Jan. 7, 1941. R. KREBS 2,227,938

CONSTANT TEMPERATURE BATH

Filed June 6, 1938

Fig. 1

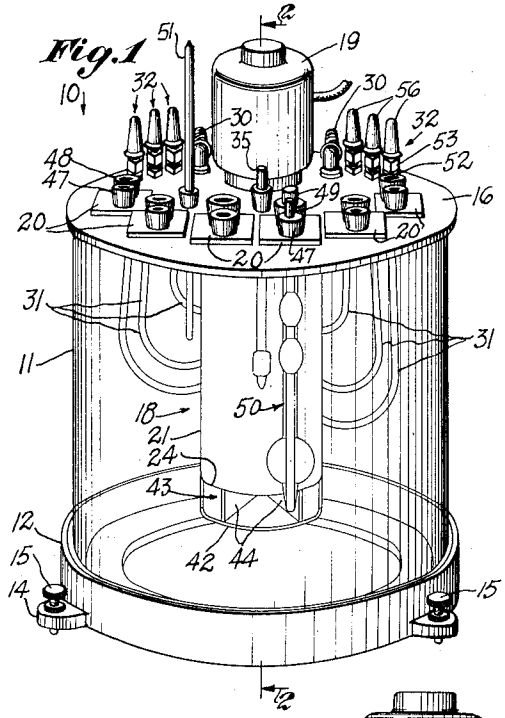


Fig. 3

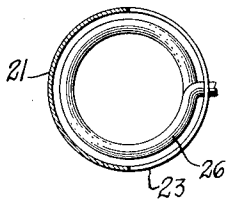


Fig. 4

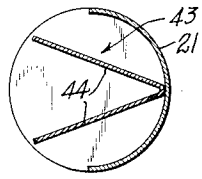


Fig. 8.

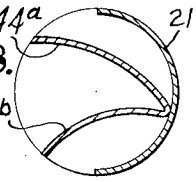


Fig. 5

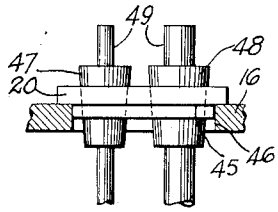


Fig. 7.

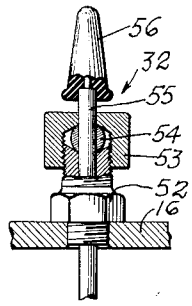


Fig. 2

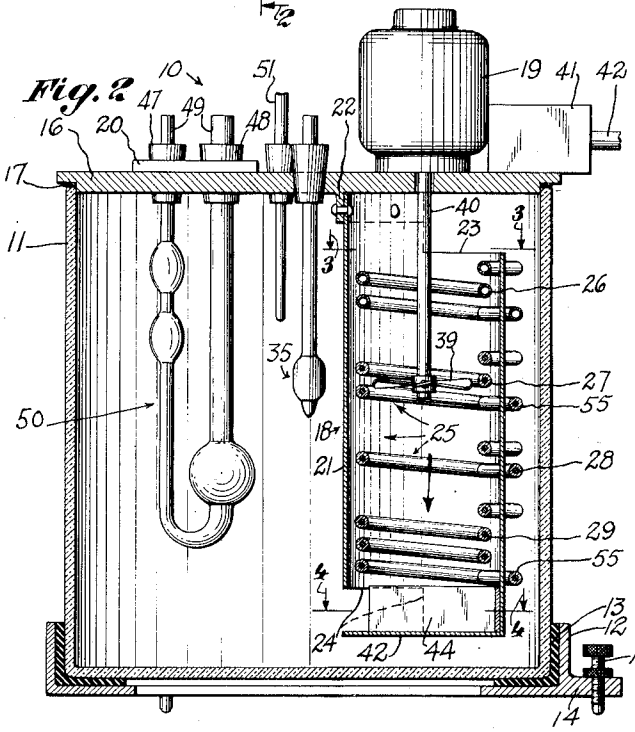
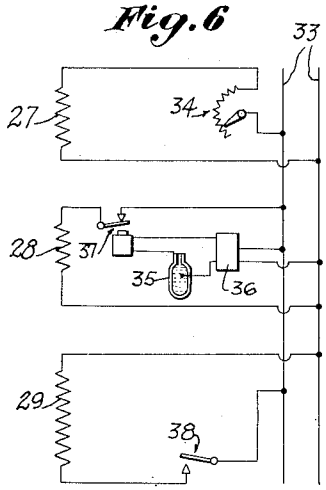


Fig. 6



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CONSTANT TEMPERATURE BATH

Rudolph Krebs, Bronx, N. Y.

