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3,736,100

IMMUNOELECTROPHORESIS GEL TRAY

Filed May 24, 1971

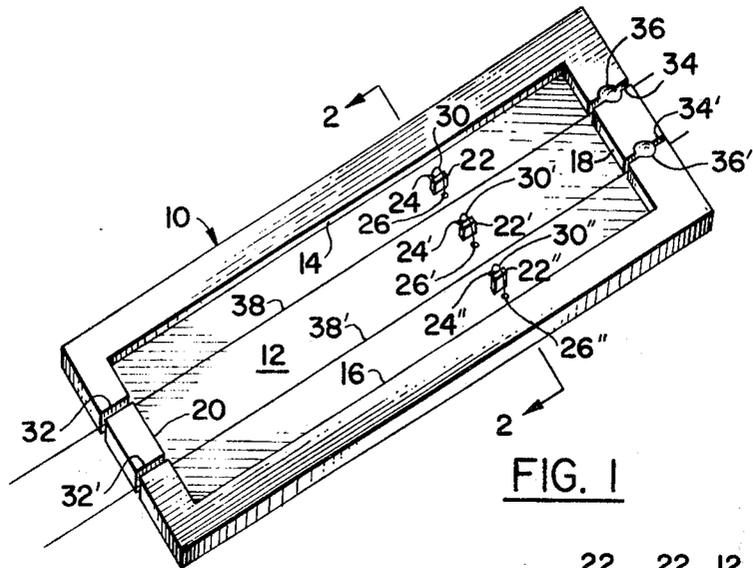


FIG. 1

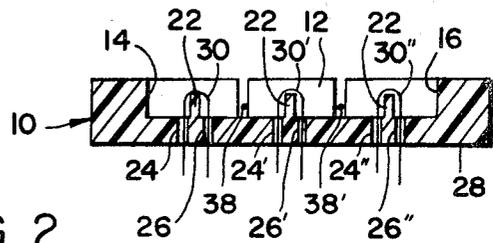


FIG. 2

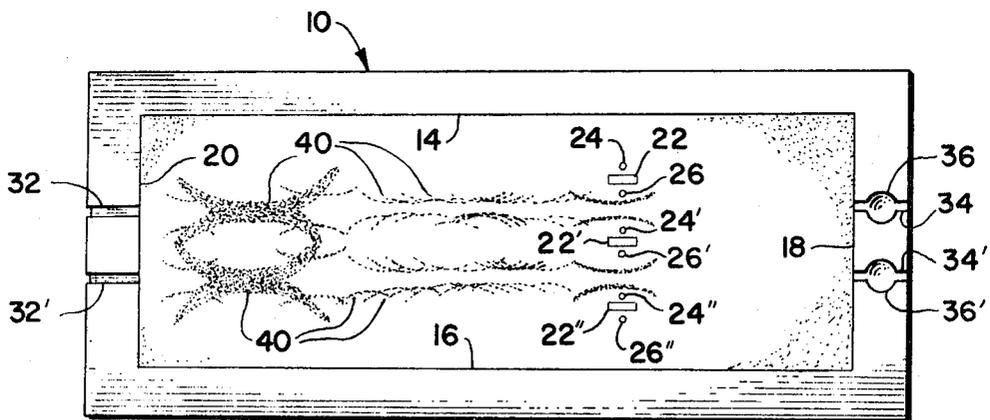


FIG. 3

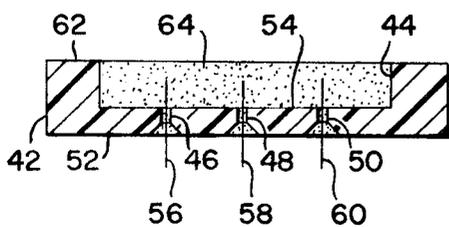


FIG. 4

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IMMUNOELECTROPHORESIS GEL TRAY

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11 Claims

ABSTRACT OF THE DISCLOSURE

An electrophoresis tray having wire-like elements disposed therein for injecting into a gel carried by the tray, serum and anti-serum to provide for electrophoresis and subsequent diffusion of the anti-serum to precipitate proteins.

