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CHECK VALVE CONSTRUCTION

Filed June 25, 1962

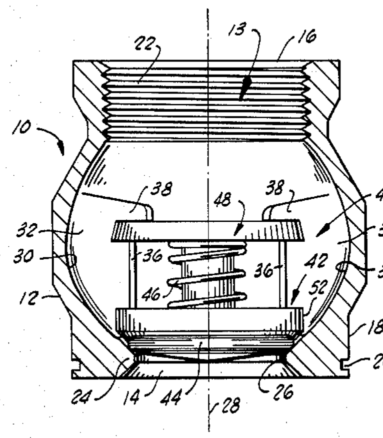

Fig-1

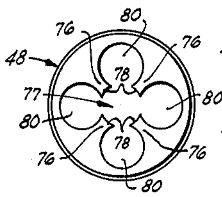

Fig-5

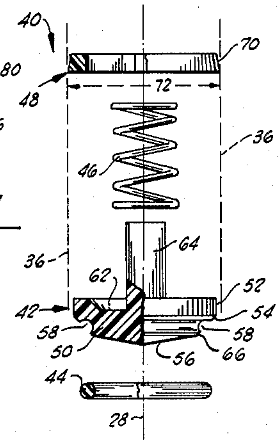

Fig-4

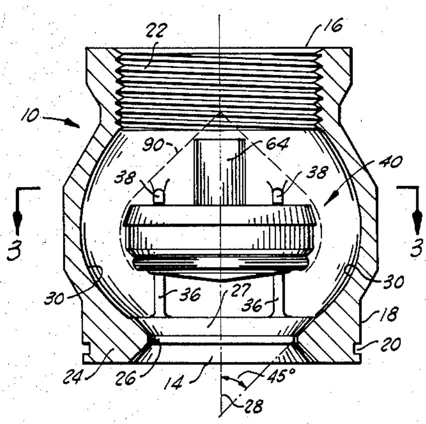

Fig-2

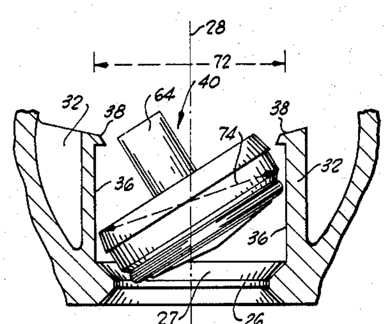

Fig-7

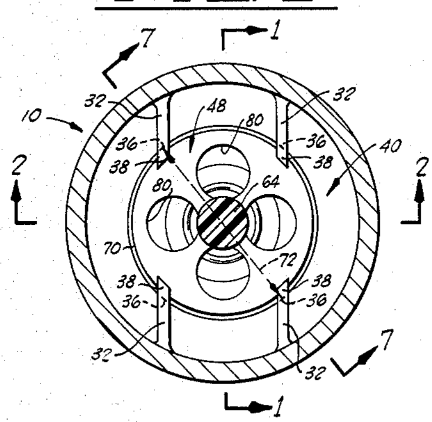

Fig-3

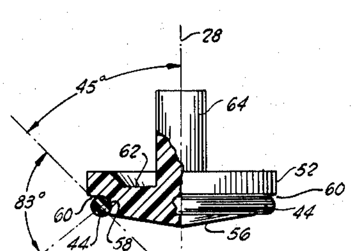

Fig-6

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CHECK VALVE CONSTRUCTION
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The present invention relates to fluid handling, and more particularly, but not by way of limitation, relates to improvements in reverse flow check valves of the type especially well suited for use as foot valves in water wells.

In many fluid handling systems it is necessary to provide a check valve for preventing reverse flow of a fluid through a conduit. In almost all situations it is highly desirable that the check valve create as little resistance to fluid flow in the forward direction as possible, that the check valve open and close as a result of minimum pressure differentials in the forward and reverse directions, and that the check valve be dependable and free from sticking in either the open or closed position. These factors are of particular importance in foot valves used in combination with water well pumping systems which utilize a suction type pump located at the surface and atmospheric pressure to draw water up through a string of tubing. Of course foot valves are also used in all types of water well pumps to maintain the tubing string primed or filled with water.

