Oct. 22, 1963 J. LINGNAU 3,107,532

THERMOSTAT

Filed April 16, 1962

Fig. 1

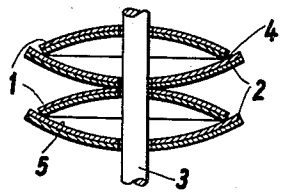


Fig. 4

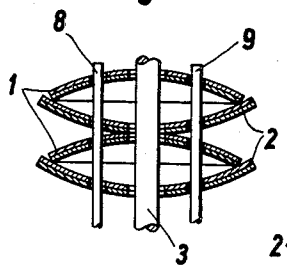


Fig. 6

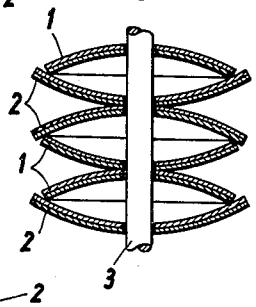


Fig. 2

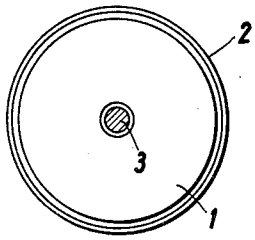


Fig. 5

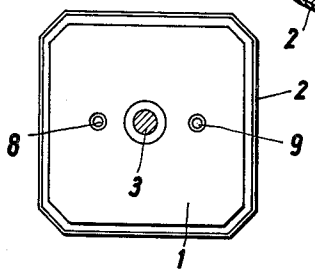


Fig. 3

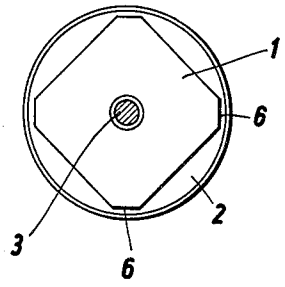
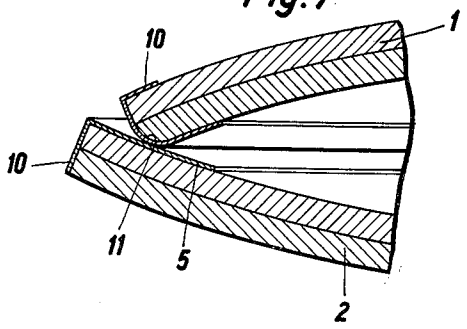


Fig. 7



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THERMOSTAT

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14 Claims. (Cl. 73—363.1)

This invention relates to a thermostat and refers more particularly to a thermostat consisting of at least one pair of bimetallic discs which are curved in opposite directions and loosely mounted one over the other.

Thermostats consisting of individual bimetallic discs loosely mounted in rows upon one or more guide rods, are generally well known and are used wherever regulation and guiding are to be carried out by means of temperature variations. These individual discs, which may be combined into a bimetallic column, have, however, the drawback that in their curved operative condition they rarely lie properly directly concentrically one over the other, since the contacting edges of the individual pairs of elements do not constitute an adequate supporting surface, so that the discs slide inwardly or outwardly between the guiding rod and the disc bore, depending upon the extent of play. In most cases pairs of discs can support each other only upon a portion of their circumference.

The result is that there is clamping or edge locking between the rod and the bimetallic discs, so that proper operation of the thermostat is jeopardized. Furthermore, a direct consequence of this condition consists in variations in the length of stroke, so that these thermostats can be used only in locations wherein no uniform precise operations are required. Finally, the irregular engagements of the discs at the contacting edges produce in time dislocations and form changes in the discs, which contribute to further irregularities.

Furthermore, thermostats which are preferably used in steam plants and the like, particularly for thermically operated dischargers of condensation water, wherein they are subjected to the attack of corrosion-producing media, such as steam, condensate and their respective chemical impurities must be constructed with special care so as to assure durability and an operating power which must remain constant.

For example, it is known in prior art to use austenite and ferrite steels to provide the greatest possible operational stroke.

