AUTOMATIC INTRAVENOUS DRIP CONTROLLER*

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Both the nursing staff shortage and the need for precise control in the administration of dangerous drugs intravenously have led to the development of various devices to achieve an automatic system. The continuous automatic control of the drip rate eliminates errors due to any physical effect such as movement of the needle—this being the main cause of rate fluctuations in a manually controlled drip-set.

One system uses a roller or a finger pump controlled by the error in the time between subsequent drops. This can be made into an accurate system but the danger of harm to the patient due to the high pressure available is an ever-present risk. Protection must be built-in to guard against pumping air into the patient at the end of the infusion.

In another system a calibrated syringe is discharged at a set rate. It is driven by a motor which again gives the system the capability of developing high pressures if the needle shifts radically. This system becomes cumbersome for volumes larger than 50 ml due to necessity of alternately charging and discharging syringes. The need for sterilization of the many parts is an added risk and inconvenience.

The system here described responds to the error in the time between subsequent drops, the rate settles rapidly, and it is accurate, completely safe and uses standard drip-sets.

DESCRIPTION OF THE SYSTEM

The general arrangement of the system and the block diagram of the electrical elements are shown in Figs. 1 and 2 respectively.

It can be seen in Fig. 1 that a standard drip-set is employed, coupled in a very simple way to the electrical unit. The drop sensor, clipped to the drip-set, uses a photocell and exciter lamp with suitable optics to detect the passage of a drop over an adequate range of slope of the set and position of the sensor.

In the electrical unit (Fig. 2) a standard tenth of a second pulse is generated when the short pulse from the sensor arrives via the signal wire. The lamp driver thus puts the indicator lamp on for a tenth of a second each time a drop falls. The purpose of the 'ramp generator', 'adjustable trigger', 'buffer' and 'logic circuit' (fed by the normal and inverted pulses) is to deliver commands to the 'electronic switch' (depending on whether the drop is early or late in time) so that it can step up or step down the 'flow controller'.

PERFORMANCE

Table I relates the flow-rate desired to the drip-set and the setting in seconds/drop.

Tests were carried out to check the accuracy of the automatic controller over the ranges shown in the table.

*Date received: 7 December 1970.

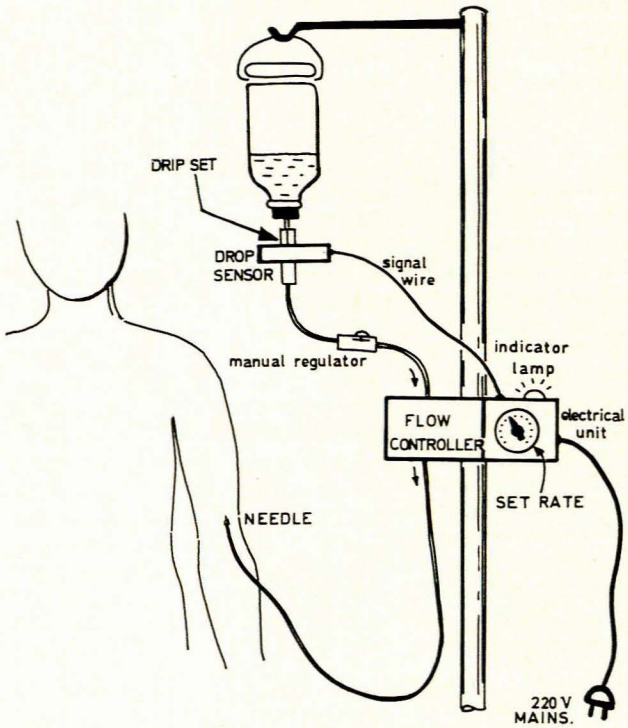

Fig. 1. The physical layout of the system.

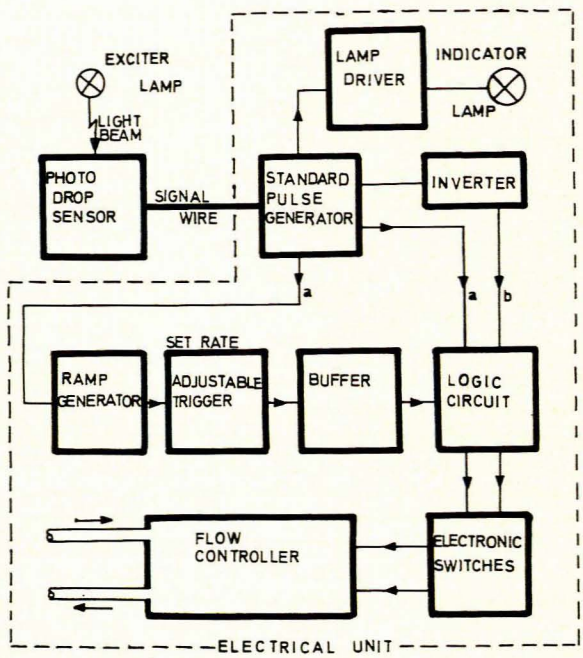

Fig. 2. The electrical elements of the system.

TABLE I. SECONDS PER DROP *vs.* FLOW FOR VARIOUS DRIP-SETS

	Flow in litres/day									
Setting in seconds/drop	*0·25*	*0·5*	*0·75*	*1·0*	*1·5*	*2·0*	*2·5*	*3·0*	*3·5*	*4·0*
10 drops/ml drip-set	—	—	—	8·6	5·7	4·3	3·5	2·9	2·5	2·1
19 drops/ml drip-set	—	9·0	3·7	4·5	3·0	2·2	—	—	—	—
50 drops/ml drip-set	6·9	3·5	2·3	1·7	—	—	—	—	—	—
60 drops/ml drip-set	5·8	2·9	1·9	—	—	—	—	—	—	—

An electronic counter was used to count the drops for half an hour in each case.

The results showed variations of rate of less than ± 5%. Here it must be noted that the dial was calibrated to an accuracy of about ± 5%, also that drip-sets have an inherent calibration accuracy of the order of ± 10%.

The drip-sets used were:

10 drops/ml .... Plexitron R41
19 drops/ml .... Plexitron R41 Pediatric
50 drops/ml .... Plexitron R38 Adapter
60 drops/ml .... Metriset

With all these sets the stabilization of the drip rate was achieved by the third drop.

The tests were conducted while discharging against atmospheric pressure as the back-pressure is negligible and tests in a ward confirmed this.

The drop-by-drop automatic controller for intravenous infusion should prove useful in an intensive care ward and even in the general wards. The accuracy achieved is compatible with the inherent accuracy of the drop count method of determining infused volume. The simplicity of the arrangement and the inherent safety of the method recommend this system for hospital use.

SUMMARY

A drop-by-drop electronic automatic controller for intravenous infusion, which settles rapidly and is safe and simple to use, has been developed. It has high accuracy over the range of 2 - 9 seconds per drop using any of the usual drip-sets.