

WHAT IS CLAIMED IS:

1. A normally closed valve (100, 200, 300) that i) can automatically open to establish communication through the valve (100, 200, 300) between first and second sides (113, 213, 313, 114, 214, 314) of the valve (100, 200, 300) in response to a pressure on the first side (113, 213, 313) of the valve (100, 200, 300) exceeding the pressure on the second side (114, 214, 314) of the valve (100, 200, 300) by a predetermined amount, and ii) can also be selectively opened to establish communication through the valve (100, 200, 300) between the first and second sides (113, 213, 313, 114, 214, 314) of the valve (100, 200, 300), said valve (100, 200, 300) comprising:

I. a body (104, 204, 304) defining

A. a first side surface (120, 220, 320) and a second side surface (124, 224, 324);

B. at least one flow passage (128, 228, 328) extending through said body (104, 204, 304) between said first side surface (120, 220, 320) and said second side surface (124, 224, 324) to define i) a flow passage opening (132, 232) at said body first side surface (120, 220, 320), and ii) a flow passage opening (136, 236, 336) at said body second side surface (124, 224, 324); and

C. a valve seat (148, 248, 348) that i) is located on said second side surface (124, 224, 324), and ii) encompasses said flow passage opening (136, 236, 336) at said second side surface (124, 224, 324);

II. a valve member (108, 208, 308) that includes

A. an anchor (152, 252, 352) that is mounted on said body (104, 204, 304) to accommodate movement between i) an initially installed first location relative to said body (104, 204, 304), and ii) a selectively mechanically maintainable second location relative to said body (104, 204, 304); and

B. a flange (156, 256, 356) that is deflectable and resilient, and that i) extends laterally from said anchor (152, 252, 352), and ii) defines a seal portion for effecting a sealing engagement with said valve seat (148, 248, 348) on said second side surface (124, 224, 324) around said flow passage opening (136, 236, 336) at said second side

surface (124, 224, 324) when said anchor (152, 252, 352) is in said first location relative to said body (104, 204, 304) while the pressure on the first side (113, 213, 313) of said valve (100, 200, 300) does not exceed the pressure on the second side (114, 214, 314) of said valve (100, 200, 300) by more than a predetermined amount; and

III. a fulcrum (112, 212, 312) located at one of said valve member (108, 208, 308) and/or said body (104, 204, 304) between said flange (156, 256, 356) and said second side surface (124, 224, 324) whereby said valve (100, 200, 300) can be selectively opened by pushing said anchor (152, 252, 352) relative to said body (104, 204, 304) toward said second location to pivot at least a portion of said flange (156, 256, 356) about said fulcrum (112, 212, 312) and thereby deflect at least part of said seal portion out of sealing engagement with said valve seat (148, 248, 348) on said second side surface (124, 224, 324) to open said valve (100, 200, 300) to establish communication through said valve (100, 200, 300) between the first and second sides (113, 213, 313, 114, 214, 314) of said valve (100, 200, 300).

2. The valve (100, 200, 300) in accordance with claim 1 in which

said body (104, 204, 304) is a part of a container that can be subjected to a first pressure on the exterior of the container that exceeds a second pressure on the interior of the container; and

said flange (156, 256, 356) is located at the exterior of said container.

3. The valve (100, 200, 300) in accordance with claim 1 in which

said body (104, 204, 304) has a plurality of said flow passages (128, 228, 328) arranged to extend between said first side surface (120, 220, 320) and said second side surface (124, 224, 324) of said body (104, 204, 304); and

each of said flow passages (128, 228, 328) defines a flow passage opening (136, 236, 336) at said second side surface (124, 224, 324) of said body (104, 204, 304) so that said flow passage openings (136, 236, 336) at said second side surface (124, 224, 324) of said body (104, 204, 304) lie on a circular locus.

