Oct. 31, 1967 R. SCHMITZ 3,350,053

CONTROLLING APPARATUS

Filed Feb. 5, 1963 2 Sheets-Sheet 1

FIG. 1

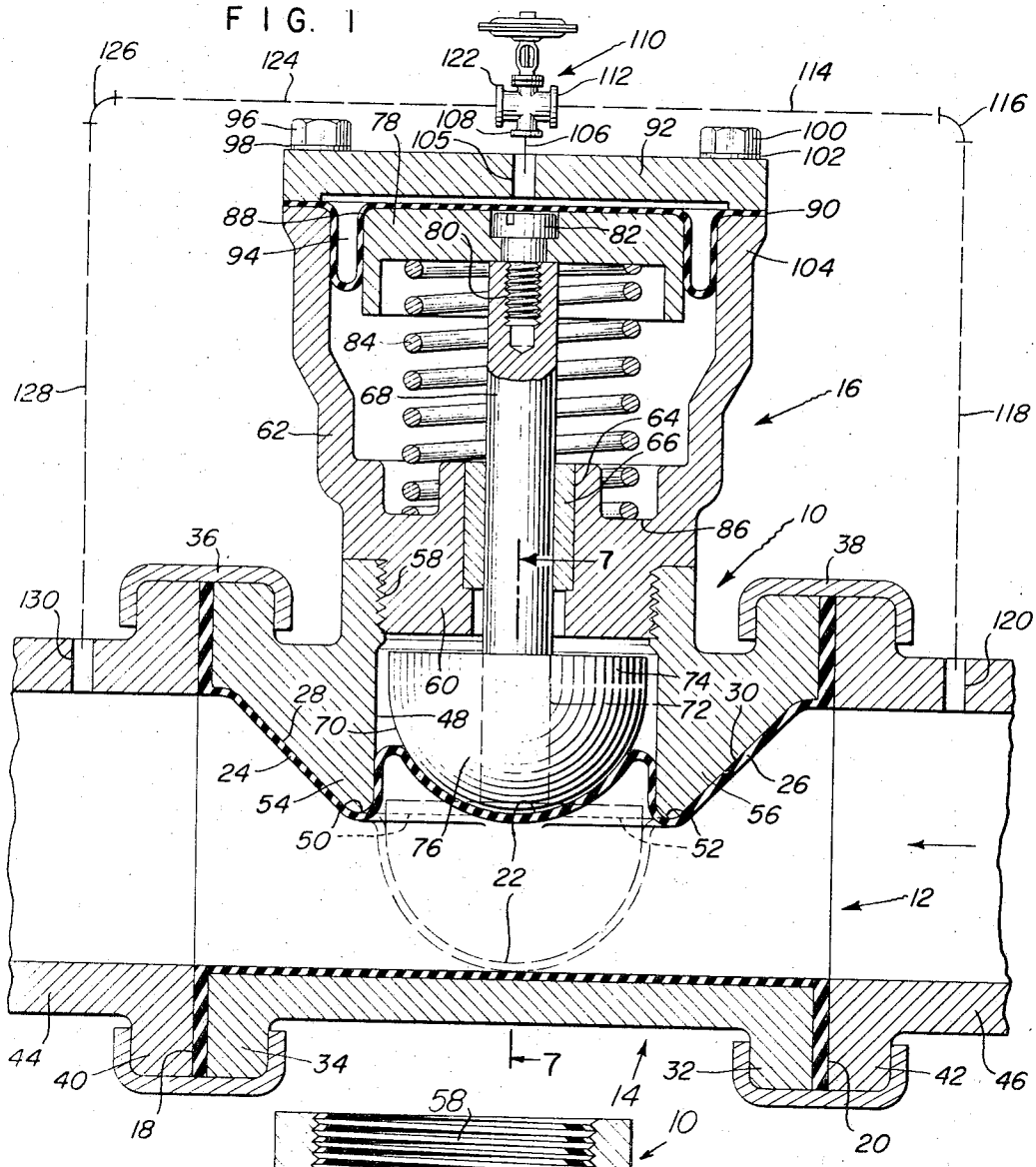
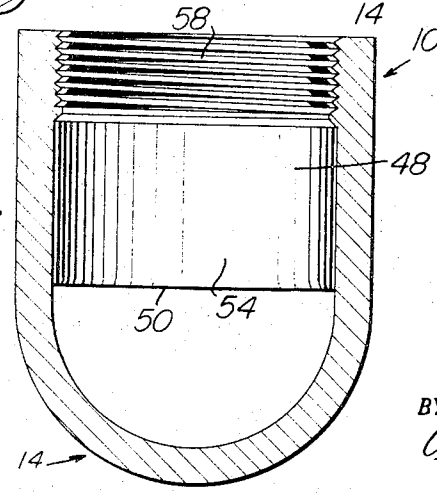


