United States Patent

Countryman

[15] **3,656,512**

[45] **Apr. 18, 1972**

[54] **MIXING VALVE**

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[22] Filed: **Nov. 9, 1970**

[21] Appl. No.: **88,227**

Related U.S. Application Data

[63] Continuation of Ser. No. 796,511, Feb. 4, 1965, abandoned.

[52] **U.S. Cl.** **137/625.4,** 251/342

[51] **Int. Cl.** **F16k 11/02**

[58] **Field of Search** 137/525.1, 625.4, 625.48, 636.3; 251/64, 251, 342

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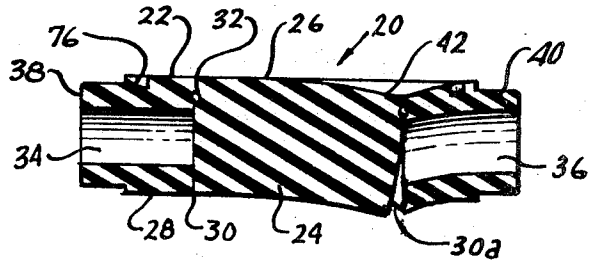
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Assistant Examiner—David R. Matthews
Attorney—Dybvig & Dybvig

[57] **ABSTRACT**

A deformable valve member having two spaced fluid inlet passageways has an arcuate exit passageway, selected portions of which are opened in response to a deforming force applied to the valve member. Embodiments of one- and two-piece valve members are disclosed.

Also disclosed are two single lever faucet constructions embodying a valve member and deforming means therefor.

