June 6, 1961 O. V. PAGE 2,987,079

SINGLE LEVER FAUCET

Filed Feb. 5, 1959 2 Sheets-Sheet 1

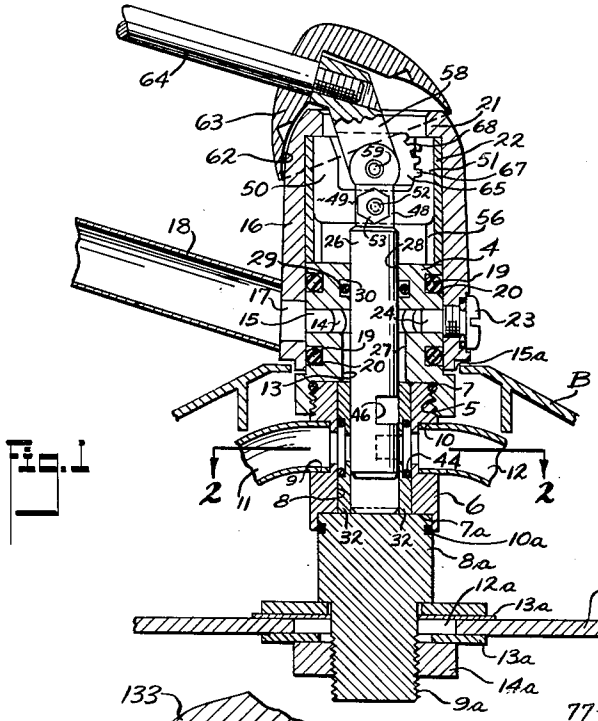

Fig. 1

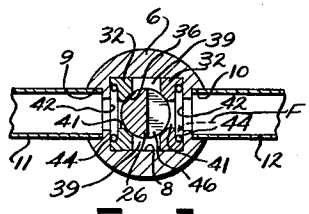

Fig. 2

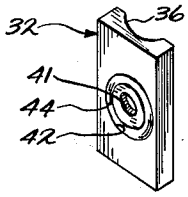

Fig. 2A

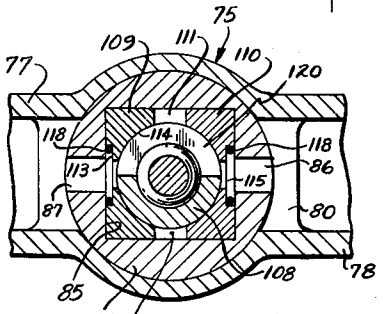

Fig. 4

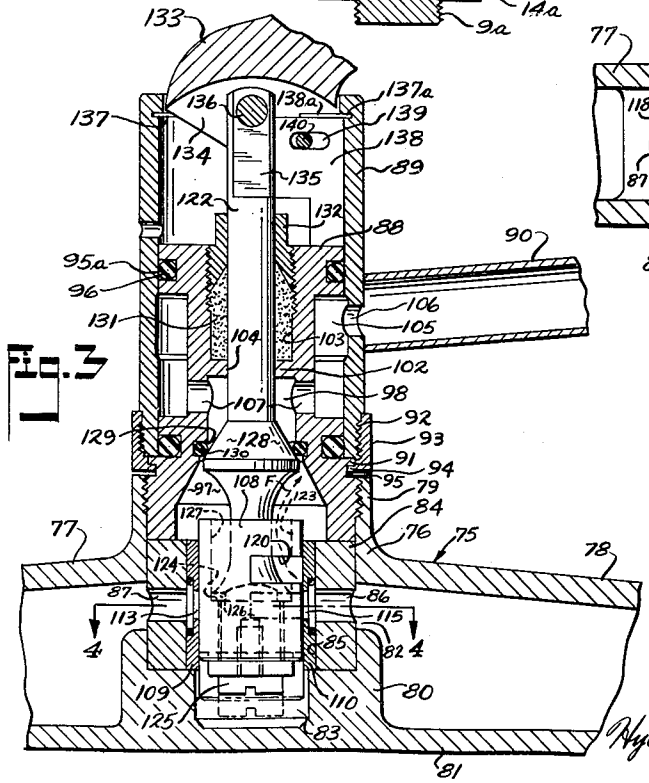

Fig. 3

INVENTOR.
OSWALD V. PAGE
BY
Hyde, Meyer, Baldwin & Doran
ATTORNEYS

June 6, 1961 O. V. PAGE 2,987,079

SINGLE LEVER FAUCET

Filed Feb. 5, 1959 2 Sheets-Sheet 2

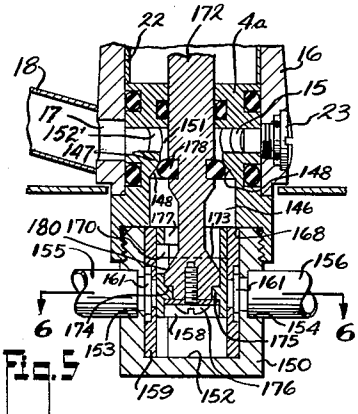

Fig. 5

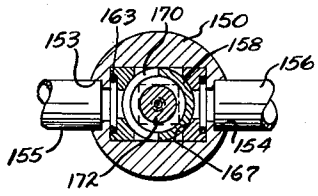

Fig. 6

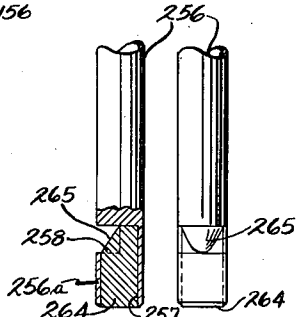

Fig. 11 Fig. 12

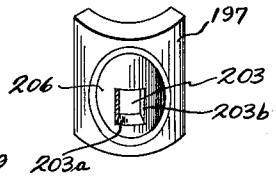

Fig. 8 A

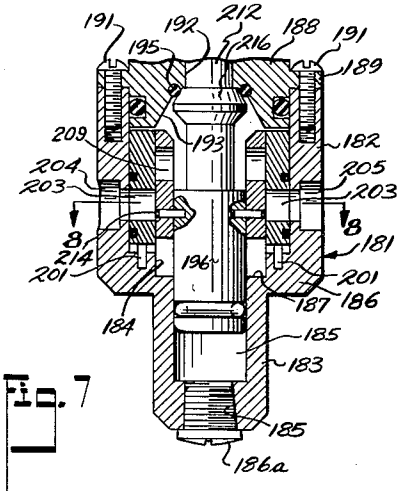

Fig. 7

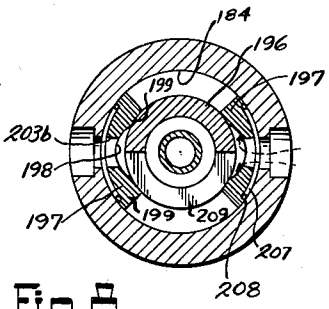

Fig. 8

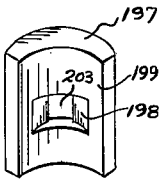

Fig. 8 B

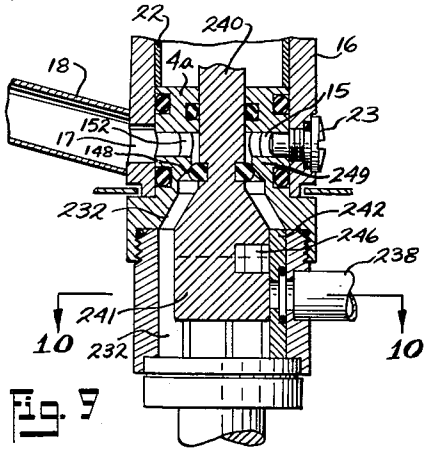

Fig. 9

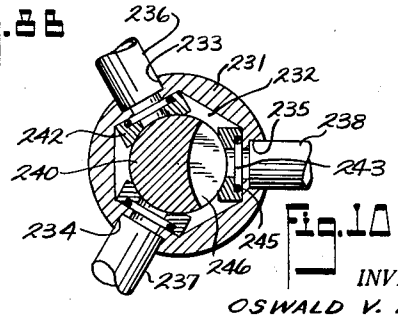

Fig. 10

INVENTOR.
OSWALD V. PAGE
BY
Hyde, Meyer, Baldwin & Doran
ATTORNEYS

United States Patent Office 2,987,079 Patented June 6, 1961

2,987,079

SINGLE LEVER FAUCET

Oswald V. Page, Mansfield, Ohio, assignor to Barnes Manufacturing Co., Mansfield, Ohio, a corporation of Ohio

Filed Feb. 5, 1959, Ser. No. 791,312
3 Claims. (Cl. 137—625.17)

This invention relates to fluid controls and more particularly to a new and improved fluid control valve wherein a single lever is actuatable to operate the valve and provide a regulated fluid output flow of one fluid or of a mixture of a plurality of fluids.

