United States Patent

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[54] **TIP FOR VALVE MEMBER AND METHOD OF ASSEMBLING SAME**
6 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **137/434,** 251/357
[51] **Int. Cl.** **F16k 31/26**
[50] **Field of Search** ..... 137/409, 410, 315, 434; 251/333, 334, 356, 357, 358; 29/157.1, 156.7 A, 450

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ABSTRACT: The needle valve stem of a float-controlled valve is provided with a tip made of resilient material such as a fluoroelastomer. The end of the valve stem includes a cylindrical bore and the resilient tip has a cylindrical portion disposed in that bore which has a relaxed diameter greater than the diameter of the bore. The tip is inserted in the bore by stretching its cylindrical portion axially to reduce the diameter of the cylindrical portion. Once in the bore, the stretching force is released whereupon the tip tends to return it its relaxed state and in doing so creates an inherent bias which acts against the bore walls to hold the tip on the valve stem. The tip includes an annular, convex in transverse cross section projection which engages an unobstructed surface surrounding the valve orifice through which flow occurs. The tip closes the orifice to flow and does so without protruding into the orifice.

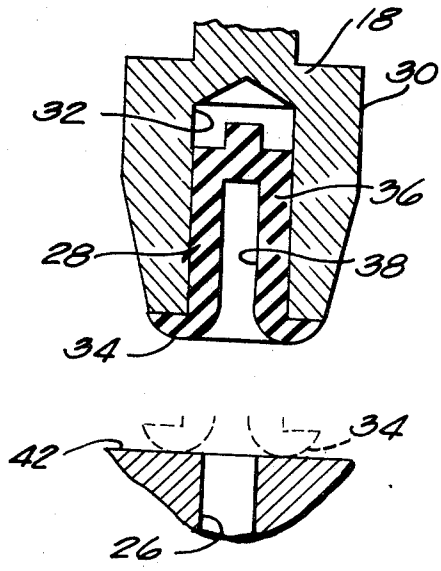


Fig. 1

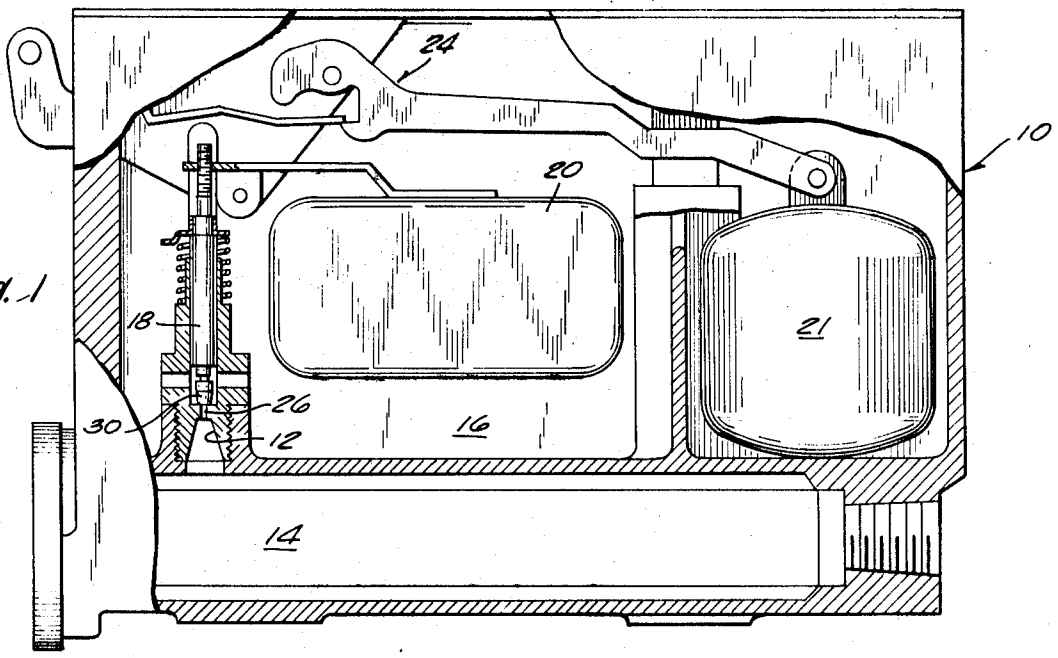


Fig. 2

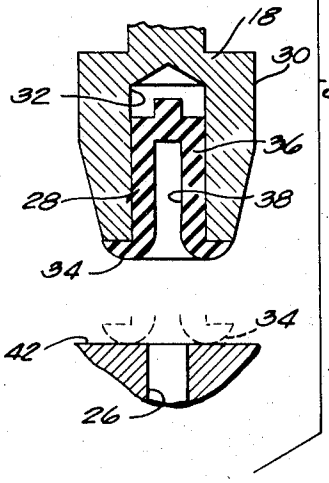


Fig. 3

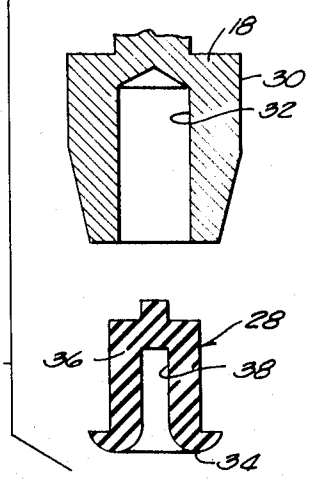
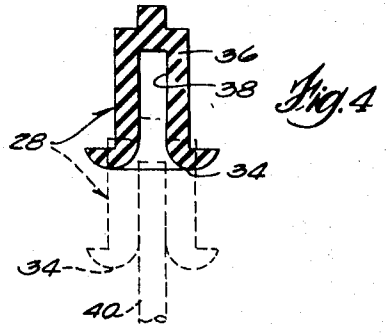


Fig. 4



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TIP FOR VALVE MEMBER AND METHOD OF ASSEMBLING SAME

BACKGROUND OF INVENTION

This invention relates to valves and to resilient tips for movable valve members and, more particularly, to the connection of the tip to the valve stem, the manner of making that connection, and the closure of the fixed orifice to flow by the resilient tip.

Resilient tips have been used in valves to achieve valve closure. Various types of connections have been proposed for mounting the tips on the valve stem, these have generally taken the form of bonding, mechanical fasteners, mechanical interlocks, etc. For the most part these methods of attachment have not been entirely satisfactory for a number of reasons among which are that they have been relatively difficult to assemble, complex in construction, and not completely reliable.

This invention is concerned with providing a resilient tip on a movable valve member and connecting that tip to the valve member.

