July 10, 1962 F. WEHRLI 3,043,982

DEVICE FOR THE TREATMENT OF BLOOD OR THE LIKE

Filed Jan. 28, 1957

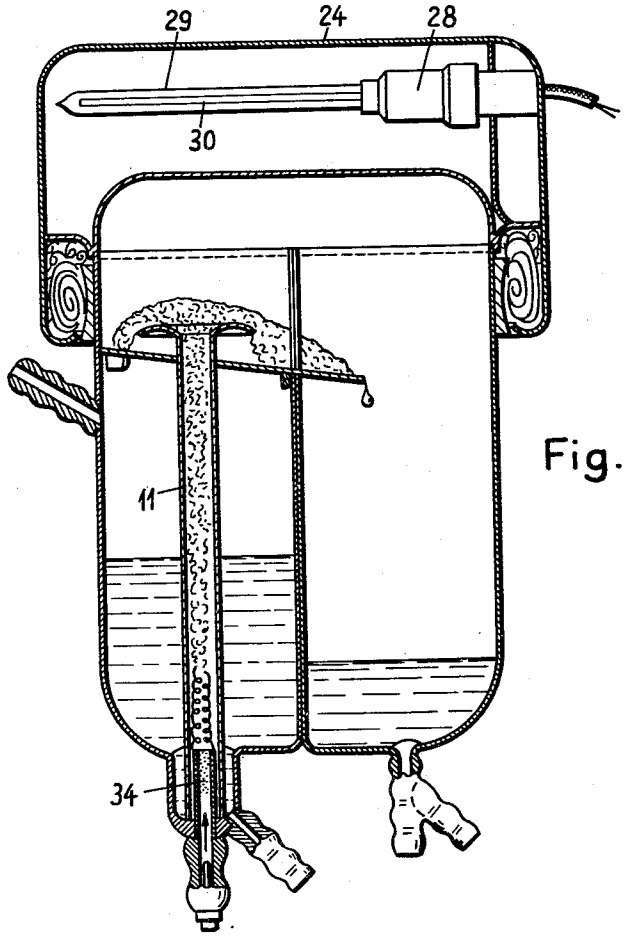


Fig.1

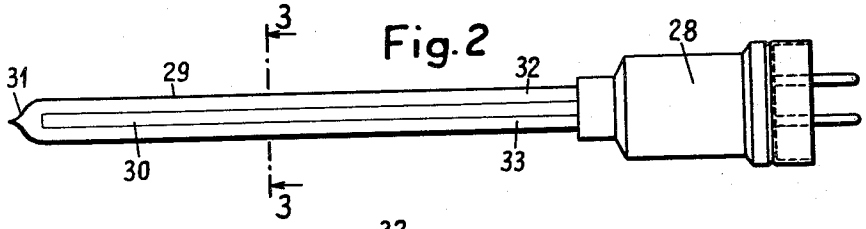


Fig.2

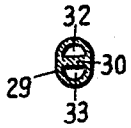


Fig.3

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DEVICE FOR THE TREATMENT OF BLOOD OR THE LIKE

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1 Claim. (Cl. 313—220)

The present invention relates to a device for the treatment of blood, stored blood, blood plasma and similar liquids.

In my patent application Ser. No. 439,849, filed on June 28, 1954, Pat. No. 2,887,107, I have described a device for the treatment of blood or the like by means of oxygen introduced into the blood and producing a blood foam, comprising two separate chambers for untreated blood and the treated blood, respectively, and a pipe line system through which the untreated blood is passed from one chamber into the upper portion of the other, the introduction of the oxygen into the first one of these chambers being so arranged that the blood passes into the other chamber exclusively in the form of blood foam. The said pipe line system comprises a tube extending into the said first chamber to the vicinity of the bottom thereof, and the oxygen supply issues into the region of its lower end in such a manner that the blood foam, formed there, rises in the said tube. The said tube penetrates with its upper end through a run-off plate in such a manner that the blood foam conveyed through the said tube spreads over the said plate and then drips off same in the other chamber.

At the point of transition of the blood foam into the said other chamber an ultraviolet irradiation lamp is provided with the object of sterilizing the blood and making the same amenable to the maximum values of the ultraviolet irradiation. The said ultra-violet irradiation lamp is so arranged that it irradiates the foam spread out over the said run-off plate.

It is a main object of my present invention to provide an improved ultra-violet irradiation lamp which is particularly suited for the treatment of the blood described hereinabove.

It is another object of the invention to provide an ultraviolet irradiation lamp having a spectrum range extending to a considerably higher number of Angstrom units than the ultra-violet lamps hitherto usual.

It is yet another object of the invention to provide an ultra-violet irradiation lamp, the spectrum range of which lacks the band detrimental to living proteins.

It is still another object of the invention to provide an ultra-violet irradiation lamp, the maximum temperature of which does not exceed the normal body temperature of a healthy human being.

It is a further object of the invention to provide an ultra-violet irradiation lamp producing biochemical changes in the blood irradiated by it corresponding to those occurring in the lung of a healthy human being.

It is yet a further object of the invention to provide an ultra-violet irradiation lamp having a powerful sterilizing effect, particularly on the virus producing icterus.

With these and other objects in view I provide a device for the treatment of blood, stored blood and blood plasma, comprising in combination: dispersion means introducing oxygen into the said blood, stored blood and blood plasma, respectively, and transforming the same into a foam, a run-off plate spreading out the said foam running over its surface, and a low pressure quartz ultra-violet irradiation lamp arranged opposite the said run-off plate and irradiating the said foam spread out over its surface.

