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CLOSED DIFFUSION APPARATUS

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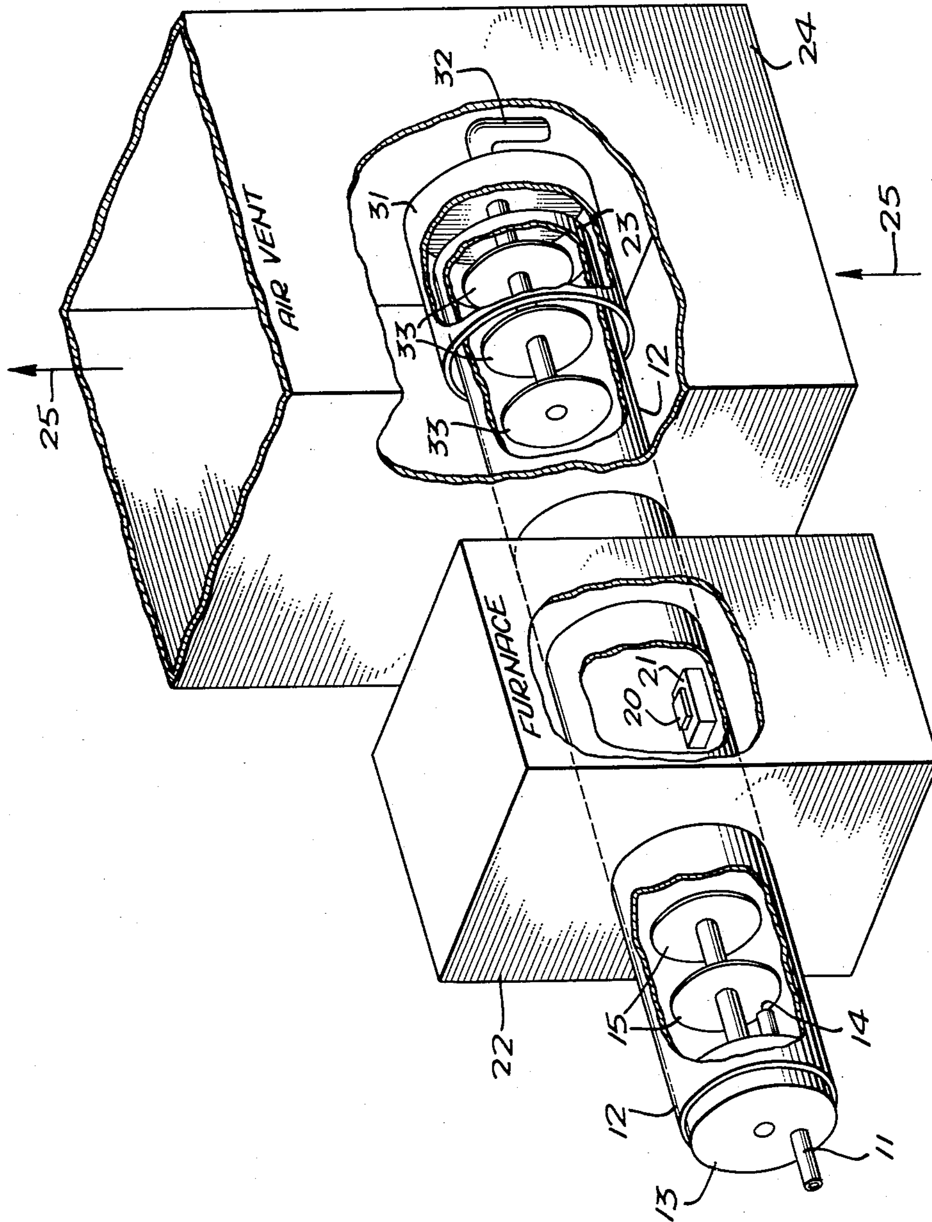

INVENTOR.
MARTIN WOLF

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CLOSED DIFFUSION APPARATUS

Martin Wolf, River Grove, Ill., assignor to Hoffman Electronics Corporation, a corporation of California

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7 Claims. (Cl. 118—48)

The present invention relates to diffusion apparatus, and more particularly to closed diffusion apparatus.

Semiconductor diffusion apparatus currently in use generally comprises a tube in which a semiconductor material is placed. The tube has a gas-inlet end and a gas-outlet end. The gas-outlet end is merely an open end inserted in an air vent and about which an external flow of vent-air is passed, in order to aid in the removal of the waste products of gaseous diffusion. It is very desirable to obtain uniform diffusion when doping a semiconductor with a gas, and, since the diffusion requires decomposition of the gas, it is very desirable to have the doping gas decompose uniformly over the length of the material being doped. The open-ended tubes currently in use are unsatisfactory in that some of the vent-air enters the tube through the open end and causes undesired oxidation products which in some cases deleteriously affect the semiconductor material.