A primary object of the present invention is the provision of a new and improved fluid control valve especially designed for use with a plurality of different temperatured fluid inlet sources and wherein said valve has a single lever that is actuatable in one direction to control the volume of output fluid flow of one or a mixture of said plurality of fluids and actuatable in another direction to pre-select the proportionate amount of the fluid and/or fluids in said output flow.

Another object of the present invention is to provide a new and improved single lever control valve especially designed for use with a plurality of different temperatured fluids as referred to in the last object, and wherein the volume of fluid output flow for said mixture of fluids may be variably selected by operation of said lever in said one direction without effecting the proportioning adjustment made to said lever.

Still another object of the present invention is the provision of a new and improved fluid control especially designed for use with a plurality of different temperatured fluid inlet sources, and wherein said control has fluid control valve means which are actuatable by a single lever in one direction to an "on" position to provide a pre-selected volume of output fluid flow of one or of a mixture of said plurality of fluids, and actuatable while in said "on" position, in another direction, to pre-select a proportionate amount of the fluid and/or fluids in said fluid output flow.

Another object of the present invention is to provide a new and improved single lever control valve for use with a plurality of fluid inlet sources which, when not performing a mixing function prevents any commingling of said fluid inlet sources.

Another object of the present invention is the provision of a new and improved single lever fluid control and mixing valve as referred to in the above objects and further characterized by its structural simplicity, the ease of assembly of its parts and apparent low cost of manufacture.

Other objects and advantages of the present invention will be realized by one skilled in the art to which it pertains upon reference to the following description of several preferred embodiments thereof and to the accompanying drawings forming a part of this specification and wherein:

FIG. 1 is a longitudinal sectional view of one form of single lever fluid control valve embodying the present invention;

FIG. 2 is a fragmentary transverse sectional view taken approximately on line 2—2 of FIG. 1, however, with the valve stem moved to its "on" position;

FIG. 2A is a perspective view of the form of sealing pad used with the valve of FIG. 1, with said pad removed from the valve to more clearly show its configuration;

FIG. 3 is a longitudinal sectional view of a second embodiment of single lever fluid control valve embodying the present invention;

FIG. 4 is a fragmentary transverse sectional view taken

substantially on line 4—4 of FIG. 3 with the valve stem moved on its "on" position, and turned to a "mixing" position;

FIG. 5 is a fragmentary longitudinal sectional view of a third embodiment of single lever fluid control valve embodying the present invention and shown in its fully closed position;

FIG. 6 is a transverse section view taken substantially through the plane of line 6—6 of FIG. 5;

FIG. 7 is a fragmentary longitudinal sectional view of a fourth embodiment of single lever control valve embodying the present invention and which is also shown in its fully closed position;

FIG. 8 is a transverse sectional view taken substantially through the plane of line 8—8 in FIG. 7;

FIG. 8A is a perspective view of the sealing pad utilized in the valve embodiment of FIGS. 7 and 8;

FIG. 8B is a perspective view similar to FIG. 8A but showing the opposite side of the sealing pad;

FIG. 9 is a fragmentary longitudinal sectional view of a fifth embodiment of fluid control valve embodying the present invention and also shown in its fully closed position;

FIG. 10 is a transverse sectional view taken substantially on line 10—10 of FIG. 9;

FIG. 11 is a fragmentary longitudinal view of an alternate form of valve stem especially designed for use with the control valve of FIG. 1 showing the side configuration of the fluid diverting portion of said stem; while

FIG. 12 is a view similar to FIG. 11 however with the valve stem rotated approximately 90 degrees to show the frontal configuration of the fluid deflecting stem portion.

Briefly, the several preferred embodiments of the novel and improved single lever fluid control valve of the present invention, as shown herein in FIGS. 1 to 8 inclusive, is embodied merely for purposes of illustration for use in a fluid circuit having two separate fluid sources, each having a different temperature, for instance, hot and cold water, and which valve is operative to provide a controlled output flow of one or both of said fluids of a predetermined amount and mixture, or temperature. The instant fluid control valve is also operative in response to its being actuated to an "off" position to seal the fluid inlets connected thereto and hence stop the aforesaid output fluid flow and also to prevent a commingling of the inlet sources within the valve proper.

In the embodiment of control valve shown in FIGS. 9 and 10, said valve is connected in fluid circuit with what shall be hereinafter referred to as separate sources of hot and cold "soft" water, and, in addition, to a third separate source of cold "hard" water, the latter being preferably used for drinking purposes. The mixing valve is operative in a manner similar to the operation of the other valve forms to selectively provide a controlled output flow of one or both of said "soft" water sources of a predetermined quantity and mixture or temperature, or a controlled output flow of a predetermined quantity of said "hard" cold water.

The several embodiments of fluid control valve, as herein shown, are also each especially designed for use in a domestic installation such as a sink or wash basin. However, as will be hereinafter apparent to the artisan, the inventive concepts of the instant valve are also applicable for use in other types of valve constructions, for example, as a valve especially designed for use in a shower or tub appliance.

Therefore, the following disclosure of the preferred valve forms described herein is not intended to define limitations as to the invention concepts of the same.

Referring now to the drawings and more particularly to FIGS. 1 and 2, one embodiment of control valve of the present invention is herein shown, and includes a sub-

stantially cylindrical adapter member 4 formed of a suitable metallic material and having an internally threaded counterbore 5 formed centrally in its lower end, and into which the upper end of a valve body 6 is threadably received, said adapter member and valve body being thus disposed in longitudinal axial prolongation relative to each other. A suitable seal, such as rubber O-ring 7 may be interposed between the adjoining surfaces of said counterbore and valve body to thus provide a fluid leak-proof seal therebetween.

The valve body 6, as seen more clearly in FIG. 2, has a chamber 8 formed centrally therein which extends longitudinally therethrough, while in its instant form being substantially square in cross sectional configuration. A pair of counterbore ports 9 and 10 are formed in said valve body, and extend radially inwardly toward the center of the latter from diametrically opposite sides thereof and communicate with the aforesaid chamber 8. A hot water supply tube 11 and a cold water supply tube 12 are adapted to be inserted into the counterbored ports 9 and 10 respectively, being rigidly secured therein by means of soldering, or the like. In this manner, the separate sources of hot and cold water are each connected in fluid circuit with the valve body chamber 8.

The adapter member 4 is also centrally provided with a channel 13 which communicates on its lower end with the aforementioned counterbore 5 and hence the valve body chamber 8, and at its upper end wtih a plurality of circumferentially spaced ports as indicated at 14, and which preferably extend radially outwardly from the center of the adapter member, and which connect at their respective outer ends with an annular groove 15 formed on the outside surface of said adapter member.

The instant form of control valve is also provided with means to direct a controlled flow of fluid to the basin or sink of the domestic appliance, and for this purpose a tubular shaped support member or sleeve, as identified by the reference character 16, is slidably disposed over the adapter member 4 and has a port 17 formed in the annular wall thereof which is so positioned as to communicate with the aforementioned annular groove 15. A suitable spout 18 is rigidly mounted on the outside surface of said tubular sleeve in such manner as to connect with the port 17 as seen in FIG. 1, and is arranged to extend outwardly therefrom and over the appliance basin or sink. The tubular sleeve is also mounted over the adapter member 4 in such manner as to be freely rotatable to swing the spout 18 to any one of a plurality of positions over the basin or sink. A pair of O-rings 19, each being carried within an annular recess 20 formed in said adapted member above and below the aforesaid annular groove 15 formed on the latter, are arranged to engaged with the inside surface of the lower end of the tubular sleeve 16, and hence provides a fluid leak-proof seal therebetweten.

The upper end of the aforesaid sleeve is integrally provided with a radially inwardly projecting rim portion 21 which is arranged to extend over and slidably engage with the upper end face of bushing member 22, the latter being preferably placed within said sleeve and resting endwise upon the upper surface of the adapter member 4 so as to slidably support said sleeve throughout its rotatable actuation. If desired, a suitable fastener such as flat head screw 23 may be carried in the sleeve member and has a smooth shank portion 24 which is adapted to extend into the annular groove 15 to thus assist in guiding said member during its actuation. With this construction the tubular sleeve 16, as will be hereinafter apparent, is also effective to retain the above described components in their normal operative position as viewed in FIG. 1.

The bottom end of the valve body 6 is formed with a shallow recess 7*a* into which is brazed the head of a plug 8*a* by brazing ring 10*a*, said plug also having an externally threaded shank portion 9*a* which extends downwardly from the said valve body in substantial longitudinal prolongation. Said shank portion is adapted to be extended into a mounting hole 12*a* located in a structural member A of the aforesaid domestic sink or basin installation, being secured therein by means of suitable washers 13*a* and a lock nut 14*a*. In this manner, the adapter member 4 protrudes upwardly through an opening 15*a* in a metal escutcheon B resting upon the basin of the installation such as to position the spout 18 over the latter in the normal way.

