

The present invention relates to plug assemblies for use in fluid passages, and more particularly to plug assemblies for use in thermal-medium passages extending through hollow vertical and horizontal members assembled as part of an air conditioning system in interior and exterior wall constructions such as unit curtain walls, partitions and the like.

According to one aspect of the invention there is provided a a plug assembly for use in a fluid passage, comprising:

- (a) a gasket seat having a contour substantially equal to an inner peripheral surface of the fluid passage;
- (b) a central cylinder projecting from said gasket seat and having an internally threaded hole;
- (c) an elastomeric gasket placed on said gasket seat around said central cylinder;
- (d) a sleeve adapted to fit over said central cylinder;
- (e) an end member attached to an end of said sleeve and having a hole; and
- (f) a threaded fastener adapted to be threaded through said hole in said end member into said internally threaded hole for pressing said elastomeric gasket axially between said gasket seat and said sleeve and resiliently radially outwardly against the inner peripheral surface of

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the fluid passage.

It is possible by means of the present invention to provide a plug assembly of a simple construction for reliably closing a heat-transporting medium passage
5 of an air conditioning system.

It is also possible by means of the present invention to provide a plug assembly which can easily and smoothly be inserted to any desired position in a thermal-medium passage and then remotely actuated to
10 close off the passage for completely blocking the flow of a thermal liquid.

According to another aspect of the present invention, a plug assembly including a gasket seat having a central cylinder with an annular elastomeric gasket
15 placed on the gasket seat around the central cylinder, and a sleeve fitted over the central cylinder and fastened thereto by a fastener such as a screw threaded through a bottom of the sleeve axially into the central cylinder; when the plug assembly is to be placed in
20 a thermal-medium passage, the screw is loosened slightly and the plug assembly is inserted into the passage with an elongate tightening tool; after the plug assembly has been pushed to a desired position in the passage, the screw is tightened by the tightening
25 tool until the annular elastomeric gasket is pressed between the gasket seat and an annular axial end of the sleeve and resiliently squeezed radially outwardly against an inner circumferential wall of the passage; a heat transporting medium such as hot water is then
30 prevented by the annular elastomeric gasket from

flowing through the passage; the plug assembly is retained in position by a set screw threaded through a passage wall and pressed against the sleeve.

The invention will be described by way of examples with reference to the accompanying drawings in which:-

FIG. 1 is a front elevational view of a unit curtain wall incorporating plug assemblies embodying the present invention, the view showing the unit curtain wall as seen from the interior of a room;

FIG. 2 is a cross-sectional view taken along line II - II of FIG. 1;

FIG. 3 is an exploded perspective view of a plug assembly embodying the present invention;

FIGS. 4 and 5 are fragmentary longitudinal cross-sectional views showing the manner in which the plug assembly of FIG. 3 is installed in a thermal-medium passage;

FIG. 6 is a fragmentary longitudinal cross-sectional view illustrative of the way on which the plug assembly is tightened in place by a tightening tool; and

FIG. 7 is a fragmentary longitudinal cross-sectional view showing a modified plug assembly and the manner of tightening the same in a thermal-medium passage.

FIGS. 1 and 2 illustrate a unit curtain wall, generally designated by the reference character 1, which constitutes an outer wall of a building. The unit curtain wall 10 includes a framework composed of a pair of hollow vertical frame members 11, 12 laterally spaced from each other, and a plurality of hollow horizontal frame members 13, 14, 15, 16, (four in the illustrated embodiment) vertically spaced from each other and interconnecting the hollow vertical frame members 11, 12. These vertical and horizontal frame members are made of extrusion-molded aluminum. The unit curtain wall 10 also comprises a panel 17 fitted between the horizontal frame members 14, 16 and a pair of glass panes 18, 18 fitted between the horizontal frame members 13, 14. The unit curtain wall 10 is attached by fasteners 21, 21 to an exterior building surface with

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the horizontal frame members 13, 15 positioned adjacent respectively to a ceiling 20 and a floor 19 of the building.

