United States Patent

Michielsen

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[54] CONTAINER FOR ORGAN PERFUSION OR THE LIKE

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[52] **U.S. Cl.** **195/127,** 128/DIG. 3, 222/522

[51] **Int. Cl.** **C12k 9/00**

[58] **Field of Search** 195/127; 128/DIG. 3; 23/258.5; 150/1; 222/211, 478, 522, 523

[56] **References Cited**

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[57] **ABSTRACT**

A container having at least one access port defined therein; and a flexible conduit passing through the access port in sealing relation, in which the conduit is slideable relative to the port without disruption of the seal.

6 Claims, 6 Drawing Figures

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SHEET 1 OF 2

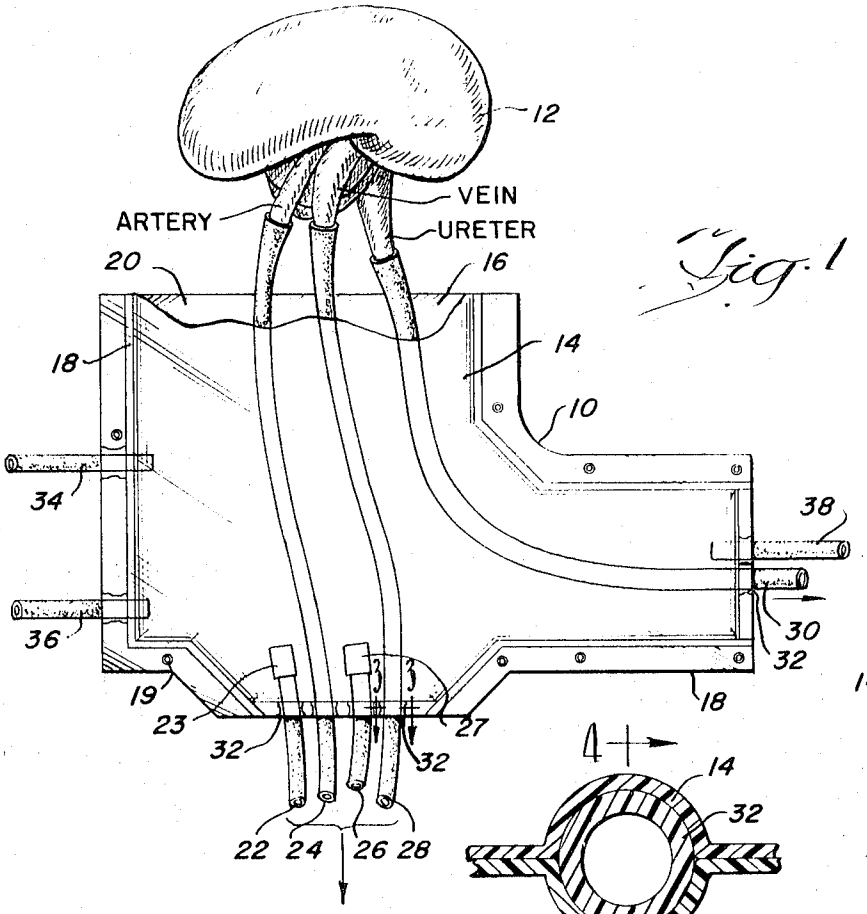

Fig. 1

Fig. 3

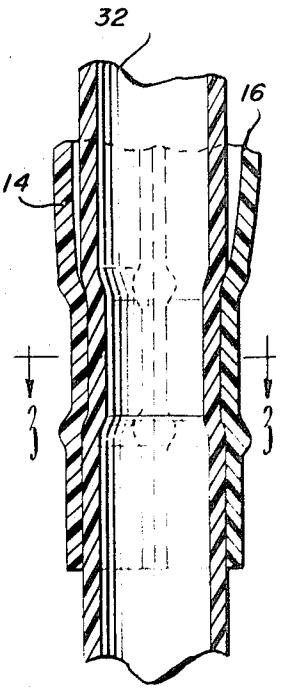

Fig. 4

Fig. 2

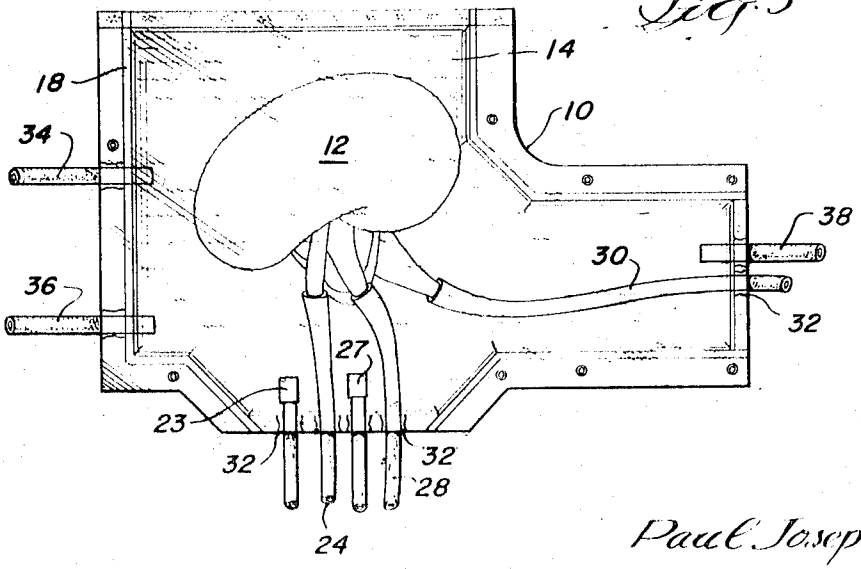

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Fig. 5

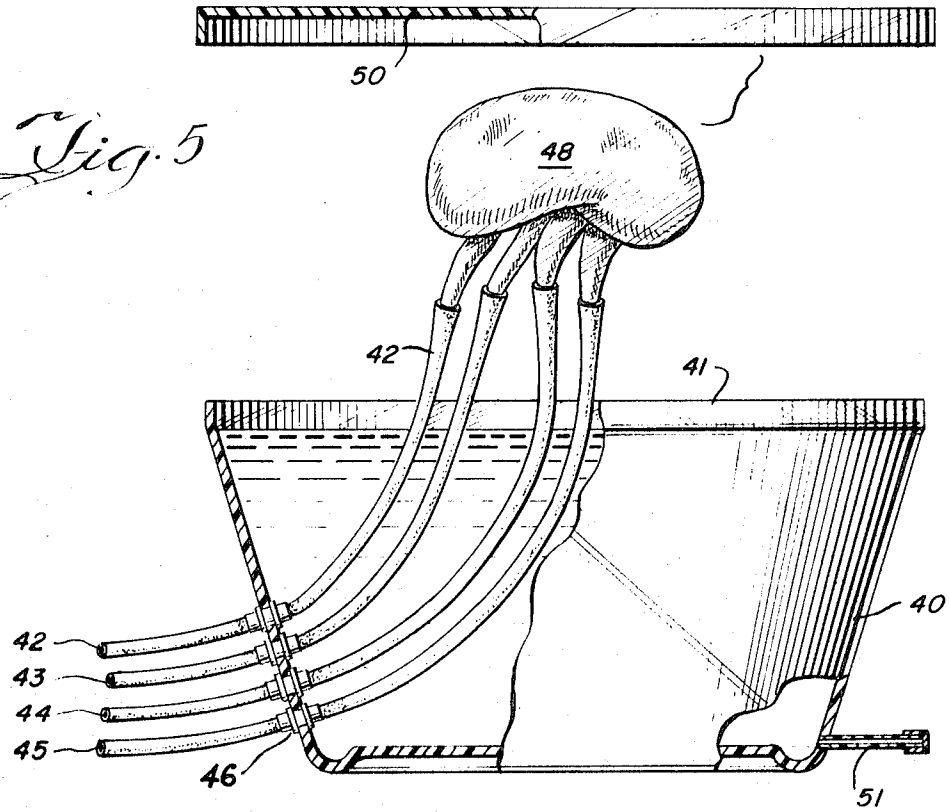
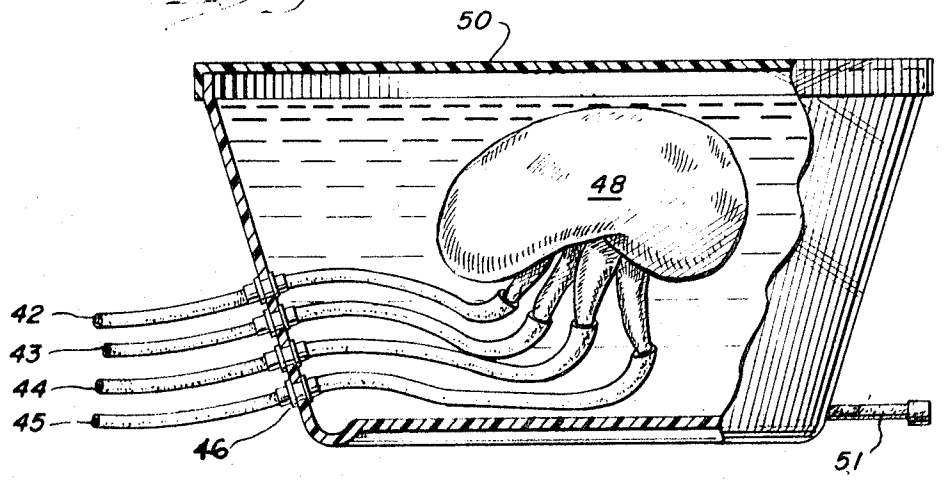


