Sept. 19, 1950 J. E. BEVINS 2,522,596

ALTITUDE SWITCH

Filed April 25, 1946

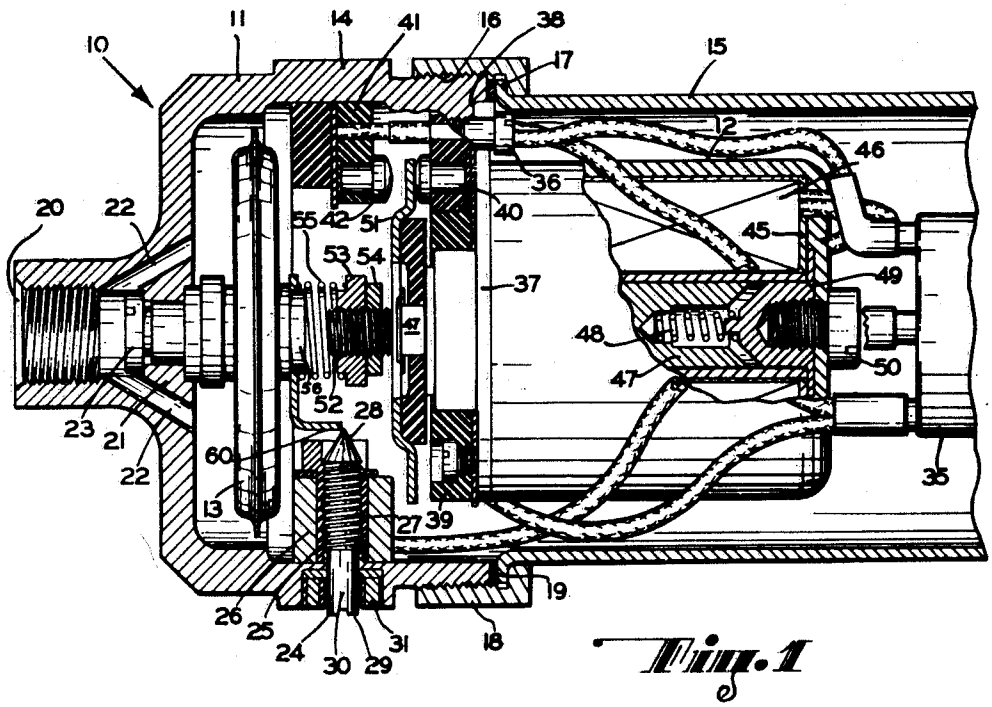

Fig. 1

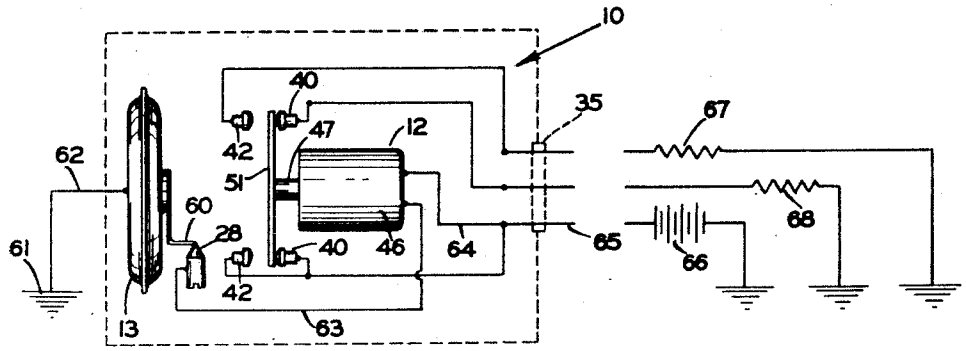

Fig. 2

INVENTOR

JAMES E. BEVINS

BY Antony Gille.

