Feb. 12, 1957 S. W. WARNER 2,780,877

FLUID CONTROLLING SYSTEM

Filed Oct. 2, 1953 2 Sheets-Sheet 1

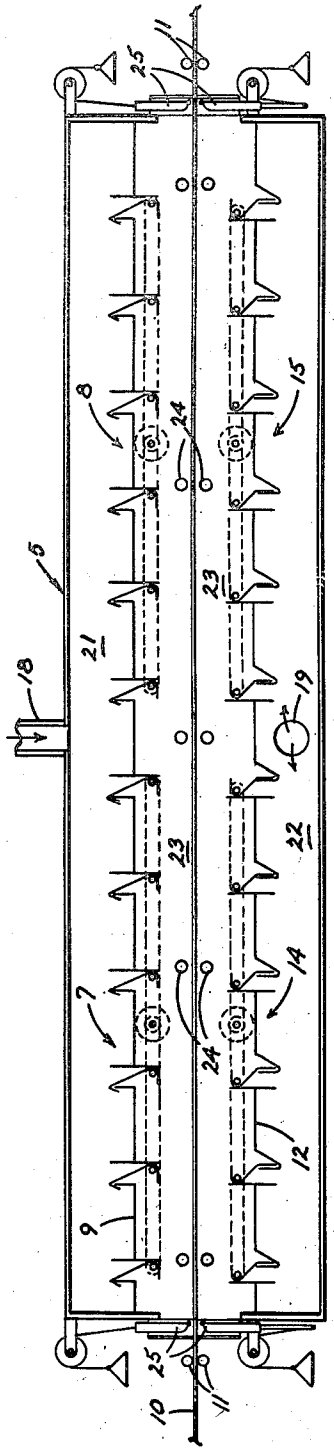

Fig. 1

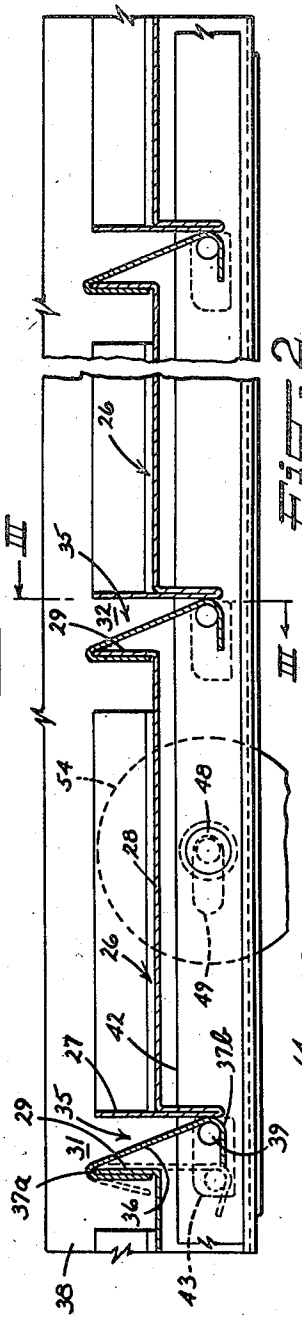

Fig. 2

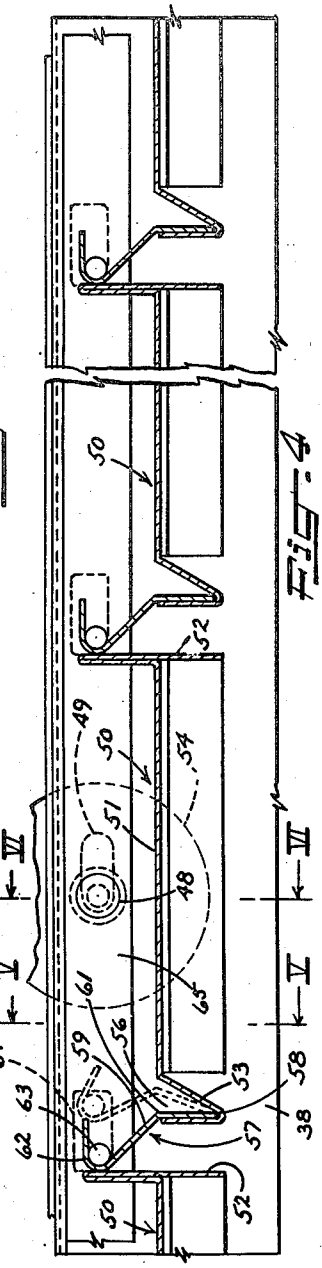

Fig. 4

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FLUID CONTROLLING SYSTEM

Filed Oct. 2, 1953 2 Sheets-Sheet 2

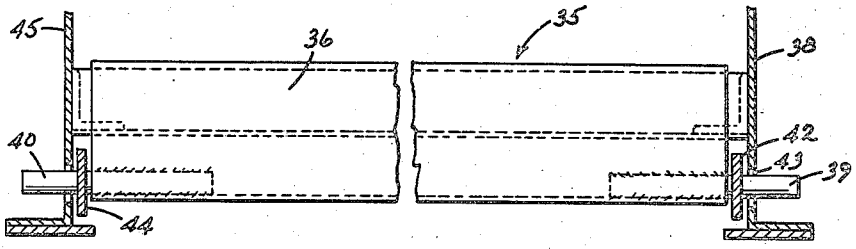

Fig. 3

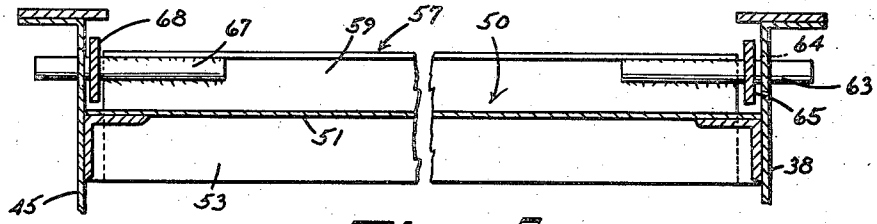

Fig. 5

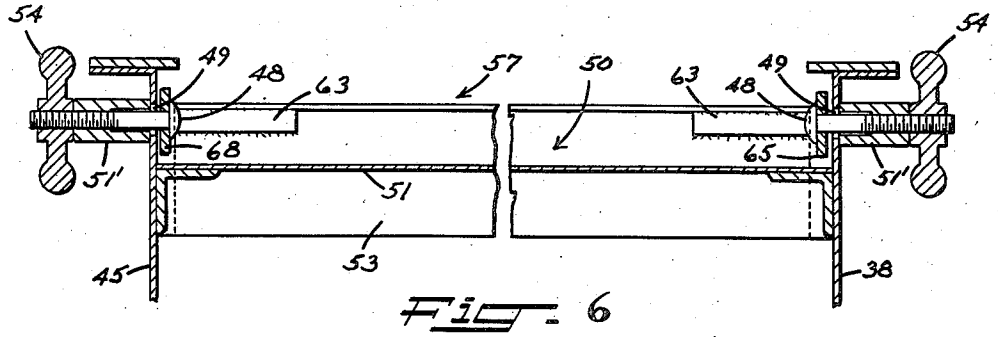

Fig. 6

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2,780,877

FLUID CONTROLLING SYSTEM

Sterling W. Warner, Fredericksburg, Va., assignor to American Viscose Corporation, Philadelphia, Pa., a corporation of Delaware

Application October 2, 1953, Serial No. 383,819

10 Claims. (Cl. 34—156)

The present invention relates to apparatus for controlling the movement of a fluid from one chamber to another and particularly to dampers for dryers, or other equipment in which a gas is brought into contact with a material to be treated thereby.

The present invention is particularly useful in overcoming some of the disadvantages of conventional apparatus for applying a moisture-proof coating to moisture-sensitive transparent films such as cellophane. In such apparatus, it is necessary, after the coating material is applied, to transport the continuous sheet of the film through an elongate drying chamber without any contact with apparatus until the coating is sufficiently dry as to be non-tacky. As a preferred practice, the film is supported in such a chamber by carefully controlling the input of heated drying air at various points within open regions which extend underneath and above the sheet. By careful regulation of the streams of air directed at right angles to the plane along which it is desired to pass the sheet of film, it is possible to support the sheet approximately within the plane. Such operation requires careful adjustment of the regulating means for the air with respect to the longitudinal direction of the sheet as well as its transverse direction. A difficulty involved in the operation of such a dryer is that the gaseous drying medium receives the material volatilized from the moisture-proofing compound. Such vaporized material tends to be deposited on the interior surfaces of the dryer and either corrodes or fouls relatively movable surfaces of the dryer in frictional engagement. Therefore, in either case, where adjustment of the inlet ports for the drying medium is obtained by dampers which slide relative to a stationary portion, the movement of such dampers is greatly impeded and may be prevented.

