March 21, 1933. C. VON HOFE ET AL 1,902,387

BOX SHAPED WATER LEVEL

Filed March 5, 1931

Fig. 1

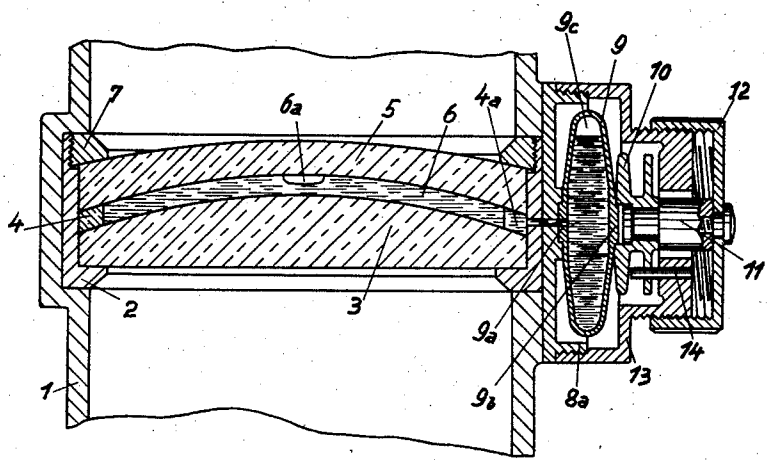
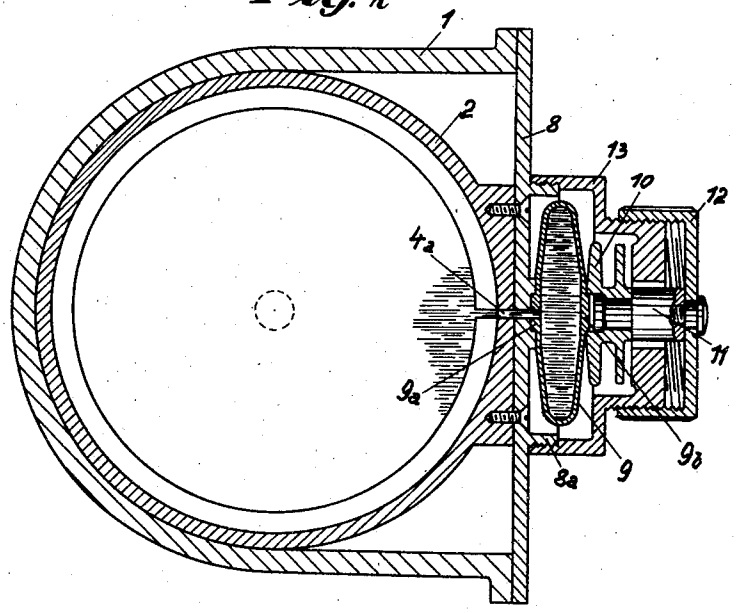


Fig. 2



Inventors:
C. von Hofe & J. Schier,
by E. F. Neudecker
Atty

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CHRISTIAN von HOFE AND JOHANN SCHIER, OF VIENNA, AUSTRIA, ASSIGNORS TO ACTIENGESELLSCHAFT C. P. GOERZ OPTISCHE ANSTALT ACTIOVA SPOLECNOST K. P. GOERZ OPTICKY USTAV, OF PRESSBURG, BRATISLAVA, CZECHOSLOVAKIA, A COMPANY OF CZECHOSLOVAKIA

BOX SHAPED WATER LEVEL

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The box shaped water levels heretofore in use more particularly the focus water levels of telescopes used for astronomic, navigation and bomb throwing purposes are open to the objection that owing to the difference in the dilation coefficient of the liquid of the water level and the glass body enclosing this liquid the air bubble of the water level increases at low temperatures to such an extent that it becomes difficult to bring the point observed exactly into the centre of the air bubble. For this reason it has already been proposed to use in box shaped water levels of this class, arrangements in which the liquid contents of the water level are in communication with the liquid contents of an elastic container fully filled with liquid and in which the pressure exerted on the said vessel by turning a screw may be so adjusted that the pressure within the liquid and consequently also the size of the air bubble may be adjusted at will.

The object of the present invention is to provide a device adapted to automatically maintain approximately constant the size of the air bubble of box-shaped or focus water levels notwithstanding the maximum variations of temperature that may occur in practice after the size of the said bulb has been adjusted at will and to so construct the said device that it may be mounted on a telescope, more particularly on an aiming telescope, in a position in which it is protected as far as possible from injury from the outside.

