United States Patent

[11] 3,615,257

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[54] **FILTER CASSETTE AND HOLDER THEREFOR**
18 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** **23/292,**
210/447, 210/450, 248/94, 23/259
[51] **Int. Cl.** **B01d 23/28,**
B01l 11/00
[50] **Field of Search** 23/292;
210/232, 447, 450, 453; 248/94

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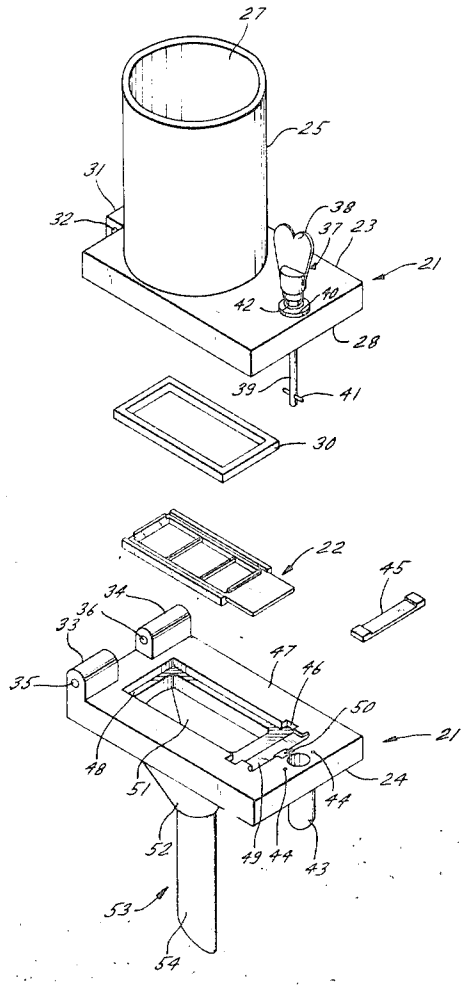
ABSTRACT: Filter cassette which basically includes a base frame composed of a bottom and extending sides from a portion of the perimeter of the bottom to form a chamber for receiving a precut filter. The bottom has means which aids in supporting the filter within the chamber and aids in permitting the fluid to drain from the underside of the filter. The base frame also has means upon it for mounting a resilient retaining frame. The retaining frame has a central opening and is adapted to be resiliently mounted upon the base frame. The base frame and the retaining frame cooperate to retain the filter between them in the chamber while permitting fluid to pass through the filter. A holder is provided to support the cassette during the filtration process.



