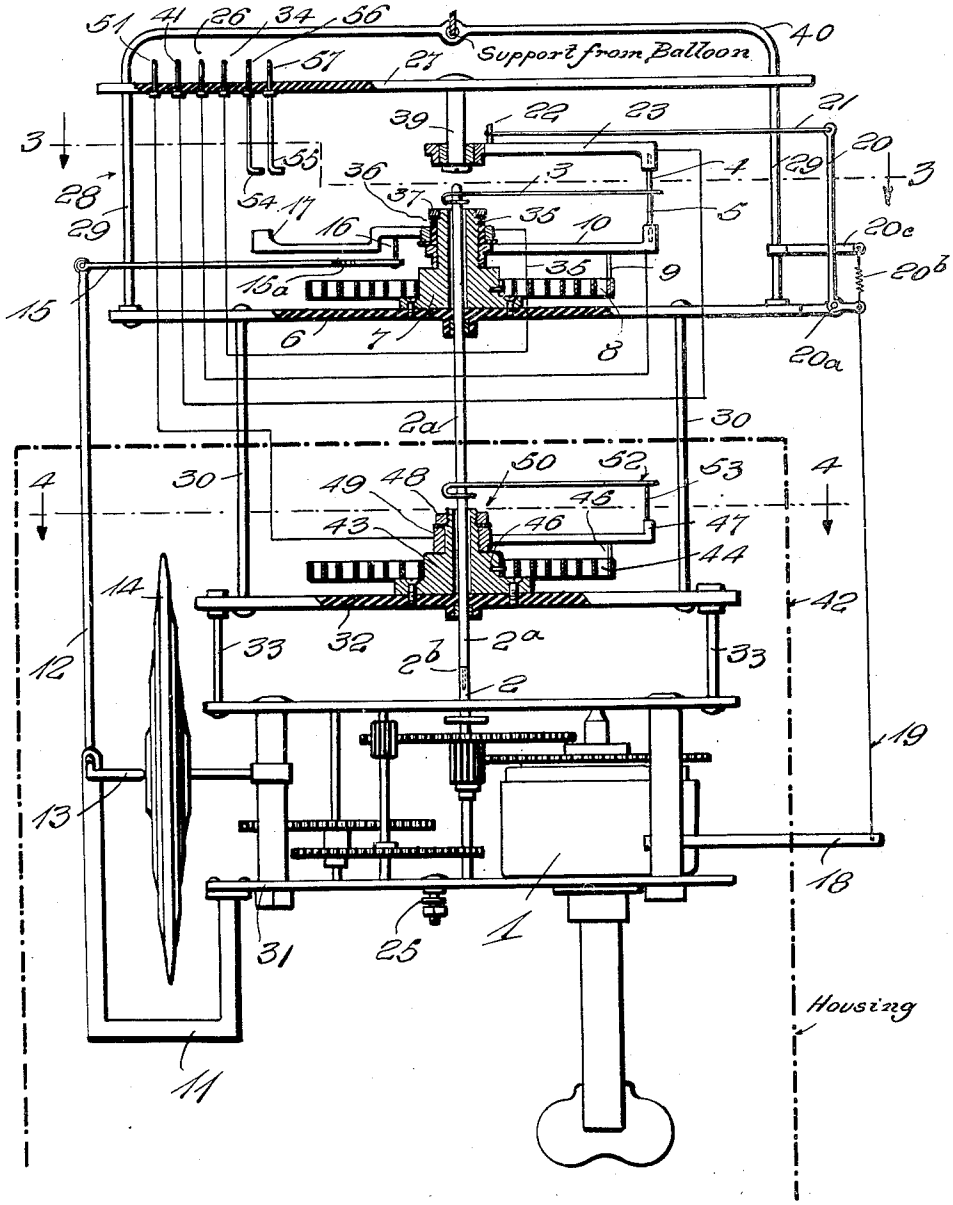
May 2, 1939. W. H. REYNOLDS 2,156,868

CONTROL DEVICE FOR A RADIOMETEOROGRAPH SIGNAL TRANSMITTER

Filed June 11, 1936 2 Sheets-Sheet 1



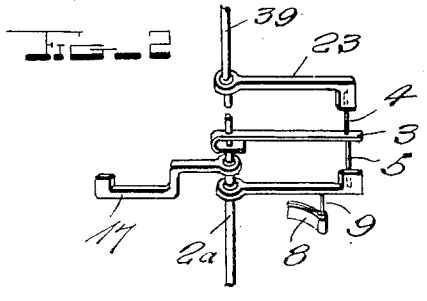


FIG. 2

FIG. 1

INVENTOR.
William H. Reynolds,
BY
John O. Brady
ATTORNEY.