As previously mentioned, the present form of fluid control valve is intended to provide a fluid output flow through the spout 18 of one or of a mixture of both the hot and cold water inlet sources, said flow being controlled as to volume and temperature.

To accomplish this, novel valve means are provided in the instant control valve, being interposed between the aforesaid inlet supply tubes 11 and 12 and said spout, and hence effective to control the fluid flow therebetween. More specifically, said valve means, as herein shown, includes a metallic, substantially cylindrical valve stem 26 which has its lower end centrally disposed in the valve body chamber 8. Said valve stem extends substantially vertically upwardly through the channel 13 in the adapter member 4 connecting with said chamber, being spaced radially inwardly of the walls of the same so as to define an annular passageway 27 therebetween. Said valve stem thence projects upwardly of said channel and through an aperture 28 formed centrally in the upper portion of said adapter member, and terminates thereabove within the aforementioned sleeve member 22. A suitable O-ring 29, carried within an annular groove 30 formed in said adapter member and opening to said stem, is positioned to engage with the surface of the latter and thereby provide a fluid leak-proof seal therebetween.

The instant form of valve means also includes a pair of sealing pads 32, which are disposed in the chamber 8 on preferably diametrically opposite sides of the valve stem 26, and which operate to center the latter in said chamber while also being effective to direct the inlet flow of hot and/or cold water into the chamber 8. As seen in FIG. 2, each sealing pad is substantially rectangular in section and is integrally formed with an arcuate groove 36 on its inner face, which groove preferably extends longitudinally centrally through the same. The contour of the arcuate grooves on each of said pads enables the curved pad surfaces defined thereby to closely fit partially around predetermined arcuate portions on the circumference of the valve stem 26. It is also intended that said pads engage the valve stem with a predetermined pre-load pressure so as to normally provide a fluid leak-proof seal therebetween, but said pressure being of such magnitude as to permit relative movement therebetween. As is shown in FIG. 2, each pad is substantially of the same thickness, having such dimension that only a part of the circumferential surface of said stem is embraced by said arcuate grooves so as to define a pair of separate fluid channels 39 between said stem and walls of the valve body chamber 8. Each of said channels communicates at its upper end with the aforesaid passageway 27. Each of said pads, in addition, is provided with a port 41 which communicates on its innermost end with the arcuate groove 36 and hence the valve body chamber 8, and at its opposite end with one of the aforesaid ports 9 or 10 connected respectively to the hot or cold water supply tubes 11 and 12. The end of the port in each of said pads remote from the valve stem 26 is counterbored, as is indicated at 42 which, with the adjacent wall of chamber 8 forms an annular recess which receives a suitable seal such as rubber O-ring 44. Another suitable seal which may readily be used is a "quad ring" as referred to in the art. Said seal is preferably of such size as to afford a sufficient fluid leak-proof seal between the pad and valve body and also to press said pad against the valve stem under a predetermined pre-load pressure.

Other operational features attributed to said seal as utilized in its present form will be hereinafter described.

The sealing pads of the present embodiment of valve structure and also in the valve embodiments hereinafter to be described are preferably constructed of a suitable prefabricated material, the structural characteristics of which will now be described.

As will be understood in the art, with the control valve connected in fluid circuit with the aforesaid inlet sources of hot and cold water, the fluid atmosphere of the valve inside is oftentimes undergoing transitional temperature changes. Therefore, in order that said temperature conditions do not affect the operative association between the sealing pads and the valve stem, the latter normally being preferably constructed of a suitable stainless steel, the pads are constructed of a synthetically formed material which affords substantially good wearing properties while presenting a low coefficient of friction to the movement of said stem, while at the same time, having highly effective self-sealing characteristics while perhaps experiencing a slight cold flow. Said sealing pad material is also intended to exhibit very high resistance to the effect of the moist atmosphere in which it is operating, and also to resist absorbing any fluids to which it may be subjected. Said pad material is also intended to be substantially unaffected by any sudden rapid changes in the temperature of the inlet fluids so as to prevent the sealing pad from being twisted or otherwise changed from its original configuration. In the present form of control valve, wherein the inlet fluids are cold and hot water, said pad material must therefore be capable of sustaining its original configuration while operating within a wide range of temperatures.

Still another important structural feature desired of the sealing pad formed of the aforesaid prefabricated material is that it should be capable of accommodating for minor changes in the surface and/or axial configuration of the valve stem **26**. The prefabricated material is intended to be sufficiently flexible to thus enable the sealing pad to maintain its sealing engagement with said valve stem and valve body while thus accommodating for the aforesaid minor structural changes in valve stem.

Several materials have been found to have the above noted qualities, but I prefer to combine one of a plurality of various materials with a base material known as "Teflon" in the art, and which is a poly tetrafluoroethylene resin sold commercially under the above name by the E. I. du Pont de Nemours & Company of Wilmington, Delaware. To this base material, I preferably add one of the following component materials, the quantity of which is identified by the volume it occupies, as defined in percentage, to the total volume of the combined material.

Teflon and one of the following:

	Percent of volume
Graphite	15–25
Copper	30–85
Glass fibers	20–25
Molybdenumdisulphids approximately	5

Still another synthetically formed material that has been found to present suitable operational and structural properties for said sealing pad is that material sold commercially under the name "Kel–F" by the M. W. Kellogg Company of New Jersey and which is a polymer of trifluorochloroethylene characterized by the formula

$$(CF_2—CFCl)$$

wherein the molecular weight of unplasticized material is from "76,000 to 110,000" and the polymer molecule consists primarily of a carbon skeleton and two halogens, fluorine and chlorine, present in the molecular rates of three to one, respectively.

Each of the Teflon and Kel–F materials above defined are substantially self-lubricating and have inherently good resistive properties to permanent deformation, and are, therefore, adequately suited for the present use.

As will also be further understood in the art, the manufacturing tolerances need not be as rigidly maintained when using a synthetic sealing pad as when utilizing a metallic pad. In actual use, it has been determined that with a pair of said synthetic sealing pads disposed within the instant valve chamber **8** in their above described operational location, the width of said pads may be such that a clearance of the order of .007–.010 inch may be experienced between the side surfaces of said pads and the side walls of said chamber. In like manner, each of said pads may be of such a thickness that a clearance of the order of .006 inch may also be experienced between the end surface of each pad, opposite the arcuate groove **36**, and the adjoining apertured wall of said chamber. With the sealing pads thus formed and mounted in the valve chamber **8** wherein the aforesaid spacing is realized between said pads and chamber walls, it is hence realized that said pads are actually floatably suspended within the aforesaid chamber by and between the O-ring **44** and the valve stem **26**, the surfaces of the arcuate grooves **36** and the O-ring **44** engaging respectively with the valve stem **26** and adjacent walls of the chamber **8** in substantially a fluid leak-proof relation. In this manner, said sealing pads are also substantially self aligning and hence capable of maintaining the valve stem **26** in its central location within the chamber **8**.

The sealing pad may also be formed of a suitable metallic material such as brass or bronze and function in substantially the same manner as described above for the aforesaid fabricated pad material. However, it has been found that when using a metallic sealing pad, the dimensions therefor must be very closely maintained in order that the valve structure function property. It has also been discovered that the metallic sealing pad, being substantially non-flexible, is not adequately capable of accommodating for minor eccentricities in the configuration of the valve stem **26**.

To provide for the transgression of either and/or both the cold and hot water sources into the valve proper, the valve stem **26**, adjacent its lower end, is formed with a channel **46**, which extends transversely diametrically across said stem. The length of the channel as considered along the circumference of the stem is seen to extend through an arc of substantially 180 degrees and is also seen to be of such dimension as to be able to connect with either and/or both of the inlet ports **41** while connecting with either of the aforesaid chambers **39**. With this construction, it is realized, for instance with reference to FIG. 2, that the stem **26** may be positioned (as shown) such that the channel **46** is in registry with the port **41** which connects with the port **10** and hot water supply tube **12**, whereby an inlet flow of hot water may be supplied to the fluid channels **39**. In this position, the arcuate surface of the valve stem opposite to said stem channel is seen to engage with the sealing pad associated with the opposite side of the chamber **8** in a fluid leak-proof relation such that the port **9** and connected cold water supply are disconnected or sealed from the chamber **8**. Considering again the construction as seen in FIG. 2, it may hence be realized that the valve stem may be rotated approximately 180 degrees from the position illustrated in such manner that only the cold water supply, as provided by supply tube **11**, may be permitted to flow into the aforesaid fluid channels **39** of the valve body. As is now further apparent, said valve stem also may be so positioned that the channel **46** formed therein is in registry with the port in each of said sealing pads in any pre-selected relationship such that a mixture of the hot and cold water may flow into the fluid channels **39**, and hence provide a fluid mixture of a predetermined temperature.

