United States Patent

[11] **3,561,728**

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[21] Appl. No. **790,546**
[22] Filed **Jan. 13, 1969**
[45] Patented **Feb. 9, 1971**
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[32] Priority **Jan. 18, 1968, May 25, 1968**
[33] **Great Britain**
[31] **2658 and 25120**

[54] **FLUID CONTROL VALVES**
17 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **251/285**
[51] **Int. Cl.** **F16k 51/00**
[50] **Field of Search** 251/284, 285, 286, 287, 288, 309, 310, 312

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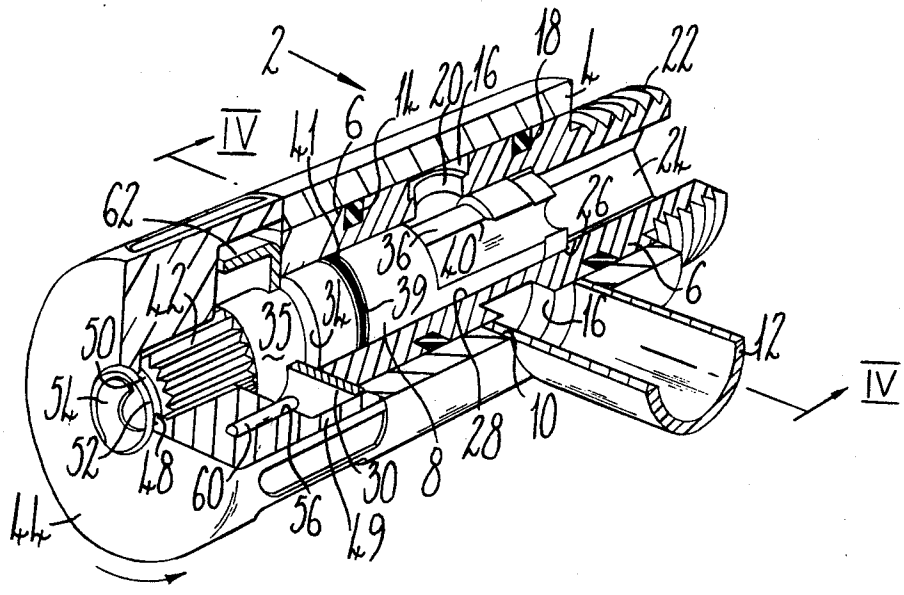
Attorneys—W. Bigelow Hall and Richard A. Wise

ABSTRACT: The invention relates to fluid-flow means, in particular connectors for fluid-flow devices and fluid-control valves and is especially concerned with fluid-control valves for use in control of flow of water through radiators of central heating systems, connector assemblies for such radiators and radiator assemblies. Fluid-control valves comprising a rotary control member by which flow of fluid through a circuit element e.g. a radiator can be controlled, connector assemblies comprising a housing in which is rotatably mounted a tubular member which can be connected to a circuit element and radiator assemblies comprising a radiator to which two connector assemblies are connected in axial alignment so that the radiator may be swung away from a wall without interrupting flow through the radiator, are described.