In a preferred form the said low pressure quartz burner is rod-shaped.

These and other objects and features of my present

invention will be clearly understood from the following description of an embodiment thereof given by way of example with reference to the accompanying drawing, in which:

FIG. 1 is a diagrammatic sectional elevation of a device corresponding in principle to my aforesaid patent application Serial No. 439,849, but incorporating the improved ultra-violet irradiation lamp according to the present invention,

FIG. 2 is a side elevation of the improved quartz burner by itself, on a larger scale, and

FIG. 3 is a section on the line 3—3 of FIG. 2.

Referring first to FIG. 1 a riser tube **11** is built into the compartment for the untreated blood. In the lower part of said tube **11** through which rises the blood foam a glass grain filter is built at **34**, which takes care of a fine dispersion of the oxygen in the blood. The glass grain filter consists of weakly sintered glass splinters which do not offer any substantial obstacle to the passage of gas and to the flow of liquid and accordingly do not produce a pressure drop but merely cause a good distribution so that very fine bubbles of blood foam are formed. The dispersion extends as far as in normal respiration in the lung i.e. to a thickness of the film layer of 0.0005 to 0.001 millimetre. This thickness of layer corresponds to the volume size of individual blood corpuscles. This dispersion takes place substantially completely free from vacuum, stresses and pressures whereby possibilities for the occurrence of haemolysis are eliminated. On the other hand, particularly favourable conditions for the irradiation of the blood with ultra-violet rays are created thereby.

This blood foam rising in the said tube **11** overflows at the upper end thereof on to a sloping run-off plate where it is exposed to the irradiation with ultra-violet rays emitted from a low pressure quartz lamp **29**, **30** arranged in an upper compartment **24** of the device. The blood foam runs off the said plate into the compartment for the treated blood on the right hand side of FIG. 1.

The ultra-violet lamp according to my present invention arranged in the said upper compartment **24** of the device illustrated in FIG. 1 will now be described more particularly with reference to FIGS. 2 and 3. It comprises a low pressure quartz burner having a head piece **28** for the current supply leads and a quartz tube **29**. This quartz tube **29** contains a partition wall **30**, by which the tube is divided into two separate ducts **32** and **33** which are in communication with one another at the tip **31** of the tube. The electric discharge runs along the duct **32**, turns back at the tip **31** and passes through the duct **33** in the opposite direction. Thereby the action is doubled.

In the production of the low pressure quartz burner the quartz tube **29** is first evacuated and then filled with argon at an absolute pressure of 4 millimetres Hg. The burner is operated at a voltage of 320 to 330 volts. The igniting voltage amounts to 1240 volts with 17 to 18 milliamps.

The device is used in blood transfusions and moreover for the treatment of stored blood and blood plasma which are produced commercially on a large scale. In the use of products produced in the devices hitherto known in practice, an average of 0.8 to 2.8% cases of iceterus virus infections occurred with plasma or blood transfusions. In contrast, plasma and blood samples have been produced with the device according to my present invention in the transfusion of which a case of icterus has never been observed, although hitherto more than 10,000 such transfusions have been performed.

The ultra-violet irradiation lamps hitherto used had a spectrum range of from 1800 to 2600 angstroms. However, with this spectrum range it has not been possible to exploit all the favorable effects of the ultra-violet irradiation. The low pressure quartz burner according to my

present invention has a spectrum range of from 1860 to 4630 angstroms. This choice of spectrum range has the advantage that not only a maximum irradiation of the blood and consequently a maximum germicidal effect is achieved, but that moreover a chemical change of the blood is effected in the same sense as it is effected by the lung as a living organ in a healthy human being, namely a conversion of saturated fatty acids into unsaturated fatty acids, etc. It is known that certain conditions of illness have shown in their test results that the lung in the state of disease no longer has the power of performing these functions. With the device according to the present invention this difficulty can also be overcome.

It has moreover been ascertained that in the device according to my present invention a drop in leucocytes occurs as in the lung of a healthy human being acting physiologically as a living catalyst. This drop in leucocytes occurs after the blood foam saturated with oxygen had been exposed to irradiation by my low pressure quartz burner. This decomposition of the white blood corpuscles yields vital ferments to the organism such as those supplied by a healthy lung.

In the spectrum of the low pressure quartz burner according to my present invention those rays are missing which might have a detrimental effect on protein, namely the rays of 2500 to 2750 angstroms. This is a particular advantage of the new device.

The device according to my present invention operates at about body temperature since the low-pressure quartz burner cannot produce a temperature exceeding 36.5° C.

While I have herein described and illustrated in the accompanying drawing what may be considered a typical and particularly useful embodiment of my present invention, I wish it to be understood that I do not limit myself to the particular details and numerical values described and illustrated, for obvious modifications will occur to a person skilled in the art.

What I claim as my invention and desire to secure by Letters Patent is:

For use in an apparatus for saturating blood with oxygen to irradiate the oxygen-saturated blood therein, an elongated straight low pressure ultraviolet quartz lamp having a head piece for the current supply leads at one end thereof and being divided by an axially extending quartz wall into two separate longitudinal ducts communicating with one another only at the end of said lamp opposite to the head piece, said lamp being filled with argon at an absolute pressure of substantially 4 millimeters, whereby the spectrum range of the lamp lacks the spectrum band of 2500 to 2750 angstroms which is detrimental to living proteins.

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