However, these known bimetals do not possess the necessary resistance to corrosion and heat for use in steam installations or the like, wherein there are flows of acid or alkali reacting media and which are subjected to high temperatures.

Up to now, the problem of making a bimetal which has adequate bending capacity and which is secure against corrosion, was not solved satisfactorily, since in the case of a corrosion-resisting element its bending capacity was too small, while when the bending capacity was great, there was no adequate resistance against corrosion.

For that reason bimetals were often used which were made resistant against corrosion by means of surface coatings which were applied galvanically by known methods. However, this protective coating is soon dissolved, since the layers are quickly affected by the attacking medium. Furthermore, these bimetals poorly resist mechanical stresses, so that the life of the bimetal is not prolonged to any substantial extent by the provision of a protective coating.

An object of the present invention is to effectively eliminate these drawbacks of prior art constructions by the simplest possible means.

Other objects of the present invention will become apparent in the course of the following specification.

In accomplishing the objects of the present invention it was found desirable to form each pair of bimetallic discs constituting a column, out of discs of different sizes in such manner that the circumferential edge of the smaller disc is supported upon the inner surface of the larger disc.

The result of this feature of the present invention is that perfect engagement is provided whenever the two individual discs support one another, since due to the difference in size the smaller disc must necessarily lie upon the inner surface of the larger disc. As compared to prior art devices, this advantage of the construction of the present invention is combined with the further feature that the smaller discs are centered automatically upon the concave inner surfaces of the larger discs during the bending process, so that operational difficulties resulting from clamping or edge locking between the guide rod and the discs are eliminated and so that there is always the same stroke length at the same temperature.

In accordance with the present invention, the individual discs of each pair can have different outer shapes. It was found as a part of the present invention, that it is particularly advantageous, when only one guide rod is used, to combine a preferably circular disc with an angular disc, whereby the angular disc should be preferably the smaller one. Due to this arrangement the loss in the stroke length of the smaller disc is balanced out again since, as was determined in actual practice, the free edges of an angular disc are bent particularly strongly. It is possible to retain the generally employed central rod guide despite the use of different discs, since in view of the size differences, the smaller angular disc can be supported upon the larger round disc in each position.

According to a further development of the present invention, the automatic centering of the discs is facilitated by rounding off at least the supporting edges of the smaller disc, thereby also increasing its sliding capacity. This rounding of the edges is particularly effective when the edge of the smaller disc and the edge surface of the larger disc serving as the support, are hardened or provided with a hard chromium coating. This feature does not only provide a further improvement in the sliding capacity, but as its result the highly stressed engaging zones of the individual discs acquire considerably greater resistance against wear and tear.

Extensive experiments with non-corrosion-resistant nickel steels have demonstrated that the attack by corrosion becomes excessive only when these steels are subjected to moving media, such as steam or condensation water. Surprisingly, it was discovered that when the medium is in state of rest, the attack by corrosion proceeds so slowly that these steels have a durability which is a substantial multiple of that prevailing during their use in a moving medium. This phenomenon can be explained by the fact that a neutralizing process takes place between the metallic layer and the boundary layer of the medium, whereby this process acts to prevent corrosion.

According to a further embodiment of the present invention, this discovery is used to eliminate the above indicated drawbacks in such heat-expanding bodies which are exposed to moving steam or condensation water, as is, for example, the case with dischargers of condensation water. Therefore, the bimetal component with great heat expansion is exposed to the moving portion of the medium and consists of corrosion-resistant steel, preferably austenitic 18/8% chromium-nickel steel, while the other component which comes into contact with the non-

moving part of the medium, consists of a non-corrosion-resistant steel having smaller heat expansion, preferably "Invar" steel with about 30–36% nickel.

This feature makes it possible to provide bimetallic expansion bodies which, on the one hand, have exceptionally great strokes as the result of the connection of composite steels with heat expansion coefficients 18×10^{-6} and 0 to bimetals, and which on the other hand, by maintaining the component made of non-corrosion-resistant "Invar" steel with heat expansion coefficient 0 away from the moving medium and keeping it in contact only with a quiet medium, have such a delayed corrosion effect due to the neutralization appearing at the border zones between the medium and the metal, that their durability will be entirely adequate and will not be substantially less than that of bimetals made of non-rusting steel.

