Short communication

A simple and efficient new design of the submersible stirrer for the YSI dissolved oxygen meter

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Abstract

A new single cable design of the submersible stirrer for the YSI oxygen meter has been developed. The construction incorporates simple components thereby ensuring availability of the instrument to any local YSI users. Several advantages of the new design over the original are listed. The instrument has been used successfully in field operations and requires minimal maintenance.

Introduction

The YSI dissolved oxygen meter is intended for measuring both temperature and dissolved oxygen in freshwater and saline applications. The probe uses a membrane-covered polarographic sensor with a built-in thermistor for temperature measurement and compensation. A thin permeable membrane, stretched over the sensor, isolates the sensor elements from the environment but allows oxygen and certain other gases to enter. It is essential to ensure adequate flushing of the medium around the sensors when measuring dissolved oxygen levels in the field. A submersible stirrer has been designed to fulfil this function. This paper describes a new design which is simple, efficient in operation and inexpensive to construct.

Original design of the YSI submersible stirrer (Fig. 1)

This accessory performs the function of stirring the medium in which dissolved oxygen and temperature are being measured. When the probe (1a) and the stirrer (1b) are assembled, the test medium is agitated directly in front of the sensor by a rotating eccentric weight which causes the spring-mounted hermetically sealed motor housing to vibrate. An impeller on the end of the motor housing flushes the media across the oxygen sensor.

To operate this system two cables are necessary, i.e. one for the probe and one to activate the stirrer mechanism by plugging into the stirrer/charge port on the dissolved oxygen meter (Fig. 1). This system usually depends on the main battery supply of the meter. When not in use the probe has to be protected by a cylindrical guard which screws over the oxygen and temperature sensor. This is then housed in a plastic bottle fitted with a damp sponge to provide moist storage for the delicate membrane.

A new design of the submersible stirrer (Fig. 2)

The probe was modified so that a threaded PVC protective sleeve was fitted around the oxygen and temperature sensor (2a). When in use the probe is screwed into the top of the submersible stirrer (2b).

The housing of the submersible stirrer itself is made from PVC material and is approximately 18 cm in length. The top end is threaded to receive the screw-in protective sleeve. The upper compartment is a chamber in which a magnetic stirrer bar is located (Fig. 2c). This chamber is exposed to the test medium via

