Dec. 11, 1956 J. MERCIER 2,773,511

PRESSURE ACCUMULATOR

Filed Dec. 23, 1952

FIG. 1.

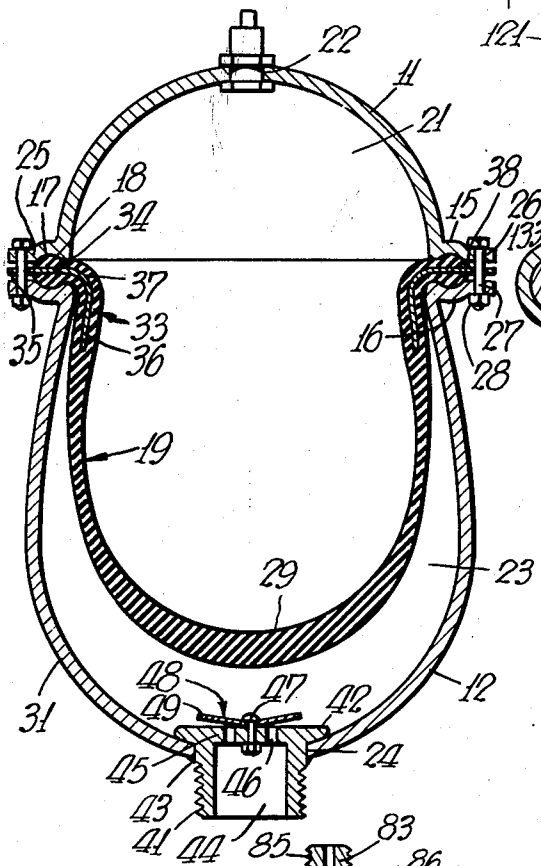



FIG. 2.

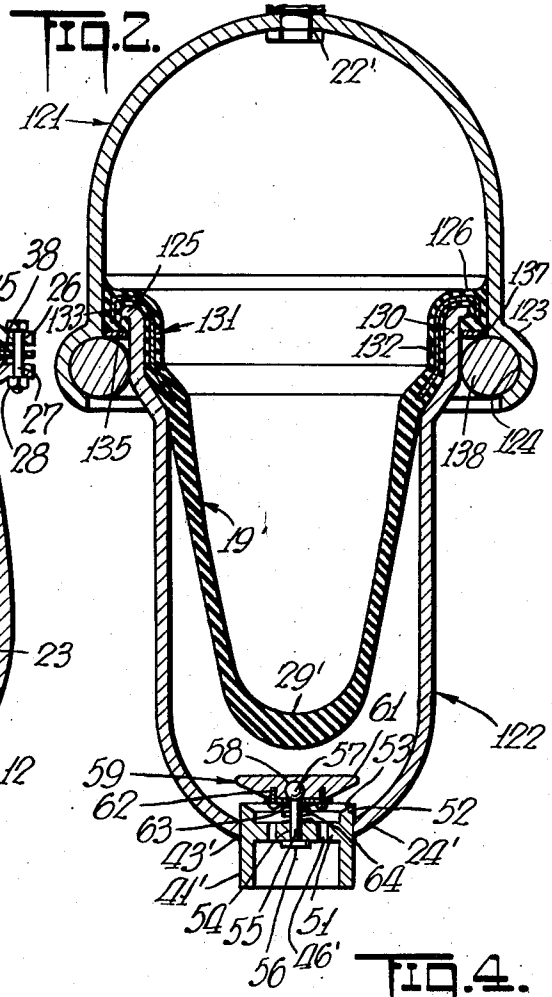



FIG. 3.