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Filed June 11, 1936 2 Sheets-Sheet 2

FIG. 3

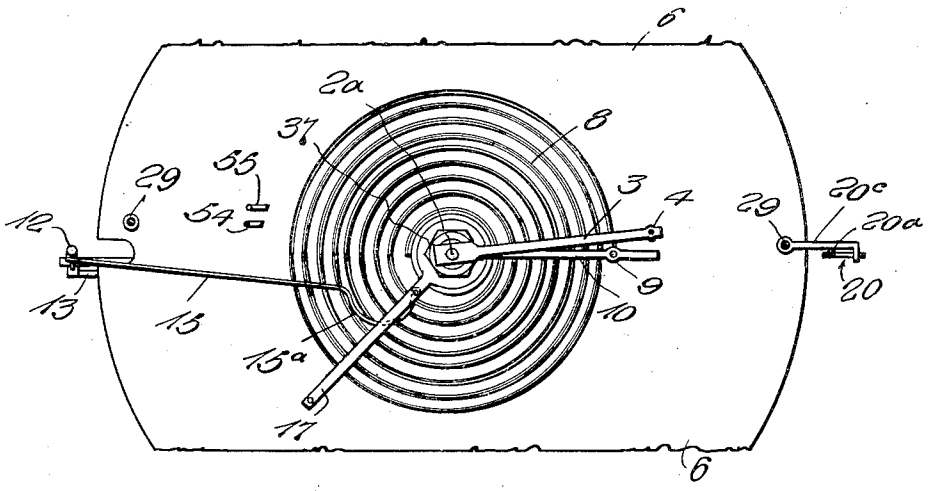
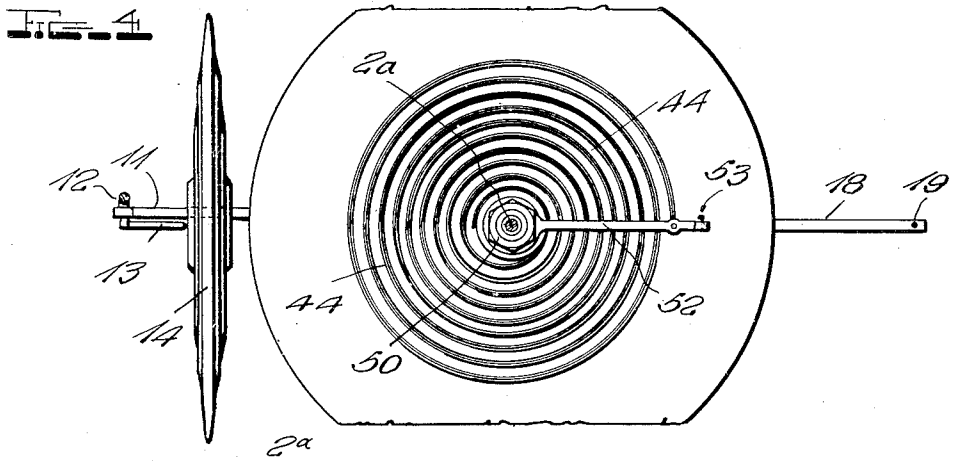


FIG. 4



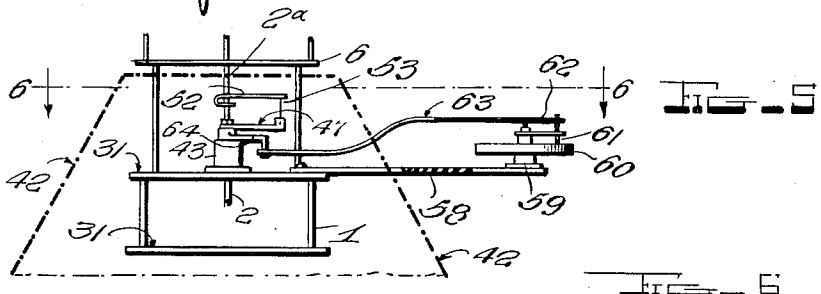
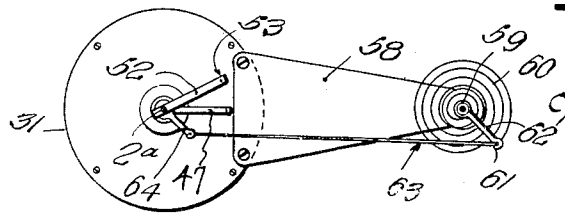


FIG. 5

FIG. 6



INVENTOR.
William H. Reynolds,
BY
John B. Brady
ATTORNEY.

