

Dec. 11, 1962

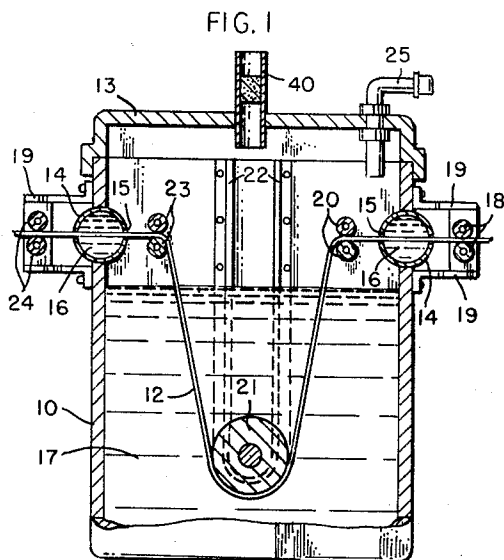
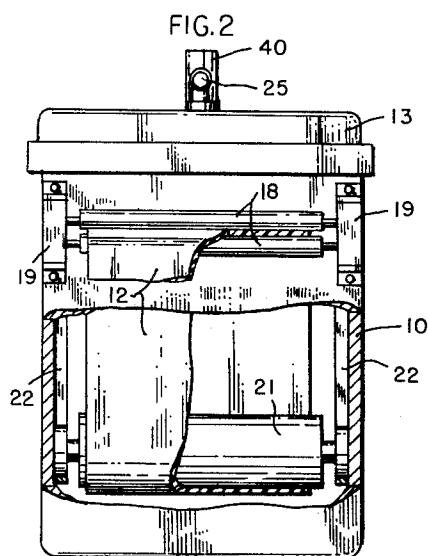
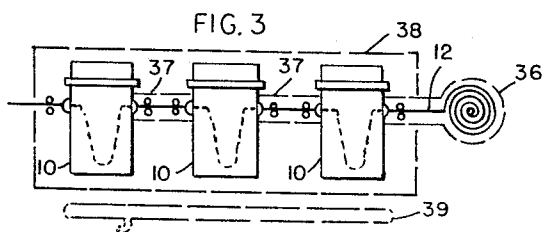
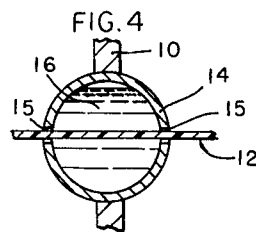
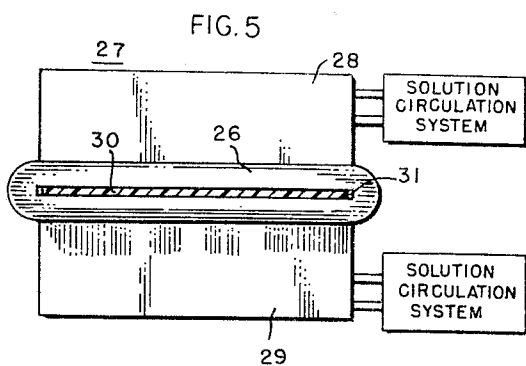
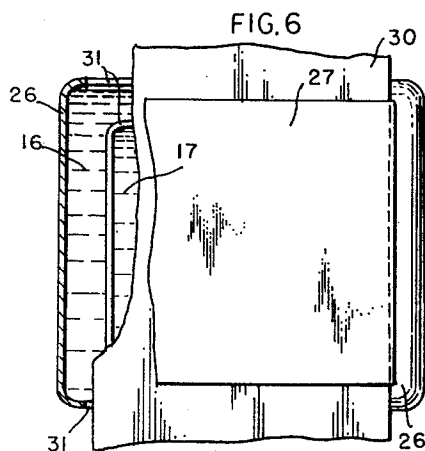
S. L. HERSH

3,067,758

LIQUID ACTUATED SEALING MEANS

Filed April 3, 1962

2 Sheets-Sheet 1



INVENTOR,

SEYMOUR L. HERSH

BY *Jack H. Linscott*

ATTORNEY.