Application June 6, 1938, Serial No. 212,215

6 Claims. (Cl. 73—151)

This invention relates to devices such as constant temperature baths, adapted for the testing and calibration of various instruments and generally wherever a highly uniform temperature may be required in a liquid bath.

One object of the invention is the provision of a constant temperature bath having improved means in heat exchanging relation to the bath for causing a circulation of the liquid in the bath in such manner as to assure an almost absolute uniformity of temperature throughout the bath.

Another object of the invention is to provide a compact portable device including a heat exchange and liquid circulating means in the bath of a simple container arranged and constructed in an improved manner so that the heat exchange means is not adapted to store any appreciable quantity of heat and is so exposed to the circulating stream of liquid that the temperature lag of the bath will be reduced to a minimum.

Another object of the invention is to furnish a constant temperature bath of a compact portable type having a combined heat exchange and liquid circulating means of tubular form arranged as in eccentric relation to the bath whereby all the test instruments may be conveniently disposed at the front of the bath so the advantages are served both of obtaining easy access to the instruments and of assuring a circulatory path of considerable length and large amplitude.

A related object of the invention is to furnish improved flow directing means to spread the circulatory flow, and yet without appreciably reducing the velocity or volume thereof.

Another object of the invention is to construct such a constant temperature bath wherein the circulatory flow occurs downward through the tubular device and upward in the bath whereby the liquid bath is almost imperceptibly but appreciably mixed while the test instruments are located mainly in the upper part of the bath.

A further object of the invention is to provide a device including a constant temperature bath having relatively few and simple parts, and which is inexpensive to manufacture, and durable, convenient, reliable, accurate, and efficient in use.

Other objects and advantages of the invention will become apparent as the specification proceeds.

With the aforesaid objects in view, the invention consists in the novel combinations and arrangements of parts hereinafter described in their preferred embodiments, pointed out in the subjoined claims, and illustrated in the annexed drawing, wherein like parts are designated by the same reference characters throughout the several views.

In the drawing,

Fig. 1 is a perspective view showing a device embodying the invention.

Fig. 2 is a vertical sectional view thereof with parts removed.

Figs. 3 and 4 are sectional views taken on the lines 3—3 and 4—4 of Fig. 2.

Fig. 5 is a fragmentary view partly in section showing details of the instrument mounting means.

Fig. 6 is a diagrammatic view of a circuit for the device.

Fig. 7 is a sectional view of details according to the invention.

Fig. 8 is a modified baffle adapted to counteract the clockwise swirl produced by the propeller.

The advantages of the invention as here outlined are best realized when all of its features and instrumentalities are combined in one and the same structure, but useful devices may be produced embodying less than the whole.

It will be obvious to those skilled in the art to which the invention appertains, that the same may be incorporated in several different constructions. The accompanying drawing, therefore, is submitted merely as showing the preferred exemplification of the invention.

Referring in detail to the drawing, 10 denotes a device such as a constant temperature bath of a compact portable type adapted for laboratory use, embodying the invention.

Heretofore baths of a generally similar type have been known, according to Patent No. 2,037,993 issued April 21, 1936. In this bath, the so called throttling or circulating tube was formed with a double wall having an intermediate insulator wall. While the purpose was to prevent direct radiation of heat upon the test instruments and to prevent undue transmission of heat to the bath, yet it resulted in an important drawback because the amount of heat stored in the tube wall was sufficiently great to cause a rise in temperature even after the thermostatic control had disconnected the source of current. This considerable temperature lag caused substantial fluctuations so that uniformity of temperature could not be obtained. In principle, the bath was based upon the concept of restricting the circulatory flow through the tube, as evidenced by a spiral groove propeller, while also restricting heat exchange. This rendered still greater the difficulty of obtaining temperature uniformity, and is directly contrary to the principle of my invention.

Further, the tube was positioned centrally of the bath so that the test instruments had to be placed unduly close to the tube and might be directly affected by the trickle of hot liquid from the tube top. Prior to the present invention, no temperature bath was known which would afford sufficient uniformity of temperature to meet the rigid requirements of the art for precision.

