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PRESSURE SWITCH ASSEMBLY

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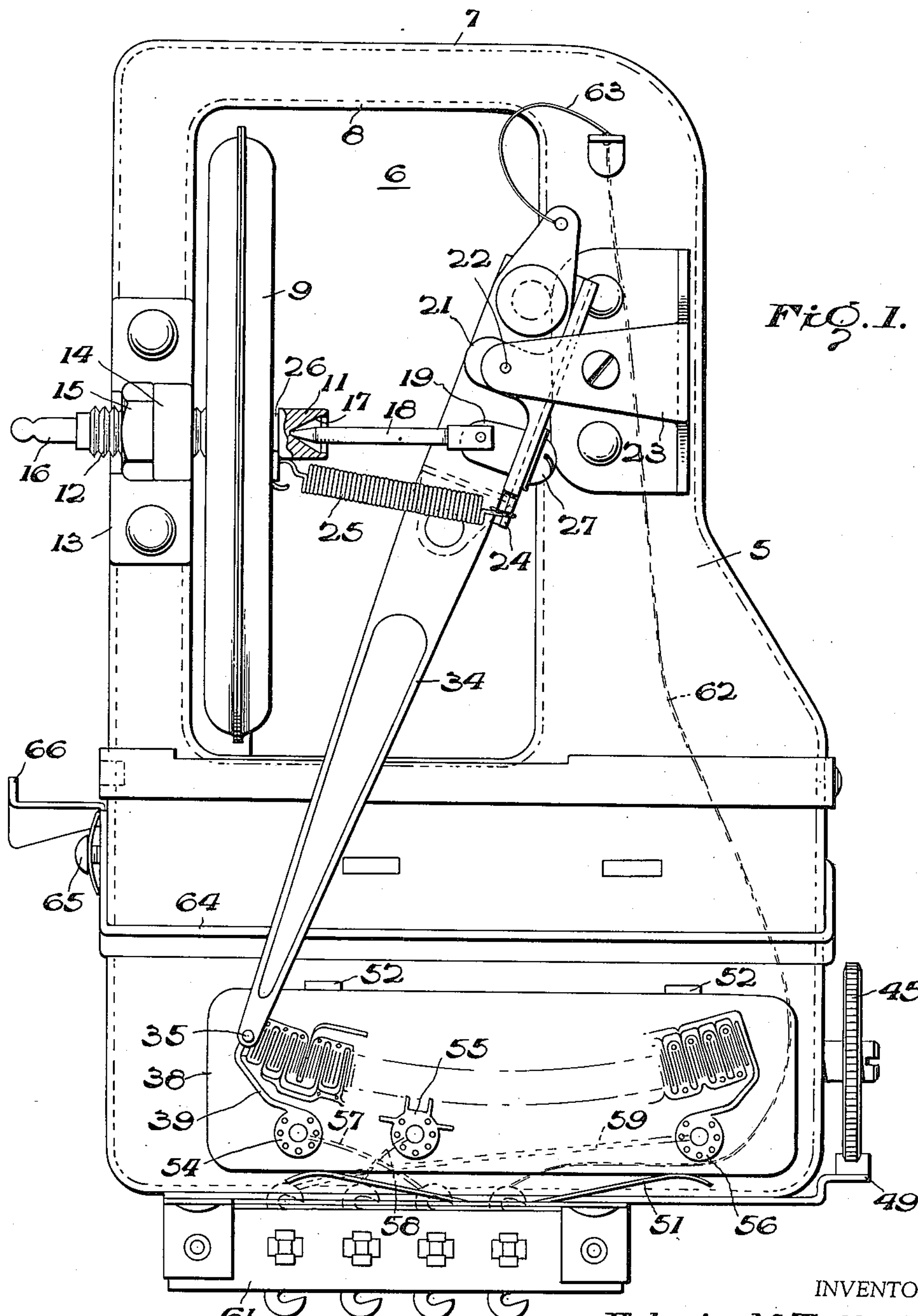

Fig. 1.