In systems where the pump is located at the surface of the ground and the water is lifted by atmospheric pressure, the maximum height to which the water can efficiently be pumped is on the order of 27 or 28 feet. As is well known, the greater the volume of fluid flowing through any conduit, the greater the frictional drop. Therefore as the volume of water pumped by the surface pump increases, the pressure drop across the foot valve and through the tubing string increases and in effect reduces the maximum height to which that particular quantity of fluid can be pumped. In other words, assuming a pressure drop of 6 feet of water across the foot valve at 5 g.p.m., the maximum depth from which 5 g.p.m. could be pumped would be reduced from 28 feet to 22 feet. Or stated in another manner, as the depth approaches the maximum efficient depth of 28 feet, the frictional resistance in the foot valve and tubing string materially reduces the volume rate of fluid which can be pumped. Similarly, the greater the pressure differential required to open the foot valve and hold it open the greater the pressure drop across the valve. The weight of the valve body of a vertically disposed foot valve is a primary factor in the magnitude of the pressure differential required to open the valve. This is but one example of a situation in which it is of considerable importance to utilize a check valve which creates a minimum pressure drop.

In water well foot valves it is also highly desirable that the working parts of the valve be wholly contained within the body of the valve. Since the outside dimensions of the foot valve are necessarily limited by the inside diameter of the casing, considerable problems are encountered in designing a valve within this limited space which has a minimum pressure drop, and particularly in designing a valve which can be easily and economically manufactured and assembled. Cost of assembling the valve is in many cases as important as cost of fabricating the various parts. Similarly, it is highly desirable that a check valve be repairable quickly and easily without necessitating use of special tools.

Another problem encountered in check valves in general and foot valves in particular is that of sticking in either the open or closed position as a result of foreign matter such as sand lodging between relatively moving parts and from sticking in the closed position as a result of prolonged pressure on resilient seals and wedging of resilient seals. Sand particles will invariably be present at least to some degree in all water wells. So long as water is being pumped from the well, sand cannot normally collect in

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the tubing, but when the pump is stopped the foot valve maintains a column of water standing in the tubing. Sand and silt then settles from the water and is deposited directly on the foot valve, creating a condition which is highly conducive to sand sticking of the valve.

Therefore it is contemplated by the present invention to provide a check valve which offers a very low resistance to fluid flow in the forward direction, which is highly economical to manufacture, which has a long and trouble free operating life, and which may be very easily disassembled and repaired by replacement of very economically fabricated working parts. Although the only limitations on the spirit and scope of the invention are set forth in the appended claims, a novel valve constructed in accordance with the present invention may be briefly described as comprising a one piece tubular body having a fluid passageway therethrough, an annular seat adjacent the inlet end and facing the outlet end, an enlarged, smoothly curved portion immediately downstream from the annular seat, and a plurality of guide flanges projecting generally radially inwardly to form a guide barrel for a valve member and having inwardly directed stops at the downstream end thereof. A circular valve member having a slightly pointed nose facing upstream is reciprocally disposed in the barrel formed by the guide flanges and has an axial guide stem extending downstream from the valve body. A guide and stop washer has a central aperture which receives the guide stem and has an external diameter corresponding to the diameter of the guide barrel formed by the guide flanges. A spring is disposed between the circular valve disk and the guide and stop washer and urges the valve member against the seat and the guide and stop washer against the inwardly projecting stops on the guide flanges. In addition to the several features of construction which contribute to an exceedingly low pressure drop and reliable operation, as hereafter described in greater detail, a very important aspect of the present invention resides in the fact that the valve member and guide and stop washer can be removed from the single piece valve body merely by compressing the two together against the force of the spring, rotating the members approximately 90° about an axis transverse to the longitudinal axis of the valve body, and removing the structure through the downstream end of the body. Of course, the valve member and guide and stop washer may be inserted very quickly and easily merely by reversing the steps.

Therefore it is an important object of the present invention to provide a check valve having a minimum resistance to fluid flow.

Another very important object of the present invention is to provide a check valve which may be very easily assembled and disassambled.

Still another very imporatnt object of the present invention is to provide a check valve which may be very economically manufactured. Yet another object of the present invention is to provide a check valve having the characteristics and advantages described which has no projection extending below the bottom of the valve housing.