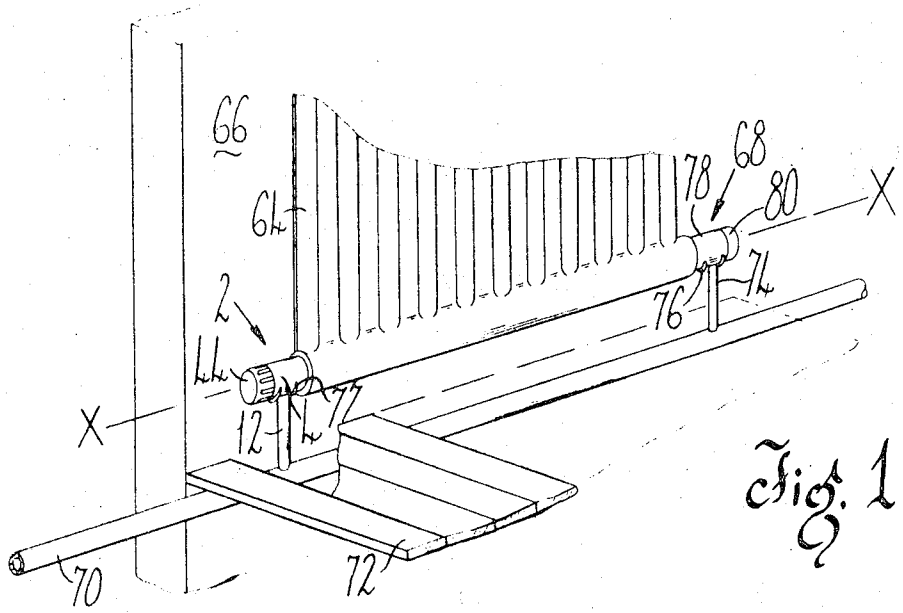

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Fig. 1

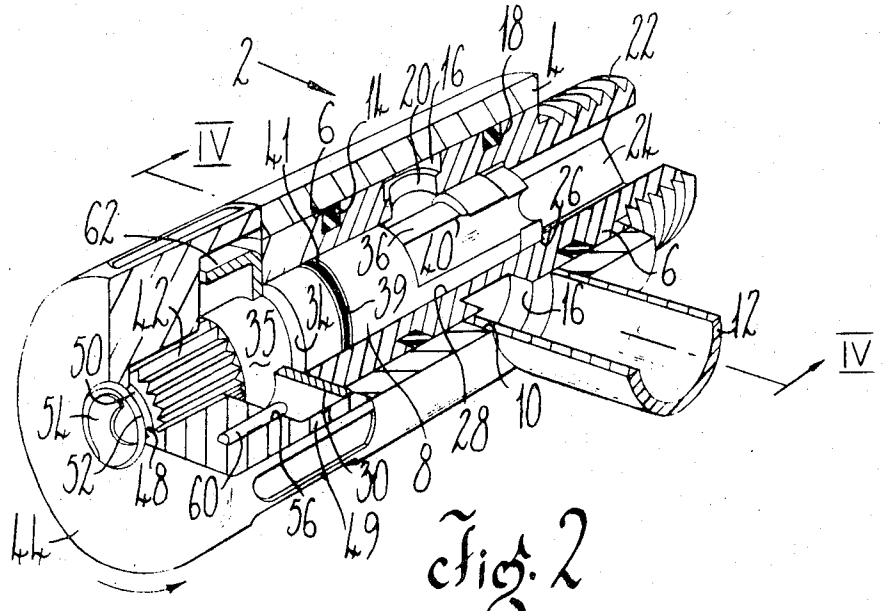
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Fig. 2

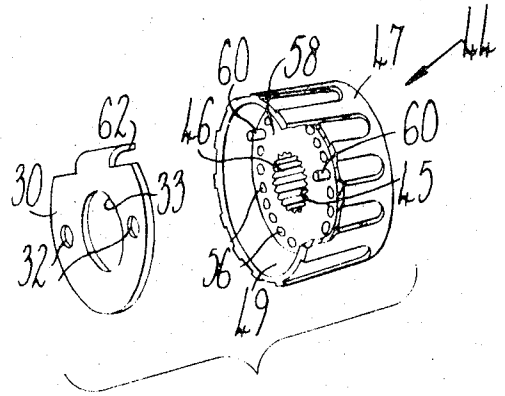

Fig. 3

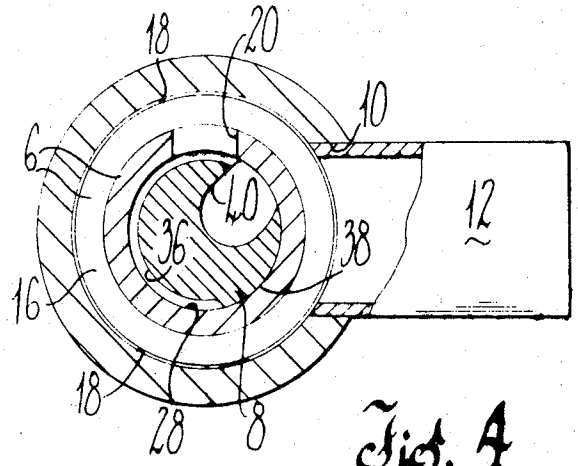

Fig. 4

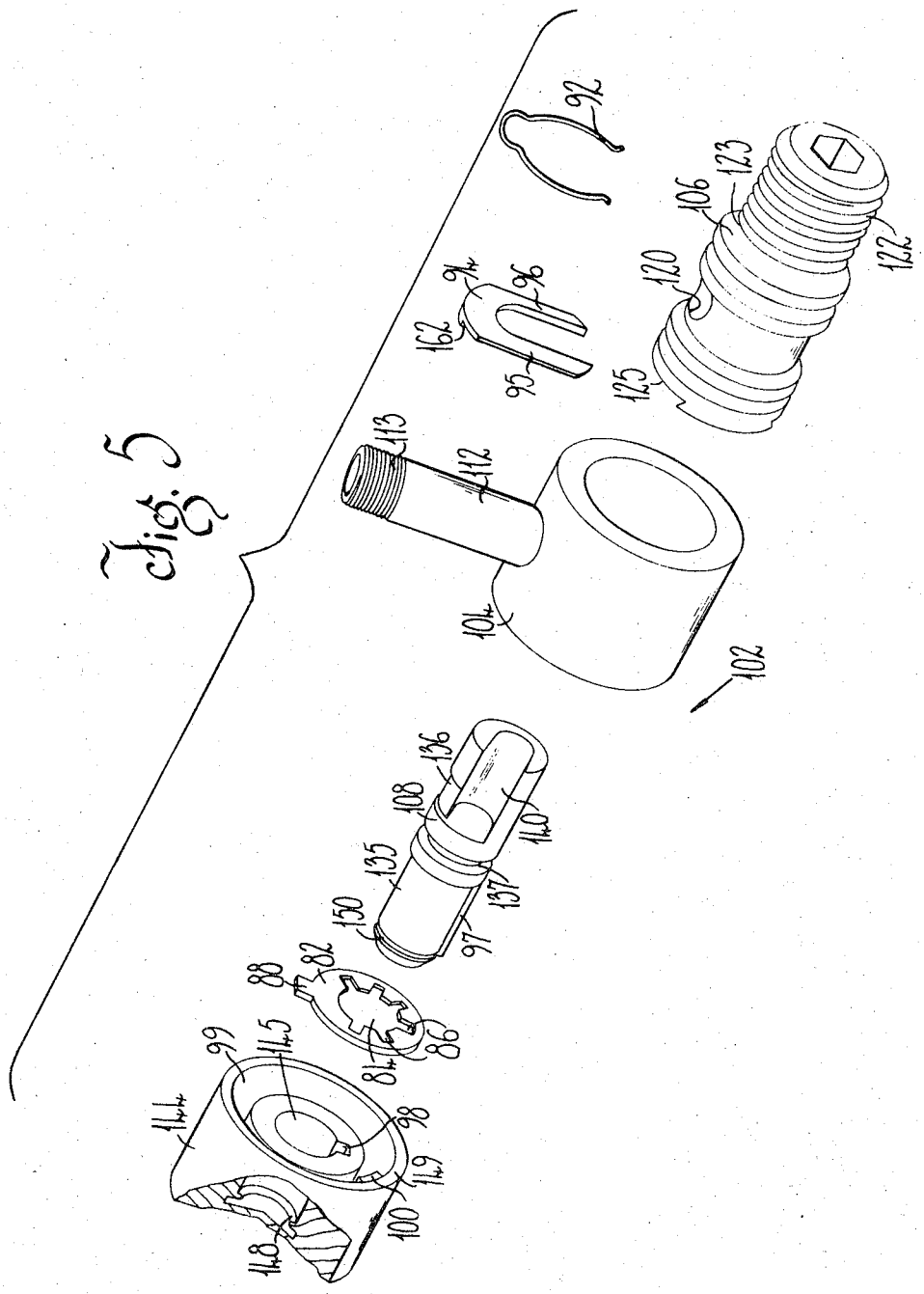
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Fig. 5

