This application is a continuation-in-part of my co-pending application Serial No. 24,606, filed April 25, 1960 (now abandoned).

This invention relates to antisiphoning devices of the type commonly used in plumbing systems. More particularly, the invention relates to antisiphoning or vacuum-breaking devices that incorporate an air gap as the vital feature thereof.

Many governmental bodies, particularly municipalities, have established codes that must be complied with by persons desiring to receive pure water from public water mains, or intending to discharge waste water into public sewerage systems. Such codes commonly require that an antisiphoning or vacuum-breaking device be inserted between the public water main and each pure water outlet of a user, and that a similar device be inserted between each waste water drain of a user and the public sewerage system. In the case of a pure water outlet, should the water pressure in the public water main be unexpectedly decreased, there is a possibility that polluted waste water would be “drawn” from sinks, washbasins, tubs and other receptacles, were the outlet immersed therein, into the pure water system thereby jeopardizing community health. In the case of a waste water drain, should the water pressure in the public sewerage system be unexpectedly increased, or should the pressure at the drain be unexpectedly decreased, there is a possibility that highly contaminated sewerage water would be “drawn” into receptacles connected to the drain. The use of antisiphoning or vacuum-breaking devices precludes the aforesaid undesirable possibilities.

The dishwashing machine is one appliance to which many plumbing codes have directed the conjunctive use of antisiphoning devices both to the pure water supply line and to the waste water discharge line thereof. Certain peculiar problems with respect to the latter application, one such problem arising due to the presence of food particles and detergents in the waste water discharged from dishwashing machines. Such food particles and detergents tend to cling to and accumulate within discharge lines. To prevent discharge lines from blocking, it has been found necessary to discharge the waste water, including food particles and detergents, at high pressure using a pump. To prevent sewerage from being “drawn” back into the dishwashing machine from the sewerage system into which the waste water is to be discharged, it has been customary to insert an air gap antisiphoning device between the dishwashing machine waste water discharge line and the public sewerage system. Since dishwashing machines are generally located and operated cooperatively with a “drop-in” kitchen sink and counter, the sink drain outlet pipe is made to serve also to couple the dishwashing machine waste discharge line to the public sewerage system. Therefore, it has been mandatory to locate the air gap device for the dishwashing machine above sink level to prevent waste water that is drained from the sink from siphoning to cause flooding through the air gap device.

One difficulty encountered due to the aforesaid requirement that location of the air gap device be above sink level, is the physical accommodation of the device and lines in an aesthetically acceptable manner.

A further problem prevails due to the fact that waste water containing food particles and detergents, when discharged across an air gap at high pressure, forms irregular divergent streams that result in splashing, flooding, and annoying sounds.

The present invention provides a device which substantially eliminates the above enumerated problems. The construction and operation of the invention will be made manifest by the following detailed description and the accompanying drawings in which:

FIGURE 1 is a schematic drawing, partly in elevation and partly in section, showing the air gap antisiphoning device of the present invention mounted on a “drop-in” kitchen sink top and leading into a waste disposal unit that also communicates with a waste water drain connected below a kitchen sink;

FIGURE 2 is a side elevation of the air gap antisiphoning device prior to installation;

FIGURE 3 is a side view, partly in elevation and partly in section, showing the air gap device installed on a kitchen sink top;

FIGURE 4 is an enlarged sectional view taken along line 4—4 of FIGURE 3;

FIGURE 5 is an enlarged sectional view taken along line 5—5 of FIGURE 3;

FIGURE 6 is an enlarged vertical section of a second embodiment of the air gap device of the invention;

FIGURE 7 is a cross-sectional view taken substantially on line 7—7 of FIGURE 6; and

FIGURE 8 is a cross-sectional view taken substantially on line 8—8 of FIGURE 6.

Referring now to FIGURES 4 and 5, the device in one embodiment is seen to consist generally of a circular plate 10 provided with a first opening 10a and a second opening 10b, a pipe 12 that passes through and is secured to the plate at opening 10a, a tube 14 having a flared end 14a that is secured to the plate at opening 10b, a nipple 16 disposed in close side-by-side relationship to the pipe in general coaxial alignment with the tube and spaced a predetermined distance therefrom and from the plate, a coupling 18 having an inlet 18a, an outlet 18b, and a generally U-shaped passage 18c therebetween that provides communication between the pipe and the nipple, a generally cylindrical dome 20 provided with apertures 20a, 20b, and 20c disposed about the pipe, coupling, and nipple, an externally threaded sleeve 22 secured at one end to the plate and disposed closely about the pipe and tube, a mounting nut 24 carried on the sleeve, and a gasket 26 carried on the sleeve between the nut and a kitchen sink top 28 provided with an opening 28a.

