

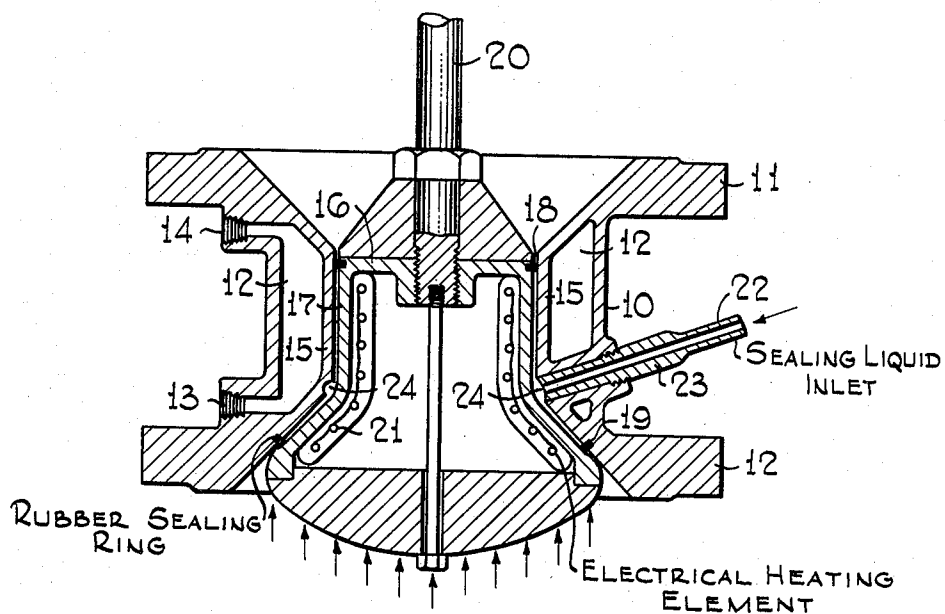
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C. W. TYSON

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VALVE

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Charles W. Tyson Inventor

By George J. Schary Attorney

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VALVE

Charles W. Tyson, Summit, N. J., assignor to
Standard Oil Development Company, a corporation of Delaware

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This invention relates to an improved valve and more particularly to an improved valve for controlling the flow of finely divided solid particles in fluidized condition.

Finely divided solid particles have been contacted with gaseous or vaporous reactants according to the fluidized solids technique in a wide variety of fields. While many processes are carried out to advantage according to the fluidized solids technique at atmospheric pressure recent studies have shown that the technique can be applied with considerable advantage to reactions between solids and gases or vapors at substantially elevated pressures. For example, hydroforming of naphtha fractions can be carried out advantageously in a fluidized solids reactor system at pressures of about 50 to about 500 lbs./sq. in. It has also been found that large savings in the gasification of coal can be effected if gasification can be carried out under substantial super-atmospheric pressure. In this case it is necessary to increase the pressure on the finely divided coal feed from atmospheric pressure to say 200-500 lbs./sq. in. in order that it may be fed into the gasification vessel.

High pressure operations of this character require the use of valves for maintaining pressure and up to the moment no satisfactory valves for such operations have been developed. Metal to metal mechanical seals have not proven satisfactory due to small leakages becoming large because of erosion at the high pressure differentials over which the valve must operate. While rubber seated valves have shown some promise they are also subject to considerable wear and tear and have failed more rapidly than is desirable.

It is the object of this invention to provide a novel type of valve seal for systems handling finely divided solids at high pressures.

It is a further object of this invention to provide valve seals for systems handling finely divided solids at high pressures which will operate continuously and satisfactorily for long periods.

These and other objects will appear more clearly from the detailed specification and claims, especially when read in connection with the accompanying drawing.

In accordance with the present invention, it has been found that a highly satisfactory valve seal for systems handling finely divided solids at high pressures can be obtained by providing a valve having a preliminary sealing surface of rubber or some other suitable material made to hold very little, if any, pressure differential, flowing a suitable liquid sealing medium between the valve seat and freezing said liquid in place to form a seal capable of withstanding high pressure differentials. In this way the valve seats need not be entirely in engagement as metal to metal contacts. By providing suitable chan-

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nels in the valve seat to facilitate distribution of the sealing liquid and by providing an adequate refrigeration jacket in which a suitable refrigerant can be vaporized or circulated, the freezing of the sealing liquid can be made to take place almost instantaneously. This having been accomplished, the valve now presents a firm closure which can be utilized for maintaining pressures as high as 500 to 1000 lbs./sq. in. or more. The valve may be opened when desired either by mechanical means or by applying heat through electrical heating elements or by circulating a heating medium through suitably arranged coils. The flow of solids passing the valve seats will serve to effect the removal of the last traces of sealing medium from the seats so that upon reclosing the valve, no solid materials will remain clinging to the valve seats to cause abrasion or erosion of the seats. In this way, it is possible to use the valve repeatedly without having any appreciable contact between the valve faces or seats which would cause wear thereof and consequently destroy the effectiveness of the valve seat at high pressures.

The accompanying drawing illustrates a vertical cross-sectional view of one form of valve constructed in accordance with the present invention.

Referring to the drawing the valve comprises a body section 10 which may desirably be of cylindrical shape having flanges 11 and 12 for securing the valve structure to a lock hopper and reactor vessel or similar source of supply of powdered or finely divided solids and high pressure reactor. The body section of the valve is provided with a refrigeration jacket into which a suitable refrigerant may be introduced through inlet 13 and withdrawn through outlet 14. In lieu of a jacket as shown, the refrigerant may be circulated through coils or the like arranged in good heat exchange relation to inner wall 15 which must be cooled below the freezing point of the liquid sealing medium.

