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2,707,397

TORSION SPRING PRESSURE INDICATOR

Filed May 17, 1954

2 Sheets-Sheet 1

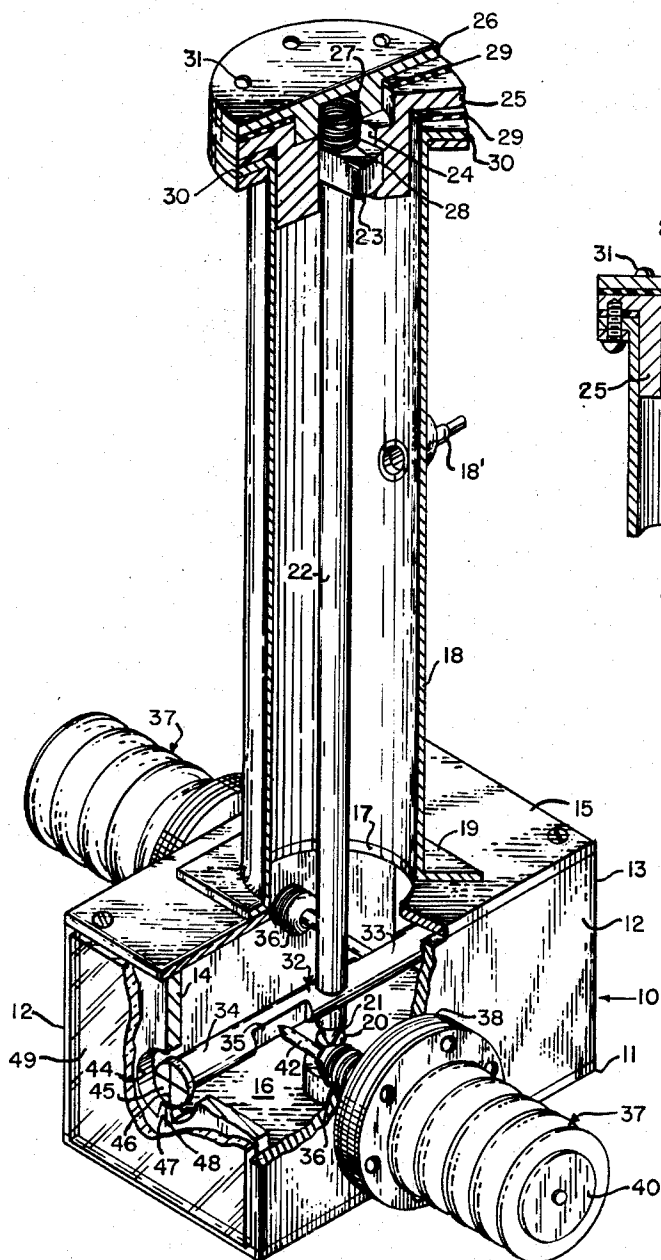


FIG. 1

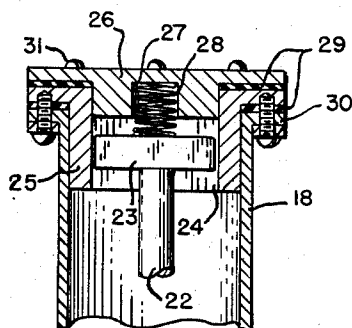


FIG. 2

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2 Sheets-Sheet 2

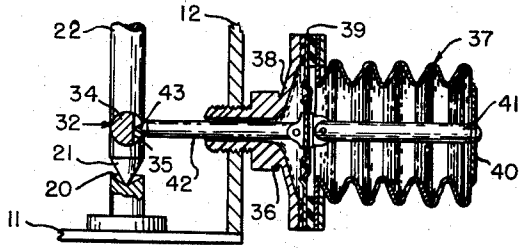


FIG. 3

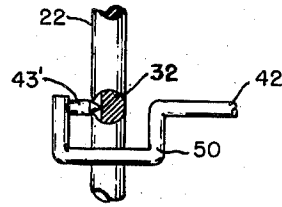


FIG. 4

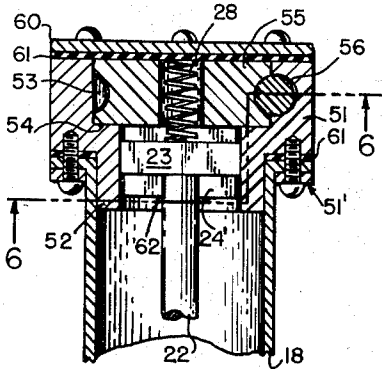


FIG. 5

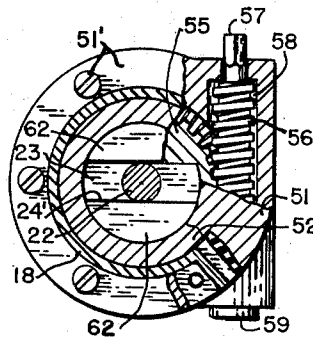


FIG. 6

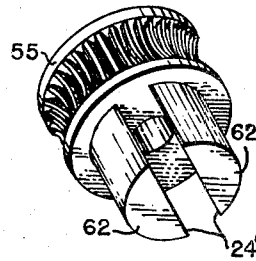


FIG. 7

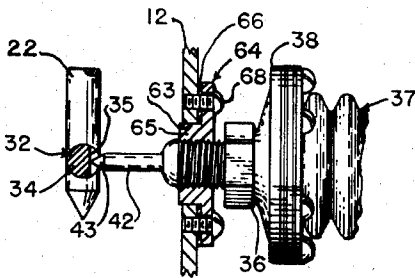


FIG. 8

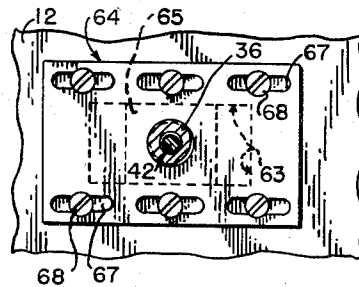


FIG. 9

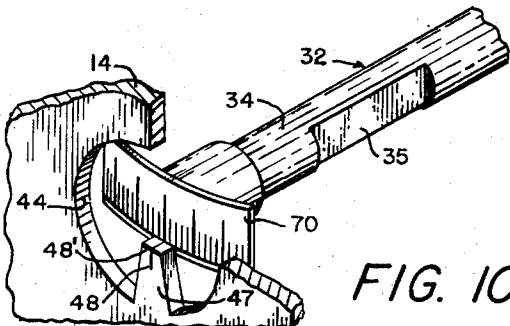


FIG. 10

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TORSION SPRING PRESSURE INDICATOR

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8 Claims. (Cl. 73—386)

The invention relates to a device of the character named especially applicable to use in barometers and it aims to present a novel construction in the mounting of a torsion spring and its coordination with aneroid capsules to the end that materials of exceptional high elastic modulus and low mechanical strength—particularly quartz—may be used more effectively. It is possible that some composition of glass or ceramic may be used, but it is well known that metal elements exhibit relatively large errors, due to an elasticity or undesirable thermal response.

A further aim is to present a novel means for integrating the various pressures sensed by the device and to enable improved response to very slight variations in pressure, so that these may be readily calibrated in values of elevation above sea level, or atmospheres, or otherwise.