By the use of discs of different size but of circular outline, whereby the edge of the smaller disc is supported upon the inner surface of the larger disc, such a good sealing at the edges is attained, that the thermostat when heated forms one or more hollow chambers containing the medium at rest and surrounded by the flowing medium, the inner walls of the hollow chambers consisting of a non-corrosion-resistant steel.

Obviously, the bimetallic discs can also consist of an austenitic steel component and a ferritic steel component, whereby both components are non-rusting steels, the two bimetallic components being joined into a bimetallic body by spot welding, roll seam welding or application welding.

According to the present invention, it is advantageous to use an austenitic 18/8 chromium-nickel steel for the component having the larger expansion and an about 13% chromium steel for the component with the smaller expansion.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawing showing, by way of example, preferred embodiments of the inventive idea.

In the drawing:

FIGURE 1 is a section through two pairs of discs mounted upon a central shaft and constructed in accordance with the present invention.

FIGURE 2 is a top view of the device shown in FIG. 1.

FIGURE 3 shows in top view a differently constructed embodiment of the present invention wherein differently shaped discs are used.

FIGURE 4 shows in section another construction having two angular pairs of discs and double rod guiding.

FIGURE 5 is a top view of the device shown in FIG. 4.

FIGURE 6 illustrates in section a different arrangement of discs constructed in accordance with the present invention.

FIGURE 7 is an enlarged section through hard-chromed edge portions of two discs of a pair.

The pairs of discs shown in FIGS. 1 and 2 consist of individual discs 1 and 2 which are different in size and which are mounted in a row upon a central guiding rod 3. The discs 1 of each pair are smaller in diameter, so that in their curved operational condition their edges 4 can be circumferentially supported upon the inner surfaces 5 of the larger discs 2, thus providing an excellent sealing of the inner hollow space.

The construction of FIGURE 3 is different from that of FIGS. 1 and 2 only in that the smaller disc 1*a* which is supported by the larger disc 2, is angular in shape and is provided with broken off corners 6. The discs 1*a* and 2 are mounted upon the rod 3.

FIGURES 4 and 5 show a construction wherein both discs 1*b* and 2*b* are angular in shape with parallel edges in stepped formation. Two guide pins 8 and 9 located on both sides of the guiding member 3 and extending through the superposed discs, are used to prevent them from turning.

It is not essential that the bimetallic column be mounted in the manner shown in FIG. 1. As illustrated in FIGURE 6, it is obviously possible to mount the individual discs 1 and 2 one over the other alternately as to size, so that two equally large discs of two disc pairs will always lie one directly over the other.

To save the edges of the smaller discs 1*c* (FIG. 7) as well as the edge surfaces 5*a* of the larger discs 2*c* from excessive wear and tear caused by friction, the frictionally exposed edges of the discs 1*c* are provided with a hard chromium coating 10, while the edge surfaces 5*a* of the larger discs 2*c* are provided with a hard chromium coating 10*a*. These coatings also increase the sliding capacity of the contacting parts.

Obviously, wear and tear can be also diminished by other means, for example, by hardening the contacting parts.

FIGURE 7 shows that the edge of the smaller disc 1*c* is rounded at 11 so as to further increase the sliding capacity of the parts, with the result that during stroke movements the discs are substantially automatically centered relatively to each other. Furthermore, the rounded edges 11 further decrease wear and tear and prevent the possibility of a sharp edge of the smaller disc damaging after a while the larger disc.

The positions of disc pairs shown in FIGS. 1, 4 and 6 can be their positions of rest or their operative positions, depending upon the size, arrangement and selection of material of the individual bimetallic components of each disc. For example, the drawing showing the discs as curving in opposite directions may show them in their operative positions while they are under the influence of heat, while when cooled the discs can be flat or only slightly curved. A reverse construction is also possible, namely, discs can be used which are curved when cool and which assume a flat shape when heated.

