XX. *On a new Construction of a Condenser and Air-pump. By the Rev.* Gilbert Austin. *In a Letter to Sir* Humphry Davy, *LL.D. F.R.S.*

Read March 11, 1813.

DEAR SIR,

Woodville, Dec. 5, 1811.

ACCORDING to your desire, I give you a description of my glass condenser, which, upon inspection, you were so obliging as to consider might possibly be found useful in some of those extensive and profound chemical researches, in which you are happily engaged.

In the year 1799, I sent to the Royal Irish Academy the description of a little condensing instrument for the extemporaneous preparation of artificial mineral waters, which I stated would be more proper for nice experiments, if it could be made entirely of glass. As this suggestion had not, to my knowledge, induced any one better qualified to construct such an instrument of that material; pursuing my own ideas, I contrived the glass condenser herein described, the different parts of which, as to their fittings and application, that is the grinding of the barrel, the fitting and connecting of the flat joints and valves, I have been obliged to execute myself.

I have found this instrument to answer my immediate purpose very well, and have also applied it successfully to some other trivial chemical experiments; but it has for a considerable time (on account of my other avocations) remained neglected, and would have continued so to remain, had not you

given me hopes that it might be admitted to a place in your laboratory.

It was my wish, in the construction of this instrument, to have made the piston of glass only, without any packing of flax or thread for fitting it to the barrel; but I have not ventured to attempt so much. And perhaps as the packing is only a very small ring of a known substance, and as that may be varied at pleasure, by using for the purpose silk, or wool, or leather, or elastic gum, the effect in any experiment may be easily appreciated. The water which lubricates the barrel, and with which the joints are wetted in the first instance only (for the permanent junctures require no second wetting, but remain perfect for any length of time) may require also to be taken into the account, and if on occasion it should be thought preferable, oil may be used in the place of water. Should it however appear to you, that the want of a piston of glass, which should act without the addition of any foreign substance, is an important defect, you may possibly get one executed perfectly by some of those ingenious and excellent artists who are to be found in London. You will probably also improve on the form and construction of this first instrument (as far as I know) made of glass for the purposes mentioned. I have myself partly executed another of more general application on similar principles, of which, with your kind permission, I shall give you an account, as soon as I have completed it.

The great impediment to the forming of pneumatic instruments of glass, appears to me to have arisen from the difficulty of making the necessary joinings, in such a manner as to be capable of sustaining very considerable pressure, to be easily

disunited or connected, as occasion might require, and to be perfectly air tight. The conical junctures hitherto used, do not bear much pressure, and are objectionable in other respects: I have therefore formed my joints of plane surfaces, and find them as perfect, as permanent, and as easy in application as I can desire. For the construction of these joints, it is necessary that the glass vessels, or pieces to be connected, should be so formed that the part where they are to be joined should admit of having a broad projecting ring cast upon it. The ring should be formed by the glass-blower, as truly square and flat as convenient. The face is then to be ground (but not polished) perfectly plane, and then it will of course fit any other plane surface;—a great convenience on many occasions, and an advantage peculiar to the flat joint.

The connecting pieces, or collars for the joints, are formed of a flat ring of brass for each, about half an inch broad, and above one-eighth of an inch thick; this ring must be just wide enough to pass over the glass ring to which it is adapted. Fig. 3, *a* (Pl. XIV.) A mahogany ring about half an inch thick, having the diameter of the hole equal to that of the neck of the vessel above the glass ring, is to be screwed to the brass, and then sawed into two pieces through its diameter, fig. 3, *b*. These pieces are to be unscrewed, and applied to the neck, and they are then to be screwed to their places on the brass. The compound ring, or collar, will be thus secured above the glass ring, and may be fastened to another collar, attached in the same manner to the piece to be joined to it, by four screws passing through both when the joint is intended to be in some degree permanent, as in fig. 3, *c*. in which (*cc*) represents the glass pieces to be joined, (*aa*) the brass ring, and (*bb*) the

ring of mahogany. But if the joint require to be frequently separated in using the instrument, it may be applied moistened to the other, and pressed closely and perfectly by three milled-headed screws in the brass bridge, which bear upon the collar or ring of brass with their points. The degree of pressure necessary is not to be very great, but it must be equably exerted and felt on each screw, in order that the surfaces should be applied truly, and that the joint may be air tight—a very little practice will render this operation easy and certain. The bridge with its screws, &c. is represented, fig. 4, *a* (Pl. XIV.)—The plan of the bridge, and the end of the barrel with the valve in the piston, is seen at (*b*).—(*c*) is a stop to prevent the piece to be joined to the barrel from being pushed too far.