4. The valve (100, 200, 300) in accordance with claim 3 in which

said flange (156, 256, 356) of said valve member (108, 208, 308) is a flexible, resilient membrane that has a generally circular configuration extending from said anchor (152, 252, 352); and

said seal portion of said valve member (108, 208, 308) is an annular lip (184, 284, 384) for sealingly engaging said valve seat (148, 248, 348) around said plurality of said flow passage openings (136, 236, 336) at said second side surface (124, 224, 324) of said body (104, 204, 304).

5. The valve (100, 200, 300) in accordance with claim 1 in which

said body (104, 204, 304) defines a mounting aperture (140, 240, 340) extending between said first side surface (120, 220, 320) and said second side surface (124, 224, 324) of said body (104, 204, 304);

said anchor (152, 252, 352) of said valve member (108, 208, 308) has i) a middle portion (164) received in said mounting aperture (140, 240, 340), ii) a first end portion (160) extending beyond said mounting aperture (140, 240, 340) at said first side surface (120, 220, 320) of said body (104, 204, 304), and iii) a second end portion (168) extending beyond said mounting aperture (140, 240, 340) at said second side surface (124, 224, 324) of said body (104, 204, 304);

said flange (156, 256, 356) of said valve member (108, 308, 308) is located adjacent said second side surface (124, 224, 324) of said body (104, 204, 304) and extends from said second end portion (168) of said anchor (152, 252, 352); and

said first end portion (160) of said anchor (152, 252, 352) is enlarged and extends adjacent to, and engages, said first side surface (120, 220, 320) of said body (104, 204, 304) for inhibiting movement of said first end portion (160) through said mounting aperture (140, 240, 340) in the direction from said first side surface (120, 220, 320) toward said second side surface (124, 224, 324) of said body (104, 204, 304).

6. The valve (100, 200, 300) in accordance with claim 5 in which said flange (156, 256, 356) is sufficiently resilient so that said seal portion can engage said valve seat (148, 248, 348) with a sealing force to bias said anchor (152, 252, 352) to said first location wherein said enlarged first end portion (160) of said anchor (152, 252, 352) is pulled against said first side surface (120, 220, 320) of said body (104, 204, 304) adjacent said mounting aperture (140, 240, 340) to maintain said anchor (152, 252, 352) at said first location unless said anchor (152, 252, 352) is moved with an external force sufficient to overcome said bias.

7. The valve (100) in accordance with claim 1 in which said fulcrum (112) is a post projecting from said second side surface (124) of said body (104) toward said valve member flange (156).

8. The valve (200) in accordance with claim 1 in which said fulcrum (212) is a post projecting from said flange (256) of said valve member (208) toward said second side surface (224) of said body (204).

9. The valve (300) in accordance with claim 1 in which
said fulcrum (312) is an annular wall that

- i) projects from said second side surface (324) of said body (304) toward said flange (356) of said valve member (308), and
- ii) extends around said flow passage opening (336) at said second side surface (324), and

said annular wall defines at least one channel (390) therein to accommodate flow through said channel (390) when said flange (356) engages said annular wall.

10. The valve (300) in accordance with claim 1 in which
said fulcrum (312) is an annular wall that

- i) projects from said flange (356) of said valve member (308) toward said second side surface (324) of said body (304) around said flow passage opening (336) at said second side surface (324),
- ii) is spaced laterally from said seal portion of said valve member (308), and
- iii) is configured to engage said second side surface (324) around said flow passage opening (336) at said second side surface (324), and

said annular wall defines at least one channel (390) therein to accommodate flow through said channel (390) when said annular wall engages said second side surface (324) around said flow passage opening (336) at said second side surface (324).

11. The valve (100, 200, 300) in accordance with claim 1 wherein said valve member (108, 208, 308) is formed from Silicone having a durometer of about 40 Shore A.

12. The valve (100, 200, 300) in accordance with claim 1 wherein said flange (156, 256, 356) includes a top surface (192) that faces away from said second side surface (124, 224, 324) of said body (104, 204, 304) and which defines a radius of curvature (R2), said flange (156, 256, 356) further includes a bottom surface (188) that faces said second side surface (124, 224, 324) and which defines a radius of curvature (R1), and wherein said radius (R1) of curvature of said bottom surface (188) is greater than said radius of curvature (R2) of said top surface (190).

