

[54] SAMPLE APPLICATOR

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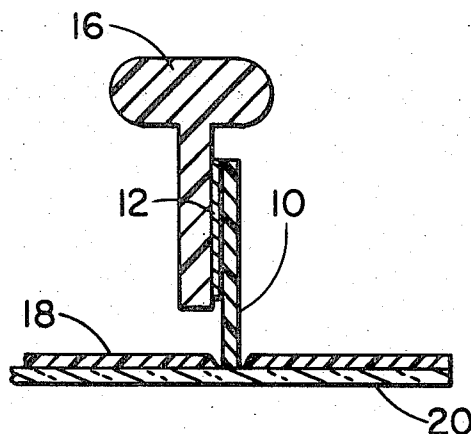
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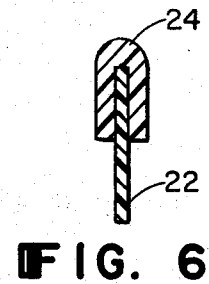
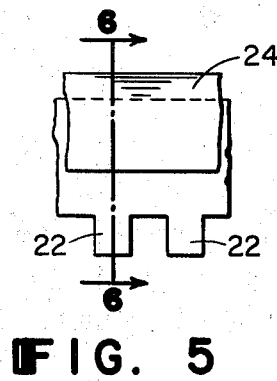
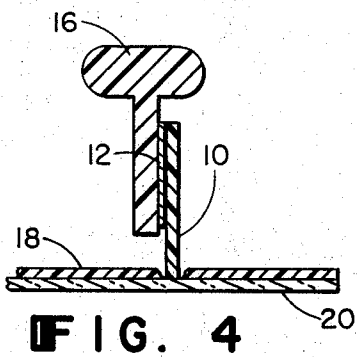
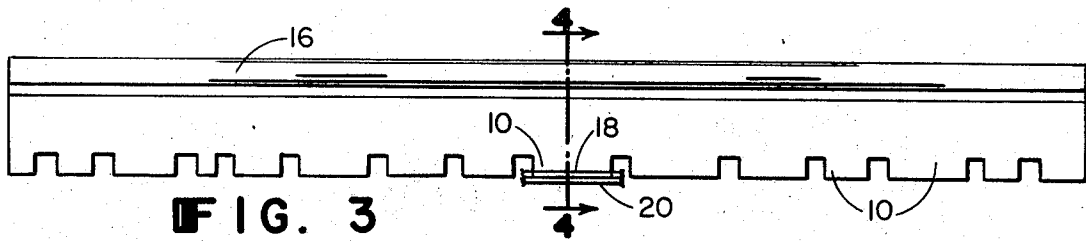
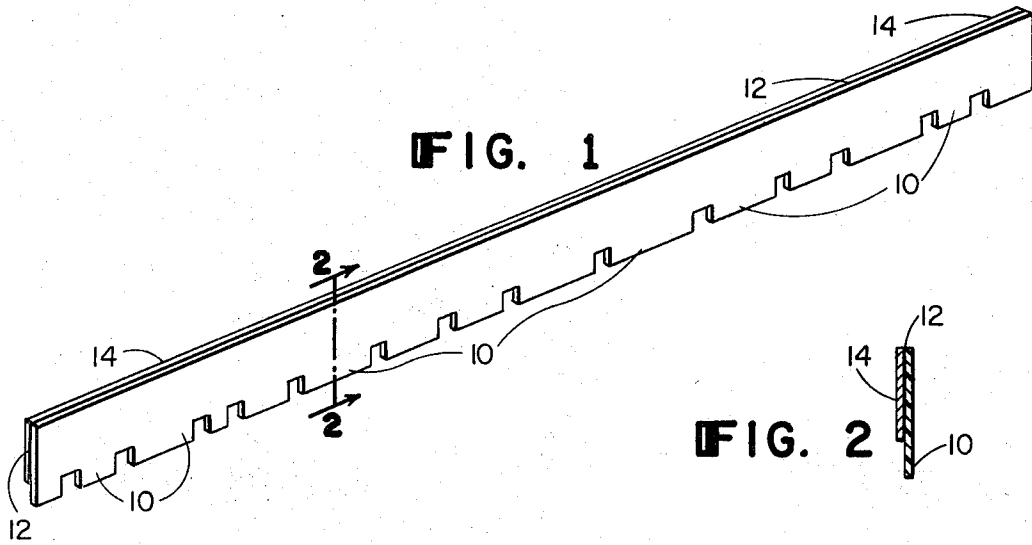
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ABSTRACT