As shown in FIG. 2, the hollow horizontal frame members 13, 14, 15 have longitudinal thermal-medium passages 22, 23, 24, respectively, and longitudinal air passages 25, 26, 27, respectively. Although not shown, the hollow vertical frame members 11, 12 also have such longitudinal thermal-medium and air passages. These thermal-medium and air passages can be formed at the same time that the horizontal and vertical frame members are extrusion-molded. When the unit curtain wall 10 is assembled, the thermal-medium passages 22 - 24 in the horizontal frame members 13 - 15 are held in fluid communication with the thermal-medium passages in the vertical frame members 11, 12. The thermal-medium passages thus interconnected serve as part of an air conditioning system for enabling the unit curtain wall 10 to directly warm or cool the interior of a room by passing hot or cool water through the thermal-medium passages. While the heat-transporting medium is flowing through the thermal-medium passages, the hollow vertical and horizontal frame members 11 - 15 serve as heat radiators.

The thermal medium such as hot water is supplied from a supply pipe 28 having a branch pipe 29 connected to the thermal-medium passage 23 in the horizontal frame member 14 and discharged into a return pipe 30 having a branch pipe 31 connected to the thermal-medium passage 24 in the

horizontal frame member 15. During operation of the air conditioning system, the thermal medium flows in the directions of the arrows 33 from the supply pipe branch 29 through the horizontal frame member 14, the vertical frame member 12, the horizontal frame member 13, the vertical frame member 11, and the horizontal frame member 15, from which the thermal medium is discharged via the branch pipe 31 back into the return pipe 30.

Since all of the frame members 11 - 15 are extrusion-molded and designed as load-bearing members, they have uniform cross-sectional shapes. It is therefore necessary to prevent the heat-transporting medium from flowing into unwanted portions of the frame members, that is, to guide the thermal medium to flow from the horizontal frame member 14 into the vertical frame member 12 in the direction of the arrow 33 and also from the vertical frame member 11 into the horizontal frame member 15 in the direction of the arrow 33. To this end, two plug assemblies 32, 32 according to the present invention are disposed in the thermal-medium passages in the vertical frame members 11, 12 as shown in FIG. 1.

As illustrated in FIG. 3, the plug assembly 32 generally comprises a male member 34 and a female member 36. The male member 34 has a circular gasket seat 35 having substantially the same diameter as the inside diameter of the thermal-medium passages, a central cylinder 37 projecting perpendicularly from the circular gasket seat

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35, and an annular elastomeric gasket 38 disposed on the circular gasket seat 35 around the central cylinder 37. The central cylinder 37 has an axial internally threaded hole 39. The female member 36 includes a cylindrical sleeve 40 having an axial sleeve hole 41 and a bottom or end member 42 attached to one end of the cylindrical sleeve 40 and having substantially the same diameter as the inside diameter of the thermal-medium passages. The bottom 42 has a central hole 47 (FIG. 4). In an assembled state, the sleeve 40 is fitted over the cylinder 37 and a fastener 43 such as a hexagonal socket head cap screw is threaded through the hole 47 into the internally threaded hole 39 in the cylinder 37 with a spring washer 46 placed between the bottom 42 and a head 44 of the fastener 43. The fastener 43 is threaded into the hole 39 until an axial end of the sleeve 40 is positioned axially adjacent to the annular elastomeric gasket 38. The annular elastomeric gasket 38 can be resiliently squeezed radially outwardly when it is axially pressed between the axial end of the sleeve 40 and the gasket seat 35 on tightening the fastener 43.

The manner in which the plug assembly 32 is inserted and fixed in a pipe 48 will be described with reference to FIGS. 4, 5 and 6. The pipe 48 is equivalent to the structure which defines each of the thermal-medium passages. The plug assembly 32 is inserted by suitable means such as an elongate pusher rod to any desired position in the pipe 48. At this time, the fastener 43

remains slightly loosened to allow smooth insertion of the plug assembly 32 into the pipe 48. A tightening tool 52 as shown in FIG. 6 is used to tighten the fastener 43 in the plug assembly 32 placed in the pipe 48. The tightening tool 52 includes a shank 53 having a guide ball 54 of metal or synthetic resin mounted thereon, the guide ball 54 having a diameter substantially the same as the inside diameter of the pipe 48. A handle 56 is attached to one end of the shank 53, and a hexagonal screwdriver head 55 is attached to the other end close to the guide ball 54. The guide ball 54 serves to keep the hexagonal screwdriver head 55 in coaxial relation to the pipe 48. The tightening tool 52 is inserted into the pipe 48 until the hexagonal screwdriver head 55 is received in a hexagonal socket 45 in the head 44 of the fastener 43. Then the handle 56 is turned to tighten the fastener 43 to thereby press the annular elastomeric gasket 38 axially between the sleeve 40 and the gasket seat 35, whereupon the gasket 38 is resiliently forced radially outwardly against an inner peripheral wall of the pipe 48. The plug assembly 32 completely closes off the pipe 48, dividing the latter into two passage sections 50, 51 one of which allows the thermal medium to flow therein. The annular elastomeric gasket 38 is forcibly held in intimate contact with the inner peripheral surface of the pipe 48 for completely cutting off the flow of the thermal medium through the pipe 48. The plug assembly 32 is also advantageous in that it can be