Referring now to FIGURE 1, which shows the device installed, a line 30 connects the discharge pump of a dishwashing machine that is mounted under sink top 28, but not shown in the drawing, to the lower end of pipe 12 which is bent in the direction of line 30 to communicate therewith via a connector 32. Waste water discharged by the dishwashing machine pump into pipe 12 passes upwardly therethrough into coupling 18 wherein the direction of upward flow is generally reversed in U-shaped passage 18c. From coupling 18, the waste water passes downwardly through nipple 16 and discharge across an air gap through opening 10b into upper flared end 14a of tube 14, the air gap being established by virtue of the spacing maintained between the nipple and the tube. The lower unsecured end of tube 14 is bent in the direction of a line 34 with which the tube communicates via a connector 36. Waste water after passing through tube 14 and line 34 passes into a waste disposal unit 38 or a conventional waste water drain outlet pipe connected below a kitchen sink 40. Subsequently the waste water passes through means not shown, but usually including soil pipe and sewerage tile, into a public sewerage system, septic tank, or other waste receiver.

Considering the device as installed in detail now,
reference is made particularly to FIGURES 4 and 5. Circular plate 10 is oriented in a horizontal plane, and rests on top 28 at hole 28a therein. Externally threaded sleeve 22 is soldered or otherwise secured at the upper end thereof to the underside of plate 10 inwardly from the peripheral edge thereof, the sleeve depending from the plate through hole 26b in top 28. Nut 24, which is threadably mounted on sleeve 22 below top 28, compresses the top and annular gasket 26, which is carried on the sleeve by nut, between plate 10 and the nut. Sleeve 22 further accommodates portions of pipe 12 and tube 14 for a short distance below plate 10. Pipe 12 is oriented vertically and is being soldered or otherwise secured to plate 10 at opening 10a through which the pipe passes. The portion of pipe 12 below sleeve 22 may be of any length as to be bent in any convenient manner, while the portion of the pipe above the plate is preferably held to a minimum length. The upper end of pipe 12 is terminated in an oblique manner for reasons set forth later, i.e., the upper end of the pipe generally defines a plane that is oblique to the axis of the pipe. The upper end of pipe 12 extends into coupling 18 at inlet 18c thereof to communicate with generally U-shaped passage 18c defined by the coupling. At outlet 18d, coupling 18, which is in communication with passage 18c, the upper end of the nipple extending into the coupling and being soldered or otherwise secured thereto at the outlet. The upper end of nipple 16, similar to that of pipe 12 is terminated in an oblique manner for reasons set forth later, i.e., the upper end of the nipple generally defines a plane that is oblique to the axis of the nipple. As a general rule, the planes defined by the upper ends of pipe 12 and nipple 16 are inclined upwardly and inwardly toward one another at equal angles and at the same height and intersect in a line that passes centrally and transversely through coupling 18. Pipe 12 and nipple 16 are generally parallel to one another, being disposed in close side-by-side relationship.

Due to the relationship between pipe 12 and nipple 16, it is undesirable to attempt to form coupling 18 by bending a conduit, since a uniform passage 18c larger than the internal diameters of the pipe and nipple at the upper ends thereof should be maintained within the coupling to achieve the desired flow pattern therein and subsequently, a non-divergent flow discharge from the nipple. Preferably coupling 18 is cast, or formed by other metallurgical techniques that will accomplish the aforesaid desired structure.

The lower or terminal end of nipple 16 is unsecured, being disposed a predetermined distance above plate 10 at opening 10b therein to establish an air gap therebetween. The length of such air gap is advisable twice the internal diameter of nipple 16 at the terminal end thereof, and suitably within the range of about ½ to one inch. The terminal end of nipple 16 defines a plane normal to the axis of the nipple and is free from mechanical irregularities to insure a stable non-divergent flow discharge from the nipple.