13. The valve (100, 200, 300) in accordance with claim 1 wherein said valve (100, 200, 300) is configured to automatically open to establish communication through the valve (100, 200, 300) when the pressure on the first side (113, 213, 313) of the valve (100, 200, 300) exceeds the pressure on the second side (114, 214, 314) of the valve (100, 200, 300) by about 20,600 Pascal.

14. The valve (100, 200, 300) in accordance with claim 1 wherein said valve member (108, 208, 308) is mechanically maintainable in said second location relative to said

body (104, 204, 304) when said anchor (152, 252, 352) of said valve member (108, 208, 308) is subjected to a pre-determined manual compressive force.

15. The valve (100, 200, 300) in accordance with claim 1 wherein said anchor (152, 252, 352) defines a central axis (116, 216, 316) and said fulcrum (112, 212, 312) is located radially outwardly of said flow passage opening (136, 236, 336) at said body second side surface (124, 224, 324), as measured from said central axis (116, 216, 316).

16. The valve (100, 200) in accordance with claim 1 wherein said fulcrum (112, 212) has the form of four rounded posts located on one of said valve member (108, 208) and/or said second side surface (124, 224) of said body (104, 204), said posts located on a circular locus.

17. The valve (100, 200, 300) in accordance with claim 1 wherein said body (104, 204, 304) includes four flow passages (128, 228, 328) each of which has the form of an arcuate slot extending between said first side surface (120, 220, 320) and said second side surface (124, 224, 324) of said body (104, 204, 304).

18. The valve (100, 200, 300) is in accordance with claim 1 in which

said body (104, 204, 304) is a molded thermoplastic insert for a container that can be subjected to a first pressure on the exterior of the container that exceeds a second pressure on the interior of the container;

said valve member (108, 208, 308) is a molded elastomer; and

said valve member (108, 208, 308) is arranged with said body (104, 204, 304) such that the flange (156, 256, 356) of said valve member (108, 208, 308) is located at the exterior of said container.

19. The valve (100, 200, 300) is in accordance with claim 1 in combination with a container in the form of a flexible pouch, said valve (100, 200, 300) located at an opening of said pouch.

20. A valve (100, 200, 300) comprising:

I. a body (104, 204, 304) having a first side surface (120, 220, 320) and a second side surface (124, 224, 324), said body (104, 204, 304) defining at least one flow passage (128, 228, 328) extending through said body (104, 204, 304) between said first side surface (120, 220, 320) and said second side surface (124, 224, 324) to define

- i) a flow passage opening (132, 232) at said first side surface (120, 220, 320), and
- ii) a flow passage opening (136, 236, 336) at said second side surface (124, 224, 324);

II. a valve member (108, 208, 308) that

- i) is movable relative to said body (104, 204, 304), and
- ii) includes a flexible and resilient flange (156, 256, 356) having a first region (172), a second region (176) extending from said first region (172), and a third region (180) extending from said second region (176); said third region (180) including a seal portion configured so that said seal portion sealingly engages said second side surface (124, 224, 324) around said flow passage opening (136, 236, 336) at said second side surface (124, 224, 324) when said valve (100, 200, 300) is in an initially closed condition to prevent communication through said valve (100, 200, 300); and

III. a fulcrum (112, 212, 312) that is located at one of said valve member (108, 208, 308) and/or said body (104, 204, 304) between said second region (176) and said second side surface (124, 224, 324) whereby if said valve member (108, 208, 308) is pushed relative to said body (104, 204, 304) to move said first region (172) toward said second side surface (124, 224, 324), then said second region (176) pivots about said

fulcrum (112, 212, 312) to deflect at least part of said sealing portion of said third region (180) out of sealing engagement with said second side surface (124, 224, 324) to establish communication through said valve (100, 200, 300).