retained in place anywhere in the pipe 48 without machining or otherwise altering the pipe 48, so that the latter can maintain its mechanical strength.

Prior to the tightening of the fastener 43, the sleeve 40 can be retained in place in the pipe 48 by a setscrew 49 threaded radially through the wall of the pipe 48 against the sleeve 40 as shown in FIGS. 5 and 6. The sleeve 40 is prevented by the setscrew 49 from rotation in the pipe 48. Therefore, the plug assembly 32 is also prevented from rotation while the fastener 43 is being tightened by the tightening tool 52. The setscrew 49 as it projects radially into the pipe 48 serves as a reference to position the plug assembly 32 when the latter is inserted into the pipe 48 since the plug assembly 32 is stopped by the setscrew 49. The setscrew 49 also serves to prevent the plug assembly 32 from moving axially under any pressure difference between the passage sections 50, 51.

FIG. 7 illustrates a modified plug assembly including a male member 57 having a circular gasket seat 58 with a central hexagonal socket 59 opening away from the hexagonal head 45 in the fastener head 44. When this plug assembly is placed in the passage 48, another tightening tool 60 similar to the tightening tool 52 is employed. The tightening tool 60 has a hexagonal screwdriver head 61 that can fit into the socket 59 in the gasket seat 58. In use, the screwdriver heads 55, 61 of the respective tightening tools 52, 60 are fitted in the sockets 45, 59,

respectively, and one of the tightening tools 52, 60 may be held at rest to keep the plug assembly 32 nonrotatable while the other tightening tool is rotated to tighten the fastener 43. Alternatively, the tightening tools 52, 60 are rotated in opposite directions to tighten the fastener 43 quickly. The modified plug assembly shown in FIG. 7 is particularly advantageous in applications in which the thermal medium flows in both the passage sections 50, 51 and no setscrew can be used due to the possibility of leakage of the thermal medium through the setscrew hole in the wall of the pipe 48. With the thermal liquid present in the passage sections 50, 51, the plug assembly is subjected to no large pressure difference and hence can be retained in place only by the gasket 38 pressed frictionally against the inner peripheral surface of the pipe 48.

While the plug assembly 32 has been shown and described as being incorporated in the unit curtain wall 10, it may be assembled into other interior and exterior building wall constructions such as partitions in rooms, for example, which are used as part of air conditioning systems.

Claims:-

1. A plug assembly for use in a fluid passage, comprising:

- 5 (a) a gasket seat having a contour substantially equal to an inner peripheral surface of the fluid passage;
- (b) a central cylinder projecting from said gasket seat and having an internally threaded hole;
- (c) an elastomeric gasket placed on said gasket seat around said central cylinder;
- 10 (d) a sleeve adapted to fit over said central cylinder;
- (e) an end member attached to an end of said sleeve and having a hole; and
- (f) a threaded fastener adapted to be threaded
15 through said hole in said end member into said internally threaded hole for pressing said elastomeric gasket axially between said gasket seat and said sleeve and resiliently radially outwardly against the inner peripheral surface of
20 the fluid passage.

2. A plug assembly according to claim 1, said gasket seat said sleeve and said end member being circular in shape, said elastomeric gasket being annular in configuration.

25 3. A plug assembly according to claim 1 or 2, said fastener comprising a hexagonal socket head cap screw.



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4. A plug assembly according to claim 3, said
hexagonal socket head cap screw including a head having a
first hexagonal socket, said gasket seat having a second
hexagonal socket defined therein and opening away from
5 said first heagonal socket.

5. A plug assembly according to claim 1,2 or 3,
including a setscrew to be threaded through a wall of the
fluid passage against said sleeve for retaining the latter
in the fluid passage.
