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1,596,754 8/1926 Moschelle 128/350
 3,136,316 6/1964 Beall 128/350
 3,430,631 3/1969 Abramson 128/350

OTHER REFERENCES

Miller et al.- Jour. Thorac. & Card. Surg., Vol. 56 No. 4,
 Oct. 68, pp. 607-608

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[54] **PERICARDIAL CATHETER**
7 Claims, 4 Drawing Figs.

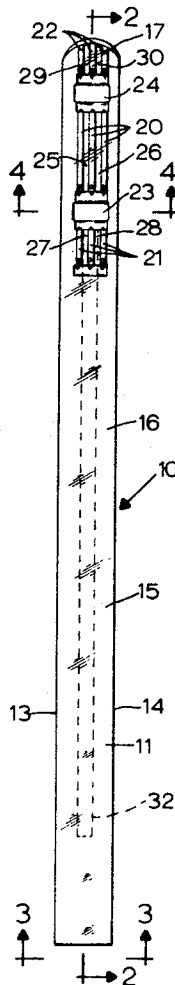
[52] U.S. Cl. **128/350 R**
 [51] Int. Cl. **A61m 27/00**
 [50] Field of Search **128/348-351**

References Cited

UNITED STATES PATENTS

204,905 6/1878 Lockwood 128/349
 1,045,326 11/1912 Ruflin 128/349

ABSTRACT: The pericardial catheter has a main tube, flat in cross section, open at one end and closed at the other. The top wall is flat and the bottom wall is generally flat, having a plurality of openings near to but spaced from the closed end. A plurality of lengthwise extending ridges lie between successive openings and on each end of them. A round collapse-prevention member is inside the main tube and has an outer diameter at least as great as the inner distance between the top and bottom walls.