21. A normally closed valve (100, 200, 300) that i) can automatically open to establish communication through the valve (100, 200, 300) between first and second sides (113, 213, 313, 114, 214, 314) of the valve (100, 200, 300) in response to a pressure on the first side (113, 213, 313) of the valve (100, 200, 300) exceeding the pressure on the second side (114, 214, 314) of the valve (100, 200, 300) by a predetermined amount, and ii) can also be selectively opened to establish communication through the valve (100, 200, 300) between the first and second sides (113, 213, 313, 114, 214, 314) of the valve (100, 200, 300), said valve (100, 200, 300) comprising:

I. a body (104, 204, 304) defining

A. a first side surface (120, 220, 320) and a second side surface (124, 224, 324);

B. at least one flow passage (128, 228, 328) extending through said body (104, 204, 304) between said first side surface (120, 220, 320) and said second side surface (124, 224, 324) to define i) a flow passage opening (132, 232) at said body first side surface (120, 220, 320), and ii) a flow passage opening (136, 236, 336) at said body second side surface (124, 224, 324); and

C. a valve seat (148, 248, 348) that i) is located on said second side surface (124, 224, 324), and ii) encompasses said flow passage opening (136, 236, 336) at said second side surface (124, 224, 324);

II. a valve member (108, 208, 308) that includes

A. an anchor (152, 252, 352) that is mounted on said body (104, 204, 304) to accommodate movement between i) an initially installed first location relative to said body (104, 204, 304), and ii) a selectively mechanically maintainable second location relative to said body (104, 204, 304); and

B. a flange (156, 256, 356) that is deflectable and resilient, and that i) extends laterally from said anchor (152, 252, 352), and ii) defines a seal portion for effecting a sealing engagement with said valve seat (148, 248, 348) on said second side surface (124, 224, 324) around said flow passage opening (136, 236, 336) at said second side surface (124, 224, 324) when said anchor (152, 252, 352) is in said first location relative to said body (104, 204, 304) while the pressure on the first side (113, 213, 313) of said valve (100, 200, 300) does not exceed the pressure on the second side (114, 214, 314) of said valve (100, 200, 300) by more than a predetermined amount; and

III. a fulcrum (112, 212, 312) located at one of said valve member (108, 208, 308) and/or said body (104, 204, 304) between said flange (156, 256, 356) and said second side surface (124, 224, 324) whereby said valve (100, 200, 300) can be selectively opened by pushing said anchor (152, 252, 352) relative to said body (104, 204, 304) toward said second location to pivot at least a portion of said flange (156, 256, 356) about said fulcrum (112, 212, 312) and thereby deflect at least part of said seal portion out of sealing engagement with said valve seat (148, 248, 348) on said second side surface (124, 224, 324) to open said valve (100, 200, 300) to establish communication through said valve (100, 200, 300) between the first and second sides (113, 213, 313, 114, 214, 314) of said valve (100, 200, 300).

22. The valve (100, 200, 300) in accordance with claim 21 in which

said body (104, 204, 304) is a part of a container that can be subjected to a first pressure on the exterior of the container that exceeds a second pressure on the interior of the container; and

said flange (156, 256, 356) is located at the exterior of said container.

23. The valve (100, 200, 300) in accordance with any of claims 21-22 in which

said body (104, 204, 304) has a plurality of said flow passages (128, 228, 328) arranged to extend between said first side surface (120, 220, 320) and said second side surface (124, 224, 324) of said body (104, 204, 304); and

each of said flow passages (128, 228, 328) defines a flow passage opening (136, 236, 336) at said second side surface (124, 224, 324) of said body (104, 204, 304) so that said flow passage openings (136, 236, 336) at said second side surface (124, 224, 324) of said body (104, 204, 304) lie on a circular locus.

24. The valve (100, 200, 300) in accordance with claim 23 in which

said flange (156, 256, 356) of said valve member (108, 208, 308) is a flexible, resilient membrane that has a generally circular configuration extending from said anchor (152, 252, 352); and

said seal portion of said valve member (108, 208, 308) is an annular lip (184, 284, 384) for sealingly engaging said valve seat (148, 248, 348) around said plurality of said flow passage openings (136, 236, 336) at said second side surface (124, 224, 324) of said body (104, 204, 304).