With reference directed particularly to FIG. 1, the valve stem **26** is shown in its "off" position in solid lines,

wherein the aforesaid stem channel **46** is located above both of the ports **41** in the sealing pads **32** such that the solid portion of the valve stem below the channel **46** engages with said pad in a fluid leak-proof relation effective to seal said ports and connected hot and cod water inlets from the aforementioned fluid channels **39**.

Said valve stem is adapted to be slidably variably movable downwardly through the valve body **6** from the above defined "off" position as viewed in FIG. 1, to one of a plurality of "on" positions, including the fully "on" position indicated in dot-dash lines in FIG. 1, whereby the aforesaid stem channel **46** registers with either and/or both of said ports, and hence permits a corresponding inlet water flow into the aforementioned fluid chamber **39**.

To provide for this movement of the valve stem, its upper end is formed with a reduced shank portion **48** which extends upwardly centrally through the aforesaid cylindrical sleeve **22**. A guided lift member **49**, substantially U-shaped in configuration and having upstanding arms **50** and **51**, is rigidly fastened at its base part to said stem shank portion by means of fastener **52** and lock nut **53**. The inner wall **55** of the cylindrical sleeve **22** is additionally provided with diametrically opposed parallel grooves **56** extending longitudinally therealong and which slidably accommodate the arms **50** and **51** of said guide member. A rocker arm **58**, has its inner end extending between the aforesaid depending arms of the guide lift member **49** and is pivotally attached to the cylindrical sleeve **22** by means of a suitable pin **59**, said pivotal connection being in alignment with the axis of said valve stem. Said rocker arm thence extends from this pivotal connection angularly upwardly of the valve stem **26** and outwardly through the upper end of the tubular support member **16**. As previously mentioned, the outer surface of said support member, at its uppermost end, is curved inwardly toward its axis. This curved surface portion is adapted to slidably interfit the curved inner surface **62** of a hollow cap member **63**, the latter being somewhat oval-shaped in sectional configuration and placed over and enclosing said upper end of the support member. The cap member is also rigidly mounted on a valve stem operating lever **64**, which has its inner end securely fastened to the aforesaid rocker arm **58**. In this manner said cap member is retained in its operative position on the outer surface of support member **16**, being effective to prevent any foreign material from entering into the valve body **6**. The cap member is also operative to form a protective covering closing the open upper end of the valve body in all working positions of the valve stem operating lever **64** as will be hereinafter apparent.

The rocker arm **58** is, in addition, integrally formed with a laternally extending flat shoulder **65** adjacent its lower end, having a plurality of external segmental gear teeth **67** (arcuate about **59** as a center) and which mesh with suitably shaped internal rack teeth **68** formed on the guided lift member arm **51**.

With this construction it will now be apparent that with a pivotal actuation of the operating lever **64** in an upward direction, as view in FIG. 1, the rocker arm **58** is also pivoted clockwise about pin **59** such that the valve stem **26** is slidably driven longitudinally downwardly into the valve body **6** to one of a plurality of "on" positions to carry the valve stem channel **46** into any pre-selected degree of registration with either and/or both the ports **41** in the sealing pads **32** and thereby provide a predetermined volume of inlet fluid flow of either and/or both the hot and cold water supply sources into the fluid chambers **39** and hence through the connected annular chamber **13** in the adapter member **4** and communicating ports **14** to the spout **18**.

With both the hot and cold water inlet sources connected to the fluid channels **39**, the inlet fluid flow from each of said sources enters into the passageway **27** and is substantially mixed therein before passing through the ports **14, 15, 17** and connected spout **18**.

With a fluid inlet flow established through either and/or both ports **41**, the pressure exerted by said inlet flow tends to squeeze the O-ring **44** of the actuated port or ports more deeply into its annular supporting recess. Consequently, as the O-ring tends to be flattened out, it exerts a greater pressure on the adjoining walls of the valve body chamber **8** and the sealing pad **32** associated therewith, forming said recess, such as to increase the liquid leak-proof seal therebetween. In addition, as said O-ring presses against its associated sealing pad, said pad, in turn, presses more firmly against the valve stem **26**. Therefore, with either and/or both hot and cold water flowing into the valve proper, the pressure exerted thereby is effective to assist in retaining the valve stem in its actuated position and in addition provides a more effective fluid leak-proof seal between the sealing pads and the valve stem. It will now be further realized that with the valve stem being moved to a pre-selected "on" position it may thereafter be rotated to carry the stem channel **46** into selective registration with either and/or both the ports **41** in the sealing pads **32** such that the proportion of the respective cold and hot water sources entering into the aforesaid fluid chambers **39** may be varied and hence provide a mixed fluid inlet flow of a preselected temperature, which may then flow through the above described fluid passageways connected thereto and out through the spout **18**.

It will also be realized that with the fluid channels **39** communicating at all times with the aforesaid passageway **27** and the lower end of the chamber **8**, any fluid that may transgress to the latter may bleed out through said channels to said passageway and hence prevent the valve stem from being pressure-locked in an actuated condition, as will be understood in the art.

Summarizing the above operation of the control valve structure thus described, it is seen that the rate of the total fluid flow through the valve proper is controlled by a longitudinal movement of the valve stem **26** through the valve body **6** which changes the effective area of either and/or both of the inlet ports **41** in the sealing pads that register with the valve stem channel **46**. In like manner, the proportional amount of each fluid entering into the fluid chambers **39** forming a mixed flow and hence the temperature of the fluid inlet flow is regulated by a rotational movement of the valve stem while the latter is in its "on" position which is effective to change the position of registry of said stem channel **46** relative to either and/or both of said sealing pad inlet ports.

In FIGS. 3 and 4 I have shown another form of single lever control valve which also embodies the same inventive concepts as are hereinabove described.

Specifically, the instant form of control valve, as herein shown, includes a hollow casing **75** which has an enlarged central part **76** and a pair of tubular parts **77** and **78** integrally connected with the latter and preferably on opposite sides thereof. A suitable source of hot water (not shown) is adapted to be connected to the tubular part **77**, whereas, a source of cold water (not shown) is connectable to the tubular part **78**.

A cylindrical sleeve **84** is placed end-wise centrally into the casing **75**, its lower end being partially disposed within a partition **80** which is formed integrally with the casing base wall **81**. In addition said sleeve is formed with a square aperture **85** which as is seen in FIG. 3, extends longitudinally centrally therethrough. Ports **86** and **87** are formed in said sleeve, preferably at diametrically opposite sides thereof and communicate at their innermost ends with the aforesaid aperture **85** and at their outer end with channels **82**, the latter, in turn, formed in said partition and connecting with the tubular casing parts **77** and **78**.

A cylindrical adapter member or plug **88** has its one end threadably disposed in the throat **79**, and preferably

abutting the upper face of the sleeve **84** and extending upwardly therefrom in substantial longitudinal prolongation, as is best seen in FIG. 3.

A tubular member **89** mounts a spout **90** and as particularly seen in FIG. 3, said member is placed end-wise over a plug **88** which is threadably attached at its lower end to the central casing part **76**. The tubular member is attached to the plug **88** by means of a threaded collar **93** in such manner as to be freely rotatable on the aforesaid plug **88** to thus locate the spout **80** in any pre-selected position over the basin appliance (not shown) of the domestic installation. Suitable O-rings, as are indicated at **95***a* are carried by said plug and engage with the inside surface of the tubular member **89** on opposite sides of the spout **90**, and hence provide a suitable fluid leak-proof seal therebetween.

A cylindrical plug **88** is formed with a suitable mixing chamber **97** which opens at its lowermost end to the aforesaid square aperture **85** in the sleeve **84**, and thence extends upwardly therefrom to communicate with a cylindrical bore **98** formed in the medial part of said plug. Said chamber receives the fluid flow transgressing through the valve body in a manner presently to be described.

The outside surface of the plug **88** is provided with an annular recess which, with the interior wall of the surrounding tubular member **89** forms an annular chamber **105**. A port **106** connects the upper end of said annular chamber in fluid circuit with the spout **90**, carried on said tubular member. In like manner, as herein shown a pair of ports **107** preferably spaced in diametrically opposed relation to each other connect the lowermost end of said chamber **105** to the upper end of the previously mentioned cylindrical bore **98**.