The glass valves are formed of plane convex lenses not polished, fitted to hollow spherical cavities, as in figs. 5 and 6.

These particulars being premised, the description of the instrument will be more easily understood.

Fig. 1, (Pl. XIII.) Represents a perspective view of the glass condenser, mounted on its frame and stand.

Fig. 2, (Pl. XIII.) A side view of the glass pieces of the condenser, disencumbered of the frame and connecting collars. The piston is seen outside of the barrel, and the iron sliding bar, with its arms which support the barrel, is represented with its clamps—but without the mahogany pieces. The same letters refer to the same parts of the instrument in figs. 1 and 2.

In figure 2 are also represented the valves in their places—the joints connected by dotted lines are permanent.

Figs. 1 and 2.

(*a*) The upper vessel which contains the liquid to be impregnated with the gas. A safety valve closes its mouth, seen at large, fig. 5 (Pl. XIV.)

(*b*) A piece connected permanently to the upper vessel; it carries the valve, which is so far below its surface as to allow it to rise a little in action, but not to turn over: the plane side of the lens is indented with a deep cross cut, to allow the gas to pass over it into the upper vessel, seen at large, fig. 6, *g. d* (Pl. XIV.)

(*c*) The glass barrel having a broad ring on each end.

Length of the barrel -	13. inches.
Diameter of the bore - -	0.$\frac{7}{8}$
External diameter -	1.$\frac{3}{4}$
Diameter of the broad rings -	2.$\frac{1}{4}$

(*d*) The hollow glass piston having one broad ring next (*e*), for the flat joint which connects the piston with it, and another ring, about four inches above this last, in order to secure it the better to the frame in which this ring and the piston are more than half sunk, and then covered over by a piece of mahogany pressing upon it with four screws. The covered part of the piston is represented by the dotted lines near (*d*) in fig. 1. At the end of the piston are two small rings, to confine the packing by which it is fitted to the barrel; and the extremity is ground into the hollow segment of a sphere, into which is fitted an unpolished plane convex lens, fig. 2, and seen at large, fig. 6.

(*e*) The receiver, from which the gas is drawn up and condensed into the upper vessel (*a*). It is furnished with a ground stopper, which may be used occasionally as hereafter mentioned.

(*f*) The pneumatic trough placed on a stool under the receiver.

(*g*) A retort, in which the gas is generated as usual.

(*hh*) Two pieces of mahogany, touching the sides of the barrel, and in their length fitting between its rings, so as when raised or depressed, to move the barrel without shake, and supporting the platform (*i*) with its bridge, as seen at large, fig. 4. These pieces are held together by iron clamps hollowed, so as to admit the barrel freely, fig. 2, *k*: they are clamped behind in the same manner, and then the barrel is secured by wedges in its proper situation, so as to be fixed perfectly parallel to the iron sliding bar. From the clamps behind proceed two strong arms (*kk*), fixed at right angles in the sliding bar (*l*), which moves equably in the long brass dove-tailed groove (*m*). This dove-tailed groove is screwed to the strong upright pillar (*o*). By means of the handle (*n*), which is fastened to the sliding bar between the two strong arms (*kk*), the barrel, with its apparatus, the platform (*i*), the brass bridge confining the upper vessel (*a*), by the piece (*b*), are alternately raised and depressed. In this action, the barrel moves upon the fixed hollow piston (*d*). The gas is extracted from the receiver at every ascending stroke, and passing through the hollow glass piston (*d*) above its valve, which opens upwards, is forced at every descending stroke through the valve between (*a* and *b*) into the upper vessel containing the liquor to be impregnated. Should more gas be forced into the vessel than the liquid readily absorbs, the safety valve at the top (seen at large, fig. 5) allows it to escape.