25. The valve (100, 200, 300) in accordance with any of claims 21-24 in which

said body (104, 204, 304) defines a mounting aperture (140, 240, 340) extending between said first side surface (120, 220, 320) and said second side surface (124, 224, 324) of said body (104, 204, 304);

said anchor (152, 252, 352) of said valve member (108, 208, 308) has i) a middle portion (164) received in said mounting aperture (140, 240, 340), ii) a first end portion (160) extending beyond said mounting aperture (140, 240, 340) at said first side surface (120, 220, 320) of said body (104, 204, 304), and iii) a second end portion (168) extending beyond said mounting aperture (140, 240, 340) at said second side surface (124, 224, 324) of said body (104, 204, 304);

said flange (156, 256, 356) of said valve member (108, 308, 308) is located adjacent said second side surface (124, 224, 324) of said body (104, 204, 304) and extends from said second end portion (168) of said anchor (152, 252, 352); and

said first end portion (160) of said anchor (152, 252, 352) is enlarged and extends adjacent to, and engages, said first side surface (120, 220, 320) of said body (104, 204, 304) for inhibiting movement of said first end portion (160) through said mounting aperture

(140, 240, 340) in the direction from said first side surface (120, 220, 320) toward said second side surface (124, 224, 324) of said body (104, 204, 304).

26. The valve (100, 200, 300) in accordance with claim 25 in which said flange (156, 256, 356) is sufficiently resilient so that said seal portion can engage said valve seat (148, 248, 348) with a sealing force to bias said anchor (152, 252, 352) to said first location wherein said enlarged first end portion (160) of said anchor (152, 252, 352) is pulled against said first side surface (120, 220, 320) of said body (104, 204, 304) adjacent said mounting aperture (140, 240, 340) to maintain said anchor (152, 252, 352) at said first location unless said anchor (152, 252, 352) is moved with an external force sufficient to overcome said bias.

27. The valve (100) in accordance with any of claims 21-26 in which said fulcrum (112) is a post projecting from said second side surface (124) of said body (104) toward said valve member flange (156).

28. The valve (200) in accordance with any of claims 21-26 in which said fulcrum (212) is a post projecting from said flange (256) of said valve member (208) toward said second side surface (224) of said body (204).

29. The valve (300) in accordance with any of claims 21-26 in which said fulcrum (312) is an annular wall that

- i) projects from said second side surface (324) of said body (304) toward said flange (356) of said valve member (308), and
- ii) extends around said flow passage opening (336) at said second side surface (324), and

said annular wall defines at least one channel (390) therein to accommodate flow through said channel (390) when said flange (356) engages said annular wall.

30. The valve (300) in accordance with any of claims 21-26 in which said fulcrum (312) is an annular wall that

- i) projects from said flange (356) of said valve member (308) toward said second side surface (324) of said body (304) around said flow passage opening (336) at said second side surface (324),
- ii) is spaced laterally from said seal portion of said valve member (308), and
- iii) is configured to engage said second side surface (324) around said flow passage opening (336) at said second side surface (324), and

said annular wall defines at least one channel (390) therein to accommodate flow through said channel (390) when said annular wall engages said second side surface (324) around said flow passage opening (336) at said second side surface (324).

31. The valve (100, 200, 300) in accordance with any of claims 21-30 wherein said valve member (108, 208, 308) is formed from Silicone having a durometer of about 40 Shore A.

32. The valve (100, 200, 300) in accordance with any of claims 21-31 wherein said flange (156, 256, 356) includes a top surface (192) that faces away from said second side surface (124, 224, 324) of said body (104, 204, 304) and which defines a radius of curvature (R2), said flange (156, 256, 356) further includes a bottom surface (188) that faces said second side surface (124, 224, 324) and which defines a radius of curvature (R1), and wherein said radius (R1) of curvature of said bottom surface (188) is greater than said radius of curvature (R2) of said top surface (190).