33 Claims, 15 Drawing Figures



PATENTED APR 18 1972

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SHEET 1 OF 2

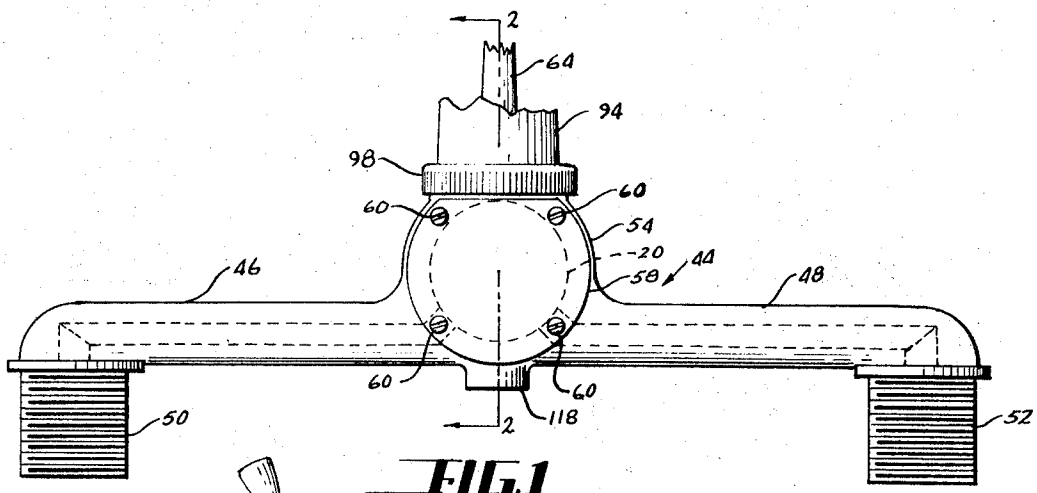


FIG. 1

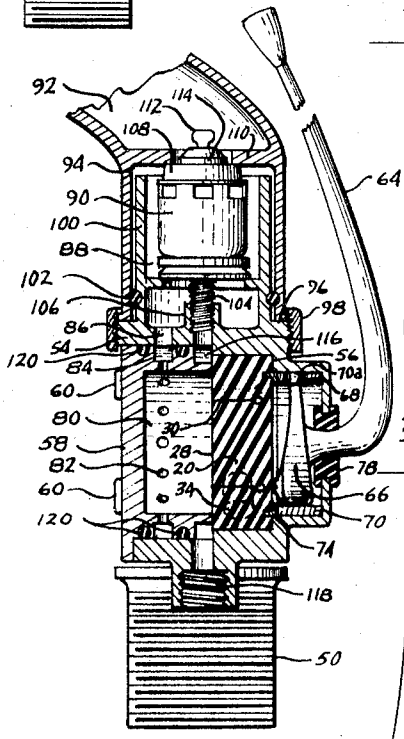


FIG. 2

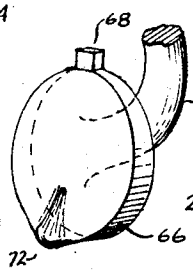


FIG. 2A

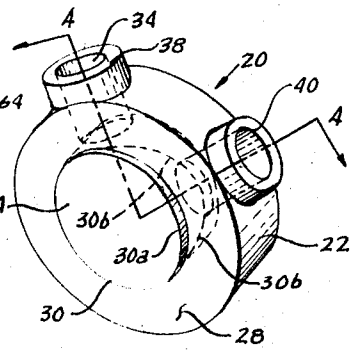


FIG. 3

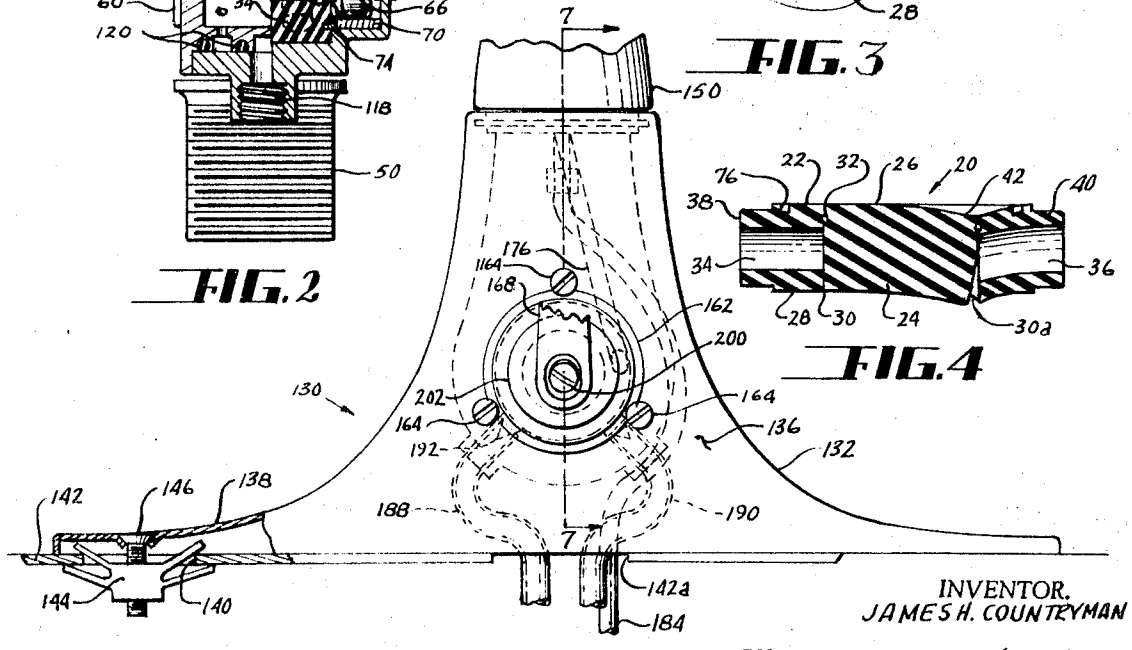


FIG. 6

FIG. 4

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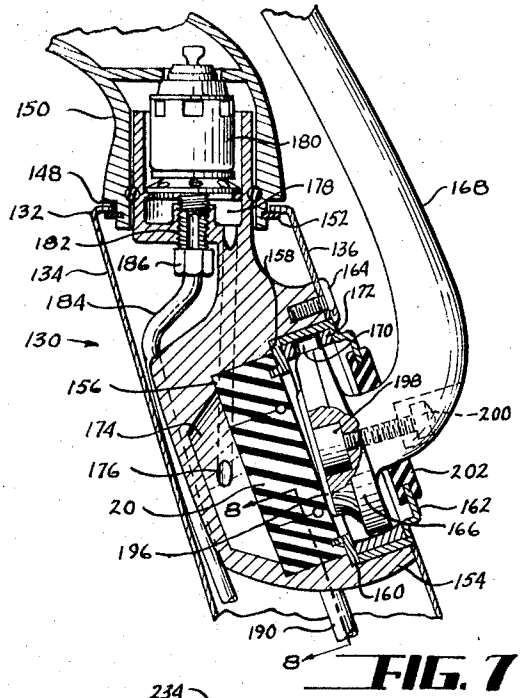


FIG. 7

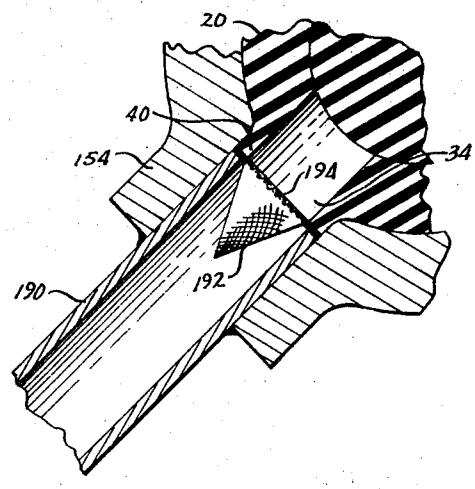


FIG. 8

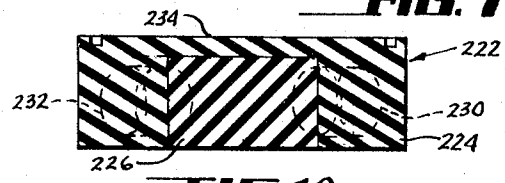


FIG. 10

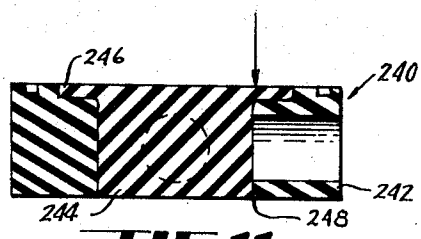


FIG. 11

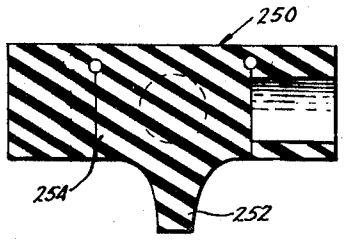


FIG. 12

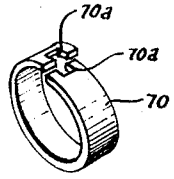


FIG. 13

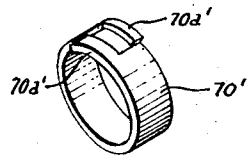


FIG. 14

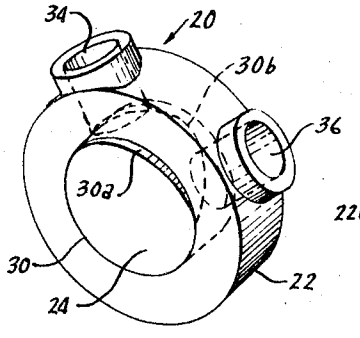


FIG. 5

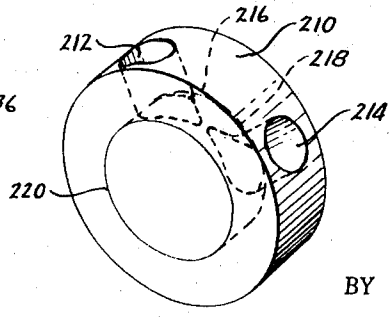


FIG. 9

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MIXING VALVE

"This is a streamlined Continuation of application Ser. No. 796,511, now abandoned."

This invention relates to mixing valves and more particularly to mixing valves for faucets having single controls. As will become apparent, the valves may be used for other purposes requiring the mixing of diverse fluids.

Faucets which have a single control lever or the like for mixing hot and cold water have become very popular in the last several years. Typically, the available single control faucets are of a complex construction having many parts and, accordingly, are quite expensive. Also, because of their complex constructions, they are difficult to install and service. Complexities encountered in such faucet constructions are primarily in the components forming the mixing valves and their operating mechanisms.

Many proposals have been made to simplify the construction of faucets controlled by a single lever or the like but the need still exists for a simple, inexpensive faucet construction yet one which is rugged and safe. Many of the proposed faucet constructions, for example, have not been satisfactory because they easily slip out of adjustment or their mixing valves are left open in the event the valve operating mechanism is damaged. These conditions can lead to accidental scalding as well as loss of water.