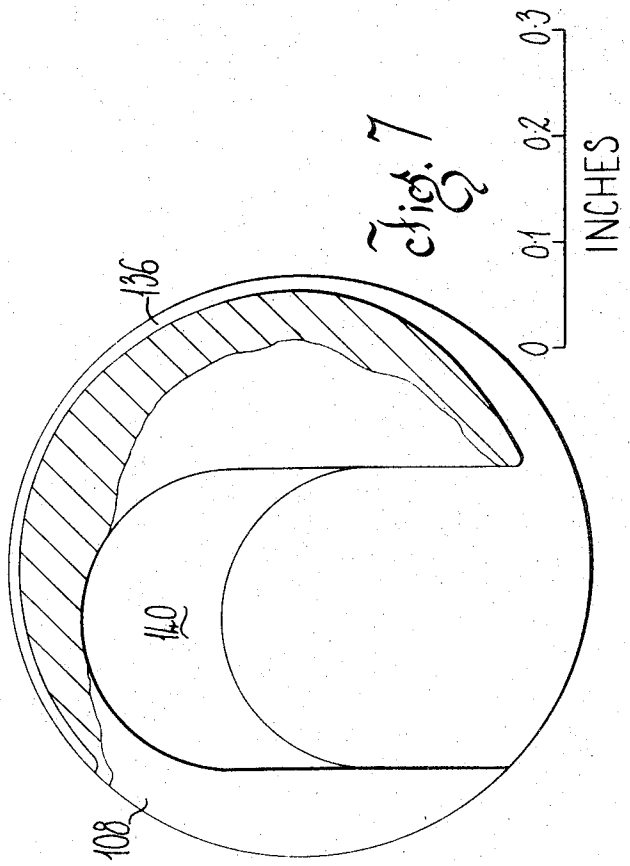

Fig. 7

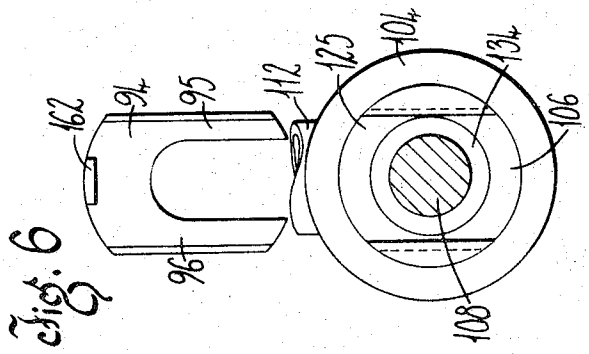

Fig. 6

FLUID CONTROL VALVES

BACKGROUND OF THE INVENTION

In systems through which fluids flow, for example domestic central-heating systems, it is frequently desired to use a fluid-control valve to regulate the flow of fluid through the system. One type of fluid-control valve in common use in domestic central-heating systems comprises a port through which fluid is to flow and a washer, movable towards and away from the port to regulate fluid flow therethrough; such a regulator valve does not readily lend itself to fine adjustments of the flow through it because when the washer is moved away from a closed position in which it covers the port, a small amount of initial movement will allow a relatively large flow of fluid. Thus it is difficult to regulate such a valve to allow flow through a radiator so as to give the required heat output, especially if only a small heat output is required.

Domestic central-heating systems frequently comprise several radiators each with a regulator valve of the type above referred to. After all the radiators in a system are in place, the system needs to be balanced. The maximum flow rate through each radiator is adjusted so that when the on/off valve of each radiator is in its fully on condition (i.e. as much as it is possible for a user to normally open the valve) the flow of heating fluid (usually hot water) through each radiator is as desired, generally so that, when all the valves are in the fully on condition, all the radiators radiate roughly the same amount of heat per unit area of radiator per unit time rather than some radiators radiating a lot of heat and some very little. This is, in many systems, accomplished by providing a separate valve for each radiator, the separate valve of each radiator being set by the installer of the system to balance the system such that when the regulator valve of each radiator is fully open the amount of heat given off by each radiator is the maximum required. This separate valve is normally not touched thereafter, the regulator valve of the type referred to being used to control the flow when the system is in normal use.

Radiators of domestic central heating systems are generally attached to walls of a building by brackets and heating fluid (generally water) is fed to and away from the radiators in pipes. Accordingly if access is required to the wall behind a radiator, for example to paint the wall, the radiator must in most instances be moved clear. The coupling of pipes to radiators in many domestic central heating systems is such that to move the radiator clear the pipes must be disconnected from the radiator, or at least the couplings loosened; thus the system must be drained before loosening or disconnecting the pipes and moving the radiator clear of the wall: an inconvenient operation.

