

## A REDESIGNED ANAESTHETIC GAS MACHINE\*

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WHEN CONSIDERING the purchase of anaesthetic gas machines for a new teaching hospital we surveyed the equipment on the Canadian market. The present concept of providing the anaesthetist with a compact machine, convenient to use with many built in accessories, was in our opinion not the ideal equipment for a teaching institution. In the past, several well designed models were found to be difficult to adapt to new vaporizers and modified breathing circuits. Since further changes in the conduct of anaesthesia can be anticipated, we were looking for an anaesthetic apparatus which would have great potential for change, allowing easy modification for experimentation with new techniques. Production of the universally applicable modified Mapleson D system, the "Bain breathing circuit"<sup>1</sup> was a strong stimulus to the development of the anaesthetic apparatus presented here.

Our main objective was a gas machine with great flexibility allowing for ready addition of different accessories and quick conversion to suit individual needs in the operating room or research area. Furthermore, we wanted a machine which would be mobile within the operating room and readily usable in any of the anaesthetizing locations of our hospital.

The Boyle Model M was selected as the basic anaesthetic machine (Figure 1). Our first modification was the attachment of the British Oxygen Company wall rail system, which allows the mounting of equipment in an unobtrusive and yet easily accessible manner (Figure 2). The rail is attached across the front and at the sides of the table and there is an extra rail across the top of the machine above the flowmeters. With mounting brackets and detachable clamps which simply clip on the rail it is possible to attach to the machine a wide range of accessories (Figure 3). Sphygmomanometers, temperature recorders, ECG pulse monitor, ventilators, suction apparatus, vaporizers and anaesthetic hoses can be mounted to the rail and can be easily removed. Use of the rail ensures that equipment is always readily available without taking up table or floor space.

To make this machine truly universal we made certain that any of the commonly used breathing circuits could be attached. The gas outlet is fixed at the right side immediately under the table top, the emergency oxygen is also delivered through this opening. Using this outlet as a source we can attach the circle system. Since the rail is very strong and the clamps practically unbreakable there is no problem with the weight of the circle system even when both cannisters are filled with soda lime. Using the same outlet one can attach any of the commonly

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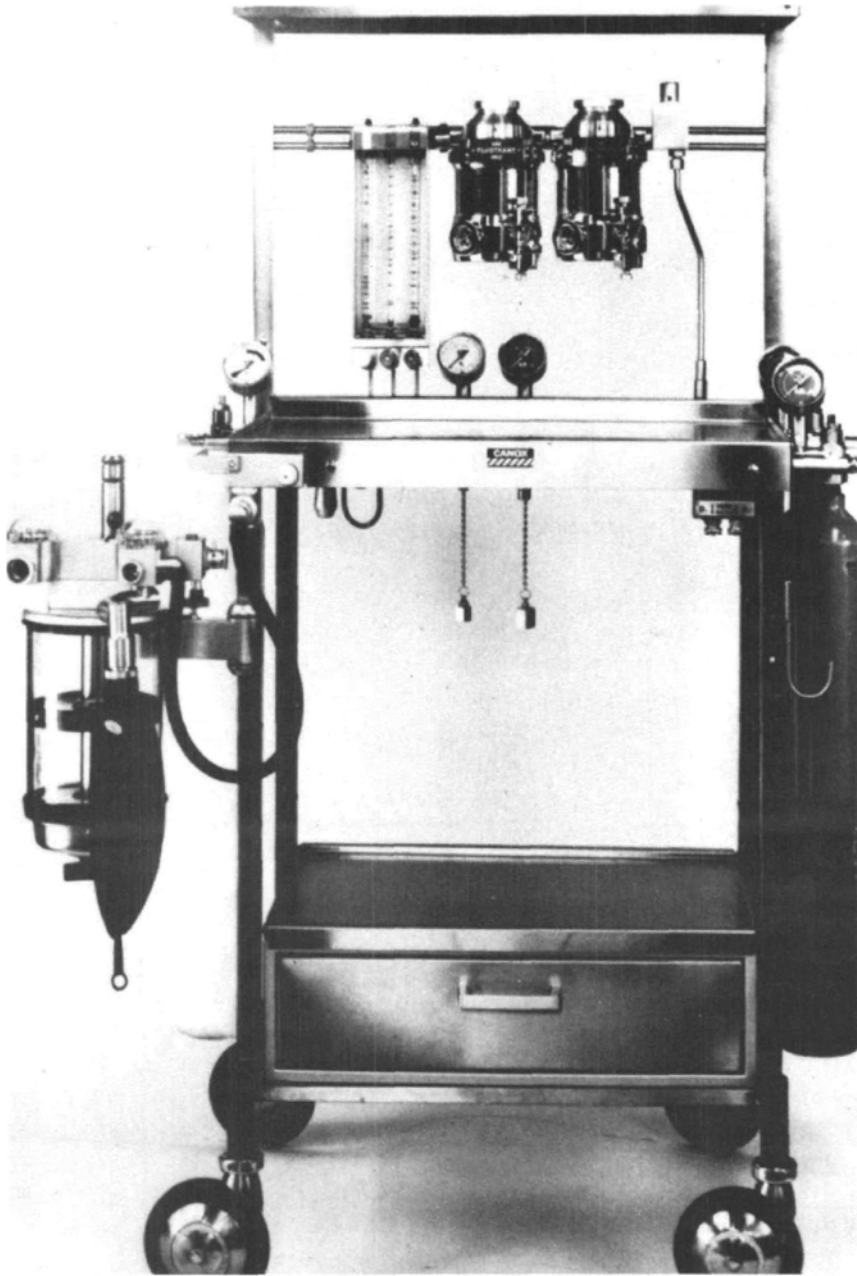


