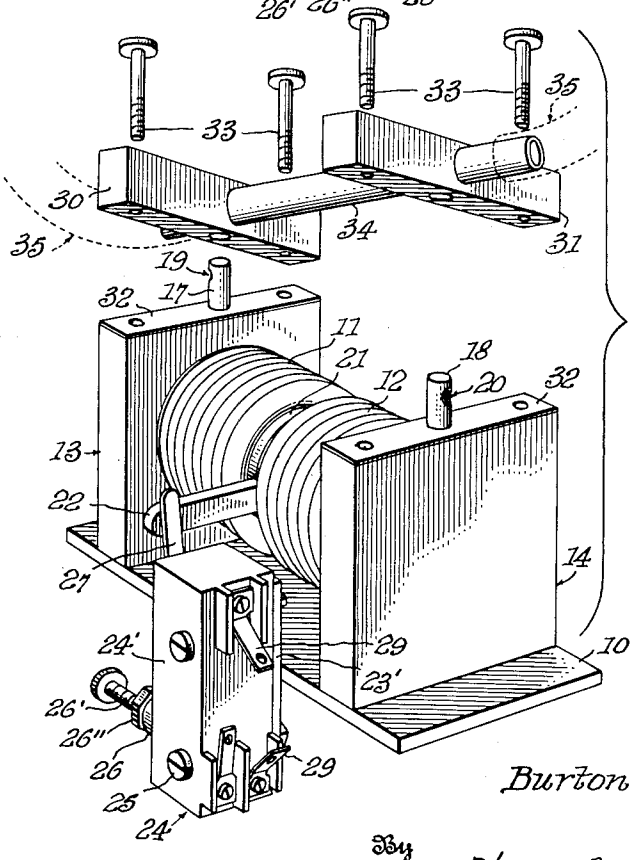


Fig. 5.

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FLUID PRESSURE RESPONSIVE DIFFERENTIAL BELLOWS SWITCH DEVICE

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2 Claims. (Cl. 200—81.9)

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The invention relates to controls responsive to liquid flow in conduits, and especially where a minimum rate of flow or more must be maintained to preserve systems or devices in safe operating conditions.

The invention is particularly designed for response to flow of coolant to devices which would be damaged if the coolant is not supplied in adequate quantity per unit of time, so as to either remedy the deficiency, or to stop or change operation of the cooled element to prevent damage.

An object of the invention is to improve the construction of such control devices which utilize the difference between the static pressure in a coolant supply duct and resultants of static pressure and velocity head of the coolant flowing through the duct, to respond properly and control operation of a cooled device so as to prevent damaging operation of the latter when inadequately cooled.

It is a specific object of the invention to present a novel construction in a switch operatively associated with a differential bellows device so as to respond effectively to differentials of pressure in two bellows, and which will be inexpensive to manufacture, simple in action, and maintenance, and easily adjustable to vary the response condition at which the switch is desired to operate.

The invention is particularly valuable in cooling systems for radio tubes of transmitters and radar units, and has been found especially important for use in field equipment of the kinds named where liabilities of impairment of flow by impurities in the coolant are especially great.

In these systems water is used as the coolant. It is often necessary in field units to remove detritus from the conduit with which the differential bellows is connected, and it is therefore an important aim of this invention to provide a construction wherein rapid access to the restricted Pitot ports and passages of the coolant duct and bellows connection may be gained by simple procedure, yet using a construction which is rugged and effective for its control function. It is specifically applied to the use of Pitot tubes, enabling quick exposure of the flow-incident apertures for cleaning without uncoupling the duct pipe.

Additional objects, advantages and features of invention will be manifest from the disclosure of this application and reside in specific construction, combination and arrangement of parts described and shown, or understood therefrom.

The invention may be applied to uses otherwise than specifically named for control or other purposes by responding to exceptional fluid flow conditions, as will be readily understood from the following description and accompanying drawings, wherein:

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Figure 1 is a front elevation of a control unit embodying the invention, partly in section;

Figure 2 is a cross section thereof on the line 2—2 of Fig. 1.

Figure 3 is a fragmentary section on the line 3—3 of Fig. 2.

Figure 4 is a perspective view of the unit of Fig. 1.