SUMMARY OF THE INVENTION

It is among the objects of the present invention to provide an improved fluid-control valve whereby control of fluid flow is improved.

With the above and other objects in view, as will hereinafter appear, the present invention in one aspect thereof contemplates a fluid control valve comprising a tubular sleeve member having a bore extending therethrough and an aperture in a wall of the sleeve member opening into the bore, and a control member which is rotatably mounted in the bore of the sleeve member, wherein the control member has a peripheral groove so disposed axially of the control member as to be in alignment with the aperture in the sleeve member, which groove extends partially around the control member and is bounded by a sealing surface of the control member which is in sealing contact with an internal surface of the sleeve member, and the control member also has a passageway extending from an end portion of the groove to a first end portion of the control member, the arrangement being such that when the aperture in the wall of the sleeve member is in register with the sealing surface of the control member the aperture is closed and the valve is in a closed condition, and rotation of the control member from its closed condition brings the groove into register with the aperture thus to provide a restrictive flow path through the valve, through the aperture, the groove and the passageway, variation of the degree of rotation of the control member from its closed condition being effective to vary the resistance to fluid flow through the valve.

It is another of the objects of the present invention to provide an improved connector assembly for a fluid circuit element. The invention further contemplates, in another aspect thereof, a connector assembly for use in a fluid circuit comprising a housing and rotatably mounted in the housing a tubular member closed at one end and having a bore opening at the other having a peripheral groove extending completely therearound, means disposed adjacent the open end for connecting the tubular member to a circuit element, and an aperture extending through a wall of the tubular member connecting the bore thereof and the groove, the housing having a hole extending through a wall thereof so disposed as to be in alignment with the groove in the tubular member, the assembly having a flow path therethrough comprising the hole in the housing, the peripheral groove, the hole in the tubular member and the interior of the tubular member.

It is another of the objects of the present invention to provide an improved radiator assembly in which the radiator may be pivoted about an axis e.g. swung away from a wall without interrupting the flow of fluid through the radiator assembly. The invention further contemplates, in yet another aspect thereof, a radiator assembly comprising a radiator having holes at opposite ends thereof arranged to lie coaxially on an axial line and connector assemblies secured in the holes the parts of the connector assemblies secured in the holes being rotatable relative to housings of the connector assemblies, in such a manner that the radiator can be pivoted about the axial line without interrupting the flow of fluid along a flow path through the radiator assembly. The configuration of the peripheral groove of the central member of a valve as set out in the last preceding paragraph but two is chosen to give a suitable range of resistances to flow as the control member is rotated from its closed condition to its fully open condition.

It will be realized that the illustrative valves described herein are also connector assemblies as set out in the last preceding paragraph but two, the spool of the valve closing the sleeve member at one end.

The above and other features of the invention including various novel details of construction and combination of parts, will now be more particularly described with reference to the accompanying drawings. It will be understood that the described valves, connector assembly and radiator assembly, embodying the invention are shown by way of illustration only and not as a limitation of the invention. The features of this invention may be employed in various and numerous embodiments without departing from the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. 1 is a perspective view showing a first illustrative valve and an illustrative connector assembly secured to a radiator to provide the illustrative radiator assembly;

FIG. 2 is a perspective view, partly in section and with parts broken away, showing the first illustrative valve in a partly open condition;

FIG. 3 is a perspective view with part broken away of a plate and a knob of the first illustrative valve;

FIG. 4 is a view in section on the line IV–IV of FIG. 2;

FIG. 5 is an exploded view of a second illustrative valve;

FIG. 6 is a view showing the assembled second illustrative valve; and

FIG. 7 is a scale view in cross section of a spool of the second illustrative valve.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The first illustrative radiator valve **2** comprises a brass housing **4**, a brass sleeve member **6** rotatably mounted in the housing **4** and a spool **8** injection moulded of polypropylene plastics material rotatably mounted in the sleeve member **6**. The housing **4** is tubular and has a hole **10** extending through the wall thereof; a copper pipe **12** is brazed into the hole **10**.

Three peripheral grooves, two outer grooves **14**, and a middle groove **16** extend completely round the cylindrical exterior of the sleeve member **6**. Sealing rings **18** are received in the grooves **14**. A hole **20** extends through the wall of the member **6** from the middle groove **16** to the interior of the sleeve member **6**. The sleeve member **6** has an externally screw threaded inner end portion **22** projecting beyond the housing viewing FIG. **2**. The interior of the sleeve member **6** at the screw threaded end has a hexagonal bore **24** leading to a cylindrical bore **28** separated from the hexagonal bore **24** by a shoulder **26**.

The spool **8** is generally cylindrical and is received in the cylindrical bore **28** of the sleeve member **6** with a first end portion thereof abutting the shoulder **26**. The spool **8** is retained in the sleeve member **6** by engagement of an annular metal plate **30**, secured to the sleeve member **6** by screws (not shown) passing through holes **32** in the plate **30** (see FIG. **3**), with a shoulder **34** on the spool **8**; a second end portion **35** of the spool **8** of reduced diameter extends through a central hole **33** in the plate **30** beyond the sleeve member **6**. The spool **8** has a peripheral groove **36** extending partially around it, the groove **36** is bounded by a sealing surface of the control member which is in sealing contact with an internal surface of the sleeve member and is so disposed axially of the spool **8** as to be in alignment with the hole **20** in the sleeve member **6**; a portion **38** of the sealing surface lies between the ends of the groove **36** (see FIG. **4**). The groove **36** is shallow and of small, substantially uniform cross-sectional area. From one end portion of the groove a longitudinal groove **40**, of approximately the same width as the groove **36** but of much larger cross-sectional area extends to the end portion of the spool abutting the shoulder **26** and opens into the hexagonal bore **24**. A groove **39** disposed between the groove **36** and shoulder **34** extends completely around the spool and houses a rubber sealing ring **41**.

