United States Patent

[11] **3,610,230**

[72] Inventor **Harold Willids Andersen**
Oyster Bay, N.Y.

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[73] Assignee **H. W. Anderson Products, Inc.**
Oyster Bay, N.Y.

[54] **MANOMETER WITH A BALLOON SEALING THE UPPER END THEREOF AND METHOD OF USING SAME**
4 Claims, 6 Drawing Figs.

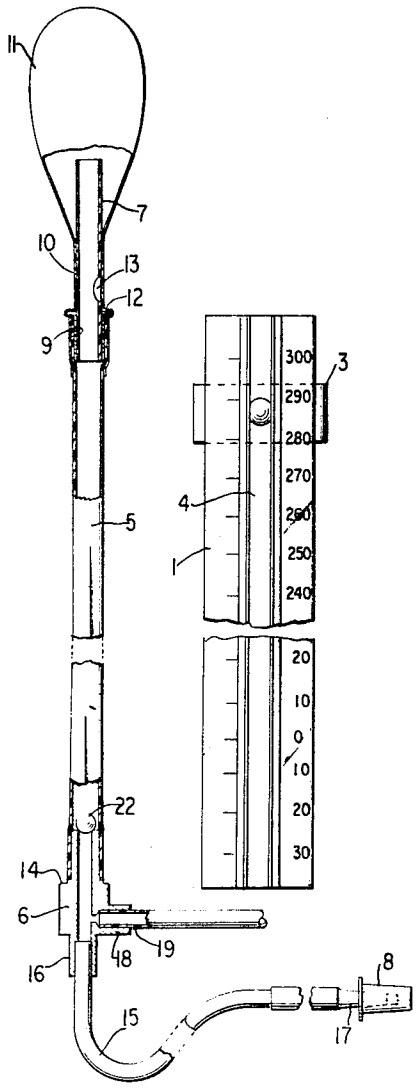
[52] **U.S. Cl.** ..... **128/2.05 D,** 128/214
[51] **Int. Cl.** **A61b 5/02**
[50] **Field of Search** 128/2.05, 214, 214.21; 73/395, 401, 402

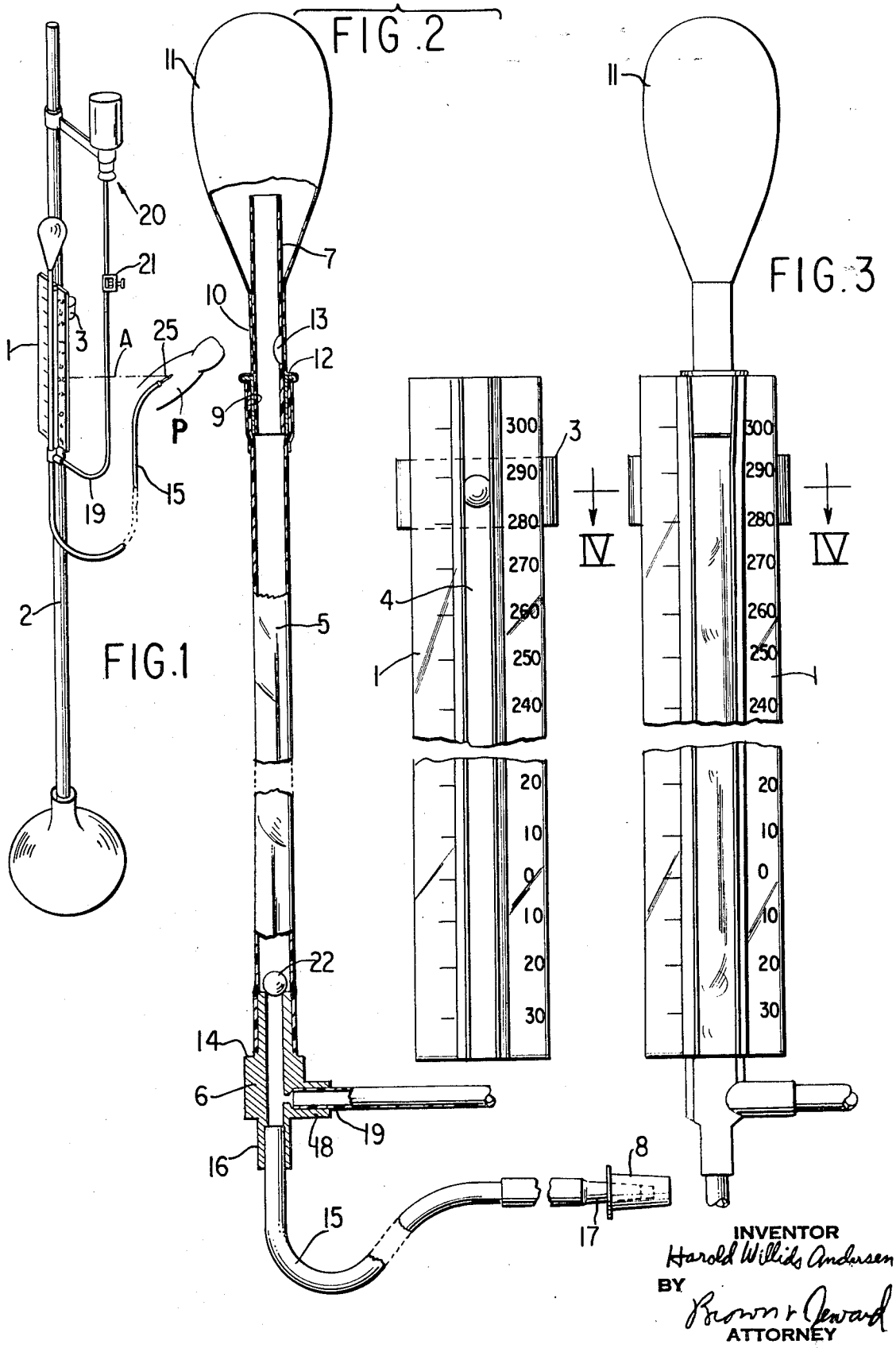
[56] **References Cited**
UNITED STATES PATENTS