A plug member 16 is mounted for vertical movement within the body section of the valve so that when the plug is in closed position as shown in the drawing, the outer wall of the plug member and the inner wall of the valve body are substantially in contact with each other. A bell shaped plug member as shown makes a highly effective closure member but it may take other forms such as a cone, an annulus, a sphere or the like. Rings 18 and 19 of rubber, if low melting sealant such as water or paraffin is used or of metal if a lead or a high melting point alloy is used as sealant, may be provided in order to provide a relatively low pressure seal between the plug and the body section.

A shaft 20 is secured to the upper part of the plug member, the upper end of said shaft being attached to suitable activating means such as a

lever, gear mechanism or the like for moving the plug member into and out of engagement with the inner wall of the valve body. Means for heating the plug member may be arranged on the interior thereof over an area substantially coextensive with the refrigerated area of the valve body. The heating means preferably consists of electrical heating elements 21 mounted in good heat exchange relation to the wall 17 of the plug member. The electrical leads for the heating element may be passed through the shaft 20.

An inlet 22 is arranged in the wall of the valve body 10 for supplying liquid sealing medium to the space between the inner wall 15 of the valve body and the outer wall 17 of the plug member. Heating means 23 such as an electrical heating element is provided on the inlet line 22 in order to maintain the sealing liquid in the liquid state during its introduction. A groove or channel 24 which has a downwardly facing bottom and is therefore self-discharging is provided in the wall 17 of the body member or it may, if desired, be arranged in the outer wall of the plug member adjacent the discharge end of sealing liquid inlet line 22 in order to facilitate or insure the introduction of sealing liquid around the entire circumference of the plug to form a complete seal. Suitable elements which may be used include water, molten sulfur, paraffin wax, plastics, low melting point alloys and the like. The choice of sealant is controlled for the most part by the temperature that can be reached on cooling the valve body and by the effect of the sealant upon the solid particles passing through the valve or the reactions in which the solid particles are subsequently involved. In general, it is preferable to utilize a sealant which will be inert in any subsequent reaction in order to avoid any deleterious effects.

Valves constructed in accordance with this invention are useful not only in coal gasification and hydroforming but also other processes where it is desired to increase the pressure of powdered solids and maintain them at such elevated pressures.

The foregoing description contains a limited number of embodiments of the present invention. It will be understood, however, that numerous variations are possible without departing from the scope of the following claims.

What is claimed is:

1. A valve for maintaining finely divided solid particles in a zone at substantially elevated pressures comprising a hollow outer body portion, a plug member mounted for movement into an open position for free passage of finely divided solids therethrough and into a closed position with the outer walls of said plug member in close proximity to the inner wall of said body member but insufficient to withstand any substantial amount of pressure, means for introducing a sealant in liquid condition into a groove between the plug member and the body portion in closed condition, a refrigeration jacket arranged around the inner wall of said body portion and adapted for the circulation of refrigerant therethrough for cooling the valve assembly to a temperature sufficiently low to solidify said sealant to form a pressure-tight seal and means for heating the valve assembly to a sufficient temperature to melt the sealant and thereby facilitate the opening of the valve.

2. A valve for controlling the flow of finely divided solid particles into a zone at substantially elevated pressure comprising a hollow outer body

portion, a plug member mounted for movement into an open position for free passage of finely divided solids therethrough and into a closed position with the outer walls of said plug member in close proximity to the inner wall of said body member but insufficient to withstand any substantial amount of pressure, means for introducing a sealant in liquid condition into a groove within the space between the plug member and the body portion in closed condition, a refrigeration jacket integral with the inner wall of said body portion and adapted for the circulation of a refrigerant therethrough to cool the valve assembly to a temperature sufficiently low to solidify said sealant and form a pressure-tight seal and means for heating the valve assembly to a sufficient temperature to melt the sealant and thereby facilitate the opening of the valve.

3. A valve according to claim 2 wherein said groove faces downward and has walls inclined downward to its lower lip.

4. A valve according to claim 2 wherein a solid low-pressure sealing ring is positioned in the space between plug and outer body portion below the said groove.

5. A valve according to claim 2 wherein solid elastic sealing rings are permanently positioned on the inner wall of the body portion below and above the said groove and are adapted to form a low pressure seal between the body portion and plug in closed position.

6. A valve according to claim 2 wherein the outer walls of said plug are convergent and the inner wall of said body member is complementary thereto.

7. A valve according to claim 6 wherein the plug is bell-shaped.

8. A valve according to claim 6 wherein said groove faces downwardly and inwardly.

9. In a valve for controlling the flow of finely divided solids into a high pressure zone, the improvement which comprises a hollow outer body portion having inner walls defining a flow space of decreasing circular cross-section, the large end of the flow space being next to the high pressure zone, a plug member in close proximity with the inner walls of the outer body portion and having outer walls complementary with the said inner walls of said outer body portion, means for causing relative movement of said plug and outer body portion whereby the plug may be displaced from close proximity of the inner wall of said body portion, said inner wall of said body portion being provided with a downwardly inclined groove and with rubber sealings rings above and below said groove, a conduit leading through said body portion to said groove, a meltable solid sealant filling said groove when the valve is in closed position and thereby sealing the space between plug and body portion, a cooling jacket within the outer body portion adapted to maintain the meltable sealant in solid condition, and a heating element adjacent to the said groove and adapted to melt the solid sealant and thereby facilitate opening of the valve.

CHARLES W. TYSON.

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