33. The valve (100, 200, 300) in accordance with any of claims 21-32 wherein said valve (100, 200, 300) is configured to automatically open to establish communication through the valve (100, 200, 300) when the pressure on the first side (113, 213, 313) of the valve (100, 200, 300) exceeds the pressure on the second side (114, 214, 314) of the valve (100, 200, 300) by about 20,600 Pascal.

34. The valve (100, 200, 300) in accordance with any of claims 21-33 wherein said valve member (108, 208, 308) is mechanically maintainable in said second location relative to said body (104, 204, 304) when said anchor (152, 252, 352) of said valve member (108, 208, 308) is subjected to a pre-determined manual compressive force.

35. The valve (100, 200, 300) in accordance with any of claims 21-34 wherein said anchor (152, 252, 352) defines a central axis (116, 216, 316) and said fulcrum (112, 212, 312) is located radially outwardly of said flow passage opening (136, 236, 336) at said body second side surface (124, 224, 324), as measured from said central axis (116, 216, 316).

36. The valve (100, 200) in accordance with any of claims 21-26 said fulcrum (112, 212) has the form of four rounded posts located on one of said valve member (108, 208) and/or said second side surface (124, 224) of said body (104, 204), said posts located on a circular locus.

37. The valve (100, 200, 300) in accordance with any of claims 21-36 wherein said body (104, 204, 304) includes four flow passages (128, 228, 328) each of which has the form of an arcuate slot extending between said first side surface (120, 220, 320) and said second side surface (124, 224, 324) of said body (104, 204, 304).

38. The valve (100, 200, 300) is in accordance with any of claims 21-37 in which

said body (104, 204, 304) is a molded thermoplastic insert for a container that can be subjected to a first pressure on the exterior of the container that exceeds a second pressure on the interior of the container;

said valve member (108, 208, 308) is a molded elastomer; and

said valve member (108, 208, 308) is arranged with said body (104, 204, 304) such that the flange (156, 256, 356) of said valve member (108, 208, 308) is located at the exterior of said container.

39. The valve (100, 200, 300) is in accordance with any of claims 21-38 in combination with a container in the form of a flexible pouch, said valve (100, 200, 300) located at an opening of said pouch.

40. A valve (100, 200, 300) comprising:

- I. a body (104, 204, 304) having a first side surface (120, 220, 320) and a second side surface (124, 224, 324), said body (104, 204, 304) defining at least one flow passage (128, 228, 328) extending through said body (104, 204, 304) between said first side surface (120, 220, 320) and said second side surface (124, 224, 324) to define
 - i) a flow passage opening (132, 232) at said first side surface (120, 220, 320), and
 - ii) a flow passage opening (136, 236, 336) at said second side surface (124, 224, 324);
- II. a valve member (108, 208, 308) that
 - i) is movable relative to said body (104, 204, 304), and
 - ii) includes a flexible and resilient flange (156, 256, 356) having a first region (172), a second region (176) extending from said first region (172), and a third region (180) extending from said second region (176); said third region (180) including a seal portion configured so that said seal portion sealingly engages said second side surface (124, 224, 324) around said flow passage opening (136, 236, 336) at said second side surface (124, 224, 324) when said valve (100, 200, 300) is in an initially closed condition to prevent communication through said valve (100, 200, 300); and
- III. a fulcrum (112, 212, 312) that is located at one of said valve member (108, 208, 308) and/or said body (104, 204, 304) between said second region

(176) and said second side surface (124, 224, 324) whereby if said valve member (108, 208, 308) is pushed relative to said body (104, 204, 304) to move said first region (172) toward said second side surface (124, 224, 324), then said second region (176) pivots about said fulcrum (112, 212, 312) to deflect at least part of said sealing portion of said third region (180) out of sealing engagement with said second side surface (124, 224, 324) to establish communication through said valve (100, 200, 300).