FIG. 7



INVENTOR.
ROBERT SCHMITZ
BY Arthur H. Swanson
ATTORNEY.

Oct. 31, 1967 R. SCHMITZ 3,350,053

CONTROLLING APPARATUS

Filed Feb. 5, 1963 2 Sheets-Sheet 2

FIG. 2

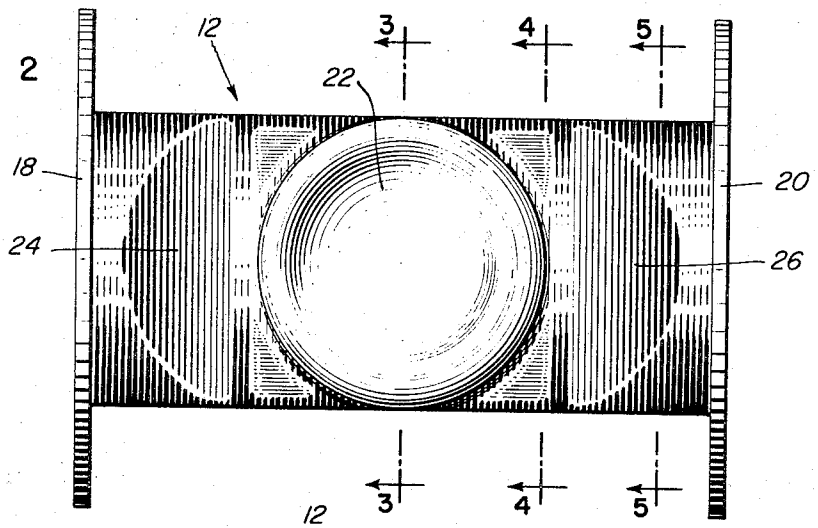


FIG. 3

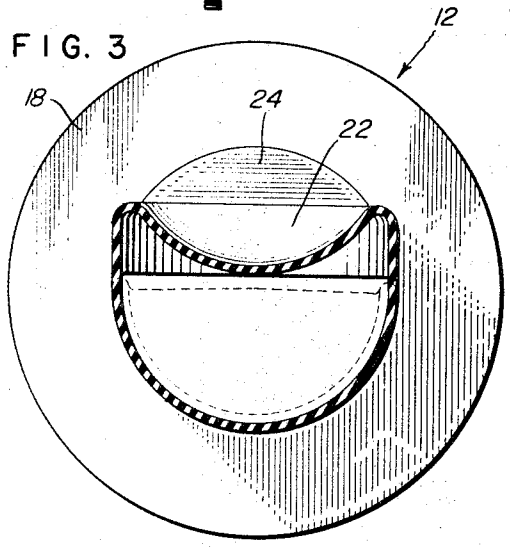


FIG. 4

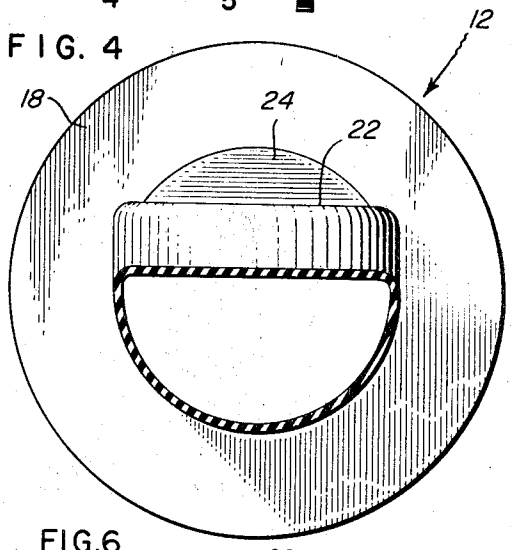


FIG. 5

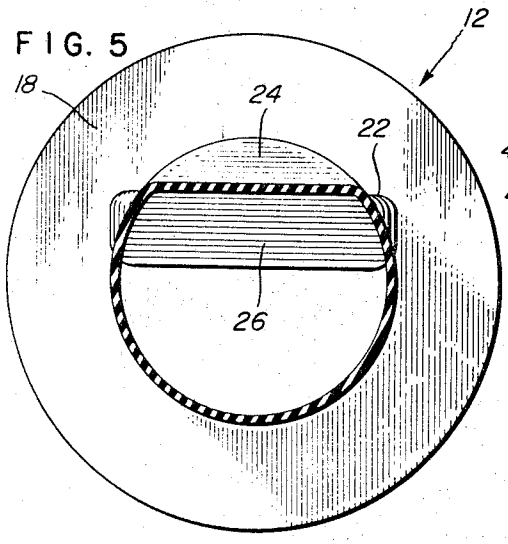
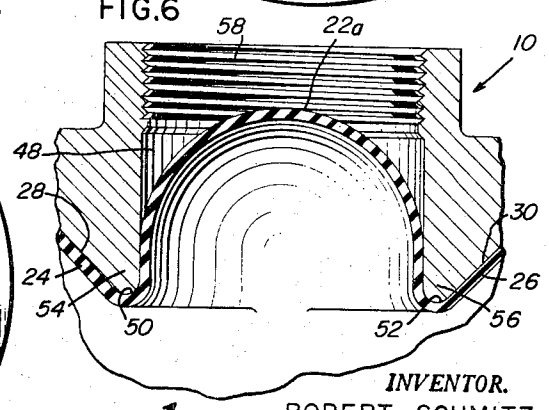


FIG.6



INVENTOR.
ROBERT SCHMITZ

BY Arthur H. Swanson

ATTORNEY.

United States Patent Office 3,350,053 Patented Oct. 31, 1967

3,350,053

CONTROLLING APPARATUS

Robert Schmitz, Hatboro, Pa., assignor to Honeywell Inc., a corporation of Delaware

Filed Feb. 5, 1963, Ser. No. 256,331
6 Claims. (Cl. 251—5)

The object of the present invention is to provide a pinch valve in the form of a flow tube section that can be readily inserted in a fluid process flow line.

One difficulty that has heretofore been encountered in the use of pinch valves is that repeated squeezing of the resilient part of the valve causes it to be stretched into a permanently flabby, unusable condition.

Various attempts have been made to overcome this difficulty by, for example, increasing the length of the pinch valve sleeve so that the aforementioned stretching can be spread over a greater length of material and thereby reduce the amount of stretching that occurs at the pinched portion of the valve sleeve. However, such a solution is not satisfactory because of the added cost of the extra material that is required to produce the pinch valve. Another reason why this solution has not been satisfactory is that the resulting overall shape of the valve is too cumbersome to handle.

It is, therefore, another object of the present invention ot disclose a compact pinch valve construction in which substantially no stretching will occur in the resilient material of the valve sleeve when it is moved between an open, unsqueezed position and a closed, completely squeezed tight position.

It is a more specific object of the invention to provide a unique, compact pinch valve of the aforementioned type whose body and sleeve diameter to length ratio can be advantageously reduced to as low a value as on (1) to two (2).

Another difficulty that has heretofore been encountered in the use of commercialy-available pinch valves is that the flange portions at the ends of the valve sleeve are pulled toward the center of the valve while the central portion of the valve sleeve is being squeezed to a closed position.

It is, therefore, still another object of the invention to disclose a compact pinch valve of the aforementioned type in which no pulling of the end flanges of this valve sleeve will occur while the valve sleeve is moved between an open, unsqueezed position and a closed, completely squeeze tight position.