An applicator for applying aqueous test solutions to a hydrated gel layer for subjection to electrophoretic or chromatographic procedures is in the form of a stiff resilient non-absorbent polymeric sheet having a thickness from 3 to 125 mils and having a hydrophilic surface. The thin film of test solution picked up by the sample holder when dipped in the solution is transferred with precise control of location by pressing the edge of the applicator into the gel.

5 Claims, 6 Drawing Figures





SAMPLE APPLICATOR

This invention relates to an applicator for applying aqueous test samples to hydrated gel films for subjection to electrophoretic or chromatographic procedures.

In carrying out such procedures it is important, for best results, to place a small controlled quantity of the aqueous test solution in a precisely controlled location in or on the gel film. In the past it has been customary to use applicators consisting of a pair of parallel wires holding the sample of test solution between them by capillary attraction or other forms of devices relying on capillarity for holding and delivering the sample. These devices do not provide close control over the sample, and they make it difficult to locate the sample in as precisely defined a location as desired. In addition, they require the development of considerable manual skill for effective use.

The present invention provides a sample applicator simple and inexpensive in construction and simple in operation, requiring little or no skill for successful use. In the drawings:

FIG. 1 is an isometric view showing one embodiment of the present invention;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a view in side elevation showing the applicator of FIG. 1 removably mounted upon a carrier;

FIG. 4 is a sectional view along line 4—4 of FIG. 3 showing a sample being applied to a gel film;

FIG. 5 is a view in side elevation of another embodiment of the invention; and

FIG. 6 is a sectional view along line 6—6 of FIG. 5.

As shown in the drawings, the applicator of the present invention comprises a stiff, resilient sheet of synthetic polymeric material having a plurality of projecting spaced apart sample holders 10, 10 having non-porous non-absorbent hydrophilic surfaces upon which water and aqueous solutions readily spread to form thin films of relatively uniform thickness. Means for mounting the sample holders on a handle is provided in the form of a layer of pressure sensitive adhesive 12 covered with a release paper 14 bonded to one face of the sheet along the length thereof near its upper edge.

In order to use the applicator the release paper 14 is removed and the applicator is removably mounted on rigid plastic handle 16 by pressing the adhesive surface against the surface of the handle. The sample holders 10 are then dipped to any desired depth in the aqueous sample solution, withdrawn together with a thin film of the solution adhering to their wetted surfaces, and then pressed against the hydrated gel layer or film 18 to which the sample is to be applied as shown in FIG. 4, preferably penetrating the gel, and withdrawn, leaving a deposit of the sample solution where the sample holders have come into contact with the gel.

Sample holders 10 may be of any convenient thickness from 3 to 125 mils, preferably 3 to 10 mils. Holders much thinner than 3 mils tend to be unsatisfactory because of excessive flexibility or fragility when pressed against the gel surface, while those thicker than 125 mils tend to deposit the sample over too large an area. The length of the bottom or gel-contacting edge of each sample holder, all of which are preferably straight and aligned with each other, is a matter of choice, usually ranging from about one-fourth to 1

inch. The size of the spaces between sample holders is also a matter of choice, usually being of the order of one-eighth to one-fourth inch. The height of each sample holder and handle measured in a direction perpendicular to the bottom or gel-contacting edge must be sufficiently great so that the fingers of the operator do not come into contact with the sample or with the gel surface. It is desirable that the spaces between adjacent sample holders 10 be sufficiently deep so that their upper edges do not come into contact with the gel when the samples are being applied, so that each sample deposited by each sample holder is separate and distinct from neighboring deposits, being spaced apart from them by the width of the space between adjacent sample holders.