Fig. 5, (Pl. XIV.) is an enlarged view of the mouth of the upper vessel (*a*), with the collar (*b*) on its neck, hollowed

into a spherical cavity at (*c*) to fit the spherical valve of glass (*d*). This valve is set loosely in the brass piece (*e*), that it may, when pressed into the cavity, accommodate itself to its proper place. The brass piece (*e*) has a long tail (*f*), which passes freely through the milled-headed screw (*g*), and is surmounted at (*f*) with a small button, with which the valve may be raised, and which prevents it from falling out, when the whole frame is detached from the collar (*b*), in order to empty or fill the upper vessel (*a*, fig. 1). On the stem (*f*) of the valve (*d*), below the milled screw, a coiled spring wire is fixed, the pressure of which on the valve may be regulated by the milled screw. The flanch of the frame (*h*) has notches cut into it, which fall into corresponding notches in pieces fixed to the ring of the collar. The notches and the whole flanch pass under these pieces with a circular motion, and are thus secured till turned round in such a manner, as that the notches shall again correspond.

When the collar is not secured by the valve, it drops loosely down on the neck of the upper vessel (*a*), as represented in the figure at (*x*).

Fig. 6, (Pl. XIV.) an enlarged view of the hollow glass piston. (*a*) part of the piston rod. (*bb*) two small rings to hold the packing. (*c*) the packing. (*d*) the valve, an unpolished plane convex lens, fitted to the end of the piston. (*f*) the plan of the end of the piston, the latter is placed on the plane side of the lens. (*eeee*) notches in the upper small ring of the piston, over which are passed crossed threads, in order to confine the valve (*f*), and to prevent it in action from being carried off the end of the piston. The notches are necessary to guard the threads from the attrition of the barrel.

Fig. 1.