More specifically, it is another object of the invention to disclose a unitary sleeve for the aforementioned compact pinch valve having a deformable central portion of a substantially semi-spherical shape configuration, a tapered wall portion extending outwardly in a radial plane from the opposite sides of the central portion toward opposite flanged ends of the sleeve.

It is another specific object of the present invention to provide an opening in the pinch valve flow tube section for accommodating the movement of a semi-spherical surface of an associated valve plug into increasing surface to surface joint moving engagement with the external surface of the deformable central portion of the sleeve when the valve is moved toward a closed position and vice-versa.

It is another object of the invention to characteristically shape the inner wall portions of the flow tube section so that it is in surface to surface contact with the aforementioned molded tapered-shaped wall portions of the sleeve.

Still another object of the invention is to provide a sleeve of the aforementioned pinch valve construction which can be usefully employed in a variety of different types of flow process lines such as a hot food process

or water treatment process flow line such as that used for the treatment of boiler feed water.

A better understanding of the present invention may be had from the following detailed description when read in connection with the accompanying drawings in which:

FIG. 1 shows a side elevation view and cross-section of the flow tube section and pinch valve in a fluid prcoess flow line;

FIG. 2 shows an external top plan view of the deformable pinch valve sleeve that is shown in FIG. 1;

FIG. 3 is a cross-sectional view taken along sectional line 3—3 of FIG. 2 showing the position of the deformable portion of the sleeve when it is in an open and closed position;

FIG. 4 is a cross-sectional view of a triangular-shaped portion of the sleeve taken along section line 4—4 of FIG. 2;

FIG. 5 is another cross-sectional view of the triangular-shaped portion of the sleeve taken along the section line 5—5 of FIG. 2;

FIG. 6 is a modified form of a deformable central portion which can be used in lieu of the central portion of the pinch valve sleeve shown in FIG. 1, and

FIG. 7 is a cross-sectional view taken along the section line 7—7 of FIG. 1 with the sleeve and actuator removed.

The pinch valve **10**, shown in FIG. 1, is comprised of a resilient sleeve **12** which is preferably made of a single molded construction, a rigid body **14**, and a valve plug actuating unit **16**.

The sleeve **12** is comprised of a flange **18, 20** at its respective right and left ends, a deformable central portion **22** of a substantially semi-spherical shaped configuration and tapered wall portions **24, 26** which extend outwardly in a radial plane from opposite sides of the central portion **22**.

When the pinch valve is required to meet certain sanitary standards such as are encountered in the food process and water treatment fields, the pinch valve sleeve is made of a unitary molded resilient material that is non-toxic, inert to chemicals and abrasive resistance. One such commercially-available material that would meet these requirements is sold under the trade name of Hypalon.

When the pinch valve is required to withstand high temperatures extending to the 600 degree Fahrenheit range, the pinch valve sleeve **12** is made of a unitary resilient material, such as the commercially-available material sold under the trade name of Viton.

The central portion **22** of this sleeve **12** is preferably made of the molded-shaped construction, as shown in solid line form in FIG. 1. In lieu of the central portion **22** of the sleeve **12** shown in FIG. 1, this central portion can be made of the bulged, molded modified construction **22A** shown in FIG. 6.

Each of the inner wall surface portions **28, 30** of the rigid valve body **14** are constructed of a tapered configuration so that the associated tapered portions **24, 26** of the sleeve **12** can be placed in a snug, unstretched engagement with the last-mentioned portions when the sleeve is in the assembled position shown in FIG. 1.

The ends of the valve body have cylindrically-shaped flanges thereon which are identified as reference numerals **32, 34** in FIG. 1 of the drawing.

Stainless steel, manually-operated, snap-action, toggle-actuated clamping members **36, 38** which may be of a commercially-available type, e.g. a clamp commonly referred to in the sanitary fitting trade as a Tri-Clamp, may be used to retain the flanges **30, 34** of the pinch valve in a fixed position with the flanged sections **40** and **42** of portions **44, 46** of a flow line into which this pinch valve **10** is inserted.

The upper portion of the pinch valve body **14**, shown in FIG. 1, has a cylindrically-shaped wall surface **48** that forms an aperture in the upper portion of the valve body **14**. A lower end surface portion of the cylindrically-shaped wall surface **48** is joined by substantially flat surfaces **50, 52** to the lowermost ends of the respective tapered valve body surface portions **28, 30**.