FIGURE 1. Model M Boyle anaesthetic machine (Canox) with tray above flowmeters.

used paediatric systems such as the Ayre's T-piece or non-rebreathing valves. We have designed a movable sturdy mount on which to attach the Bain circuit. It is of solid metal construction (Figure 4) with removable pressure gauge, a bag mount, an anaesthetic hose mount, a pressure release valve, "the Norry valve,"<sup>2</sup> and a simple pop-off pressure valve to which suction can be attached for removal

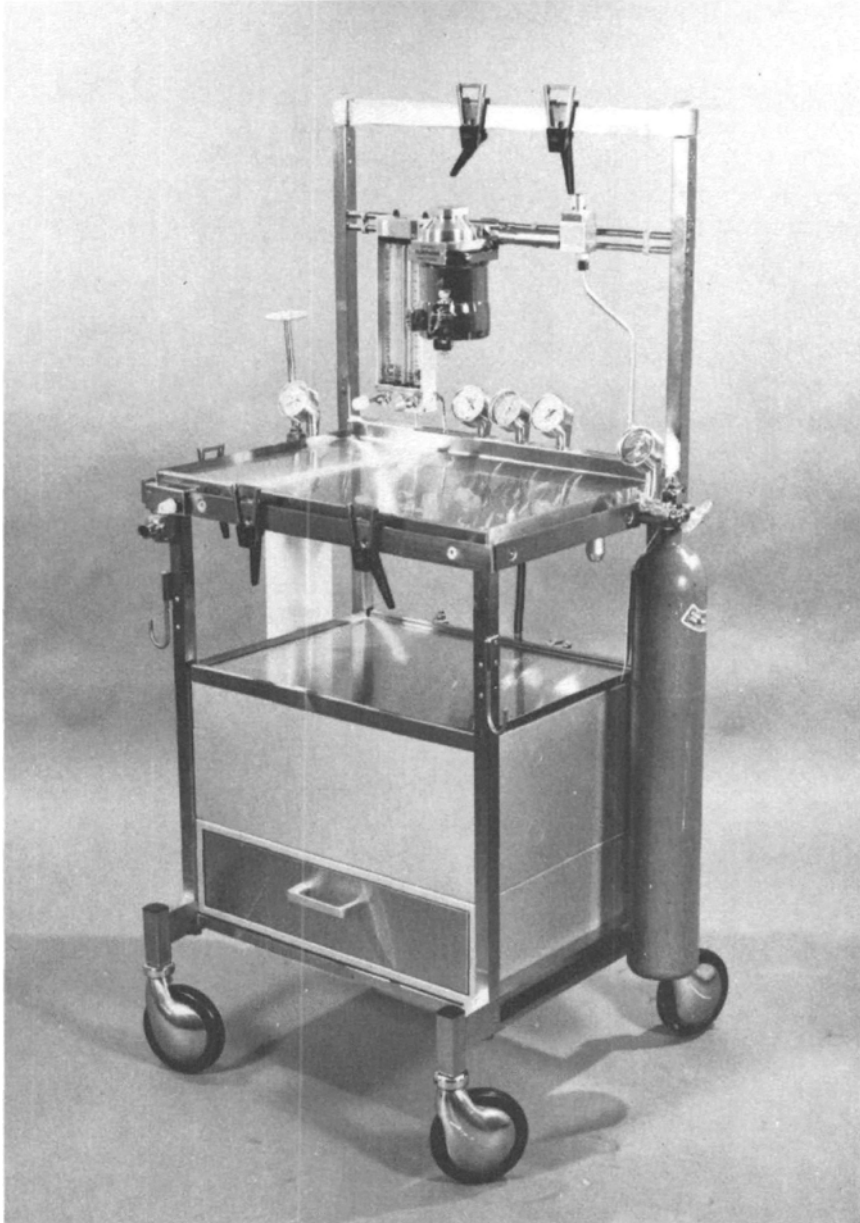


FIGURE 2. BOC wall rail (with empty clamps) attached to front and sides of table top and above flowmeters.