It is therefore an object of the present invention to provide a multiple-port damper system in which the closure elements for the ports are free of sliding relation with any stationary surfaces adjacent such ports.

It is an object of the present invention to provide as mechanically simple a shutter or damper system devoid as possible of cams and levers for controlling the passage of fluid between two chambers.

Another object is to provide an inexpensive damper system in which panel sections may be constructed primarily of a thin gauge material, such as sheet metal, requiring little or no reinforcement by other metal shapes.

Still another object is to construct a simply operated multiple-port damper system in which there is little opportunity for play or slackness to develop in control members therefor, whereby the uniformity of adjustment of the shutter system may be maintained over a long service period.

A further object is to provide a multiple-port damper system of which closures thereof have some resilient flexibility and may be warped to overcome structural irregularities in the contour of respective ports and to correct undesirable inlet current conditions developed within the treatment zones.

Other objects, features, and advantages will become apparent from the following description of the invention and the drawings relating thereto in which

Fig. 1 is a schematic elevation of a drying apparatus incorporating the embodiments of the invention separately illustrated by the other figures;

Fig. 2 is a fragmentary transversely-shortened elevation in section of a portion of the drying apparatus;

Fig. 3 is a fragmentary transversely-shortened section view taken along line III—III of Fig. 2;

Fig. 4 is a fragmentary longitudinally-shortened elevation of another portion of the drying apparatus illustrating another embodiment of the invention;

Fig. 5 is a fragmentary transversely-shortened section of the apparatus taken along line V—V of Fig. 4; and

Fig. 6 is another fragmentary transversely-shortened section of the apparatus taken along line VI—VI of Fig. 4 illustrating a device for maintaining damper settings.

In brief, the invention resides in a damper system comprising one or more movable closure members of thin-gauge material and a thin-section generally-planular wall member having a separate slot or port for each closure defined by spaced parallel portions of the wall member folded out of the general plane thereof. Each of the closure members extends in its longitudinal direction in hinged relation with one of the folded portions of the wall member by extension of one member into the trough defined by a saw-tooth or angularly folded portion of the other member. Each closure member and the wall member have folds of angular cross section which extend parallel to the longitudinal direction of the closures and the saw-tooth portions to provide stiffness to the members.

Fig. 1 illustrates schematically one type of apparatus, i. e., a dryer 5, in which the dampers of the present invention may be used. As shown, the dryer is provided with two groups 7 and 8 of dampers of one type which open and close ports through a thin section wall 9 disposed horizontally above a sheet material 10 which advances through the dryer over rollers 11 disposed exteriorly of the dryer at opposite ends thereof. Dampers of another type to be hereinafter described are divided into groups 14 and 15, each group comprising six dampers. As shown, each group of dampers is controlled by a single control member running lengthwise of the group in pivotal connection with each damper. It is to be understood that such a dryer may comprise many groups of dampers since the ports of one installation constructed in accordance with the invention were less than on inch wide and spaced approximately eight inches apart.

The dryer shown is adapted for removing a solvent or other vaporizable material from the sheet 10. The dryer is thus provided with inlet ducts 18 and 19 which supply hot air to chambers 21 and 22 which constitute headers from which the heated air may be discharged through the ports of the partitions or separating walls 9 and 12, into the chamber 23 in which a sheet 10 is disposed. The sheet 10 extends longitudinally through the chamber 23 and thus divides the chamber into two portions supplied separately with heated air by the ducts 18 and 19. The air carrying the solvent leaves the chamber 23 through the exhaust ports 24. The sheet 10 is unsupported except for the difference in gas pressure between the region of the chamber 23 above the sheet and the region below the sheet. The dampers of groups 14 and 15 are regulated so as to discharge upward supporting currents of air which, in addition to counteracting the downward currents of air or gas being discharged from the groups of dampers 7 and 8, counteract the force due to the weight of the sheet 10. Upon proper adjustment of the various groups of dampers, the sheet may pass through the dryer along a desired plane, usually horizontal, extending longitudinally and transversely with respect to

the dryer. Vertically adjustable doors 25 at each end of the dryer are adjusted into adjacent relation with the sheet, in accordance with the plane of passage assumed by the sheet, to restrict the passage of air from the chamber 23. The dryer of simple design shown is merely illustrative of the way in which the dampers of the present invention may be employed to control the flow of a treating fluid into contact with a material to be treated.