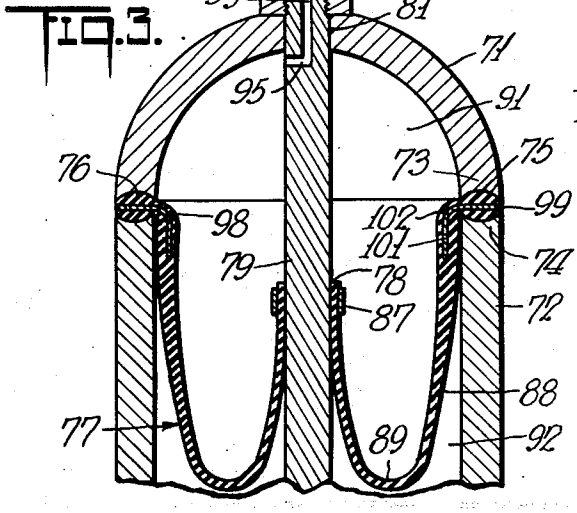
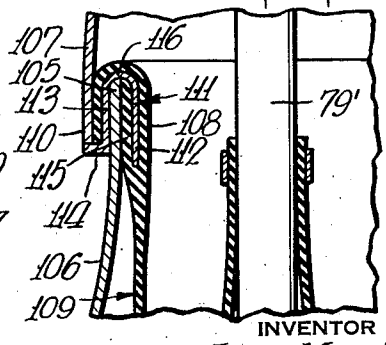



FIG. 4.




INVENTOR
Jean Mercier
BY
Dean Fairbank & Hirsch
ATTORNEYS

United States Patent Office 2,773,511 Patented Dec. 11, 1956



2,773,511

# PRESSURE ACCUMULATOR

Jean Mercier, New York, N. Y.

Application December 23, 1952, Serial No. 327,602

3 Claims. (Cl. 138—30)

This invention relates to pressure accumulators, more particularly of the type having two shells with a deformable partition therebetween.

It is among the objects of the invention to provide a pressure accumulator of the above type that may readily be fabricated at relatively low cost and in which the deformable partition will be securely clamped at its periphery between the rims of the shells without excessive compression of said periphery with resultant weakening thereof, yet will be retained therebetween without likelihood of inward displacement of such periphery due to the pressure against the partition which might cause leakage between the gas and liquid chambers of the accumulator with resultant inoperativeness thereof.

Another object is to provide a pressure accumulator of the above type in which the portion of the deformable partition adjacent the rim thereof, which is clamped between the two shells, will have substantially no sharp bending stress or strain imposed thereon which might cause weakening of the partition at such region with resultant tearing of the partition, regardless of the number of times the partition is expanded and contracted due to charging and discharging of the accumulator with continuous use.

Another object is to provide a valve for the liquid port of the accumulator which, upon initial engagement by the expanding partition will only partially close the liquid port to prevent extrusion of the partition and only when substantially all of the liquid has been expelled from the accumulator by the expanding partition will completely close the liquid port of said accumulator.

According to the invention, these objects are accomplished by the arrangement and combination of elements hereinafter described and particularly recited in the claims.

In the accompanying drawings in which are shown one or more of various possible embodiments of the several features of the invention,

Fig. 1 is a longitudinal sectional view of one embodiment of the invention, and

Figs. 2, 3 and 4 are views similar to Fig. 1 of other embodiments of the invention.

Referring now to the drawings, the accumulator shown in Fig. 1 desirably comprises a pair of substantially cup-shaped shells 11 and 12 of any suitable rigid material capable of withstanding relatively high pressures.

Each of the shells 11 and 12 desirably has an annular rim 15 and 16 respectively extending laterally outward from the mouths thereof. Each of the annular rims 15 and 16 has an annular depression 17 therein between which, when the rims 15 and 16 are in juxtaposition, may be positioned the thickened peripheral rim 18 of a flexible and deformable partition 19 of resilient material. The partition 19 divides the accumulator into two sections which define a gas chamber 21 having a port 22 in the end wall of shell 11 for example, and a liquid chamber 23 having a port 24 in the end wall of shell 12. The rims 15 and 16 are conformed so as to have a



portion 25 thereof extending laterally outward from the annular depression 17 therein. Each of the extending portions 25, which lie in parallel planes as shown, desirably has a plurality of openings 26 therethrough which are spaced therearound. These openings 26 in rims 15 and 16 when aligned, receive bolts 27 on which nuts 28 may be screwed to draw the rims 15 and 16 together to clamp the thickened periphery of the partition 19 therebetween to provide an effective gas and liquid tight seal.

The resilient partition 19 desirably is a bladder of natural or synthetic rubber which is substantially cylindrical in cross section along the major portion of its length and has a rounded bottom wall 29 of greater thickness than said cylindrical wall portion thereof.

The shell 12 in which the non-inflated bladder 19 normally extends, desirably flares outwardly from the rim 16 thereof to its rounded bottom 31 through which the port 24 extends. Thus, the distance from the outer surface of bladder 19 to the inner surface of shell 12 progressively increases from the clamped periphery 18 of the bladder to its free end 29.