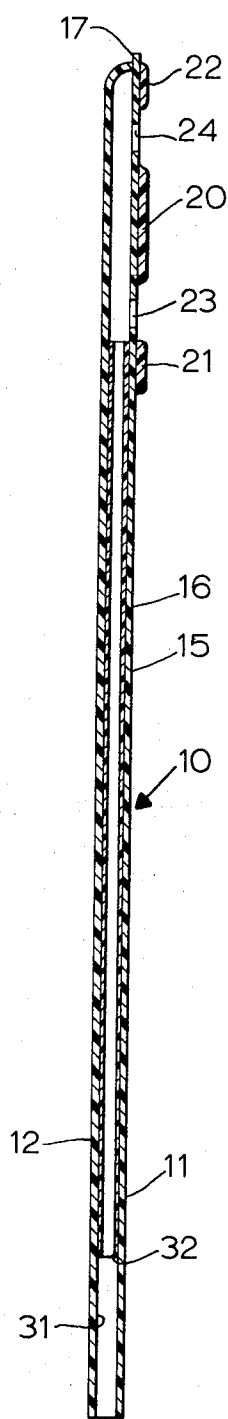


FIG. 2

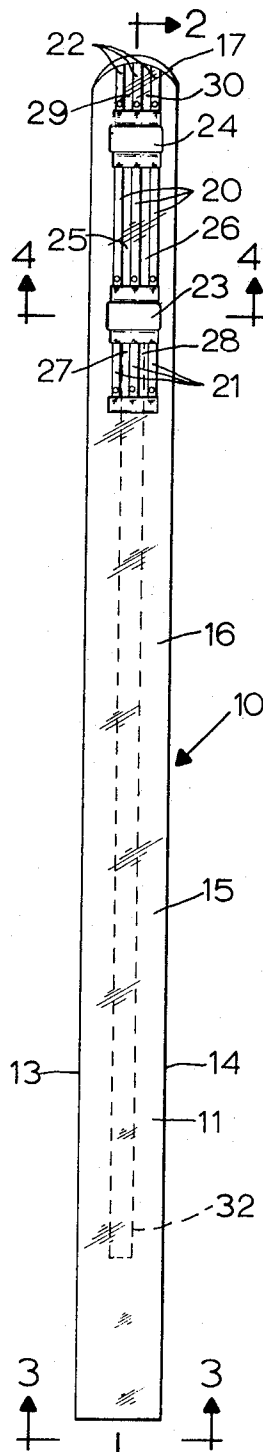


FIG. 1

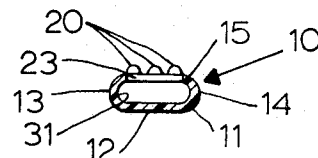


FIG. 4

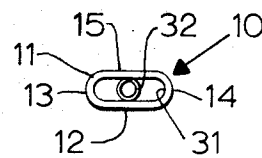


FIG. 3

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PERICARDIAL CATHETER

This invention relates to an improved pericardial catheter or drainage tube.

Among the serious problems that remain in the field of surgery requiring extracorporeal circulation are intraoperative hemolysis and postoperative tamponade.

While there are many possible causes of hemolysis, it has been found that one of the major causes relates to blood lying in extracardiac spaces (pericardial or pleural) for prolonged periods of time before being returned to the pump oxygenator. As this blood pools, it is contaminated by tissue fluid and fat droplets, and drying occurs at the blood-air-membrane junction. Further, cell trauma has been found to occur when this mixture is returned to the venous reservoir by a suction source that mixes great amounts of air with the blood. Together, these factors appear to be a major source of hemolysis, at least in some systems of extracorporeal circulation.

It has been found that these factors can be largely eliminated by the continuous evacuation of the pericardial space by means of a gentle source of suction, thereby reducing to a minimum the time for tissue fluid to mix with the blood, for drying to occur, and for the blood and air to mix in the cardiomy suction. In considering these problems of intraoperative hemolysis and postoperative tamponade, it became apparent that a drainage or catheter tube placed in a dependent position in the pericardium would effectively remove the blood during the procedure and could be placed or left in place postoperatively as a means of dependent pericardial drainage, so long as it would not cause cardiac irritability or otherwise interfere with cardiac contraction. However, for a tube to be suitable for this use, there must be means to insure against its collapse, because if it should collapse, or if anything should rest on it, serious problems might result.

I have found that these problems can be solved by employing a tube or catheter which is rather flat in shape, is quite flexible, and is kept open at all times by means of a small round inner tube of substantially the same material and about the same diameter, or slightly larger in minimum exterior diameter than the smallest interior dimension of the flat tube to be used. The inner tube included in the lumen of the catheter prevents collapse even when bending occurs. Another feature of the tube or catheter of my invention is that the surface of the dependent end of the tube, which lies against the pericardium, has smooth, interrupted ridges; these serve to prevent the suction opening from being drawn against the pericardium, and they also provide multiple channels for the progression of the blood into the catheter. The tube or catheter is provided with a pair of generally rectangular entrance openings on the surface having the ridges.

Further objects and advantages of the invention will appear from the following description of the preferred embodiment.

In the drawings:

FIG. 1 is a bottom plan view of a tube or catheter embodying the principles of the invention.

FIG. 2 is a view in section taken along the line 2—2 in FIG. 1.

FIG. 3 is a view in section taken along the line 3—3 in FIG. 1.

FIG. 4 is a view in section taken along the line 4—4 in FIG. 1.

A catheter 10 embodying the principles of the invention is shown in the drawings; typically, the catheter 10 may be approximately 12 inches long, three-fourths of an inch wide, and one-fourth of an inch thick. It comprises a flattened flexible tube 11 made from a suitable plastic, such as a silicone which does not introduce problems of infection. It should be, in other words, inert, so far as the body fluids are concerned. The tube 11 has a generally flat top surface 12 and rather shallow sidewalls 13 and 14. The largest proportion of its bottom surface 15 comprises a flat portion 16, but adjacent the dependent end 17 of the tube 11 there is a plurality of ridges 20, 21, and 22 of about the proportion shown in the drawings. Between the ridges 20 and 21 there is an entrance opening 23, and between the ridges 20 and 22 there is an entrance opening

24. These entrance openings 23 and 24 are preferably approximately rectangular and serve to take in the fluid. The smooth ridges 20, 21, and 22 prevent the suction openings 23 and 24 from being drawn against the pericardium and at the same time they provide between them multiple channels 25, 26, 27, 28, 29, and 30 for the progression of the blood into the openings 23 and 24.

