

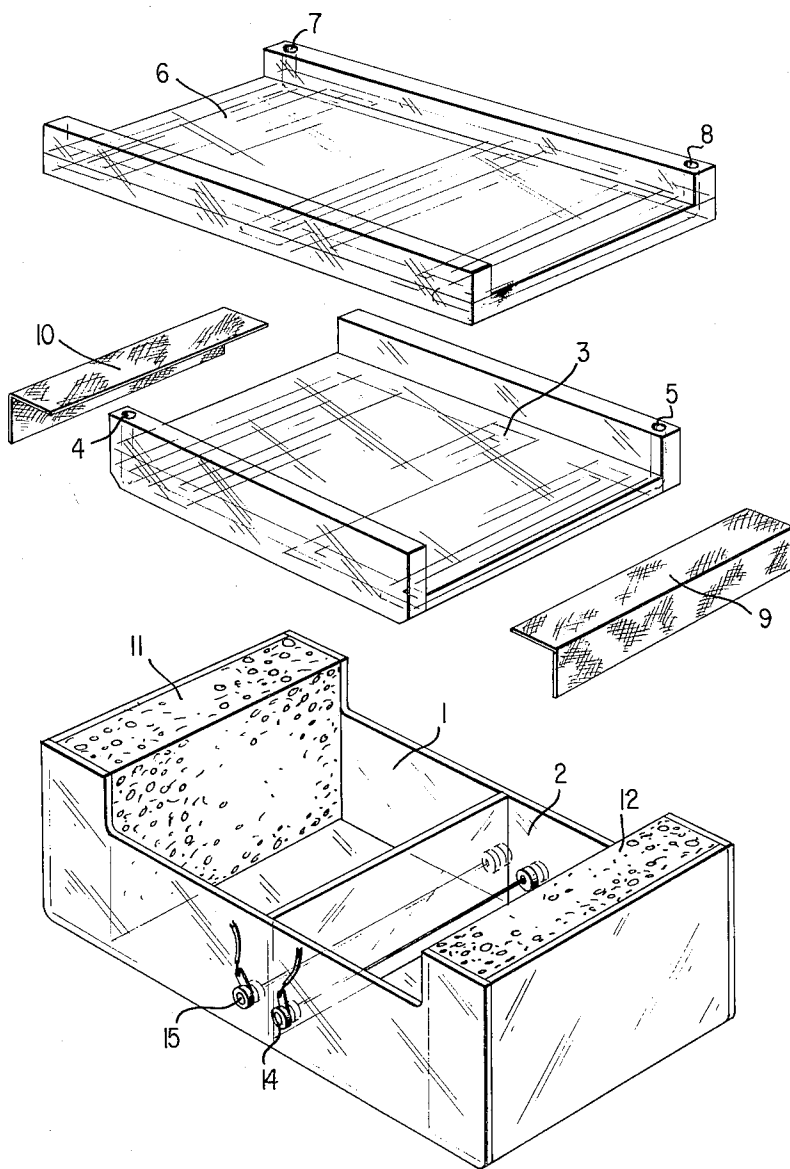
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## APPARATUS FOR ZONE ELECTROPHORESIS

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1

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## APPARATUS FOR ZONE ELECTROPHORESIS

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This invention relates particularly to zone electrophoresis in which the migration medium such as aqueous buffer solution is supported by an internal substantially inert support such as filter paper or starch gel. In such apparatus the heat generated by passage of the electric current through the migration medium results in evaporation of the solvent therefrom. Although in some applications such evaporation has desirable effects, in other applications of zone electrophoresis such evaporation is undesirable.

Methods previously used for preventing evaporation in those cases where it is not wanted include, (1) operation at low voltages and currents to minimize the quantity of heat produced and hence the amount of evaporation which takes place, (2) enclosing the electrophoresis apparatus in a tightly closed container to prevent the escape of the vapor generated by the evaporation, (3) operation of the apparatus at a lower temperature, (4) filling the apparatus with a fluid of increased heat conductivity such as helium gas or kerosene liquid.

All of these methods have disadvantages. For example, I have found that the use of a tightly closed container surrounding the electrophoresis apparatus does not prevent evaporation from the supporting medium. Under equal conditions of current, voltage, and temperature, evaporation is identically the same from the supporting medium whether it is enclosed tightly within a container or left open to the external ambient. The sole effect of enclosing the electrophoresis medium in a completely enclosed container is to cause the evaporated vapor to condense on the walls of said container. By proper design of the apparatus the condensed vapors may be allowed to run back into and mix with the electrophoresis medium. I have found, however, that this introduces concentration gradients within the electrophoresis medium which are undesirable.