The surface portion **28**, shown in FIG. 1, forms one side surface of a triangular-shaped protuberance **54** that extends between two opposite side wall portions of the pinch valve body **14**. The surface portion **30** shown in FIG. 1 that forms one side surface of another triangular-shaped protuberance **56** extends between two other side wall portions of the pinch valve **14**.

A threaded surface **58** is formed on an upper end surface portion of the cylindrically-shaped wall surface **48**. The lower end **60** of the casing **62** of the valve plug actuating unit **16** is shown in threaded engagement with the body surface **58**.

A cylindrical surface **64** formed in the central portion of the plug actuating unit casing **62** has an outer surface of a sleeve bearing **66** in forced fit engagement therewith. The stem **68** of the pinch valve is shown in FIG. 1 in slidable engagement with the inner surface of the sleeve bearing **66**.

A valve plug **70** is provided with a cylindrical surface **72** that forms an aperture therein into which the lower end of the stem **68** is rigidly connected. The top peripheral surface **74** of the unitary plug is of a cylindrical-shaped configuration and the remaining lower surface **76** of the plug **70** is of a semi-spherical configuration, the lower surface portion of which is shown in solid line surface engagement with the outer surface of the top central portion of sleeve **12**.

When the plug **70** is moved to its closed valve position, as shown in dotted-line form in FIG. 1, it can be seen that substantially the entire semi-spherical surface of the plug will be brought into contact with the central portion **22** of the sleeve **12**.

The upper end of the stem **68** has a plate of cup-shaped configuration **78** threadedly connected thereto, as shown at **80**, by means of a tap bolt **82**. A compression spring **84** is shown retained between the plate **78** and a stationary cylindrically-shaped surface **86** of the valve actuating unit casing at **62**.

A diaphragm **88** is shown as having a central portion thereof in contact with the top of the plates **78**. The outer peripheral portion **90** of the diaphragm **88** is shown sandwiched in fluid tight relation between the top surface of the actuator casing **62** and a stationary cylindrical plate **92** which forms a fluid pressure chamber **94** with the diaphragm **88**.

A suitable number of tap bolts and washers, such as the tap bolt and washer connections **96, 98; 100, 102**, pass through apertures, not shown, in the plate **78** and the peripheral portion **90** of the diaphragm **88** and are threadedly connected to the upper peripheral portion **104** of the casing **62**.

A cylindrical wall surface **105** is shown forming a passageway in the plate **92**. A fluid transmitting conduit **106** is schematically shown in dash-line form connecting the passageway **105** that opens into the actuator chamber **94** with a port **108** of a three-way valve **110**.

Another port **112** in the three-way valve **110** is connected by way of conduit **114**, an elbow connection **116**, conduit **118** and passageway **120** in the wall of the upstream end portion of the flow line **46**.

A third port **122** in the three-way valve **110** is connected by way of conduit **124**, elbow connection **126**, conduit **128** and passageway **130** in the wall of the downstream end portion of the flow line **44**.

The three-way valve **110** can be of a commercially-available type which is either manually or automatically controlled. In either instance, the pinch valve **10** can be moved to a first position to allow fluid to flow under a

preselected regulated pressure from the upstream end of the flow line **46** through the fluid transmission conduit **118**, elbow **116**, conduit **114**, ports **112** and **108**, conduit **106**, passageway **105** into the chamber **94**.

The aforementioned action will apply a downward force against the diaphragm **88** and plate **76** to compress the spring **84**. While spring **84** is being compressed by the plate **78**, the stem attached to the plate **78** and the plug **70** will simultaneously be moved in a downward direction toward its closed dotted-line position. While the three-way valve **110** is in the aforementioned first position, the port **122** of this three-way valve will be closed.

The plug **70** and the associated central portion **22** of the sleeve **12** will return to a selected position anywhere between their dotted-line and solid-line positions by closing off port **112** of the three-way valve **110** and connecting the then open ports **108, 122** by way of the conduit **124**, elbow **126** to the conduit **128** and passageway **130** of the downstream end of the flow line **44**.