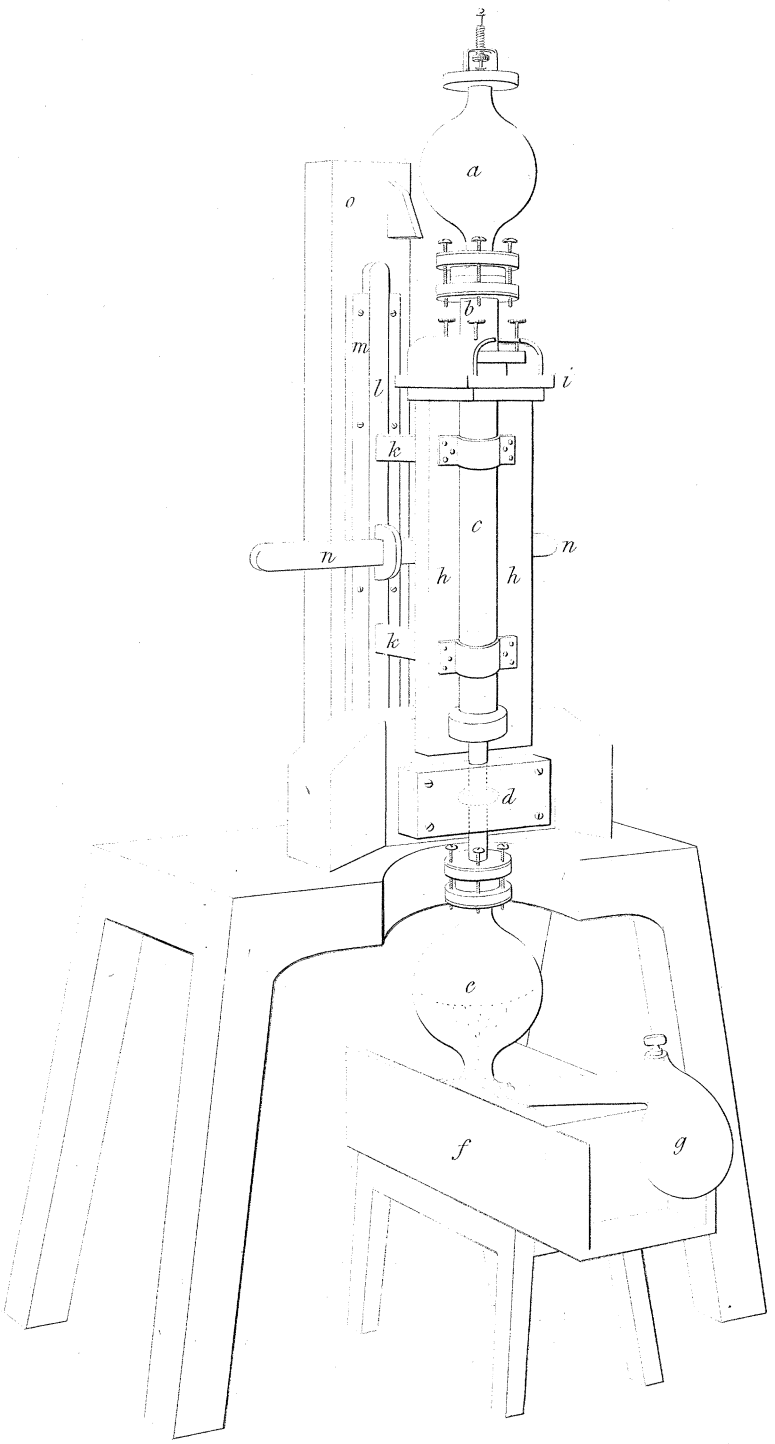

Fig. 2.

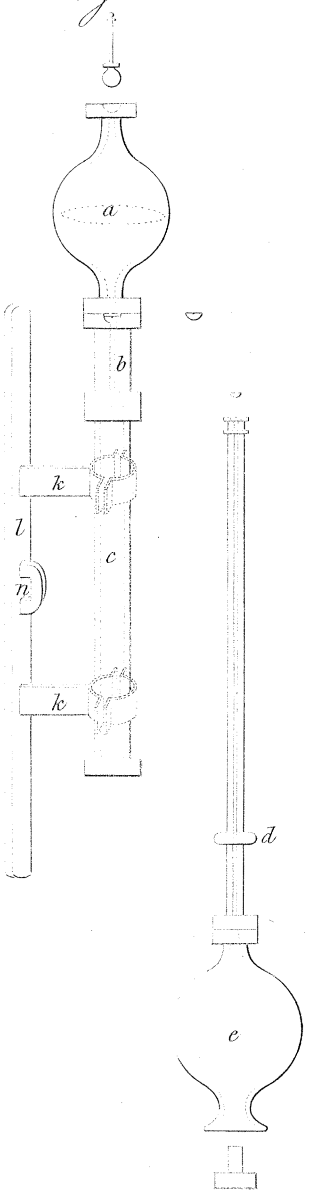

Fig. 3.

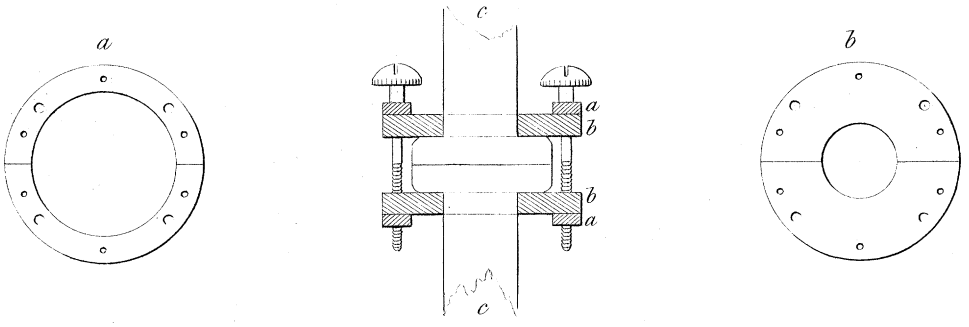

Fig. 4.

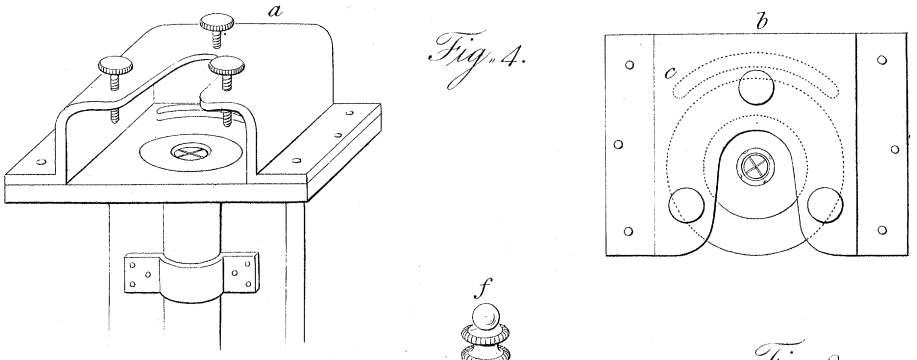

Fig. 5.