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Fig. 3.

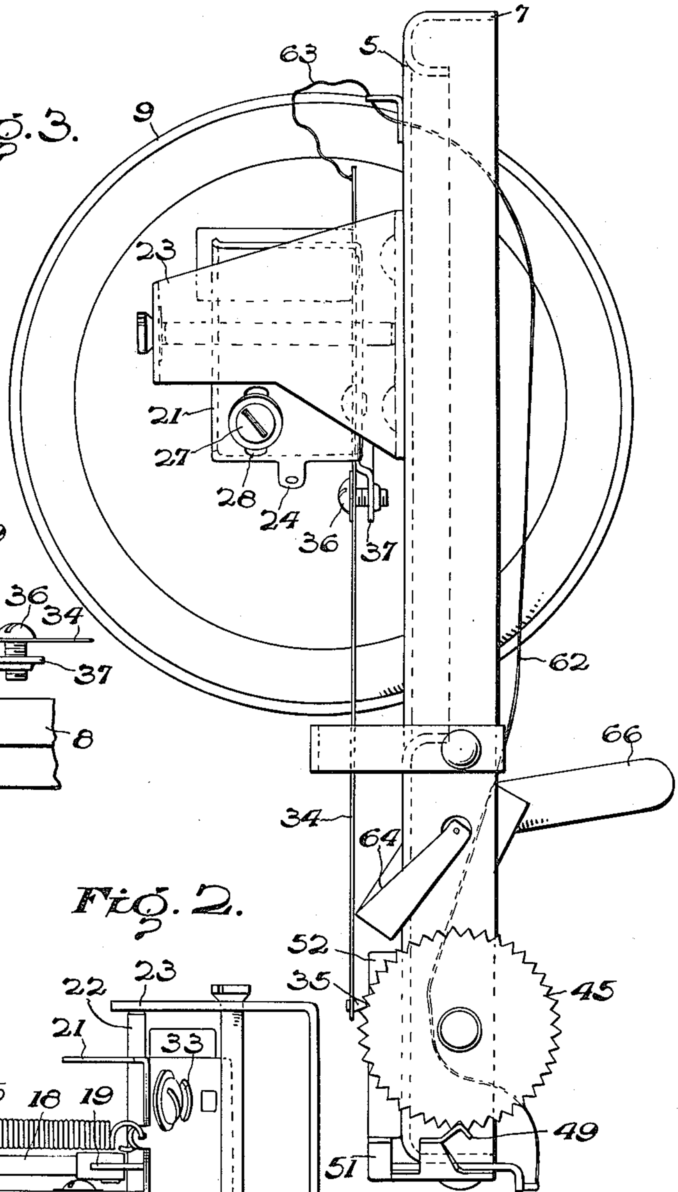


Fig. 4.

