

APPARATUS FOR SOLDERING AND MELTING.

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No laboratory is complete without an efficient blowpipe and some means for operating it; and while it is, as a rule, advisable to purchase apparatus of this class rather than make it, a few hints on the construction of a bellows, a blowpipe, and a small furnace may not be out of place. The bellows and furnace are of the kind devised by Mr. Fletcher, and made by the Buffalo Dental Mfg. Co. The blowpipe differs in some respects from those furnished by the above-named house.

In the construction of the bellows the following materials are required: Two hardwood boards 10×11 inches and $\frac{3}{8}$ inch thick; one circular board 1 inch thick and 9 inches in diameter; one piece of heavy sheepskin 30 inches long, 7 inches wide at the middle, and tapering to 2 inches at the ends; two disks of elastic rubber, each 11 inches in diameter and $\frac{3}{8}$ inch thick; one small scoop net; 3 inches of $\frac{3}{8}$ brass tubing; 3 small hinges; a spiral bed spring, and two iron straps.

The 10×11 inch boards are rounded at the ends, as shown in Figs. 1 and 2, and their square ends are connected together by the hinges as shown in Fig. 4. A hole is made in the lower board near the hinged end and covered by the valve shown in Fig. 3. The valve consists of a soft piece of leather, having attached to it two wooden blocks, one of which is fastened to the board in position to hold the other in the position of use. These blocks are beveled so as to give the valve sufficient lift and at the same time limit its upward motion. The circular board has a groove turned in its edge, and in a hole formed in its edge is inserted the brass tube. A hole is bored into the top of the circular board, which communicates with the inner end of the brass tube, and a series of holes are made in the circular board, which also pass through the upper board of the bellows. Over these holes is placed a strip of soft, close-grained leather, which is secured by nailing at the ends. This leather strip forms the upper valve.

The bed spring is secured to the upper and lower boards, and the bellows is ready to receive its covering. The spring, the hinges, and the valves should be secured with great care, as they are inaccessible when the leather covering and the rubber disks are in place. The boards are closed together, reducing the space between them to about $5\frac{1}{2}$ inches. They are held in this position in any convenient way until the cover is attached. The leather covering is glued, and tacked at frequent intervals. The leather is carried around the corner and over the hinged ends of the boards. An additional piece of leather is glued over the hinged end, and a narrow strip of leather is glued to the edges of the boards to cover the tacks and the edges of the leather covering. The job will be somewhat neater if the edges of the boards are rabbeted to receive the edge of the covering and the tacks.

The rubber disks are stretched over the circular board and secured by a strong cord tied over the rubber and in the groove in the edge of the board. The net is afterward secured in place in the same way. The net should be so loose as to allow the rubber, when inflated, to assume a hemispherical form, as shown in Fig. 5. A cleat is attached by screws to the hinged end of the lower board, and a straight iron strap is attached to the rounded end of the same board. The corresponding end of the upper board is provided with an offset strap, upon which the foot is placed when the bellows is used. The hole closed by the lower valve is covered by a piece of fine wire gauze tacked to the under surface of the lower board to prevent the entrance of lint and dust.

The blowpipe, which is connected with the brass tube of the bellows by means of a rubber pipe, is shown in section in the upper part of Fig. 6. It consists of two pipes attached to each other and adapted to receive the rubber pipe connections at one end. At the opposite end they are arranged concentrically, the aperture of the smaller pipe—which receives the air—being reduced 0.05 of an inch. The outer and larger pipe, which receives the gas, is provided with a sliding nozzle, by means of which the flow of gas can be easily controlled. The internal diameter of the smaller end of the nozzle is one-quarter inch. These dimensions are correct only for a blowpipe for small and medium work, *i.e.*, for brazing or soldering the average work done in the making of physical instruments; for melting two or three ounces of gold, silver, brass, and other metals, and for forging and tempering tools and small articles of steel, and for glass blowing on a small scale.

The gas is taken from an ordinary fixture by means of a rubber tube, the supply being regulated entirely by the movable nozzle of the blowpipe. The force of the blast varies with the manner in which the bellows is operated.

One of the best supports for articles to be brazed or soldered is a brick of pumice stone. It heats quickly, is very refractory, it admits of securing the work by tacks or nails driven into it. It has the further advantage of being incombustible. The work to be brazed or soldered must be well fitted, *i.e.*, there must be a good contact between the abutting or overlapping edges, and the contact surfaces must be well painted with a cream formed by grinding borax with a few drops of water on a slate (Fig. 7). When necessary, the work may be held together by an iron binding wire. The solder is coated with the borax cream before it is applied to the joint. For most work silver solder is preferred, as it is very strong, being both ductile and malleable.

The work is heated gradually until the water of crystallization is driven from the borax, then the work is heated all over until the solder is on the point of melting, when a concentrated flame is applied to the joint until the solder flows. Care should be taken to use the reducing flame rather than the oxidizing flame. Should it be found difficult to confine the heat to the work, pieces of pumice stone may be placed around the part containing the joint, as shown in Fig. 6.

A large number of small articles may be easily and quickly soldered by placing them on a bed formed of small lumps of pumice stone and proceeding from one article to another in succession.

For supporting small work, having a number of joints and requiring much fastening, the slabs of asbestos are very desirable. For very small work to be done with the mouth blowpipe, the prepared blocks of willow charcoal are used.

After soldering the borax may be removed by boiling the article in sulphuric acid.

The small gas furnace shown in Fig. 8 may be used in connection with the blowpipe and bellows, already described, by arranging the blowpipe on a stand and placing the furnace upon the pumice stone brick or a fire brick. The blowpipe is adjusted to deliver a blast to the opening of the furnace. The crucible in which the metal is melted rests upon an elevation at the centre of the furnace, as shown in the sectional view in Fig. 8. The crucible contains besides the metal a small quantity of borax for a flux. A roaring flame is required, and the blowpipe must be carefully adjusted with reference to the opening of the furnace to secure the best results. With this furnace and blowpipe two ounces of metal can be melted in ten minutes. Its capacity, however, is greater than that.