A further important aim is to enable the production with ease of a device having the advantages set forth, from readily available stock materials with a minimum requirement for special fabrication procedures, and enabling assembly of the device effectively without requiring exceptional skill in the instrument art. A further important aim is to present a construction which may be readily disassembled and repaired without requiring special jigs, so that it may be maintained satisfactorily by field personnel in remote locations.

Additional objects, advantages and features of invention reside in the construction arrangement and combination of parts involved in the embodiment of the invention, as may be understood from the following description and accompanying drawings, wherein

Fig. 1 is an isometric perspective, partly in vertical section, of an apparatus embodying the invention, with portions broken away to disclose internal elements;

Fig. 2 is a fragmentary vertical section at the top of the stand pipe;

Fig. 3 is a fragmentary vertical sectional view in a plane on the axis of one of the bellows;

Fig. 4 is a fragmentary section in the plane of Fig. 3 illustrating a modification of the connection between the bellows and rocking lever;

Fig. 5 is a view like Fig. 2, illustrating a modification of the anchorage for the T-head of the torsion spring rod, including adjusting means to rotate the T-head in case of need in compensating for, or correcting departures of the rocking lever from proper position;

Fig. 6 is a cross section on the line 6—6 of Fig. 5, looking upward;

Fig. 7 is a perspective view of the rotatable anchor block of Fig. 5;

Fig. 8 is a fragmentary vertical section at the right hand side wall of the casing, at the plug 36, of a modified bellows mounting;

Fig. 9 is an elevation of the casing and modified bellows mounting;

Fig. 10 is a fragmentary perspective view of the indicator on the end of the lever carried by the torsion rod, showing the use of a scale marking extended as may be required.