Dec. 11, 1962

S. L. HERSH

3,067,758

LIQUID ACTUATED SEALING MEANS

Filed April 3, 1962

2 Sheets-Sheet 2

FIG. 7

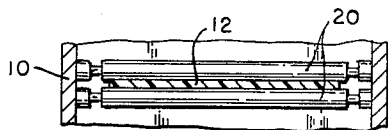


FIG. 8

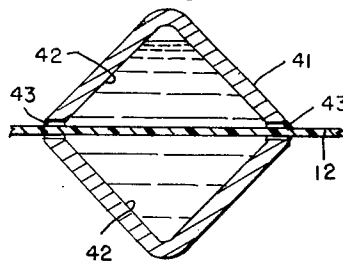


FIG. 9

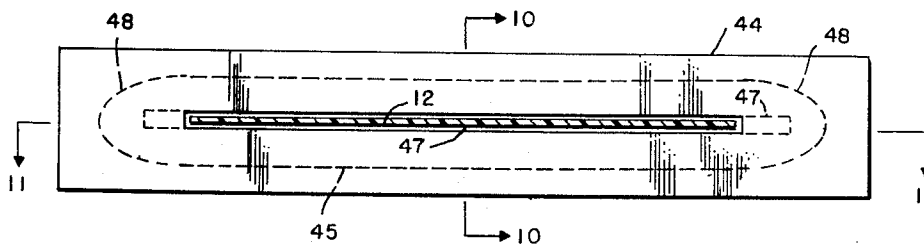


FIG. 10

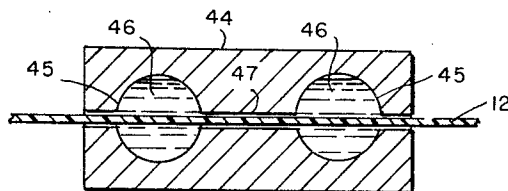
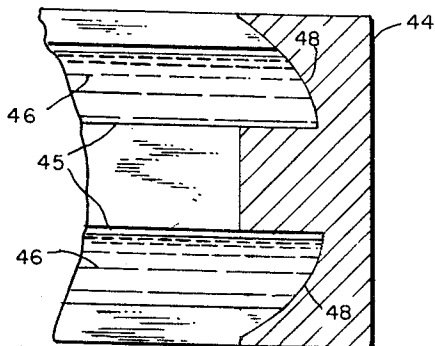


FIG. 11



INVENTOR,
SEYMOUR L. HERSH
BY *Jack H. Lincoff*
ATTORNEY.

1

3,067,758

LIQUID ACTUATED SEALING MEANS

Seymour L. Hersh, 9 Terrence Terrace, Freehold, N.J.

Filed Apr. 3, 1962, Ser. No. 184,865

16 Claims. (Cl. 134-114)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment of any royalty thereon.

This invention relates to a liquid actuated sealing device acting to establish a liquid and gas tight seal between a wall separating the contents of a containing vessel and the outer atmosphere and providing for the passage of a thin sheet or membrane such as a photographic film through the wall without breaking the seal.

It has been attempted to provide a seal having the properties above outlined but prior to the present invention none have been entirely successful. Attempts to do this have heretofore involved the use of wiping contacts of resilient material such as rubber at the access slot. Such devices must press upon the film with substantial pressure and even then a tight seal is not accomplished especially at the edges of the film. Moreover this pressure is not tolerable for many applications. In the case of photographic film such pressure causes scratching and mutilation of the delicate emulsion particularly when the emulsion is wet.

In the present invention the seal is established and maintained by contact of a high surface tension liquid which bridges adjacent surfaces between the wall of a container or any impervious barrier and the film or other element passing through the barrier.

In its broad aspect the invention provides for the insertion of a sheet or strip of thin material through a wall or barrier while sealing off access of liquid or gas between the spaces on opposite sides of the wall. There are many applications wherein the benefits of the invention may be realized. However by way of illustration, it will be described in connection with processing such elements as photographic film wherein the full effectiveness of the invention is realized.

In connection with the processing of photographic film it is necessary to employ one or more containers for the processing solutions into which the film must be immersed. During this procedure the film must be protected from undesirable physical and environmental conditions. With conventional equipment many undesirable influences degrade the quality of the finished film. Oxidation of the solutions from contact with the air is a serious matter since it modifies the action of the developing agents, reducing and changing their normal effectiveness. Moreover when the process involves the continuous feeding of the strip from one bath to another there is the problem of carrying solution from one solution container to another by the strip itself. When this happens solutions become contaminated and must be discarded which is wasteful and expensive.

The practice of the invention corrects such degrading factors. To accomplish this a fluid tight seal of special construction seals the entering and exit slots where the strip enters and leaves the processing tank. All other portions of the tank are or may be fluid tight to provide complete protection of the film.