ATTORNEY

Patented Sept. 19, 1950 2,522,596

UNITED STATES PATENT OFFICE

2,522,596

ALTITUDE SWITCH

James E. Bevins, Ramsey, N. J., assignor to Bendix Aviation Corporation, Teterboro, N. J., a corporation of Delaware

Application April 25, 1946, Serial No. 664,718

11 Claims. (Cl. 200—81)

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This invention relates to an altitude switch, and more particularly to an altitude switch which is closed and then opened at different predetermined values of absolute pressure.

An object of my present invention is to provide an altitude switch in which an aneroid will actuate a circuit making device when barometric pressure reaches a predetermined value, and which will restore said device to its initial condition when the absolute pressure returns to a second predetermined value.

Another object of my invention is to provide an altitude switch of the character described in which the absolute pressure values at which the circuit making device will be actuated by the aneroid, and at which said device is restored to its initial condition are readily adjustable.

A further object of my invention is to provide an altitude switch of the character described in which the expansion and contraction of the aneroid is affected by the actuation of the circuit making device to vary the absolute pressure at which said device is restored to its initial condition by said aneroid.

Still a further object of the present invention is to provide an altitude switch of the character described in which immediate recycling is prevented upon restoration of the circuit making device to initial condition in the event the absolute pressure varies a small amount.

Still another object of the invention is to provide a highly compact and rugged altitude switch of the character described which shall be automatic and positive in its operation, relatively inexpensive to manufacture, which shall have a large variety of applications and yet be practical and efficient to a high degree in use.

Other objects of this invention will in part be obvious and in part hereinafter pointed out.

The invention accordingly consists in the features of construction, combinations of elements, and arrangement of parts which will be exemplified in the construction hereinafter described, and of which the scope of application will be indicated in the following claims.

In the accompanying drawings in which one of the various possible illustrative embodiments of my invention is shown,

Figure 1 is a side view of an altitude switch, portions of which have been broken away, the working parts of said switch being shown in elevation and cross section, while,

Figure 2 is a wiring diagram showing the electric connections for said altitude switch.

The altitude switch herein provided comprises an aneroid and a solenoid mounted in a sealed casing, ambient pressures being applied to the

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interior of said casing through a suitable inlet. The aneroid carries a pilot contact which is adapted upon expansion of the aneroid to engage a stationary contact to complete an energizing circuit for the solenoid. Energization of the solenoid will cause the core thereof to be retracted, the movement of the core being used to open and close the controlled circuit.

Two springs are associated with the solenoid of the herein described altitude switch. One of said springs is a return spring normally provided in solenoid construction for the return of the core to its initial condition upon de-energization of the solenoid. The second spring, of less resilience than the first spring, is interposed between the core and the aneroid. When the pressure is higher than the predetermined pressure at which the solenoid is to be energized, the return spring of the solenoid causes pressure to be exerted upon the aneroid due to the bias of the second spring. Thus, the normal expansion of the aneroid is retarded by the increased pressure thereon by the aforesaid spring.

Upon sufficient expansion of the aneroid against the bias of the spring, the pilot contacts will close to energize the solenoid. The energization of the solenoid will cause the core to retract, releasing the pressure of the aneroid spring to permit the aneroid to expand normally. The expansion of the aneroid upon release of the spring pressure will cause the pilot contacts to remain closed until the absolute pressure is reduced in value to a lesser value than that at which the pilot contacts were first closed. The disengagement of the pilot contacts will open the energizing circuit of the solenoid permitting the solenoid spring to return the core to its initial position causing the aneroid spring to compress the aneroid in the manner previously described. The pilot contacts are thus opened a greater amount which will prevent immediate recycling in the event that the absolute pressure is decreased a small amount.

Referring now in detail to the drawings, 10 designates an altitude switch embodying the invention, said switch comprising a sealed housing 11, a solenoid 12, and a pressure responsive member, or aneroid, 13.