3,033,038	5/1962	Murphy, Jr.	128/2.05 X
3,242,920	3/1966	Andersen	128/2.05
1,900,286	3/1933	Huber et al.	73/402 UX
3,124,133	3/1964	Marbach	128/2.05 X

Primary Examiner—William E. Kamm
Attorney—Frank J. Jordan

ABSTRACT: A manometer for measuring and indicating venous pressure in the human body by observation of the height of a column of liquid in continuous fluid communication with the interior of a vein, combined with means for rapid transfusion or infusion, whenever needed, without interrupting the continuous fluid path between the column and the vein; and the method of using same. A balloon seals the upper end of the manometer and serves as an atmospheric pressure transmitter while isolating the manometer from atmospheric contamination.





INVENTOR
Harold Willis Andersen
BY
Brown & Jeward
ATTORNEY

FIG. 4

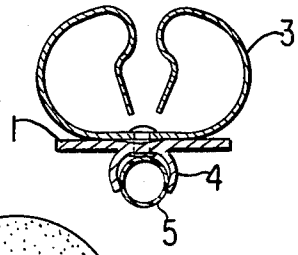


FIG. 5

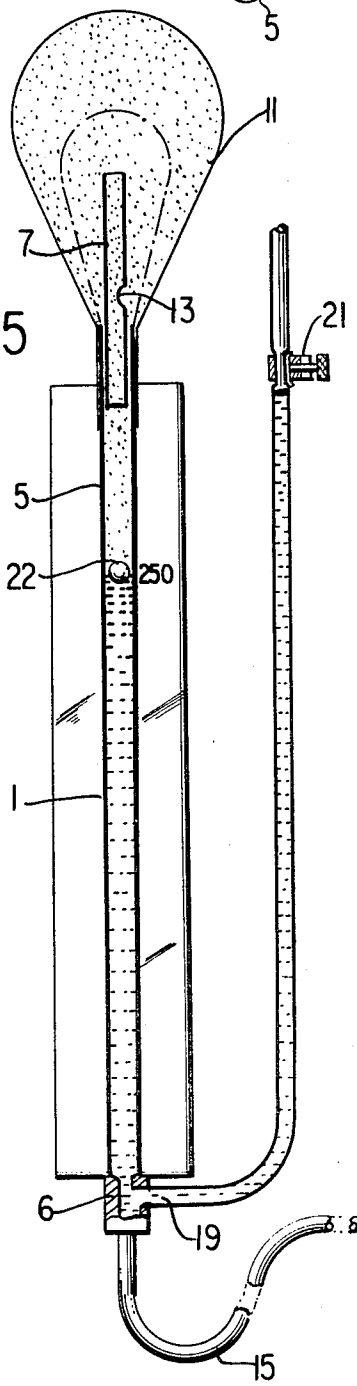
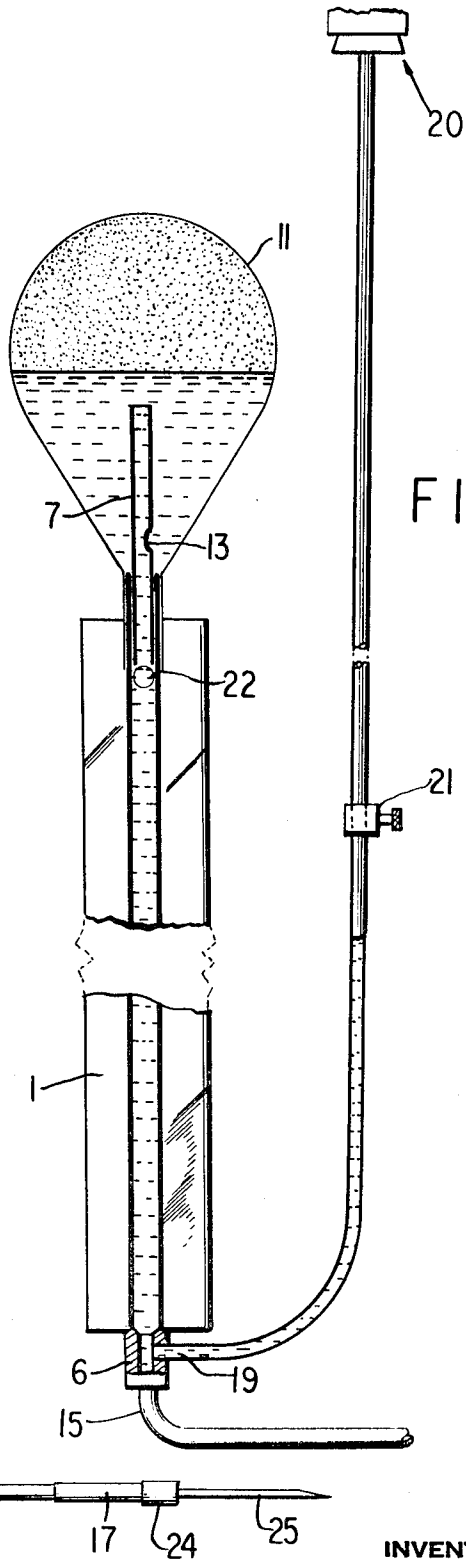


FIG. 6



INVENTOR
Harold Willis Andersen
BY
Brown & Jewett
ATTORNEY

MANOMETER WITH A BALLOON SEALING THE UPPER END THEREOF AND METHOD OF USING SAME

FIELD OF INVENTION

The present apparatus and method represent an improvement of the "manometer and method of using same" described and claimed in Andersen U.S. Pat. No. 3,242,920, Mar. 29, 1966. The patented apparatus has been practically successful in that its ability to record continually the venous pressure of a patient without the need for manipulating a three-way stopcock or the like has made it a valuable monitoring tool for hospitals. It is not, however, readily adaptable to meet situations where rapid (pressure) transfusion or infusion is required. The improved apparatus disclosed herein meets that need and makes possible the practice of the new method.