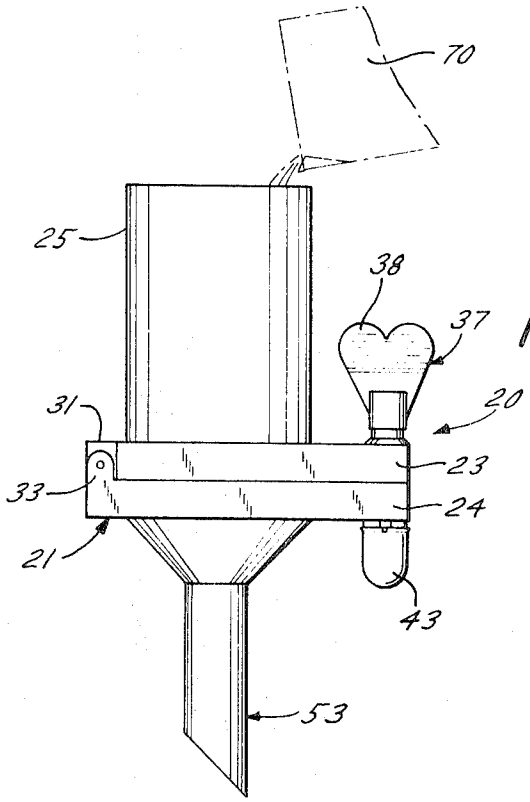


FIG. 1

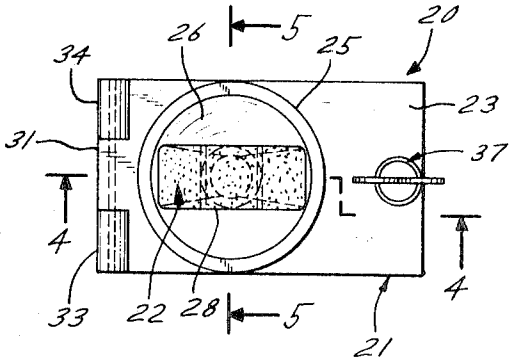


FIG. 3

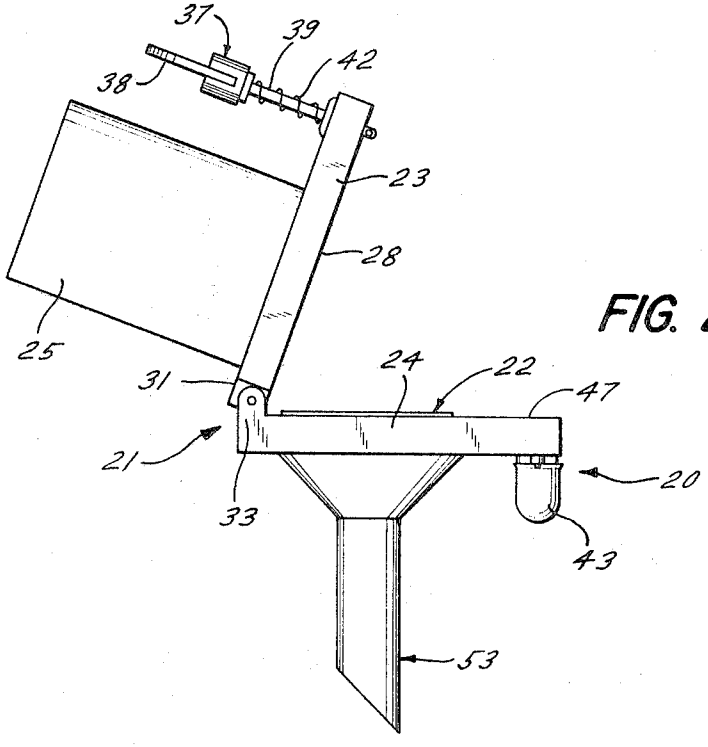


FIG. 2

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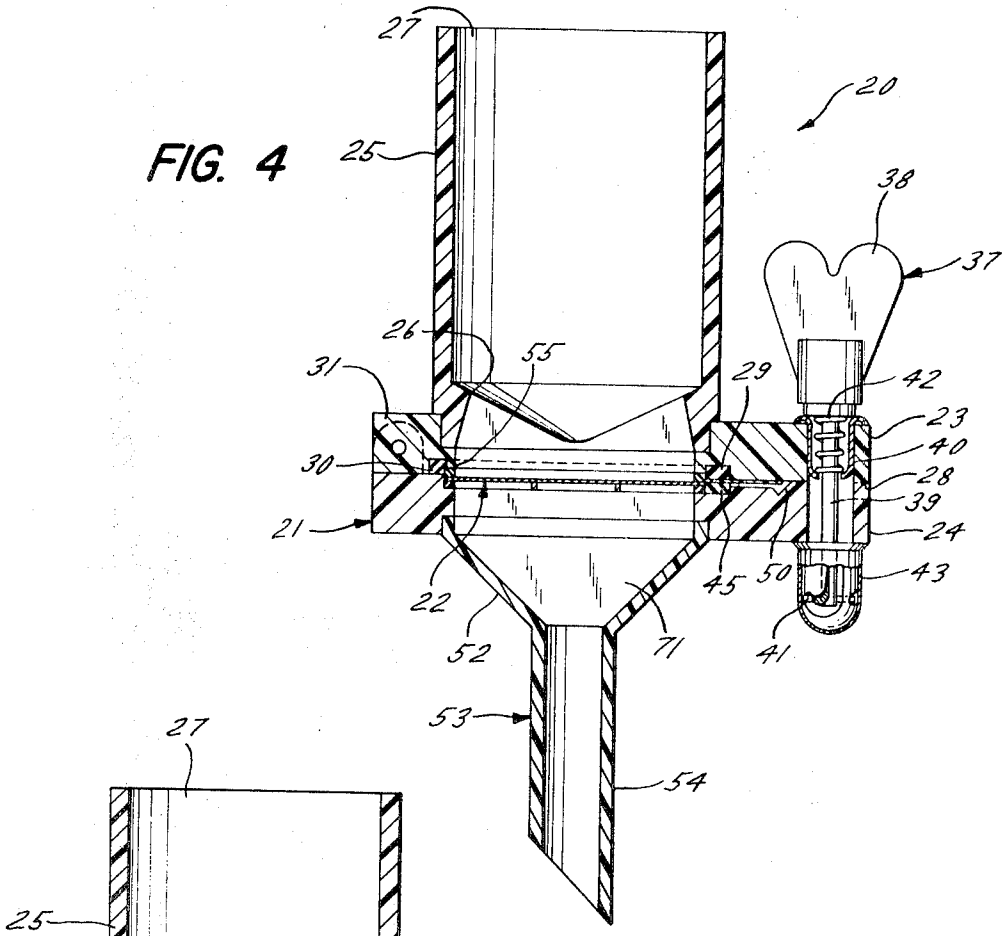
FIG. 4



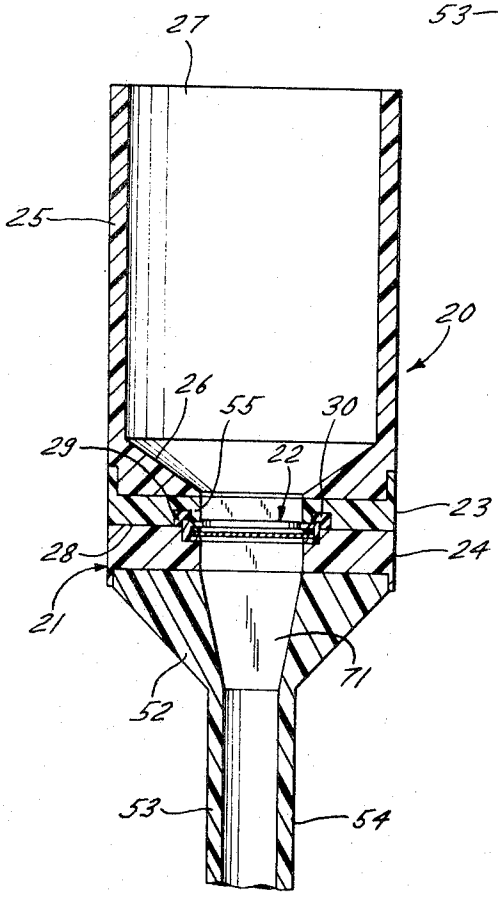


FIG. 5

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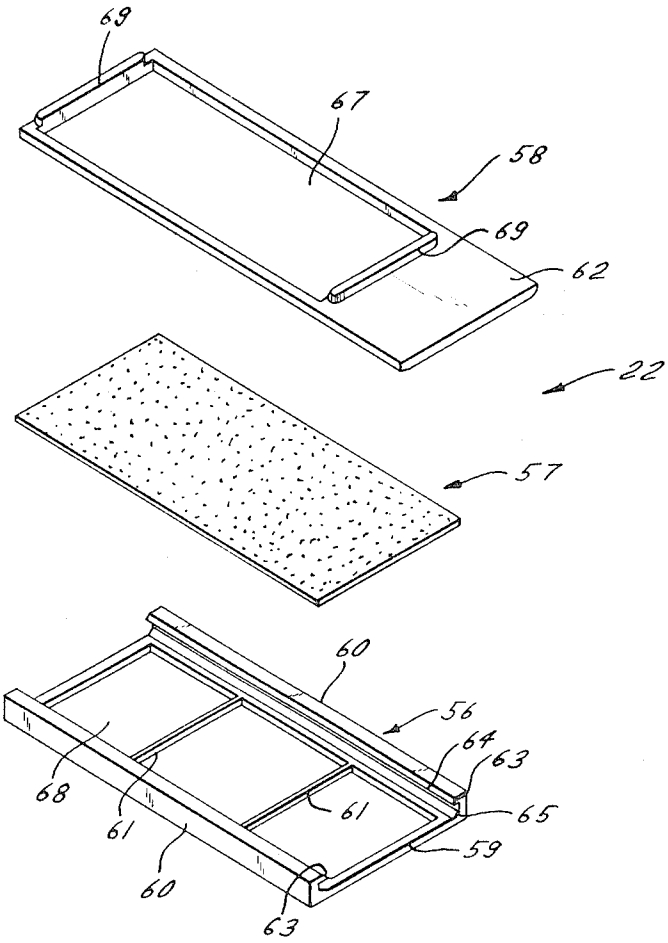
FIG. 7