The valve means adapted for use in the present form of control valve includes a cylindrical valve member **108** which is disposed within the square aperture **85** in the aforesaid sleeve **85**. Said valve member is located centrally with said square aperture, substantially in radially inwardly spaced relation to the walls thereof, by means of a pair of sealing pads **109** and **110**, respectively. Said pads are preferably constructed of the same synthetic material as the pads **32** in the previous form of control valve, having also substantially the same operational clearances between the surfaces thereof and the walls of said square aperture so as to be somewhat floatably suspended within the latter, and functioning similarly to said pads **32** so as to permit the valve member **108** to be rotatably and slidably movable within the sleeve **84** while yet engaging with said valve member in a fluid leak-proof relation and hence effective to prevent a transgression of fluid between the engaging surfaces thereof. Said sealing pads may also be constructed of the aforementioned metallic material in such case taking on the operational characteristics of said material as above described. As best seen in FIG. 4, the thickness of each of the aforesaid sealing pads **109** and **110** is such that only pre-selected spaced arcuate portions of the surface of said valve member are embraced by the same and thereby define a pair of fluid inlet channels **111** between the mutually facing sides of said pads, said channels communicating at their upper ends with the aforesaid mixing chamber **97**. The instant sealing pad **109** is likewise provided with a counterbored port **113**, located much like the port **41** in the previous form of sealing pad **32**, in such manner as to communicate at its outer end with the inlet port **87** in the sleeve **84** and hence the tubular casing port **77** and connected hot water inlet source. The port **113**, at its inner end, opens to the surface of the arcuate groove **114** formed on the inner face of said pad. In like manner, the sealing pad **110** is provided with a counterbore **115** which connects at its outer end to the inlet port **86** and hence to the cold water inlet, and at its inner end to the inner curved face of its associated arcuate groove on said pad.

With this construction, it is hence realized that the flow of each of the cold and hot water inlets is restricted

to the aforesaid inlet ports **86** and **87**, and their respective sealing pad ports **113** and **115**.

As is likewise seen in FIG. 4, the counterbored portion in each of the ports **113** and **115**, cooperates with the adjoining surface of the sleeve **84** to define an annular recess which surrounds the inlet port **86** or **87** associated therewith, and into which a rubber O-ring **118** is disposed. Like in the previously described embodiment, a sealing member commonly referred to in the art as a "quad ring" may also be utilized in said recess. Said seal is intended to operate in the identical manner to the O-ring **44** disclosed in the previously described embodiment, and hence an additional recitation of its function is deemed unnecessary.

With reference again directed to FIG. 4, the valve member **108** is provided with a channel **120** which extends circumferentially through the annular wall of the same for an arc of preferably 180 degrees. This preferred construction is such as to enable said valve stem channel **120** to be carried into communication with either and/or both ports **113** and **115** whereby the latter are connected in fluid circuit with the spout **90**, in a manner as will presently be described, and hence permit a predetermined fluid flow of either and/or both the cold and hot water inlet sources to transgress therethrough.

The valve member **108**, as seen in solid lines in FIG. 3, is disposed in its "closed" position, wherein the aforesaid channel **120** is above the ports **113** and **115** and hence the latter are sealed from the interior of the valve proper. In this position, the sealing pads **109** and **110** engage with said valve member such as to prevent any flow of fluid through said valve.

The valve member **108** is hence adapted to be movable longitudinally downwardly through the aforesaid sleeve **84** to a position such as is shown in dotted lines in FIG. 3, or any intermediate position, and thence while being held in said position, to be rotatably moved to carry the valve member channel **120** in said member into any one of a plurality of positions of registry with either and/or both the ports **113** and **115**.

For this purpose a suitable valve stem, such as is indicated by the reference numeral **122**, is centrally disposed within the casing **75** and extends into and is rigidly connected at its lower end to the valve member **108** by means of fastener **125**.

As best seen in FIG. 3, the portion of the valve stem disposed within the valve member **108** is spaced inwardly of the wall of said member being inwardly curved in such manner as to provide ample clearance to thus define a passageway as indicated at **127** between the surface of said stem and the adjacent surface of said valve member, said passageway communicating with the valve member channel **120** such as to accommodate a suitable flow of fluid therethrough when said valve member is in any of its open positions of adjustment.

The valve stem **122**, immediately above its inwardly curved portion, is integrally provided with an upstanding conical-shaped part, as seen at **128** which forms a valve head operable in conjunction with a suitable O-ring as indicated at **130** carried within the aforesaid plug **88**, surrounding said stem to thus define a valve seat. Said O-ring is intended to engage with the tapered surface of said conical-shaped port **128** of the valve stem when the latter is in its "closed" position so as to seal the fluid passageways located thereabove to fluid flow.

The upper part of the valve stem **122**, as seen in FIG. 3, extends upwardly through the plug **88**, being surrounded therein by a suitable packing material **131**. Said stem then protrudes upwardly through and above a packing gland nut **132** threadedly disposed in the upper end of the plug **88**.

As best seen in FIG. 3, the slotted end of an operating lever **133** extends into the upper end of the tubular member **89** and over the upper end of the valve stem **122**, being connected to the latter by a pin **136**.

With this connection thus made between the lever **133** and stem **122**, it is now seen that by swinging said lever about the stem axis, the valve member **108** will also be correspondingly rotated.

To move the valve stem **122** and hence the attached valve member **108** longitudinally through the aforesaid valve sleeve **84**, a flat plate as seen at **138** is placed end-wise into the tubular member **89** such that its one end rests upon the upper surface of the valve plug **88** and is slidable thereon. The opposite end of said plate projects upwardly into a slot **134** in the lever **133** and is provided with an aperture **139**, the latter being elongated in a plane perpendicular to the axis of the valve stem. A pin **140** is freely extendable into said aperture and has its ends anchored to the lever **133** spaced from the pin **136**. A ring **137** is disposed in an annular groove **137***a* located on the inner surface of the tubular member **89** adjacent its upper end, and is integrally provided with a tongue **138***a* which projects into the aforesaid slot in the lever **133** and above the adjacent upper end of the plate **138**. Said ring is intended to be carried around its supporting groove with a rotatable movement of said lever such that the tongue **138***a* remains in its position above said plate.

With this construction, it will thus be understood that by swinging the lever **133** in a vertical plane upwardly as viewed in FIG. 3, the plate **138** will be retained in the position shown, and hence said lever will be fulcrumed about the pin **140** to cause a corresponding downwardly directed movement to the valve stem **122** and attached valve member **108**.

This movement will unseat the conical-shaped part **128** of said stem from the O-ring **130** thereby connecting the several internal fluid passageways, as are above described, in circuit with the spout **90**, and, if said lever movement is of sufficient magnitude it will also carry the valve member **108** to a level within the aforesaid sleeve **84** such that its channel **120** is moved to a plane which enables the latter to be carried into registry with either and/or both the inlet ports **113** and **115** in the sealing pads **109** and **110**, respectively.

With the valve stem **122** and valve member **108** in this latter position, it will thus be understood that with a rotatable movement of the aforesaid lever **133**, said valve member channel may be carried into selective registration with the aforesaid inlet ports **113** and **115** whereby either the cold or hot water inlet sources or a mixture of both may be connected in circuit to the aforesaid fluid passageways and spout **90** flowing through the valve structure in the direction of the arrow F in FIG. 3. With this latter movement of the valve member whereby the proportionate amount of either or both the hot and cold water inlet sources is pre-selected, it will hence be realized that by moving the valve stem in a longitudinal direction within the sleeve **84**, the volume of the output flow may thereafter be selectively regulated. It will now be realized that in the instant form of valve means wherein the sealing pads are interposed between the fluid inlet ports and the adjustable valve member **108** the latter of which controls the input flow to said casing, and in addition with said sealing pads preferably constructed of a synthetic material of the type hereinabove described, said sealing pads are thus operative in a manner identical to the pads **32** of the previous form to provide a highly efficient control valve which is capable of operating through substantially a wide range of temperatures.

Summarizing the operation of the present form of mixing valve structure, it is now seen that the volume of the fluid flow through the valve is controlled by a longitudinal movement of the valve stem **122** which changes the effective area of either and/or both of the inlet ports **113** and **115** that registers with the valve member channel **120**. In like manner the proportionate amount of each fluid and hence the temperature of the total fluid flow is regulated by a rotational movement of the valve stem while the latter is in its "on" position.

In FIGS. 5 and 6 I show another embodiment of single lever control valves wherein several of the elements used therein are identical to those disclosed in the previous valve embodiment of FIG. 1; said identical elements being therefore designated in the instant form by the same reference numerals as were previously denoted. The particular modification as employed in the present valve structure will hence be hereinafter more fully explained. Referring now to FIG. 5, the instant form of control valve includes a cylindrical adapter member **4***a*, which corresponds to member **4** in the FIG. 1 valve construction, said instant member being modified in that the mixing chamber **146** is formed centrally therein adjacent its one end and is partially constricted at its one extremity by means of an angular wall **147**, the under surface of which faces said mixing chamber to thus form an upwardly and inwardly inclined annular valve seat **148**. In the present modified valve structure, the previously described solid plug **8***a* is replaced by a cup-shaped member **150** which is threadably disposed within the internally threaded counterbore **5***a* in said modified adapter member **4***a* in such manner as to extend in axial prolongation thereto. The interior of said cup-shaped member **150**, as is best seen in FIG. 6, is centrally provided with a rectangular-shaped chamber **152** which communicates at its one end with the mixing chamber **146**.