Figure 5 is an exploded perspective view showing the heads and the duct detached.

The system herein disclosed is generally similar to that in the disclosure of the application of Steigerwalt, S. N. 631,191, filed November 27, 1945, for Differential Bellows Switch, now Patent No. 2,508,584 of May 23, 1950.

Referring to the drawings, there is shown a differential bellows switch device responsive to differences in static pressure and static pressure plus velocity head or velocity head components, in a conduit through which a coolant, such as water, flows to a point of heat exchange.

The device in its present embodiment comprises a base plate 10 as a support, which may be located in a position convenient for access, over and upon which are mounted two generally cylindrical coaxially expandible and contractible bellows 11 and 12 arranged end to end, their outer ends being closed by means of stationary heads 13 and 14 respectively which extend below the bellows and rest upon the base plate 10. The tops of these heads are planiform at a common level, and the heads are recessed at their inner sides in communication with the respective bellows and have respective vertical ports 15 and 16 extending upwardly from the recesses through the upper faces of the heads. Set in these ports there are respective Pitot tubes 17 and 18 closed at their upper extremities but having apertures 19 and 20 therein near their extremities and opening in opposite directions coincident with the axis of the duct 34 hereinafter described.

The mutually adjacent ends of the bellows are joined to a plate or floating head 21 having a rigid integral radial arm 22 extended therefrom substantially parallel to the plate 10. A bracket 23 is secured to the plate 10, having a vertical planiform switch-carrying plate 23' extending above and below the plate. A switch assembly 24 is mounted pivotally on this plate 23' for oscillation in a vertical plane beside the plate 23',

approximately normal to the arm 22. The pivot for this switch assembly may be a switch assembly bolt 25 located near the lower end of the switch assembly and engaged through the plate 23'. Engaged in a nut 26 secured to the plate 23' there is an adjustment screw 26' impinging against the lower end of the case 24' and having a locknut 26''. This limits movement of the switch case on its pivot, and serves to adjust the upper end of the switch toward the arm 22 or allow it to move from the arm. The switch proper consists of a leaf spring or blade 27, in the present instance fixed on the lower part of the case 24' of the switch assembly and extending a distance above the case and past the arm 22. The blade rests constantly against the arm 22, maintaining the latter under sufficient stress to hold the lower end of the case at all times against the adjusting screw 26', which determines its position under pressure of the blade 27. A fixed contact 28 is mounted on the case exposed so as to be engaged by the spring blade 27 when the latter is pressed far enough horizontally by the arm 22.

Terminals 29 are mounted on the case 24', one connected to the contact 28, and the other to the base of the spring blade 27 conventionally.

The bellows 11 and 12 are inherently resilient and tend to assume a medial position where their opposing stresses are balanced. In this state, it will be appreciated that if liquid under unbalanced pressures is admitted through the ports 15 and 16, the predominating pressure will move the arm 22 toward the bellows having the lesser pressure.

Mounted on the heads 13 and 14 there are respective caps 30 and 31 with gaskets 32 interposed, the caps being secured by suitable screws 33 of which two are shown in each cap. Welded in and extending through these caps there is a duct 34, consisting of a simple cylindrical tube parallel to the axis of the bellows, its ends extending sufficiently beyond the caps to permit conventional influent and effluent conduit connections or couplings 35 detachable or displaceable, such as hose or pipe. In the uses to which the invention has heretofore been applied, flexible hoses 35 have been clamped on the ends of the duct, one leading from a water supply and the other to a point of discharge.

The caps and the duct tube are bored at their lower sides to receive freely and simultaneously therethrough the upstanding Pitot tubes 17 and 18, which stop short of the upper side of the duct 34 when the caps are secured firmly upon the heads 13 and 14. When so assembled, it will be seen that the openings 19 and 20 in the Pitot tubes are presented longitudinally of the tube and outwardly and away from the respective bellows with which the tubes communicate.