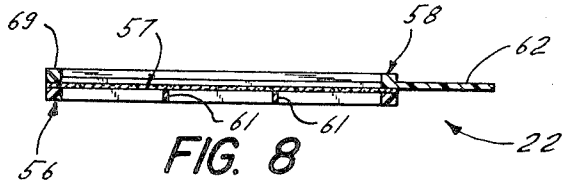


FIG. 8

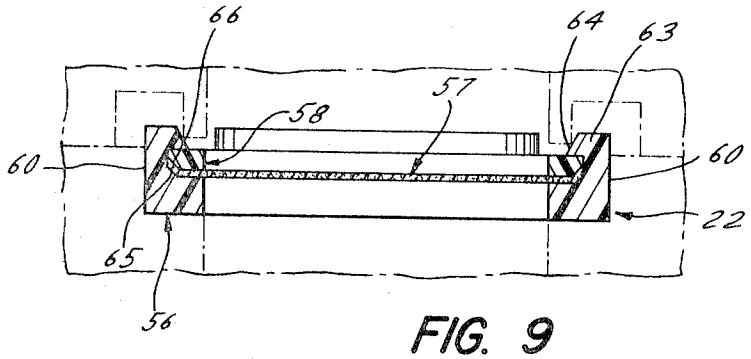


FIG. 9

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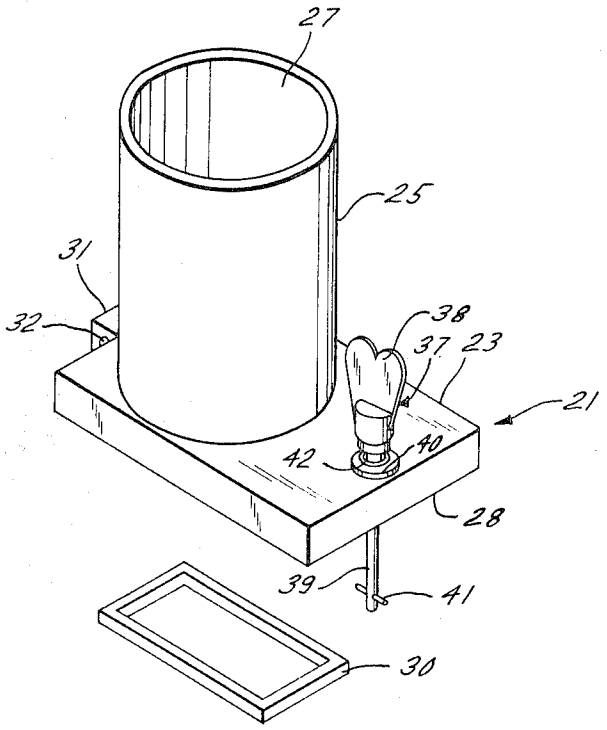
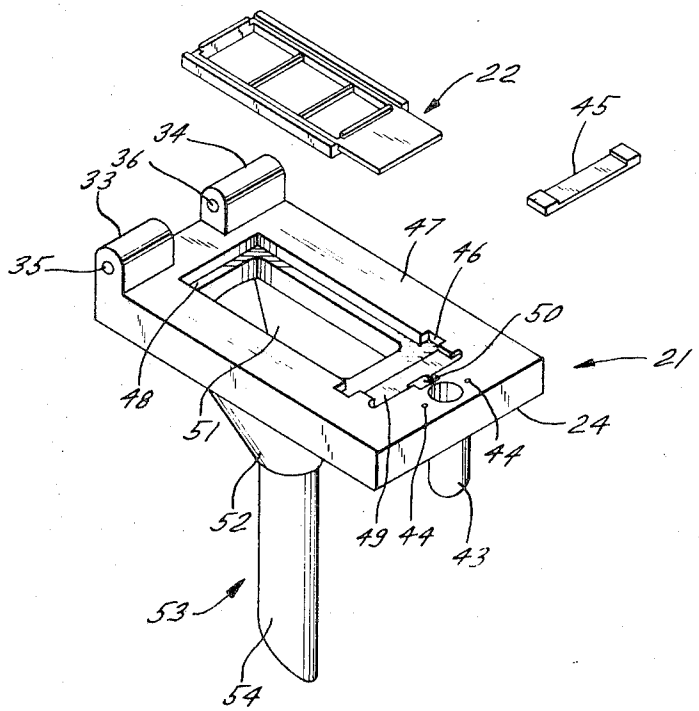


FIG. 6



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FILTER CASSETTE AND HOLDER THEREFOR

BACKGROUND OF THE INVENTION

During normal laboratory procedures, when a liquid is to be filtered, the technician must cut and shape a piece of filter material and mount it in a frame particularly designed to receive the frame and filter. The time required to cut and mount the filter in the laboratory is a time-consuming and annoying process. Furthermore, when the filter material is removed from the holder being used in the particular filtering device in use, often special devices such as forceps, clamps and similar mechanical devices are required to hold the filter while transferring and processing the sediment contained thereon so that the filter is not contaminated by the fingers or hands of the laboratory technician. Naturally, the filter can also be contaminated by the technician's hands when it is first loaded into the frame of the filter device to be used. When the same frame is being used for a consecutive series of filter samples, although a different filtering material is recut and placed within the frame there is always the danger of cross-contamination of samples from different patients due to continuous contact with the same frame. In the alternative, the frame must be repeatedly sterilized for each individual sample which obviously is another time-consuming factor. The excessive amount of handling of the filters during cutting, in placing the filter material within a frame, in removing the filter material from the frame and in examining the sediment contained on the filter gives rise to many instances of tearing or rupturing of the filters with consequent loss of the specimen. After the specimen has been obtained on the filter material, the filter must generally be cut a further amount in order to fit the smaller microslides on which the filter is to mounted for study of the specimen. Naturally, this further cutting gives rise to a greater possibility of contamination or tearing or rupturing of the filter.