According to the present invention, the tube consists of a single thin wall having a relatively nonradiating external face that will not appreciably radiate heat, and the heat exchange elements therein being arranged in open spaced relation to each other and to the tube in the manner of a grid to permit circulation of liquid between and around the elements to reduce to a minimum the heat capacity of the device. At the same time, the principle of the invention contemplates a large and substantial liquid flow through the tube as by the use of a high speed bladed propeller. With the tube eccentrically arranged, the test instruments are conveniently arranged at the front side of the bath remote from the tube, and a long circulatory path is provided which is flared toward the instruments in an improved manner. By causing the liquid to discharge from the tube near the bottom thereof, uniformity of temperature is enhanced as the liquid rises, whereas the test instruments are disposed mainly in the upper part of the bath.

Specifically described, the device **10** may include a transparent cylindrical glass container **11** open at the top, and resting on a ring shaped base **12** having an interposed cushioning gasket **13**. Said base may have feet **14** provided with adjustable set screws **15** for leveling the container.

Resting on the container **11** is a disc cover plate **16** having an interposed ring packing or gasket **17**. The operating parts of the device including the heat exchange and circulatory means **18**, motor **19**, instrument supports **20**, and related parts may all be mounted on the cover **16** for removal as a unit therewith from the container **11**.

The means **18** may include an upright throttle tube **21** of relatively large diameter, located off center, near a side wall of the container. If desired, the cover **16** may have a flange **22** to which the tube may be secured. At its upper end, the tube may have a large lateral inlet **23** facing the adjacent side wall of the container. At its lower end, the tube **21** may have a large lateral opening **24** facing toward the front region of the container, at which the instrument holding means **20** are located.

It is noted that the tube **21** consists of a single thin metal wall, whose outside face may be polished and have low capacity for radiating heat, whereas its inside face may desirably be dark so as to absorb relatively little radiant heat.

Within the tube **21** is disposed a heat exchange means **25** arranged in a generally tubular form, with the elements such as **26** thereof spaced from each other and from the wall of the tube to permit circulation of liquid between and around the elements to thus render the liquid immediately responsive to the temperature of the elements. The latter are thus adapted to have as little body or mass as possible so as to have a minimum of heat retaining capacity to thus avoid undue temperature lag. Desirably, the elements referred to may be arranged in the form of coils so as to promote agitation and break up the liquid stream.

The heat exchange means **25** may include a tubular coil such as **26** for receiving warm or cold liquids or refrigerating mediums and may illustratively comprise two coils located just below the opening **23**. Next below the coil **26** is a main heating coil **27** having two or more coils. Next below the latter is an auxiliary or control heating coil **28**. Next below the latter is a quick heating coil **29**. The several coils pass through suitable holes in the wall of the tube **21** which serve to mount them. Additional support is afforded by connections secured to the cover **16**. For example, the cooling coil **26** is laterally bent and connected to the inlet and outlet hose connections **30**. Similarly the various heating coil conductors are laterally bent as indicated generally at **31**. Since these conductors as well as their heating elements are insulated and encased in metal tubing, such tubing can be reliably secured to the cover **16** as by any suitable connector devices **32**. These various connections to the cover **16** are preferably liquid tight.

In Fig. 6 is shown the circuit for the heat exchange members **27**, **28**, and **29** whereby their several functions will be more clearly apparent. For instance, these members may be connected into aline circuit **33** in multiple. Controlling the main heating coil **27** is a rheostat **34** whereby the amount of applied heat can be roughly regulated. With the rheostat set, the auxiliary heating coil **28** keeps the temperature constant under the control of any thermostatic device **35** that preferably is of the mercury type. This thermostat may be operated by a dry cell or by current from the line **33** whose voltage has been sufficiently reduced by a suitable device **36**. Controlled by the thermostat is a relay type switch **37** whereby, when the temperature rises, the switch is opened and vice versa. The quick heating coil **29** is merely controlled by a manual switch **38** and serves to permit the bath to be rapidly heated from cold, without undue waiting.