A knob **44** injection moulded of nylon comprising a body portion **47** and a depending skirt **49** is secured to the end portion **35** of the spool **8**. The end portion of the spool **8** has longitudinal external serrations **42** which cooperate with longitudinal serrations **46** in a cylindrical central hole **45** in the body portion **47** of the knob **44** so that rotation of the knob rotates the spool **8**. The knob **44** is retained on the spool **8** by engagement of a lip **48** in the hole **45** in the knob **44**, in a groove **50** in the end portion **35** of the spool **8**. A frustoconical lead portion **52** is provided on the end portion **35** so that the lip **48** may be easily forced on to the end portion **35**. The arrangement is such that when the lip **48** is received in the groove **50** the skirt **49** is in engagement, or substantially so, with an end face of the housing **4** thus shrouding the plate **30**. An end face **54** of the end portion **35** has marked on it in register therewith, a representation of the groove **36** and passageway **40** in the spool **8**.

A number of small holes **56** are provided in an underface **58** of the body portion **47** of the knob **44**, each lying parallel to the central hole **45** equally spaced around a circle the center of which lies on the axis of the hole **45** and the plane of which is normal to the axis of the hole **45**. The holes **56** are so disposed that pegs **60** in the holes **56** will, when the knob **44** is in place on the spool **8**, engage a metal tang **62** projecting at right angles from the plate **30**, away from the sleeve member **6** when the knob **44** is rotated, to prevent further rotation of the knob **44** (and thus the spool **8**). The tang **62** is of the same width as the diameter of the hole **20** in the sleeve member and is positioned in alignment therewith.

The illustrative connector assembly **68** comprises a housing **78** (similar to the housing **4**) from which a pipe **74** extends, the pipe **74** being brazed into a hole (not shown) in the housing **78** in the manner described with reference to the housing **4** and pipe **12**, of the valve **2**. A connector sleeve member (not shown) similar to the sleeve member **6** but with a hexagonal bore (not shown) thereof extending the length of the connector sleeve member except for an internally threaded inner end portion at the end of the connector sleeve member opposite to the externally threaded end portion thereof, is rotatably mounted in the housing **78**. A nylon plug **80** comprising a head portion and an externally threaded shank (not shown) threaded into the internally threaded end portion of the sleeve member of the connector assembly **68** assists in retaining the assembly **68** in an assembled condition and closes the outer end of the sleeve member of the connector assembly.

The first illustrative valve **2** is shown in FIG. **1** secured to a radiator **64** mounted adjacent a wall **66**. The first illustrative valve **2** (supplied to an installer with the knob **44** separated from the rest of the valve) and radiator **64** are assembled, along with the connector assembly, in the following manner to provide the illustrative radiator assembly. The valve **2** and connector assembly **68** are first secured to the radiator. To accomplish this the valve **2** is disassembled and the screw-threaded inner end portion **22** of the sleeve member **6** is screwed into a mating thread in the radiator and tightened in place using a suitable hexagonally-ended key received in the hexagonal bore **24** of the sleeve member **6**. The housing **4** is then slid on to the sleeve member **6** and the spool **8** is slid into the sleeve member **6**. Finally the plate **30** is secured in place on the sleeve member **6** to hold both the spool **8** and housing **4** in place. The sleeve member of the connector assembly **68** is likewise threaded into the radiator **64**, the housing **78** slid on to it and the plug **80** screwed into place to hold the housing in place. The central axes of the holes in the radiator into which the sleeve members are threaded are coaxial and lie on an axial line X–X; thus the central axes of the housing **4** and the housing **78** are also arranged to lie on the line X–X.

Next, a bracket **76** is secured to the wall at a desired position and the housing **78** of the connector assembly **68** is rested on this bracket with the pipe **74** projecting downwardly therefrom through the floor **72**; the housing **78** may be rotated slightly so that the pipe **74** does not foul a main supply pipe **70** running beneath the floor. The edge portion of the radiator opposite the lower edge portion into which the sleeve members are screwed may be at this stage held in its normal upper position by a workman assisting in the installation of the radiator, or allowed to swing downwardly, the radiator pivoting about the line X–X with the sleeve member of the connector assembly **68** rotating in the housing **78** until the former edge portion touches the floor **72**. The housing **4** of the first illustrative valve **2** is then allowed to rest on a bracket **77** supported by a workman with the pipe **12** projecting downwardly through the floor **72** clear of the pipe **70**. The position of the bracket **77** is then adjusted by the workman to level the radiator and the position it must occupy on the wall **66** is marked. The radiator **64** is then removed and the bracket **77** is secured to the wall **6** in the marked position.

Next the radiator **64** is placed with the housings **4** and **78** on the brackets **76**, **77** and the pipes **12** and **74** projecting downwardly; the pipes **12** and **74** are cut to the correct length and joined, for example by brazing, to the supply pipe **70** (the radiator **64** may have to be raised slightly above the brackets to get the pipes **12**, **74** in place, and then lowered again on the brackets).

The radiator is finally secured in place as shown in FIG. **1** by means of a single clamp member (not shown) which is secured to the wall and clamps the upper edge of the radiator in place.

