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METHOD FOR MEASURING THE DEGREE OF VACUUM IN A SEALED CONTAINER

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Fig. 1

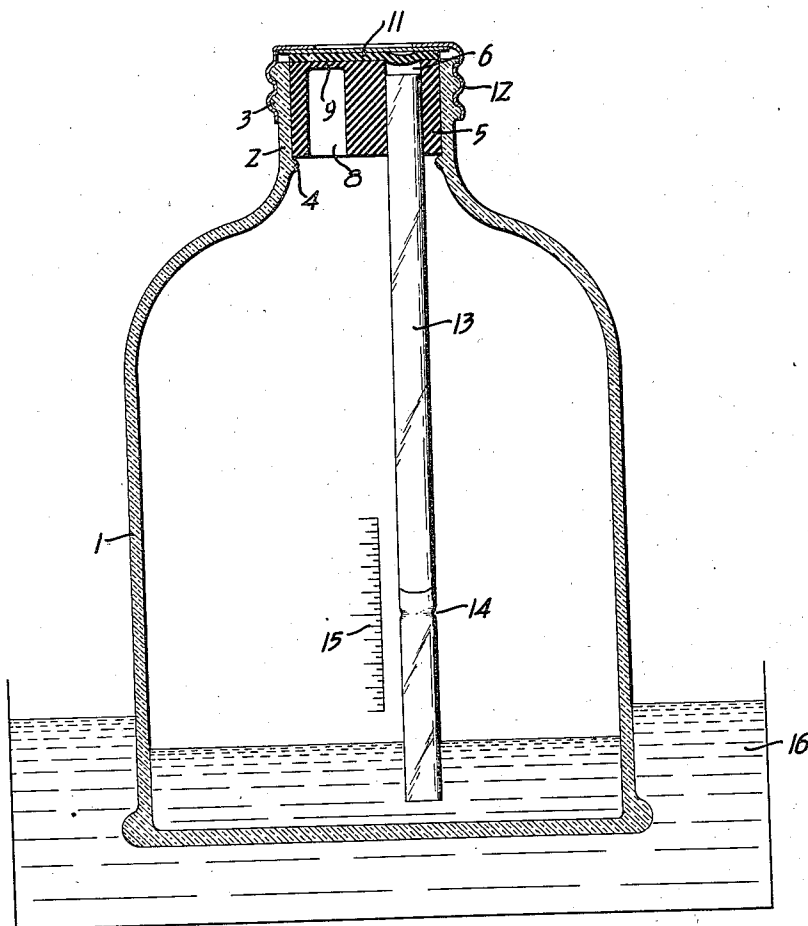
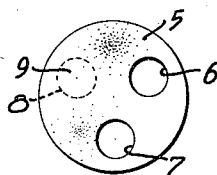


Fig. 2



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METHOD FOR MEASURING THE DEGREE OF
VACUUM IN SEALED CONTAINERS

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3 Claims. (Cl. 73—31)

This invention relates to the construction of a flask for making blood transfusions and to a method by which the vacuum within such a flask can be readily measured.

Flasks for making blood transfusions contain a small quantity of a solution such as sodium citrate for preventing the donor's blood from coagulating, and are sealed under vacuum so that the differential pressure between the blood stream of the donor and the interior of the flask is sufficient when communication between the two is established, to draw blood from the donor into the flask without the use of any additional vacuum equipment.

In order to determine whether the vacuum within a flask of this character is sufficient to draw a predetermined quantity of blood into the flask and be certain that no complications will arise from a lack of sufficient vacuum, it is highly desirable that a vacuum determination of the flask be made before the flask is shipped to the hospital for use.

In general, then, the object of this invention is the provision of a flask so constructed that by a suitable and simple method its degree of vacuum may be readily ascertained.

Another object of this invention is the provision in conjunction with a transparent or partially transparent vacuum-sealed flask partially filled with liquid into which a tube sealed at its upper end extends, of a method of determining the degree of vacuum within the flask by materially increasing the vapor pressure within the flask and surrounding the tube without appreciably increasing the vapor pressure within the tube, so that the resulting differential pressure will cause a column of liquid to rise in the tube, the height of which is indicative of the degree of vacuum within the tube.

The invention possesses other advantageous features, some of which with the foregoing will be set forth at length in the following description where that form of the invention which has been selected for illustration in the drawing accompanying and forming a part of the present specification is outlined in full. In said drawing, one form of the invention is shown, but it is to be understood that it is not limited to such form, since the invention as set forth in the claims may be embodied in a plurality of forms.

Referring to the drawing:

Figure 1 is a vertical mid-section taken through a flask and associated water bath embodying the objects of our invention and in conjunction

with which the method of our invention may be practiced.

Figure 2 is a top plan view of the three-hole stopper shown in Figure 1.