Patented May 2, 1939 2,156,868

UNITED STATES PATENT OFFICE

2,156,868

CONTROL DEVICE FOR A RADIOMETEOROGRAPH SIGNAL TRANSMITTER

William H. Reynolds, Silver Spring, Md., assignor to American Instrument Company, Silver Spring, Md., a copartnership composed of William H. Reynolds and Leopold Freedman

Application June 11, 1936, Serial No. 84,775

5 Claims. (Cl. 73—151)

My invention relates broadly to apparatus for controlling electrical circuits according to meteorological conditions of temperature, pressure, and humidity, and more particularly to radio transmitting and control apparatus adapted to be carried by a free balloon.

One of the objects of my invention is to provide a construction of control apparatus which operates with a high degree of precision in the control of electrical circuits according to variable conditions of temperature, pressure and humidity.

Another object of my invention is to provide a construction of control apparatus which may be readily mounted in position with respect to a protective housing adapted to be elevated by a balloon and operative to control the circuits of a radio transmitter for transmitting signals to an observing station according to variable conditions of temperature, pressure, and humidity to which the apparatus may be subjected.

Still another object of my invention is to provide a construction of apparatus having means for timing and controlling the transmission of radio signals according to temperature conditions existing both externally and internally with respect to a protective housing.

A further object of my invention is to provide a construction of apparatus in which the frame structure of a suitable driving mechanism serves as a mounting means for a frame structure adapted to carry a multiplicity of electrical contactors which serve to control the transmission of signals according to variable conditions of temperature, pressure and humidity to which the apparatus may be subjected.

A still further object of my invention is to provide a construction of apparatus including a uniformly driven circuit controlling member operative in the path of a multiplicity of adjustable contactors with means for advancing or retracting the position of the contactors in the path of the circuit controlling member for determining the successive time intervals at which signals may be transmitted representative of variable conditions of temperature, pressure and humidity.

A further object of my invention is to provide a construction of apparatus having means for controlling the transmission of timing signals and the transmission of signals designating variable conditions of temperature, pressure and humidity.

Other and further objects of my invention reside in a control apparatus for a signal transmitter as set forth more fully in the specification hereinafter following by reference to the accompanying drawings, in which:

Figure 1 is a side elevational view with parts shown partially in cross-section and illustrating the control apparatus of my invention; Fig. 2 is a fragmentary perspective view showing the relationship of the adjustable contactors in the path of the uniformly driven electric circuit control; Fig. 3 is a horizontal sectional view through the control apparatus on line 3—3 of Fig. 1; Fig. 4 is a horizontal sectional view taken on line 4—4 of Fig. 1; Fig. 5 is a side elevational view of a modified form of control apparatus embodying my invention; and Fig. 6 is a horizontal sectional view taken on line 6—6 of Fig. 5.

My invention is directed to a precision instrument adapted to control a radio transmitter mounted in a protective housing supported by a balloon adapted to be released for observing conditions in the upper atmosphere. The apparatus of my invention serves to control the transmission of radio signals from the free balloon to the observing station. I provide means responsive to barometric pressure, temperature and humidity conditions for controlling the emission of radio signals from the radio transmitter which is elevated by the balloon. Various embodiments of the apparatus of my invention may be made and I have selected for illustration the construction shown in the accompanying drawings. However, I desire that it be understood that the construction illustrated in the drawings is not to be considered in the limiting sense but merely as illustrative of certain forms of my invention.

