APPLIANCES

A MINIATURE OPHTHALMIC DIATHERMY MACHINE*

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THE paramount considerations in the design of an ophthalmic operating diathermy machine are that the surgeon should be able to rely on the production of adequate coagulation without sparking or charring, and that the instrument should be robust and compact in construction, requiring a minimum of adjustment. There are several machines available which fulfil most of these requirements, but the one described here has some advantages both in electrical characteristics and in constructional detail.

ELECTRICAL CHARACTERISTICS

The circuit is noteworthy in several ways:

(1) The oscillator is directly controlled by a feedback circuit which includes the electrical resistance of the patient himself; as a result of this the power output remains constant until coagulation is complete, when the rise in the patient's resistance leads to a large fall in output. In contrast to this the conventional valve circuit gives a sharply rising voltage towards the completion of coagulation, leading to sparking and charring. The steadiness of power output with the present circuit thus considerably reduces this risk.

(2) Coagulation is best achieved by a relatively low voltage and high current, whereas perforation requires "cutting" characteristics of high voltage and low current. The coagulation characteristics of this circuit share with the spark-gap type of oscillator a suitable voltage-current ratio. A simple switch modifies the output to provide characteristics more suited to perforation, as the use of a coagulating circuit for this purpose leads to unnecessary damage through overcoagulation of a considerable area around the point of the electrode.

(3) Measurement of the radio frequency current used during coagulation is achieved by rectification by a germanium diode and subsequent display on a moving coil meter. This gives a "dead-beat" reading of current without the time-lag defect of thermocouple meters, and is more robust with greater overload resistance. The meter has a linear scale from 0–150 milli-amps, giving an easily recognizable reading over the range normal in ophthalmic surgery.

(4) The outer screen of the coaxial cable leading to the active electrode is not connected to earth but to the output circuit before the current measuring circuit. In this way inner and outer cables have virtually the same potential and there is

* Received for publication April 7, 1960.

no loss from inner conductor to screen. The current registered on the meter is thus independent of losses due to the screen, handling and the proximity of other equipment etc. Though this system is not unique it is not yet a standard feature.

In this machine a small constant current of about 5 m.a. is registered when idling. This is due to stray capacity, inevitable in such a compact instrument. It is almost constant and forms only a small proportion of the total current registered and so causes no difficulty.

(5) The circuit employs only one miniature valve of a standard type; other components also have a very long life. The machine is therefore likely to be very robust and reliable. At the time of writing it has been in use in a busy theatre for eighteen months; there has been no defect other than in the flexible lead, which is the part most exposed to damage. If the equipment fails to function normally, therefore, the first step is to try another lead. To this end, it is advisable always to have a spare lead available; this precaution naturally applies to any diathermy apparatus. The most likely anomaly in the lead is a faulty screen connection, leading to the appearance of an idling current in excess of the normal 5 m.a., varying with handling and with proximity of the lead to other equipment.

(6) By careful matching of the characteristics of the circuit to the resistance of the patient maximum use is made of available power. This, together with the use of modern components and assembly techniques, has resulted in an instrument measuring only 8 in. by 5 in. by 4 in. (Fig. 1). In spite of its small physical size, the power is ample for all ophthalmic operations except exenteration.

FIG. 1.—The miniature diathermy machine.

CONSTRUCTION AND USE

The small size and low weight not only give a very portable instrument with a low demand on storage space but make it possible for the surgeon to have direct control of output during operation. The unit may be clamped adjacent to the surgeon on a standard operating-table lithotomy post (Fig. 2) or a separate floor stand. The lead, of flexible boilable silicone rubber, can therefore be kept as short as is consistent with ease of manipulation. It can be kept in place by sliding it into a modified towel clip. The rotary output control on the front panel is graduated arbitrarily in 10 divisions. A sterilisable and detachable knob clips over this control and can be removed to operate the switch selecting output for coagulation or perforation. It is thus possible for the surgeon to control the output of the instrument himself, a boon for those whose only ophthalmic trained staff are likely to be "scrubbed up". With practice it is possible to adjust output with one hand while controlling the active electrode with the other.

FIG. 2.—The machine in use.

In practice it has been found that a setting of 4–5, giving 65–75 m.a. produces an easily recognizable area of coagulation. These settings have been repeatedly checked with a thermocouple electrode (Stanworth, 1955) and

have been shown to produce a temperature of 75°C. in 10–15 sec., this having been found to be the optimum for surface diathermy in most cases. For the perforation circuit a higher setting of 7 or 8 gives a clear and freely draining perforation. Settings and currents will however be modified by many factors, especially by the size of electrode used.

SUMMARY

A miniature ophthalmic diathermy is described. It has the advantages of a steady output; separate circuits for coagulation and perforation; an easily read and accurate milli-ammeter; and robust construction. Its small size and sterilizable controls make direct adjustment by the surgeon or his assistant possible.

We should like to acknowledge the considerable assistance given to us by Mr. P. M. Caudell of Rayners Limited and Mr. K. F. Hopkins of R. B. Pullin & Company. They originally drew our attention to the possibility of miniaturization by modern electronic techniques and have met our many, varied, and often demanding requirements with unfailing skill and patience.

REFERENCE

STANWORTH, A. (1955). *Trans. ophthal. Soc. U.K.*, **75**, 379.