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An Apparatus for Nebulizing Liquids.*

CLAYTON G. LOOSLI.

From the Department of Medicine, the Douglas Smith Foundation for Medical Research, and the Bartlett Memorial Fund, University of Chicago.

The apparatus described below was designed† especially for the atomization of human sera. It was employed by the Commission on Influenza during studies concerning the prophylactic effects of the inhalation of convalescent human sera against experimental influenza infections in man.[1] Because of its excellent efficiency in providing a large output of nebulized liquid a detailed account of its construction seems worth while.

The nebulizing unit (Fig. 1) consists of a container and a metal atomizer. The container may be made either of metal or glass and be of any size or shape. That shown in Fig. 1 was designed to hold a large amount of liquid (500 cc). It was made by fusing an outlet of 22 mm glass tubing into the bottom of a short-necked, round-bottom, pyrex flask of one liter capacity.

The atomizer is constructed of chromed brass tubing. Fig. 2 (3 sectional views) shows various aspects of its design. It consists of a

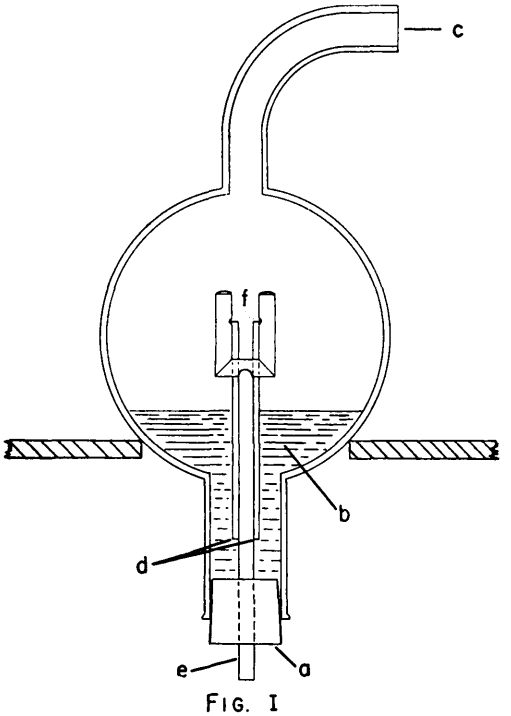

FIG. 1

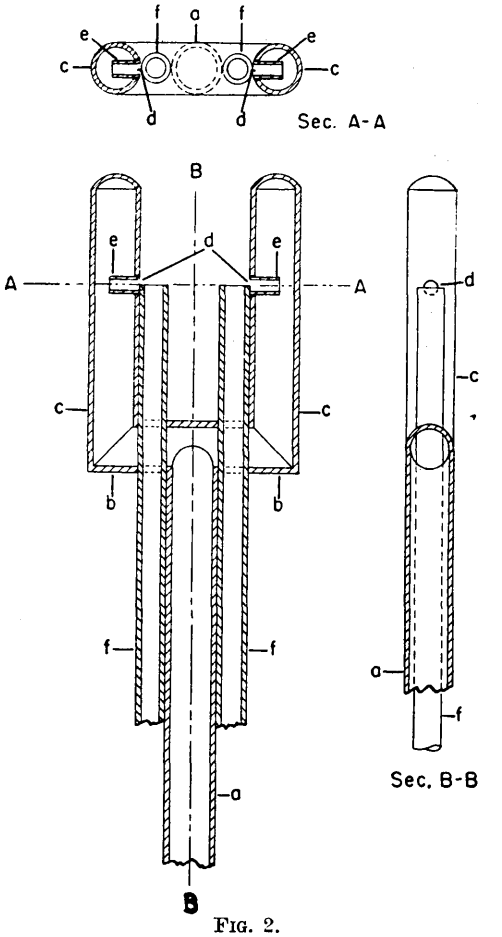

FIG. 2.

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† Mr. D. H. Loosli designed and built the metal nebulizer.

single inlet tube (Fig. 2-a) 6 inches long with a 3/16 inch inside diameter which communicates with a "U" shaped head or nozzle, made of tubing of similar size. The base (Fig. 2-b) of the nozzle is one inch wide and the stems (Fig. 2-c) one inch each in length. The stems are closed at their ends and on their side walls directly opposed discharge orifices (Fig. 2-d) slightly less than 1/16 inch in diameter are made. The orifices are made by soldering at right angles short pieces of 1/8 inch tubing (Fig. 2-e) into the walls of the nozzle stems to give a jet effect to the outgoing air. Two smaller tubes through which the fluid flows (Fig. 2-f) 4 inches in length with 1/8 inch outside and 3/32 inch inside diameters and opened at both ends are placed parallel to the stems of the nozzle. They extend through the base of the nozzle downward and adjacent to the air inlet tube. The upper ends of the liquid-bearing tubes (Fig. 2-f) lie approximately in the plane of the centers of the discharge orifices (Fig. 2-d). The joints where the tubes (Fig. 2-f) pass through the base (Fig. 2-b) of the nozzle are soldered to render them air tight.

The unit is assembled by inserting the metal atomizer into the neck of the inverted container where it is held in place by a rubber cork (Fig. 1-a). It is then adjusted so that the ends of the tubes (Fig. 1-d) are about ¼ inch from the cork. The serum or liquid (Fig. 1-b) to be nebulized is added through the outlet opening (Fig. 1-c) of the container in a sufficient quantity (25 to 500 cc) to immerse the serum tube opening (Fig. 1-d). The main air tube (Fig. 1-e) is then connected to an air supply (compressed air etc.) and under pressure, air is forced through it and out through the 2 opposing air jets (Fig. 1-f) in the nozzle. As the jets of air cross the upper ends of the tubes containing fluid (Fig. 2-f) an aspirating effect is produced in them and liquid is drawn up into the respective air streams. The streams moving at a high velocity in directly opposite directions, meet head on at approximately the medium plane between the stems of the nozzle, and reduce the liquid to a state of fine suspension.

This is shown by the fact that the droplets leaving the container appear as a fine mist which does not settle but disseminates through the room air. In spite of the marked turbulence of air in the container the liquid is only slightly agitated when the nebulizer is in operation. The bombardment of the 2 opposing jets of liquid and air directly against one another at close proximation, which creates the effect of a baffle, is considered to be the important and new feature of the nebulizer.

The output of liquid from this nebulizer will depend on the size of the outlet opening of the container and the rate of air flow through it. Using serum (undiluted) and an air flow of 1.1 cubic feet per minute the output was approximately one cc per minute. When four 22 mm outlets were made in the same container and 2.5 cubic feet of air passed through it the serum output was approximately 3.5 cc per minute. The unit has also been used satisfactorily in atomizing influenza virus in suspensions of mouse lungs during studies on the survival of influenza virus in the air. The details of the practical use to which this nebulizer was put in influenza studies will be reported elsewhere.[1]

[1] Commission on Influenza, to be published.