Variations in the Circuit of a Pump-oxygenator*

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S INCE THE ADVENT OF OPEN-HEART SURGERY, surgeons and pump-oxygenator technicians have striven to make their work more simple, yet remain within safe boundaries. The purpose of this paper is to present two details we have adopted in our pump-oxygenator circuit.

In many pump-oxygenators, the venous blood from the patient is returned to the top of a venous reservoir where it then falls down into the pool of blood at the bottom of the reservoir. It seemed to us that this must cause an unnecessary increase in hemolysis. We then utilized the venous reservoir provided in the profound hypothermia apparatus, model 20†† with the venous intake at the bottom of the reservoir. This has proved entirely satisfactory (Fig. 1). After approximately one hour of whole body perfusion, blood samples taken from the pump-oxygenator at the time of termination of perfusion show from 40 to 50 mgm. per cent of plasma hemoglobin.

Also, in most pump-oxygenators utilizing a disc oxygenator, after the circuit is primed and after the surgeon has connected the “in” and “out” lines to the pump-oxygenator, the operator, together with the pump technician must then make the lines free of any air bubbles. This may take some time and the delay in certain cases may prove to be detrimental to the patient. We then sought to emulate the setup provided in the Mayo-Gibbon vertical screen pump-oxygenator†† where the venous intake and arterial output lines are short circuited.

The circuit is fully primed and blood recirculated (Fig. 2). When the surgeon is ready to have the tubing connected from the patient to the pump-oxygenator, the lines are clamped (Fig. 2, II). The short circular line is then removed and the longer tubing connected. The clamps are removed and blood recirculated, this time through the longer tubing, eliminating all air bubbles. The lines are then clamped distal to the short circuit (Fig. 2, III). The sur-

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Figure 1: View of the pump-oxygenator “in” and “out” lines. The venous reservoir is to the left and the arterial filter to the right. The “in” and “out” lines are connected by the curved piece of tubing and “shortened” by a straight piece. Locknut “T” connectors provide this arrangement. The venous blood from the patient flows in at the bottom of the venous reservoir.
geon then attaches the arterial and venous lines to the patient. When ready to go “on bypass,” the clamps are changed by the technician (Fig. 2, IV). When ready to go “off bypass,” the clamps are again changed (Fig. 2, V). The technician is required only to change clamps and does not have to make any necessary adjustments on the rate of output of the arterial pump. In certain cases, it may be necessary to go on bypass again and simply switching clamps will do it. This has proved to be safe and reliable in two years of use.

NOTE: Recently we have eliminated the venous reservoir from the circuit having the venous “in” line connected directly with the heat exchanger. This has also proved safe and has decreased the priming volume of the pump-oxygenator. We still utilize a central priming reservoir.

Figure 2: Diagram showing the necessary steps to go from recirculating within the pump oxygenator circuit to “on” and “off” cardiopulmonary bypass. VR=venous reservoir. F=filter. I—Recirculating within the pump oxygenator circuit. II—Arterial pump turned off. Lines clamped. III—Arterial pump turned on. Recirculating. IV—Clamps changed. On bypass. V—Clamps changed. Off bypass.