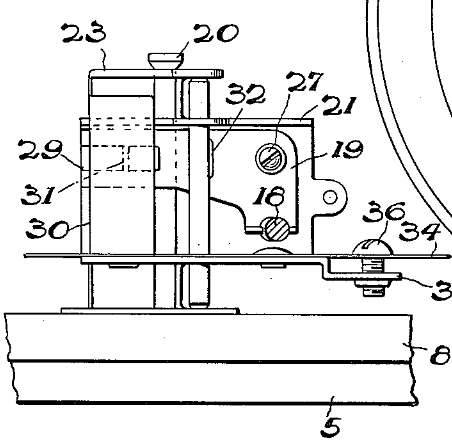
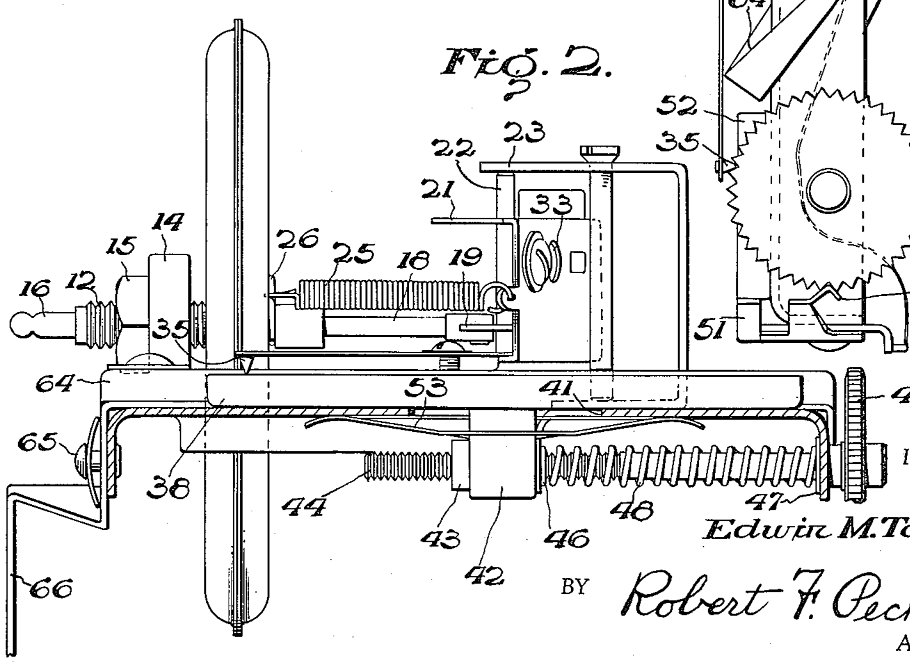


Fig. 2.



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PRESSURE SWITCH ASSEMBLY

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3 Claims. (Cl. 200—83)

The present invention relates generally to pressure responsive switch devices and more particularly to an improved pressure responsive switch especially adapted for use in connection with radiosonde apparatus.

Such switches are commonly designated as baroswitches and in general, comprise a supporting frame, an aneroid cell responsive to atmospheric pressure, an arm driven by the cell, so that one of its extremities traverses an arcuate path, and an electrical contact carried by the arm for cooperating with a switch block having a plurality of spaced conducting members thereon. When mounted in a radiosonde and sent aloft, up into the atmosphere, decreasing pressure will cause the pressure cell to expand and move the contact across the switch block.

Successive making and breaking of the contacts controls the action of reference and measuring circuits whereby audio-modulated radio frequency signals are generated by the radio transmitter. Each signal corresponds to a definite position of the contact and therefore can be translated in terms of atmospheric pressure.

Now the ordinary radiosonde is an expendable item in that the apparatus is tied to a balloon and sent aloft in a direction controlled by the winds prevailing at the time of flight. Although each radiosonde is provided with a parachute to permit same to gradually return to earth after the point of maximum ascension has been reached (at which time the pressure differential across the balloon is sufficient to cause the balloon to burst), actual practice in hundreds of thousands of flights shows a low recovery of the apparatus so returned to earth. Obviously, the radiosonde, meaning all of its components, must be constructed at the very lowest cost levels attainable, yet be of rugged construction to enhance the re-use of the equipment in those instances when same is recovered. This is also true of the military services where recovery of equipment is not of prime importance. Despite low recoveries, the units must be sufficiently rugged to permit re-use after flight without major salvage or repair attendant thereto.

Coupled with a continuous effort to reduce manufacturing costs, has been a continuous, ever-increasing demand for greater accuracy. For example, present requirements call for accuracies of plus or minus 3 millibars in the very low pressure region as contrasted to plus or minus 10 millibars for baroswitches made ten years ago.

At the core of many of the problems surrounding manufacture of baroswitches is the problem of temperature compensation. The units must be able to work properly through a temperature range of plus 30° C. to minus 60° C. and this range in temperature, if not properly compensated for, would introduce errors of such magnitude that the baroswitch would be incapable of meeting the accuracy requirements.

Accordingly, the primary object of this invention is to provide a temperature-compensated baroswitch, compatible with minimum manufacturing costs and maximum

accuracy, and sufficiently rugged to permit rough handling in the field and re-use after flights.