With this object in view according to the present invention the dimensions and the materials of the parts constituting the box-shaped or focus water level and more particularly the liquids of the water level, the air filling, the actuating devices for the elastic container and the pressure transmitting elements are so proportioned and selected that by compensating for the dilation of these elements by heat the size of the air bubble is automatically maintained constant very nearly. Thereby also the further advantage may be obtained that the said device for adjusting the size of the air bubble may be mounted in a casing on the cover of the water level frame.

The drawing illustrates by way of example an embodiment of the present invention. Fig. 1 is a longitudinal section and Fig. 2 is a transverse section of the device.

The water level frame 2 is mounted in a laterally open extension 1 of the telescope casing. In this frame 2 are mounted the bottom lens 3, the intermediate glass or metal ring 4 ground spherically on its top and bottom side and the top lens 5. The water level liquid 6 with the air bubble 6*a* is enclosed in the chamber formed between the two lenses and the intermediate ring 4 and is tightened by screwing down the screw threaded ring 7. The cover plate 8 is bolted to the water level frame 2 for closing the extension 1 of the telescope casing. A button 9*a* on the elastic container 9 is seated in a central recess in the cover plate 8. A button 9*b* on the opposite side of the container is seated in a flanged pressure plate 10 mounted on the central pin 11 of a cap 12 provided with an internal screw thread. This cap is screwed on a casing 13 which in turn is screwed on a threaded flange 8*a* of the cover plate 8. A pin 14 fixed in the casing 13 and engaging into a slot in a flange of the pressure plate 10 prevents this plate 10 from turning when the cap 12 is turned.

The elastic container 9 communicates with the liquid containing chamber of the water level through a central bore in the button 9*a*, the cover plate 8, the water level casing 2 and a slot in the intermediate ring 4. If now the elastic container were fully filled with water level liquid, the air bubble 6*a* would increase in size at any decrease of temperature owing to the contraction of the

liquid which notably exceeds the contraction of the parts enclosing the said liquid.

A reduction of the size of the air bubble may be brought about by exerting a suitable pressure on the elastic container 9 by turning the cap 12.

If, however, the elastic container is not completely filled with liquid but an air bubble is left in the same which is considerably greater than the air bubble of the water level, then experience shows that the size of the air bubble remains almost unaltered even if the temperature decreases by 50° C. A simple computation shows that the variations of the size of the air bubble of the water level are the smaller, the larger the contents in air of the elastic container and the smaller the total contents in liquid of the water level 6 and of the elastic container 9 are.

A similar compensation of the dilations by heat is arrived at when the pressure plate 10 and the pin 11 are made of a material having as small a coefficient of dilation as possible, for instance of steel while the casing 13 and the cap 12 are made of a material having a coefficient of dilation as great as possible for instance of an aluminum silicon alloy. Then in the case of a decrease of temperature the pin 11 will contract to a less extent than the casing 13 and the cover 12. Consequently the pressure on the elastic container is increased, so that in this way too an increase of the air bubble in case of a decrease in temperature is automatically prevented or at least reduced.

What we claim is:

1. A box shaped water level comprising a liquid chamber enclosing the air bubble of the water level, an elastic container filled with the liquid of the said water level and communicating with the said liquid chamber, means for exerting external pressure on the said elastic container and a structure supporting the said liquid chamber, elastic container and pressure exerting means, the proportions and materials of the said elements being such that the dilations by heat of the said elements substantially compensate for each other whereby the size of the air bubble in the said air chamber is automatically kept constant substantially in case of variations of temperature.

2. A box shaped water level comprising a liquid chamber enclosing the air bubble of the water level, an elastic container filled with the liquid of the said water level and communicating with the said liquid chamber, means for exerting external pressure on the said elastic container and a structure supporting the said liquid chamber, elastic container and pressure exerting means, the proportions of the parts of the said pressure exerting means and the coefficients of dilation by heat of the supporting means and pressure exerting means being such that the dilations by heat of the said elements substantially compensate for each other whereby the size of the air bubble in the said air chamber is automatically kept constant substantially in case of variations of temperature.

In testimony whereof we affix our signatures.

CHRISTIAN VON HOFE.
JOHANN SCHIER.