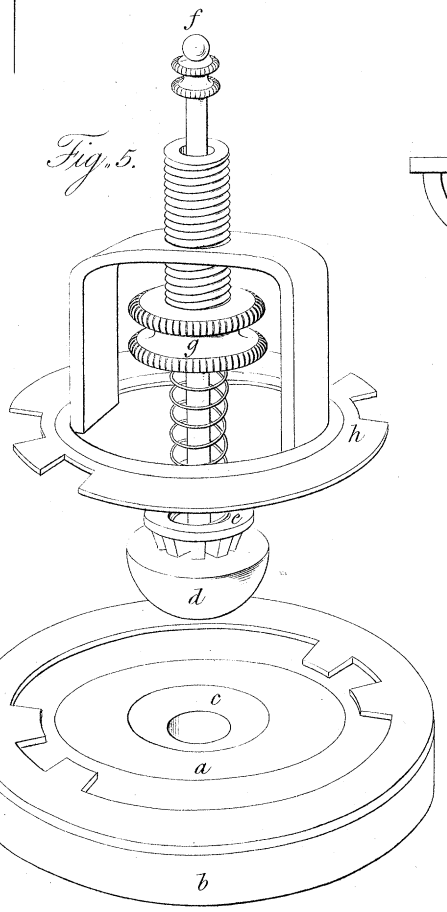

Fig. 6.

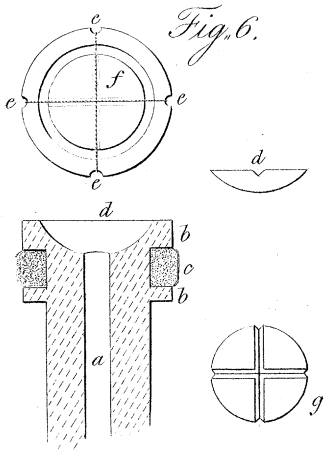

Fig. 7.

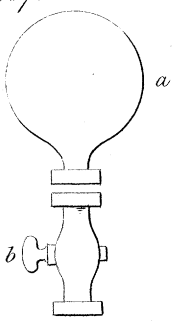

Fig. 8.

Fig. 8.

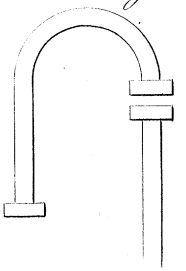

Fig. 5.

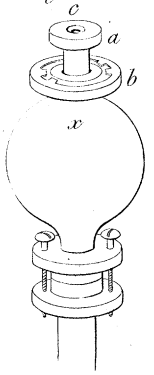

Fig. 7, (Pl. XIV.) (*a*) a glass vessel with only one aperture to be used instead of the upper vessel (*a*) when the safety valve is considered unnecessary. For the same purpose the receiver (*e*) figs. 1 and 2, may also be used occasionally, as all the joints fit each other. (*b*) a glass stop-cock to be joined occasionally by a pair of collars to the vessel (*a*) in this figure, or to any other at pleasure. This vessel (*a*), with its stop-cock being joined to the bottom of the piston (*d*, fig. 1.), and in the place of the receiver (*e*) may be exhausted if required. But in order to apply the instrument to the purposes of exhaustion, the bottom of the piston should be set in a platform, and have under it a bridge reversed, similar to that represented in fig. 4.—If the instrument were so constructed, bent tubes with rings of glass and collars might be applied by their flat joints, and would answer for exhausting jars connected with them.

Fig. 8, (Pl. XIV.) tubes differently bended, which may be connected at pleasure by flat joints, so as to form syphons of any size, and conducting pipes in any direction, and of any length.

I have to apologize for the minute particularity of this communication; but as I wish artists to understand me perfectly, I have preferred to be rather prolix, than obscure.

I am, dear Sir, with high esteem and respect,
your humble servant,
GILBERT AUSTIN.