The sealed housing 11 is formed by two shells 14, 15; the shell 14 being provided with a threaded portion 16, while shell 15 is provided with an annular flange 17. The two shells are fastened together by an annular ring clamp 18 threaded on portion 16 and engaging the flange 17. A resilient gasket 19 is interposed between the two shells to form a pressure tight seal.

The shell 14 is formed with a threaded open-

ing 20 to which a pressure line (not shown) may be connected. Within the opening 20 is a supporting wall 21 provided with a series of ports 22. Fixed to the center of said wall and concentric with opening 20, as by screw 23, is the pressure responsive member 13. The member 13 is thus fixed within a sealed casing into which the controlling pressures may be conducted by way of opening 20 and the ports 22.

The shell 14 is further provided with a transverse opening 24, concentric with a threaded opening 25 in a block 26 fixed within the shell. Threaded in the opening 25 is a screw 27, the purpose of which will be hereinafter apparent. The interior end 28 of said screw is beveled, while the cap or slotted end 29 extends exteriorly to said casing. The shank 30 of the screw is sealed against pressure leaks by bushings 31.

The shell 15 of the casing is provided with an electrical socket connector 35 (broken away) to which the various wires hereinafter described are soldered. Connection of the altitude switch into the controlled circuit or circuits is made by a plug connector (not shown) fitted into the socket connector.

The solenoid 12 is fixed within the casing 11 by screws 36 (one shown) passing through a flange 37 on said solenoid and threaded into a shoulder 38 within the shell 14. The screws 36 also mount an insulation block 39 carrying contacts 40. A second insulation block 41 carrying contacts 42 is suitably mounted within shell 14 spaced apart from block 39; the contacts 42 being in alignment with the contacts 40.

The solenoid 12 comprises a shell structure 45 supporting a coil 46; a movable core 47 and a return spring 48 therefor, the tension of which is adjustable by means of a threaded block 49 and a screw 50. The core 47 has affixed thereto by suitable means, and insulated therefrom, a contact arm 51 adapted to engage the contacts 40 when the solenoid is energized, as indicated in the figures, and to engage the contacts 42 when said solenoid is de-energized.

The solenoid core 47 is formed with a threaded end portion 52. Threaded thereon is a shouldered member 53 and a locknut 54. Abutting the shoulder of member 53 is a coil spring 55, the other end of which abuts a shouldered plate 56 fixed on the aneroid 13. The tension of spring 55 may be adjusted by means of shouldered member and the locknut. The spring is weaker than the solenoid return spring 48 previously described. Thus, when the solenoid is de-energized, the return spring 48 will return the core to its initial condition in which contacts 42 are engaged by contactor 51, to compress the spring 55.

Compression of spring 55 will exert a pressure on the member 13. Thus, in the case of decreasing ambient pressure, the expansion of the aneroid will be retarded by the pressure exerted by the spring. Upon actuation of the solenoid, the core will be moved against the bias of spring 48, releasing the compression of spring 55 as shown in Figure 1. The aneroid 13 may thus expand with but a small pressure thereon due to the spring 55.

Means is now provided to energize the solenoid 12 when a predetermined pressure affects the member 13, and to de-energize the solenoid when a second predetermined pressure affects said member.

To this end, there is fixed to the member 13 an electrical contact, grounded as at 61 through a lead 62 (Figure 2). The expansion of the

aneroid upon a decrease in ambient pressure within the casing 11, will move the contact 60 into engagement with the beveled contact 28 (of screw 27). Engagement of contacts 60, 28 will complete an energizing circuit for the solenoid which may be traced in Figure 2 from the ground connection 61, through the lead 62, contacts 60, 28, through a lead 63, thence through coil 46 of the solenoid, lead 64, to connector 35; continuing through the connector and lead 65 to a high side of a grounded battery 66. Actuation of the solenoid will break the circuit through the contacts 42 to the load resistor 67, and complete the circuit through contacts 40 to the load resistor 68.