Referring to the drawings in detail, the control apparatus is driven by a spring wound clock 1 with a spindle 2 making one revolution per minute. The clock mechanism is mounted within the protective housing which is carried by the balloon. The spindle 2 connects with the spindle 2*a* as indicated at 2*b*. Spindle 2*a* projects through the wall of the protective housing 42 as illustrated and adjacent the top of the spindle 2*a* and at right angles thereto, there is an arm 3, carrying two delicate contact wires 4 and 5. Plate 6, forming part of the frame which projects outside the protective housing, is made of electrically insulating material and is supported through posts 30 with respect to insulating panel 32 which is in turn supported from frame 31 of the clockwork by members 33. All the mechanism mounted on panel 6 is insulated from the clock frame. Concentric with plate 6 and surrounding spindle 2*a* but electrically insulated therefrom through an air gap is a metal bushing 7, to which it attached

a spirally arranged thermally responsive element 8 fixed at its inner end and free to move at its outer end. This element 8 carries on its outer turn a pin 9, which in turn is fastened to arm 10. As the temperature of element 8 changes, the outer turn describes an arc and carries with it arm 10. Thus, it may be seen that, as spindle 2a is rotating at the rate of one revolution per minute, arm 10 will meet contact 5 earlier or later, depending upon the surrounding temperature.

Accordingly, a signal may be transmitted by connecting the control circuit of the radio transmitter to terminals 25 and 26 supported respectively on metallic frame 31 of the clockwork and on insulated panel 27 of the auxiliary frame structure 28. The auxiliary frame structure 28 also includes insulated panel structure 6 supported by members 30 from the insulating panel 32 which is in turn supported through members 33 displaced in position with respect to members 30 with respect to frame 31 of the spring wound clock 1. Terminal 25 connects with the spindle 2a through the mechanism of the clockwork supported by frame 31 on which terminal 25 is mounted for establishing electrical connection therewith. Circuit connections taken from terminals 25 and 26 to the control circuit of a radio transmitter provide means for electrically controlling the transmission of a signal impulse at the time that contact wire 5 supported by minute arm 3 establishes wiping connection with the contact carried by contact arm 10.

A bracket 11 attached to the clock frame 31 carries at its upper extremity bell crank lever 12, the inner portion of which, 13, bears against the face of an exhausted capsule 14. Thus, it may be seen that, with changes in barometric pressure, the top end of arm 12 in moving in and out carries with it lever 15, which transfers its motion through pin 16 to arm 17. Arm 17, being mounted rotatably about the central axis, it may be seen that with changes in barometric pressure, arm 17 rotates and meets contact 5 earlier or later in its excursion, depending upon the barometric pressure. Fig. 3 shows the manner of imparting the operating force to arm 17 through the curved portion 15a of lever 15 which would allow lever 15 to be displaced to a position on which portion 15a surrounds the upstanding cylindrical portion of bushing 7. The connection is taken from contact arm 17 to binding post 34 on panel 27. Panel 27 is supported by means of pedestals 29 from insulating panel 6. A circuit connection taken from binding posts 25 and 34 to the control circuit of a radio transmitter serves to control the transmission of a signal when contact wire 5 carried by minute arm 3 makes connection with the contact on contact arm 17 at a time period depending upon the angular position of contact arm 17. As heretofore pointed out, the angular position of contact arm 17 is controlled in accordance with barometric pressure under control of pressure device 14.

The contact arms 10 and 17 heretofore described are electrically insulated from the spindle 2a by means of the annular air gap separating bushing 7 from spindle 2a. Furthermore arm 17 is insulated from arm 10 by means of the insulating cylindrical collar 35. The arms 10 and 17 suitably insulated from each other are secured in position by a suitable washer 36 and a nut 37 coacting with a shoulder and screw threads formed on the extremity of bushing 7. The contact arms are thus free to be angularly shifted in accordance with temperature and pressure conditions to advance or retard the time of connection between contact arms 10 and 17 with respect to the contact wire 5 carried by arm 3.