Still another object of the present invention is to provide a check valve requiring a minimum pressure differential to open the valve even when the valve is oriented in a vertical downwardly closing position.

Still another object of the present inention is to provide a check valve utilizing an O-ring situated in such a manner as to substantially reduce sticking of the resilient material.

A further object of the present invention is to provide a check valve which is less likely to be stuck in either the open or closed position by sand or other foreign matter in the fluid, particularly when utilized as a foot valve in a water well.

Many additional objects and advantages of the present invention will be evident to those skilled in the art from the following detailed description and drawings, wherein:

FIG. 1 is a longitudinal sectional view of a foot valve constructed in accordance with the present invention showing the valve in closed position;

FIG. 2 is a longitudinal sectional view similar to FIG. 1, but showing the valve in the full open position;

FIG. 3 is a cross sectional view taken substantially on line 3—3 of FIG. 2;

FIG. 4 is an exploded view, partially in section, of the working parts of the valve construction shown in FIG. 1;

FIG. 5 is a top view of the uppermost working part shown in the exploded view of FIG. 4;

FIG. 6 is a slightly enlarged view of the valve member shown in FIG. 4, partially broken away, to better illustrate details of construction; and,

FIG. 7 is a sectional view taken substantially on lines 7—7 of FIG. 3, and serves to illustrate the method of assembling the novel check valve of FIG. 1.

Referring to the drawings, and particularly to FIGS. 1–3, a check valve, or more specifically, a water well foot valve, is indicated generally by the reference numeral **10**. The valve **10** has a single piece tubular body **12** having a longitudinally extending passageway **13** therethrough and an inlet end **14** and an outlet end **16**. The inlet end **14** is provided with a cylindrically shaped exterior surface **18** having an annular groove **20** therein for connection to a novel screen described in my copending application Serial No. 204,782, now United States Patent 3,163,229, entitled "Improved Screen for Water Well Foot Valves." The outlet end **16** of the body **12** is provided with internal threads **22** for connecting the valve **10** to a tubing string. Of course it is to be understood that the inlet end **14** may be slightly extended and also provided with internal threads in the conventional manner; or the ends **14** and **16** may be provided with any combination of internal and external threads or other coupling means for connecting the valve body **12** in a fluid conduit.

An inwardly projecting shoulder **24** adjacent the inlet end **14** forms a restricted passageway **26** which is of smaller diameter than the outlet end **16** and also forms an annular seat **27**, as best seen in FIG. 2. The annular seat **27** is preferably formed at approximately 45° to the longitudinal central axis of the tubular valve body **12**, which axis is represented by the customary dotted line **28**. The 45° angle of the annular seat **27** substantially reduces sticking while also serving to center the valve member as hereafter described in greater detail. In accordance with a very important aspect of the present invention, the interior surface **30** of the body walls downstream of the annular seat **27** are smoothly curved from the 45° angle seat **27**, substantially as illustrated in FIGS. 1 and 2. The curvature of the interior surface **30** is such as to maintain a minimum clearance from the valve member, hereafter described, so as to continuously provide at least as great a fluid passageway as any conduit which may be connected to the threads **22**, and also form, in combination with the valve structure, a flow path having a radial cross section which is highly conducive to laminar flow as will hereafter be described in greater detail.

Four guide flanges **32** are molded integrally with the tubular body **12** and project, generally speaking, radially inwardly as best seen in FIG. 3. The innermost edges of the guide flanges **32** are cut back by machining on a lathe to a diameter approximately equal to the maximum diameter of the annular seat **27** such that the machined inner edges **36**, shown in FIGS. 1 and 2, and in dotted outline in FIG. 3 form, in combination, what may be considered a cylindrical guide barrel having an axis coincident with the center line **28** of the valve body **12**. The downstream ends of the guide flanges **32** are not machined back and project inwardly beyond the machined inner edges **36** to stop portions **38** which serve to retain the valve mechanism in place as hereafter described in detail. It will be noted from FIG. 3 that the guide flanges **32** do not project inwardly along radials, but instead adjacent pairs are aligned in a plane spaced from the center line **28**. Although this particular orientation of the guide flange is not essential, it promotes the ease with which the valve mechanism can be inserted and removed as hereafter described. It should also be appreciated that the guide flanges **32** serve as fluid flow straightening veins to reduce turbulence and threfore the frictional pressure drop as hereafter described in greater detail.