Accordingly, it is an object of this invention to provide an improved valve member which is generally useful for mixing diverse fluids and especially useful in faucet constructions controlled by a single operating member. In accordance with this invention, a one-piece or two-piece valve member is provided, the member having an outer rim and an inner core which normally seals against the inner surface of the outer rim. The inner ends of a pair of spaced fluid inlet passageways are closed by the sealed rim and core. A fluid exit passageway is provided by deforming the valve member such that a gap is created between the inner core and the rim. Those skilled in the art will recognize that the valve member has many advantages. For example, the rubber or other material forming the valve member may be so chosen that the valve member is substantially unaffected by freezing and is free from corrosion.

It is also an object of this invention to provide an improved mixing valve for apportioning and controlling the volume of diverse fluids. The mixing valve includes a deformable valve member opening to a mixing chamber and means for applying a deforming force to the valve member. In this connection, it is another object of this invention to provide a mixing valve in which unwanted or accidental mixing of the diverse fluids before they flow toward the mixing chamber is prevented.

Another object of this invention is to provide improved simplified valve operating mechanisms for single lever faucets. In accordance with this invention, valve operating cam means are provided on the control lever of a single lever faucet, the cam means being rotatable by the control lever and clamped by a clutch ring that frictionally restricts the pivotal movement of the control lever used to vary the volume of water permitted to flow. The clutch ring itself is snugly confined within the faucet or valve housing to frictionally restrain the rotation of the control lever that results in the apportioning of the hot and cold water.

Another object of this invention is to provide relatively simple and inexpensive faucet constructions embodying the novel mixing valves and control levers.

Other objects and advantages will become apparent from the following description and the drawings in which:

FIG. 1 is a front elevational view of a portion of a faucet which may be made in accordance with this invention;

FIG. 2 is a cross sectional view as viewed in the direction of arrows 2—2 of FIG. 1;

FIG. 2A is a perspective view of a portion of the mechanism shown in FIG. 2;

FIG. 3 is a perspective view of a valve member made in accordance with this invention in one condition of operation;

FIG. 4 is a cross sectional view of the valve member taken along the section line 4—4 of FIG. 3;

FIG. 5 is a perspective view similar to FIG. 3 but showing the valve member in a different operating condition;

FIG. 6 is a rear elevational view of a modified faucet construction which may be made in accordance with this invention;

FIG. 7 is a cross sectional view of the construction of FIG. 6 as viewed in the direction of arrows 7—7 thereof;

FIG. 8 is a cross sectional view of a portion of the apparatus of FIG. 7 viewed in the direction of arrows 8—8 thereof;

FIG. 9 is a perspective view of a modified valve member in accordance with this invention;

FIGS. 10, 11 and 12 are each cross sectional views of separate modifications of valve members in accordance with this invention;

FIG. 13 is a perspective view of a clutch ring which may be used in the faucet construction of either FIGS. 1 or 6; and

FIG. 14 is a perspective view of a modified clutch ring.

Referring first to FIGS. 3 and 4, a one-piece valve member, generally designated 20, is illustrated therein which may be made from neoprene rubber or other satisfactory elastomeric material in the form of a generally cylindrical body member having a circular outer rim 22 which encircles a cylindrical inner core 24. The valve member 20 has a planar substantially unbroken rear face 26 and a planar front face 28 which is broken by an annular slit 30 that defines the line of separation between the outer rim 22 and the inner core 24. A ring-shaped cavity 32 may be formed at the base of the slit 30 inside the valve member 20 when molded. The outer rim 22 has two circumferentially spaced fluid inlet passageways 34 and 36 open to the cylindrical outer periphery thereof and extending substantially radially therethrough along axes perpendicular to the center axis of the inner core 24. For reasons discussed below, radially extended annular flanges 38 and 40 aligned with the fluid inlet passageways 34 and 36, respectively, may be formed integrally with the valve member 20.

The valve member 20 is so constructed that, when undeformed, the slit 30 has no finite width and, accordingly, the contiguous, confronting surfaces of the outer rim 22 and the inner core 24 are in sealing engagement and the inner ends of the passageways 34 and 36 are blocked by the cylindrical outer surface of the inner core 24. When a deforming force is applied in an axial direction to the rear face 26, the outer rim 22 and the inner core 24 will separate, causing a widening of the slit 30. By applying this deforming force in an axial direction at a point aligned with the slit 30, the greatest spread between the inner core 24 and the outer rim 22 will occur on the front face 28 directly opposite the point at which the deforming force is applied. The ring-shaped cavity 32 is provided to resist splitting of the body of the valve member 20 which could ultimately result in an extension of the interior end of the slit 30 through the valve member 20. Also, the web of elastomeric material between the cavity 32 and the rear face 26 serves as a flexible hinge. Because of this hinge the slit 30 is more readily spread in response to a deforming force.

FIGS. 3 and 4 illustrate the valve member 20 in a deformed condition with its rear face 26 depressed at a point designated 42 which is axially aligned with the slit 30 along a line common to the central diameter of the inner end of the fluid inlet passageway 36. When thus deformed, the outer rim 22 and the inner core 24 separate along a line which follows an arcuate, generally conical path 30*b* to form a fluid exit orifice opening to the front face 28 of the valve member 20. The maximum gap, designated 30*a*, between the inner core 24 and the outer rim 22 is aligned with the center of the circular inner end of the fluid inlet passageway 36.

In FIG. 3, the inner ends of the inlet passageways 34 and 36 are shown mutually circumferentially spaced by 90° and the arc of the exit orifice is substantially 180°. Because of the shallow depth of the extreme ends of the exit orifice, it is open only to the inlet passageway 36 in FIG. 3. The area of the exit orifice open to the inlet passageway 36 can be changed by varying the depth of the depression in the rear face 26 caused by the applied deforming force. It is thus seen that the valve

member 20 can be used as a volume control for water or other fluids entering through the inlet passageway 36. Due to the resiliency of the valve member 20, this fluid exit orifice is closed when the deforming force is removed. The maximum arc through which the slit 30 opens is preferably substantially 180°. This arc depends in part upon the durometer of the valve member and upon the degree of deformation, but by confining the valve member 20 under radial compression, as will be discussed below, the arc of the maximum opening will be substantially 180°.

It is believed apparent from the foregoing that the position of the fluid exit orifice could be so changed as to open only to the inlet passageway 34 by changing the point at which the deforming force is applied. Further, the exit orifice could occupy an infinite number of intermediate positions open partially to the inlet passageway 34 and partially to the inlet passageway 36. Thus, in FIG. 5, the deforming force has been applied in an axial direction at a point aligned with the slit 30 midway between the centers of the fluid inlet passageways 34 and 36. The fluid exit orifice is, accordingly, open equally to both fluid inlet passageways 34 and 36.

