AUTOMATIC BURETTES.

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DURING the last few years I have interested myself in devising automatic apparatus for the purpose of rapidly, accurately, and safely measuring liquids, especially such liquids as strong ammonia and sulphuric acid.

To be truly automatic, the apparatus should *without watching*—

1. Fill itself.
2. Empty itself.
3. Refill itself at the same time that it is emptying.
4. Be incapable of letting the whole of the supply run from the reservoir.
5. Need only one motion of the hand for all these operations.
6. Be adjustable to deliver any required quantity.

Only one of the apparatus I show you to-night fulfils all these requirements.

Fig. 1 is a plan I contrived that for exactitude excels all the apparatus hitherto introduced for this purpose. In this the measuring vessel, having a lateral opening at the top and another at the bottom, itself revolves. The lower end connected with the supply revolves in a sleeve, and the upper end, in communication with the overflow, revolves in another sleeve. The instant the measuring vessel is revolved all connection with the reservoir is cut off, so that an absolutely exact quantity is contained in the measure. Half a revolution brings its lower opening to the exit-tube, and its upper opening to an air-inlet. This form takes up its own supply of air, so

FIG. 1.

and its upper opening to an air-inlet.

that the reservoir may be a closed vessel, if necessary. It, however, does not at the same time refill itself, nor can the quantity it delivers be varied without changing the measuring vessel.

Fig. 2 involves a new principle—that is, the introduction of a capillary tube into the measuring vessel so as to vary its capacity at will, and to avoid connecting the reservoir with any over-flow pipe. The capillary tube really forms an over-flow pipe, but as it is carried straight up above the level of the reservoir there can be no actual over-flow. By forcing this tube down into the measuring-vessel, the capacity of this latter is lessened, so that it will deliver a smaller quantity than before. The capillary tube also protects the cork through which it passes from being acted upon by any corrosive liquid that one may be measuring. But when the level of the liquid in the reservoir varies, it would apparently result that a varying quantity of liquid would be delivered, due to the greater or lesser height of the over-flow in the capillary tube. But a capillary tube may be used whose whole length would be filled by a single drop. Evidently, then, the variation of a few inches in the level of the reservoir will not vary the quantity delivered by more than some fraction of a drop.

Time, however, is lost with this apparatus, because it does not refill itself at the same time that it is emptying.

FIG. 2.

FIG. 3.

In Fig. 3 I duplicated the measuring-vessel, and used a capillary tube in each. By the kindness of Messrs. Lister, of Dursley, who have patented this and some other of my measuring devices, I am able to show you specimens to-night.

It fulfils all six of the conditions I noted at the beginning of this paper, as required of a truly automatic measure, and needs only a half-turn of the tap to repeat the measuring indefinitely. Its supply-pipe, acting as a syphon, can be dipped into any ordinary reagent-bottle without removing this from its shelf, and it will then deliver any required quantity.

When different quantities are required alternately, one capillary tube can be pushed down further than the other, so that one measuring-tube will, for instance, give 5 c.c., the other 10 c.c. at every half-turn of the tap. By using a capillary tube with a bulb blown on it accurate quantities far larger than the capacity of the measuring vessel can be delivered. The measuring vessel in such case serves only as a regulator, the bulb holding most of the quantity to be delivered.