SUMMARY

The apparatus comprises a calibrated tubular reservoir supported vertically at a height related to the level of a patient's right atrium, tubular means adapted to connect the bottom of the reservoir to the interior of the patient's vein, a source of liquid supply communicating with the tubular connecting means for supplying liquid to the reservoir and to the vein, an adjustable valve for controlling the rate of liquid supply, and a low-resistance expansible closure for the top of the reservoir, such that a quantity of liquid flowing rapidly from the source can be accommodated within the reservoir and its closure to the extent that such accommodation may be necessary during pressure infusion or transfusion of bloods or other liquids, the system being maintained entirely closed from atmosphere at all times, whether under pressure or operated at a slow flow rate, as during ordinary monitoring periods.

A practical embodiment of the invention is shown in the accompanying drawings wherein:

FIG. 1 represents a perspective view of the instrument, mounted on a pole and in use;

FIG. 2 represents an elevation, partly in vertical section, of the instrument separated from its mounting board;

FIG. 3 represents an elevation of the instrument attached to the mounting board;

FIG. 4 represents a horizontal section on the line IV—IV of FIG. 3;

FIG. 5 represents an elevation, partly in section, of the instrument in a condition preliminary to use for monitoring venous pressure, certain structural details being omitted, and

FIG. 6 represents a corresponding view of the instrument in use during pressure infusion.