The valve member 20 can advantageously be used in a mixing valve for apportioning the fluid flowing from the inlet passageways 34 and 36 through the fluid exit orifice formed by separation of the confronting surfaces of the outer rim 22 and the inner core 24. The volume of water permitted to flow from both inlet passageways 34 and 36 through the exit orifice can also be controlled by controlling the depth of the depression formed in the rear face 26 by the applied deforming force.

In addition to the obvious simplicity and economy of manufacture resulting from the design of the valve member 20, there are numerous other advantages to this invention. By suitable choice of materials, the valve member 20 will be substantially non-corrodible. For example, commercially available neoprene rubber compositions can be used to form valve members 20 which are essentially corrosion free when used in water faucets. The valve member 20 is also substantially unaffected by freezing, again assuming a suitable choice of materials. In practice the slit 30 need never be spread to more than about one-half its depth. Therefore, there is no danger of accidental mixing of the diverse fluids, such as hot and cold water, flowing into the inlet passageways 34 and 36. The valve member 20 can be made quite small whereby many designs of faucets and the like which were heretofore impossible can now be employed. Those skilled in the art will recognize that faucets employing a valve member 20 could be widely used in deck or wall type installations for sinks, lavatories, showers and so forth. Since the valve member 20 responds to a simple, substantially axially directed force, it is obvious that a variety of simple valve operators or actuators could be employed in association therewith.

FIGS. 1 and 2 illustrate a single lever faucet construction embodying the valve member 20 described above. The valve member 20 is housed in a mixing valve body generally designated 44 having hot and cold water ducts 46 and 48, respectively, with remote ends 50 and 52, respectively, adapted to be inserted through standard holes in a kitchen sink or the like for connection to water supply lines (not shown). The valve body 44 further includes a generally cylindrical, upstanding midportion 54 which, as shown in FIG. 2, is hollow, the hollow bore of which has an annular shoulder 56 against which the valve member 20 is clamped by a housing cap 58. The housing cap 58 is a generally cylindrical member having a closed outer end affixed to the midportion 54 of the body 44 by screws 60. The innermost, ring-shaped annular end of the housing cap 58 abuts the front face 28 of the valve member 20 near its outer periphery. When a deforming force is applied to the rear face 26 of the valve member 20, as will be described below, the inner end of the housing cap 58 acts as an abutment preventing movement of the valve member 20 therepast. The valve member 20 is so located in the bore of the housing portion 54 that it closes the bore intermediate its ends and its fluid inlet passageways 34 and 36 are aligned with the conduits or water delivery passageways within the ducts 46 and 48. Preferably the valve member 20 is pressed by force into the cavity in the housing midportion 54 so that it is radially compressed to insure a good seal between the confronting faces of the inner core 24 and the outer rim 22 except when the valve member 20 is deformed.

A valve operating control lever 64 is mounted in a chamber formed by the rear face 26 and the housing bore in the rear of the housing midportion 54 for rotation about an axis aligned with the axis or centerline of the valve member 20. For this purpose, a circular, valve actuating cam plate 66 is connected to or integral with the end of the control lever 64 inside of the housing midportion 54, the cam plate 66 having a protuberance 68 (FIG. 2A) which projects into a slot or notch in a clutch ring 70 snugly confined within a reduced diameter portion of the bore of the housing midportion 54. Because of this interengagement between the clutch ring 70 and the cam plate 66, the clutch ring 70 rotates with the control lever 64 about the center axis of the valve member 20. At any rotated position thereof, the lever 64 may be pivoted relative to the clutch ring 70 generally about an axis transverse to the center axis of the valve member 20. The clutch ring 70 is preferably made from spring steel prestressed to tightly clamp against the outer periphery of the cam plate 66. Because so prestressed, the clutch ring 70 will automatically compensate for any wear of its inner surface or the outer edge surface of the cam plate 66.

The cam plate 66 has a forwardly extending lobe 72 positioned to engage the rear face 26 of the valve member 20 along the arcuate surface thereof aligned with the previously described slit 30. The frictional force exerted by the clutch ring 70 is greater than the restoring force of the valve member 20. Accordingly, the cam plate 66 is held by the clutch ring 70 in any tilted position. When the control lever 64 occupies the position shown in FIG. 2 wherein the cam lobe 72 just touches the valve member 20, the valve member 20 is undeformed and, because of its inherent springiness or restoring force, coupled with the radial compressive force applied thereto, the inner core 24 fully blocks the fluid inlet passageways 34 and 36. By virtue of the pivotal mounting of the control lever 64 within the clutch ring 70, it can be pivoted in a clockwise direction, as viewed in FIG. 2, to apply the aforedescribed deforming force to open or spread selected portions of the slit 30. The portions spread open will depend upon the position of the control lever 64 to which it has been rotated about the center axis of the valve member 20. The area of the opening will depend upon the angle through which the cam plate 66 is tilted relating to the same axis.

When initially pivoted in a clockwise direction from that position shown in FIG. 2, the control lever 64 begins to pivot about the point of engagement between the protuberance 68 and ring 70. Preferably, the ring 70 has an outer diameter slightly smaller than the confining bore of the housing portion 54. Accordingly, the ring 70 will slip in a direction transverse to its centerline as pivotal movement of the lever 64 is continued. As a result, the lever 64 tends to pivot primarily about the point of engagement between the cam lobe 72 and the rear face 26 of the valve member 20. The deforming force thus applied to the valve member 20 is, therefore, almost entirely along an axis parallel to its center axis.

Also shown in FIG. 2 is an annular restraining ring 74 which has a right angled V-shape in cross section, one leg of which bears against the inner edge of the clutch ring 70 to provide a bearing surface therefor and the other leg of which extends into an annular notch 76 (FIG. 4) in the rear face 26 of the valve member 20. The restraining ring 74 engaging in the notch 76 overcomes any tendency of the valve member 20 to pull away from the bore in the housing midportion 54 when a deforming force is applied. A rubber grommet 78 may be located in the aperture in the rear of the housing midportion 54 through which the control lever 64 extends to prevent an accumulation of dirt around the cam plate 66. Also the grommet 78 may be designed to serve as a stop preventing the application of an excessive deforming force to the valve member

20. Other stop means (not shown) may also be provided for this purpose.

The spreading of the slit 30 permits water under pressure to flow from the ducts 46 and 48 through the fluid inlet passageways 34 and 36 and the fluid exit orifice formed by the spread slit 30 into a mixing chamber 80 which is formed by the hollow interior of the housing cap 58 and the abutting front face 28 of the valve member 20. The construction of FIG. 2 illustrates the manner in which a valve member 20 in accordance with this invention can be embodied in an overall faucet of simple design. Water mixed in the mixing chamber 80 flows through outlet ports or passageways 82, of which several may be provided as shown in FIG. 2, into an annular recess or groove 84 cut in the outer periphery of the housing cap 58, and, thence, through a water outlet port 86 into a diverter valve chamber 88 and through a diverter valve conventionally shown at 90 into the upper part 92 of a swing spout 94. The spring spout 94 can conveniently be rotatably mounted upon a horizontal ledge 96 formed on the housing midportion 54 and clamped to the housing midportion 54 by a clamping nut 98. Side support for the swing spout 94 is provided by an upwardly extending diverter valve housing portion 100 which receives the diverter valve 90. An O-ring seal 102 is provided between the swing spout 94 and the diverter valve housing portion 100.