As in the previously described embodiment of control valve, the instant valve structure also includes the tubular shaped support member **16** upon which is rigidly mounted the spout **18**, said tubular member in turn being disposed over the adapter member **4***a* and suitably movably fastened thereto through the cooperative association of the aforementioned fastener **23** and peripheral groove **15**, the latter also being provided in the modified form of adapter member **4***a*. Said adapter member **4***a* is also centrally provided with passageway **151** adjacent the valve seat **148**, said passageway in turn connecting at its opposite end with a series of circumferentially spaced ports **152'**.

As in said previously described embodiment the tubular sleeve is also provided with a port **17** which connects the spout **18** in circuit with the passageway **151** and mixing chamber **146** to thus provide for the output fluid flow to transgress therethrough.

The aforementioned cup-shaped member **150** is also preferably formed with inlet ports **153** and **164** into which is rigidly secured by brazing or the like one end of a conduit **155** and **156**, respectively, the opposite ends of said conduits, each in turn, connecting to separate sources of cold and hot water. As best seen in FIG. 6, said inlet ports **153** and **154** are preferably disposed in said cup-shaped member in a substantially diametrically opposed relation such that they communicate with opposite sides of the chamber **152**.

The present form of valve construction is also operable to provide a regulated output flow from either and/or both the aforesaid hot and cold water inlet sources, and for this purpose said control valve includes valve means comprising a cylindrical sleeve **158** which is disposed in an endwise position within the aforesaid chamber **152**, being preferably centrally located therein by means of a pair of sealing pads **159**.

Each of the sealing pads **159** is preferably constructed of the same material and/or materials utilized for the paids **32** in the previous valve construction, and, in addition, is centrally provided with a counterbored inlet port **161** which communicates at its innermost end with the chamber **152**, and at its outer end with its adjacent fluid inlet port **153** or **154**.

With each of the sealing pads **159** disposed in their operative position in the chamber **152**, the portions of the inlet port **161** having the larger diameter, together with the adjacent end wall of the chamber **152** surrounding each of the inlet ports **153** and **154**, defines a recess into

which is disposed a suitable seal such as a quad ring **163**. Said quad ring is intended to be of a preselected configuration and possesses sufficient resilient characteristics as to engage with the wall of said chamber **152** and to force its associated sealing pad toward and against the sleeve **158** under a predetermined pressure.

Each of said pads is also formed on its inner face with an arcuate groove **167**, the contour of which corresponds to the circumference of the sleeve **158** whereby the surface of said grooves embraces the latter and closely fits around the surface of said sleeve in substantially a fluid leak-proof relation.

The sealing pads, in addition, are each preferably constructed under the same manufacturing tolerance as are hereinabove defined for the pads **32** in the FIG. 1 valve embodiment, and hence, when placed in their operative position within the chamber **152**, are normally slightly spaced from the walls of the latter as to be floatably suspended by and between said sleeve and quad ring seal.

As seen in FIG. 5, the diameter of the chamber **152** is slightly larger than the diameter of the mixing chamber **146** thereby forming an annular rim **168** therebetween. The sealing pads **159** are preferably long enough to extend longitudinally completely through the chamber **152** such that one end of said pad abuts against the closed end of the chamber **152** and the opposite end similarly abuts against the aforesaid annular rim **168**. In this manner, each of said pads is prevented from being moved longitudinally through and out of said chamber.

The cylindrical sleeve **158** is also provided with a slot **170** which preferably extends circumferentially at least 180 degrees therearound, adjacent one end of said sleeve. With this construction, it is intended that the sleeve **158** be manipulated by means identical to the valve actuating means in the previous valve form of FIG. 1 to hence position said slot **170** in preselective registry with either and/or both of the sealing pads inlet ports **161** and thus provide a regulated fluid flow of either hot or cold water or a preselected mixture of said fluids to the spout **18**.

For this purpose, a valve stem **172** extends centrally through the adapter member **4***a* and into the cylindrical sleeve **158**, in radially inwardly spaced relation to the latter, being provided on its lower end with a head portion **173** having an annular downwardly facing annular shoulder **174**. Said shoulder is adapted to extend over one face of an inwardly projecting rim **175** formed on the inner face of the cylindrical sleeve **158** and a flat plate placed over the opposite face of said rim and rigidly fastened as at **176** to the valve stem head portion **173** effective to securely fasten the aforesaid sleeve **158** to said stem. An annular fluid passage **177** is thereby defined between the outer surface of said stem and the inner surface of said sleeve.

Valve stem actuating means identical to that disclosed and described in the previous FIG. 1 valve structure is also utilized to obtain the desired movement for the valve stem and attached cylindrical sleeve in the instant valve embodiment, and therefore said actuating means need not be additionally disclosed nor further described in detail.

As seen in FIG. 5 the cylindrical sleeve **158** is disposed in the upper portion of the chamber **152** whereby the sleeve slot **170** is not in registry with either of the sealing pad inlet ports **161**. This position is therefore defined as the valve "closed" position.

In this valve "closed" position, a resilient valve element **178** carried on the medial portion of the valve stem **172** seats against the aforementioned valve seat **148** and hence seals the mixing chamber **146** from the spout **18** and interconnected fluid passageways **17**, **152** and **151**.

The cylindrical sleeve **158** is thereafter movable downwardly with said valve stem within the chamber **152**, as viewed in FIG. 5, by the previously described valve actuating means, to thus carry its slot into any desired vertical plane and degree of registry with either and/or both of the aforesaid sealing pad ports **161** to thus enable a fluid flow to transgress through said slot and annular passage **177** to the mixing chamber **146**. Said flow thence passes around the now unseated valve element to the fluid passageway **151** and connected spout **18**.

With an inlet flow passing into either or both of the sealing pad ports **161**, it will now be realized that a portion of said flow will tend to flow into the aforementioned sealing pad recess, following a course such as is indicated by the arrow A. As a result an additional force attributed to said flow will tend to force the sealing pad more firmly against the cylindrical sleeve **158**.

As is also seen in FIG. 5, the valve stem head portion **173**, substantially directly opposite the slot **170**, is provided with an annular wall **180** which inclines upwardly in the direction of fluid input flow.

This particular valve stem configuration is operative to substantially decrease valve noise created as a result of the input fluid sources entering the chamber **152** under pressure and being therefor diverted in still another direction to the interior of the valve proper. The inlet fluid flow passes through the sleeve slot **170** and is directed across said sleeve and toward the valve stem **172**. With the annular wall **180** formed on said valve stem, and with the same inclined upwardly and inwardly in the direction of fluid flow through the valve, said inlet flow is diverted in a much less abrupt manner which thereby creates substantially less turbulence and hence is effective to substantially reduce the aforementioned audible noise.

In FIGS. 7 and 8, another form of control valve is herein shown embodying the concepts of the present invention, the particular construction thereof now to be described in detail.

As best seen in FIG. 7, the instant valve structure includes a valve housing **181**, comprising an upper and a lower housing part **182** and **183**, respectively, said housing parts being integrally connected end to end, one to the other, in substantial axis prolongation. Said upper housing part **182** is centrally internally provided with a chamber **184** which communicates at its lower end with a similar shaped cavity **185** provided in said lower housing part **183**. The lowermost end of the housing part **183** is provided with an internally threaded aperture **185***a* which communicates with the cavity **185**. A suitable plug **186***a* is threadably disposed in said aperture and hence provides access to the interior of the valve housing **181**. As the diameter of the upper housing part **182** is substantially greater than the diameter of the lower housing part **183**, the respective diameters of the aforesaid chamber and cavity in said housing parts are likewise corresponding; the adjoining ends of the latter thereby defining a concentrically located annular rim portion **187**.

The valve structure also includes a suitable cylindrical plug **188** which corresponds to the plug **88** in the valve construction of FIG. 3, being modified in its present form by having an exteriorly extending annular shoulder **189** adapted to lie over the upper end face of the housing part **182** as is seen in FIG. 7, said annular shoulder being rigidly secured to said housing preferably at spaced peripheral points thereon by means of fasteners **191** to thus secure said plug in its operative position over the valve housing **181**. The plug **188** is also centrally provided with a suitable bore **192**, said bore communicating at its lowermost end with a counterbore **193** defining an annular groove **194** at its upper end. A suitable resilient seal such as O-ring **195** may be partially disposed within said groove so as to project outwardly therefrom and into the aforementioned counterbore **193**, said projecing portion hence defining an annular valve seat.