As a result of the shape of the shell 12 and partition 19 above described, as the bladder 19 expands in use of the accumulator to force the liquid in chamber 23 out of port 24, it will progressively engage the shell wall. As a result, no liquid pockets will be formed and substantially all the liquid in the chamber 23 will be expelled therefrom.

As such progressive engagement of the shell by the bladder is set forth in detail in Patent No. Re. #23,437, dated December 4, 1951, and per se forms no part of this invention, it will not be further described.

As the portion of the bladder at and near its clamped rim is under stress due to the deformation of the rubber by the clamping action, means are desirably provided to support the bladder 19 to eliminate extreme bending stress at and adjacent such rim which might cause cracking or rupture of the bladder with resultant inoperativeness of the accumulator.

To this end, an annular supporting member 33 is desirably affixed to the thickened rim 18 and the adjacent wall portion of the bladder 19 preferably by being bonded thereto or molded therein as illustratively shown. The supporting member 33 is of resilient sheet material such as metal or suitable plastic and is substantially L-shaped in cross section. One leg 34 of the supporting member 33 may if desired extend laterally outward beyond the thickened rim 18 of the bladder 19 and defines an annular rim 35 and the other leg 36 extends downwardly into the cylindrical wall portion of bladder 19 adjacent rim 18. Desirably the junction between legs 34 and 36 is rounded as at 37 to eliminate a sharp edge.

The rim 35 desirably has a plurality of openings 38 therethrough which may be aligned with the openings in rims 15 and 16 so that the bolts 27 will also extend therethrough.

Thus, the nuts 28 need be tightened only sufficiently to ensure that the rims 15, 16 will press against thickened periphery 18 with sufficient clamping force to provide an effective seal, yet without cutting of such rim, as the bolts 27 through the openings 38 in rim 35 will prevent inward movement of the thickened rim of the bladder regardless of the pressure thereagainst in the container.

By reason of supporting member 33, regardless of the number of times the bladder is expanded and contracted, there will be no sharp bend therein at the stressed portion of the bladder adjacent rim 18, and consequently there is no likelihood of cracking or rupture of such bladder.

In the embodiment shown in Fig. 1, the port 24 desirably has a plug 41 therein which has an annular flange 42 positioned on the inner periphery of port 24. Al-

though the plug 41 may be securely affixed in the port 24, in any suitable manner, it desirably is welded therein as at 43.

The plug 41 desirably has an axial bore 44 with a wall 45 at the inner end thereof, the latter desirably having a plurality of openings or passageways 46 therethrough arranged in a ring. Affixed to the inner surface of wall 45 as by a bolt 47 is a valve member 48 desirably a disk of stiff flexible material which is slightly cup-shaped so that the periphery 49 thereof is normally spaced from the openings 46.

Thus, when a valve (not shown) controlling the port 24 is opened, the expanding bladder 19 will force the liquid in the previously charged liquid chamber 23 out through openings 46 and bore 44 of plug 41.

When the bladder has expanded sufficiently so that a portion of the thickened bottom 29 thereof engages the periphery 49 of plate 48, such engaged portion of the periphery will be moved downwardly to seal the openings therebelow. Consequently, extrusion of the bladder through openings 46 will be prevented. Upon further expansion of the bladder the thickened bottom thereof will engage the remaining portion of the periphery of the plate to press the latter downwardly against wall 45 to seal the remaining openings 46.

As a result, regardless of the position of the bladder in the accumulator, when it engages the plate 48 the portion of the plate adjacent the openings 46 closest to the bladder will seal such openings to prevent extrusion of the bladder with resultant injury thereto.

The embodiment shown in Fig. 2 desirably comprises a pair of substantially cup-shaped shells 121, 122 of rigid material, the mouth of shell 121 having a rim 123 with an internal annular groove 124 and the mouth of shell 122 having an annular outwardly extending lateral rim 125, the outer diameter of which is less than that of the mouth of shell 121.

A flexible and deformable partition 19' of resilient material preferably a bladder of natural or synthetic rubber is normally positioned in shell 122. The bladder 19' is substantially conical in longitudinal cross section and has a rounded bottom wall 29' of greater thickness than its side wall.

