A SIMPLE DIATHERMY MACHINE*

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THE construction of a satisfactory valve diathermy machine is a relatively simple matter, but the lack of practical details in text-books tends to make the matter more mysterious than it really is. The apparatus as described was made for a few pounds and has been used for a number of retinal detachment operations, epilation of lashes, and removal of lid tumours. The parts used are readily available.

The superiority of valve machines over the spark-gap variety is often hotly contested, but in practice it is difficult to detect any difference in the quality of coagulation when either method is used. By its inherent construction the spark-gap must be rather more stable and there will be large variation in frequency in the valve type when power is drawn from it. In practice, however, the frequency can vary between such wide limits that this factor appears to be of little importance.

Circuit.—The essence of a circuit is, of course, to obtain a high frequency oscillating current driven by an adequate voltage. At least 500 volts A.C. are required, but the very high voltages of surgical diathermies need not be considered. This voltage can be obtained by altering the secondary tapings of a common radio transformer from 250–0–250 to 0–250–500. The current rating should be at least 100 milliamps. The Hartley oscillator proved very satisfactory (Fig. 1).

FIG. 1.—Wiring diagram.

C1	0.01 F 1,000 volt working.	R2	10K 2 watt.
C2	0.00016 F variable.	V	5B/254M, 807, RK34, 6L6, etc.
C3	750 pF 1,000 volt working.	T	250–0–250 v. 150 m/a.
C4	0.002 500 volt working.		H.F. Choke.
R1	270 ohm 1 watt.		Valveholder, 3-Way Switch, Mains Dropper.
Coil consists of 24 turns of 20 S.W.G. tinned copper wire wound on a 1½" diam. ribbed bakelite former 6" long.			

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The variation in frequency might be overcome by using crystal control or by having a separate oscillator valve driving a power amplifier, but the simple type works well and other types, although theoretically desirable, suffer from multiplicity of controls.

Valve.—Numerous valves were tested. A very satisfactory one is the Brimar 5B/254M. This is a modern beam tetrode and is small and very efficient. Other valves which work well are the 807 (a favourite amateur transmitting valve) and the RK34, and even the 6L6 will give quite a good output. Most of these valves become hot when operated and adequate ventilation is necessary.

It will be noted that control of power output was made by alteration of the mains voltage on the primary of the transformer. This method might appear crude and clumsy but was most satisfactory in practice. There are other methods of output control which work at high outputs but often caused failure of oscillation of the valve at low outputs. Such low outputs are desirable when contemplating destruction of hair follicles.

Output Meter.—The value of an output meter is a controversial issue. Some operators like to control the output accurately and rigidly use a certain current for a fixed length of time. Others state that the current as registered on the meter gives no certain indication as to the diathermy reaction inside the eye. Current can be dissipated on the surface, especially if wet. If required, an output meter which is merely a thermocouple A.C. meter can be connected in series in the lead to the patient. When testing this circuit, the simple and well-tried device of a 12-volt bulb in series with a resistor and 0.05 mfd. condenser connected across the two output terminals was used. Adjustments were made to the maximum brightness of the bulb.

Construction and Operating Details.—The machine is best constructed in wood, but a metal screen which is earthed is necessary in the front panel to avoid hand-capacity effects. Fig. 2 (opposite) shows a satisfactory component layout.

The cathode tapping on the coil should be connected 8 turns up and, with the simple output meter connected, the tapping of the output connection is varied until the lamp glows to its brightness. Next the condenser is adjusted until further brightness of the lamp is obtained. The circuit is now adjusted for maximum output, but this may not be best for coagulation and a cutting effect may be produced. An alteration in the output tapping on the coil will be necessary for this and once this point is found none of these adjustments need be altered. There is hardly need to mention that a thick slice of lean meat is very satisfactory for testing and the coagulation obtained appears to simulate accurately the effects produced on the human eye.

Conclusion

The object of this article is to disclose constructional details of a valve diathermy machine. A machine so constructed will satisfy nearly all the requirements of the ophthalmic surgeon. Most manufacturer's valve

Fig. 2.—Component lay-out.

- V Valve.
- T Transformer.
- S Switch.
- P Patient.
- R Mains dropping resistance.

diathermy machines are modifications of this simple circuit, but it is not considered that the amateur can compete with the manufactured article, as the latter will always score in finish, appearance, and probably in reliability.

It is desirable, however, that the ophthalmic surgeon should understand the mechanism of his instruments, and it is hoped that consideration of the above paragraphs will take some of the mystery out of what is quite an ordinary subject.