of excess anaesthetic gases from the atmosphere. The entire assembly is then attached to the gas machine with a removable bracket; the Bain breathing circuit is connected to the 15 mm outlet. The mount can also be used as an attachment for the Magill system; to do this one simply removes the pressure manometer and attaches the fresh gas flow in its place. The assembly's pop-off valve is then closed, and a blow off valve attached at the patient end of the breathing tube.

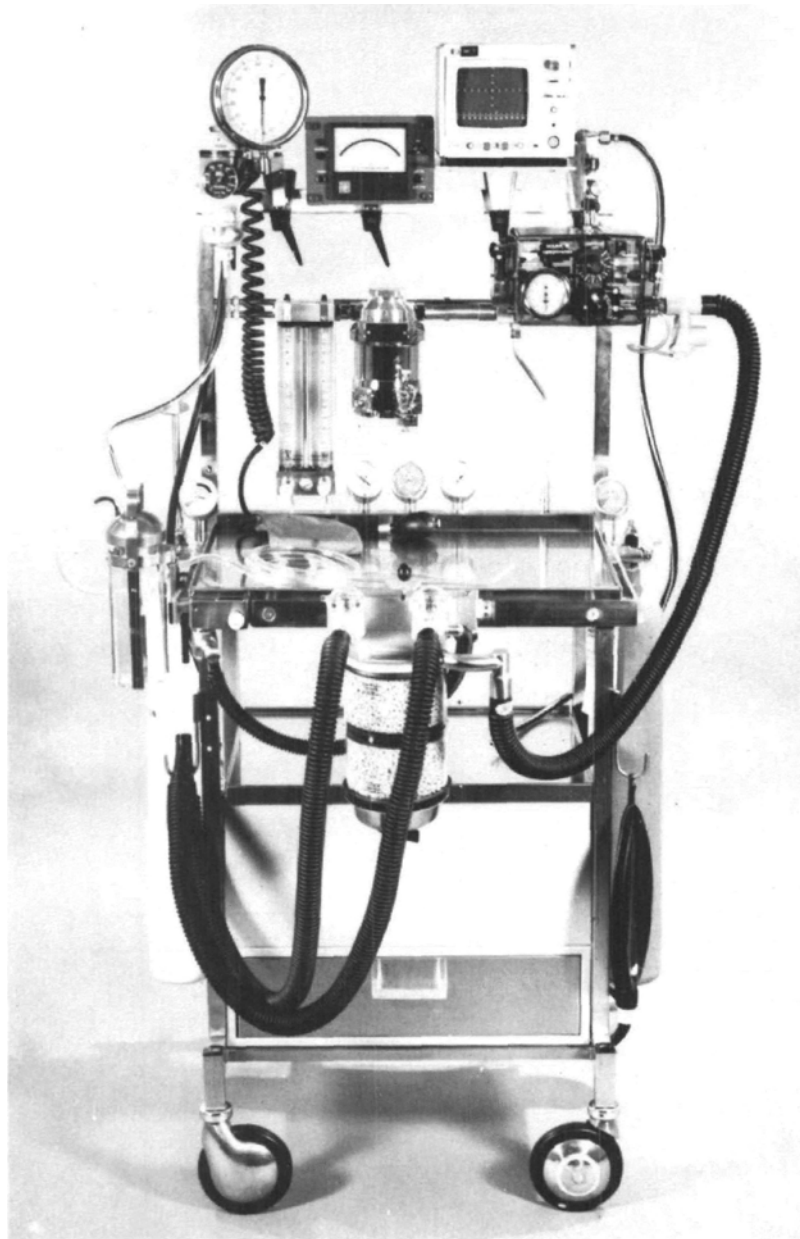


FIGURE 3. Various accessories mounted on machine with attached rails.