A valve member assembly indicated generally by the reference numeral **40** in FIGS. 1, 2 and 3 is shown in greater detail in the exploded view of FIG. 4. The valve member assembly **40** is comprised of a valve member **42** and an associated O-ring gasket **44**, a coil spring **46** and a guide disk **48**. The valve member **42** is comprised generally of a circular disk portion **50** having a cylindrically shaped edge **52**, a 45° tapered seating portion **54**, and a conically tapered nose portion **56** which faces upstream. The diameter of the cylindrical edge portion **52** is preferably slightly less than the diameter of the guide barrel formed by the machined inner edges **36** of the inwardly projecting flanges **32** of the valve body **12**. The seating portion **54** is provided with an annular groove **58** for receiving the O-ring gasket **44**. As best illustrated in FIG. 6, the annular groove **58** is cut into the 45° tapered seating portion **54**, at an angle somewhat less than 90°, such as 83°, in order to provide an annular open area **60** to assist in preventing sticking of the O-ring gasket **44** as hereafter described in greater detail. The downstream face of the valve member **42** is provided with an annular recess **62** and a central guide stem **64** which extends downstream. In accordance with an important aspect of the present invention, the entire valve member **42** is molded from a lightweight plastic having a high compressive strength, such as the acelic resin sold under the tradename Delrin by E. I. du Pont de Nemours, Inc. The O-ring gasket **44** is a standard or conventional circular O-ring having a circular cross section as illustrated. The O-ring gasket **44** is fabricated from any resilient material such as rubber and preferably has a normal diameter slightly less than the minimum diameter of the annular groove **58** such that the O-ring gasket **44** can be stretched over the annular point **66** and will then snap into the annular groove **58** and be retained in place by tension.

The disk **48** functions as both a stop and a guide. The peripheral edge **70** of the disk **48** is tapered downstream and has a maximum lower diameter **72** which is equal to the diameter of the guide barrel formed by the machined inner edges **36** of the guide flanges **32**, as represented by the dotted lines in FIG. 4. If desired, the tapered edge **70** may in actuality be rounded in such a manner that the maximum composite diagonal diameter **74** (see FIG. 7) of the valve member **42** in combination with the stop disk **48** does not exceed the maximum diameter **72** of the stop disk **48** and guide barrel so that the valve member assembly **40** may be inserted in the valve body **12** as hereafter described in greater detail. The stop disk **48** also has a plurality of radially inwardly extending guide fingers **76**, the inner ends **78** of which, generally speaking, form a circular guide aperture **77** for receiving the guide stem **64** of the valve member **42** in a loose, sliding fit. Relatively large openings **80** are provided between the guide fingers **76** to permit fluid flow therethrough and to reduce the likelihood of sand sticking as hereafter described in greater detail. In accordance with an important aspect of the present invention, the stop disk **48** is also molded from a lightweight, inexpensive plastic such as polystyrene. When the valve member 42 and the stop disk 48 are molded from a lightweight plastic, the coil spring 46 may be formed from a lightweight spring steel wire so as to have a relatively low force. This is possible because no matter in what position, vertical or horizontal, the valve is placed, the spring will be required only to support either the lightweight stop disk 48 or the lightweight valve member 42. The combination of the lightweight plastic parts and the relatively weak coil spring 46 permits a very low pressure differential to open the valve even when oriented in the vertical, downwardly closing position.