As the arrangement of the dampers of groups 7 and 8 is identical, Fig. 2 is illustrative in enlarged section of either group. The horizontal wall 9 is disposed in generally parallel relation with the sheet 10 and comprises a series of sections 26, each of which terminates at one end in a vertical panel 27 extending both above and below the horizontal panel 28. At the other end of the panel 28, the section 26 extends in an upturned panel 29 extending at an angle of approximately 90° with the panel 28. The vertical panels 27 and 29 are contiguous with a horizontal panel 28 and define the nearer sides of adjacent ports 31 and 32 through the wall 9. The wall 9 comprises a series of sections 26 disposed, as shown in Fig. 1, along a generally horizontal plane to provide a plurality of ports spaced progressively in a direction parallel to a material to be treated such as the sheet 10. The side of the ports as defined by the various upwardly-extending panels 27 and 29 are shown extending at right angles to the general direction of spacing of the ports and to the general plane of the conveyor elements 11 on which the material to be treated is supported.

The closures or dampers 35 for the ports are constituted preferably of single panels of material which are bent, folded, or otherwise formed to the contour as shown in Fig. 2. The damper may be fabricated as shown from a single sheet folded to form a flat panel 36, a saw-tooth or angularly folded portion 37*a* contiguous therewith extending over the upturned panel 29 of each section 26, and a concavo-convex portion 37*b* extending along the lower side of the panel 36. As the center of gravity of the dampers is disposed generally downwardly from the saw-tooth portion, the damper for each port is suspended preferably from the upturned panel 29. The convex surface of portion 37*b* engages the end panel 27 of the wall section 26. At one end of each damper adjacent the lateral wall 38 of the dryer, a small cylindrical member or stub shaft 39, such as a piece of rod, may be welded to the concave surface of the concavo-convex portion of the damper. At the other end of the damper, as shown in Fig. 3, another similar element 40 is secured. The elements 39 of a group of dampers 35 (six dampers as shown in Fig. 1) protrude beyond the ends of respective dampers and extend through complementary apertures of a bar 42 supported along the inner surface of the dryer wall 38. The elements may rotate within respective apertures with respect to the bar. The elements 39 also protrude through apertures or slots 43 in the lateral wall 38 which allow each damper to move from its open position to its closed position. In a similar manner, the elements 40 extend through a control bar 44 and the opposite lateral wall 45. In Fig. 2, the closed position of the damper is shown in which the lower convex surface of the damper engages the panel 27 of a wall section 26. The open position of the dampers is shown in dotted outline.

Fig. 4 is illustrative of a section of the ported wall 12 and dampers from the groups 14 and 15. The wall 12 for separating the compartments 22 and 23 comprises a plurality of sections 50, each section having a generally horizontal panel 51, an end panel 52 constituting one transverse portion of the periphery of a port, and a portion 53 of saw-tooth or angular cross section at the other end of the section having a vertical panel constituting a peripheral portion of each port opposing a panel 52 of another wall section 50. The saw-tooth portion of the section points downwardly to provide a trough 56 for supporting a damper 57. The damper may rest on its bottom edge 58 and swing with respect to stationary portions of the dryer with the bottom of the trough as an axis. The panel 59 of the damper is folded sharply at 61, and also bent to provide a concavo-convex portion 62 which engages the panel 52 of the adjacent wall section 50.

A cylindrical element 63 is attached to the inner concave surface of the portion 62 and extends through a bar 65 in pivotable relationship therewith. The element 63 also extends through a horizontally-elongate slot 64 within the lateral wall 38. The damper 57 has a cylindrical element 67 similar to element 63 which extends through a control bar 68 and the lateral wall 45 from the other end of the damper in the same manner as described with respect to damper 35 of Figs. 2 and 3. A plurality of dampers are connected by the bars 65 and 68, and are secured in a desired position in the same manner (see Fig. 4) as the damper system of Figs. 2 and 3 by clamping devices of the same construction as that illustrated in Fig. 6 and described below.

