Analysis by Machinery*

Devices That Facilitate Laboratory Work

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In the department of analytical chemistry little has been devised to lighten the manipulative requirements of the chemist. Every operation undertaken requires the utmost skill and patience, while often the time expended is out of all proportion to the results obtained.

The wash-bottle—the chemist's staff—is ever in his hand, which, when so occupied, is not free for any other operation.

The washing of precipitates is one of the greatest time-absorbing factors in the laboratory. Yet there is no escape from it, demanding as it does the utmost attention and skill; in this way the output of a laboratory is considerably limited.

With a view to minimizing the loss of time, and thus increasing the scope of the chemist, the machine is illustrated in Fig. 1.

After thorough and severe tests it has shown itself capable of satisfying this long-felt want, and hence is worthy of the notice of analysts. The machine can carry out quite automatically the washing of any precipitate in a more efficient way than can be done by hand. The constructional details are set out briefly in the following: The apparatus intrinsically is a balance, on one arm of which is fixed a supporting ring for a filter funnel, on the other a movable counterpoise weight and also an electrical commutator. Over the beam is fixed a table carrying two electric motors, shown in diagram as *B* and *C* in Fig. 2, one to control through a specially constructed mercury valve (*A* and *B*, Fig. 3) the flow of water to a jet which is rotated by the other motor. The two motors are connected to the current supply through the commutator arm *A*, Fig. 2, in such a way that when the funnel end of the beam is up the water supplied by gravity flow from a flask or tin-lined copper tank, which may be heated if necessary, passes freely to the jet which sprays the water around the edge of the paper containing the precipitate to be washed reposing in the funnel.

The counterpoise weight at the other end of the beam, which is regulated by a screw, is moved into such a position that when sufficient water has flowed into the funnel the increased weight causes the beam to drop, thus shutting off the water supply to the jet, so that no current is washed during the period it is not required.

As the water drips from the funnel the arm supporting it becomes lighter, the beam rises, and water again enters the filter through the rotating jet. In this manner the washing process continues until it is complete.

The valve controlling the water supply to the jet is a glass bulb, shown in Fig. 3, containing mercury represented in the figure by shading, fitted with an inlet tube *C*, which reaches to the bottom of the bulb, and an outlet tube *D*. When the bulb is in an upright position, as in *A*, Fig. 3, the water supplied to it cannot flow on account of the resistance of the mercury to it. If the valve be turning through 90 degrees, as in *B*, Fig. 3, the mercury rolls away from the inlet tube, thus allowing the water a free passage to the outlet *D*.

This bulb is mounted on the machine in such a way that the motor *B* (Fig. 2), which is reversible, will turn it from the horizontal to the vertical plane and *vice versa*, as the commutator arm *A* is raised or lowered. In order to check the rotation of the motor in either direction after it has turned over the valve, it is cut out of circuit by a turn of the wheel *O*, fixed to the valve on which are mounted two steel contacts, *P* and *R*, Fig. 2, capable of alternately dipping into the mercury cups, *H* and *J*, so that while one is out of circuit contact is made in the other ready for the return journey as soon as the commutator moves over.

The apparatus is simple in construction, robust, and with few moving parts. The electric contacts are made by steel rods dipping into steel mercury cups carried on ebonite insulators. The working parts are enclosed from dust and chemical fumes by suitable covers, and when in use appear as in Fig. 1.

If it should be required to wash a precipitate, with a predetermined quantity of wash-water, say 200 cubic centimeters, a small float can be arranged, attached

to a cut-out on the main circuit to the apparatus, and this will arrest the washing quite automatically when the amount of water has passed through the filter.

Fig. 1.

Six or twelve of these machines can be mounted together for use in laboratories where a considerable portion of the analyst's time is consumed, as in steel

Fig. 2.

and refractory materials laboratories, in this laborious operation of filter-washing.

The current, which is only intermittently used, that

Fig. 3.

is when water is being sprayed into the filter, can be taken from the main power or lighting circuit.

The machine shown in the accompanying illustra-

tion is actuated by a pressure of 240 volts in conjunction with a suitable resistance. If, however, electric power or lighting is not laid on in the particular laboratory in which the apparatus is to work, a pressure of eight volts from an accumulator is sufficient to control it.

The apparatus thus becomes to the chemist a companion of the first order. It gives him a means of completely and effectively washing precipitates with the minimum quantity of hot or cold water in the shortest possible time. As the complete apparatus may be covered during the process of washing dust can be excluded and the contents of the filter-paper left uncontaminated. The machine may be left to complete a washing after the laboratory is closed down for the night.

In conjunction with this machine a decanting apparatus, the details of which may be communicated later, can be used, so that large bulks of liquid may be automatically decanted through the filter-paper. This apparatus is of especial value in agricultural laboratories, where much time is spent in this operation.

It is hoped that this brief account may interest readers in an endeavor to minimize some of the time-absorbing operations of the analytical laboratory

An Oil Pipe Line Across the Atlantic Ocean

An interesting scheme for a submarine pipe line to convey oil is proposed by an Irish inventor. The flexible pipe he has designed for the purpose is constructed of mild steel ribbon on the helical tube principle, the helices being packed with asbestos twine. The steel ribbon is coated with a protective metallic alloy, and is of such a thickness as to render the completed pipe capable of withstanding an internal pressure of 2,000 pounds and an external pressure of 10,000 pounds per square inch. Finally, a cotton casing is woven over the outside of the pipe and coated with preservative compound. To give longitudinal strength a stranded steel cable or hawser is put inside the pipe. The inventor considers that a pipe line between England and America could be laid in three or four months. The course would be divided into twenty sections, and as many laying ships would be employed, so that each would have about 130 miles to lay. The ships would be provided with sufficient steel ribbon on reels, with cotton, cable, and other requirements, to complete their allotted distance, and each would carry a tube-forming and sleeve-weaving apparatus. The former consists of a cross frame carrying reels of ribbon and asbestos and the forming and bending rollers, the whole being rotated round a steel mandrel. As the frame rotates the rollers press the steel ribbon to the required shape, enclosing the asbestos and interlocking the edges of the ribbon, and, finally, the cotton casing is woven on, the preservative compound being applied at the same time. The operations take place round the steel cable, by means of which the pipe would be fed into the water. The apparatus is designed to produce at least sixteen feet of pipe a minute. When beginning work each ship would attach its pipe cable to an anchored buoy. The cable would be wound on a drum having its rotation controlled frictionally, and when a predetermined amount of cable had been produced the drum would be allowed to unwind a proportionate length of cable, on which the whole strain of laying would rest. Subsequently the sections would be joined together, the pipe by means of bronze couplings, cotton covered and preserved, and the internal cable by similar couplings of steel. The inventor calculates that a single Anglo-American pipe line, 3,000 miles long and 18 inches in diameter, would deliver about 700 gallons a minute, or about 6,000,000 gallons a week, with a pump pressure of 2,000 pounds per square inch. The capital outlay he puts at £10,000,000, and the annual working and maintenance costs, exclusive of clerical and directorship costs, at £50,000—power (at 1/4d. per unit) accounting for £13,500, wages and salaries for £4,000, repairs and renewals to plant for £500, and a repair ship always in commission for £32,000, including repair materials. On this basis he estimates the cost per 1,000 gallons per 1,000 miles at 2s., as compared with £12 with tank steamers.—*Engineering Supplement of the London Times*.

*The Chemical News.