There are also existing problems with filter holders in common use, for instance, it is a problem to provide sufficient support for the filter during the filtering operation without causing clogging of the filter surface. Furthermore, during various process steps of the filter material, it is important that along with added support to the filter structure, the filter be protected from excess movement which is also prevalent with many common types of holding devices which could produce cross-contamination of specimens. Existing frames also are often designed with dimensions of such large cross section as to allow the stain applied to the filter to carry over.

It should also be kept in mind that many of the frames in existence are of the round type which naturally must have round filter sections cut to fit them. Therefore, when the fluid has been filtered and it is desired to view the specimen, the round filter must be cut to fit the normally rectangular slides thereby creating a certain amount of waste of filter and specimen which must be cut from the round filter and discarded.

Another prevalent problem in the filter holder art, is the fact that the filter holders are not designed to hold a large variety of different thickness filter material such as from very thin materials to more heavier types like the heavier macerated or built-up filters.

In regard to the nondisposable types of cassettes on the market, these generally could give rise to cross-contamination between patients and require thorough washing to remove cellular material or even sterilizing. Furthermore, they are often constructed of expensive material which naturally does not lend itself to disposability.

I short, it would be extremely advantageous in the art if a filter cassette could be provided which would be preloaded by the manufacturer, be precut to fit a standard microslide, the frame capable of holding substantially all of the filter before, during and after the filtration process, provides extreme ease in handling over other conventional methods, is economical, and results in higher quality of work. Furthermore, a holder specifically designed to receive such a cassette for filtration procedures would be advantageous.

SUMMARY OF THE INVENTION

A filter cassette which includes a resilient base frame having a bottom and sides extending from a portion of the perimeter of the bottom to form a chamber into which substantially all of a precut filter may be placed. The bottom is constructed so as to support a filter and also permit the filtrate to pass therethrough. The base is constructed with means for mounting a resilient retaining frame. The retaining frame has an opening and is adapted to be removably resiliently mounted on the base frame. The base frame and the retaining frame together cooperate in retaining the filter therebetween within the chamber and to permit fluid to be introduced to the filter through the central opening in the retaining frame and the filtrate to be removed from the cassette through the base frame.

A holder for the cassette is also provided including a top portion and a bottom portion. The top portion includes a fluid receptacle on the upper side which has an opening therein to receive fluid for filtration. There is also a second opening on the lower side of the top portion communicating with the receptacle to release fluid for communication with the cassette. The bottom portion has an upper surface which engages with the upper portion when the portions are combined to form the holder. The lower surface of the upper portion and the upper surface of the lower portion define aligned recesses to receive the cassette and sealing means when the portions of the holder are combined. A funnel extends from the lower surface of the lower portion and has an opening therethrough communicating with an opening in the remainder of the lower portion and the opening in the cassette. The openings in the upper portion, the cassette and the lower portion are aligned to permit fluid to flow from said receptacle to said filter and the filtrate to drain from said funnel.

It is amount the primary objectives of this invention to alleviate the above-discussed problems in the filtering art and to provide a disposable cassette whereby cross-contamination between patients will be reduced, there will be no necessity for thorough washing to remove the cellular material or sterilizing and the cassette can be manufactured economically out of inexpensive material.

Furthermore, the cassette is preloaded by the manufacturer so that in production he will be able to use any commercially available filter. Filters which are difficult to work with in loading filter apparatus will not have to be touched by the consumer, the filters will not be contaminated by dirt, grease or cells from the user's fingers, the filters will not be broken by forceps or other instruments which would have to be used to load the cassette, the disadvantages of bulk handling of large amounts of filter material such as the accumulation of dust contamination will be obviated and waste and discard of bulk filters thus made unusable will also be obviated.

With this device, all filters may be precut to fit a standard microslide. Therefore, the consumer will not have to waste time cutting a larger or round filter to fit a rectangular slide. Furthermore, barely sufficient space is left with the proper sealing of the filter onto the side without wasting specimen examining area, yet allowing the use of the large commercially available cover slip labels. In this manner, the cassette allows the greatest possible examining area per preparation thereby saving preparatory technician's time and microscopic examining cytotechnologist's time, as well as yielding a maximum amount of specimen area to be examine.

The cassette holds the filter firmly, without loss, without waving and specimen disruption throughout the whole filtering, fixing, and staining process. It also provides a convenient method for transferring the filter in all processing steps. By being able to handle the cassette including the frame, the use of forceps and other instruments liable to be damaging to the filter in its transference is avoided. In this manner, breakage and tearing of the filter is avoided and touching of the filter which might add dirt and grease is also avoided.

The cassette proved extreme ease in handling over other conventional methods which saves time for the consumer in handling of the filter. It also permits use of filters which are

difficult to use by conventional manners such as extremely thin materials, collodion membrane, and many others. It is easily adapted to in situ fixation and staining techniques, holds the filters flat with less swelling than in dip staining and is easier to handle than single filters in passing through the various dip stains, loading on microslides for dip stains, loading on clips for dip stains and other steps in normal staining process.

As previously stated, the cassette is economical to produce and it also creates a financial saving in the laboratory in personal time and in filters which may be broken by handling in loading, precessing and mounting.

Use of this cassette also results in higher quality of work in the fact that fingers never touch the filter eliminates the possibility of contamination from the user. Furthermore, as previously mentioned contamination of storage of bulk material, such as from dust, is obviated especially if the cassettes are individually packaged or neatly boxed with dividers whereby the removing of one does not expose the next one to atmospheric contamination materials. All the cells contained on the filter are retained rather than losing a portion of them during processing, such as in dip staining of filters in present practices where they are clipped together and hang loosely. In the same manner, filters which are attached to slides with clips so that they will not hang loosely, result in filters which have cleared areas where there is not stain and where the cellular specimen has been knocked off by the clips. Naturally, this does not occur with the cassette of this invention. In accordance with the procedure where the filters are clipped together so they hang freely which is the classical dip staining technique, the filters pick up cells from other filters since they are allowed to touch one another which is an obvious undesirable characteristic of the process. Once again, this is avoided by the cassette of this invention.

To summarize, time will be saved in handling the filter and loading the filter funnels used in the present filtering methods. Quality is increased by higher specimen retention and a larger area present for examination. All types of filters may be used regardless of how difficult they are to handle or how friable they may be. The cassette lends itself well to design of special filter funnel holders for the saving of time in giving better specimens. It also lends itself well to many of them being placed in a particular rack being used for staining and transporting through staining procedures. Finally, the cassette also lends itself well to automatic staining by mechanical transport and electronic fluid mechanics.