Below plate 10 in close side-by-side relationship to pipe 12, tube 14 is disposed within sleeve 22 for a short distance in general coaxial relationship to nipple 16. Tube 14 is soldered or otherwise secured at flared end 14a to plate 10, the flared end being enlarged and generally elliptical in cross-section as shown in FIGURE 5, while the major portion of the tube is circular. Preferably tube 14 is larger than nipple 16, not only at flared end 14a but throughout, to insure that liquid received from the nipple will not accumulate in the tube and cause flooding at opening 10b of plate 10. Opening 10b in plate 10, as well as flared end 14a, is generally elliptical in cross-section, with the major axis of such ellipse being disposed in a plane normal to the plane defined by the axes of the nipple 16 and pipe 12 as shown in FIGURE 5 since any spreading or divergence of flow discharge from nipple 16 that may occur will tend to be in such plane. It will also be noted that the major axis of such ellipse lies away from the axis of nipple 16 remotely from pipe 12, since divergence of flow discharge also tends to occur in a direction away from the pipe. Other reasons for the illustrated geometry of flared end 14a, concerned with the flow pattern of air into tube 14 through apertures 20a, 20b, and 20c, are explained below. The portion of tube 14 below sleeve 22 may be of any convenient length as to be bent in any desired manner.

As may be best seen in FIGURES 3, 4, and 5, generally cylindrical dome 20 is disposed about coupling 18, nipple 16, and the portion of pipe 12 above plate 10. Dome 20 rests at its top on sink top 28, and also on coupling 18 at the zenith thereof. The internal diameter of dome 20 at the terminal end thereof is equal to or slightly less than the external diameter of circular plate 10, so that the terminal end of the dome may be press fitted by hand into removable frictional securing with the peripheral edge of the plate. A key 42 formed on the terminal end of dome 20 registers with a notch 44 provided in the peripheral edge of plate 10 to insure the mounting of the dome with apertures 20a, 20b, and 20c thereof in proximity to the air gap between nipple 16 and tube 14. Apertures 20a, 20b, and 20c are generally rectilinear, and embrace a horizontal plane slightly above plate 10 to a horizontal plane slightly above the lower end of nipple 16 as shown in FIGURE 4; the vertical expanse of the apertures is therefore generally equal to the length of the air gap between nipple 16 and tube 14. In FIGURE 5, 20c subtend an angle with the axis of the dome that embraces the elliptical cross section of flared end 14a of tube 14, as may be visualized from FIGURE 5. This configuration has been found to establish an air flow pattern, from the exterior of dome 20 to the interior thereof, that serves to counteract any divergence of the flow discharge from nipple 16 that may tend to occur. This phenomenon is due to the high velocity discharge of liquid across the air gap, a certain quantity of air from outside dome 20 being "drawn" therein, as in a Venturi tube. A plurality of narrow apertures 20a, 20b, and 20c are provided rather than a single wide aperture to prevent the deliberate or accidental insertion of objects large enough to block tube 14, for structural and esthetic reasons. Although the exact theoretical causation underlying the effect of non-divergent flow discharge from nipple 16 when the upper ends of pipe 12 and the nipple are terminated in the illustrated oblique manner is not accurately known, the following reasoning has been hypothesized. Since pipe 12 and nipple 16 are disposed in close side-by-side relationship, an abrupt reversal of liquid flow in passage 18c within coupling 18 is required. Liquid at the outer portions of passage 18c has a much greater distance to travel than liquid at the inner portions of the passage. This being so, flow pattern stability in passage 18c is disrupted, turbulence is generated, and an irregular divergent flow discharge from nipple 16 results. Termination of the upper ends of pipe 12 and nipple 16 in the oblique manner taught herein however, reduces fluid friction in proportion to the distance that liquid must travel through passage 18c since the passage is larger than the internal diameters of the pipe and the nipple. This proportionate reduction in fluid friction has a compensatory effect on the otherwise disrupting influence of passage 18c on flow pattern stability between pipe 12 and nipple 16.

To further reduce the disruptive effect of passage 18c, it is desirable to ream or internally chamfer the oblique ends of pipe 12 and nipple 16, as shown in FIGURE 4. Another equally important reason for so doing is to absent any abrupt ledges which could catch and accumulate food particles, detergents, and the like, with con-
sequent turbulence, flow irregularity, and divergence of flow discharge at nipple 16. Plate 10, pipe 12, tube 14, nipple 16, coupling 18, dome 20, sleeve 22 and nut 24 may be copper, brass, bronze, aluminum or similar materials that resist chemical deterioration and that are advantageously formed and secured to one another. Annular gasket 26 may be fabricated from any conventional plumbing sealing material.