The remaining construction for the plug **188** may be identical to the plug **88** utilized in the previous valve structure of FIG. 3 and hence not required to be further described or explained. In like manner, it may also be

assumed for this embodiment that the spout supporting member and the valve actuating means in the present valve construction are also identical to that utilized in said FIG. 3 embodiment, and therefore, will not be additionally described.

It will be further seen the valve means for the instant valve structure is movably disposed in this chamber **184** and includes a cylindrical sleeve **196** disposed in an endwise position within the aforesaid chamber, being centrally positioned therein by means of a pair of sealing pads **197** disposed preferably on diametrically opposite sides of said sleeve, the instant configuration of said pads now to be more fully described.

As best seen in FIG. 8, the sealing pads **197** are each identical in configuration, being substantially arcuately-shaped in cross section. The outer surface of each of said sealing pads, remote from the surface of the cylindrical sleeve **196** is shaped to conform to the housing annular wall defining the aforementioned chamber **184**. The inner surface of each of the aforesaid sealing pads **197** is centrally provided with a recessed portion **198** extending longitudinally therethrough defining on each side thereof a bearing part **199**. The inwardly facing surface of said bearing part **199** is shaped to conform to the circumferential surface of the cylindrical sleeve **196** so as to lie over and closely fit the latter at predetermined spaced surface portions thereon. As previously mentioned the sealing pads **197** are disposed in the housing chamber **194** preferably on diametrically opposite sides of the cylindrical sleeve **196** thereby centrally positioning the latter in said chamber. In addition, each of said sealing pads is fixedly secured in its above defined position relative to said sleeve by means of a pin **201** embedded in the rim portion **186** of the chamber **184** and which extends upwardly therefrom, being anchored within the lower end of said sealing pad.

As best seen in FIG. 7, each of said sealing pads **197** is provided with an inlet port **203** substantially rectangular in configuration, being elongated in a vertical plane and which communicates directly at its outer end with a water inlet port to which is connected either the hot or cold water inlet source, said hot water inlet port being identified in its present location by the numeral **204**, and likewise said cold water inlet port being identified by the reference numeral **205**. The lowermost side of the rectangular inlet port **203** in each sealing pad, as is best seen in FIG. 8A, is inclined upwardly from the outer surface of said pad as indicated in **203***a*, whereas the vertically disposed side walls **203***b* defining said port, are inclined or angled inwardly from said outer pad surface and project toward each other. This particular elongated configuration of inlet port **203** and of the aforementioned side walls **203***a* and **203***b* thereof is operative to shape and direct the inlet fluid flow therethrough and thence into the valve chamber **184**. In this manner, the inlet fluid flow is projected at an upwardly directed angle as it transgresses through the inlet port, whereby the noise in the valve created by said inlet fluid flow is substantially reduced.

Each of the aforementioned sealing pad inlet ports **203** is also provided at its outer end with a counterbored portion **206** which, together with the adjacent surface of the chamber **184** surrounding the water inlet ports **204** and **205** defines a recess **207** into which is disposed suitable sealing means such as a quad ring **208**. Said quad ring is intended to engage with the aforesaid adjacent chamber surface to thereby prevent a transgression of fluid therebetween and hence restrict a fluid flow to the sealing pad inlet port **203**. Said quad ring is also selected to be of such predetermined size and resiliency as to press its respective sealing pad **197** toward and against the cylindrical sleeve **196** under a predetermined pressure much in the same manner as sealing means **44** in the previous embodiment of FIG. 1 so that the aforesaid sealing pad **197** is floatably suspended in said valve chamber **184**.

As in the previous embodiment of FIG. 3, the cylindrical sleeve **196** is also provided with a slot **209** which extends circumferentially therearound a distance of approximately 180 degrees.

As in the previously described valve embodiments of FIGS. 3 and 5, the instant cylindrical sleeve **196** of the present form of valve means is also intended to be adjustably manipulated within the housing chamber **184** in such manner as to locate its aforesaid slot **209** in any preselected degree of registry with either or both of the sealing pad inlet ports **203** and thus provide a regulated input fluid flow into said valve of either or a mixture of the hot or cold water sources.

For this purpose, a valve stem **212** is disposed within the housing **181**, projecting downwardly through the bore **192** in the plug **188** and into the cylindrical sleeve **196**, being integrally provided with an aligning piston **213** on its one end which is slidably disposed in the housing cavity **185**. The cylindrical sleeve **196** is rigidly attached to said piston by means of suitable pins **214**, the latter, as is seen in FIG. 7, being preferably embedded within said piston adjacent its upper end and extending outwardly therefrom in diametrically opposite directions and thence being anchored within the aforesaid sleeve below the slot **209** in the latter. A suitable sealing ring **216**, carried by said sleeve adjacent its lower end, is adapted to engage the annular wall of the housing cavity **185** and thus prevent a transgression of fluid medium therepast.

The valve stem **212** is adapted to be slidably actuated by the above mentioned valve actuating means as is shown in FIG. 3 from its FIG. 7 position, herein defined as the valve "closed" position, downwardly into the valve housing **181** whereby the cylindrical sleeve carried by said stem is moved to one of the valve "on" positions to bring its slot **209** into its aforementioned operative association with the sealing pad inlet port or ports **203**. With the valve stem moved downwardly, it is seen that the piston part **213** on said stem also moves downwardly into the cavity **185** to thus maintain the proper alignment for said stem and cylindrical sleeve **196** within the housing chamber **184**.

With the valve stem **212** thus moved to one of the valve "on" positions as above referred to, and then rotated to carry the slot **209** of the sleeve **196** into a pre-selected degree of registry with either or both of the sealing pad inlet ports **203**, an inlet fluid flow from the connected hot and cold water inlet sources passes into said inlet ports, through the sleeve slot **209** and thence into the annular opening **217** provided between the inner wall of the sleeve **196** and the valve stem surface. Said inlet flow thence passes upwardly past the unseated valve element **216** and into the plug bore **192**, and thereafter to the spout means in the identical manner as that seen in the FIG. 3 valve embodiment.

In FIGS. 9 and 10 yet another valve form is herein shown, being similar to the previous valve embodiment of FIG. 1, however, modified in structure as to accommodate three separate fluid inlet sources.

With reference directed particularly to FIG. 10, the instant valve construction includes a valve housing **231** of cylindrical configuration, having formed therein a chamber **232** substantially hex-shaped in section. At approximately 120 degree intervals around the circumference of said valve housing, there is provided an inlet port which communicates with the aforesaid chamber **232**, said ports being identified by the reference numerals **233**, **234** and **235**, respectively.

A source of cold water, as identified by the conduit **236**, and a source of hot water, as indicated by the conduit **237**, said fluids being further defined as "soft water" sources, are each suitably connected, respectively, to inlet ports **233** and **234**. To inlet housing port **235** is similarly connected a suitable "hard water" source, commonly used for drinking purposes, is herein identified by the conduit **238**.

The valve means for the present valve embodiment includes a valve stem **240** which is disposed in the valve housing **231** and has a bulbous-like end **241** extending into the housing chamber **232**. Said valve stem is centrally positioned with said chamber by means of a plurality of identically formed sealing pads **242** which are rectangular in section and adapted to be interposed between the surface of the aforesaid valve stem end **241** and the adjacent walls of said hex-shaped chamber **232**.

As best seen in FIG. 10, said pads are spaced substantially 120 degrees one from the other within said chamber so as to lie against each of the chamber walls containing the aforementioned inlet ports **233–235**, respectively.

In addition, each of the sealing pads **242** is centrally provided with a counterbored port **243** which communicates on its outer end with the inlet port associated therewith and on its inner end with the housing chamber **232**. The inner surface of each said sealing pads is also shaped to conform to the circumferential surface of the valve end **241** so as to closely fit over the same in a substantial fluid leak-proof seal.

The counterbored portion of the sealing pad port **243**, together with the adjacent chamber wall, define a recess into which is disposed a suitable resilient sealing means, such as a quad ring as indicated at **245**. Said quad ring is adapted to press the sealing pad against the surface of the valve end **241** under a predetermined pressure and thereby maintain the aforementioned leak-proof seal therebetween. In this manner said pad is floatably suspended between the chamber wall and valve stem **240**.

The instant valve stem is also formed with a slot **246**, extending partially transversely through the valve end **241** in substantial perpendicular relation to the valve stem axis and which also projects circumferentially therearound a distance greater than the distance between any two adjacent sealing pad ports.