It is also an objective of the invention to provide a holder for the above-discussed cassette which is especially designed to hold the cassette during the filtration process to allow quick and efficient filtering to take place. The holder provides adequate reservoir capacity for specimen collection and a tapered flow pass for fluids to pass from the reservoir into the rectangular entrance over the filter paper. The top and bottom portions are hinged together for ease of assembly, therefore, parts cannot be interchanged and therefore improperly fitted or misplaced as two or more component assemblies can. Furthermore, an integral locking mechanism is provided in the top and bottom portions whereby no clamps are necessary to apply or remove as separate operation. When the holder is closed and the locking mechanism is applied, constant pressure is applied on gaskets surrounding the filter cassette frame to alleviate the danger of leakage of any filter fluid out of the cassette area onto the holder where it may come in contact and contaminate the operator's hands or possibly contaminate another cassette placed in position for a subsequent filtering operation. There are aligned recesses in the top and bottom portions to accept the preassembled filter cassette which is discussed above. Further recesses are provided in order that the proper insulating or gasket material may be positioned around the perimeter of the cassette thereby preventing the fluid from spreading over the cassette frame and reducing the possibility of contaminating the frame. These gaskets also seal against fluid leakage and retain vacuum when the vacuum filtration technique is to be employed.

The holder also contains a tapered bottom funnel section for fast removal of fluid after it passes through the filter. A straight section of funnel is provided at the bottom for ease of attachment of a rubber hose for use in the vacuum filtration process in common laboratory procedure. Finally, means are provided on the base for assisting in removal of the cassette from the holder after the filtration process is completed. The design of the holder includes utilizing high volume, mass production, injection molding techniques to produce a low-cost plastic holder.

With the above-discussed objects in mind, amount others, reference is had to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** is a side elevation view of the assembled filter holder and cassette of this invention with a fluid to be filtered being shown poured into the holder in phantom;

FIG. **2** is a side elevation view thereof with the holder being in the opened position so as to expose the filter cassette for removal;

FIG. **3** is a top view thereof;

FIG. **4** is a sectional side elevation view thereof taken along the plane of line **4—4** of Fig. **3**;

FIG. **5** is a sectional end elevation view thereof taken along the plane of line **5—5** of Fig. **3**;

FIG. **6** is an exploded perspective view of a filter cassette and holder therefor of this invention;

FIG. **7** is an exploded perspective view of a filter cassette of this invention;

FIG. **8** is a sectional side elevation view of a filter cassette of this invention; and

FIG. **9** is a fragmentary sectional end elevation view of the filter cassette and holder of this invention with the filter cassette shown positioned within the holder for the filtration process.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The filter cassette and holder combination **20** is depicted in assembled form in Fig. **1–6**. The combination is made up basically of the holder **21** and the filter cassette **22**. FIGS. **7–9** show the filter cassette **22** in its assembled and disassembled form. The details of cassette **22** will be discussed in detail at a later point in this disclosure. FIG. **6**, the exploded view, displays the individual parts which comprise combination **20** in disassociated form so that they may be studied individually. For descriptive purposes, the holder structure will be discussed in detail initially.

In FIG. **6**, it can be seen that holder **21** comprises two basic parts, a top portion **23** and a bottom portion **24**. Extending from the upper surface of top portion **23** is a cylindrical fluid receptacle **25** which is of an adequate reservoir capacity for the specimen to be filtered. It may be also noted from FIG. **4** that reservoir **25** has a tapered lower portion **26** which facilitates the flow path from fluids from the reservoir into the rectangular entrance and over the filter paper. Reservoir **25** has an opening **27** at its upper end through which the filtrate may be poured as shown in FIG. **1** and a rectangular opening extending from its tapered surface **26** through the remainder of upper portion **23** so that a rectangular opening is present on the undersurface **28** of upper portion **23**. Rectangular opening on the undersurface of upper portion **23** is of substantially the same size and configuration as the exposed filter paper surface in cassette **22**. Extending around the perimeter of the rectangular opening in undersurface **28** is a rectangular dent **29** which is of sufficient size to receive gasket **30** which facilitates the formation of a sealing surface on the upper side of the cassette when it is properly positioned within the holder. Gasket **30** may be of rubber or any similar type of common sealing material.

Additionally, extending laterally from the surface of upper portion **23** is a projection **31** having a bore therethrough

which forms a portion of the hinge connection with lower portion 24. Projection 31 will fit between two upwardly extending projections 33 and 34 on lower portion 24 when upper portion 23 is aligned with lower portion 24. The rectangular lower surface of upper portion 23 is designed to substantially mate with the rectangular upper surface of lower portion 24. Upwardly extending projections 33 and 34 have bores 35 and 36 extending therethrough and aligned so that they will be aligned with bore 32 in projection 31 when the upper and lower portions are assembled. A pin is the positioned continuously through bores 32, 35 and 36 so as to form a permanent hinge connection between upper portion 23 and lower portion 24. It should be noted that the upper surfaces of projections 33 and 34 on lower portion 24 have an arcuate configuration to facilitate the opening and closing hinged movement of upper portion 23 with respect to lower portion 24. With this permanent hinge design of the top and bottom portion connection leads to ease of assembly. Furthermore parts cannot be interchanged and, therefore, improperly fitted or misplaced as two or more component assemblies could be.

Also located on upper portion 23 is a suitable locking mechanism 37 which consist basically of a rotatable handle 38 extending upwardly from upper portion 23 and a stem portion 39 which extends through bore 40 in upper portion 23 and downwardly into a receiving area in lower portion 24. A transverse pin 41 is mounted near the lower end of stem 39 and provides the locking surface when handle 38 is properly rotated after upper portion 23 and lower portion 24 have been combined. A spring 42 is mounted in bore 40 and in surrounding relationship to stem 39. Spring 42 is positioned so that when handle 38 is grasped and stem 39 extended into the receptacle area of lower portion 24 and compressed slightly and rotated, spring 42 will bias locking assembly 37 upwardly so that transverse pin 41 forms a locking engagement with the proper surface in lower portion 24 to prevent the lower and upper portions of the holder from being displaced from one another and into tight engagement so that a seal is preserved around the perimeter of the cassette located between the upper and lower portions thereby preventing any fluid or filtrate from escaping from the filter area. There are no clamps to remove or apply as a separate operation. The locking mechanism is integrally engineered into the top and bottom portions and designed so that application of constant pressure on the gaskets and filter cassette frame is maintained when the holder is in the closed position.