Referring now to FIGURES 6 to 8, I have illustrated a second embodiment of my invention incorporating the principles above described and accomplishing the same advantageous results. As shown, this embodiment comprises a circular mounting member 110, a tube 114 having a flared end 114a with apertures 120a, 120b, and 120c and disposed about the pipe and the reverse bend thereof, an externally threaded sleeve 122 secured at its upper end to the mounting member and disposed closely about the pipe and tube, a mounting nut 124 carried on the sleeve, and a gasket 126 carried on the sleeve between the nut and a kitchen sink top 128.

The mounting member 110 is oriented in a horizontal plane and rests on the sink top 128. The externally threaded sleeve 122 which is formed integrally with, or otherwise secured at its upper end to the member 110 is provided with apertures 120a, 120b, and 120c and disposed about the pipe and the reverse bend thereof, extends downwardly through the hole in the sink top 128, and receives thereunder the nut 124 and the gasket 126 for securing the mounting member 110 on the sink top. The sleeve 122 further intimately receives portions of the pipe 112 and the tube 114, both of which are oriented vertically.

The portions of both the pipe and the tube below the sleeve 122 may be of any desired length to facilitate bending of the pipe and tube in any convenient manner. Preferably, the tube 114 is somewhat longer than the pipe 112. Also, to provide an extremely compact assembly, and to enable the tube to be fitted into standard size holes in sink tops, I embed the pipe 112 partially within the tube 114 by providing a partially cylindrical longitudinally extending indentation in the wall of the tube within which the pipe is received, as shown in FIGURE 8.

As a physical rule-of-thumb, it is generally recognized that turbulence in a fluid connection by traverse of a bend or other obstruction can be dissipated in a distance that does not exceed about 3.3 times the inner diameter of the conduit through which the fluid is flowing. As will be appreciated from FIGURE 1, however, the environmental and esthetic pre-requisites imposed upon an antisiphoning air gap device simply do not admit of following this rule, since the total height of the device above the sink top must be no more than about 3.5 inches, and must be confined within a maximum diameter of about 2 inches. Assuming an air gap of 1 inch, this leaves only about 2 inches for formation of the entire bend and discharge nipple. Consequently, the bend, whether it be formed as shown in FIGURE 4, or as shown in FIGURE 6, must mitigate turbulence of the fluid so as to result in discharge of fluid from the nipple into the outlet tube without splashing. The reasons why the construction of FIGURE 4 accomplishes this result have been explained above. The construction of the device shown in FIGURE 6 follows essentially the same reasoning.

In the FIGURE 6 embodiment of the invention, the pipe 112 at the closest possible point above the upper surface of the mounting member 110 has imparted to it a gentle curve in an outward direction to facilitate as large diameter a bend as feasible within the dimensions indicated above expressed, and the inverted U-shaped bend is made therein as smoothly as possible. In this manner, as explained in conjunction with FIGURE 4, turbulence is mitigated by increasing the flow path, reducing fluid friction as much as possible in proportion to the distance that the liquid must travel and avoiding to the extent possible sharp bends, obstructions and the like. These reasons that I make the U-shaped bend larger or longer than what would be occasioned by a simple bend in the pipe.

At the discharge end of the reverse bend, the nipple 116 is maintained as tight for the longest distance possible, and the same terminates in a plane normal to its axis and free from mechanical irregularities to mitigate turbulence in the discharging liquid. Also, the nipple 116 is inclined downwardly and inwardly toward the vertical rise of the pipe 112 so that the outlet of the nipple will be directed toward the inner margin of the flared end 114a of the tube 114.

The consequence of the above described shaping of the portions 116 and 118 of the pipe 112 is the formation at the upper end of the pipe of a configuration simply described as a shepherd's crook.

As in the previously described embodiment of the invention, the flared end 114a of the tube 114 is enlarged and generally elliptical in cross-section as shown in FIGURE 7. The tube is larger than the nipple 116, not only at its flared end but throughout, to insure that liquid received from the nipple will not accumulate in the tube and cause flooding at the air gap. As shown the major axis of the elliptically flared portion 114a is disposed in a plane normal to the plane of the shepherd's crook, i.e., the plane defined by the axes of the nipple 116 and the pipe 112, and the axis of the nipple 116 intersects the flared end 114a inwardly of its center.