The valve member assembly 40 is completely assembled and inserted in the body 12 merely by snapping the O-ring gasket 44 in the annular groove 58, placing the coil spring 46 around the guide stem 64, placing the stop disk 48 over the guide stem 64, and then compressing the coil spring 46 until the stop disk 48 abuts the disk shaped valve member 42, substantially as shown in FIG. 7. The stop disk 48 is then held against the valve member 42 and the entire valve member assembly 40 is inserted through the threaded outlet end 16 and passed downwardly between the stop portions 38 of the guide flanges 32 until the assembly is positioned within the guide barrel formed by the machined inner edges 36. Of course it will be appreciated that as the assembly 40 is passed into the guide barrel, the assembly is oriented such that the guide stem 64 is generally perpendicular to the center line 28 of the body 12. It will also be appreciated that the assembly 40 can be relatively easily manipulated within the body 12 because access is provided for a person's fingers through both ends 14 and 16 of the body. Once the assembly 40 is within the guide barrel, the assembly is then rotated until the guide stem 64 is substantially aligned with the center line 28, and then released to permit the spring 46 to expand and bias the stop disk 48 upwardly against the stop portions 38 and bias the valve member 42 downwardly against the annular seat 27. This can easily be accomplished since the maximum diagonal diameter 74 of the valve member assembly 40 is less than the constant diameter of the guide barrel as represented by 72 in FIG. 3. The valve member assembly 40 can be removed from the valve body 12 simply by pressing the stop disk 48 and valve member 42 together, rotating the assembly 90°, and removing the assembly through the opening in the outlet end 16 of the body 12.

It will be appreciated by those skilled in the art that the valve member 42 cannot possibly become disoriented in the guide barrel and jam in either the closed or open position because the valve member 42 is effectively maintained in aligned position by the combined action of the guide barrel machined inner edges 36 acting on the cylindrical edge 52 of the valve member, and by the ends 78 of the fingers 76 which act on the guide stem 64. As illustrated, the maximum diameter of the valve member 42, i.e., the diameter of the cylindrical edge 52, is preferably slightly less than the diameter of the guide barrel formed by the machined inner edges 36. Similarly, the guide aperture 77 formed in the stop disk 48 by the ends 78 of the fingers 76 is preferably slightly larger than the diameter of the guide stem 64. These features permit automatic aligning adjustments of the valve member 42 each time that the O-ring gasket 44 seats on the 45° tapered annular seat 27. However, it will be noted that the stop disk 48 cannot move radially because the maximum diameter 72 of the stop disk 48 is virtually the same as the diameter of the guide barrel formed by the machined inner edges 36. In this manner, the maximum movement of the upper end of the guide stem 64 can be maintained within desired limits, and yet still permit a maximum space between the guide stem 64 and the ends 78 of the fingers 76 to prevent sand sticking as hereafter described in greater detail.

Heretofore, check valves which utilized O-rings as resilient sealing gaskets were frequently troubled by sticking of the resilient O-rings due either to wedging of the O-ring in a tapered seat or as a result of somewhat prolonged compression by high pressure forces. In water wells, for example, the compression force acting on the O-ring is equal to the weight of the column of water standing on the valve member. When this force is divided by the relatively small area of the O-ring which is in contact with the seat, a very high unit area pressure is applied to the O-ring gasket. Valve structures heretofore utilizing O-ring gaskets have in general employed tapered mating surfaces disposed at angles less than 45° to the longitudinal axis of the valve in order to provide an annular groove which will adequately retain the O-ring gasket in position on the valve member. In such cases, the O-rings frequently become radially inwardly compressed so as to become wedged between the valve member and seat and tend to cause the valve to stick. As previously mentioned, the annular seat 27 of the disclosed valve body 12, as well as the seating portion 54 of the valve member 42, are tapered at approximately 45° to the axis of the valve. Also the annular groove 58 for receiving the O-ring is formed along an angle less than 90° to the seating portion 54 so as to provide an enlarged annular open area 60 downstream from the O-ring gasket 44. Therefore, as the valve member 42 is pressed against the annular seat 27 by fluid pressure, the O-ring gasket 44 will tend to roll upwardly along the annular seat 27 into the annular open space 60. Not only does this appreciably reduce sliding contact of the O-ring gasket 44 with the annular seat 27 to reduce wedging and sticking, but also tends to both expand the O-ring and create a twist or torsion in the O-ring. Upon release of the pressure against the valve member 42, the resiliency of the O-ring gasket 44 as it contracts and twists back into shape will tend to eliminate sliding friction and also tend to spring the valve member 42 from the annular seat 27 and thereby materially reduce sticking.