The structure shown in Figure 1 comprises a transparent flask 1 formed at its upper end with a neck 2 provided with screw threads 3. Seated within the neck 2 on projections 4 is a rubber stopper 5 formed with three holes 6, 7, and 8. The holes 6 and 7 extend entirely through the stopper, whereas the upper end of the hole 8 is closed by a rubber diaphragm 9 capable of being readily punctured by a scalpel or hypodermic needle. Seated on top of the stopper 5 is a rubber disk 11 held in sealed engagement with the stopper by a two-piece screw cap 12 threaded to the neck 2 of the flask. Secured within and depending from the hole 6 is an air eduction tube 13. Formed intermediate the ends of the tube 13 is a fiducial line, ring, or indentation 14 and provided on one or more of the sides of the flask is a vertical scale 15.

In preparing and testing a flask of this character for use in making blood transfusions, it is first sterilized and then partially filled, as indicated, with a solution such as sodium citrate for preventing the coagulation of blood. The flask is then sealed under vacuum as for example by the method outlined in the Baxter Patent No. 2,004,027 of June 24, 1935.

To test the flasks so sealed for their degree of vacuum, a differential vapor pressure is created between the exterior and interior of the tube 13. This can conveniently be accomplished by holding the flask for a period of about one minute in a bath 16 of water, the temperature of which is about 75° C. greater than room temperature. Under these conditions the increase of vapor pressure within the tube 13 is not appreciable, while the increase in the pressure of the vapor surrounding the tube is sufficient to cause a column of liquid to rise in the tube. The height of this column is then indicative of the degree of vacuum within the flask, and the tube 13, the scale 15, or a separate rule designed to be held in back of the flask and in line with the tube may be calibrated so as to quantitatively indicate the vacuum within the flask. For the purpose of making blood transfusions, the vacuum within the flask should be not less than 20 inches of water, and by experimentation we have found that a rise of about one inch in the column of liquid in a standard $\frac{1}{8}$ " outer diameter tube indicates a vacuum of this acceptable order. Under these conditions, the fiducial line 14 on the tube

13 should be placed 1" above the liquor level in the flask, which for practical purposes is substantially constant in any blood transfusion flask of predetermined capacity.

The most essential element of this process is the creation of a vapor pressure surrounding the tube without appreciably increasing the vapor pressure within the tube. Although this result is accomplished by increasing the temperature of the contents of the flask, it is to be noted that such exchange of heat is a function of time as well as of temperature. So long as the vapor pressure within the tube is not appreciably increased, the rate at which this heat exchange takes place is immaterial. If the temperature of the flask were to be increased over an extended interval of time, the vapor pressure within the tube 13 would be substantially equal to the vapor pressure surrounding the tube, and under such conditions there would be no rise of the column of liquid within the tube and consequently in indication of the vacuum within the flask. The accuracy of our method therefore depends upon the extent to which the vapor pressure surrounding the tube can be increased without any appreciable increase of the vapor pressure within the tube, and for some reason or other also upon the degree of vacuum within the flask. The greater the vacuum within the flask, the greater the accuracy of our method. Furthermore, we have found that with a vacuum in the flask below twenty inches of water, a qualitative but not quantitative result can be obtained.

Most of our tests have been made with a room temperature of about 21° C. and a water bath temperature of between 95° and 100° C., the flasks being held in the water for a period in the order of ½ to 2 minutes. However, other values of temperature and time can readily be established which will serve just as well by a few simple experiments.

Insofar as we have been able to ascertain, the above method is the only method available for determining the degree of vacuum within a

sealed container without the use of additional equipment.

We claim:

1. The method of determining the degree of vacuum within a sealed transparent container partially filled with liquid and provided with a transparent tube having its lower open end immersed in said liquid and its upper end closed, comprising: heating the contents of said container so as to increase the vapor pressure surrounding said tube without materially increasing the vapor pressure within the tube, and thereby causing a column of liquid to rise in said tube; and immediately comparing the height of said column with a previously calibrated scale.

2. The method of determining the degree of vacuum within a sealed transparent container partially filled with liquid and provided with a transparent tube having its lower open end immersed in said liquid and its upper end sealed, comprising: heating said container for a short predetermined interval of time so as to cause a differential pressure between the exterior and interior of said tube and a consequent rise of a column of liquid in the tube, and then comparing the height of said column of liquid with a previously calibrated scale.

3. The method of determining the degree of vacuum within a sealed transparent container partially filled with liquid and provided with a transparent tube having its lower end immersed in said liquid and its upper end sealed, and wherein the vapor pressure within the tube is substantially equal to the vapor pressure surrounding said tube, comprising: increasing the temperature of the contents of said container substantially 75° C. in a period of from 15 seconds to 2 minutes so as to cause a column of liquid to rise in said tube; and immediately comparing the height of said column with a previously calibrated scale.

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