The objective is attained through a novel arrangement of parts and a careful selection of materials, and the advantages and novel features will be readily apparent upon purview of the detailed description set forth below, when read in conjunction with the drawings annexed hereto, in which:

Figure 1 is a plan view of the new and novel baroswitch;

Figure 2 is an end view of the baroswitch shown in Figure 1;

Figure 3 is a side-view of the baroswitch shown in Figures 1 and 2; and

Figure 4 is a partial view, in elevation, showing the shaft and associated parts for the lever arm actuated by the pressure cell.

Referring now to the drawings, the baroswitch has a frame **5** generally rectangular in shape, with one end slightly wider than the other, the frame being formed with an opening **6** in its narrow end. The frame **5** may be of aluminum and is stamped out by conventional sheet metal fabricating equipment. The edges of the frame **5**, surrounding its periphery and surrounding the opening **6**, are turned down to form flanges **7**, **8** respectively. The flanges add rigidity and ruggedness to the frame.

Located within the opening **6** and adjacent to the flanges **8**, is a pressure cell **9** in the form of co-acting diaphragms having driving and mounting studs **11**, **12** respectively. The metal used for the diaphragms is a nickel-iron alloy, with small parts of titanium and chromium, known commercially as Ni-Span-C, and this material is characterized by a substantially zero temperature coefficient, i. e., the material is substantially unaffected by changes in ambient temperature.

A mounting support **13** for the pressure cell **9** is riveted to the frame **5** and it has a vertically extending boss **14** provided with a threaded aperture for cooperating with the threaded stud **12**. A lock-nut **15** holds the cell **9** securely in place after it has been affixed to the support **13**. It is to be noted that the stud **12** encloses the cell exhaust tubulation **16**.

The driving stud **11** has a conical seat **17** cooperating with the pointed extremity of a pin link **18**. The other extremity of link **18** is pivotally secured to a ranging bracket **19** which in turn is carried by the U-shaped contact arm bracket **21**. The bracket **21** has a shaft **22** extending through its side legs, the ends of the shaft being rotatably supported in the side legs of another U-shaped bracket **23** riveted to the frame **5**. Bracket **21** and shaft **22** are press-fit together to form an integral unit and bracket **21** is provided with an apertured ear **24** which holds one end of a spring **25**, the other end of which is secured to a spring clip **26** frictionally engaging a reduced section of the driving stud **11**. The upper leg of bracket **23** can be moved with respect to the lower leg by means of screw **20**. This permits adjustment of the end-play in the shaft **22**.

Considering this part of the mechanism so far described, any motion of the pressure cell will cause the bracket **21** to rotate about the axis of shaft **22** by virtue of the co-action between the driving stud **11**, pin-link **18** and ranging bracket **19**.

The ranging bracket **19** is adjustably mounted with respect to bracket **21** by means of screw **27** threadably engaging one end of bracket **19** through a horizontally elongated hole **28** provided in bracket **21**. The other end of bracket **19** is slotted at **29** to cooperate with an inturned projection **31** "kicked-up" from bracket **21**, and this arrangement preserves alignment of the brackets **19** and **21** when same are moved with respect to one another. An elongated slot **32** provided in bracket **19** is contiguous to aperture 33 in bracket 21 and this arrangement permits a simple tool (not shown) to be inserted into the cooperating parts (after screw 27 has been loosened) to shift them with respect to one another. From an inspection of the drawings, and upon consideration of the mode of operation set forth above, any movement of the bracket 19 with respect to bracket 21 changes the leverage ratio of the driving linkage. This ratio must be adjusted from unit to unit to compensate for variations in the pressure cells so that a predetermined motion range on the output end of the baroswitch is standard for each unit manufactured.