BACKGROUND OF THE INVENTION

(1) Cross-references to related application

This invention is related to the invention described in the concurrently filed and copending applications entitled (1) "Method of and Apparatus for Depositing a Fluid in a Gel," Ser. No. 146,262 for inventors Stephen D. Rains and Leon L. Wheelless, Jr. and (2) "Electrophoresis System and Gel Frame," Ser. No. 146,387 for inventor Stephen D. Rains.

(2) Field of the invention

This invention relates to an apparatus for carrying gel for immunoelectrophoresis analysis of serums and anti-serums and more particularly to a self-contained unit for supporting the gel including apparatus for individually introducing serum and anti-serum.

(3) Description of the prior art

The practice of immunoelectrophoresis has been known for many years and certain difficulties have been experienced in the practice, with particular regard to introducing serums and anti-serums into a gel in order to carry out the process. Frequently, contamination of the serums and anti-serums between each other has resulted while attempting to introduce the two into the medium for carrying out the electrophoresis processes and subsequent precipitation processes. These difficulties have lead to results which are undependable, costly and time-consuming. Quite often, it is necessary to repeat the process in order to assure that accurate results are obtained.

SUMMARY OF THE INVENTION

This invention provides an apparatus for expeditiously and inexpensively carrying out the process of immunoelectrophoresis with dependable accurate results. In the hereinbefore mentioned patent application entitled "Method of and Apparatus for Depositing a Fluid in a Gel" for Rains et al., there is described, in detail, a method for introducing fluids into a gel for analyzing chemical constituents. Further, R. J. Wieme in "Agar Gel Electrophoresis"; published by Elsevier Publishing Company in 1965, describes, in detail, the particular processes of electrophoresis as well as immunoelectrophoresis. The embodiments disclosed therein generally show a wire-like element which extends across the frame for introducing a fluid into a gel contained within the frame. It is described in the specification that the wire-like element may be constructed from various materials which will produce a wire-like element that may be anything from rigid to flexible and, also, anything therebetween. The only definite requirement is that the wire-like element should be able to be pulled from the gel and generally remain within the path that it initially defined within the gel. Accordingly, in the present de-

vice wire-like elements are disclosed having paths which are other than linear. These wire-like elements are ideally suitable, in particular, for introducing into the gel serum to be subsequently analyzed electrophoretically.

After the process of immunoelectrophoresis this invention further provides for introducing anti-serum into the same gel for continuing the process of immunoelectrophoresis and for precipitating proteins. The simplicity of this device is easily appreciated and would be inexpensive to manufacture and thereby meets some of the most critical demands for devices of this type for use in today's medical analysis laboratories.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an apparatus according to the principles of the present invention;

FIG. 2 is an enlarged cross-sectional view of the apparatus of FIG. 1 taken along the line 2—2 of FIG. 1;

FIG. 3 is a visual pattern of the precipitated proteins after completion of the process of immunoelectrophoresis; and

FIG. 4 is a cross-sectional view of another embodiment of the apparatus according to the principles of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1 there is disclosed a gel frame 10 having a recessed area 12 defined by parallel lateral walls 14 and 16 and transversely disposed walls 18 and 20 for carrying any gel suitable for use in the process of electrophoresis. Extending upward from the bottom portion of the recessed area 12 are a plurality of protrusions 22, 22' and 22'' of similar construction. The protrusions 22, 22' and 22'' are ideally formed as an integral part of the gel frame 10 and are generally rectangular in shape. Disposed at opposite sides of each of the protrusions 22, 22' and 22'' are respective apertures 24 and 26, 24' and 26' and 24'' and 26''. The series of apertures 24, 26, 24', 26', 24'' and 26'' extend through the gel frame 10 from the recessed area 12 to the underside 28 of the gel frame 10.

As best seen in FIG. 2, inverted U-shaped wire-like elements 30, 30' and 30'' extend respectively through the series of apertures 24, 26, 24', 26' and 24'', 26'' to bridge the respective series of protrusions 22, 22' and 22''.