The degree to which the ports are open may be determined by manipulation of the clamping assembly illustrated in Fig. 6 which fixes or holds the position of the bar 65 at any point along a path of movement lengthwise of itself in moving the dampers attached thereto from their open positions to their closed positions and vice versa.

To secure the bar relative to the lateral wall of the dryer and to thereby obtain the degree of opening of the damper ports desired, a bolt 48 is provided which extends through the bar 65 with its head welded or otherwise secured to the inwardly-facing surface of the bar. The bolt extends also through a slot 49 in the wall 38. The slot 49 is elongated in a horizontal direction to allow movement of the bolt for moving the bar between the open and closed positions of the dampers. In threaded relationship with the bolt 48 is a sleeve 51′ which may be secured, as shown, in coaxial relationship to a small wheel 54 such as conventionally found on valve handles. By turning the wheel, the sleeve 51′ may be tightened against the wall 38 to bring the bar 65 tightly against the wall 45.

Thus, the dampers may be adjusted simultaneously to open, closed, or partly open, positions, and secured in such positions within respective ports. The control bar 68 disposed along the wall 45 and the opposite ends of the dampers, is secured in the same manner as just described with respect to the clamp device for the control bar 65. Since the dampers are constituted primarily of sheet material, and if the sheet material is sufficently thin, the ends of the dampers along one wall of the dryer may thus spring with respect to the ends along the opposite wall. Therefore, for accurate adjustment of the dampers, a scale may be provided which extends horizontally along the periphery of the side-wall slot for each bolt of a clamping device whereby opposite ends of the dampers may be secured to accurate postions of the dampers.

In operating apparatus such as illustrated in Fig. 1, it is practically impossible to predict positions of the dampers within respective ports which will bring about satisfactory approximate support of the sheet 10 along a desired plane. Many factors entering into the construction and operation of the apparatus affect the velocity of the air currents issuing from the ports in the dampers toward the plane in which the sheet is supported. The adjustment of the dampers is a meticulous operation involving usually two operators working at opposite sides of the dryer who, by observation of the running sheet through transparent windows in the lateral walls of the dryer, adjust the dampers at one end independently of the adjustment made at the other end. Thus, the capacity of the dampers to be intentionally warped adds greatly to the facility in adjusting and balancing the air pressure in such a dryer. Once such a complete adjustment is made with accuracy, the dryer may be operated indefinitely without readjustment provided that the structure and the operation of the dryer is not altered.

While preferred embodiments of the invention have been shown and described, it is to be understood that changes and variations may be made without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. In fluid-conducting apparatus, a wall member for separating two compartments having a port extending from one compartment to the other, the periphery of the port having one pair of opposite portions which extend in generally parallel relation within a plane, the wall member having surfaces extending from said opposing peripheral portions transversely to said plane, a closure member for the port extending with its longitudinal direction parallel to the length of said peripheral portions, one of said members having a folded marginal portion of angular cross section adjacent one of said surfaces of the wall member to provide a trough extending parallel to the length of said peripheral portions of the port, the other member having a marginal portion extending into engagement with the bottom surface of the trough in pivotal connection between the members whereby the closure member is supported by the wall member in swingable relationship, said closure member being swingable about said pivotal connection into and out of engagement with the other surface of the wall member.

2. In fluid-conducting apparatus, a thin section wall member for separating two compartments having a port extending from one compartment to the other, the periphery of the port extending generally within a plane and having a pair of parallel portions along which portions of the wall member are folded out of the general plane of the member and extend in transverse directions from said plane, a closure member of thin-gauge material for the port extending with its longitudinal direction parallel to the length of said parallel peripheral portions, one of said members having a folded marginal portion of angular cross section to provide a trough extending parallel to the length of the closure member, the other member having a marginal portion extending into engagement with a bottom surface of the trough to provide a hinge joint whereby the closure member is supported by the wall member in swingable relationship, said closure member being swingable about the hinge joint into and out of engagement with the other folded portion of the wall member.