As previously mentioned, the valve member 42 and stop disk 48 are preferably fabricated from a lightweight, hard plastic material. When the check valve 10 is utilized as a foot valve and is oriented in a vertical position as illustrated, the light weight of the valve member 42 will appreciably reduce the pressure differential required to open the valve. In this regard, it will be appreciated that the light weight of the stop disk 48 substantially reduces the force required from the coil spring 46 to hold the stop disk in position, and thereby also reduces the force which must be overcome by fluid pressure differential to open the valve. Since only a relatively low pressure differential is required to open the valve, in most cases the valve will instantly be moved to a full open position and even though the pressure drop as the fluid passes through the valve is then very small, the valve will in most cases be maintained full open to thereby maintain a minimum flow resistance configuration as hereafter described in greater detail. Once again, in a water well foot valve this can be of significant importance because as the pressure required to open and maintain the valve open increases, the maximum depth from which water can be pumped at a given rate is reduced.

A very serious problem with any check valve construction is sticking due to foreign particles which may lodge between two relatively moving parts. In general, this sticking is primarily caused by the small particle wedging between two parts which are in sliding contact, such as, in the present invention, between the guide stem 64 and the ends 78 of the guide fingers 76; or between the valve member 42 and the machined inner edges 36 which form the valve member guide barrel. In the present invention these contacting guide surfaces are reduced to an absolute minimum because as it will be noted the machined inner edges 36 of the guide flanges 32 which contact the cylindrical edge 52 of the valve member 42 are both relatively narrow, and the ends 78 of the guide fingers 76 which contact the surface of the guide stem 64 are preferably held at a minimum. Also, it will be recalled that a slight spacing is provided between both the edge 52 and the edges 36, as well as between the ends 78 and the guide stem 64, to permit proper alignment of the valve member with the seat. This further reduces the likelihood of sticking because the particles which may settle between these parts will usually be washed away by fluid. In this connection, it will be noted that the guide flanges 32 also serve as straightening veins for fluid flow as hereafter described and accordingly are in immediate proximity to the full flow of the fluid stream. Similarly, the apertures 80 provide fluid flow to some extent adjacent the ends 78 and the valve stem 64 as the valve opens to wash particles therefrom.

Sticking of foot valves due to accumulations of sand and silt are of particular significance in water wells because when the pump is stopped, sand, silt and other foreign particles entrained in the water standing in a tubing string will, over a period of time, settle out and be deposited on the foot valve and upon the upwardly opening valve member assembly 40. In this case the openings 80 permit a substantial portion of the sand to pass therethrough and be deposited directly upon the valve member 42 rather than around the aperture 77 which receives the guide stem 64. At the same time, the fingers 76 prevent a total accumulation of sand between the valve member 42 and the stop disk 48 so that the valve member 42 may be opened ever so slightly to permit a jet of fluid to pass through the valve. Also, the openings 80 prevent sand from accumulating upon the stop disk 48 so that the weight of the sand cannot press it down tightly against the valve member 42 to prevent at least a slight opening of the valve to produce a jet wash. Even in the event of substantial sanding, if the valve member 42 can be opened ever so slightly, the jet of fluid will quickly wash the sand from between the various moving parts and particularly from between the valve member 42 and the stop disk 48 by passing through the openings 80. Should the stop disk 48 become loaded with sand sufficiently to be forced downwardly against the bias of the coil spring 46 and away from the stop portions 38, there is no real danger of the stop disk 48 being dislocated from an operative position because the guide stem 64 and guide barrel formed by the machined inner edges 36 will, in almost all cases, maintain the disk 48 properly oriented at 90° to the center line 28 of the valve.

As previously mentioned, one of the most important aspects of the present invention is the provision of a jet valve which has a very low resistance to fluid flow. Starting at the inlet end 14 which may be formed substantially as shown for a foot valve, it will be noted that a smooth taper is provided inwardly to the restricted passageway 26 which has the smallest diameter. Then the 45° taper of the annular seat 27 continues evenly into the smooth curvature 30 of the interior of the body 12. The curvature 30 is such as to maintain a substantially constant minimum distance to the closest portion of the valve member assembly 40 the entire length of the fluid passageway 13 through the valve 10. The total cross sectional area of the fluid passageway at any longitudinal point is substantially greater than the cross sectional area of the restricted passageway 26 or of the cross sectional area of a standard conduit to which the valve may be attached.