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Referring more particularly to the drawings, Fig. 1 illustrates a rectangular box-like casing 10, which may be of metal or other suitable structural material. It may be of various forms, but in this instance consists of a bottom 11, opposite side walls 12, a rear wall 13, front wall 14, and a top plate 15. These complete a rigid inclosure, which is made hermetic, as will appear, and constitutes an independently pressurized chamber 16, which is preferably either evacuated, or filled with a non-hygroscopic and non-corrosive gas. Centrally in the top plate an opening 17 is formed therein, around which there is erected a stand pipe 18 of cylindrical form, the flanged base 19 of which is welded or soldered to the top plate. A duct connection 18' is provided on the stand pipe, which may be connected to a pump, or gas supply, for regulation of pressure and/or content of the chamber 16.

Upon the bottom 11 there is provided a recessed conical step bearing or socket bearing 20, in which there is set a needle point pivot bearing 21 of a torsion spring rod device 22 formed of quartz, as a rectilinear cylinder, coaxial with, and extending nearly to the top of the stand pipe. The upper end of this rod is provided with a T-head 23, which is fitted slidably in a vertically extending slot 24 of an anchor block 25 secured upon the upper end of the tube 18. The slot 24 has parallel sides, and extends vertically above and below the T-head 23 so that the latter is accommodated slidably between the sides of the slot under expansion and contraction involved by variations of temperature to which the device may be subjected. A closure cap 26 is secured upon the block 25, having a recess 27 therein concentric with the rod 22 and having a helical compression spring 28 set therein bearing upon the upper side of the T-head 23, so that the rod 22 is yieldingly confined by this spring with the needle bearing 21 held in the socket bearing 20. Suitable gaskets 29 are confined between the cap 26 and block 25, and between the latter and the upper flanged end 30 of the stand pipe 18, the cap and block being suitably flanged so that they may be secured together and to the flange of the pipe by screws 31 as shown.

At its lower part, the rod 22 is provided with a rectilinear cross lever 32 fixed at right angles to the axis of the rod securely so as to transmit torsional stress to the latter when the lever is rotated on the axis of the rod. The lever is formed with a rearwardly extending arm 33 and a somewhat longer forwardly extending arm 34. The needle bearing 21 may be formed on the lower side of the lever or omitted if it is desired to suspend the rod by the head 23.

On the rear arm 33 a vertical flat 35 is formed on the left hand side of the arm extending from top to bottom of the arm and for a suitable distance longitudinally and on the arm 34 a similar flat is formed on the right hand side of the arm, at and extending the same distance radially from the rod.

In the left hand and right hand walls of the casing, there are set plug elements 36, having threaded engagement in the respective walls so that the plugs may be adjusted axially, and mounted on the outer ends of the plugs exteriorly of the housing 10, there are respective aneroid bellows or capsules 37. The bases of the bellows are suitably secured hermetically to an enlarged head plate 38 on the plug, and a flexible corrugated elastic metal diaphragm 39 is hermetically connected peripherally to the bellows and head plate so as to close the inner end of the bellows and seal communication with the housing 10. The outer end of the bellows is closed conventionally by a disk 40 to which there is connected an axial rod 41, so that the latter will be moved axially by expansion or contraction of the bellows. The inner end of the rod 41 is attached centrally to the diaphragm 39. Also connected to the diaphragm and extending exte-

riorly oppositely from the rod 41 and slidably through the plug 36, there is a push rod 42 having a point bearing 43 at its extremity engaged against the flat 35 of the adjacent arm of the lever 32.

From the foregoing it will be seen that with the plugs properly adjusted the push rods 42 will bear against respective arms of the lever from opposite directions, and that collapsing movement of the bellows will rotate the lever clockwise as viewed from above.

By proper adjustment of the upper end or T-head mounting of the rod, pressure corresponding to sea level will apply tension to the rod to bring it to a zero position which may be utilized as an index of sea level, or zero elevation, and that as pressure decreases recovery of the torsion rod 22 from strain is permitted by the push rods to move its lower end in such manner as may be utilized to indicate higher levels relative to the earth.