3. In fluid-conducting apparatus, a thin section wall member for separating two compartments having a port extending from one compartment to the other, the periphery of the port extending generally within a plane and having a pair of parallel portions, the wall member having spaced portions folded along said peripheral portions out of the general plane of the member which extend in transverse directions from said plane, a closure member of thin-gauge material for the port extending with its longitudinal direction parallel to the length of said folded portions, one of said members having a folded marginal portion of angular cross section to provide a trough extending parallel to the length of the closure member, the other member having a marginal portion extending into engagement with the bottom surface of the trough to provide a hinge joint whereby the closure member is supported by the wall member in swingable relationship, said closure member being swingable about the hinge joint into and out of engagement with the folded portion of the wall member, said members having folds of angular cross section, the apexes of such folds extending parallel to the length of the port to render said members more rigid and self-supporting.

4. In fluid-conducting apparatus, a thin section generally-planular wall member for separating two compartments having a port extending from one compartment to the other, the periphery of the port having a pair of parallel portions extending generally along the plane of a wall member, the wall member having spaced portions folded along said peripheral portions out of its general plane and extending transversely from said plane, side walls for the apparatus extending in a direction transverse to said plane adjacent the periphery of the wall member, a closure member of thin-gauge material for the port extending with its longitudinal direction parallel to said peripheral portions, one of said members having a folded marginal portion of angular construction to provide a trough extending parallel to the length of the closure member, the other having a marginal portion extending into engagement with the bottom surface of the trough to provide a hinge joint whereby the closure member is supported by the wall member in swingable relationship, said closure member being swingable about the hinge joint into and out of engagement with the other folded portion of the wall member, an element extending parallel to the length and beyond the end of the closure member, and means associated with said element and the adjacent side wall for securing the element in fixed position with respect to the side wall whereby the closure member may be secured in any desired position within its swinging ambit within said port.

5. In a fluid-conducting apparatus, a thin-section generally-planular wall member for separating two compartments having a plurality of ports for connecting the compartments in communicating relationship, said ports being progressively spaced along a straight path, the periphery of each port having a pair of opposite parallel portions, the wall member having portions folded along said peripheral portions out of the general plane of the wall member and extending in transverse relationship to said path, a closure member for each port comprising a thin-gauge material and having its longitudinal direction parallel to said parallel peripheral portions, one of said members having a folded marginal portion of angular cross section to provide a trough extending parallel to the length of the closure member, the other member of said members having a marginal portion extending into engagement with the bottom surface of the trough to provide a hinge joint whereby the closure member is supported by the wall member in swingable relationship, each closure member being swingable about the hinge joint into and out of engagement with the other folded portion of the wall member, the hinge joints of all the closure members being disposed in the same general plane parallel to the plane of the wall member, a pivotal element extending from the end of each closure member in a direction parallel to the length thereof, all pivotal elements being disposed in a plane approximately parallel to the plane of the wall member, an elongate member extending in parallel relationship to said path in pivotal connection with all of said elements, and holding means associated with the elongate member and an adjacent side wall of the apparatus for securing the elongate member in a fixed position with respect to said side wall.

6. In fluid-conducting apparatus, a wall member of thin sheet material for separating two compartments having a port extending from one compartment to the other, the periphery of the port having a pair of opposed parallel portions, the wall member having spaced portions folded along said parallel peripheral portions out of the general plane of the wall member and extending transversely from said plane, a closure member of thin sheet material for the port extending with its longitudinal direction parallel to the length of said peripheral portion, one of said members having a folded marginal portion of angular cross section to provide a trough extending parallel to the length of the closure member, the other member having a marginal portion extending into engagement with the bottom surface of the trough to provide a hinge joint whereby the closure member is supported by the wall member in swingable relationship, said closure member being swingable about the hinge-joint into and out of engagement with the other folded portion of the wall member, the portion of said closure which swings into and out of engagement with the wall member comprising

a rounded convex surface of the folded portion of the closure member, said members having folds of angular cross section, the apexes of such folds extending parallel to the length of the closure member to provide stiffness and resistance to bending.

7. In fluid-conducting apparatus; a wall member comprising a thin sheet material and having a port therethrough of which opposing portions of its periphery are disposed in approximately parallel relationship along a plane; the sheet material being folded along said peripheral portions of the port to provide a flat portion of the member adjacent opposite sides of the port extending generally along the plane, and a separate portion of the member extending transversely to said plane from each of said portions of the periphery in contiguous relation with the adjacent flat portion of the member; one of said transverse member portions extending first downwardly away from said plane and upwardly toward the plane in angular cross-section defining a trough opening toward the plane; a closure member of thin sheet material for the port extending with its longitudinal direction parallel to the length of the trough, the closure member having a longitudinal marginal portion extending into engagement with the bottom surface of the trough and another portion contiguous to said marginal portion extending into the port and adapted to swing into and out of engagement with the opposing surface of the other folded portion.