When all the radiators in the system have been installed, fitted with control valves similar to the first illustrative valve **2**, they are balanced, for the reason hereinbefore mentioned. The radiator **64** is balanced as follows. First, with the knob **44** removed from the spool **8**, the spool **8** is rotated to a closed

condition in which the sealing portion **38** closes the seals the hole **20** in the sleeve member **6** and thus the flow path through the valve **2** (the spool is brought to this position by rotation until the representation of the sealing portion **38** on the end face **54** is in register with the tang **62**). A peg **60** is placed in one of the holes **56** and the knob **44** is slid on to the serrations **42** in such a position that the peg **60** makes sliding contact (or nearly so) with the tang **62** such that the spool **8** may be rotated from its closed condition only in an anticlockwise sense viewing FIG. **4** (in the direction of the arrow on the knob **44** in FIG. **2**) to bring the groove **36** into register with the hole **20** thus opening a restrictive flow path through the valve **2** from the pipe **12**, round the groove **16**, through the hole **20**, along the groove **36**, along the groove **40** into the bore **24** and into the radiator **64**. As can be seen viewing FIG. **4** rotation of the spool **8** from the closed condition in an anticlockwise sense shortens the length of the flow path along the groove **36** and thus decreases resistance to flow through the radiator **64**. The spool of each valve is rotated from its closed condition so that the rate of flow through each radiator is such that the heat output from each radiator is balanced at the desired maximum level probably each valve will have to be adjusted several times because opening the valve of one radiator alters the total resistance of the circuit and thus will alter the rate of flow through the other radiators). When the spool of each valve has been rotated so that the system is balanced the knob **44** is removed from the spool and another, second pin **60** is inserted in another one of the holes **56**, so that when the knob **40** is replaced on the serrations **42** in the position it occupied before removal therefrom it is prevented, by engagement of the second pin **60** with the tang **62**, from rotating beyond the point at which the radiators are balanced; this is at the fully on condition. The knob is then pushed home on the serrations **42** until the lip **48** is received in the groove **50** to retain the knob **44** on the spool **8**. The pegs **60** in the knob **44**, by engagement with the tang **62**, thus allow rotation of the spool between a closed condition to a fully on condition beyond which the spool cannot be rotated without removal of the knob **44** and resetting of the valve. Should a greater degree of control of the fully on setting of the spool be required the number of holes **56** in the knob **44** may be increased. If it is desired to add a radiator to the system at any time, the knobs may be removed from the control valves and the system rebalanced.

The amount of heat radiated by the radiator **64** is regulated by adjusting the flow of heating fluid through the radiator **64**, using rotation of the spool between zero flow when the spool is in its closed condition and maximum flow when the spool is in its set fully on condition.

Fluid flows from the pipe **70** along the following flow path up the pipe **12**, along the groove **16**, through the hole **20**, along the groove **36**, along the groove **40**, through the bore **24** into the radiator **64**; through the radiator **64** and along the hexagonal bore of the sleeve member of the connector assembly **68**, through the hole in the wall thereof to the peripheral groove of the sleeve member, along the groove and out through the wall of the housing **78** along the pipe **74** back to the supply pipe **70**. Depending on the setting of the valve **2** a certain amount of fluid will bypass the radiator along the supply pipe **70**.

Maximum possible flow through the first illustrative valve **2** occurs at a fully open condition when the groove **40** is in register with the hole **20**; normally in setting up a radiator system the valve of the radiator most distance from the source of heated fluid is set so that at its set fully on condition it is in its fully open condition with the groove **40** in register with the hole **20**.

If it is desired to gain access behind the radiator **64**, for example to paint or to clean, the clamp member (not shown) may be released and the radiator pivoted, without interrupting the flow of fluid along the flow path through the illustrative radiator assembly about the line X–X until its upper edge rests on the floor **72**, the sleeve member **6** of the valve **2** rotating in the housing **4** and the sleeve member (not shown) of the connector assembly **68** rotating in the housing **78** thereof.

In a modified version of the first illustrative valve the knob thereof may be provided with a projection from the underface thereof formed when the knob is made by injection moulding. This projection is so positioned that when the knob is in place on the spool of he modified version of the first illustrative valve it can engage the tang. This knob is positioned on the spool so that the projection engages the tang when the valve is in the closed condition to prevent rotation of the valve from the closed condition direct to the fully open condition without gradually decreasing the flow resistance; the projection is such that it reengages the tang when this fully open condition is reached and prevents rotation straight back to the closed condition. In the modified version of the illustrative valve the longitudinal serrations on the spool are replaced by a single key formed when the spool is injection-molded and the serrations in the knob are replaced by a keyway; the key and keyway are so positioned that, when the knob is on the spool with the key in the keyway, the projection and tang are in the relation necessary to achieve the result mentioned in the last preceding sentence. Thus, in the modified version of the first illustrative valve, only one peg is needed, the position of which is to be adjusted, when balancing a circuit, to set the fully on condition. The peripheral groove of the spool of the modified version of the valve is of constant depth but in plan is parallel sided near the longitudinal groove and is of V shape at the end portion of the peripheral groove opposite the longitudinal groove.

The second illustrative valve **102** is generally similar to the first illustrative valve except as hereinafter described and comprises a metal housing **104**, a metal sleeve member **106** rotatably mounted in the housing **104** and a suitable plastics material spool **108** rotatably mounted in the sleeve member **106**. The plastic material used is conveniently "Noryl" a thermoplastic material available from N.V. Polychemie, Arnhem, Holland and believed to be based on polyphenylene oxide or may be for example polypropylene.

The sleeve member **106** is generally similar to the sleeve member **6** of the first illustrative valve except that a groove **123** surrounds the sleeve member **106** adjacent a threaded inner end portion **122** and a dovetail slot **125** extends across an outer end portion of the sleeve **106**. A stop element provided by a spring clip **92** is arranged to be accommodated in the groove **123** when the illustrative valve is assembled to assist in location of the sleeve member **106** axially of the housing **104**, projecting portions of the clip **92** being arranged to contact an annular end face of the housing **104** to prevent the end portion **122** being drawn into the housing.