Fig. 6



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CONTAINER FOR ORGAN PERFUSION OR THE LIKE

BACKGROUND OF THE INVENTION

This application relates to a container having tubing leading into the interior through a sealing port, which is useful as an organ container for perfusion techniques.

The science of organ perfusion has been rapidly increasing in importance in recent years because of the increase in organ transplantation as a medical procedure. Basically, in organ perfusion an organ such as a kidney, liver, lung, or heart is removed from a donor and maintained in viable condition by artificial means. This is done to maintain the organ until the recipient is selected and prepared to receive it. At the present time, organs of potential donors have sometimes been unavailable to recipients in desperate need of them, because the donor, who is often a victim of a fatal accident or illness, is located at a region remote from the recipient. In this case, emergency measures, such as maintaining the vital functions of a clinically dead donor by elaborate artificial means, must be performed while transporting the donor and the required life maintenance equipment to the location of the recipient. This is frequently impossible to do.

The technique of organ perfusion is intended to simplify the problem of storing and transporting living organs by providing a generally portable artificial environment in which the organ can survive until the time of implantation.

The organ, once severed from a donor, is generally cannulated to connect it to a source of circulatory fluid which carries oxygen and optional nutrients. The cannulation process generally takes substantial manual dexterity, and it is desirable to perform the operation in a relatively large space unhindered by the walls of an organ perfusion container. However, the cannulated organ must then be placed in the container, and it is undesirable to have extraneous loops of cannula tubing coiling around the organ within the container.

DESCRIPTION OF THE INVENTION

In accordance with this invention, a container is provided having at least one access port defined therein which is spaced from a mount opening in the container. Flexible conduit tubing passes through the access port, the conduit tubing having a cross-sectional shape generally conforming to the shape of the access port, and being of at least equal transverse dimension to the port to provide a pressure seal between the container and conduit at the port. Thus, the conduit tubing is slideable relative to the port without disruption of the seal to permit leakage and interior contamination. Typically, the conduit tubing is long enough to be able to pass through both the access port and the mouth of the container in one sliding position of the conduit. Thus an organ such as a heart, liver, lung, or kidney can be cannulated outside of the container, and then placed within the container, drawing excess tubing through the port out of the container.

The container of this invention can be rigid and self supporting, or it can be a flexible, collapsible bag, or any other configuration as desired. Referring to the drawings:

FIG. 1 is a plan view of a flexible, collapsible bag made in accordance with this invention, showing a cannulated organ connected to some of the conduits of the bag.

FIG. 2 is a plan view of the same bag as in FIG. 1, showing how the organ is placed within the bag and the conduits drawn through the access ports out of the bag.

FIG. 3 is a sectional view taken along line 3—3 of FIG. 1, showing details of the structure of the access port.

FIG. 4 is a sectional view taken along line 4—4 of FIG. 3.

FIG. 5 is an elevational view of another modification of a rigid, self-supporting container of this invention.

FIG. 6 is a view of the closed container of FIG. 5.

Referring to FIGS. 1 through 4, flexible bag 10 is shown being used as an organ perfusion container for a human kidney 12. Bag 10 comprises a pair of flexible, transparent plastic sheets 14, 16 sealed together at the edges by seal line 18 and rivets 19, or by any other conventional means, to define a bag.

In FIG. 1, sheet 14 is partly broken away to show sheet 16 behind it. A portion 20 of the edges are left unsealed to define a mouth opening in the bag.

Conduits 22, 24, 26, 28, and 30 are sealingly slideable, each in a separate semi-rigid plastic sleeve 32. The sleeves 32 are sealingly mounted between plastic sheets 14 and 16 to provide access ports into the bag 10. Conduits 22, 24, 26, 28, and 30 are made of a flexible material such as silicone rubber, and have a cross-sectional shape generally conforming to the shape of the sleeves or access ports 32, which are typically cylindrical. The above mentioned conduits are typically of slightly larger size than the ports 32 to provide a pressure seal between the bag and conduits at the port. Thus conduits 22, 24, 26, 28, and 30 are sealingly slideable within sleeves 32 when pulled on one end or the other so that the length of each conduit within the bag is adjustable.