In its use the gel frame 10 is turned to its underside 28 so that an operator would be able to dispose a serum droplet onto one end of each of the U-shaped wire-like elements 30, 30' and 30'' and thereafter extract the wire-like elements from the gel frame 10 by pulling on the end of the U-shaped wire-like element opposite the droplet. This action will cause the droplet to follow and, consequently, fill the void left in the gel by the extraction of the U-shaped wire-like elements 30, 30' and 30'' from the gel retained in the recessed area 12. Once the serum is introduced into the gel the frame is electrically connected by any suitable means and the process of electrophoresis is conducted. After the serum migration has transpired across the top surface of the gel frame in the direction parallel to the walls 14 and 16, the gel frame is ready for the further process and the operation of immunoelectrophoresis.

To this end the gel frame 10 has included therein aligned recesses 32 and 34 extending from the transverse walls 18 and 20 outward to the outer periphery of the gel frame 10. Additionally, included in the path of the recess 34 is a reservoir 36 having any suitable shape and extending, for example, to the same depth as the recessed area 12. It will be appreciated that a plurality of recesses 32 and 34 and reservoir 36 may be incorporated as shown by recesses 32'

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and 34' and reservoir 36'. Extending through the gel carried in the recessed area 12 and aligned to the recesses 32 and 34 is a wire-like element 38. Likewise, a wire-like element 38' extends through recesses 32' and 34'. The wire-like element 38 is best made of an electrically non-conductive material, since it is in place in the gel while the electrical power is applied for the electrophoresis process.

After the hereinbefore mentioned process for electrophoresis of a serum has been conducted, an anti-serum of known composition to conduct particularly desired tests is disposed in the respective reservoirs 36 and 36' and the wire-like elements 38 and 38' are extracted. Correspondingly, upon extraction of the wire-like elements 38 and 38', the anti-serum fills the void left by the respective wire-like elements as described in the hereinbefore mentioned Rains et al. patent application entitled "Method of and Apparatus for Depositing a Fluid in a Gel."

After the above-mentioned steps have been completed it is only necessary to incubate the gel in an environment suitable for diffusion of serum and anti-serum, and for precipitation of the antigen-antibody complexes. After the prescribed amount of time has elapsed the serum and anti-serum will have reacted to each other and an analysis can quickly be made by simple visual interpretation. The results of the reaction of the serum to the anti-serum can readily be seen in FIG. 3. The precipitin arcs that appear take on an appearance of a series of overlapping crescents designated as numeral 40 in the drawing of FIG. 3.

A further embodiment of the present invention is disclosed in FIG. 4. Specifically, a gel frame 42 is shown having a recessed portion 44 therein. A plurality of passageways 46, 48 and 50 are located in the gel frame 42 so as to communicate the lower surface 52 of the gel frame with the bottom 54 of the recess 44. A plurality of wire-like elements 56, 58 and 60 are positioned in the passageways 46, 48 and 50, respectively, so that they do not protrude above the upper surface 62 of the gel frame 42. A gel 64 is then introduced into the recessed portion 44 of the gel frame 42 and allowed to set. Once the gel 64 has set a portion of the residual gel that remains in the conical portions of the passageways 46, 48 and 50, respectively, may be removed therefrom. The removal of the small amount of residual gel is necessary to allow a fluid sample to be deposited in the conical shaped sections of the passageways 46, 48 and 50. The fluid sample may be deposited by any known acceptable manner such as, for instance, was disclosed in the concurrently-filed and co-pending application "Method of and Apparatus for Depositing a Fluid in a Gel" for inventors Stephen D. Rains and Leon L. Wheelless, Jr. After the fluid sample has been deposited in the passageways the wire-like elements may be withdrawn therefrom. The fluid, as previously described, is caused to flow into the voids left by the extraction of the wire-like elements. The hereinbefore mentioned patent application entitled "Method of and Apparatus for Depositing a Fluid in a Gel" specifically describes this phenomenon.