Since the diverter valve 90 may be of a conventional construction, it is not described in detail herein. The specific diverter valve 90 illustrated is commercially available and includes a hollow, internally threaded stem 104 which is threadedly engaged in a boss 106 projecting centrally upwardly from the mixing chamber 80. The diverter valve 90 also includes an annular sealing member 108 which seats against an apertured plate 110 in the swing spout 94 and a valve stem 112 which carries another annular sealing member 114 that is adapted to seat within the sealing member 108. Fluid communication is provided within the diverter valve 90 to the stem 104 and the boss 106 to an annular chamber 116 formed by an annular notch or recess at the inner end of the housing cap 58 and the confronting valve face 28. The chamber 116 opens to a depending diverter boss 118 which is internally threaded to receive a flexible fluid conduit of a spray head (not shown).

As known to those familiar with the art, water will normally flow from the mixing chamber 80 into the diverter chamber 88 and then through the seals 108 and 114 to the top part 92 of the spout 94. When a valve (not shown) associated with the spray head is opened, the diverter valve stem 112 automatically drops and the water then flows from the diverter chamber 88 downwardly through its stem 104 and ultimately to the spray head. Of course, it will be appreciated that the faucet illustrated in FIGS. 1 and 2 need not be provided with the diverter construction in the event a spray head or other secondary water outlet is not desired. In this case the upstanding boss 106 could be plugged and the diverter valve 90 omitted. It may be noted that the annular grooves 84 and 116 and the housing cap 58 are separated by the body of the housing cap 58 as well as by O-ring seals 120. Of course, as usual in faucet constructions of this type, a suitably designed escutcheon (not shown) would be provided to cover the ducts 46 and 48 as well as the housing midportion 54.

The faucet of FIGS. 1 and 2 can easily be assembled by inserting the control lever 64 and the clutch ring 70 into the bore of the housing midportion 54 and then positioning the ring 74 in the valve member 20 with the valve member 20 abutting the shoulder 56. Thereafter the housing cap 58 is inserted in the housing bore and the screws 60 threaded to affix the housing cap 58 to the housing midportion 54. Thereafter it is simply a matter of threading the diverter valve 90 in place and appropriately mounting the swing spout 94. This assembly would normally be the entire assembly that takes place during manufacture. The connections to the members 50, 52 and 118 would be made when the faucet is installed in a sink.

FIG. 13 shows one form of clutch ring 70 which may be used in the faucet of FIGS. 1 and 2, the clutch ring 70 in this case being a split ring with notches 70a in each end which, when assembled, will be aligned to receive the cam protuberance 68. The two ends of the split ring 70 are preferably twisted or offset with respect to one another, the ring 70 being prestressed in a slightly spiral shape. By virtue of this construction the ring 70 will tend to bear tightly against the confining surface of the ring 74 and the confronting inside rear surface of the housing portion 54. The rotational movement of the ring 70 and the control lever 64 is thus frictionally resisted. FIG. 14 shows a modified and preferred clutch ring construction, designated 70', which also is formed as a split ring with the ends thereof slightly offset. In this case the adjacent ends of the ring 70' have fingers 70a' at the opposite edges thereof which cooperate to form the notch for receiving the cam protuberance 68.

FIGS. 6 and 7 show portions of another, and presently preferred, faucet construction embodying the principles of this invention. Because of the comparatively small size of the valve member 20, the entire mixing valve assembly can be placed in a much smaller escutcheon than normal. In FIGS. 6 and 7 the construction is further simplified by connecting the valve assembly directly to the escutcheon. The faucet, generally designated 130, of FIGS. 6 and 7 includes an escutcheon 132 having a front wall 134 and a rear wall 136. These walls are integrally joined with an escutcheon top wall 138. The escutcheon 132 has a forwardly projecting midportion and downwardly and outwardly sloping side portions which cover the holes, one of which is shown at 140 in FIG. 6, conventionally provided in a sink deck or top, designated 142. The escutcheon 132 can be clamped to the sink top 142 as by a suitable connector 144 having a screw 146, the beveled head of which fits within a recess in the escutcheon top wall 138. As shown in FIG. 7, a central aperture 148 is located in the top of the upwardly extending midportion of the escutcheon 132 and the swing spout, designated 150, is rotatably mounted therein and connected thereto as by a snap ring 152. The entire faucet valve assembly of FIGS. 6 and 7 is mounted on the rear wall 136 of the escutcheon 132.

As shown in FIG. 7, the faucet valve assembly includes a housing comprising a housing body 154 having a bore extending from the rear wall thereof to form a cavity. The cavity has a first annular shoulder 156 intermediate its ends against which the front surface of the valve member 20 is abutted and a second annular shoulder 158 against which a restraining ring 160 is positioned. The restraining ring 160 is generally L-shaped in cross section with the base of the "L" fitting into the annular notch 76 in the valve member 20 and performs the same function as the restraining ring 74. The valve housing further includes a housing cap 162 which in this case is a cup-shaped member, the cylindrical wall of which projects into the bore of the housing body 154 and the inner end of which bears against the restraining ring 160. The housing cap 162 is held in position on the housing body 154 by screws 164 which pass through the escutcheon rear wall 136 and are threaded into the housing body 154. Accordingly, the screws 164 not only hold the housing cap 162 in place but also serve as the mounting means for supporting the faucet valve on the escutcheon rear wall 136. Confined within the chamber formed between the housing cap 162 and the valve member 20 is a cam plate 166 which may be connected to or integral with a valve control lever 168 projecting through an aperture into the housing cap 162 and outwardly behind the escutcheon. The cam plate 166 has a protuberance 170 engaging in a notch in the clutch ring 172 frictionally bearing against the restraining ring 160 and a confronting, internal surface of the cap 162. The clutch ring 172 may be identical to either the clutch ring 70 or the clutch ring 70' described above and, for the reasons discussed in connection with FIGS. 1 and 2, should have an outer diameter smaller than the internal diameter of the surrounding portion of the housing cap 162. In FIG. 7, the inside surface of the clutch ring 70 is shown to be slightly concave to match the

slightly rounded or convex outer edge of the cam plate **166**. As a result, there will be a more uniform resistance to pivotal movement of the control lever **168**. The concavity of the inside surface of the ring **70** is optional because it may be desired that the resistance to pivotal movement of the control lever **168** be non-uniform to enhance the "feel" of the movement of the control lever **168** from the valve closed to the valve open positions.