Turning to lower portion 24, the cylindrical hollow receiving pit 43 for stem 39 and transverse pin 41 is riveted to lower portion 24 by means of rivets 44 and is in alignment with the upper locking assembly 37. A keyway is present in the lower portion of pit 43 to receive transverse pin 41 in one direction and when pin 41 extends into the keyway and handle 38 is rotated the undersurface of the keyway portion of pit 43 forms a cam surface and will cause pin 41 to bear tightly against the surface to form a locking engagement therewith which is facilitated by the bias presented by spring 42 which biases handle 38 upwardly. In this manner, a constant pressure is achieved on the holder so that constant pressure is present on the gaskets and the cassette 22. It should also be noted that in addition to gasket 30 which fits into detent 29 in the undersurface of upper portion 23, a gasket 45 of rectangular configuration is designed to fit into detent 46 in upper surface 47 of lower portion 24. Gasket 45 may also be of a rubber material as is gasket 30 and combines with gasket 30 to aid in ensuring a locking and tight engagement with all portions of the cassette when properly positioned in the holder.

It may also be noted that upper surface 47 of lower portion 24 contains a rectangular dent 48 which is of sufficient size to receive cassette 22 and to be aligned with detent 29 holding gasket 30 so that these combined recesses in the top and bottom portions form a sealed chamber for cassette 22. The filter area of cassette 22 is then in alignment with the rectangular opening in the undersurface 28 of upper portion 23 so that the filter fluid may contact the majority of the surface area of the filter during the filtration process. It may also be noted that lower portion 24 contains an additional extended recess 49 which is present to receive a portion of the cassette 22, the purpose of which will be discussed at a later point in the disclosure. Also, on the upper surface 47 of lower portion 24 is a depression 50 which facilitates the removal of the cassette by hand after the filtration process is completed. It allows the user to manipulate his fingers under the cassette and remove it from recess 48.

A rectangular opening 51 extends downwardly from upper surface 47 and is roughly of size and configuration of the filter area of cassette 22 so that the filtrate may pass therethrough and into the upper portion 52 of funnel 53. Funnel 53 is integrally molded with the remainder of lower portion 24 and provides an exiting means for the filtrate. Upper portion 52 of funnel 53 has a tapered configuration for fast removal of the fluid after it passes through the filter. On the lower portion 54 of funnel 53 is a straight section which is designed for attachment of a rubber hose for use in a vacuum filtration process where the holder is to be attached to a vacuum source.

Gaskets 30 and 45 are previously stated combine to assist in maintaining the tight sealing engagement to prevent loss of fluid during the filtration process by means other than through the filter paper. An additional safeguard in this regard is the presence of the channel ribs 55 in undersurface 28 of upper portion 23 which are present between the rectangular opening in undersurface 28 and the detent 29 in which gasket 30 is positioned. These channel ribs 55 assist in directing the fluid flow over the filter paper. They also aid in keeping the fluid from spreading over the cassette frame thereby reducing the possibility of contaminating the frame. The gaskets seal against fluid leakage and retain the vacuum when this technique is utilized.

The overall design of holder 21 is such that high volume, mass production, and injection molding techniques are utilized to produce a low-cost plastic holder for filtration processes.

Turning to the construction of cassette 22, FIGS. 7–9 best depict the salient features of this group of parts of the assembly. Cassette 22 is comprised of a base frame 56, a precut piece of filter medium 57 and a snap-in retaining frame 58. As previously discussed, the filter medium 57 is precut and placed within cassette 22 by the manufacturer so that the technician in the laboratory need not be bothered with cutting and fitting of the filter to the filtering apparatus. The cassette is amenable to many different types of filter materials, some of which are esters of cellulose, nylon, cellulose acetate, polyvinyl chloride, polycarbonate, polyvinyl fluoride, and regenerated cellulose. The dimensions of base frame 56 and snap-in retaining frame 58 may be adjusted to accommodate any of a variety of different filter thicknesses prior to assembly in the factory. Width and length dimensions may also be adjusted if it is necessary.

Cassette 22 is preassembled with the filter in the factory as previously mentioned so that it may be used only once and then disposed off thereby alleviating the problem of resterilization and reconditioning of filter frame holders previously known and used in the art. The low cost of the cassette as manufactured in the factory to predetermined specifications is aided in the base frame 56 and retaining frame 58 may be constructed of any common type of plastic material normally well known and used in the art. The result is a preassembled cassette which is of low cost and economic construction thereby lending itself to multiple manufacture and sale and consequent disposability after single use.

Base frame 56 is of a rectangular configuration as is retaining frame 58 and precut filter 57. Base frame 56 consists of a rectangular bottom portion 59 which has upstanding side members 60 extending along both of its longer bottom portions so as to be in parallel and spaced relationship. A pair of transverse members 61 are present in connection with bottom portion 59 of base frame 56 and are parallel-spaced relationship with each other and with the shorter end portions of bot-

tom 59. In this position, they are in relative perpendicular relationship to upstandings sides 60. These transverse crossmembers 61 form a gridlike surface with the remainder of base frame 56 on which filter 57 rests. In this manner, bottom 59 forms a supporting surface for filter 57 as well as allowing the passage of filtrate through the bottom of the cassette and through the majority of the exposed surface of filter 57. These transverse supporting ribs 61 are helpful in providing additional support for the thin filter paper when it is exposed to vacuum procedures.

Retaining frame 58 contains an extension 62 which extends from one end thereof to form a grasping surface or handle to facilitate the user's handling of the cassette 22. The remainder of retaining frame 58 other than extension 62 is of substantially the same size as rectangular base frame 56 so that when base frame 56 and retaining frame 58 are combined extension 62 extends laterally therefrom. The previously discussed recess 49 in lower portion 24 of holder 21 is designed to receive extension 62 when cassette 22 is properly positioned within the holder. This rectangular projection or extension 62 is useful as a gripping surface, as previously mentioned, when performing tests and staining techniques and it also can be used for patient identification by recording number or patient's name on the surface of extension 62. In this manner, the danger of confusion in test slides is minimized during the various process steps. The size of the filter and the cassette is designed to fit on to most common glass slides used today in the laboratory, for instance, a 1×3 glass slide which is commonly used. This naturally eliminates the need for cutting after the cassette has been opened and the filter 57 is to be placed on the slide. It will naturally fit the glass slide and all of the sample present on filter 57 will be preserved.

