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# A versatile gas/liquid valve

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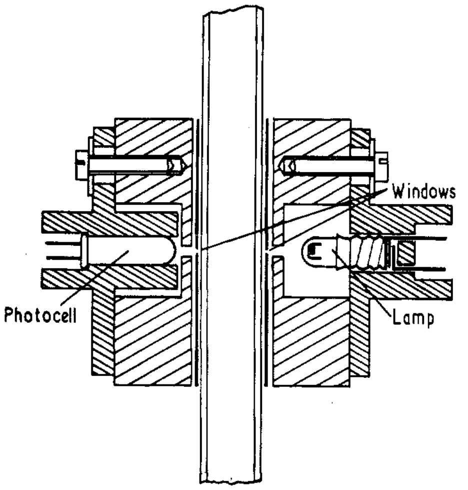


**Figure 3** Detecting head for the soap film flowmeter

both lamp and photocell relative to the fiducial mark can be adjusted to produce maximum sensitivity. It was found necessary to pass cooling water through the lamp housing, as otherwise heat generated would dry out the wall of the flowmeter, and thus cause the soap film to rupture.

A block diagram of the system is shown in figure 4. The timer is switched on when a soap film passes photocell P1 and

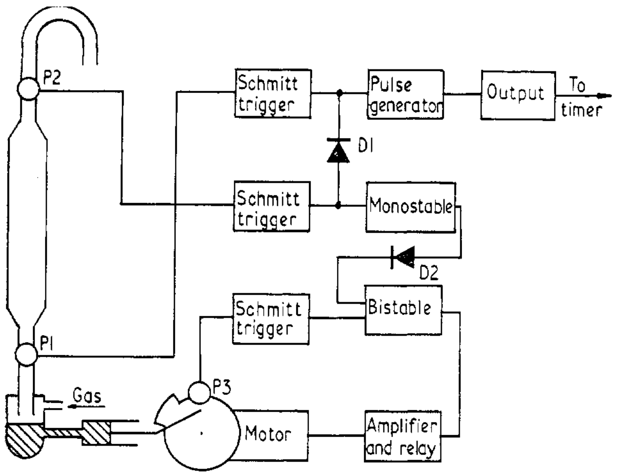


**Figure 4** Block diagram of the automatic soap film flowmeter

is stopped as the film passes P2. The signal from P2 also causes a pulse to trigger the monostable circuit, which after a delay returns to its quiescent state and triggers the bistable circuit, causing the relay to be switched on. This operates a motor which drives a piston to raise the level of the soap solution above the entrance to the flowmeter, so that the gas flow forces a soap film into the meter. When the shaft driving the piston has completed one revolution the light to photocell P3 is cut off. This triggers the bistable circuit and so causes the motor to be stopped. The delay is necessary so that one film can be removed from the meter before the next one is introduced.

Since the passage of a soap film causes a much smaller change in light intensity than a mercury pellet, it was necessary to modify the input circuits to provide greater amplification. The base voltage of the BC109 input transistor is adjusted so that the first transistor of the associated Schmitt trigger is just switched on when no soap film is present.

As this instrument was to be used as a primary flowmeter, the delay between passage of the film and the appearance of a timing pulse at the output was investigated. It had been noted that when a soap film passed, the resistance of the photocell changed from 0·8 MΩ to 1·5 MΩ. Therefore, two lamps were set up, the first giving a photocell resistance of 1·5 MΩ, and so simulating the presence of a soap film, and the second (a neon lamp) giving, together with the first, a photocell resistance of 0·8 MΩ. A mechanically driven switch was used to interrupt the power to the neon lamp for periods of 1–1000 ms, thus simulating different film speeds. It was found that the delay was 1–2 ms, and that it was independent of the time, above 2 ms, that the neon lamp was off, provided the input circuits were set up as described above. This time of 2 ms corresponds to a soap film speed of about 10 cm $s^{-1}$, which is greater than can be achieved in practice.

**Acknowledgments**
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# A versatile gas/liquid valve

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**Abstract** A glandless full flow control valve suitable for the rapid switching of slurry, particles, liquids or gases is described.

## 1 Introduction

The valve was developed to enable a sample of dead insects, collected in alcohol, to be removed from the base of a conical glass vessel with the minimum quantity of carrier liquid. To clear the particles completely an almost instantaneous movement from zero to full flow conditions had to be achieved, followed by an equally fast closing of the valve to minimize the volume of liquid removed from the vessel.

Of several valves tried none was satisfactory because either the speed of operation was too slow or the valve blocked and trapped the particles. The most suitable of the valves and clips tested was the simple Mohr's clip as used for burettes, etc., but because of the head of liquid and bore of pipe required, complete shut-off could not always be assured. As a wide range of solvents might be used and a fast acting wide bore valve was required, efforts were concentrated on developing a mechanism based on collapsing the wall of a silicone rubber tube of the type used in most peristaltic pumps.