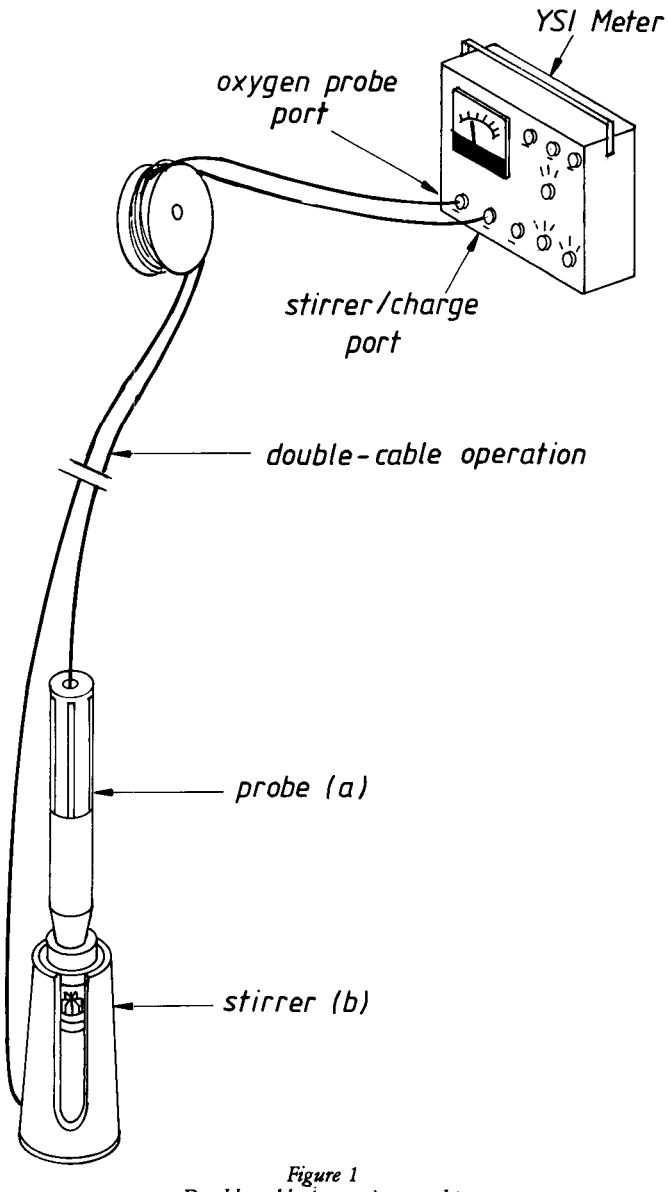

Figure 1
Double cable (operating mode).

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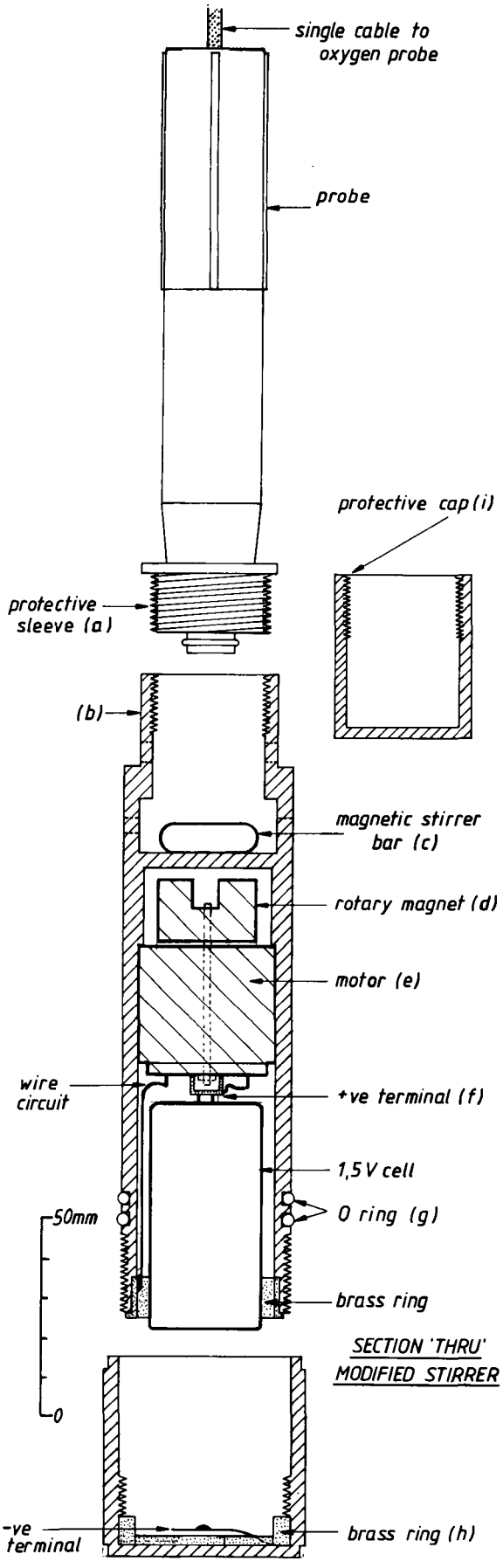

Figure 2
Modified submersible stirrer.

cavities which permit a free flow of liquid past the sensors, thus ensuring adequate response time of the probe. The lower compartment houses an Eclipse rotary magnet (2d) which is fitted to a shaft from a small motor (2e). A distinct notch on the wall of the PVC housing prevents the motor from restricting free rotation of the magnet in the space provided. The remaining space in the lower compartment is occupied by a normal 1,5 V cell with the + ve terminal in contact with a small brass cap (2f) which is clipped onto the base of the motor. Two "O" rings are positioned at the edge of the threads (2g) to form a water-tight seal during immersion.