The upwardly extending sides 60 extending upwardly from the longer portions of bottom 59 combine with bottom 59 to form a chamber into which filter 57 may be placed when the cassette 22 is assembled. To facilitate assembly of cassette 22, an inwardly projecting lip 63 extends from each side 60 so as to form a retaining surface. The upper portion 64 of lip 63 is beveled to facilitate the snapping in of the retaining frame 58 when the cassette is assembled. The resilient nature of the plastic cassette facilitates the snapping in of the retaining frame under lip 63 with the precut filter 57 positioned between bottom 59 and retaining frame 58. This provides the unitary construction of cassette 22 and the ease of assembly. The bevel on upper surface 64 of lip 63 is generally of approximately a 45 degree angle which adequately aids in the assembling procedure.

On the inner surface of the corner where sides 60 engage with bottom 59 is a beveled surface 65 which mates with a similar beveled surface 66 on the underside of retaining frame 58 to facilitate the positive holding and locking of filter 57 in position between base frame 56 and retaining frame 58. Generally approximately a 30 degree angle will work adequately for this purpose.

It should also be generally noted that base frame 56 and retaining frame 58 have central rectangular openings 68 and 67 respectively which provides the maximum surface area of exposure for filter 57 to receive the fluid to be filtered. To aid in this regard only two transverse ribs 61 are provided, although more may be, so that proper support is provided while the cassette is under a vacuum and yet draping of the filter around these transverse supports is minimized with only two supports 61 present. It is readily apparent that this draping action will cause blank spots on the filter paper where insufficient specimen will be collected, and will also have a deleterious effect on the uniform collection of specimen across the surface area of the filter 57.

Turning to consideration of retaining frame 58 again, on the upper surface of the two shorter sides of the frame are raised ribs 69 in parallel relationship which when retaining frame 58 is snapped into base frame 56 in combining relationship, will provide a means to apply pressure on the ends of the filter paper when the cassette 22 is held in the cassette holder 21. These ribs 69 along with the upper surface of sides 60 combine to form a sealing relationship with gasket 30 around the entire perimeter of cassette 22. This facilitates the retaining of the vacuum during the filtering process and alleviates the danger of leakage as previously discussed.

Cassette 22 is designed to fit into holder 21 such as previously described by merely grasping extension 62 and sliding the entire cassette into position. The filter material is precut and positioned by the manufacturer so that the user in the laboratory need not at any time be concerned with preparing the filter material for the filtration process. A cassette 22 need only be removed from the box of such cassettes supplied by the manufacturer and placed in position within the holder for use and after completion the cassette may be disposed off. Once cassette 22 is positioned within holder 21, the holder may be closed and locked as previously discussed and the fluid to be filtered may be introduced into receptacle 25 through opening 27. This may be done in any common manner such as by means of a beaker 70 as shown in FIG. 1. To facilitate the filtering process, a vacuum source may be attached to the lower end 54 of funnel 53 to draw the filtrate through the openings in upper portion 23 and lower portion 24 of the holder 21 including central bore 71 extending the length of funnel 53 and communication with opening 51 at its upper end and the vacuum source at its lower end. The resultant specimen to be examined is thereby collected on filter 57. A common type of device used for this vacuum filtration system well known in the art is a device known as an Erlenmeyer flask. Naturally, other similar devices well known in the art will work equally well.

After all of the desired fluid has gone through the filtration process, the operator need only unlock locking means 37 and open holder 21 by moving upper portion 23 relative to lower portion 24 in accordance with their hinged interengagement so that cassette 22 may be grasped and removed. Cassette 22 may have been previously marked on extension 62 or may then be marked after the filtration process once again on extension 62 and may then be placed along with other cassettes containing specimens in a common type of rack to proceed through the staining process. Since each cassette is isolated from each other, there is no danger of cross-comtamination of the specimens since none of the filters come in contact with one another. Similarly, the filter being precut to a standard size may be removed from the cassette by merely snapping retaining ring 58 out of position which frees filter 57 for removal from base frame 56. It may be then easily transferred to a similar size common slide for further examining procedures. Although the source of vacuum has been suggested here in order to facilitate the filtration process, naturally the force of gravity will be sufficient to accomplish the same result without the assistance of negative pressure. As discussed above and after a suitable quantity of material has been filtered, the cassette with the filter is removed and is placed in a fixing solution. From the fixing solution, the cassette with the filter is passed through several washings, dehydration and staining steps to properly stain and fix the cellular material for viewing under a microscope. After staining, the filter is removed from the cassette by prying off the snap-in It is then placed on a glass slide where it is mounted in the conventional manner. As stated before, having been precut to conventional sizes it will not be necessary to cut the filter in any manner in order to properly fit it on the slide thereby obviating the problem of waste of specimen caused by cutting away portions of the filter in order to mount it on the slide.

In summary, because the filter is precut and loaded in the frame, the time to cut and mount the filter in the laboratory is eliminated. Furthermore, no special devices, forceps, clamps or other similar devices are required to hold the filter while transferring and processing. Therefore, the filter cannot be contaminated by the fingers or hands of the laboratory technicians or vice versa and since each filter is contained in a separate cassette, the danger of cross-contamination of sam-

ples from different patients is virtually eliminated. Furthermore, since the filter itself is never touched by the user, the danger of tearing or rupturing in handling is substantially eliminated. The filter is designed to fit commonly used size slides accurately and needs no further cutting at any time, and additional size of cassettes and holders can be provided as required. The filter is cut so that it covers all the available space on the common size slides thereby eliminating the waste of specimen as discussed above which allows the greatest possible examining area for preparation.