An object of my invention is to provide an apparatus suitable for zone electrophoresis which will effectively and completely prevent the evaporation of the electrophoresis medium from the supporting medium. Another object is to improve the separations obtainable in zone electrophoresis by providing apparatus which will prevent the formation of undesirable concentration gradients within the electrophoresis medium. Still another object is to provide apparatus which controls the temperature of the electrophoresis medium while preventing completely evaporation of buffer or solvent therefrom.

These and other objects of my invention will become evident from the present drawings and specifications which follow.

Referring to the drawings:

The single FIGURE is an exploded view of a preferred form of my invention.

In accordance with my invention, the apparatus in a preferred form shown in the single FIGURE, comprises two buffer medium chambers 1, 2 with associated electrodes 14, 15, a lower cooling plate 3 (with cooling channels 4, 5) extending from one such chamber to the

2

other above the level of the buffer solution in said chambers, an upper cooling plate 6 (with cooling channels 7, 8) covering said lower cooling plate 3 and extending over the said chambers, means such as wicks 9, 10 at each end of lower cooling plate 3 for electrolytically connecting buffers to electrophoresis supporting medium between said cooling plates 3, 6 and porous material 11, 12 filling the space between said upper cooling plate and the surfaces of buffers in buffer chambers 1, 2. In most cases the porous material has to be electrically non-conducting.

Having thus described a preferred form of apparatus for my invention, I will now describe a preferred method of operation. In the following description it is assumed that the materials to be separated, the buffer solutions to be employed and the supporting medium, whether it be paper, starch grains or gel material, have been properly prepared for electrophoresis.

The supporting medium containing the appropriate quantity of buffer and the sample to be separated is placed on the lower cooling plate. It is essential that the supporting medium cover the entire surface of the lower cooling plate or that the uncovered portions of said plate be blanked off by the use of blank pieces of inert material. Buffer solution is placed in each buffer reservoir to a convenient depth. Then the ends of said supporting material are brought into electrolytic contact with said buffer solutions, respectively, by means of wicks, sponges, or other non-metallic electrolytically conducting contacts. The remaining spaces otherwise unoccupied by previously mentioned substances are filled with a porous substance saturated with the appropriate buffer, as previously used. For example, I prefer to use cellulose sponge blocks appropriately cut to fit into the available spaces. The upper cooling lid is then positioned so as to be in contact with the electrophoresis supporting material over its entire exposed surface, and also in contact with the space filling porous substances last mentioned. The assembly is now ready for the electrophoretic run which may be carried out without evaporation of any sort since there are no vapor spaces within the apparatus to be filled with evaporated vapor. At the conclusion of the electrophoresis run the apparatus is dismantled in any convenient way to recover the separated fractions.

I claim:

1. Apparatus for spreading mixtures by zone electrophoresis, the apparatus comprising;

(a) a tank containing separate open top buffer solution chambers with electrodes therein,

(b) a readily removable lower plate having a size and shape to partially cover the tank and extend from one solution chamber to the other and provide open spaces above each chamber for access to each chamber, the lower plate being positioned on top of the tank with the top of the lower plate above the normal level of the buffer solution chambers,

(c) a readily removable upper plate having a size and shape to substantially cover the lower plate and extend completely over the open top of the buffer solution chambers and completely cover the tank and thereby substantially prevent the escape of vapors therefrom,

(d) the space between the top of the lower plate and the bottom of the upper plate containing an electrophoresis zone supporting medium which is electro-

3

- lytically connected to the buffer solution in the chambers,
- (e) means defining coolant passages extending through both of the plates for individually cooling both of the plates by the circulation of a liquid cooling medium, and
- (f) an electrically inert porous substance in each of the buffer solution chambers adapted to be saturated with the buffer solution used, the porous electrically inert substance being shaped and positioned to fill up all of the vapor spaces within the open top chambers below the level of the upper plate to thereby prevent evaporation.

5

10

4

2. An apparatus as defined in claim 1, wherein the electrically inert porous substance consists of cellulose sponge blocks shaped to fit the available vapor spaces in the open top chambers.

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