As shown in the drawing, the diameter or the largest distance between opposed edges of the larger disc is greater than the diameter or the largest distance between the edges of the smaller disc by a length which is at least twice the size of play between the guiding rod 3 and the edges of the openings through which the guiding rod 3 extends.

It is apparent that the above-described examples have been given solely by way of illustration and not by way of limitation and that they are subject to many variations and modifications within the scope of the present invention. All such variations and modifications are to be included within the scope of the present invention.

What is claimed is:

1. A thermostat comprising at least one pair of bimetallic discs curving in opposite directions and loosely mounted one over the other, said two discs being of different size, the edges of the disc of smaller size being supported by the inner surface of the disc of larger size.

2. A thermostat in accordance with claim 1, comprising a guide member extending through openings formed in the discs, the largest distance between opposed edges of the larger disc being greater than the largest distance between opposed edges of the smaller disc by a length which is at least twice the size of play between said guide member and said openings.

3. A thermostat in accordance with claim 1, wherein said edges of the disc of smaller size are rounded.

4. A thermostat in accordance with claim 1, wherein the two discs are of different shape

5. A thermostat in accordance with claim 4, wherein the disc of larger size is round.

6. A thermostat comprising at least one pair of bimetallic discs curving in opposite directions and loosely mounted one over the other, said two discs being of different size, the edges of the disc of smaller size being supported by the inner surface of the disc of larger size, said edges being hardened.

7. A thermostat comprising at least one pair of bimetallic discs curving in opposite directions and loosely mounted one over the other, said two discs being of different size, the edges of the disc of smaller size being supported by

the inner surface of the disc of larger size, and a hard chromium coating over said edges.

8. A thermostat comprising at least one pair of bimetallic discs curving in opposite directions and loosely mounted one over the other, said two discs being of different size, the edges of the disc of smaller size being supported by the inner surface of the disc of larger size, the portion of the inner surface supporting said edges being hardened.

9. A thermostat comprising at least one pair of bimetallic discs curving in opposite directions and loosely mounted one over the other, said two discs being of different size, the edges of the disc of smaller size being supported by the inner surface of the disc of larger size, and a hard chromium coating over the portion of the inner surface supporting said edges.

10. A thermostat, particularly for armatures exposed to flowing gases or liquids, said thermostat comprising at least one pair of bimetallic discs curving in opposite directions and loosely mounted one over the other, said two discs being of different size, the edges of the disc of smaller size being supported by the inner surface of the disc of larger size, one bimetallic component of each disc consisting of austenitic steel and the other bimetallic component of the same disc consisting of ferritic steel, the two components being non-rusting steels joined by welding.

11. A thermostat in accordance with claim 10, wherein said one component consists of an 18/8 chromium-nickel steel and said other component consists of a substantially 13% chromium steel.

12. A thermostat adapted to be exposed to flowing fluids, said thermostat comprising at least one pair of round bimetallic discs curving in opposite directions and loosely mounted one over the other, said two discs being of different size, the edges of the disc of smaller size being supported by the inner surface of the disc of larger size, whereby an inner chamber is formed between the two discs, the outer surfaces of said discs being exposed to a flowing fluid while said inner chamber is adapted to contain said fluid in condition of rest, one bimetallic component of each disc which is exposed to the flowing fluid having a comparatively larger heat expansion coefficient and consisting of corrosion-resisting steel, the other bimetallic component of the same steel which is exposed to the fluid in condition of rest having a comparatively smaller heat expansion coefficient and consisting of non-corrosion-resisting steel.

13. A thermostat in accordance with claim 12, wherein said corrosion-resisting steel consists of austenitic 18/8 chromium-nickel steel.

14. A thermostat in accordance with claim 12, wherein said non-corrosion-resisting steel consists of "Invar" steel with substantially 30–36% nickel.

No references cited.