Referring to the drawings, the apparatus comprises the suitably calibrated manometer board 1 adapted to be mounted on an infusion pole 2 by means of the spring clip 3 on the back of the board. A channel 4 extends vertically from top to bottom of the face of the board and the transparent tubular reservoir 5, of somewhat elastic plastic, lies in the channel where it is retained throughout its length by the slightly inturned edges of the channel (see FIG. 4). The reservoir 5 is fitted at its lower end on the upper arm of the T-connector 6, while its upper end is fitted over the lower end of a rigid plastic tube 7, said lower end being provided with a short metal sleeve 9, the outer diameter of which is greater than the normal inner diameter of the reservoir 5 so that the upper end of the latter is slightly expanded in the area of the sleeve 9. The stem 10 of a thin wall highly flexible latex balloon 11 is stretched over the flange 12 of the sleeve and over the outer surface of the reservoir in said expanded area. Tube 7 is provided with a hole 13 just above the zone engaged by the sleeve.

The T-connector 6 is formed with an upwardly facing annular shoulder 14 and has a plastic connecting tube 15 secured in its lower arm 16 and extending a suitable distance (such as three feet) to a rigid plastic needle adapter 17. The sidearm 18 of the T-connector is designed to receive the discharge end 19 of a conventional infusion set 20 mounted on the pole 2 and provided with an adjustable clamp 21. A lightweight ball 22, as of white plastic foam, is located within the reservoir 5 where it can float freely on the surface of liquid in the reservoir and serve as a highly visible indicator of the liquid level.

In use, the reusable manometer board 1 is clipped to the pole 2 at the patient's bedside, by means of the spring clip 3. The fluid path, which is intended to be packaged separately and sterile, as a replaceable and disposable unit (with removable caps, such as the cap 8 in FIG. 2, sealing both the adapter 17 and sidearm 18), is mounted on the board by snapping the upper end, on which the balloon 11 is mounted; into the upper end of the channel 4 with the flange 12 against the top of the channel. The reservoir 5 is of a length such that it must be stretched slightly to permit the upper arm of the T-connector 6 to be snapped into the lower end of the channel with the shoulder 14 resting against the bottom of the channel, and the intermediate part of the reservoir 5 can then be pressed easily into the channel.

An infusion set 20 containing a solution such as isosmotic water is hung from the top of the infusion pole 2 and connected to the sidearm 18 of the T-connector 6. The clamp 21 is manipulated to permit the liquid to fill the reservoir 5 to the 250-mm. mark, displacing the air from the reservoir into the balloon 11. (FIG. 5). Because of the extremely low inertia of the walls of the balloon, the pressure needed to inflate it is insignificant.

A venipuncture is performed in the patient (P in FIG. 1) in the usual manner. The liquid held in the manometer reservoir 5 is then allowed to flow into the connecting tube 15 (as by removing the cap 8 from adapter 17) in order to displace the air therein. The adapter 17 is then press fitted into the hub 24 of the needle or cannula 25 in the patient's vein, and the liquid is allowed to flow from the infusion set through the T-connector and into the patient, to assure the potency of the needle or cannula 25. As in the case of the manometer shown in U.S. Pat. No. 3,242,920, the manometer board 1 is moved up or down the infusion pole so that the zero mark on the board will be located at the same level (indicated by line A in FIG. 1) as the patient's right atrium.

The infusion set is then shut by closing the clamp 21, whereupon the level of liquid in the reservoir 5 will fall to a point corresponding to the pressure in the patient's vein, the level being made readily ascertainable by the presence of the ball 22. The air above the meniscus of fluid, having returned from the balloon 11, remains at atmospheric pressure not appreciably affected by the presence of the balloon.

To place the unit in continuous record mode (as explained in U.S. Pat. No. 3,242,920) the clamp 21 is opened sufficiently to permit infusion at a rate of approximately 5 drops per minute. This rate of flow has been demonstrated not to significantly affect the venous pressure readings in the reservoir 5 while providing sufficient flow through the needle or cannula 25 to prevent blood from entering the lumen thereof with possible clotting and plugging of the system. If the needle or cannula is smaller than 18 gauge the infusion rate may have to be reduced below 5 drops per minute to eliminate the possibility of deceptive changes in the height of the fluid column in the reservoir; with gauges of 18 or larger no further adjustment is necessary.