The method of attachment of hoses which conduct gases from the wall outlet to the machine has also been redesigned. The position of the machine in relationship to the piped gas outlets is determined by the length of pressure tubing between the outlet and the gas machine. If the gas outlets are at a fixed position, added length of tubing between the outlet and the machine lies in coils on the floor and is unsightly and hazardous. In order to get the tubing off the floor

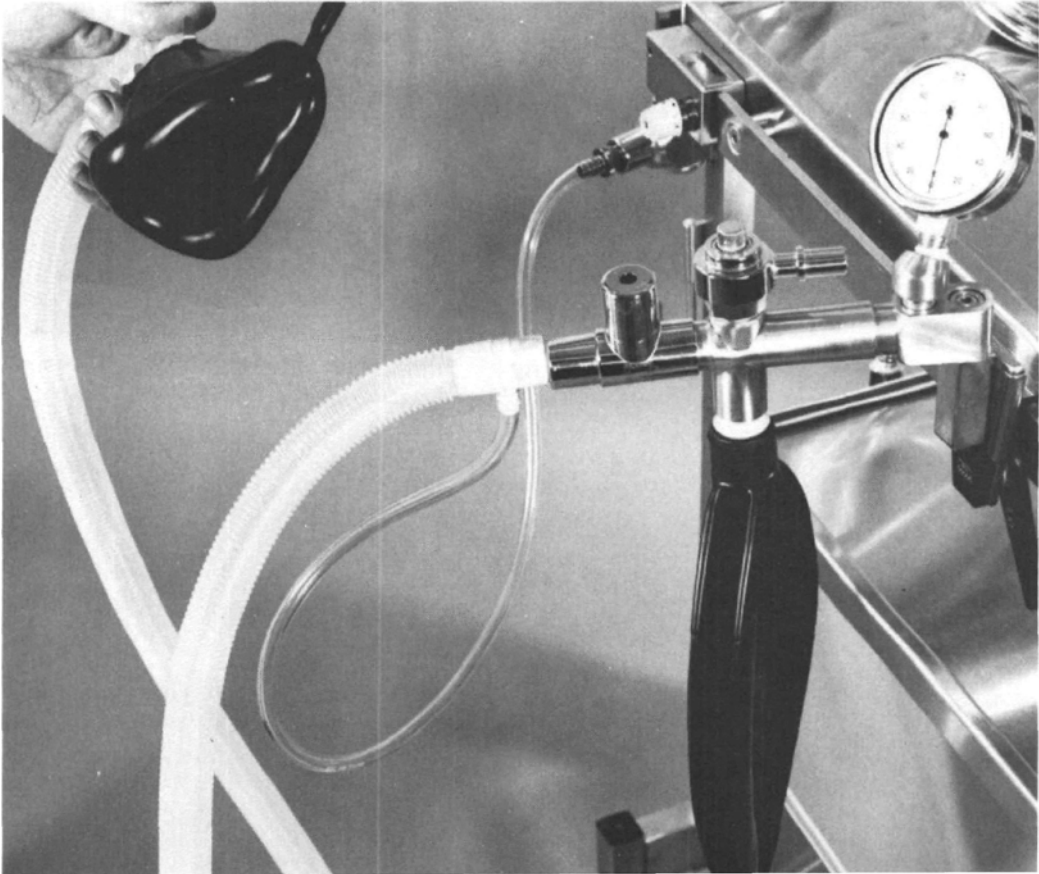


FIGURE 4. Bracket for modified Mapleson D system (Bain circuit) incorporating bag mount and spring loaded blow-off valve with pressure limiting valve on the left and manometer on the right.

booms can be used; they are cumbersome and one boom is required for each anaesthetizing location in the room. In our operating room the outlets are supplied through columns; a retractable system in the ceiling would have to be re-duplicated in each location where the gas machine is used. This is not only an added expense, but imposes limitations on the number of outlets available. The use of ceiling gas tracks improves the mobility of the anaesthetic machine inside the operating room, but was technically not possible. Moreover, this system too restricts the number of outlets.