The spool **108** is arranged to be held in axial location in the sleeve **106** by engagement of an inner end portion of the spool **108** with a shoulder **126** within the sleeve member and engagement of a slide member **94** received in the dovetail groove **125** with a shoulder **134** on the spool **108**. The slide member **94** is generally U-shaped and comprises two legs **95**, **96** of unequal widths arranged to be received in a peripheral groove **137** of the spool. The dovetail groove **125** is slightly offset transversely of the sleeve **108** and thus the slide member **94** can only be received in the slot **125** with its legs **95**, **96** in the groove **137** when the member **94** is inserted in the slot **125** from one end. When the member **94** is inserted in the slot **125** from said one end a tang **162** projecting from the slide member **94** is in alignment with a hole **120** (corresponding to the hold **20** in the sleeve member **6** of the first illustrative valve) in the sleeve member **106**.

An outer end portion **135** of the spool **108** has a key **97** (in place of the serrations **42** and similar to the key of the modified version of the first illustrative valve) on to which a nylon knob **144** (similar to the knob of the modified version of the first illustrative valve) can be slid. This knob **144** has a central cylindrical hole **145** in which the outer end portion **135** of the spool is received with the key **97** in a keyway **98** in the hole **145**; the knob **144** is retained on the spool by snap engagement of a lip **148** in the hole **145** with a groove **150** in the end portion **135** of the spool **108**. An annular groove **99** is provided in the underface **158** of the knob **144** in which the tang **162** is received when the second illustrative valve is assembled

with the knob 144 on the spool with the lip 148 in the groove 150. A projection 100 is provided in the groove 99 which engages the tang 162, of the assembled second illustrative valve when the valve is in a closed condition, to fix the closed condition prevent rotation of the spool from the valve closed condition direct to the fully open condition. The knob 144 also comprises an annular skirt 149 arranged, when the valve is assembled to almost contact an annular end face of the housing 104; this skirt assists in retaining the slide member 94 in place.

The second illustrative valve also comprises a generally annular washer 82 having a central hole 84 with six keyways 86 disposed at intervals round the hole 84; a tongue 88 projects from the generally circular outer periphery of the washer 82. The washer 82 is arranged to be slidably received on the end portion 135 of the spool 108, before the knob 144 is snapped into place, with the key 97 in one of the keyways 86, thus when the spool 108 is rotated the washer 82 is rotated therewith. The path of the tongue 88 is such that on rotation it can engage the tang 162.

The second illustrative valve is intended for incorporation in a radiator system, each radiator having one of the second illustrative valves screwed therein, and as described with reference to the first illustration valve each of the second illustrative valves must have its fully on condition preset to balance the radiator system. Accordingly the washer 82 is placed on the spool 108 with the key 97 in one of the keyways 86 selected so that the tongue 88 strikes the tang 162 to prevent rotation of the valve beyond the desired fully on condition. The washer 82 is marked to indicate which of the keyways 86 should receive the key 97 to give the maximum-flow fully on condition and which to give the minimum flow. Having placed the washer 82 on the spool with the key 97 in the selected one of the keyways 86 the spool 108 is rotated until the tongue 88 engages the tang 162 in the fully on condition and the knob 144 is then snapped in place; this ensures that the projection 100 of the knob, the tang 162 and the tongue 88 are correctly disposed relative to each other.

The second illustrative valve also comprises a copper pipe 112 brazed to the housing 104. The end portion 113 of the pipe 112 disposed away from the housing 104 is screw-threaded (or grooved) externally and this end portion 113 is coated with a solder compound. Thus the pipe 112 may be joined to another pipe (not shown) having an internal diameter such that the pipe 112 is a sliding fit therein, by heating the pipes to melt the solder and, after the pipes have been slid together allowing the solder to cool to seal the two pipes together.

The spool 108 has a peripheral groove 136 (generally similar to the groove 36 of the first illustrative valve) extending partially around it. The groove 136 is generally parallel sided nine thirty-seconds of an inch wide but has a semicircular end portion 143 at the end of the groove opposite the end which opens into a longitudinal passage 140 (similar to the passage 40 of the first illustrative valve) of the spool 108.

The spool 108 is shown, to scale, in FIG. 7 in section through the groove 136 and as can be seen in FIG. 7 the depth of the groove 136 increases round the spool from the semicircular end portion 143; at any point of the groove 136 round the spool the groove 136 is of constant depth across its width. Round the first 75° from the semicircular end portion 143 the depth of the groove is a constant 0.01 inches, thereafter the depth gradually increases to 0.012 inches at 105°,0.014 inches at 135°,0.027 inches at 165° and 0.040 inches at 195° just before the passage 140. It has been found that with a groove of such configuration using a radiator 4 feet by 2 feet by one-half inch the flow of heating fluid can be increased such that there is approximately unit increase in the temperature of the radiator for unit rotation of the spool.

We claim:

1. A fluid control valve comprising a tubular sleeve member having a bore extending therethrough and an aperture in a wall of the sleeve member opening into the bore, and a control member which is rotatably mounted in the bore of the sleeve member, wherein the control member has a peripheral groove so disposed axially of the control member as to be in alignment with the aperture in the sleeve member, which groove extends partially around the control member and is bounded by a sealing surface of the control member which is in sealing contact with an internal surface of the sleeve member, and the control member also has a passageway extending from an end portion of the groove to a first end portion of the control member, and adjustable limiting means for rotation of the control member, the arrangement being such that when the aperture in the wall of the sleeve member is in register with the sealing surface of the control member the aperture is closed and the valve is in a closed condition, and rotation of the control member from its closed condition brings the groove into register with the aperture thus to provide a restrictive flow path through the valve, through the aperture, the groove and the passageway, variation of the degree of rotation of the control member from its closed condition being effective to vary the resistance to fluid flow through the valve.