The shell 122 in which the non-inflated bladder 19' normally extends, is substantially cylindrical along the greater portion of its length and is of enlarged diameter near its mouth as at 130. Thus the distance from the outer surface of bladder 19' to the inner surface of shell 122 progressively increases from the rim 126 of the bladder to its free end 29' to prevent the formation of liquid pockets as previously described.

The bladder 19' is desirably supported at its rim 126 in such manner that regardless of the number of times it is expanded and contracted during charging and discharging of the accumulator, no sharp bending stress will be imparted to such rim with the disadvantages previously pointed out.

To this end, an annular supporting member 131 is affixed to bladder 19' at the rim 126 and adjacent portion thereof. The supporting member 131 is also of resilient sheet material such as metal or plastic and is substantially reversely bent forming an inner and outer leg 132, 133 which desirably are molded into the rim 126 and adjacent wall portion of the bladder respectively. Thus, as shown in Fig. 2 the rim 126 of the bladder will also be reversely bent so that the rim 125 of shell 122 may be positioned between legs 132, 133. The inner surface of rim 126 on leg 133 desirably has an annular groove 135 to receive rim 125 to retain the rim of bladder 19' over the mouth of shell 122.

To assemble the accumulator, the open end of the shell 122 with the bladder 19' mounted thereon as previously described, is moved into the mouth of shell 121 until the enlarged diameter portion 130 of shell 122 is



between the annular groove 124 and the port 22' of shell 121.

An annular washer 137 is then positioned around the enlarged diameter portion 130 of shell 122 against the undersurface of the reversely bent rim 126. The shell 122 is then locked in shell 121 as by means of a split type snap ring 138 positioned in annular groove 124. The snap ring is desirably circular in cross section and of diameter substantially equal to the distance between the outer surface of the enlarged diameter portion of shell 122 and the floor of annular groove 124 most remote from said shell 122.

Thus the snap ring will prevent lateral displacement of shell 122 in shell 12. When pressure is applied through port 22' to charge the accumulator with gas, the shells will tend to move apart compressing rim 126 between washer 135 and rim 125 to provide a dependable seal between the opposed walls of shells 121 and 122.

As the outer diameter of rim 125 is greater than the inner diameter of snap ring 138 when it is seated in annular groove 124, the outward movement of shell 122 from shell 121 will be limited.

The shell 122 desirably has a plug 41' positioned in the port 24' and affixed therein as by welding as at 43'. Plug 41' has an inner wall 51 with a neck 52 which extends outwardly therefrom into the container and has a beveled inner edge 53 defining a valve seat. The wall 51 has a plurality of passageways 46' desirably arranged in a ring about an axial opening 54 through which extends a pin 55. The pin 55 desirably has a stop in the form of a nut 56 screwed on the outer end thereof and has a ball conformation 57 at the inner end thereof positioned in a socket 58 in a valve head 59. The ball 57 is desirably retained in socket 58 by means of a plate 61 affixed to the underface of the valve head 59 as by screws 62 and having an opening 63 through which pin 55 extends.

The valve head is desirably retained in its outermost position spaced from its seat 53 by a coil spring 64 compressed between the undersurface of valve head 59 and wall 51.

In the operation of the accumulator shown in Fig. 2, regardless of which portion of the periphery of the valve head 59 is engaged by the thickened bottom 29' of partition 19', the valve head will pivot in the direction of the force applied thereagainst until a portion of the periphery of the valve head is against its seat 53. As a result, extrusion of the partition through openings 46' is prevented. Upon further expansion of the partition and as pressure is applied against the entire valve head, the entire periphery of the latter will finally be seated to close the port 24'.

By reason of the valve construction above described, regardless of the position of the partition 19' in the accumulator when it engages the valve head, the portion of the valve head adjacent the openings 46' closest to the partition will seal such openings to prevent extrusion of the partition.

The pressure accumulator shown in Fig. 3 desirably comprises a pair of cup-shaped substantially cylindrospherical shells 71 and 72 desirably having the same outer diameter, the shell 72 preferably being of greater length than the shell 71. Each of the rims 73 and 74 of the shells 71 and 72 has an annular depression 75 therein between which the enlarged periphery or rim 76 of a deformable partition 77 may be positioned.

