based have been performed in collaboration with Dr. G. Schwarzenbach. The details will, it is hoped, be included in a subsequent publication.

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Adjustable Needle Valve Leaks.

A SATISFACTORY adjustable needle valve for admitting a small constant flow of gas into a highly exhausted vessel is difficult to make. A number of ingenious forms have been described by various workers.[1] The valve should close tightly, open slowly, and yet it should have wide range. I have recently designed such a valve. The idea is not new; any originality that the device may have lies largely in the mechanical arrangement. Three forms, all employing very long and exceedingly narrow needles, are herewith described. The order is that of increasing complexity. The last one admits of being calibrated.

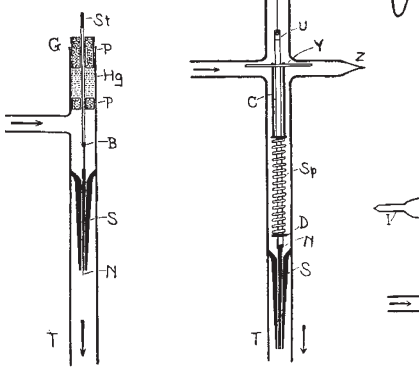

FIG. 1. FIG. 2. FIG. 3.

FIG. 1.

GT, Pyrex or Monax glass tube about 1 cm. in diameter.
S, Long valve seat made by drawing down capillary tubing, ring-sealed or waxed in position.
N, Valve needle made of copper wire tapered by dipping successively in acid.
St, Small steel rod for moving needle, fused to copper wire at B.
PP, Plugs of cork to guide steel rod, and to retain mercury.
Hg, Mercury for making air-tight seal around *St*. Mercury is retained between plugs *P*, *P*, so that valve may be used in any position.

FIG. 2.

GT, Pyrex or Monax glass tube about 1 cm. in diameter.
S, Long valve seat, same as in (1) above.
N, Valve needle same as (1).
U, Upper end of needle stem, copper rod.
D, Brass washer soldered to needle stem.
Sp, Heavy brass spring, rests on *D*, is held compressed against glass collar *C*, which in turn pushes against the yoke *Y*. Yoke is inserted through *Z*.
W, Winch for lowering or raising needle.

FIG. 3.

GT, Pyrex or Monax glass, upper half about 1·5 cm. in diameter.
C, Glass collar turned through 90°, showing the position of yoke *Y*.
U, Valve stem threaded at upper end.
L, Brass supporting collar seated on shoulder in glass tube.
Q, Slot in collar, and pin through needle stem.
K, Stud to keep collar from turning, inserted through *J*.
F, Flat enlargement blown in glass tube to allow pointer *H* to swing with nut A in lifting needle stem *U*. Enlargement carries a paper scale on outer circumference.
I, Nipple for inserting pointer *H*.
E, Spanner wrench.
W, Winch for engaging upper end of spanner wrench in turning nut *A*.

(1) This adjustable leak is very simple. It was suggested and constructed by L. P. Garner, graduate student in electrical engineering and physics, and was recently used in our laboratory in the determination of pump speeds by the mercury pellet method.[2] The essential parts are shown in Fig. 1.

In constructing this valve (and the two that follow) considerable care must be taken in seating the needle. It should be ground in with rouge before placing the valve seat in position. Obviously the needle in this form is adjusted by hand.

(2) The second form of needle valve requires a little more care in glass-blowing. The adjustment of the needle is accomplished by a stiff spring actuated by a winch. This valve was designed and constructed by me while at the Cavendish Laboratory, Cambridge, and during the past year was used by Prof. G. L. Clark, of the University of Illinois, in connexion with a Hadding-Siegbahn gas-type diffraction X-ray tube. The pressure was maintained constant at 0·011 mm. of mercury for periods of 50 hours on continuous runs, using an ordinary type of mercury vapour pump supported by a Cenco-Hyvac oil pump. The essential parts are shown in Fig. 2.

This valve needle seats tightly, depending on the stiffness of the brass spring *Sp*. For this reason the winch *W* should be made rather rugged. It is well to make the squared aperture engaging the winch rod as shown in Fig. 2, instead of placing it at the end of the plug, where the strains are liable to crack the glass. Use a stout grade of white linen thread.

(3) The third form of adjustable leak differs from the second in the mechanism employed for raising and lowering the needle. This mechanism is sketched in Fig. 3, in which the lower part of the valve is omitted. As in Figs. 1 and 2, the construction is made clear by reference to the letters assigned to the various parts of the figure.

Referring to Fig. 3, the upper end of the valve stem, the yoke, the supporting collar, nut, and spanner wrench are all of metal (preferably brass), and the remainder is of glass. The valve stem *U* must move freely through the glass collar *C* and through the brass supporting collar *L*. The nut *A* rests on *L*. The slot *Q* should be of sufficient depth to allow an overall up-and-down movement of the valve stem *U* of about 1 cm. This will give a wide range of leaks. By means of the pointer *H* and attached scale any setting may be repeated.

Finally, the successful operation of these leak valves, especially when a minute leak is desired, depends upon the care used in drawing into shape and seating the long needle valve.

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The Velocity Coefficient for Bimolecular Reactions in Solution.

IN a letter under the above title in NATURE of May 12, the interchange of energy between solvent and dissolved reactant molecules is discussed. This matter was considered in a paper entitled "The Benzylation of Amines: Part 3," in the *Journal of Physical Chemistry*, 673; 1926. If activated molecules of solute are deactivated by collision with solvent molecules, the latter molecules may either acquire a higher velocity, or be themselves activated,

[1] Kaye, "High Vacua," p. 51; Hopfield, *Amer. Jour. Optical Soc.*, vol. 12, p. 391; 1926.

[2] Kaye, *ibid.*, p. 162.