The front face of the valve member **20** in FIG. **7** cooperates with the wall at the inner end of the bore in the housing body **154** to form a mixing chamber **174** from which the mixed water flows through an outlet passageway **176** cored in the housing body **154** into a diverter chamber **178** having a diverter valve **180** therein. The diverter valve **180** is shown having a stem **182** threaded into the top of the housing body **154**. A flexible spray hose **184** is connected by a coupling **186** to the diverter valve stem **182**. As shown in FIG. **6**, the spray hose **184** passes downwardly in the escutcheon **132** around the housing body **154**. Water under pressure is supplied to the housing body **154** through a hot water supply or delivery line **188** and a cold water supply or delivery line **190**. The lines **188** and **190** along with the hose **184** can conveniently pass through the standard center aperture, designated **142***a*, in the sink deck or top **142**.

With reference to FIGS. **6** and **8**, the supply lines **188** and **190** may be welded or otherwise connected to the housing body **154** and project into fluid delivery bores formed in the housing body **154** for this purpose. The valve member **20** is so positioned in the bore of the housing body **154** that the fluid inlet passageways **34** and **36** are aligned with the water supply lines **188** and **190**. FIG. **8** illustrates the manner in which the radially extending annular flange **40** projects into the delivery bore for the water supply line **190**. A strainer **192** can conveniently be trapped between the confronting ends of the flange **40** and the supply line **190**. The strainer **192** may comprise a generally conical member having an annularly flanged base **194**. As illustrated by dotted lines in FIG. **6**, another strainer **192** is similarly trapped between the flange **38** and the line **188**.

The primary purpose of the annular flanges **38** and **40** is to prevent collapse of the fluid inlet passageways **34** and **36** when a deforming force is applied to the rear face of the valve member **20**. The water pressure within the hot and cold water ducts or delivery lines acting against the internal surfaces of the flanges **38** and **40** should avoid collapse of the passageways **34** and **36**. The flanges **38** and **40** also form pressure seals preventing any possibility of water leakage around the valve member **20**. The pressure seals thus provided are not essential and, as an alternative, the flanges **38** and **40** could be omitted and plastic sleeves or the like (not shown) may be inserted in the inner ends of the fluid delivery passageways in the valve housing, the plastic sleeves projecting partially into the fluid inlet passageways **34** and **36**.

The valve member deforming means of FIGS. **6** and **7** is constructed differently from that of FIGS. **1** and **2** and includes, in addition to the cam plate **166**, a bearing member **196**. The bearing member **196** is a flat, circular disc having a rounded or beveled edge and further having a centrally located cylindrical axle or hub **198** which is received rather loosely within a bore in the front face of the cam plate **166**. When the control lever **168** is manually rotated, the bearing member **196**, because of its frictional engagement with the rear face of the valve member **20**, does not rotate. However, the bearing member **196** does pivot with the cam plate **166**. Accordingly, there is little or no frictionally caused wearing away of the valve member **20**.

If desired, an adjusting screw **200** may be provided which is threaded in the end of the control lever **168** and coaxial with the center axis of the cam plate **166**. The inner end of the screw **200** abuts against the rear face of the axle or hub **198**. It can be appreciated that the force exerted by the screw **200** against the bearing members **196** and **198** can be preadjusted. This preadjustment can be used to change the response of the valve member **20** to the pivotal movement of the control lever **168**. The lower end of the control lever **168** may be encircled by a rubber grommet **202** which seals off the aperture in the housing cap **162**. As described in connection with the grommet **78** shown in FIG. **2**, the rubber grommet **202** may limit the pivotal movement of the control lever **168** in a clockwise direction from that position shown in FIG. **7**.

The assembly of the faucet construction of FIGS. **6** and **7** is also quite simple. Before connection to the sink top **142**, the lower end of the swing spout **150** is first inserted through the aperture **148** and the snap ring **152** applied thereto. The housing **154** with the valve member **20** and restraining ring **160** in place can then be appropriately positioned in the escutcheon **132** from below. The control lever **168** can be preassembled with the bearing disc **196**, the clutch ring **172** and the housing cap **162** with the grommet **202**. This preassembly is then inserted through the rear wall **136** of the escutcheon **132** and affixed in place by the screws **164**.

It will be appreciated that various features of the faucet assembly of FIGS. **1** and **2** could be interchanged with the assembly of FIGS. **6** and **7**. Thus, the assembly of FIGS. **1** and **2** could have a cam construction with the bearing disc **196** as the valve deforming means. Also, for example, the flexible diverter hose **184** of FIG. **7** could be replaced by a bore or passageway cored in the housing body **154**. As apparent, an important difference between the two faucet assemblies illustrated are that the faucet assembly of FIGS. **1** and **2** is assembled from the front and the faucet assembly of FIGS. **6** and **7** is assembled essentially from the rear. In both cases the valve assemblies may be easily installed from the top of the sink or other surface to which they are to be connected. Disassembly and repair can also be accomplished entirely above the sink. The great ease with which these faucets may be installed and serviced, in contrast to many existing faucets, should be apparent.

FIGS. **9**, **10**, **11** and **12** show various modifications of the valve member **20**. The modified valve members do not have the optional annular flanges **38** and **40**. Otherwise, the valve member **210** of FIG. **9** is constructed identically to the valve member **20** except that it has fluid inlet passageways **212** and **214** which are circular throughout most of their length but have enlarged bases **216** and **218**, respectively, designed to more accurately meter or apportion the amount of hot and cold water supplied regardless of the width of the fluid exit orifice caused by opening of the slit **220** when a deforming force is applied to the valve member **210**.