2. A valve according to claim 1 wherein the sleeve member is rotatably mounted in a tubular housing in sealing engagement therewith with a peripheral groove extending completely round the sleeve member in register with a hole extending through a wall in the housing.

3. A valve according to claim 2 wherein the sleeve member comprises a threaded end portion arranged to be screwed into a circuit element to connect the valve thereto.

4. A valve according to claim 3 comprising a shoulder in the sleeve member near the threaded end portion against which the first end portion of the control member bears.

5. A valve according to claim 3 comprising a stop element on the sleeve member beyond which the threaded end portion of the sleeve member projects, the housing being arranged to contact the stop element to locate the sleeve member axially of the housing and to ensure that the threaded end portion projects beyond the housing.

6. A valve according to claim 1 wherein the control member comprises a second end portion, opposite the first end portion, which projects beyond the sleeve member.

7. A valve according to claim 6 wherein the limiting means comprises a knob mounted on the second end portion of the control member so that rotation of the knob rotates the control member, pegs disposed in a plurality of holes in the knob disposed about said axis, and stop means on the sleeve member so disposed as to be engaged by the pegs as the control member is rotated to limit rotation of the control member.

8. A valve according to claim 7 wherein the stop means of the sleeve member comprises a projection from a member mounted on the end of the sleeve member from which the second end portion of the control projects, said member mounted on the sleeve member having an aperture through which said second end portion extends, and bearing on a shoulder of the control member whereby to assist in retaining the control member in the sleeve member.

9. A valve according to claim 6 wherein the limiting means comprises a setting ring having a hole in which the second end portion of the control member is slidingly received and a projection from the periphery of the ring, the construction and arrangement being such that the setting ring may be engaged with the control member for rotation therewith with the projection from the ring disposed in one of a plurality of angular positions with respect to the control member whereby the projection from the ring can engage stop means on the sleeve member on relative rotation of the control member and sleeve member to limit the degree of rotation.

10. A valve according to claim 9 wherein the setting ring has a plurality of keyways disposed round the hole and the second end portion of the control member has a longitudinal key thereon, the key being received in one of the keyways to provide engagement of the ring with the control member for rotation therewith.

11. A valve according to claim 10 comprising a knob located on the second end portion of the control member by

engagement of the key with a keyway in the knob whereby to provide a connection between the knob and the control member so that rotation of the knob rotates the control member, and wherein the knob has a projection so disposed that, when the knob is mounted on the second end portion of the control member, it is engageable with the stop means on the sleeve member whereby to limit rotation of the control member.

12. A valve according to claim 9 wherein the stop means of the sleeve member comprises a projection from a slide member mounted at the end of the sleeve member from which projects the end portion of the control member, the slide member being arranged to be slidingly retained in a groove extending transversely of an end portion of the sleeve member with the second end portion of the control member projecting through an open ended generally U-shaped aperture in the slide member extending generally parallel with the groove in such a manner that a portion of the slide member around the aperture bears on a shoulder of the control member to assist in retaining the control member in the sleeve member.

13. A valve according to claim 12 wherein the width of the leg of the slide member at one side of the aperture is greater than the width of the leg at the other side of the aperture and the groove extending transversely of the end portion of the sleeve member is offset so that the slide member can be accommodated in the groove with the second end portion projecting through the aperture only when the slide member is inserted in the groove from one end thereof whereby the projection from the slide member in the assembled valve can assume only one angular orientation about the axis of he sleeve member.

14. A valve according to claim 6 comprising a knob having a hole therein in which part of the second end portion of the control member is slidingly received to mount the knob on the end portion so that rotation of the knob rotates the control member, wherein the knob comprises a lip projecting inwardly of the hole the construction and arrangement being such that the lip is a snap fit in a groove on said second end portion whereby to locate the knob lengthwise of the axis of rotation of the control member and to retain the knob thereon.

15. A valve according to claim 1 wherein said groove is of nonuniform cross-sectional area and wherein said groove area decreases in cross section from said passageway end portion toward the opposite end of said groove.

16. A connector assembly for use in a fluid circuit comprising a housing and rotatably mounted in the housing a tubular member having a bore closed at one end by valve means for controlling flow of fluid through the assembly and open at the other, a peripheral groove extending completely around the tubular member, means disposed adjacent the open end of the bore for connecting the tubular member to a circuit element, and an aperture extending through a wall of the tubular member connecting the bore thereof and the groove, the housing having a hole extending through a wall thereof so disposed as to be in alignment with the groove in the tubular member, the assembly having a flow path therethrough comprising the hole in the housing, the peripheral groove, the hole in the tubular member and the interior of the tubular member.

17. An assembly according to claim 16 wherein the valve means comprises a control member rotatably mounted in the bore of the tubular member, having a peripheral groove so disposed axially of the control member as to be in alignment with the aperture in the tubular member, which groove extends partially around the control member and is bounded by a sealing surface of the control member which is in sealing contact with an internal surface of the tubular member and a passageway extending from an end portion of the groove to a first end portion of the control member the arrangement being such that when the aperture in the wall of the tubular member is in register with the sealing surface of the control member it closes the aperture, rotation of the control member opening a flow path through the assembly.