Affixed to the lower leg of bracket 21, by way of rivets or other suitable means, is an arm 34 carrying on its outer end the contact 35 and on its inner end the counterweight 30. This arm may be of phosphor bronze or stainless steel and is given sufficient resiliency so that screw 36, cooperating with a threaded aperture in the offset extension 37 of the lower leg of bracket 21, can be adjusted to vary the contact pressure exerted by the contact 35. Counterweight 30 prevents whipping of arm 34 in case of severe vibration or shock.

Recapitulating, rotary movement of bracket 21 imparted by pressure cell 9 will cause the contact 35 to traverse an arcuate path, the exact length of which can be adjusted by means of shifting the position of ranging bracket 19, as aforesaid.

Cooperating with the contact 35 is a switch block or commutator 38 mounted on the wide end of frame 5. The switch block 38 is a molded plastic member usually formed from polystyrene, and having an inlaid electrical contact pattern 39, the surface of the contacts and associated connectors, the surface of the block, and the surface of the portions of the block in between the contacts and connectors lying in one plane. The inlaid contact pattern 39 is only partially shown in the drawings and comprises an arcuate arrangement of a plurality of spaced conducting segments integrally molded into the plastic base member 38. Certain of the segments are interconnected through the pattern 39 so that repetitive switching is obtained as the contact 35 relays across the contact pattern 39. It is to be noted that the contact 35 has a very sharply defined contact point which contacts only one segment at a time as it moves across the contact pattern 39. Each individual contact segment is separated by a segment of plastic insulating material. The plastic material selected for this unit possesses electrical insulating properties. In other words, the block presents a smooth polished surface at all points thereon, and the arrangement of the contacts, alternately spaced by portions of the block, suggests the common name by which these blocks are designated—namely, commutators.

Extending downwardly from beneath the commutator, and passing through opening 41 in frame 5, is a centrally located stud 42. The stud has an aperture intermediate its ends in one side of which is molded nut 43. Screw 44 passes through the stud 42 and cooperates with nut 43 to move the commutator as desired. Screw 44 also passes through the flanged edge of frame 5 and has affixed to its outer end the detent knob or wheel 45. Suitable washers 46, 47 surround the screw, adjacent the stud 41 and the inner surface of the flanged edge of frame 5, respectively. Between the washers 46, 47 there is a coil spring 48 surrounding screw 44 to take up any play in the parts and maintain a steady positive driving force on the commutator. Cooperating with detent wheel 45 is the detent 49, suitably secured to the flanged edge of frame 5.

From the above arrangement, it is seen that the commutator can be moved along the axis of screw 44 simply by moving the detent wheel 45. This adjustment is necessary to "zero set" the commutator, i. e., shift the contact pattern to line it up with contact 35 at atmospheric pressure.

The commutator 38 is held in place, and guided for

motion by the leaf spring 51 pressing against its front edge to hold it against the guide members 52. Members 52 are part of frame 5 and are merely punched out and up to serve as guiding members. Also serving to hold the commutator in place is the retaining leaf spring 53. This spring surrounds stud 42 and has its outer extremities pressing against the under side of frame 5 and has its inner extremities pressing against nut 43 and washer 46.

Thus, the commutator is frictionally held in place by the leaf springs 51 and 53 and can be moved by rotation of the detent wheel 45. The use of stud 42 and its location is a very important part of applicant's invention and in a large measure completes the temperature compensation of the device. The plastic material of the commutator 38 changes with temperature and by selecting the location of stud 42, changes in dimension of the commutator can be controlled in such a way as to match the characteristics of the pressure cell and connecting linkage, to thereby afford complete temperature compensation. Thus, in the extreme case, the stud could be located at either end of the commutator, thus minimizing dimensional changes at the end selected and permitting maximum changes at the free end. For the particular baroswitch shown, it was found that a central location was most effective, permitting both ends of the scale to change and minimizing changes in the central portion, thereby accomplishing maximum compensation where most needed.

In the arrangement shown, stud 42 is a separate part, molded of the same material as the commutator, and integrally joined by suitable connecting techniques. The commutator and stud could be molded as one piece, if desired, without affecting the compensating action of the arrangement.