The apparatus shown and described has an important additional capability in that it can be used, without change, to infuse liquid (e.g., isosmotic water, plasma or blood) at higher rates than 5 drops per minute or to pressure infuse the liquid at very high rates. For such purposes the clamp 21 is opened as fully as desired, permitting the liquid from the source 20 (whether water or, by substitution in a known manner of a different infusion set, blood) to flow rapidly through the T-connector, displacing the liquid in the reservoir 5 upwardly into the balloon 11 which expands until the pressures within the system are stabilized. The liquid then flows from the infusion set into the patient at any desired constant rate under the control of the clamp 21. When used for pressure infusion, at pressures above the highest reading on the manometer board, no such readings are possible, the ball 22 being stopped at the top of the reservoir (FIG. 6). The surface of the plastic ball is

rough enough to prevent it from acting as a stop valve, so that the liquid easily passes around it and up into the balloon. A smooth surface ball could be substituted, if desired, and permitted to act as a stop valve, in which case the balloon would serve mainly to ensure sterility of the system.

In order to return the apparatus to continuous recording mode it is only necessary to adjust the clamp 21 to the 5 drops per minute position (first closing it completely for a short time, if desired) and the liquid stored in the balloon and reservoir will drain down into the patient until the meniscus in the reservoir again indicates the true venous pressure reading.

The balloon on the top of the reservoir makes possible conversion to pressure infusion whenever desired without overflow of the liquid. The upward projection of the tube 7 into the balloon stabilizes the position of the balloon, preventing it from flopping over sideways and the opening 13 permits the liquid to drain completely out of the balloon. The interior of the entire system is closed at all times, so that its initial sterility cannot be impaired. The sterile fluid path is inexpensive enough to be disposable while the board and its channel can be reused indefinitely. All control is effected by simple adjustment of a clamp, without need to manipulate three-way stopcocks or the like. The needle or cannula in the patient need not be disturbed or replaced as the apparatus is changed from pressure-monitoring mode to infusion mode and back.

It will be understood that various changes may be made in the form, construction and arrangement of the several parts without departing from the spirit and scope of the invention and hence I do not intend to be limited to the details shown or described herein except as the same are included in the claims or may be required by disclosures of the prior art.

What I claim is:

1. A manometer for measuring and indicating venous pressure in the human body comprising, a substantially vertically disposed reservoir, a column of liquid in said reservoir, a conduit adapted to place said column in continuous fluid communication with the interior of a vein, means communicating with said conduit below said reservoir adapted to supply liquid to the vein at controlled rates, means on said reservoir separating the interior of the reservoir from ambient atmosphere while permitting said interior to remain substantially at atmospheric pressure, said separating means being a thin wall elastic balloon mounted on the upper end of said reservoir and projecting upwardly therefrom, said balloon being adapted to permit the liquid column to rise and fall freely and adapted to retain any quantities of said liquid forced out of the reservoir by an increase of fluid pressure and to return said liquid to the reservoir upon a reduction of pressure.

2. A manometer according to claim 1 which includes a support within said balloon.

3. A manometer according to claim 1 which includes a support for the reservoir comprising a board adapted to be attached to a stand or the like and a channel on said board receiving releasably the reservoir, the reservoir being of transparent plastic tubing and being retained in said channel under longitudinal tension.

4. The method of visually indicating the venous pressure in a living body and alternatively infusing liquid into said body, which includes providing a liquid-containing system comprising a reservoir, a liquid source and a hollow bore needle, placing the bore of the needle in communication with a vein of the patient, supplying liquid from said source to the reservoir and the needle, causing the level of liquid in the reservoir to stand at a point indicative of the pressure of blood in said vein, isolating the air in said reservoir above said liquid level from ambient atmosphere, continuing the supply of liquid to said reservoir at a rate sufficient to prevent back flow of blood into said needle bore upon any increase of blood pressure in said vein, said rate being insufficient to raise said level except in response to an increase of said pressure, and alternatively increasing said rate to infuse liquid into said vein while filling said reservoir with liquid under higher pressure, and retaining the liquid isolated from ambient atmosphere and in a position to be returned to pressure-indicating level.