In the arrangement shown, it will be seen that the device may be so adjusted that at a balanced condition of pressure in the bellows, the arm 22 may be in an engagement with the switch spring 27 holding the latter under moderate tension but without pressing it against the contact 28 by which a circuit could be closed. This also holds switch assembly case against the adjusting screw 26' so that the position of the contact 28 with respect to the spring 27 at a predetermined pressure resultant in the position of arm 22 may represent a normal operating condition and position of the parts and the systems with which the device may be associated as a control. As shown in Figures 1 and 3, the arrangement would be suitable for use, for instance, where the right end of the tube is the influent one, the liquid leaves the tube toward the left. Thus, as long as a sufficient flow of the liquid is maintained to the cooling system the predominance of pressure including both static pressure and velocity head, will hold the bellows 12 so extended against the moderate pressure in the bellows 11 as to permit the switch arm 27 to swing away from the contact 28. Should the coolant supply fail however, or its velocity fall to an objectionable degree, or obstruction of the orifice 20 occur, the predominance of pressure at the right in the bellows 12 will be relieved, and the inherent resilience of the two bellows will cause corresponding movement of the arm 22 toward the right, pressing the spring 27 upon the contact 28. This may be used in various ways, as will be readily understood, as, to close an alarm circuit; to close a solenoid circuit or other device circuit; to open or close the circuit to the radio tube or other element then threatened, as for instance, a rectifier tube or other tube in a circuit for transmission or reception of radiant energy.

It will be appreciated that the apertures in the Pitot tubes can become blocked or partly obstructed by detritus such as threads and fibers which are especially apt to get into the coolant liquid incident to field operations of military units, especially in combat service. In case such obstruction should occur, the arrangement of the Pitot tubes is such that an immediate indication wil be given because of the change of pressures in the bellows. It will then be possible for an attendant to remove the assembly screws 33 holding the caps 30 and 31 in place, so that the tube 34 may be lifted from the device with the caps. With looped hose connected to the tube 34, the separation of the caps from the heads may be done without disconnecting the duct couplings. This exposes the Pitot tubes for cleaning with facility, and if the hoses are disconnected it also makes possible an optical inspection of the interior of the duct 34 and cleaning of the latter. In case the Pitot tubes 17 and 18 are threaded and screwed into the heads, removal and cleaning of the passages therethrough becomes a very simple matter.

I claim:

1. In a differential bellows switch control device comprising opposed bellows having fixed stationary heads at the distal ends of the bellows and pressure-responsive movable heads at the mesial ends of the bellows, a switch device operatively connected with the movable heads for movement thereby so as to be held toward one limit by normal differentials of opposing pressures in the bellows, and to be moved to an exceptional position by variation toward a given extreme in the resultant of the two pressures; the construction wherein the fixed heads have ports therethrough from respective bellows, respective outstanding parallel Pitot tube nipples set in said ports, said Pitot tube nipples extended from the heads in the same direction, and cap members separably connected with the heads around the bases of the Pitot tube nipples and having a duct tube fixed therethrough, said caps and duct tube having openings therethrough spaced and positioned to receive the Pitot tubes simultaneously and slidably therethrough, and means to secure the caps separably upon the heads in fluid-tight relation, with said Pitot tubes extending into the duct tube, the open-

ings in said Pitot tube nipples being presented in opposite directions longitudinally of the duct, whereby a differential of static and velocity head pressures will be manifest in the bellows proportionate to the rate of flow of liquid through the duct.

2. The structure of claim 1 wherein said switch comprises a stationary base, a case pivoted thereon for movement in a plane generally coincident with the path of movement of said switch device to and from said exceptional position, a stop fixed with the base adjustable in said plane to engage a movable part of the case and limit pivotal movement thereof in one direction, said switch having a leaf spring switch blade having a free end extended a substantial distance radially from the pivot of the case and swingable in said plane, said blade having a closed switch position adjacent the case and tending inherently to move to an open position and beyond, the said switch device having an arm fixed to the movable heads of the bellows and movable therewith generally in the direction of swing of said blade and in a linear path intersecting the blade medially and transverse

to said first named plane, said arm having a medial position spaced from the closed position of the free end of said blade for translative movement by the said connected heads of the bellows under variations of differential in pressures in the bellows, said arm being positioned against said blade to engage the latter so as to apply flexing moment thereto and therethrough to the case acting toward said stop, and a contact on the case in the path of flexure of the blade opposite the arm, whereby said blade tends to hold the switch open yieldable to said arm, and holds the first named part of the case against said stop throughout adjustment positions of the stop.

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