The structure for providing such seals is briefly described as follows. At the entering and exit points for the film strip, desirably above the level of the solution, sealing units are inserted in opposite walls of the tank. The units are small elongated hollow containers or pockets of a length slightly longer than the width of the film strip. Narrow slits are formed in opposite sides of

2

the containers. The slits extend lengthwise of the units and are about a few thousandths of an inch wider than the thickness of the strip. The container is filled with a liquid having a high surface tension characteristic such as mercury. This liquid must also be unaffected by the solutions and have no chemical reaction with the film or with the material of its container.

The nature of the liquid insures that it will not leak out of the narrow slots and when the film is passed through the slot the body of liquid in the sealing unit provides an effective seal between the film and the wall of the tank and movement of the film strip through the wall will not break the seal because the mobility of the liquid will instantaneously maintain a tight seal at every point of contact between the film and the sealing liquid.

In the system herein described the film enters the tank and is guided down into the solution in a loop conformation and leaves the tank through an exit slit. It will thus be seen that the seal at the exit point of the tank will function to strip the surplus solution from the film as it leaves the tank and that a fluid tight seal is also maintained at both entrance and exit points thus providing for the exclusion of air and the maintenance of an inert atmosphere within the tank by the introduction of an inert gas.

It is a primary object of the invention to provide an access opening in an impervious wall which automatically maintains a tight seal between the wall and a freely movable element insertable in the access opening.

A further object of the invention is to provide an automatically acting seal for an access opening wherein the sealing agent is a high surface tension liquid.

A further object of the invention is to provide a gas and liquid tight seal wherein the seal provides for the insertion of an element and remains completely effective while the inserted element is moved through the seal even though the element may present irregular surface characteristics.

A further object of the invention is to provide a sealing device for an enclosed vessel operative to maintain a gas and liquid tight seal while permitting a sheet like element to be fed from outside into and or from the interior of the vessel outward.

A still further object of the invention is to provide a seal for an access opening wherein the seal is established by a non-wetting liquid contact with the inserted elements.

A still further object of the invention is to provide a seal for an access opening which will function as a surface liquid stripping means and not injure the most delicate surface on the material fed therethrough.

A still further object of the invention is to provide a sealed access opening in a container which will remain completely effective even though the container be submitted to vibration and tipping as in air-borne or ground vehicles.

Other objects and features of the invention will more fully appear from the following description and will be particularly pointed out in the claims.

To provide a better understanding of the invention particular embodiments thereof will be described and illustrated in the accompanying drawings wherein:

FIG. 1 is a vertical cross section through a liquid container embodying the invention.

FIG. 2 is a side elevation of the container in FIG. 1 with portions broken away.

FIG. 3 is a diagrammatic view of a system for serially processing a film in a plurality of steps.

FIG. 4 is a cross section at enlarged scale of the sealing means embodied in the invention.

FIG. 5 is a side elevation of a form of the invention wherein the inserted element divides a liquid or gas tight

3

receptacle into two chambers isolated by a continuous seal.

FIG. 6 is a plan view of the device of FIG. 5, with portions thereof broken away to better illustrate its structure.

FIG. 7 is a detail figure showing the manner in which the inner guidance rolls are journaled.

FIG. 8 illustrates a specialized construction for the sealing units which facilitate threading the strip element through the seal.

FIG. 9 illustrates a modified structure for a sealing unit.

FIG. 10 is a cross section on line 10—10 FIG. 9.

FIG. 11 is a detail cross sectional view taken on line 11—11 FIG. 10 showing a specialized construction of the end portion of the slot and the sealant pockets of the unit shown in FIG. 9.

The principles of the invention may be practiced in a wide variety of applications wherein it is desired to pass a relatively thin sheet or strip of material through an access slot in a wall on the side of a container of any description and to maintain a fluid tight seal between the wall and the inserted strip.

A highly effective application of the invention is its use in connection with the processing a strip materials such as photographic film. It will be understood however that the presentation of such use herein is by way of example only.

For treating photographic film a tank of processing solution is provided such as the tank 10 containing the liquid. The film may require a plurality of different treatments in which case a plurality of tanks are required each containing the required solution. Such an arrangement is shown in FIG. 3 wherein the film is fed into and out of the tanks successively to complete the processing cycle. It is desirable for a number of reasons in certain of such treatment procedures to provide sealing means to exclude the passage of gas or liquid at the access slots in the tanks. The invention provides a highly efficient and novel means for accomplishing such a result. Heretofore a tight seal such as the invention provides was only partially achieved and then only at the expense of subjecting the sheet material to severe abrasion and other undesirable effects.