The polymeric sheet material from which the applicator is formed may be any one of a wide variety of synthetic materials which are relatively stiff, resilient, and non-porous in nature such as polystyrene, polypropylene, polymethyl methacrylate, polyacrylic esters, superpolyamides such as nylon, polyesters such as polyethylene terephthalate, polycarbonates, polyvinyl chloride, polyvinyl butyral, copolymers of acrylonitrile, butadiene, and styrene, and many others. The surface of the sheet forming the sample holders must be hydrophilic, i.e., capable of being readily wet by water and aqueous solutions so that the latter spread into a thin film on the surface rather than standing in the form of beads or droplets of indeterminate size and distribution. The foregoing polymeric materials are for the most part hydrophobic rather than hydrophilic in nature, so that the surface of the sheet must be subbed or treated by any one of the numerous well known procedures for rendering it hydrophilic, among which are exposure to an electric corona discharge, treatment with ozone, ultraviolet radiation, concentrated sulfuric acid, tetraethyl titanate, tetraisopropyl titanate, nitrous oxide, copolymers of vinylidene chloride, acrylic ester and itaconic acid, gelatin and others. Two or more of such procedures may be used in combination, either simultaneously or successively, as is well known. In general, a surface against which water forms a contact angle from 0° to 10° is sufficiently hydrophilic for use in the present invention; preferably the contact angle is 0°.

The hydrated gel films 18 commonly employed in chromatographic and electrophoretic procedures, including such materials as agar, agarose, starch, polyacrylamide, and the like, are usually in the form of a film or layer from 1 to 2 millimeters in thickness and are tender, readily cut materials supported, during the electrophoretic or chromatographic procedure, upon a rigid support or backing member 20 (FIG. 4). In using the applicator, it is preferred to hold it at right angles to the surface of the gel film, as shown in FIG. 4, and press it against the rigidly supported film to penetrate and cut the latter substantially throughout its thickness by means of the straight bottom edges while depositing the sample solution.

The applicator of the present invention can also be used to deposit a sample at the bottom of a slot or well which has been precut or preformed in the gel film.

Another form of the applicator of the present invention is shown in FIGS. 5 and 6 in which the stiff resilient sheet forming sample holders 22, 22 is embedded in a handle 24 of plastic material, the entire device being disposable.

Excellent results have been attained by using as the flexible sheet a 4 mil sheet of polyethylene terephthalate subbed with a copolymer of vinylidene chloride, acrylic ester and itaconic acid and with gelatin cured by heating, sold under the trademark "Cronar." With this material, a sample holder one-fourth inch in width can be used to deposit a sample as small as 0.5 microliter on a gel film. Excellent results have also been obtained using polymethyl methacrylate for handle 16, while polyethylene is suitable for handle 24. The sheet from which sample holders 22 are made may be simply a friction fit within a slot in handle 24. While individual sample holders may be separately attached to the handles, it is preferred, when more than a single sample holder is to be attached to an individual handle, to cut all of them from a single sheet of material, leaving them connected at their upper ends as appears in FIG. 1.

The capacity of the sample holders for holding aqueous solution can be increased, if desired, by slightly abrading or roughening the surface, for example by scraping gently with a penknife.

What is claimed is:

1. An applicator for applying samples of aqueous test solution to a hydrated gel film for subjection to electrophoretic or chromatographic procedures comprising a

plurality of spaced apart stiff resilient non-absorbent polymeric sheet sample holders having a thickness from 3 to 125 mils and having a hydrophilic surface each sample holder having an uninterrupted straight flat bottom.

2. An applicator as claimed in claim 1 comprising in addition means for removably mounting said applicator upon a handle.

3. An applicator as claimed in claim 2 in which said means comprises a layer of pressure sensitive adhesive bonded to said sheet.

4. An applicator as claimed in claim 1 in which all of the sample holders are integral parts of a single sheet and all have their straight edges aligned with each other for contacting said gel film.

5. An applicator for applying a sample of aqueous test solution to a hydrated gel film supported on a rigid support member for subjection to electrophoretic or chromatographic procedures comprising a stiff resilient non-porous sheet of polymeric material having a thickness from 3 to 10 mils and having a hydrophilic surface on which water spreads to a thin film, the bottom edge of said sheet being straight, flat, and free from grooves and a handle connected to said sheet.

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