The interior or lumen 31 of the tube 11 is quite flat in cross section as shown in FIGS. 3 and 4 and is featured by containing an interior collapse-preventing tube 32 which is nominally round in cross section and is preferably slightly larger in outer diameter than the interior diameter of the lumen 31 in its narrowest direction. This tube 32 need not be cemented in place if so made slightly larger, for it will then be held by the natural elasticity of the outer flat tube 11, slightly compressing the walls of the round tube 32, and making the lumen 31 seek to regain its shape and thus hold the tube 32 in place. In place of the tube 32, a rod may be used, but a tube is better because it distorts more easily and therefore is more easily retained in place; moreover a tube 32 provides an additional lumen for suction. Cement or welding may be used to hold the tube 32 in place, but as stated, this is usually unnecessary.

Wherever bending should occur, the tube 32 prevents collapse of the tube 11 and even substantial weights do not collapse the tube 11 made in this manner.

The relationship of the heart to the pericardial space is such that if approached by way of a median sternotomy, the oblique sinus is slightly cephalad to the angle formed by the diaphragmatic and posterior parietal pericardium. This anatomic feature thus necessitates only a very slight bend in the catheter 10 for the lowermost hole 24 to be in its dependent position. In clinical use, it has appeared to work best if it enters the pericardial space by a stab wound in the right subcostal space just lateral to the lower end of the median sternotomy skin incision.

In clinical use, the catheter 10 is placed just as bypass is instituted and is connected by a wired connector to a cardiomy suction source. At the completion of bypass it is connected to the usual chest suction and remains so during postoperative period, until drainage has ceased. It is removed in the same way as any other chest tube.

The catheter 10 has been used on many patients without any ill effects. So long as used in the described manner, the catheter 10 does not interfere with operative manipulations and has been noted to keep the pericardium free of blood. In the postoperative period, there has been no evidence of cardiac irritability, the tube 11 is drained well, and the milking of the tube 11 by the left ventricular action prevents clotting. Frequently, the blood level will be seen moving back and forth with the heart action.

To those skilled in the art to which this invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the spirit and scope of the invention. The disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

We claim:

1. A pericardial catheter, including in combination, a main tube of flexible plastic flat in cross section open at one end and closed at the other and having a flat top wall, a generally flat bottom wall, and shallow sidewalls, said bottom wall having entrance opening means spaced from the closed end of the tube, said bottom wall also having a plurality of lengthwise extending ridges adjacent the longitudinal ends of said opening means, and

a collapse-prevention member, round in cross section, inside said main tube along the longitudinal centerline thereof and having an outer diameter at least as great as the inner distance between said top and bottom walls.

2. The catheter of claim 1 having a plurality of entrance opening means spaced apart from each other by a plurality of lengthwise extending ridges.

3. The catheter of claim 1 wherein said collapse-prevention member is a hollow tube.

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4. A pericardial catheter, including in combination,
a main flexible plastic tube, flat in cross section open at one
end and closed at the other and having a generally flat
bottom wall, a flat top wall, and shallow sidewalls, said
bottom wall having a plurality of entrance openings
spaced from each other and from the closed end of the
tube, said bottom wall also having a plurality of
lengthwise extending ridges between said openings and
adjacent their distal ends, and
a collapse-prevention tube, round in cross section inside
said main tube along the longitudinal outline thereof

and slightly larger in outer diameter than the inner
distance between said top and bottom walls.

5. The catheter of claim 4 wherein said entrance openings
are generally rectangular.

6. The catheter of claim 5 wherein there are two said en-
trance openings and wherein there are three said ridges in
each location of said ridges.

7. The catheter of claim 6 wherein said entrance openings
are approximately as wide as the width across said ridges.

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