The tank 10 may have any desired conformation. As shown it is rectangular and is provided with a removable cover 13 which should for certain uses, to be pointed out hereinafter, have a fluid tight connection with the tank.

One or more sealing units 14 having access slots for the strip 12 are provided for each tank. As shown in the drawings two such units are provided for each tank to permit insertion and withdrawal of the strip. The units may have any suitable conformation but desirably are elongated receptacles having an inner chamber and are made of material which is inert with respect to the liquid sealant and the material to be passed through the slots. These units are of a length somewhat longer than the width of the strip 12. Each unit 14 has narrow opposite disposed slots 15 formed in its wall extending lengthwise of the unit and lying upon a horizontal plane passing through the central portion of the unit to permit the strip 12 to pass freely therethrough and the unit is filled with mercury 16 or other high surface tension liquid sealant.

The units are formed integral with or hermetically sealed into openings in the upper portion of the tank wall. If two units are provided they are desirably but not necessarily located in opposite walls of the tank. The slots 15 are only slightly wider than the thickness of the strip 12. The width dimension of the slots should be about 2 to 5 thousandths of an inch wider than the strip thickness and no more than about 10 thousandths of an inch wide. The slots should be slightly longer than the widest strip to be treated. Narrower strips are also accommodated in which case the seal is equally well maintained.

4

Processing solution 17 is placed in the tank up to a level below the units 14 and the strip is threaded through the access slots with a loop thereof extending into the solution 17 as shown in FIGS. 1 and 2. To properly guide the strip it is desirable to provide directional guide rolls desirably both outside and inside the tank. Rolls 18 journaled in brackets 19 feed the strip accurately into the slots 15 and rolls 20 maintain the strip in alignment with the slots as it enters the tank.

To conveniently thread the film the tank cover 13 is removed and a weighted roll 21 is placed over the strip to cause it to loop downward into the solution. Trunnions on the roll 21 move vertically between guide flanges 22 on the walls of the tank to maintain alignment of the roll. Pairs of rolls 23 and 24 guide the film in its path out of the tank through the exit seal 14. Rolls 20 and 23 are pivoted in journals secured to the inside of the wall of the tank as shown in FIG. 7.

A normally capped filling nozzle 25 may be provided for introducing solution as it is consumed or antioxidizing gas may be introduced therethrough into the tank to prevent oxidation of the solution.

It will be evident that the tank remains sealed at all times by the sealing units. The mercury in the unit 14 functions automatically to seal the access slots with the strip therein by maintaining close contact with the strip at every point on its surface. The complete mobility of the mercury follows every minute irregularity in the faces of the strip and its edges whether the strip is at rest or in motion through the slots. The seal is completed at the tank wall by reason of the contact of the mercury with the inner surface of sealing unit chambers. The mercury will not flow out of the slots 15 because of its inherent surface tension characteristics.

Another form of the invention is shown in FIGS. 5 and 6 wherein the sealing unit 26 applied to the tank 27 functions to completely seal off the upper and lower portions 28 and 29 of the tank when a strip 30 is threaded through access slots 31 in the unit 26 which is filled with mercury. Guiding rolls not shown may be employed to guide the strip through the slots as in the device shown in FIGS. 1 and 2.

The unit 26 extends continuously around the four sides of the tank in a flat plane and has its access slots formed in such a manner that the strip 30 may pass completely through the tank in a flat plane. To accomplish this result access slots 31 are cut through both walls of the tube constituting the unit 26 throughout substantially the full length of portions 32 and 33 thereof disposed on opposite sides of the tank and in addition the inner wall of each of the remaining portions 34 and 35 of the tube have slots cut therein in line with the slots in portions 32 and 33 and interconnecting them. Thus the strip when threaded through the slots will seal off the upper section 28 from the lower section 29 and the strip can be treated by two different solutions one in section 28 and the other in section 29, the two solutions acting independently upon opposite faces of the strip simultaneously and the solutions will remain separated from each other.

In this latter form of the invention it will be seen that a sheet may be treated in a variety of ways including the selective independent treatment of either one or both sides of the sheet. One side may be treated with a solution at normal or elevated temperature while its other side is protected against unwanted action due to treatment solution because the solution cannot reach the other side of the strip.