During the movement of the plug **70** and the sleeve **12** between their open and closed positions, it can be seen from the aforementioned description that substantially the entire exterior surfaces of the sleeve or liner **12**, are in engagement with the rigid interior surface of the pinch valve body **14** and the plug **10**. Since substantially no stretching of the resilient sleeve **12** will take place during the aforementioned opening and closing of the valve **10**, the fluid passing through the center of the sleeve will not cause the flanged ends **18, 20** of the sleeve **12** to be pulled toward the central portion of the sleeve as has heretofore been the case with other presently-available pinch valves.

A rolling action is effected between the central portion **22** of the sleeve **12** and plug **70** as the plug is moved between its solid line open and dotted closed positions. Because of this substantially frictionless rolling sleeve-on-plug construction, a negligible force is all that is required to move the pinch valve from a fully open position to a fully closed position.

Because the pinch valve disclosed herein has the very desirable attributes of being compact, of a sanitary, low-friction variety, easily closed with an abnormally small actuator force, long life can be expected from the sleeve used in this valve because substantially no stretching can occur therein when it is moved between an open, unsqueezed position and a closed, completely squeezed position.

What is claimed is:

1. A pinch valve adapted to be inserted as part of a flow pipe, comprising a valve body, a unitary resilient sleeve and a valve plug actuating unit, an inlet and outlet port in the valve body, an inner wall of the body forming a first passageway between the ports, two spaced-apart protuberances forming inner wall portions of the first passageway, a flexible sleeve of the same uniform wall thickness between its end portions extending through the passageway between the inlet and outlet ports and having outer surfaces thereof in physical surface to surface engagement with said protuberances, a second passageway opening into the first passageway and formed by two opposing side wall surfaces of the body and a surface of each of the protuberances, the actuating unit having a mechanically operable compressing means positioned within the second passageway, an actuated end of the compressing means being provided with a semispherical-shaped surface, the largest circumferential ring portion of said semispherical-shaped surface being operably positioned for movement from a non-engaged first position with the largest circumferential ring portion of a preformed flexible concave-shaped central portion of the sleeve that is positioned in the second passageway into rolling substantially frictionless physical contact with the last-mentioned circumferential preformed ring portion of the sleeve when moving the central sleeve portion toward an opposite portion of the sleeve that is in contact with

the inner wall of the first passageway to thereby regulate the flow of fluid passing between the inlet and outlet ports, the sleeve having a transitional unstressed portion extending between the compressing means and protuberances in the fully closed position of the valve.

2. The pinch valve, as defined by claim 1, wherein the protuberances have converging tapered surfaces.

3. The pinch valve, as defined by claim 1, wherein the protuberances have converging tapered surfaces and the inside flow area encompassed by the sleeve extending through said passageways adjacent each protuberance is substantially one-half the flow area encompassed by the inner wall surface of the sleeves adjacent the inlet and outlet ports.

4. The pinch valve, as defined by claim 1, wherein the cross-section of the protuberances are of a triangular-shaped configuration.

5. The pinch valve, as defined by claim 1, wherein the protuberances are of a triangular-shaped configuration, and wherein a portion of the sleeve is in physical contact with a surface portion of each triangular-shaped protuberance.

6. The pinch valve, as defined in claim 1, wherein the center of the flexible central portion of the sleeve is of a

semi-spherical configuration and the periphery of the central portion is constructed to roll away from a surface of each protuberance onto the semi-spherical surface of the plug when the valve plug actuating unit is moved toward a closed position and to be rolled off of the semi-spherical surface back onto the said surfaces of each protuberance when the valve plug actuating unit is moved away from the closed position toward an open valve position.

References Cited

UNITED STATES PATENTS

2,600,493	6/1952	Farris	251—5 X
2,622,620	12/1952	Annin	251—5
3,285,563	11/1966	Clarkson	251—8

FOREIGN PATENTS

137,351	1947	Australia.
504,449	1930	Germany.
614,351	1935	Germany.

WILLIAM F. O'DEA, *Primary Examiner.*

R. GERARD, *Assistant Examiner.*