The valve member **222** of FIG. **10** has an elastomeric outer rim **224** and an elastomeric inner core **226** with fluid inlet passageways **230** and **232** again extending through the body of the outer rim **224**. In FIG. **10** the valve member **222** is made in two pieces, the outer rim **224** being closed along its rear face by a web **234**. The cylindrical portion of the outer rim **224** and the web **234** form a cup-shaped receptacle for the inner core **226** which, in this case, is disc-shaped and snugly received within the outer rim **224** with its rear face intimately engaged with, and preferably cemented to, the web **234**, and its front face coplanar with the front face of the outer rim **224**. When confined within a valve housing, the operation of the valve member **222** of FIG. **10** will be essentially identical to the operation of the valve member **20** previously described. If desired, the inner core **226** could be made from a more rigid material, such as a plastic, provided that there is sufficient restoring force in the outer rim to return the valve member **222** to the shape shown in FIG. **10** after a deforming force applied thereto has been removed. In lieu of cementing the inner core **226** to the web **234**, spring means (not shown) could be housed with the valve member **222** which act against the front face of the core **226**. Even such spring means may not be necessary if the outer rim **224** is adequately resilient.

FIG. **11** shows another two-piece valve member designated **240** having a circular outer rim **242** and a cylindrical inner core **244**. The rear face of the inner core **244** has a radially extended annular flange **246** received within a cooperating

recess or counterbore in the rear face of the outer rim 242. Again both the inner core 244 and the outer rim 242 may be elastomeric but the inner core 244 could be made from a different material. The operation of the valve member 240 again is substantially identical to the valve member 20, the slit, designated 248, being opened in response to an axially directed force as indicated by the arrow in FIG. 11.

FIG. 12 illustrates a valve member designated 250 which is constructed similarly to that of the valve member 20 but includes a centrally located resilient tongue 252 of elastomeric material projecting forwardly from the front face of its inner core 254. As conventionally illustrated, the tongue 252 may be integral with the valve member 250. The tongue 252 serves as a resilient valve closing means which would coact with a confronting surface of the valve housing means, such as the inner confronting end of the mixing chamber 174 or the mixing chamber 80, so that, when the deforming force exerted by the cam means at the end of the control lever is removed, the tongue 252 resiliently urges its associated core 254 back to its original position.

In all of the valve members disclosed herein, the fluid inlet passageways, such as the passageways 34 and 36, are circumferentially spaced on center axes that intersect at an angle of substantially 90° and the axes thereof are also perpendicular to the axial centerline of the valve members. Although the inner ends of the passageways 36 are preferably circumferentially spaced by 90° because of the simplicity of the valve assemblies which can result from this relationship, it will be apparent that substantial variations would be workable. That is, the fluid inlet passageways could extend through the outer rims of the valve members at angles different from 90° relative to the center axis of the valve members and the inner ends of the fluid inlet passageways could be mutually spaced by more than or less than 90°. It may be desired, for example, to space these axes at an angle of less than 90° for a quicker response to the rotation of the associated control levers for mixing hot and cold water. Conversely, the fluid inlet passageways may be spaced by more than 90° for purposes of more completely isolating the hot and cold water inlets.

Those skilled in the art will appreciate that various elastomeric compositions, such as neoprene rubber, may be used in the manufacture of the valve member 20 and the other valve members disclosed herein. Of course, for mixing any fluids, the valve member 20 should be of a composition substantially inert thereto.

Having thus described my invention, I claim:

1. In a fluid mixing valve, a valve member having first and second faces and a fluid exit orifice opening to said first face defined by contiguous surface portions of said valve member extending from said first face toward said second face, a pair of fluid inlet passageways opening to said contiguous surface portions between said first and second faces, at least a portion of said valve member being resiliently deformable and constructed such that part of said surface portions are spread apart when a force acting in a direction toward said first face is applied to said valve member, valve operating means engageable with said valve member for applying a deforming force acting toward said first face, means engaging said valve member restricting movement of said valve member in the direction of the applied force whereupon said valve operating means may be actuated to apply a deforming force acting in said direction to open selected portions of said fluid exit orifice thereby to selectively open at least part of one or parts of both of said fluid inlet passageways through said fluid exit orifice depending upon the location at which said deforming force is applied.

2. The apparatus of claim 1 wherein said valve member is generally cylindrical, said fluid exit orifice being circular, and wherein said valve operating means includes rotatable means rotatable about an axis aligned with the centerline of said circular fluid exit orifice and engaging said second face of said valve member at points axially aligned with parts of said fluid exit orifice.

3. The apparatus of claim 2 wherein said valve operating means comprises a manually operable valve control lever, said rotatable means comprising cam means connected to said control lever, a clutch ring rotatably movable and axially confined within and frictionally engaging said housing means in surrounding relation to said cam means and clampingly engaged therewith, said cam means including a protuberance projecting into an aperture in said clutch ring whereby said cam means may pivot about the point of engagement of said protuberance with said clutch ring to apply varying amounts of deforming force to said valve member.

4. In a fluid mixing valve, valve housing means having a mixing chamber, a valve member within said housing means, said valve member having a pair of fluid inlet passageways extending partially therethrough and a fluid exit orifice communicating between the inner ends of said fluid inlet passageways and an outer surface of said valve member opening to said mixing chamber, said fluid exit orifice being defined by contiguous surfaces of relatively movable parts of said valve member which comprise a generally circular outer rim and a generally cylindrical inner core which are normally in sealing engagement relative to one another, and at least said outer rim being made from resiliently deformable elastomeric material whereupon said parts may be moved relative to one another to open said fluid exit orifice, valve operating means for applying a deforming force to said valve member to open selected portions of said fluid exit orifice, and a fluid outlet passageways extending from said mixing chamber through said housing means.

5. The apparatus of claim 4 wherein said outer rim and said inner core are integrally formed from elastomeric material.

6. The apparatus of claim 4 wherein said fluid inlet passageways extend through said outer rim from its outer surface.

7. The apparatus of claim 4 wherein said fluid inlet passageways have axes perpendicular to the center axis of said inner core and mutually circumferentially spaced by substantially 90°.

8. A mixing valve comprising: housing means having spaced fluid delivery passageways, a mixing chamber, and a fluid outlet passageway leading from said mixing chamber to the exterior of said housing means, a valve member having an inner core and an elastomeric outer rim separated by a normally closed slit in the front surface of said valve member and extending at least partially into said valve member, said outer rim having a pair of spaced fluid inlet passageways open to said fluid delivery passageways and having spaced openings to said slit, abutment means fixed within said housing and engaging the front surface of said outer rim to prevent displacement of said valve member past said abutment means, and valve actuating means including means engageable with the rear surface of said valve member constructed and arranged for exerting a deforming force against the rear surface of said valve member to cause said inner core and said outer rim to separate along a portion of the engaged surfaces thereof whereupon said slit is widened to form a fluid exit orifice opening to said mixing chamber.