Arm 18 has attached to it, fibre 19, which may be made of any material sensitive to changes in moisture, such as human hair, horse hair, goldbeater's skin, wood, or other material. Thus, with changes in the moisture content of the air, fibre 19 shortens or elongates, and in so doing, moves bell crank lever 20. Lever 20 has attached to it at the top, rod 21, which, through pin 22, moves arm 23. The bell crank lever 20 is journaled at 20a on insulating panel 6 and is normally biased to a predetermined position by spring 20b supported by arm 20c. Arm 23, being mounted concentric with the axis of the instrument, swings in an arc with changes in relative humidity and meets contact 4 earlier or later in its excursion. The arm 23 is journaled on the supporting member 39 about which the arm is adapted to be angularly shifted. I may mount arm 23 in a variety of ways and the method illustrated is not to be regarded in the limiting sense. A connection is taken from arm 23 to binding post 41. An electrical circuit may be established between binding post 25 and binding post 41 for controlling a radio transmitter as contact wire 4 carried by arm 3 engages the contact on contact arm 23. Conditions of humidity therefore determine the angular position of contact arm 23 and the time contact wire 4 engages the contact carried by contact arm 23. Inasmuch as panel 27 is formed from insulation material, arm 23 is insulated from all surrounding parts except terminal 41 with which it is connected.

Heretofore, I have described electrical contact means for determining variable conditions existing outside the protective housing which I have shown generally at 42. It may also be necessary to determine conditions of temperature existing interiorly of protective housing 42 for determining the temperature correction of the capsule 14 and for checking the temperature correction of the clock. For this purpose, I provide a bushing member 43 through which spindle 2a passes and is supported by insulating panel 32 and spaced away from spindle 2a by an annular air gap. Bushing member 43 provides mounting means for the spirally arranged thermally responsive element 44 having pin 45 adjacent the free end thereof and fixed at 46 adjacent the inner end thereof. A contact arm 47 is free to be shifted angularly about spindle 2a as an axis. Contact arm 47 is insulated from spindle 2a by reason of the annular air gap separating spindle 2a from bushing 43. Suitable securing means 50 are provided on member 43 for maintaining contact arm 47 is position, such as washer 49 and nut 48 engaging screw threads on the end of bushing 43. An electrical connection is taken from contact arm 47 to binding post 51. Another arm is provided on spindle 2a as indicated at 52 revolving one revolution per minute. Arm 52 carries contact wire 53 which meets the contact on contact arm 47 as arm 52 revolves. Contact arm 47 is changed in angular position by virtue of the change in position of thermally responsive element 44 connected through member 45 to contact arm 47. The time at which contact wire 53 meets contact arm 47 is determined by the internal temperature conditions within housing 42 and the action of the flat spirally arranged temperature responsive element

44. The circuit for effecting the control thus provided extends between binding post 25 and binding post 51. The entire structure and control mechanism is supported from a balloon through a suitable bail member indicated at 40.

In order to provide means for transmitting a timing signal or a reference or a fiduciary signal which is uniformly and successively transmitted, I arrange a pair of contact wires at 54 and 55 connected with binding posts 56 and 57 respectively and supported from the insulating panel 21. The contact wires 54 and 55 are arranged in the path of the contact 4 carried by arm 3 so that as arm 3 revolves, connection is successively established with contact wires 54 and 55. A control circuit extending between binding post 25 and binding posts 56 and 57 respectively provide control means for the transmission of successive timing impulses.

In lieu of the superimposed arrangement of the temperature responsive elements 8 and 44 for measuring external and internal temperature conditions with respect to housing 42, I may adopt the arrangement illustrated in Figs. 5 and 6 wherein a frame extension 58 of insulating material is connected with frame 31 of the clock mechanism and projects exteriorly of housing 42. The frame extension 58 carries a standard 59 to which the spirally arranged relatively flat temperature responsive element 60 has one end fixed. The opposite end of element 60 connects to a pin 61 which in turn connects to the end of arm 62 pivoted about standard 59 as a center. Arm 62 is thus angularly shifted in position in accordance with variable temperature conditions and the action thereof on temperature responsive device 60. A link 63 interconnects the end of arm 62 with a projecting portion 64 of contact arm 47 interiorly of housing 42. As arm 62 moves and imparts movement to link 63, contact arm 47 is shifted to advance or retard the time of contact between the contact carried by arm 47 and the contact 53 carried by arm 52. Thus, the contact devices interiorly of the housing 42 are controlled by changes in temperature existing exteriorly of housing 42.