SUMMARY OF INVENTION

Among the general objects of this invention are to provide an improved and simplified connection of a resilient tip on a movable valve member and one which facilitates the assembly of the tip to the valve member; and, furthermore, to achieve an improved closure of a valve orifice with the resilient tip.

For the achievement of these and other objects, this invention proposes an arrangement wherein a movable valve member is provided with a bore in the end thereof. A resilient tip is supported in the bore. To connect the tip to the movable valve member the bore is provided with opposed wall portions which are spaced a preselected distance apart. The resilient tip includes a portion which projects outwardly from the movable valve member and a second portion adapted to extend into the bore of the movable valve member. When the resilient tip is relaxed, the second portion has a transverse dimension which is greater than the preselected distance between the opposed bore wall portions. To assemble the tip onto the movable valve member, the second portion of the tip is stretched so that it becomes elongated and its transverse dimension is reduced sufficiently for insertion into the bore. Once in the bore, the stretching force on the second portion of the tip is released and, due to its resiliency, that portion tends to return to its relaxed position. This provides an inherent bias which maintains engagement between the tip and the opposed walls of the bore thereby securely holding the tip assembled on the movable valve member.

Preferably, the resilient tip also includes a bore extending into the second portion thereof. This bore facilitates stretching the second portion of the tip and moreover, permits a suitable elongated tool to be inserted into the tip. The tip can be stretched on the tool and the tool provides the instrument by which the tip is inserted in the valve member bore.

Also it is preferred that the projecting portion of the tip is annular and also is convex in transverse cross section. The resilient tip is movable to close a fixed orifice of the valve to flow through the valve. The fixed orifice is surrounded by an unobstructed surface and the annular portion of the tip engages the unobstructed surface. The movable valve member has generally unobstructed movement toward the unobstructed surface generally throughout the extent of the projecting portion of the tip. Throughout this movement of the movable valve member is a valve closing or sealing direction, the annular projection does not protrude into the fixed orifice.