Our design incorporates retractable reels for pressure tubing below the table top of the anaesthetic machine (Figure 5). These reels are in a box readily accessible for maintenance and repair. Three reels which supply tubing for oxygen, nitrous oxide and compressed air are placed at the back and a reel for suction tubing on the left hand side (Figure 6). A fifth reel could be placed on the right side if required. Each reel holds fifteen feet of pressure tubing. The length of tubing required to cover the distance between the machine and the gas

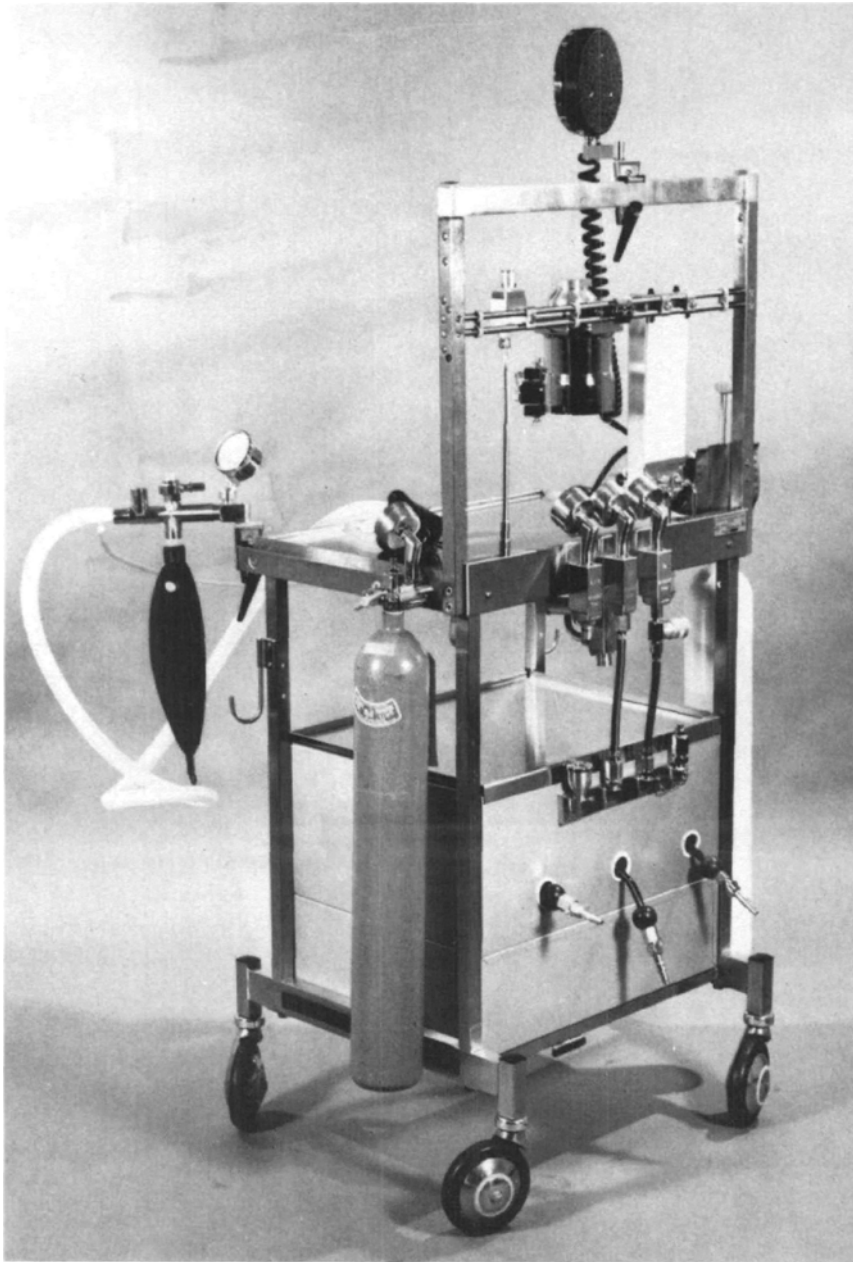


FIGURE 5. Reels for retractable pressure line are located below the table top.

outlet on the wall or ceiling turret is pulled out when the machine is in use, and there are no loops of tubing on the floor. With this arrangement the machine can be attached to any of the gas outlets inside or outside of the operating room with the same degree of convenience. At present the air line at the gas machine ends in an outlet for attachment of a pressure operated ventilator. However a flow-meter can be attached if desired in order to use air in the patient's breathing circuit. The oxygen line also has an extra outlet in the back of the machine to provide for high pressure oxygen.