For the purpose of indicating variations of pressure, the front wall 14 is formed with a port opening 44 and the adjacent arm 34 is formed with a head 45 having vertical and horizontal cross hairs 46. Formed on an up-standing lug 47 within the port 44 immediately below the head 45 there is a fiducial mark 48, and if desired, other means may be associated therewith in the nature of dial or scale to indicate in stages of height or pressure movements of the cross hairs under operation of the bellows connections previously described.

A transparent cover plate or window plate 49 is secured upon the end of the housing so as to close the port 44 and seal the housing.

If preferred, the push rods 42 may be formed as hook-like members 50 extended below and past the respective arms of the lever, and provided with upwardly extended parts having returned point bearings 43' to engage against the far flat sides of the lever arms, so that the arms will be pulled counterclockwise by expansion of the bellows, and in such case the rod mounting would be adjusted so that it is at a minimum tension initially, and expansion of the bellows would apply increased stress to the rod causing its rotation at the lower end. The last mentioned construction is shown in Fig. 4.

If desired, conventional means may be provided for rotatably mounting the upper end of the torsion spring rod 22 so that its stress may be properly regulated and coordinated with the function of the bellows. Also, conventional means may be provided for adjusting the bellows mountings along the sides of the housing so that the points of bearing of the push rod points on the lever may be adjusted radially of the rod to coordinate the action of the respective bellows with the stresses in the rod involved in progressive variations of pressure.

This might be of use in case one bellows or capsule manifests a coefficient of expansion different from that of the other and opposite one acting on the lever, or in case both bellows manifest a curve of thermal expansion which is unsatisfactory, or not coordinated with the stress response of a particular material in the spring element 22.

Figures 5 to 7 illustrate one means for effecting the rotative adjustment of the T-head of the torsion rod.

In this case, the stand pipe 18 and torsion spring rod 22 are of the same structure and mounting as before described. Set in the top of the stand pipe 18 there is a bearing block 51 having a bushing portion 52 fitted within the pipe and receiving the head 23 revolvably therein, this mounting permitting also vertical sliding movement of the head within the bushing incident to expansion or contraction of the rod 22. The upper end of the block 51 is enlarged and secured to the flanged end of the pipe by screws and ring at 51'. This larger part is formed with a circular bore 53 of larger diameter than the bore of the bushing 52 thus providing a shoulder 54, upon which there is set a worm gear 55, and engaged revolvably through one side of the block 51 there is a worm 56 meshed with the gear 55. This worm is formed with a key tenon 57 at one end which is extended through a

reduced terminal part of a horizontal bore 58 accommodating the worm; and at its opposite end the worm is retained by a screw plug 59 engaged in the end of the bore 58. The tenon 57 is angular in section so that it may be rotated by a conventional key or other device to rotate the gear 55. A cover plate 60 is held upon the block 51 by suitable screws to retain the gear in place, suitable gaskets being provided at 61 above and below the block 51 to effect proper sealing. The gear 55 is axially bored to accommodate the spring 28, which is confined by the cover plate 60 so as to press upon the T-head of the rod 22.

On the under side of the gear 55 there are formed integral lugs 62 having parallel opposed faces receiving the head 23 slidably therebetween so that the upper end of the torsion rod is anchored by the gear 55, against relative rotation.

The last described adjustable anchor means may be utilized in case local conditions or other causes disturb the registration of the cross hair at 46 with the fiducial mark 48, or in case test or special use of the instrument shows need for such correction.

Figs. 8 and 9 show the mounting of the bellows units so that they may be adjusted radially with respect to the adjacent arms of the lever 32, the construction of the bellows units and form and mounting of the torsion rod being unchanged and conforming to any or all of the constructions before described.

In this instance, the wall of the case is formed with a horizontal slot 63, and the plug 36 is mounted in a closure plate 64 having a thickened block part 65 fitted slidably in the slot, the plate being of adequate dimensions to cover the slot at all adjusted positions of the block in the slot. The plug 36 is engaged centrally through the block portion 65. A suitable gasket 66 is interposed between the plate and the wall of the casing. The upper and lower edge portions of the plate are longitudinally slotted at 67 to receive mounting screws 68 engaged in the wall of the casing, so that by loosening these screws the plate may be moved horizontally to adjust the point bearing of either or both of the plunger rods along the arms of the lever as discretion dictates.