9. The mixing valve of claim 8 wherein said housing means includes a valve body having a bore receiving said valve member, said valve member being radially compressed by said bore.

10. The apparatus of claim 8 wherein said housing means comprises a housing body having a bore therein, said valve member being located adjacent one end of said bore, said housing means further including a hollow, generally cylindrical housing cap received within said bore, said housing cap being closed at one end, and having spaced, isolated annular recesses in its outer surface, one of said recesses providing fluid communication from said mixing chamber to a first opening exteriorly of said body and the other of said recesses providing fluid communication through said body to a second opening exteriorly of said body.

11. In a fluid mixing valve, valve housing means defining a closed bore, said valve housing means having a pair of fluid delivery passageways through the wall thereof and opening to said bore intermediate its ends, a valve member confined within said bore and closing said bore intermediate its ends, said valve member having a pair of fluid inlet passageways, one end of each of said fluid inlet passageways being aligned with the inner ends of said fluid delivery passageway, said valve member further having spaced front and rear surfaces facing opposite ends of said bore and said valve member having relatively movable parts, the contiguous surfaces of which are normally in sealing engagement and define a slit opening to said front surface and open to the inner ends of said fluid inlet passageway, said front surface and one end of said bore defining a mixing chamber, a fluid outlet passageway extending through the wall of said housing means from said mixing chamber, said rear surface and the other end of said bore defining a chamber, valve operating means including means engaging said rear surface mounted for rotatable and pivotal movement in said chamber and further including control means projecting from said chamber exteriorly of said housing, at least one of said parts of said valve member being resiliently deformable whereby portions of said slit may be spread in response to said pivotal movement of said valve operating means, the portions so spread being determined by the rotary position of said valve operating means.

12. In a single lever faucet of the type having valve housing means confining a mixing valve member responsive to pivotal and rotational movement of a control lever for apportioning the hot and cold water supplied to a mixing chamber, the improvement comprising cam means on said control lever engaged with said valve member, and a clutch ring made of spring material clampingly surrounding said cam means and axially confined within said housing means for frictionally resisted rotation therein, said cam means and said clutch ring having interengaging surfaces about which said cam means may be pivoted.

13. The improvement of claim 12 wherein said valve member is at least partially elastomeric and has parts deformed and separated upon pivotal movement of said cam means toward said valve member.

14. The improvement of claim 12 further including an escutcheon having an aperture in its rear wall, said control lever projecting through said aperture, and means connecting said housing means to said escutcheon.

15. The improvement of claim 12 wherein said clutch ring is movable in said housing generally transversely of the axis of rotation of said control lever.

16. The improvement of claim 12 wherein said cam means includes a rotatable cam and a bearing disc with a hub received by a bore in said cam, said bearing disc being confined between said cam and said valve member.

17. The improvement of claim 16 further including adjusting means engaging said hub of said bearing disc and connected to said lever for presetting the relative positions of said disc and said valve member.

18. A disc-shaped valve member having parallel front and rear surfaces, an arcuate slit opening to said front surface, said slit being defined by inwardly directed contiguous surface portions of said valve member, at least one fluid passageway extending through a portion of said valve member and opening to said slit between said front and rear surfaces, and being closed from said front and rear surfaces, said valve member including resiliently deformable portions adapted to be deformed by application of a deforming force to said rear surface to widen said slit along a portion of the length thereof and open said fluid passageway to said front surface.

19. The device of claim 18 wherein said valve member is formed in one piece from an elastomeric material.

20. The device of claim 19 wherein said slit is generally circular, the interior end of which terminates in a ring-shaped cavity.

21. The device of claim 19 further including a second fluid passageway opening to said slit between said front and rear surfaces, the openings to said slit of said first mentioned and said second fluid passageway being spaced apart along the length of said slit.

22. A valve member having spaced front and rear surfaces with two relatively movable parts having confronting faces defining a slit opening to said front surface, one of said parts having a pair of fluid passageways opening to said slit, at least one of said parts being resilient and deformable whereby the width of portions of said slit may be changed by the application of a deforming force to said rear face, the other of said parts being generally cylindrical and encircled by said one of said parts, and the ends of said passageways opening to said slit having axes perpendicular to the center axis of said cylindrical part and mutually circumferentially spaced by approximately 90°.

23. For use in a mixing valve, a deformable valve member comprising an outer rim of elastomeric material and an inner core received within said outer rim, said outer rim having a pair of spaced fluid passageways extending therethrough, and said valve member being constructed to have an undeformed shape wherein the outer surface of said inner core blocks the innermost ends of said fluid passageways.

24. The valve member of claim 23 wherein said outer rim and said inner core are integrally formed from elastomeric material.

25. The valve member of claim 23 further including a web integral with said outer rim closing one end thereof, and wherein said inner core abuts said web and closes the other end of said rim except along the adjacent surfaces of said rim and said core.

26. The valve member of claim 23 wherein said outer rim is closed at both ends by said core and said core has a radially extending annular flange located in a recess at one end of said rim.

27. The valve member of claim 23 wherein said inner core has a resilient tongue projecting from one face thereof.

28. The valve member of claim 23 wherein said inner core is cylindrical and wherein the inner ends of said fluid passageways are circumferentially spaced by approximately 90°.

29. The valve member of claim 23 wherein said valve member has spaced, substantially planar front and rear faces, said outer rim is generally circular, and said inner core is generally cylindrical.

30. The valve member of claim 29 wherein said outer rim and said inner core are integrally formed from elastomeric material.

31. The valve member of claim 30 wherein said valve member has an interior, generally ring-shaped cavity adjacent said rear face, the web of said elastomeric material between said cavity and said rear face forming a hinge between said outer rim and said inner core.

32. The valve member of claim 29 further including a resilient tongue projecting forwardly from the front end face of said inner core.

33. For use in a mixing valve, a disc-shaped valve member having a closed rear surface and a front surface which is closed except along a circular, inwardly directed slit defined by contiguous surface portions of said valve member, a pair of fluid inlet passageways extending through the rim of said valve member along generally radial axes and opening to said slit internally of said valve member, said valve member including resiliently deformable portions adapted to be deformed by application of a deforming force to said rear surface and, when deformed, to cause said slit to widen along arcuate portions thereof.

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