The partition 77 which desirably is of rubber, natural or synthetic, preferably is a circular disc of diameter considerably greater than the inner diameter of the shells 71 and 72 and has an axial opening 78 therethrough. The rims 73 and 74 of the shells are desirably clamped against the enlarged periphery 76 of the partition 77 by means of a central rod 79 which extends longitudinally through the juxtaposed shells 71 and 72, through axial opening 78 in partition 77 and through axial openings 81 at the ends of the shells respectively.

The protruding ends 83 of the rod 79 are desirably threaded as at 85 so that they may receive a nut 86, which when screwed upon such threaded ends and tightened, will move the shells 71 and 72 together so that the rims 73 and 74 thereof will press tightly against the enlarged rim 76, securely retaining the latter in place and providing a dependable seal between such rim portions of the shell.

The periphery of opening 78 in partition 77 is securely retained against the central rod 79 as by means of a suitable clamp 87. The dimensions of the partition 77 and the position at which the periphery of opening 78 thereof is clamped to the rod 79 are so selected that as shown in Fig. 3, the partition will hang downwardly in shell 72 to define a bladder that is substantially conical in cross section, the distance of the outer surface 88 of the partition from the inner wall of the shell progressively increasing from the enlarged rim 76 thereof to the reversely bent bottom 89 thereof.

Means are desirably provided to charge the chamber 91 of the accumulator on one side of the partition 77 with gas, for example, and the chamber 92 on the other side of the partition 77 with a liquid such as oil. For this purpose each of the ends 83 of the central rod 79 desirably has a longitudinal bore 93 therein defining a gas and oil port respectively, and a transverse bore 95 leads from such longitudinal bore into the accumulator. Thus, a gas under pressure may be forced through bores 93 and 95 into the accumulator chamber 91 on one side of the partition and a liquid such as oil may be forced through the bores 93 and 95 into the accumulator chamber 92 on the other side of the partition. As the valve means controlling the gas inlet port and the oil port are conventional, they will not be shown.

In the operation of the accumulator shown in Fig. 3, gas under pressure is initially charged into the accumulator through the gas inlet port and such port is thereupon sealed. Oil under pressure greater than that in the gas chamber 91 is forced through the oil inlet port into liquid chamber 92. As the result, the partition 77 will be deformed and the gas in the chamber 91 will be compressed.

When the oil port is opened in use of the accumulator, the compressed gas in chamber 91 will cause the partition 77 to move outwardly thereby forcing oil through bores 95 and 93. As the partition 77 expands, the portion of the outer wall 88 thereof closest to the inner wall of shell 72 will first contact such shell and as more and more oil is forced from the accumulator, the wall of the partition will progressively engage such shell.

As a result, no oil pocket will be formed between the partition and the wall of the container and substantially all of the fluid in the container will be forced out therefrom as is set forth in detail in re-issue Patent No. 23,437, previously identified.

The partition 77 is also desirably supported near the clamped rim thereof in such manner that regardless of the number of times the partition is expanded and contracted during charging and discharging of the accumulator, no sharp bending stress will be imparted to such clamped rim with the disadvantages previously pointed out. To this end, an annular supporting member 98 similar to those shown in Figs. 1 and 2 is desirably molded into the thickened rim 76 and adjacent wall portion of the partition 77. The supporting member 98 is also of resilient sheet material such as metal or suitable plastic and is substantially L-shaped in cross section. One leg of the supporting member extends laterally into the thickened rim 76 and the other leg 101 extends downwardly into the wall portion of partition 77 adjacent rim 76. Desirably the junction between legs 99 and 101 is rounded as at 102 to eliminate a sharp edge.

By reason of supporting member 98, the portion of the partition adjacent rim 76 will be spaced from the rims 73 and 74 of the shells. Thus, regardless of the number of times the partition is expanded and contracted, there will be no sharp bend therein at such portion and consequently there is no likelihood of tearing of such bladder.