It should also be kept in mind that the cassette grid bottom surface 59 and transverse ribs 61 provide support for the filter without clogging the filtration process thereby allowing the filtrate to drain freely. Additionally, the transverse ribs 61 give additional support to and avoid excess movement of the filter during the emerging and staining procedure thereby decreasing the danger of contact between filters among other advantages. Furthermore, the cassette frame members are designed with minimum dimensions to avoid stain carryover and, to reiterate, the precutting and mounting eliminates waste of filter material resulting from cutting off sections from round filters while mounting on slides. In this context there is no need for the storage of large bulk volume of filter material which can collect dust and other contaminating media during storage since the cassette can be individually packaged and protected. There is a great savings in time in handling for the preparation and processing since the filter is premounted in the cassette and the cassette allows the use of any common type of filter without special devices for transferring or holding from very thin materials to heavy macerated or built-up filters. The holder is specifically designed to quickly and efficiently receive the cassette, maintain the cassette in a sealed and isolated relationship during the filtering process to alleviate the danger of contamination of the operator or other portions of the frame or holder from those which the fluid should normally pass through and to allow the quick and easy removal of the cassette after the filtration process. The cassette and holder are economical to produce, efficient to use and, therefore, provide a great savings in time and cost to the normal laboratory.

Thus, the above-mentioned objects of the invention, among others, are achieved. The range and scope of the invention are defined in the following claims.

We claim:

1. A disposable preassembled filter cassette adapted for laboratory use and comprising: a resilient base frame having a bottom and side extending from a portion of the perimeter thereof so as to define a chamber for receiving substantially all of a relatively thin precut filter, said bottom including means for facilitating the support of said filter and for permitting fluid draining from said filter to pass therethrough, said base frame having means thereon for mounting a resilient retaining frame, a retaining frame having a ribless central opening therein and being adapted to be removably resiliently mounted on said base frame, and said base frame and said retaining frame cooperating to retain said filter substantially flat therebetween within said chamber and to permit said filter to receive fluid through the central opening for filtration.

2. The invention in accordance with claim 1 wherein said means for facilitating the support of said filter and for permitting fluid to drain from said filter includes at least one transverse member connected between two opposed perimeter members of said bottom thereby forming a gridlike surface on said bottom.

3. The invention in accordance with claim 1 wherein said means on said base frame for mounting said retaining frame includes a lip extending inwardly from the upper surface of each of said sides, the bottom surface of said lip being substantially perpendicular to said sides and spaced from said bottom, and the upper surface of said lip being beveled inwardly to facilitate the resilient mounting of said retaining frame within said base frame.

4. The invention in accordance with claim 1 wherein said cassette is rectangular in configuration and said sides extend upwardly from the longer two perimeter portions of said bottom.

5. The invention in accordance with claim 1 wherein a grasping means extends from the side of said retaining frame to facilitate the handling of said cassette.

6. The invention in accordance with claim 1 wherein said cassette is adapted to be removably mounted in a holder into which a liquid is introduced for filtration.

7. A holder for a filter cassette having a passage therethrough comprising: a top portion and a bottom portion in hinged engagement, said top portion including a fluid receptacle on the upper side thereof having an opening therein to receive fluid for filtration and a second opening on the lower side of the top portion communicating with said receptacle to release fluid for communication with the cassette, said bottom portion having an upper surface which engages said upper portion when said portions are combined to form said holder, the lower surface of said upper portion and the upper surface of said lower portion defining aligned recesses to receive said cassette and sealing means when said portions are combined, said sealing means being positioned so as to apply constant pressure to the perimeter of a cassette placed in the holder to alleviate the danger of leakage from the cassette area after the portions have been combined, a funnel extending from the lower surface of the lower portion and having an opening therethrough communicating with an opening in the remainder of said lower portion and the opening in said cassette, and the openings in said upper portion, said cassette and said lower portion aligned to permit fluid to flow from said receptacle to said filter and the filtrate to drain from said funnel.

8. The invention is accordance with claim 7 wherein said sealing means are rubber gaskets.

9. The invention in accordance with claim 7 wherein said funnel is mounted on a container to receive said filtrate.

10. The invention in accordance with claim 7 wherein there are means on said container to apply a vacuum to said holder to draw the filtrate during a filtration process.

11. The invention in accordance with claim 7 wherein said container is an Erlenmeyer flask.

12. The invention in accordance with claim 7 wherein locking means are mounted on the upper and lower portions so that when the lower surface of the upper portion is engaged with the upper portion of said lower portion said locking means may be engaged to lock said portions in position with a cassette properly positioned therein.

13. The invention in accordance with claim 7 wherein said holder is adapted to be mounted on a container into which a liquid is drawn during a filtering process.

14. The invention in accordance with claim 13 wherein there are means on said container to apply a vacuum to said holder to draw the filtrate during a filtration process.

15. The invention in accordance with claim 13 wherein said container is an Erlenmeyer flask.

16. A filter assembly comprising: 1. a filter cassette including a resilient base frame having a bottom and sides extending from a portion of the perimeter thereof so as to define a chamber for receiving substantially all of a precut filter, said bottom including means for facilitating the support of said filter and for permitting fluid draining from said filter to pass therethrough, said base frame having means thereon for mounting a resilient retaining frame, a retaining frame having a central opening therein and being adapted to be removably resiliently mounted on said base frame, said base frame and said retaining frame cooperating to retain said frame therebetween within said chamber and to permit said filter to receive fluid through the central opening for filtration and 2. a holder for said cassette, said cassette being adapted to be removably mounted in the holder into which a liquid is introduced for filtration, said holder including a top portion and a bottom portion, said top portion including a fluid receptacle

on the upper side thereof having an opening therein to receive a fluid for filtration and a second opening on the lower side of the top portion communicating with said receptacle to release fluid for communication with the cassette, said bottom portion having an upper surface which engages said upper portion when said portions are combined to form said holder, the lower surface of said upper portion and the upper surface of said lower portion defining aligned recesses to receive said cassette and sealing means when said portions are combined, a funnel extending from the lower surface of the lower portion and having an opening therethrough communicating with an opening in the remainder of said lower portion and the opening in said cassette, and the openings in said upper portions, said cassette and said lower portion aligned to permit fluid to flow from said receptacle to said filter and the filtrate to drain from said funnel.

17. The invention in accordance with claim **16** wherein said sealing means are rubber gaskets.

18. The invention in accordance with claim **17** wherein at least one tab extends upwardly from substantially the remainder of the perimeter other than the perimeter from which the sides extend to contact said sealing means and facilitate the sealing of said cassette in position.