The load resistors 67 and 68 illustrated herein may be any type of electrical equipment, such as electrically driven air pumps for superchargers, control mechanism for pulling a plane out of a dive, retracting mechanism for flap or landing gears on airplanes when predetermined pressure due to airspeed is reached, etc.

The pressure at which the aneroid will close the contacts 60, 28 is determined by the distance traveled by contact 60 upon the expansion of the aneroid. The distance may be varied by turning the screw 27 to increase or decrease the diameter of contact 28 in the line of travel of the contact 60. Thus the pressure at which the solenoid is energized may be readily changed from the outside of the casing 11. This is also true of the pressure at which the solenoid is deenergized, since the pressure on the contacts 60, 28 upon energization of the solenoid will be increased or decreased, as the case may be, by the increase or decrease of the diameter of contact 28.

De-energization of the solenoid will be affected upon the disengagement of the contacts 60, 28. Since the expansion of the aneroid was retarded by the compression of spring 55 by the solenoid, the pressure value at which the contacts were closed is lower than that at which the contacts would close were there no added spring pressure added thereto. Upon energization of the solenoid the pressure of spring 55 on member 13 is relieved permitting the member to expand. Thus upon an increase in ambient pressure, the aneroid will contract until a pressure is reached where the aneroid is sufficiently contracted to move the contact 60 away from contact 28. The pressure at which the contacts are opened will be higher than that at which the contacts first were closed since the pressure of spring 55 is not aiding in contracting the aneroid.

Upon opening of contacts 60, 28 the solenoid will be de-energized whereupon spring 55 will again compress the aneroid. The contact 60 is thus moved away quickly from contact 28 upon solenoid de-energization to prevent the immediate closure thereof should the ambient pressure affecting the aneroid momentarily decrease at that instant.

From the foregoing it will be obvious that the pressure responsive member 13, instead of being an evacuated capsule as described, actuated by the pressure within the casing 11; could be used to operate the herein described switch upon a predetermined pressure differential affecting the same. The interior of member 13 would be connected to the exterior of the casing 11 by a suitable line to which a second pressure line could be fastened in the manner herein described for the threaded opening 20. In the use of the switch for controlling aircraft equipment, the Pitot tube pressures could be used to expand and contract

the member 13; the dynamic pressure delivered to the interior of member 13, and the static pressure to the interior of casing 11, or vice versa.

Thus in the claims, the expression "predetermined pressure" will include a predetermined pressure within the casing 11, and a predetermined pressure differential of the pressure within member 13 and of the pressure within casing 11.

It will thus be seen that there is provided an altitude switch adapted to be used in an airplane to control many different types of electrical equipment at or between predetermined altitudes (pressure).

As various possible embodiments may be made of the above invention, and as various changes may be made in the embodiment above set forth, it is to be understood that all matter herein set forth, or shown in the accompanying drawings is to be interpreted as illustrative, and not in a limiting sense.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. A pressure switch comprising a pressure responsive member, contacts adapted to be actuated by said member at a predetermined pressure, and a circuit making device actuated upon actuation of said contacts, said device including resilient means for applying pressure on said member which is relieved upon actuation of said device permitting said contacts to be returned to initial condition by said member when a second predetermined pressure affects said member.

2. A pressure switch comprising a pressure responsive member, contacts adapted to be actuated by said member at a predetermined pressure, a circuit making device actuated upon actuation of said contacts, said device including resilient means for applying pressure on said member which is relieved upon actuation of said device permitting said contacts to be returned to initial condition by said member when a second predetermined pressure affects said member, and means for varying the values of the predetermined pressures at which said contacts are actuated and at which they are restored to initial condition.

3. A pressure switch comprising a pressure responsive member, contacts adapted to be actuated by said member at a predetermined pressure, a solenoid energized upon actuation of said contacts, and a resilient member associated with said solenoid for applying pressure on said member, said pressure being relieved upon energization of said solenoid permitting said contacts to be restored to initial condition by said member when a second predetermined pressure affects said member.