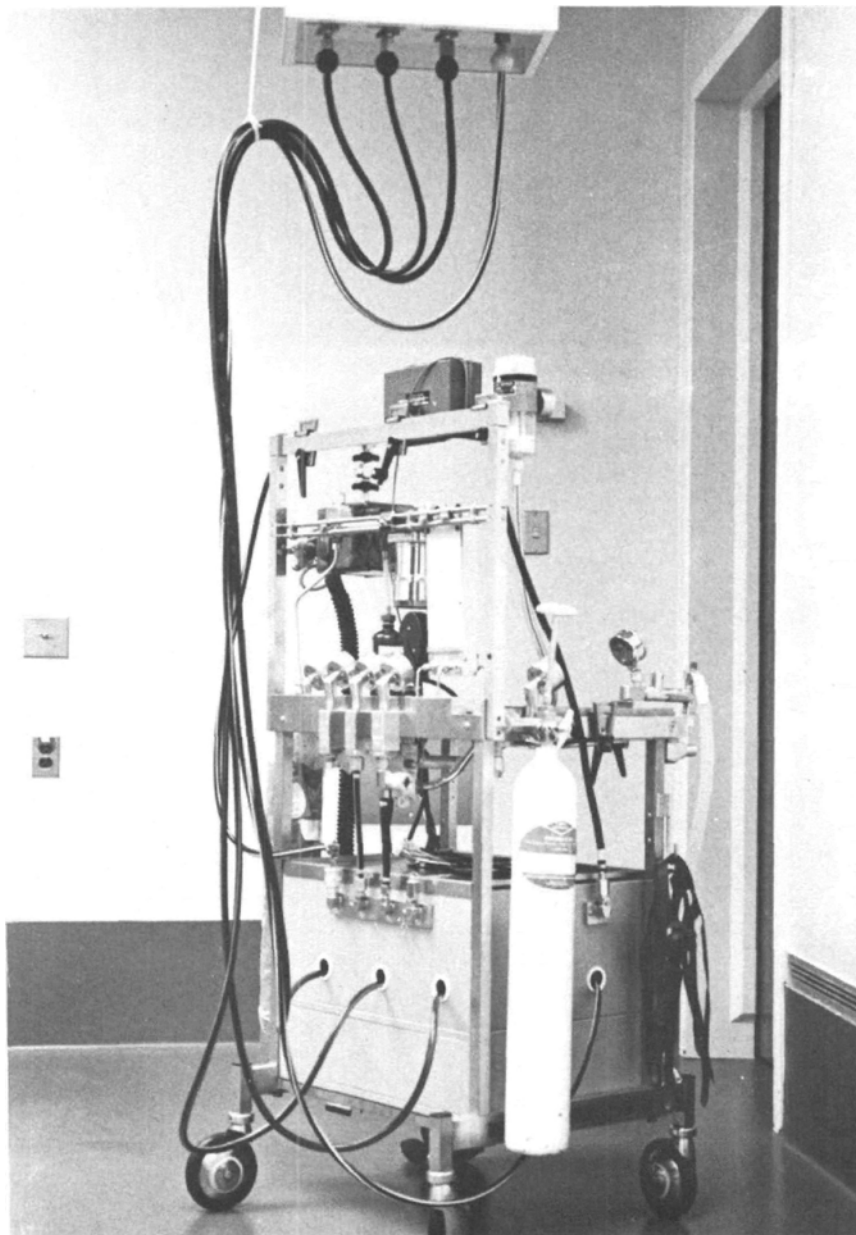


FIGURE 6. Gas machine attached to ceiling column; the required length of pressure tubing is pulled off the retractable reel. Nitrous oxide, oxygen and air line are in the back of the machine, the suction line on the left side.

#### SUMMARY

A basic Model M Boyle anaesthetic machine was modified to improve mobility and adaptability to different needs. The main changes from the commercial model (Canox) are the attachment of a wall rail system (British Oxygen Company) to the sides of the table top and above the flowmeters and the use of

retractable reels for the storage of excess pressure tubing below the table top. This modification allows the easy placement of a variety of detachable anaesthetic and monitoring equipment and allows the machine to be used with the same convenience irrespective of the location of outlets for compressed gases. A special bracket was designed, attachable to the rail system, for the use with a modified Mapleson D system (Bain breathing circuit).

#### ACKNOWLEDGMENTS

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#### REFERENCES

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