In the embodiment shown in Fig. 4, the rim 105 of shell 106 desirably has an outer diameter less than the inner diameter of the rim 110 of shell 107 so that it may readily fit therein. The enlarged rim 108 of partition 109 which is similar to partition 77 shown in Fig. 3, desirably has a reversely bent annular retaining member 111 associated therewith, said retaining member having an inner and outer leg 112 and 113 respectively extending substantially parallel to each other and an annular lip 114 extending laterally outward from the end of said outer leg 113. The annular leg 112 of said retaining member is molded into the rim of the partition in such manner that the inner surface of such annular leg 112 has a layer 115 of resilient material thereon which extends to the reversely bent edge 116 of said retaining member. The layer of resilient material also extends over the outer surface of said leg 112 as well as over the reversely bent edge 116 thereof and over the outer surface of annular leg 113 to the laterally projecting lip 114.

In assembling the accumulator, shown in Fig. 4, the rim 105 of shell 106 is positioned against the reversely bent edge 116 of retaining member 111 between the resilient material 115 of the partition and the inner surface of leg 113. The rim 110 of the shell 107 will seat on the laterally extending lip 114 with the inner surface of such shell against the resilient material on the outer surface of leg 113. Thus when the two shells 106 and 107 are pressed together by the tightening of the nuts (not shown) at each end of the central rod 79' (similar to that shown in Fig. 3) the rims of the shells will be against a rigid metal support i. e., reversely bent edge 116 and lip 114 and the resilient material associated with the rims of the shells will provide a liquid and air tight seal which will prevent leakage from the accumulator. Desirably, the wall of shell 106 flares outwardly as shown and the wall of partition 109 defines a substantially cylindrical bladder, which construction will also cause progressive engagement of the partition with the shell to insure complete expulsion of oil from the accumulator and avoidance of any oil pockets therein.

It is of course to be understood that the shell 72 of Fig. 3 could flare outwardly from the rim thereof and the partition 77 could be cylindrical and the shell 106 of Fig. 4 could be cylindrical and the partition 109 conical to provide progressive engagement of the partition with the associated shell.

With the constructions above described, a simple yet highly efficient pressure accumulator is provided which is capable of continuous use for long periods of time without breakdown of the deformable partition therein.

As many changes could be made in the above construction, and many apparently widely different embodiments of this invention could be made without departing from the scope of the claims, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A pressure accumulator comprising a pair of substantially cup-shaped shells, each having a laterally extending rim at the mouth thereof and a port through the wall thereof, a deformable partition of resilient material in the shape of a bladder having its periphery positioned between said rims and normally extending in one of said shells, said rims extending laterally beyond the periphery of said partition, said extending portions having a plurality of openings therethrough, a bolt extending through pairs of aligned openings in said rims, a

nut screwed on the ends of each of said bolts, whereby when said nuts are tightened the rims will be drawn together to clamp the periphery of said partition therebetween, an annular supporting member of flexible material affixed to said partition, said member having a portion thereof extending laterally beyond the clamped periphery of said partition and a portion extending along the wall of said partition near the clamped portion thereof to limit the bending of the portion of said partition adjacent said periphery when the partition is expanded and contracted during use of the accumulator, the portion of said annular supporting member extending laterally beyond the clamped periphery of said partition having a plurality of openings therethrough, through which said bolts extend to prevent inward displacement of said periphery.

2. A pressure accumulator comprising a pair of substantially cup-shaped shells each having a laterally extending rim at the mouth thereof and a port through the wall thereof, a deformable partition of resilient material in the shape of a bladder having its periphery positioned between said rims and normally extending in one of said shells, means to clamp the rims against the periphery of said partition to retain the latter therebetween, an annular supporting member of flexible material substantially L-shaped in cross section forming a pair of legs with the junction between said legs being rounded, said supporting member being affixed to said partition with one of the legs extending laterally beyond the clamped periphery of said partition and the other leg extending along the wall of said partition near the clamped portion thereof to limit the bending of the portion of said partition adjacent said periphery when the partition is expanded and contracted during use of the accumulator, said clamping means coacting with the end of said leg extending laterally beyond the clamped periphery of said partition to prevent inward displacement of said periphery.

3. The combination set forth in claim 2 in which the port in the shell in which the partition is normally positioned is through the end of said shell, said port having a plug affixed therein, said plug having an axial bore with a wall at the inner end thereof, said wall having a plurality of openings therethrough, a substantially cup-shaped disk of stiff flexible material affixed to the inner surface of said wall, the periphery of said plate being normally spaced from said openings, whereby upon expansion of said partition and engagement of the periphery of said plate thereby, the latter will move downwardly to close the openings in the wall therebeneath.

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