## 2 Description

An early pattern of valve developed had a solid cam operating a cam-follower pin that compressed a tube against a fixed stop. This valve is still in use but has a rather heavy and rough action.

Figure 1 shows the final more versatile form of valve developed. The basic unit consists of two 4 in diameter disks separated by three pillars. The main spindle passes through the centre of the plates and has an eccentrically mounted roller attached to it. The roller is formed by sliding a standard needle bearing over an eccentrically mounted brass core that is attached to the main spindle by a grub screw.

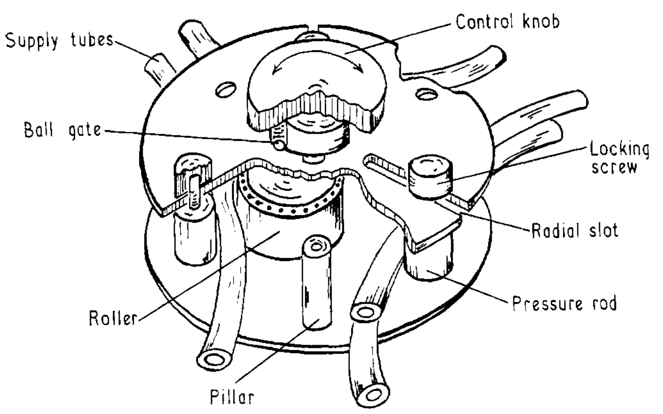


**Figure 1** Cut-away isometric projection of gas/liquid valve

Three pressure rods are located in radial slots cut in the upper plate. These rods can be locked at any desired radius to permit different thicknesses of tubing to be used, or moved in to form stops when not all of the three positions are required. A ball gate fitted to the main spindle and positioned beneath the control knob acts as a locator when all three positions are required.

Silicone rubber tubing of 12 mm outside diameter, 8 mm bore, was fitted when a single tube through each section was used, and tubing of 6 mm outside diameter, 4 mm bore, when two tubes in a section were used. The wall thickness of the tubing limits the maximum usable pressure.

When suitable tubing is fitted, the valve is adjusted by turning the control knob so that the point of maximum displacement of the roller is aligned with one of the radial slots. The pressure rod, located in this slot, is then pushed firmly up to the tubing and locked in place by tightening the locking screw. When this is repeated for each slot position the valve is ready for use.

## 3 Operation

Rotation of the control knob to any one of its three positions will radially compress and close the tubing at that position, and leave the other two positions fully open.

When used for switching particles in suspension, the valve was fitted with a single 6 in length of 8 mm bore silicone rubber tubing. One end of the tubing was connected to the outlet of a conical glass vessel containing a suspension of insects in alcohol and the other end positioned over a 3 in × 1 in specimen tube.

When the particles had collected at the base of the conical vessel the control knob was moved quickly through 120° to give full flow conditions, and then rapidly returned to its original fully closed position. The rapid opening and closing of the wide bore tubing enabled the particles to be flushed into the collecting vessel with only a small volume of the liquid and without any particles remaining in the valve or the supply vessel.

## 4 Performance

Tests were made using air up to a gauge pressure of 60 lb in$^{-2}$, the upper pressure depending on the type of tubing and its wall thickness. For the high pressure tests, standard laboratory red rubber tubing was used. Complete cut-off was achieved with all tubing tested, but the more flexible translucent silicone rubber tubing gave the lightest action.

## 5 Discussion

Many configurations based on this unit can be envisaged. Sequential control can be achieved by the phasing of two slim eccentrically mounted rollers within one unit, or two standard stacked units. Figure 2 shows the connections when the valve was used to operate a double-acting air cylinder. Present research with fluidic systems requiring complex simultaneous switching of air and liquid flows is being done using this valve.

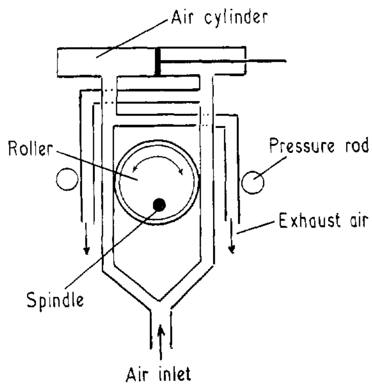


**Figure 2** Schematic diagram showing valve connections to operate a double-ended air cylinder. Valve shown in the neutral position for clarity

The valve can be much smaller when low flow rates of air or liquid are to be switched. As the valve does not require any glands or seals to be fitted, it is very easy to construct.

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# A simple transmission-to-extinction converter

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**Abstract** Commercial electronic units have been used in a converter which is sufficiently accurate and stable for use in combination with most photometers.

The output voltage from most photometers is proportional to the transmission of the sample, and the very desirable conversion of this to extinction ($E$) has mostly been achieved by means of segmented diode circuits (e.g. Yang 1954) or by mechanical devices in the recording equipment. Electronic units for logarithmic conversion after the principle of