4. A pressure switch comprising a pressure responsive member, contacts adapted to be actuated by said member at a predetermined pressure, a solenoid energized upon actuation of said contacts, a resilient member associated with said solenoid for applying pressure on said member, said pressure being relieved upon energization of said solenoid permitting said contacts to be restored to initial condition by said member when a second predetermined pressure affects said member, and means for varying the bias of said resilient member to adjust the pressures at which said member will actuate said contacts and restore said contacts to initial condition.

5. A pressure switch comprising a pressure responsive member, a contact movable therewith, a stationary contact adapted to be engaged by said first contact when a predetermined pressure

affects said member, a solenoid energized upon engagement of said contacts, a resilient member associated with said solenoid for applying pressure on said member, said pressure being relieved upon energization of said solenoid permitting the disengagement of said contacts by said member when a second predetermined pressure affects said member.

6. A pressure switch comprising a pressure responsive member, a contact movable therewith, a stationary contact adapted to be engaged by said contact when a predetermined pressure affects said member, means for varying the travel of said first contact by adjustment of said second contact, and a resilient member associated with said solenoid for applying pressure on said pressure member, said pressure being relieved upon energization of said solenoid permitting the disengagement of said contacts by said pressure member when a second predetermined pressure affects said pressure responsive member.

7. A pressure switch comprising a pressure responsive member, a contact movable therewith, a stationary contact adapted to be engaged by said contact when a predetermined pressure affects said member, means for varying the travel of said first contact by adjustment of said second contact, a resilient member associated with said solenoid for applying pressure on said pressure member, said pressure being relieved upon energization of said solenoid permitting the disengagement of said contacts by said pressure member when a second predetermined pressure affects said pressure responsive member, and means for biasing said resilient member to adjust the pressure applied on said pressure member by said resilient member.

8. A pressure switch comprising an aneroid, a contact movable thereby, a second contact adapted to be engaged by said first contact when a predetermined pressure affects said aneroid, a solenoid adapted to be energized upon engagement of said contacts, a movable core for said solenoid, and a spring for returning said core to an initial condition upon de-energization of said solenoid; a second spring of less tension than said first spring adapted to be biased by said core, said second spring adapted to apply pressure on said pressure member, said pressure being relieved upon energization of said solenoid permitting the disengagement of said contacts when a second predetermined pressure affects said pressure responsive member.

9. A pressure switch comprising an aneroid, a contact movable thereby, a second contact adapted to be engaged by said first contact when a predetermined pressure affects said aneroid, means for varying the travel of said first contact by adjustment of said second contact, a solenoid adapted to be energized upon closure of said contacts, a movable core for said solenoid and a spring to return same to an initial position upon de-energization of said solenoid, a second spring of less tension than said first spring adapted to be biased by said core, said second spring adapted to apply pressure on said pressure member, said pressure being relieved upon energization of said solenoid permitting the disengagement of said contacts when a second predetermined pressure affects said pressure member, and means for biasing said second spring to adjust the pressure applied on said pressure responsive member by said spring.

10. In combination with a controlled electrical means, means comprising an axially displaceable

member adapted for movement in one direction to energize said electrical means and for movement in an opposite direction to de-energize said electrical means, means comprising a yieldable wall adapted for movement in one direction or the other relative to said displaceable member in response to changes in ambient pressure, means associated with one side of said wall adapted to cause displacement of said member in response to movements of said wall, and resilient means interposed between said member and said wall to restrain movement of said wall.

11. In combination with electrical switching means, means comprising an axially displaceable member adapted for movement in one direction to close said switching means and for movement in an opposite direction to open said switching means, means comprising a yieldable wall adapted for movement toward said displaceable member or away therefrom in response to changes in ambient pressure, means associated with one side

of said wall adapted to cause displacement of said member in response to movements of said wall, and resilient means interposed between said member and said wall to restrain movement of said wall in one position of said member.

JAMES E. BEVINS.

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