Thus, it will be seen that a variety of methods of controlling the contact devices according to changes in temperature both interiorly and exteriorly of the housing, barometric pressure and humidity may be effected. Should there be any confusion in distinguishing the temperature, humidity and barometric pressure signals, I have the following choice of methods of individual characterization for clarifying them: I insulate arms 10, 17 and 23 from each other and through the respective control circuits connected therewith, control the broadcasting of each signal on a different frequency or wave length, having at the observing station separate receivers tuned to each frequency or wave length. In lieu of this, I may give each contact an identifying characteristic, as, for instance, one contact for the temperature arm, two contacts for the zero or fiduciary signal, three contacts for the barometric element, and four contacts for the relative humidity element. In order to maintain the accuracy of the instrument, only the first of each of these signals would be used for timing and the remainders used only as identifying characteristics.

The drawings indicate that the relative humidity element and temperature element are well separated from the clock mechanism, and from the barometric capsule, for the reason that the ordinary clock is subject to some error due to temperature changes and the same may be true of the barometric capsule. With this construction, it is possible to house the barometric capsule and clock in the special thermally insulated case and allow the fibre 19 and thermally expansive element 8 to be out in the atmosphere that they are to measure.

There are many modifications of this device which I contemplate, and I do not intend to limit myself to the exact construction shown, but may employ in my invention the combination of first, the clock and temperature elements, second, the clock, temperature and barometric elements, and third, the clock, temperature, barometric and relative humidity elements.

The general purpose of the device of my invention is to immediately broadcast weather signals from an observation balloon, the signals to be recorded on the ground and immediately plotted. Any form of such structure I regard as part of my invention and I intend no limitations upon my invention except as may be imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. Control apparatus for a signal transmitter adapted to be carried by a free balloon which comprises a frame structure, a driving mechanism mounted at the base of said frame structure and having a rotatable shaft extending upward through said frame structure, a housing enclosing said mechanism with said shaft extending exteriorily of said housing, contact members carried by said shaft exteriorily and interiorily of said housing, and movable coacting contacts engageable by said contact members upon rotation of said shaft, said movable coacting contacts being positioned in accordance with meterological conditions exteriorily and interiorly of said housing.

2. Control apparatus for a signal transmitter adapted to be carried by a free balloon which comprises a housing, a frame structure partly within and partly without said housing, a driving mechanism mounted on said frame structure within said housing and having a rotatable shaft extending through said frame structure and a wall of said housing, contact members carried by said shaft exteriorly and interiorly of said housing, movable coacting contacts engageable by said contact members upon rotation of said shaft, and separate means for controlling the positions of said movable coacting contacts in accordance with meterological conditions exteriorly and interiorly of said housing.

3. Control apparatus for a signal transmitter adapted to be carried by a free balloon which comprises a housing, a frame structure partly within and partly without said housing, a driving mechanism mounted on said frame structure within said housing and having a rotatable shaft extending through said frame structure and a wall of said housing, a contact member carried by said shaft exteriorly of said housing, fixed contacts and a plurality of movable coacting contacts engageable by said contact member upon rotation of said shaft, and separate means mechanically connected with said movable coacting contacts for controlling the position thereof with respect to said fixed contacts in accordance with different meterological conditions exteriorly of said housing.

4. Control apparatus for a signal transmitter adapted to be carried by a free balloon which

comprises a frame structure, a driving mechanism mounted on said frame structure and having a rotatable shaft extending vertically therethrough, a contact member carried by said shaft, a trio of movable coacting contacts; a spirally arranged thermally responsive device insulatingly mounted in said frame structure coaxially with said shaft and having the outer end thereof operatively connected with one of said movable coacting contacts; a barometric capsule mounted on one side of said frame structure with the axis of its displacement normal to said shaft, bell crank and lever means piotally mounted with respect to said frame structure and operatively disposed between said capsule and another of said movable coacting contacts; a support extending from the lower portion of said frame structure on the opposite side thereof from said barometric capsule, bell crank and lever means pivotally mounted on said frame structure above said support and operatively connected with the third of said movable coacting contacts, a thread like element responsive by changes in length to changes in humidity mounted between said support and the bell crank and lever means thereabove, and means for maintaining said thread like element under tension.

5. Control apparatus for a signal transmitter as set forth in claim 4 and including a second contact member carried by said shaft between said driving mechanism and the aforesaid contact member, a movable coacting contact therefor, a second spirally arranged thermally responsive device insulatingly mounted in said frame structure coaxially with said shaft and having the outer end thereof operatively connected with the last said movable coacting contact, and a housing for heat conservation enclosing said second thermally responsive device, said barometric capsule and said driving mechanism.

WILLIAM H. REYNOLDS.