The heat exchange means **25** provides a central flow passage in which is provided a large capacity propeller such as **39** mounted on a spindle **40** which extends downward through the cover **16** from the motor **19** that is suitably directly supported on and affixed to said cover. The motor, as well as the various heating coils may obtain their current from a terminal box **41** fixed on the cover **16**, and having a cable **42** leading to any control box which may contain the members **34**, **36**, **37** and **38**. The propeller is desirably positioned adjacent to the coil **27** centrally thereof so as to powerfully agitate the liquid adjacent to this main heater. Further the propeller is arranged to drive the liquid downward so that the opening **23** is the inlet whereas the opening **24** serves as the outlet. Obviously, because of the centrifugal character of the propeller action, the liquid is also driven in and around the heating coils.

The tube **21** may have a bottom wall **42** relatively close to the bottom of the reservoir to thus constitute the opening **24** a lateral outlet. Associated with the latter is a flow directing means of such character that it will not restrict nor retard the flow of a large stream of liquid, and the arrangement is desirably such that a flaring out of the liquid stream may be effected as closely as possible to the tube **21** and hence remotely from the test instruments. For example, a horizontally extending V shaped baffle **43** is disposed on the wall **42** and secured to the tube **21**, with the arms thereof diverging toward the opening **24** to divide the same into three angularly related outlet openings. Preferably the arms **44** of the baffle are adjustable or bendable for instance, to the form shown at **44a**, **44b** in Fig. 8

to adjust for the tendency of the liquid to be thrown to the right where the propeller is turning clockwise. Since the arms 44 lie in upright planes, the liquid stream readily enters between or alongside the arms for the lateral discharge.

The instrument supporting means may include the plates 20 which are marginally stepped as at 45 to be received in openings 46 of the cover 16 and to rest thereon along the edges of said openings. Each plate 20 may have one or more rubber stoppers 47, 48 fitted in suitable holes thereof, these stoppers having axial bores to receive for instance, the arms 49 of the viscosimeters 50. The instrument supporting means may be arranged along an arc-like line whose center is offset from said tube 21 so as to lie in front thereof, said line being concaved toward the tube and the ends of the line being in spaced relationship to the sides of the tube, so that the flared flow of liquid produces a highly even temperature at the instruments 50.

Preferably a thermometer 51 may be mounted in the cover 16 in any suitable manner to permit the bath temperature to be checked.

A preferred way of arranging the electrical conducting devices 32 is to provide a headed nipple 52 screwed at its lower end into the cover 16 and having a cap 53 screwed onto its upper end. The cap 53 serves to axially compress and hence inwardly distort a thin walled relatively soft metal band or ferrule 54 to cause the latter to securely grip the metallic sheath or tube 55 of a conductor for an electrical heating element. The ferrule 54 also serves as a sealing gasket to afford a liquid tight joint. The terminal connection of the conductor may be insulated by a removable rubber cap 56.

It will now be seen that I have provided a constant temperature bath which fulfills the objects of the invention and is well adapted for practical use.

I claim:

1. In a device comprising a constant temperature bath including a reservoir adapted to contain a liquid, an upright single wall metallic tube therein and a cover adapted to fit the reservoir, of heat exchange means in the tube comprising elements arranged to follow the circular contour of said tube and spaced from the wall thereof, said elements being freely exposed to direct individual contact with liquid in the tube and being arranged so that liquid can freely pass between and around the individual elements, axially propelling centrifugal type rotor means of relatively large capacity, extending into the heat exchange means between the elements thereof to cause a longitudinal downward flow of liquid through the tube, said tube being spaced from the center of the cover and in proximity to an edge thereof, said tube having top and bottom openings for the circulation through the tube of the reservoir liquid, the bottom opening being at a side of the tube, and means for supporting a series of test articles on said cover along an arc concaved toward the tube and whose center is offset from said tube and whose ends are in spaced relations to the sides of the tube, said tube being adapted to laterally discharge liquid from its bottom opening toward the center of the arc.

2. In a device comprising a constant temperature bath including a reservoir adapted to contain a liquid, an upright single wall metallic tube therein and a cover adapted to fit the reservoir, of heat exchange means in the tube comprising elements arranged to follow the circular contour of said tube and closely adjacent to the wall thereof, said elements being freely exposed to direct individual contact with liquid in the tube and being arranged so that liquid can freely pass between and along the individual elements, axially propelling centrifugal type rotor means of relatively large capacity, extending into the heat exchange means between the elements thereof to cause a longitudinal downward flow of liquid through the tube, said tube being spaced from the center of the cover and in proximity to an edge thereof, said tube having top and bottom openings for the circulation through the tube of the reservoir liquid, the bottom opening being at a side of the tube, and means for supporting a series of test articles on said cover along an arc concaved toward said tube and whose center is offset from said tube and whose ends are in spaced relations to the sides of the tube, said tube being adapted to laterally discharge liquid from its bottom opening toward the center of the arc, a baffle being disposed in the lower portion of the tube having arms extending and diverging toward the bottom opening of the tube along a horizontal plane.