With reference now directed to FIG. 9, the valve stem **241** is herein shown in its "valve closed" position wherein a valve element **248** carried thereby upwardly of its valve end **241** is seated against an annular valve seat **249** formed on a valve housing plug which corresponds to the plug *4a* in the valve embodiment of FIG. 5. In this position the housing chamber **232** is sealed from the spout carrying means mounted over the aforesaid plug. Merely to minimize the present disclosure, it may be assumed that the configuration and structural assembly of the housing plug, spout carrying sleeve and valve stem actuating means in the instant valve form are identical to that for the plug *4a*, sleeve **16** and the valve actuating means of the aforesaid FIG. 5 embodiment. Hence the same reference numerals will be used in the instant valve structure to denote like elements.

To connect the spout **18** to either or both of the hot and cold "soft water" inlet sources, as identified by the conduits **236** and **237**, respectively, the valve stem **241** is moved downwardly from its FIG. 9 "closed" position, by the aforementioned valve actuating means, to carry its slot **246** to a pre-selected transverse plane with respect to the sealing pad ports, and thereafter rotated to move said slot **246** into predetermined registry with either or both of the aforesaid sealing pad ports communicating with the housing inlet ports **233** and **234**.

The connected hot and/or cold "soft water" inlet soures will thence pass into the housing chamber **232** through said communicating sealing pad ports and valve stem slot **246** and transgress upwardly through the housing plug bore and communicating ports **14** to the valve sleeve port **17** and spout **18**.

To provide an output flow of cold "hard" water from the instant control valve, the valve stem is actuated to position the slot in communication with the inlet housing port **235** and connected conduit **238** as is seen in FIG. 10. With said stem thus positioned, the cold "hard" water

inlet source is connected to the valve chamber **232** and the above described fluid passageway in the valve housing plug *4a* and thence to the spout **18** through the aforesaid port **17** in the sleeve **16**.

It will now be apparent that the quantity or the volume of inlet flow into the valve housing chamber **232** is controlled by a longitudinal adjustment being made to the valve stem **241** whereby a pre-selected slot area is brought into communication with the sealing pad part or ports. In like manner, to provide for a separate cold or hot "soft" water inlet flow or a mixture of both of said inlet sources, or a separate cold "hard" water inlet flow, the valve stem is rotated in such manner as to connect the aforesaid slot **246** in communication with respectively the housing inlet port **233**, inlet ports **233** and **234**, or inlet port **235**. And further it will also be realized that the temperature of the aforesaid mixture of hot and cold "soft" water may be selectively regulated by additional rotational adjustments being made to the valve stem to position the slot **246** in any desired ratio of communication with the housing inlet ports **233** and **234**.

In FIGS. 11 and 12 an alternate form of valve stem is herein shown, which is especially designed to reduce audible noise in the valve construction created as a result of, for example, when a low volume of water is introduced into the interior of the valve proper.

The instant modified valve stem is especially designed for use in a valve structure as is herein shown in FIG. 1, however, as will be understood in the art, the valve stem may be susceptible to various other modifications and hence used in other valve embodiments without departing from the inventive concepts for the same as are hereinafter defined.

Specifically, the valve stem of FIGS. 11 and 12 takes the form of a solid cylindrical bar **256** which is centrally provided on its one end with a longitudinal bore **257** defining thereby a tubular portion **256***a*. Said bore, remote from the aforementioned one end of the valve stem, communicates with a transverse slot **258** formed in said valve stem corresponding to slot **46** of the FIG. 1 valve embodiment and which is also preferably of substantially semi-circular configuration. This circumferential projection for the slot **258** may be pre-selected for various modifications of valve structure, it being required that said slot project a distance sufficient to communicate simultaneously with both the cold and hot water inlets for the instant class of control valve so as to obtain a mixture of said fluids.

A solid plug formed of any suitable material and which is identified by the reference numeral **264** is pressed into the valve stem bore **257**, preferably abutting against its closed end, and has a portion disposed within the confines of the aforementioned transverse slot **258**.

The latter portion of the plug **264** is provided with an arcuately formed, downwardly and outwardly inclined fluid diverting surface, as indicated at **265**, said arcuate surface facing toward the slot opening. Said surface, as best seen in FIG. 11, preferably extends downwardly from substantially the axis of the valve stem and thence outwardly to the inner wall surface of the aforementioned valve stem tubular portion **256***a* at the transverse plane wherein the latter connects with the bottom of the slot **258**.

With this particular construction for the instant valve stem **256** and with the same disposed in the valve structure of FIG. 1 in place of the valve stem **26**, and thence with said modified stem actuated to position the slot **258** in communication with one or both of the water inlets **11** and **12**, it will be realized that as the water passes into the aforesaid slot it is partially diverted in an upward or downstream direction by the fluid diverting surface **265** of said valve stem. As a result, the velocity of the water inlet flow is not reduced as abruptly as is the case when utilizing a valve stem such as stem **26** having a slot **46**.

This is especially so when the water inlet volume is of a relatively low value. Consequently there is substantially less tendency for said inlet flow to become turbulent to the extent that it generates an audible noise as it passes through said slot and through the valve interior to the spout **18**. The valve structure as thus modified is hence operable to provide a regulated fluid output flow with substantially little or no audible noise.

Having thus described several preferred embodiments of single lever control valve it is now realized that in each disclosed embodiment, the total quantity of fluid flow through the valve proper is controlled by a longitudinal actuation of the respective valve stem. Also, it is now realized that in each of the disclosed valve structures, the proportionate amount of hot and/or cold water; or cold "hard" water as in the valve of FIG. 9, is regulated by a rotatable actuation being made to the particular valve stem construction therein utilized while the latter is in one of its "on" positions.

It is also to be realized that additional modifications may be made to the several valve embodiments herein shown, for example, the sealing pads in the valves of Figs. 1 and 3, may be formed so as to completely embrace the valve stem surface whereby the channels **39** and **111** respectively are no longer utilized. In this instance the valve stem of FIG. 1 would necessarily have to be hollow, connecting at one end to the slot **46** and at its opposite end with the annular chamber **27** in the plug **4**. And, in the valve of Fig. 3, the inlet water flow with the modified sealing pads would transgress through the connected slot **120** in the sleeve **108** in its normal course and upwardly through the annular opening **127**.

Having thus described in detail several preferred control valve embodiments of my invention what I claim is:

1. A fluid control valve for use with a plurality of sources of different fluids and effective to provide a regulated output fluid flow therefrom, comprising a valve body having a chamber formed therein, fluid inlet means for each of said fluid sources separately communicating with said chamber, outlet means communicating with said chamber and operable to direct an output fluid flow from said body, a control valve in said body including a cylindrical valve member movably disposed in said chamber, sealing pads disposed in said chamber being interposed with slight clearance between said valve member and the walls of said chamber and each pad extending entirely around one of said inlet means, each of said sealing pads having through port means communicating with its associated inlet means, fluid channel means operatively connected with said control valve and responsive to a predetermined actuation of said valve member being actuatable to selectively connect said port means to said

chamber for directing a predetermined fluid flow from said connected fluid inlet means to said chamber, each of said pads having an arcuate surface contacting said cylindrical valve member throughout the length of said pad, and sealing means operatively engageable with said sealing pads and the walls of said chamber being open in its plane to said port means and responsive to the input fluid flow therethrough and through said port means to cause a sealing relation between said sealing pads and said valve member.

2. A fluid control valve for use with a plurality of sources of different fluids and effective to provide a regulated output fluid flow therefrom, comprising a valve body having a chamber formed therein, fluid inlet means for each of said fluid sources separately communicating with said chamber, outlet means communicating with said chamber and operable to direct an output fluid flow from said body, valve means in said body including a cylindrical valve member disposed in said chamber for axial and rotative movement, said valve member having means defining a channel thereon normal to its axis, sealing pads disposed in said chamber being interposed with slight clearance between said valve member and the walls of said chamber and each pad extending entirely around one of said inlet means, each of said sealing pads having through port means communicating with its associated inlet means, each of said pads having an arcuate surface contacting said cylindrical valve member throughout the length of said pad, said valve member being actuatable to selectively connect said valve member channel to said port means and inlet means for directing an input fluid flow from said connected fluid inlet means to said chamber, and a resilient uninterrupted sealing ring between each pad and the adjacent chamber wall and surrounding its associated inlet means, said ring being mounted on the marginal surface defining the port means of said pad and expandable by fluid pressure from said inlet means.

3. A fluid control valve as defined in claim 2, wherein said pads are spaced circumferentially to provide a passage between them parallel to the axis of said valve member, said passage forming part of said outlet means.

References Cited in the file of this patent

UNITED STATES PATENTS

1,126,478	Joyce	Jan. 26, 1915
2,818,878	Russell	Jan. 7, 1958
2,868,497	Graham	Jan. 13, 1959
2,886,282	Miller	May 12, 1959
2,888,041	Moen	May 26, 1959