The dome 120 is essentially a decorative cover for the unit. The dome rests at its lower edge on the sink top 128 and also at its zenith on the reverse bend 118. The internal diameter of the dome at the lower end thereof is equal to the external diameter of the mounting member 110, and the latter member preferably is of significant height so that the terminal end of the dome may be press fitted by hand into removable frictional securement with the peripheral edge portion of the member 110. Key 142 formed on the dome registers with a notch 144 provided in the peripheral edge of the member 110 to insure the mounting of the dome in proper position. Also, an O-ring seal 146 is received within a peripheral groove in the side wall of the member 110 to provide a seal between the member and the dome to prevent leakage of liquid onto the counter top. The dome is essentially the same size that described in conjunction with FIGURE 4, except that the apertures 120a, 120b and 120c are disposed opposite the air gap to minimize the possibility of liquid splashing through the apertures onto the sink top.

Air gap devices made in accordance with the teachings herein present have proved economical of manufacture and efficient and practical in operation, and have passed all of the applicable tests and standards of municipal water departments. Thus, it is to be appreciated that the invention provides an antisiphoning device for dishwashing machines and other appliances that is economical, compact, safe, quiet, splashless, hygienic, maintainence free, and esthetic.

Since modifications of the preferred embodiments of the invention described and illustrated here will occur to those skilled in the art, without departing from the scope and spirit of the invention, it is intended to limit the invention only by the appended claims.

I claim as my invention:

1. An antisiphoning device comprising a pipe, a nipple disposed in closed side-by-side relationship thereto, a coupling having a generally U-shaped passage connecting said pipe and nipple, and a tube aligned generally with said nipple and spaced a predetermined distance therefrom remotely from said coupling, said passage being larger than the internal diameters of said pipe and
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nipple at the connecting portions thereof and having an outer wall length substantially longer than that of a simple pipe bend, said connecting portions of said pipe and nipple defining planes oblique to the axes thereof each of which planes is inclined in the direction away from said coupling from the inner margin to the outer margin of said passage.

2. An antisiphoning device comprising a pipe having one end portion thereof bent in the form generally of a shepherd's crook and terminating in a discharge nipple, said shepherd's crook including a first section diverging outwardly relative to the other end portion of said pipe and a reverse bend section joining said first section to said nipple, said nipple being inclined toward the other end portion of said pipe, and a tube aligned generally with said nipple and spaced a predetermined distance below the free end thereof.

3. An antisiphoning device comprising a pipe having one end portion thereof bent in the form generally of a shepherd's crook and terminating in a discharge nipple, said shepherd's crook including a first section diverging outwardly relative to the other end portion of said pipe and a reverse bend section joining said first section to said nipple, said nipple being inclined toward the other end portion of said pipe, and a tube aligned generally with said nipple and spaced a predetermined distance below the free end thereof, said tube at the end thereof adjacent said nipple being of generally elliptical cross-section with the major axis of the ellipse disposed transverse to the plane of said crook and outwardly of the axis of said nipple.

4. An antisiphoning device comprising a mounting member, a relatively large diameter outlet tube secured to and depending from said member, and a relatively small diameter inlet tube partially imbeded in said outlet tube and extending through said mounting member, said inlet tube above said mounting member being bent in the form generally of a shepherd's crook and terminating in a depending discharge nipple aligned with and spaced upwardly from the open upper end of said outlet tube and defining an air gap therebetween.

5. An antisiphoning device comprising a pipe, a nipple disposed in close side-by-side relationship thereto, a coupling having a generally U-shaped passage connecting said pipe and nipple, said passage being larger than the internal diameters of said pipe and nipple at the connecting portions thereof and having an outer wall length substantially longer than that of a simple pipe bend, said connecting portions of said pipe and nipple defining planes oblique to the axes thereof each of which planes is inclined in the direction away from said coupling from the inner margin to the outer margin of said passage, and a tube aligned generally with said nipple and spaced a predetermined distance therefrom remotely from said coupling, said tube at the end thereof adjacent said nipple being of generally elliptical cross-section with the major axis of the ellipse disposed transverse to the plane of said coupling and outwardly of the axis of said nipple.

References Cited by the Examiner

UNITED STATES PATENTS

758,188 4/04 Miller 137—216
2,158,267 5/39 Arborgast 137—216 XR
2,287,534 6/42 Powers 137—216
2,303,949 12/42 Nordell 285—157 XR
2,655,024 10/53 Sway 137—216 XR
2,993,354 7/61 Bilde 137—216 XR
3,066,691 12/62 Lengyel 137—216

FOREIGN PATENTS

501,470 4/54 Canada.

ISADOR WEHL, Primary Examiner.

M. CARY NELSON, WILLIAM F. O'DEA, Examiners.