DESCRIPTION OF DRAWINGS

FIG. 1 is a view of a float-controlled oil valve in which this invention is embodied;

FIG. 2 is an enlarged section view of a portion of an assembled valve stem and resilient tip together with the fixed orifice illustrating the cooperation between the tip and orifice to close the valve to flow;

FIG. 3 is an exploded view of the tip and a portion of the valve stem illustrating the relationship between the relaxed resilient tip and the bore of the valve stem; and

FIG. 4 illustrates a step in assembling the tip.

DESCRIPTION OF PREFERRED EMBODIMENT

The invention is illustrated as embodied in a float-actuated oil flow control valve **10**. However, the invention is specifically concerned with the resilient tip used on the valve stem and the manner of connecting that tip to the valve stem and, in its more specific aspects, to the manner in which closure of the valve to flow is achieved. Accordingly, the invention has application broadly to valves and is not necessarily limited to any particular type of valve or valve usage.

In valve **10** flow occurs from inlet **14** through passage **12** into float reservoir **16**. The construction and arrangement of needle valve stem **18**, float **20**, and the connection between float **20** and the needle valve stem can take any generally accepted form. The valve can also be provided with a safety cutoff float **21** and a cutoff actuator **24**. The construction and arrangement illustrated is generally that disclosed and claimed in U.S. Pat. No. 2,547,995 of William A. Biermann et al., entitled "Fluid Flow Control Mechanism" and assigned to the assignee of this application. Reliance is placed on this patent for a more complete description of the valve structure should such a description become necessary. As alluded to briefly above, the amount of flow through valve **10** is controlled by the valve element which control flow spicifically through passage **12** from inlet **14** to valve chamber **16**. Needle valve stem **18** opens and closes passage **12** by moving axially with respect to passage **12** to close fixed orifice **26** provided in that passage.

Particular reference will now be made to FIG. 2–4 for a description of resilient tip **28** and its connection to valve stem **18**. End **30** of the valve stem is provided with a cylindrical bore **32**. Tip **28** is engaged in the bore and is held on the valve stem solely by the frictional engagement between the tip and the bore walls.

More specifically, tip **28** includes a portion **34** which, when the tip is assembled on the valve stem, projects axially from the end of the valve stem and is the part of the tip which cooperates in closing orifice **26** to flow. The tip also includes a cylindrical portion **36** which fits into bore **32**. Tip **28** is made of a suitable resilient material, such as a fluoroelastomer, so that the tip is deformable but will tend to return to a normal relaxed state when the deforming force is released. The relaxed state of the tip is illustrated in FIG. 3 and in this state portion **36** has a diameter which is greater than the diameter of bore **32**. The tip being resilient can be deformed, specifically it can be stretched along the axial extension of portion **36** to reduce the diameter of that extension for insertion into the valve stem bore. In the stretched condition the tip is inserted into the bore and released. Upon release the tip tends to return to its normal state. However, since the bore diameter is less than the relaxed diameter of portion **36**, that tip portion cannot return fully to its relaxed state. Consequently, an inherent biasing force is provided urging the tip into engagement with the bore walls to hold the tip on the valve stem.

With this arrangement it will be noted that opposed portions of the walls of bore **32** define a transverse dimension (e.g., a diameter) and this transverse dimension is less than a corresponding transverse dimension (e.g., a diameter) of tip portion **36** in its relaxed state. Friction engagement is then provided between the tip and the bore walls to securely hold the tip on the valve stem.

Preferably, tip **28** is provided with an interior bore **38**. This bore will accommodate a suitable tool such as rod **40** upon which the tip can be stretched in an axial direction to reduce the diameter of the cylindrical portion, this is illustrated by the full line of FIG. 4. Rod **40** also facilitates insertion of the tip into bore **32** while the tip is in a stretched condition. That is, rod **40** is inserted into bore **38** and the tip is stretched over the

rod to reduce the diameter of tip portion **36** to less than that of bore **32** whereupon the tip is inserted in bore **32**. Rod **40** is then removed releasing tip portion **36** and allowing it to expand into engagement with the walls of bore **32** as described above.

This arrangement provides a simplified and effective manner of mounting a resilient tip onto a valve stem.