The fiducial mark 48 may terminate at a horizontal mark 48' at its upper end, arranged to align with the horizontal line of the cross hair marks on the lever end, so as to indicate relation of the arm to a predetermined normal or zero position of the lever in thermal or other expansion and contraction of the rod 22 and/or stand pipe 18 relatively to each other, in case the rod is suspended by the head 23. The marks on the lug 48 would thus be in the form of the letter T with the horizontal line at the top of the lug, although other arrangement is possible. The cross hair lines on the lever are formed on a face which may be approximately normal to the axis of the lever arm, although it may be extended concentrically with the axis of the rod, and additional marks applied to form a scale calibrated in any units which may be properly indicated by movement of the lever. By conventional uses of magnifying lenses (not shown) small variations may be indicated. Fig. 10, illustrates at 70 one possible incorporation of such a scale device.

While the rod has been shown as cylindrical, various other cross sectional forms may be employed, to increase the range of movement of the lever for given variations in pressure, or for other reasons.

To adjust the plunger element 42' of Fig. 4, it is necessary to disconnect the anchorage at the top of the rod from the tube 18 and raise the rod, so as to bring the lever 32 out of the path of the bight portion of the hook-like part 50, while the plug or plugs are rotated to effect the required adjustment. The needle point bearing in this device being coaxial with the body of the plunger in the plug 36, the bight part need not be in a vertical plane, but may be inclined, and located either above or below the axis of the part 42'.

I claim:

1. A pressure indicating device comprising a sealed case, an elongated torsion member therein anchored at one end and free to rotate at its other end around its longitudinal axis, a transverse lever fixed to the torsion member approximately at said free end at right angles to said axis and having oppositely extended arms, aneroid chamber devices mounted exteriorly of said case at opposite sides, sliding torque-applying members mounted on the case movable approximately in the plane of rotation of said arms and each in a path across the position of a respective one of said arms when said lever is at a given initial position, and bearing against respective said arms from opposite directions, operative connections between said aneroid devices and respective said torque applying members, flexible diaphragm-like seal means forming parts of respective sides of said case around, and connected centrally to said torque applying members, and exteriorly visible means to indicate angular positions of one at least of said arms relative to the case.

2. A device of the character described comprising a hermetic case, external aneroid devices having terminal connection members mounted at opposite sides thereof, reciprocable on axes approximately in a common plane and spaced from each other in said plane, said case including an elongated tubular extension on an axis in a plane normal to said first named plane and to said axes of the terminal connection members, said axis of the extension being midway between said axes of the terminal connection members, a rod-like elastic torsion member longitudinally extended in said tubular extension, means to anchor one end of said torsion member at the outer end of said extension, a rectilinear lever fixed at the opposite end of and at right angles to the axis of the torsion member having oppositely extending arms normally in said second named plane and across respective said axes of the terminal connection members, reciprocating torque generating members mounted on the case movable along said axes of said terminal connection members at opposite sides of the second named plane and connected between respective said arms and terminal connection members in-

cluding a low friction means to seal the case at each such connection, and a duct connection communicating with the interior of the case.

3. The structure of claim 2, wherein the said low friction means comprises a flexible sealing diaphragm forming part of the wall of the case, and its central part included in said connection.

4. The structure of claim 3 wherein said diaphragm is mounted on a plug body having screw engagement through the wall of the case, whereby adjustment of the aneroids relative to said lever may be effected, said torque generating members consisting of point bearing plungers, said arms having vertical radial flats receiving the points thereagainst.

5. The structure of claim 2 wherein said lever is formed with an indicator mark at the extremity of one of said arms, said case having a window and transparent closure therefor adjacent the said extremity of the arm, and a fiducial mark on the case closely adjacent the path of said first named mark under oscillation of the lever.

6. The structure of claim 5 wherein the said extremity of the lever arm is formed with a surface substantially normal to the radius of the arm, cross hairs being marked thereon, one normal to the plane of oscillation of the lever, and the other aligned with this plane, said fiducial mark including a line normal to the last named plane, and one coincident with the direction of oscillation of said lever around the axis of the torsion member.

7. The structure of claim 6 wherein the fiducial mark is positioned to align with the said one hair at a predetermined zero position of the lever, and another positioned to align with the said other hair at a predetermined zero position of expansion and contraction of the rod.

8. The structure of claim 3 wherein means is provided for evacuating gases from the interior of the case.

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