In the embodiment shown, conduit 24 is cannulated to the renal artery of kidney 12 to provide blood or other perfusate to the kidney during perfusion. Conduit 28 is attached to the renal vein of kidney 12 to receive the same fluid upon circulation through the kidney and to carry it away from the kidney to conventional organ perfusion equipment, which provides the necessary functions of pumping the fluid and oxygenating it. Conduit 30 is cannulated to the ureter of kidney 12 to receive and carry away waste products formed therein. Conduits 22 and 26 are not used in this instance and carry caps 23 and 27. These conduits are made available to permit use of the bag with other organs or in the case of bifurcations of the renal artery and vein.

After cannulation of the kidney with the aforementioned conduits, the kidney 12 is placed within bag 10 and the mouth opening is sealed by folding over and clamping or any other manner as desired. Simultaneously therewith, the cannulated conduits are pulled by their outer ends to cause each of them to slide through their associated sleeve 32 to reduce the length of each conduit residing within bag 10 so as not to crowd the kidney or to cause twisting of the cannulation sites at which each conduit is connected to the kidney.

Conduits 34, 36, and 38 serve as inlet and outlet conduits for providing wash or perfusion solution to bathe the inside of the bag and the outside of the organ. If desired, one can bathe the kidney in an oxygenated, nutrient-containing isotonic solution through conduits 34 and 36, which is withdrawn through conduit 38. Throughout the period of kidney storage in bag 10, blood or other perfusion solution is pumped to and from the kidney 12 through conduits 24 and 28.

If desired, only one sliding conduit is connected to the kidney at the renal artery, the renal vein and the ureter being allowed to spill into the bag. Perfusion solution is then withdrawn from the bag by a conventional conduit, e.g. conduit 38.

The entire bag 10 can be placed in an outer cooling bath to control the temperature of kidney 12 and the perfusion solution. By the use of this bag, great convenience is achieved in cannulating the kidney to connect it to the appropriate conduits prior to placing it into the bag. Then the kidney can be inserted in the bag and sealed in a relatively sterile environment to maintain it in a viable condition by perfusion of oxygenating solution which optionally contains nutrient.

Referring to FIGS. 5 and 6, a self supporting organ perfusion container made of acrylic plastic or the like is shown as including a cylindrical bowl 40 having an open top 41, four sliding conduits 42, 43, 44, and 45, each of which slides through an access port comprising a sleeve 46 to gain entrance to the container. As in the previous embodiment, conduits 42 to 45 have a cross-sectional shape conforming to the shape of each access port or sleeve 46, and are of equal or slightly greater cross-sectional size to ports 46 to provide a sliding pressure seal between the container 40 and the conduits. Thus the conduits are slideable relative to the access ports without disruption of the seal, thus preventing leakage out of the container. Conduits 42 to 45 are of such length that they can extend out of the top opening of bowl 40 for cannulation to an

organ such as a liver **48** (the conduits connecting, for example, to one artery, two veins, and the bile duct). After cannulation is complete, the conduits are withdrawn into the container by sliding them through their respective sleeves **46**, and the organ is simultaneously placed into the container. The mouth opening **41** of the bowl **40** can then be sealed or capped in any manner desired, such as by sealing top **50**.

The bowl **40** can be drained from bottom drain **51** as desired. A conduit for flushing the outside of the organ can also be added, if desired.

The containers of this application are thus suited for the convenient cannulation and perfusion of a number of different organs, to maintain the organs in viable condition outside of a living body.

The previous disclosure is for illustrative purposes only and is not to be taken as limiting the scope of the invention of this application. It is to be understood that the arrangement and the numbers of conduits connected to the containers of this invention can be varied as desired in accordance with the objective to be obtained.

I claim:

1. A container having an outer casing with a plurality of access ports and a mouth opening defined therein, said mouth opening being spaced from said access ports, a flexible conduit passing through each said access port having a cross sectional shape generally conforming to the shape of said access port and being of at least equal transverse dimension to said port to provide a seal between said container and conduit at the port, whereby said conduit is slidable relative said port without disruption of said seal.

2. The container of claim **1** in which each said conduit is of such length as to be able to extend through both said port and said mouth opening at one sliding position of said conduit.

3. The container of claim **1** which said outer casing is made of flexible material.

4. The container of claim **1** which said casing is rigid and self-supporting.

5. The container of claim **1** comprising a pair of flexible, transparent plastic sheets sealed together at the edges to define a bag, said access ports being defined by tubular plastic sleeves mounted between said plastic sheets at edges thereof.

6. The container of claim **9** in which a portion of the edges of said plastic sheets are in unsealed relation to define said mouth opening.

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