It will be appreciated that although specific articles have been given specific identifications there are a great number of other variations of these articles that would work equally as well. For instance, the means for introducing the fluid into the gel has been called a "wire-like element," although anything that resembles a wire, such as a strand of hair, a nylon or plastic filament, or even a string, would work equally as well. Further, the wire-like element may be either rigid or flexible and it is not necessarily limited to a cross-section of circular shape. A strip of material such as paper or plastic, for example, can also serve as the "wire-like element," as well as can probes of triangular, square or any of the cross-sectional shape.

I claim:

1. An apparatus for use in the process of immunoelectrophoresis where gel is useable as a support medium, comprising:

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a frame defining a recessed portion therein for carrying gel, said recessed portion having at least one aperture communicating the recessed portion with an outer surface of the frame;

at least one first filament, said first filament extending through the aperture to define a first path for fluid through the aperture and gel carried within the recessed portion to facilitate the introduction of chemical constituents into gel carried within the recessed portion; and

at least one second filament, said second filament disposed within and traversing at least part of the length of the recessed portion to define a second separate path for fluid to facilitate the introduction of additional chemical constituents into gel carried within the recessed portion.

2. The apparatus as defined in claim 1, wherein the recessed portion has two apertures, and the first filament is U-shaped and extends through said two apertures in the recessed portion of the frame to define a U-shaped first path for fluid.

3. The apparatus as defined in claim 2, further comprising support means for supporting the U-shaped first filament within the recessed portion.

4. The apparatus as defined in claim 3, wherein the support means for supporting the U-shaped first filament is a protruding member disposed between the apertures in the recessed portion.

5. The apparatus as defined in claim 4 wherein the protruding member is integral with the frame.

6. An apparatus for use in the process of immunoelectrophoresis where a gel is useable as a support medium, comprising:

a frame defining a recessed portion therein to carry gel, said recessed portion having a plurality of apertures communicating the recessed portion with an outer surface of the frame;

at least one U-shaped element, said element extending through two apertures to define a first continuous path for fluid through the two apertures and gel carried within the recessed portion;

at least one support member for said U-shaped element, said support member disposed between said U-shaped element and the recessed portion to provide support for said U-shaped element; and

at least one elongated straight element positioned adjacent said U-shaped element and within the recessed portion to define a second continuous path for fluid within the gel separate from the first continuous path.

7. An apparatus for use in the process of immunoelectrophoresis where a gel is useable as a support medium, comprising:

a frame defining a recessed portion therein for carrying gel, said recessed portion having at least one aperture communicating the recessed portion with an outer surface of the frame;

at least one first substantially straight element extending through said aperture to define a first path for fluid through the aperture and gel carried within the recessed portion to facilitate the introduction of chemical constituents into the gel carried within the recessed portion at the first path; and

at least one second substantially straight element disposed within and traversing at least part of the length of the recessed portion to define a second separate path for fluid to facilitate the introduction of additional chemical constituents into gel carried within the recessed portion at the second path.

8. An apparatus for use in the process of immunoelectrophoresis where gel is carried as a support medium for analysis, comprises:

a frame defining a recessed portion therein for carrying a gel, said recessed portion having at least one

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aperture communicating the recessed portion with an outer surface of the frame;
 a gel carried within the recessed portion of the frame;
 at least one first filament, said first filament disposed in the gel and extending through the aperture to define a first path for fluid through the aperture and gel carried within the recessed portion to facilitate the introduction of chemical constituents into the gel carried within the recessed portion; and
 at least one second filament, said second filament disposed within the gel and traversing at least part of the length of the recessed portion to define a second separate path for fluid to facilitate the introduction of additional chemical constituents into the gel carried within the recessed portion.

9. The apparatus as defined in claim 8, wherein the second filament is elongated and substantially straight.

10. The apparatus as defined in claim 8, wherein the recessed portion has two apertures and the first filament

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is U-shaped and extends through the gel at the recessed portion and through said two apertures in the recessed portion of the frame to define a U-shaped first path for fluid through the gel.

11. The apparatus as defined in claim 10, further comprising support means for supporting the U-shaped first filament within the recessed portion.

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U.S. Cl. X.R.

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