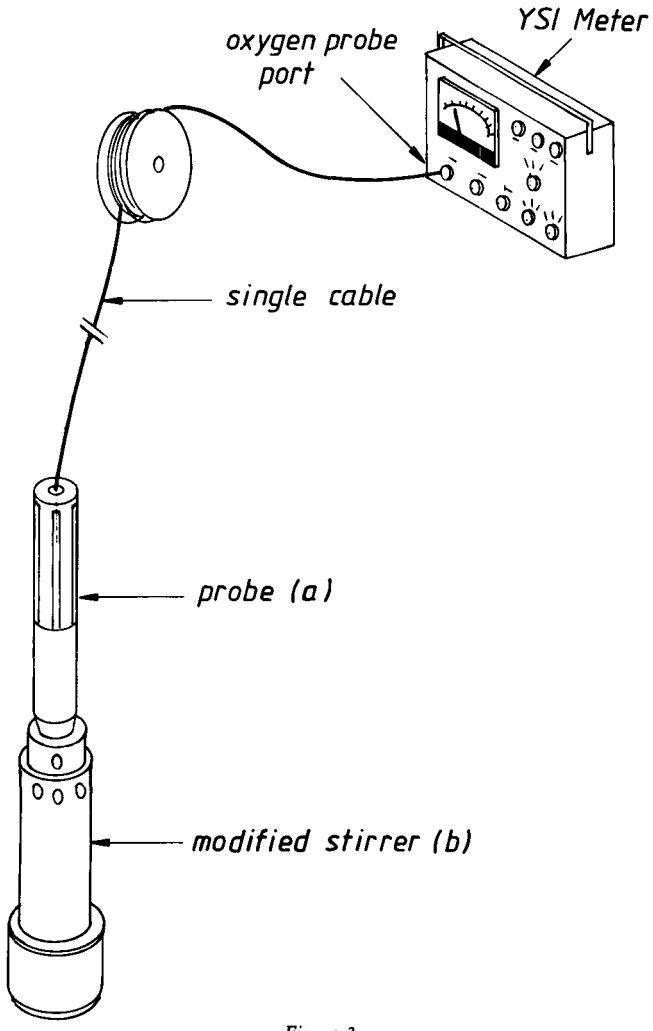

Figure 3
Single cable (operating mode).

The screw-on cap is fitted with a brass ring and a contact pin (-ve terminal) (2h). When the cap is screwed down firmly, contact is made and the motor is activated causing rotation of the magnet which in turn rotates the stirrer bar steadily. When in use (Fig. 3) the probe (3a) is screwed onto the top of the submersible stirrer (3b) and since battery power is independent, only one cable is necessary for operating the instrument. The battery is removed when not in use, while the modified probe is screwed into a sturdy, matching PVC cap (2i) containing distilled water for maximum protection of the delicate membrane. The capped probe and the submersible stirrer are stored with appropriate Terry-clips attached to the main carrying case on either side of the cable holder.

Advantages of the new submersible stirrer

- The unit is constructed of robust material and can be produced at minimal cost from local components.
- A removable independent battery supply obviates the necessity for two cables.
- Single cable operation is more efficient and prevents problems of intertwining cables.
- All components are removable, easily maintained or replaced at low cost.
- Field operation is reliable and simplified.
- Good protection is provided in the storage mode.

Field operation

This system has been used successfully on many occasions without functional problems. As a precautionary measure the "O" ring seal should be coated with silicone grease to ensure a water-tight seal. A weighted cap will also provide stability where turbulence in subsurface water is anticipated.

Acknowledgements

Development of the modified version was a cooperative exercise between members of the erstwhile Technical Services Department (Durban Branch) and the Reservoir Research Group of the CSIR (Durban Regional Laboratory). Mrs. A.S. van der Merwe is thanked for typing the manuscript.

References

ANON (1975) Instruction manual for YSI model 57 dissolved oxygen meter Item 022153 P/N A-057 16E 1-15.

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