3. In a device comprising a constant temperature bath including a reservoir adapted to contain a liquid, an upright single wall metallic relatively straight tube therein and a cover adapted to close the reservoir, of heat exchange means disposed solely within the tube, comprising a series of elements arranged to follow the circular contour of the tube in close proximity to the wall thereof, said elements being freely exposed to direct individual contact with the liquid in the tube and being arranged so that liquid can freely pass between and along the individual elements, axially propelling centrifugal type rotor means of relatively large capacity located wholly within the tube between certain of the heat exchange elements to cause an axial flow of liquid through the tube to effect the said contact of the liquid with said elements, said tube having top and bottom openings for the circulation through the tube of the reservoir liquid, and means mounting on said cover a series of test articles to project into said liquid in spaced relation to the tube.

4. In a device comprising a constant temperature bath including a reservoir adapted to contain a liquid, an upright single wall metallic relatively straight tube therein and a cover adapted to close the reservoir, of heat exchange means disposed solely within the tube, comprising a series of elements arranged to follow the circular contour of the tube in close proximity to the wall thereof, said elements being freely exposed to direct individual contact with the liquid in the tube and being arranged so that liquid can freely pass between and along the individual elements, axially propelling centrifugal type rotor means of relatively large capacity located wholly within the tube between certain of the heat exchange elements to cause an axial flow of liquid through the tube to effect the said contact of the liquid with said elements, said tube having top and bottom openings for the circulation through the tube of the reservoir liquid, and means mounting on said cover a series of test articles to project into said liquid in spaced relation to the tube, and outlet baffle means at one of the tube openings comprising plates lying in planes generally parallel to the tube axis so

as to directly receive and break up the liquid swirl caused by the rotor means.

5. In a device comprising a constant temperature bath including a reservoir adapted to contain a liquid, an upright single wall metallic relatively straight tube therein and a cover adapted to close the reservoir, of heat exchange means disposed solely within the tube, comprising a series of elements arranged to follow the circular contour of the tube in close proximity to the wall thereof, said elements being freely exposed to direct individual contact with the liquid in the tube and being arranged so that liquid can freely pass between and along the individual elements, axially propelling centrifugal type rotor means of relatively large capacity located wholly within the tube between certain of the heat exchange elements to cause an axial flow of liquid through the tube to effect the said contact of the liquid with said elements, said tube having top and bottom openings for the circulation through the tube of the reservoir liquid, and means mounting on said cover a series of test articles to project into said liquid in spaced relation to the tube, and outlet baffle means at one of the tube openings comprising plates lying in planes generally parallel to the tube axis so as to directly receive and break up the liquid swirl caused by the rotor means, and said plates being angularly related to each other so as to diverge toward the side wall of the tube.

6. In a device comprising a constant temperature bath including a reservoir adapted to contain a liquid, an upright single wall metallic relatively straight tube therein and a cover adapted to close the reservoir, of heat exchange means disposed solely within the tube, comprising a series of elements arranged to follow the circular contour of the tube in close proximity to the wall thereof, said elements being freely exposed to direct individual contact with the liquid in the tube and being arranged so that liquid can freely pass between and along the individual elements, axially propelling centrifugal type rotor means of relatively large capacity located wholly within the tube between certain of the heat exchange elements to cause an axial flow of liquid through the tube to effect the said contact of the liquid with said elements, said tube having top and bottom openings for the circulation through the tube of the reservoir liquid, and means mounting on said cover a series of test articles to project into said liquid in spaced relation to the tube, and outlet baffle means at one of the tube openings comprising plates lying in planes generally parallel to the tube axis so as to directly receive and break up the liquid swirl caused by the rotor means, and said plates being angularly related to each other so as to diverge toward the side wall of the tube, said tube being spaced from the center of the cover, said mounting means being disposed to support the test articles along an arc concaved toward the tube and whose center is at a side of the tube and whose ends are spaced from the tube, the divergence of said plates being toward the center of said arc, and the tube opening that is remote from said plates being arranged to face away from the mounting means.

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