APPARATUS FOR CONTINUOUS HAEMODIALYSIS

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The apparatus is based on a minicoil\(^{(1)}\) used in conjunction with an integrated pumping unit. Figure 1 shows the flow diagram of the system set up for use with or without pumps and regional heparinisation.

The coil unit in its modified form has been described\(^{(2)}\); the dimensions of the blood lines are slightly different for their use with the HAL pumping unit. The total blood volume of this system is between 200-250 ml. and varies with the pressure in the circuit (Figure 2). When used without pumping the combined air trap and filter operates as a safety valve to prevent air being returned to the patient. When the trap contains blood to the correct level the float holds the rubber valve off the seating ring allowing a flow of blood. Should the level of blood fall to approximately 25 mm. above the seating ring, the valve will descend and seal the lower part of the trap from the upper. The clear PVC tubing used in the blood and dialysing fluid lines is 4 mm. bore x 5.5 mm. outside diameter. The arterial set, coil unit, air trap-filter and venous set are separate units to allow changing of any one during dialysis.

The HAL pump unit is based on 4 occlusive roller peristaltic pumps (Watson-Marlow M.H.R.E. flow inducers). Four multi-turn potentiometers vary pumping speed and are calibrated to give a linear relationship between dial reading and delivered volume (Figure 3). The effective range of the dialysing fluid and blood pumps using 4.77 mm. bore x 7.9 mm. outside diameter silicone rubber tubing is 15-360 ml./min., and that of the heparin and protamine pumps using 0.5 mm. bore silicone rubber tubing 3.5-170 ml./hour.

The equipment is automatic; all functions being protected by alarm circuits that give initial audio and visual warning of pressure and temperature variations and an over-riding cut-out if the variations are not remedied. Actuation of warning and cut-out system is from two Cambridge dial manometers and one dial thermometer sited at the front of the machine. One manometer actuates the warning system, the other the cut-out circuit. Figure 4 is a diagram of the safety circuit showing details of warning and cut-out for temperature and pressure variation from pre-set levels. External connections are provided for remote monitoring facilities so that the equipment does not require the continuous attention of medical and nursing staff.

The dialysing fluid is heated to 42°C by a thermostatically controlled 375 W heater housed in a closed container of approximately 400 ml. capacity. Dialysing fluid enters at 20°C and emerges at 42°C for all flow-rates of less than 250 ml. per minute.

During priming or correction of dialysis conditions the automatic system may be short circuited with the manual/auto switch situated in the centre of the control panel.

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The pumping unit was originally designed for use with the modified minicoil but is readily adaptable to any dialysing apparatus requiring blood and bath pump facilities, regional heparinisation or continuous heparin infusion.

REFERENCES

Figure 1. Flow diagram of modified minicoil for use with HAL pump unit.

Figure 2. Graph showing relationship between priming volume of circuit at varying pressures measured at the air trap. (Dialysing fluid flow rate - 200 ml./min. Temp. 40°C)
Figure 3. Graph showing range and linear relationship of blood and dialysing fluid pumps at varying dial settings of controls.

Figure 4. Diagram of electrical safety circuit operating warning and cut-out systems.