A further feature of the invention is the fact that extremely delicate surfaces on the strip are not scratched or in any way disturbed because of the gentle action of the sealant thereon.

To maintain contact between the faces of the strip 30 and the solutions recirculation systems shown in FIG. 5 may be connected to the respective portions 28 and 29 of the tank 27.

In the use of the invention as the strip is pulled through the tank at a regulated rate the strip is treated by the solution which may be a developer solution acting to develop a latent image in a photographic film strip. During such treatment the tank remains sealed by the units 14 or 26 and in addition the mercury acts as a liquid stripping or squeegee device for removing surface liquid from the strip as it leaves the tank. By so doing the strip is more readily dried after treatment and where a plurality of tanks are used in a series arrangement as shown in FIG. 3 solution from one tank is not carried over to a succeeding tank nor is it spilled and thus wasted and moreover the working areas are thus protected from the harmful action of the spilled solutions.

Sealing of the tanks also protects the strip from light as in the case of photosensitive materials, protection against fogging is achieved without the use of a dark room. The film may be fed directly from a light tight cassette 36 to one of the tanks and if a series of tanks are used the film may pass from tank to tank through light tight channels 37.

As above pointed out inert gas such as nitrogen may be introduced into the sealed system to eliminate oxidation of the solutions by contact with air.

Other sealing liquids may be used instead of mercury. One of which may be Wood's metal which is liquid at a moderately high temperature such as 100° F. Many treatment operations are carried out within this region of temperature in which case the sealing unit may be filled with this material which will form an effective seal. Moreover when the operation is discontinued the apparatus may be allowed to cool to room temperature in which case the liquid will solidify and create a closed immobile system which may be transported and stacked away without regard to careful handling.

There are many alloys of different metals similar to Wood's metal which are liquid at moderately high temperatures and may be used for a sealant. The necessary temperature may be maintained in any suitable manner such as by enclosing the tank or tanks in a heating oven 38 shown in dotted lines in FIG. 3 having a source of heat such as the burner 39. For use at normal room temperature mercury appears to be uniquely suitable as a sealant since its surface tension is 485 dynes per centimeter at 20° C. and it is an extremely mobile liquid.

As the solution in the tank is consumed by the absorption thereof by the strip 12 it is desirable to overcome the lowering of pressure in the tank. This may be done in any suitable manner. One manner to achieve this result is to provide a gas permeable pressure equalizing valve 40 inserted in the upper portion of the tank. In this manner gas pressure in the tank be it air, inert gas or other gas may be maintained at atmospheric level.

FIG. 8 illustrates a modified construction for the sealing units and shows in cross section a specialized shape for the unit chamber. This sealing unit 41 is so formed that its walls are substantially flat and form a substantially prismatic space with its converging walls 42 meeting at the line where the access slots 43 are formed. This structure aids in threading the strip 12 through the sealing unit. The converging walls direct the end of the strip into the exit slot.

Although it has been stated that the sealing units are filled with sealant it should be pointed out that a small space must be provided in the units into which displaced sealant may flow when the strip is inserted. FIGS. 9, 10 and 11 illustrate a modified form of sealing unit 44 wherein there are at least two small parallel chambers 45 containing the sealant 46. The chambers are spaced a short distance apart and provide a double seal which requires only a minimum of sealant. The access slot 47 lies in a plane passing through the chambers. The chambers may be as small as 15 thousandths of an inch in diameter.

This type of sealing unit is desirable where the apparatus in which it is used is subjected to vibration and tipping into positions at substantial angles from the level position such

as in air-borne or land vehicle installations. Since a small space must be left in the chambers to provide for the liquid displaced by insertion of the strip there is at times a degree of endwise movement of the liquid in its chambers. This movement may cause the liquid to be forced out of the access slots when severe tipping is encountered due to the ram-like action of the liquid. The small volume of liquid required in this structure minimizes this ram-like action. To further minimize this action the ends of the chambers may be provided with a tapered contour as shown at 48 in FIG. 11. The contour of the surfaces 48 is designed to minimize the impact of the liquid against the end of the chamber which if flat and extending at 90° transversely to the chambers would tend to cause excessive spattering of the liquid with the possibility that some liquid would escape.