The valve member assembly 40 also has a conically tapered nose portion 56 which effectively separates the fluid stream as described in my copending application entitled "Universal Position Check Valve," Serial No. 823,-166, filed June 26, 1959. It will also be noted that when fully opened as shown in FIG. 2, the valve member assembly 40 has an external configuration closely complementary to the interior curvature 30 of the body 12 so as to provide a rather uniform flow path and promote laminar rather than turbulent flow. The guide flanges 32 also function as fluid flow straightening veins to prevent rotational or corkscrew turbulence which is exceedingly detrimental to efficient fluid flow. Even the guide stem 64 assists materially in maintaining laminar flow in that it tends to prevent swirling behind the stop disk 48. Thus it will be noted that except for somewhat small surface irregularities, the valve member assembly 40 assumes an effective fluid flow streamlining form approximating a teardrop when in the full open position, as indicated by the dotted outline 90 in FIG. 2.

From the above detailed description it will be evident to those skilled in the art that a check valve has been described which can be economically manufactured, easily assembled and easily repaired by replacement of very inexpensive parts. A very low pressure differential will fully open the valve. The valve is so constructed as to be highly efficient and produce an exceptionally low pressure drop. The valve is highly reliable in operation and relatively free from sticking in either the open or closed position.

Although a specific embodiment of the present invention has been described in great detail, it is to be understood that various changes, substitutions and alterations can be made therein without departing from the spirit and scope of the present invention as defined by the appended claims.

I claim:

1. A check valve comprising:

a body having a tubular wall forming a longitudinally extending fluid passageway having an upstream inlet end and a downstream outlet end;

an annular seat formed in the body around the fluid passageway and facing downstream;

a longitudinally extending guide barrel formed in the body and extending downstream from the annular seat, the guide barrel having a diameter and inwardly projecting stop means spaced from the annular seat; and,

a valve member assembly comprised of a circular valve portion having a seating surface on the upstream end for mating with the annular seat, a guide stem portion extending downstream from the circular portion, the circular portion being slidably received in the guide barrel, a separable stop disk having a maximum diameter corresponding to the diameter of the guide barrel and having a central guide aperture for receiving and guiding the guide stem portion, the stop disk being removably disposed around the guide stem and within the guide barrel, and a coil spring disposed around the guide stem between the circular valve portion and the stop disk for forcing the stop disk against the inwardly projecting stop means and biasing the circular valve portion against the annular seat.

2. A check valve as defined in claim 1 wherein:

the guide barrel and inwardly projecting stop means are formed by inwardly projecting and longitudinally extending flanges molded integrally with the body; and,

the maximum diameter of the valve member assembly when the spring is compressed and the valve portion abutted against the stop disk does not exceed the diameter of the guide barrel,

whereby the valve member assembly can be inserted and removed from the guide barrel by pressing the stop disk against the valve portion and rotating the valve member assembly.

3. A check valve as defined in claim 1 wherein:

the circular valve portion and guide stem are fabricated essentially from lightweight plastic material and the stop disk is fabricated from lightweight plastic material,

whereby the weight of the valve member assembly will be substantially reduced such that the check valve may be opened by a lower differential pressure.

4. A check valve as defined in claim 1 wherein: the tubular walls of the body downstream of the annular seat uniformly curve outwardly and then inwardly, the curvature of the interior surface of the walls being such as to maintain a substantially uniform radial distance from the nearest portion of the valve member assembly when the valve member assembly is fully open.

5. A check valve as defined in claim 1 wherein the valve member assembly is further characterized by:

an annular groove in the seating surface on the circular valve portion; and,

a resilient O-ring gasket disposed in the annular groove for engaging the annular seat and forming an annular fluid seal.

6. A check valve as defined in claim 1 wherein:

the annular seat is a frusto-conical surface complementary to the seating surface; and,

the seating surface is further characterized by an annular groove cut in the seating surface having an enlarged annular portion on the downstream edge of the groove, and a resilient O-ring disposed in the annular groove for engaging the annular seat and forming a seal,

whereby as the O-ring is pressed against the frusto-conical surface of the seat, the O-ring will tend to roll into the enlarged portion of the groove to reduce sticking of the valve.

7. A check valve as defined in claim 1 wherein:

the stop disk is comprised of an annular rim portion and a plurality of inwardly projecting finger portions, the inner ends of which form the guide aperture for receiving the guide stem.

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