8. In fluid-conducting apparatus; a wall member comprising a thin sheet material and having a port therethrough of which opposing portions of its periphery are disposed in approximately parallel relationship along a plane; the sheet material being folded along said peripheral portions of the port to provide a flat portion of the member adjacent opposite sides of the port extending generally along the plane, and a separate portion of the member extending transversely to said plane from each of said portions of the periphery in contiguous relation with the adjacent flat portion of the member; one of said transverse member portions extending from the flat portion in a lateral direction from said plane and then in doubled relation back over itself through the port to the other side of the plane, the folded portion of the wall member at the other side of the opening extending first downwardly away from said plane and upwardly toward the plane in angular cross-section defining a trough opening toward the plane; a closure member of thin sheet material for the port extending with its longitudinal direction parallel to the length of the trough, the closure member having a longitudinal marginal portion extending into engagement with the bottom surface of the trough and another portion contiguous to said marginal portion extending into the port and adapted to swing into and out of engagement with the opposing surface of the first-defined other folded portion, said latter-named portion of the closure member being folded in a concavo-convex contour to provide a rounded convex surface extending lengthwise of the closure member for engaging the first-named folded portion of the wall member.

9. In fluid-conducting apparatus; a wall member comprising a thin sheet material having a port therethrough of which opposing portions of its periphery are disposed in approximately parallel relationship along a plane; the sheet material being folded along said peripheral portions of the port to provide a flat portion of the member adjacent each of said portions of said periphery and extending generally along the plane, and a separate portion of the member extending transversely with respect to said plane from each of said peripheral portions in contiguous relation with the adjacent flat portion; one of the transversely-extending portions extending upwardly, a closure member of thin sheet material for the port extending with its length parallel to said portions of said periphery and having a marginal portion folded in angular cross section to provide a trough extending lengthwise of the closure member and opening in a downward direction, said upwardly-extending wall member portion extending loosely into engagement with the bottom surface of the trough to provide a hinge joint between the members whereby the closure member is swingably supported by the wall member, said closure member having a portion extending from said angular portion into the port adapted for swinging into and out of engagement with the other transversely-extending portion of the wall member.

10. In fluid-conducting apparatus, a wall member comprising a thin sheet material having a port therethrough of which opposing portions of its periphery are disposed in approximately parallel relationship along a plane; the sheet material being folded along said peripheral portions of the port to provide a flat portion of the member adjacent each of said portions of said periphery and extending generally along the plane, and a separate portion of the member extending transversely with respect to said plane from each of said peripheral portions in contiguous relation with the adjacent flat portion; one of the transversely-extending portions extending from the flat portion first in a lateral direction from the plane and then in doubled relation back over itself through the port to the other side of the plane in opposed spaced relation with the other transversely-extending member portion, the latter-named member portion extending upwardly a closure member of thin sheet material for the opening extending with its length parallel to said portions of said periphery and having a marginal portion folded in saw-tooth cross section to provide a trough extending lengthwise of the closure member and opening in a downward direction, said latter-named transversely upwardly-extending wall member portion extending loosely into engagement with a bottom surface of the trough to provide a hinge joint between the members whereby the closure member is swingably supported by the wall member, said closure member having a portion extending from the saw-tooth portion into the port adapted for swinging into and out of engagement with the latter-named other transversely-extending portion of the wall member, said latter-named portion of the closure member being folded in concavo-convex contour to provide a rounded convex surface extending lengthwise of the closure member and facing toward the first-named folded portion of the wall member for engagement therewith.

References Cited in the file of this patent

UNITED STATES PATENTS

927,995	Morrow	July 13, 1909
1,575,144	Bishop	Mar. 2, 1926
2,060,289	Downs	Nov. 10, 1936
2,224,312	O'Day	Dec. 10, 1940
2,225,505	Offen	Dec. 17, 1940
2,422,105	Lehrer	June 10, 1947