The two chamber construction of the unit 44 is also advantageous in preserving the seal more effectively in instances where the strip presents such irregularities as sprocket holes. In this instance the spacing of the chambers 45 should be such that as the strip containing holes passes through the slot 47 one or the other chamber will constitute a tight seal unaffected by the presence of a hole or other irregularity in the strip. This latter construction is in the nature of a refinement. It has been found by actual use that the structures shown in FIGS. 4 and 8 provide satisfactory performance.

What is claimed is:

1. A fluid tight seal for use between relatively movable elements one of which is an impervious wall and the other is a thin sheet member movable through said wall said seal comprising an elongated tube-like pocket in said wall with its longitudinal dimension substantially parallel thereto and containing a body of liquid sealant having a high surface tension characteristic, said pocket having a pair of oppositely disposed narrow slots formed therein lying in a common plane passing through the pocket, said slots being of a width sufficiently narrow to prevent escape of said sealant and to permit said thin sheet member to freely pass therethrough.

2. A fluid tight seal according to claim 1 and wherein said sealant is mercury.

3. A fluid tight seal according to claim 1 and wherein the sealant is Wood's metal and heating means to maintain the sealant in its liquid state.

4. A fluid tight seal according to claim 1 and wherein the sealant is a metallic alloy having a melting point between 100° and 400° C. and heating means to maintain the sealant in its liquid state.

5. A fluid tight seal for use between relatively movable elements one of which is a fixed impervious wall and the other is a thin sheet or strip movable through said wall comprising an elongated tube like casing hermetically sealed in said wall with its longitudinal dimension substantially parallel to said wall and containing a body of liquid sealant having a high surface tension characteristic, said casing having a pair of oppositely disposed narrow slots therein lying in a common plane at substantially the central portion of said casing said slots being of a width sufficient to prevent escape of said sealant and to permit the said sheet or strip to pass freely therethrough.

6. A fluid tight seal according to claim 5 and wherein the sealant is mercury.

7. In combination with an enclosed container, a sealed access opening suitable for the insertion of a thin sheet or strip of flexible material comprising a pocket in the wall of said container having a liquid sealant therein, said sealant having a high surface tension characteristic, said pocket having a pair of elongated slots oppositely disposed in the walls thereof, said slots being sufficiently narrow to prevent said sealant from escaping from said pocket and permitting said thin sheet or strip to pass freely therethrough whereby contact of the sealant with its pocket wall and with the strip maintains the sealed state of the container.

7

8. A fluid tight seal according to claim 7 and wherein said sealant is mercury.

9. The combination according to claim 7 and wherein at least two access openings are provided to permit insertion in and withdrawing said strip from said container.

10. A fluid tight seal according to claim 9 and wherein the sealant is a metallic alloy having a melting point between 100° and 400° C. and heating means to maintain the sealant in its liquid state.

11. A fluid tight seal for use between relatively movable elements one of which is a closed container and the other is a thin sheet of flexible material movable through the container, said seal comprising a continuous tube-like pocket system extending completely around the container and incorporated in the sides thereof, said pocket containing a high surface tension liquid sealant and having formed in the walls thereof a system of narrow slots lying in a common plane coinciding with the general plane of the pocket, said slots being of a width sufficiently narrow to prevent escape of said sealant and to permit said strip to freely pass therethrough, said slots being formed in opposite walls in two opposite portions of the pocket system and formed in the inner wall only of the remaining portions of the pocket system.

12. A fluid tight seal according to claim 11 and wherein said sealant is mercury.

8

13. A fluid tight seal according to claim 11 and wherein the sealant is Wood's metal and heating means to maintain the sealant in its liquid state.

14. A fluid tight seal according to claim 1 and wherein said sealing means is provided with converging substantially flat inner walls to guide said strip into the exit slots therein.

15. A fluid tight seal according to claim 1 and guide rollers between which said strip passes to guide said strip into a plane corresponding to the plane of said access slot.

16. A fluid tight seal for use in an impervious wall between two sealed off spaces comprising a pair of small parallel spaced elongated chambers formed in said wall, an access slot in said wall passing through both chambers, a liquid sealant in said chambers having a high surface tension characteristic and being non-adherent to sheet material passed through said access slot, said slots being of a width sufficient to freely pass said strip and of a width small enough to prevent escape of said sealant.

References Cited in the file of this patent

UNITED STATES PATENTS

2,647,296	Shive	Aug. 4, 1953
2,905,522	Fahringer	Sept. 22, 1959