It is an object of the present invention, therefore, to provide a closed diffusion apparatus.

It is another object of the present invention to provide a closed diffusion apparatus that permits uniform gaseous diffusion of a semiconductor.

According to the present invention, a closed diffusion apparatus comprises a diffusion tube having its output end loosely fitted with a cover connected to baffle discs for preventing external vent-air from entering the tube while permitting the removal of the waste products of the diffusion process by the vent-air.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with further objects and advantages thereof, may best be understood by reference to the following description, taken in connection with the accompanying drawings, in which,

The sole figure is a cut-away view of a closed diffusion apparatus embodying the present invention.

Referring now to the drawing, the sole figure shows inlet 11 for introducing boron trichloride and nitrogen gases, for example, into quartz tube 12 through cork 13. As the gases leave end 14 of inlet 11 they collide with quartz baffles 15 so as to be uniformly dispersed when they reach the zone of diffusion of semiconductor material 20. Such material is supported by quartz holder 21 within the portion of tube 12 that is headed by furnace 22. In the present example, the boron trichloride decomposes, yielding boron, an electron acceptor material, which diffuses into the semionductor material. The waste gases, including silicon tetrachloride where semiconductor material 20 is silicon, then flow toward open end 23 of tube 12 and are drawn out of tube 12 by air flowing in vent 24 in the direction shown by arrows 25. End 23 is loosely capped by a cylindrically-shaped quartz cover 31, which is connected by means of handle 32 to quartz baffles 33. The purpose of cover 31 and baffles 33 is to

prevent vent-air from entering tube 12, while permitting the flow of vent-air to aid in the uniform removal of the waste gases from end 23 of tube 12.

While particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broader aspects, and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of this invention.

What I claim as my invention is:

1. Closed diffusion apparatus comprising: a chamber for holding a semiconductor material and having gas inlet and outlet ends; an air vent surrounding at least a portion of said outlet end, said air vent supplying an external flow of air past said outlet end; and a cover fitting loosely over said outlet end and having at least one outlet baffle connected thereto for impeding said flow of air in said air vent into said outlet end, while permitting sail flow of air in said air vent to aid in the uniform removal through said outlet end of waste gases produced in said chamber.

2. Apparatus as defined in claim 1 including, in addition, one or more inlet baffles positioned in said chamber at said inlet end so that said gas introduced into said inlet end strikes said one or more inlet baffles and is uniformly dispersed in said chamber.

3. Apparatus as defined in claim 2 in which said chamber, inlet and outlet baffles, and cover are made of quartz.

4. Closed diffusion apparatus comprising: a chamber for holding a semiconductor material and having gas inlet and outlet ends; an air vent in which said outlet end is placed, said air vent supplying an external flow of air past said outlet end; a cover fitting loosely over said outlet end; one or more outlet baffles positioned in said chamber between said semiconductor material and said outlet end, said cover and each of said one or more outlet baffles serving to impede said flow of air from said air vent into said outlet end, while permitting said flow of air in said air vent to aid in the uniform removal through said outlet end of gases in said chamber.

5. Closed diffusion apparatus comprising: a tube-like chamber for holding a semiconductor material and having gas inlet and outlet ends; an air vent surrounding at least a portion of said outlet end, said air vent supplying an external flow of air past said outlet end; a cylindrically-shaped cover fitting loosely over said outlet end and having one or more disk-like outlet baffles connected thereto for impeding said flow of air in said air vent into said outlet end, while permitting said flow of air in said air vent to aid in the uniform removal through said outlet end of waste gases produced in said chamber; and one or more disk-like inlet baffles positioned in said tube-like chamber at said inlet end so that gas introduced into said inlet end strikes said one or more inlet baffles and is uniformly dispersed in said tube-like chamber.

6. Apparatus as defined in claim 5 in which each of said disk-like outlet baffles is supported perpendicular to the flow of gas through said tube-like chamber.

7. Closed diffusion apparatus comprising: a chamber for holding a semiconductor material and having gas inlet and outlet ends; an air vent surrounding at least a portion of said outlet end, said air vent supplying an ex-

ternal flow of air past said outlet end; a cover fitting loosely over said outlet end and having one or more outlet baffles connected thereto for impeding said external flow of air in said air vent into said outlet end, while permitting said external flow of air in said air vent to aid in the uniform removal through said outlet end of waste gases produced in said chamber; one or more inlet baffles positioned in said chamber at said inlet end so that gas introduced into said inlet end strikes said one or more inlet baffles and is uniformly dispersed in said chamber; and a heater positioned about said chamber in the vicinity of said semiconductor material.

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