A further problem encountered in the use of resilient valve tips to close an orifice is the problem of the tip protruding into the orifice, in this instance orifice **26**. When such protrusion occurs, the sealing surface of the tip is indented and after continued use the tip indentation may take a relatively permanent set. Any such set can eventually interfere with proper seal off at the orifice since there is no assurance that the tip will engage in the orifice in the same manner upon each operation. To achieve effective seal off at orifice **26**, portion **34** of tip **28** is generally annular and is provided with a convex outer surface, i.e., the annular tip portion has a convex configuration in transverse cross section as seen in FIGS. **2** and **3**. Surface **42** immediately surrounding orifice **26** is planar and unobstructed and it is on this surface that tip **28** makes sealing engagement. The valve stem is positioned so that the annular projection **34** engages surface **42** but at areas spaced laterally from the walls of orifice **26**. It will be noted that the valve stem is capable of unobstructed movement toward orifice **46** in pressing tip **28** into sealing engagement with surface **42**. The valve stem and portion **34** of the valve tip are so constructed and arranged that through out this unobstructed sealing movement of the valve stem toward surface **42**, the valve tip remains laterally spaced from the orifice and does not protrude into the orifice. This arrangement provides an effective seal at the orifice even through extended usage and does not require close tolerance to be held either in manufacturing or assembly of the valve elements.

I claim:

1. A flow control valve comprising, in combination,

a valve member including a fixed orifice through which flow occurs,

a movable valve member having an end,

a generally resilient tip carried on said end and movable with said valve member,

means for moving said valve member relative to said orifice to move said tip selectively into and out of closing engagement with said orifice,

means defining a bore in said end of said movable valve member with said bore having generally opposed wall portions defining a transverse dimension,

said tip including a first portion projecting from said end and a second portion having a transverse dimension and an extension generally normal to said transverse dimension thereof, said tip characterized by having a normal relaxed state wherein said transverse dimension thereof is greater than said transverse dimension of said bore and said tip being stretchable along its extension to reduce the tip transverse dimension and tending to return to its normal relaxed state from said stretched state when released whereby stretching of said tip extension reduces said transverse tip dimension for insertion in said bore and release of said tip causes said tip to expand in the direction of its transverse dimension to engage said wall portions,

means defining an interior bore in said resilient tip extending through said first tip portion into said second tip portion,

and said second tip portion disposed in said movable valve member bore and having an extension dimension greater than its relaxed extension dimension and a transverse dimension less than its relaxed transverse dimension so that said tip securely engages said wall portions due to said second tip portions's tendency to return toward its normal state.

2. The valve of claim **1**

wherein said first tip portion is generally annular and has a convex transverse cross section,

wherein said fixed orifice is surrounded by an unobstructed surface,

and wherein said first tip portion engages said unobstructed surface around said fixed orifice to close said orifice to flow and said movable member has generally unobstructed movement toward said orifice substantially throughout the extent of the projection of said first tip portion, the entire sealing engagement between said tip and said unobstructed surface being spaced from said orifice so that the closure of said orifice is effected throughout said range of unobstructed movement without said first tip portion protruding into said orifice.

3. The valve of claim **2** wherein said bore and second tip portions are cylindrical and said transverse dimensions are diameters.

4. The valve of claim **3** wherein said means for moving said valve member comprises a float mechanism.

5. The valve of claim **1** wherein said bore and second tip portions are cylindrical and said transverse dimensions are diameters.

6. A flow control valve comprising, in combination,

a valve member including a fixed orifice through which flow occurs,

a movable valve member having an end,

a generally resilient tip carried on said end and movable with said valve member,

means for moving said valve member relative to said orifice to move said tip selectively into and out of closing engagement with said orifice,

means defining a bore in said end of said movable valve member with said bore having generally opposed wall portions defining a transverse dimension,

said tip including a first portion projecting from said end and a second portion having a transverse dimension and an extension generally normal to said transverse dimension thereof, said transverse dimension being generally uniform along the extension of said tip and said tip characterized by having a normal relaxed state wherein said transverse dimension thereof is greater than said transverse dimension of said bore and said tip being stretchable along its extension to reduce the tip transverse dimension and tending to return to its normal relaxed state from said stretched state when released whereby stretching of said tip extension reduces said transverse tip dimension for insertion in said bore and release of said tip causes said tip to expand in the direction of its transverse dimension to engage said wall portions along the entire extension of said tip in said movable valve member bore,

and said second tip portion disposed in said bore and having an extension dimension greater than its relaxed extension dimension and a transverse dimension less than its relaxed transverse dimension so that said tip securely engages said wall portions due to said second tip portion's tendency to return toward its normal state and generally along the entire extension of said tip in said movable valve member bore.

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