Referring to the partial showing of the contact pattern 39, there are three circular areas, 54, 55, 56. These areas connect to three groups of connected contact bars and are in turn connected by suitable leads 57, 58, 59, respectively, to appropriate terminals on the terminal board 61 affixed to the front edge of frame 5. Also connected to the terminal board by lead 62 is the contact 35 via the conducting arm 34 and jumper lead 63.

It is desirable to elevate the contact 35 slightly to prevent same from wiping over the contact pattern 39 during storage and shipment prior to actual use of the device and to this end, contact lift bar 64 is provided, suitably pivoted at 65, and having an actuating arm 66.

With the above arrangement of parts in mind, some of the important benefits and advantages accruing from the design are as follows:

(1) An inexpensive but rugged frame is provided by a simple, formed sheet metal part.

(2) A compact assembly is provided by the shape of the frame and the arrangement of parts thereon.

(3) Ranging of the unit is simplified by means of the action of the ranging bracket.

(4) Simple sheet metal parts are used throughout most of the assembly to provide for minimum manufacturing costs.

(5) Complete temperature compensation is accomplished through the use of Ni-Span-C alloy material for the diaphragms, proper selection of materials in the frame and connecting linkage and the unique manner of mounting the commutators.

What is claimed and desired to be secured by United States Letters Patent is:

1. A pressure responsive switch particularly adapted for a radiosonde, comprising, in combination: a generally rectangular flat supporting frame having an opening formed through one extremity thereof, a pressure responsive element located in said opening and mounted on said frame, said element having a wall thereof adapted to move in response to changes in ambient pressure, an arm pivotally mounted at its one extremity on said frame

adjacent said opening and having an electrical contact at its opposite extremity, a driving linkage connecting said contact arm to said movable wall, a flat plate-like commutator coacting with said movable contact, said commutator being formed of electrical insulating material and having an inlaid contact pattern on its exposed outer surface over which said contact has movement and an internally-threaded stud projecting from its inner or opposite surface through an opening formed in the frame, said stud being located at a point intermediate the ends of the commutator, an adjusting screw having one extremity threaded through said stud and its opposite extremity accessible from the exterior of said frame for adjusting the commutator plate with respect to the frame, resilient means connected to said stud and frictionally engaging the adjacent frame structure for holding the commutator in adjusted position, and means for guiding said commutator on said frame while at the same time holding it against lateral displacement, comprising a leaf spring anchored to the frame and engaging the adjacent edge of said commutator and one or more projections formed on said frame and engaging the opposite edge of said commutator.

2. A pressure responsive switch particularly adapted for a radiosonde, comprising, in combination: a generally rectangular flat sheet-metal frame having an opening formed through one end thereof, a pressure cell located in said opening and mounted on said frame, said cell having a wall thereof movable in response to changes in ambient pressure, a switch arm, a substantially U-shaped bracket rigidly secured to one extremity of said arm and movable therewith, a driving linkage pivotally connected at one end to said bracket and at its opposite end engaging said movable wall, a substantially U-shaped supporting bracket connected to said frame, said first-named bracket and arm being located between the legs of said second-named bracket, a pivot pin projecting through the legs of said first-named bracket and journaled at its opposite ends in the legs of said second-named bracket, means for varying the spacing between the legs of said second-named bracket to thereby adjust the end play of said pin, said arm having an electrical contact at its opposite extremity, a flat plate-like commutator coacting with said movable contact, means movably supporting said commutator on said frame, said commutator having an inlaid contact pattern on its exposed outer surface over which said contact has movement and a supporting stud projecting from its opposite surface through an opening formed in the frame, and an adjusting screw coacting with said stud for adjusting the position of the commutator plate with respect to the frame.

3. The combination defined by claim 2 wherein said driving linkage is in the form of a link pin having its one end pivotally engaged with said movable wall and its opposite end pivotally connected to a ranging bracket which in turn is adjustably connected to said first-named bracket.

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