In an embodiment of the invention there is provided a valve assembly for controlling flow through a fluid pathway comprising a valve body having a bore with an upstream end which in use connects to the fluid pathway to be controlled and an opposing downstream end; a spindle received within the bore which is actuatable to open and close the bore, the spindle having an axially upstream end arranged towards the fluid pathway and an opposing downstream end; a first seal provided about the spindle between the spindle and the bore; and a ~~biasing element~~spring arranged to impart an axial compressive force to the first seal. The ~~biasing element~~spring is located within the valve body between the spindle and the bore on the downstream side of the first seal. Conventionally any seal biasing means is provided externally to the valve body on the dry side of the valve. However, it has been found that by providing the seal biasing means within the valve boy enables a more direct compressive force to be applied to the seal which significantly improves the sealing efficiency. The provision of a live loaded flow-side seal which is internal to the valve is therefore highly advantageous but has not previously been considered.

The first seal preferably comprises a first section formed of a first material and a second section formed of a second material which is softer than the first material, the first and second sections being arranged such that when the first seal is axially compressed the second material is caused to cold flow between the first section and the bore to increase the efficiency of the first seal. The first section acts as a supporting and/or reinforcing section to prevent excessive deformation of the softer second section. As the second section compresses the softer material cold flows and wicks between the first section and the bore which acts to fill any remaining gap between the second section and the bore thereby increasing the sealing efficiency. As such, the valve may be assembled with the first seal closely toleranced with the spindle and the bore but no so close as to inhibit assembly, with the tolerance then being greatly increased on loading of the first seal. This type of compression sealing therefore enables highly efficient sealing without the requirement for elastomeric seals such as o-rings which are not able to be used in high temperature high pressure applications.

The first seal may comprise support rings located at axially opposing ends of the seal which are formed from the first material and define the first section and a plurality of sealing rings formed from the second material axially located between the end rings and

defining the second section. The end rings support and reinforce the second section at the axially opposed contact points. In addition, by providing end rings at both ends provides increased sealing at both end of the seal due to the clod flow of the softer second seal section.

The first material is preferably polyether ether ketone (PEEK) and the second material is preferably Polytetrafluoroethylene (PTFE), with the PTFE material being softer than the PEEK while both materials include the required high melting points.

The valve assembly preferably further comprises a collar axially located about the spindle on the downstream side of the first seal between the first seal and the ~~biasing element~~spring which is arranged to compress the first seal under the action of the ~~biasing element~~spring.

The valve assembly preferably further comprises a second seal provided about the spindle between the spindle and the bore which is axially spaced along the spindle at a position downstream from both the first seal and the ~~biasing element~~spring. ~~A~~ The valve assembly ~~according to claim 2~~ further ~~comprising~~ comprises secondary biasing means for imparting a compressive force to the second seal. The second seal provides a back up sealing means for sealing against any emissions which have passed the first seal thereby further reducing fugitive emissions.

The valve assembly may further comprise a guide member axially fixed relative to the valve body and an axially movable clamping member slidingly supported on the guide member and about the spindle at a downstream axial position from the second seal. The secondary biasing means urges the clamping member towards the second seal to impart said compressive force thereto. This means of biasing the second seal is provided externally to the valve body and is therefore accessible and adjustable by the operator.

The valve assembly may further comprise a slidable collar provided about the spindle between the second seal and the clamping member such that the collar is urged into engagement with the second seal by the clamping member to impart said compressive force thereto.

CLAIMS

1. A valve assembly for controlling flow through a fluid pathway comprising:

a valve body having a bore with an upstream end which in use connects to the fluid pathway to be controlled and an opposing downstream end;

a spindle received within the bore which is actuatable to open and close the bore, the spindle having an axially upstream end ~~arranged towards the fluid pathway~~ and an opposing downstream end;

a first seal provided about the spindle between the spindle and the bore; and

a ~~biasing element~~spring arranged to impart an axial compressive force to the first seal;

wherein the ~~biasing element~~spring is located within the valve body between the spindle and the bore on the downstream side of the first seal.

2. A valve assembly according to claim ~~any preceding claim~~1 wherein the first seal comprises a first section formed of a first material and a second section formed of a second material which is softer than the first material, the first and second sections being arranged such that when the first seal is compressed the second material is caused to cold flow between the first section and the bore to increase the efficiency of the first seal.

3. A valve assembly according to claim 2 wherein the first seal comprises support rings located at axially opposing ends which are formed from the first material and define the first section and a plurality of sealing rings formed from the second material axially located between the end rings and defining the second section.

4. A valve assembly according to claims 2 or 3 wherein the first material is polyether ether ketone (PEEK) and the second material is preferably Polytetrafluoroethylene (PTFE).

5. A valve assembly according to any preceding claim wherein the valve assembly further comprises a collar axially located about the spindle on the downstream side of the first seal between the first seal and the ~~biasing element~~spring which is arranged to compress the first seal under the action of the ~~biasing element~~spring.

6. A valve assembly according to any preceding claim further comprising a second seal provided about the spindle between the spindle and the bore which is axially spaced along the spindle at a position downstream from both the first seal and the ~~biasing element~~spring.

7. A valve assembly according to claim 6 further comprising secondary biasing means for imparting a compressive force to the second seal.

8. A valve assembly according to claim 7 further comprising a guide member axially fixed relative to the valve body and an axially movable clamping member slidingly supported on the guide member and about the spindle at a downstream axial position from the second seal, wherein the secondary biasing means urges the clamping member towards the second seal to impart said compressive force thereto.

9. A valve assembly according to claim 8 further comprising a slidable collar provided about the spindle between the second seal and the clamping member such that the collar is urged into engagement with the second seal by the clamping member to impart said compressive force thereto.

10. A valve assembly according to any one of claims 6 to 9 wherein the second seal is a back up fire-safe seal formed from a material having a melting point greater than the material of the first seal.

11. A valve assembly according to claim 10 wherein the body section comprises a lower section axially located at the flow wise upstream end of the valve assembly and an upper section axially located at the flow wise downstream end and the collar and ~~biasing element~~the spring are located within the lower body section and the ~~biasing element~~spring is axially compressed against the collar by the a portion of the upper body section.

12. A valve assembly according to claim 11 wherein a third seal is provided between the upper and lower body sections on the downstream side of the first seal.

13. A valve assembly according to claim 12 wherein the second and/or third seals are formed from a graphite material.

14. A valve assembly according to claim 13 wherein the third seal is formed from a material having a higher melting point than the material of the first seal.

15. A valve assembly according to any preceding claim wherein the valve body includes an inlet and an outlet and the spindle is actuatable to open and close the bore to selectively permit fluid flow between the inlet and the outlet.

16. A valve assembly according to any preceding claim, wherein ~~the first seal comprises~~ a gator is provided about the spindle to prevent ingress of material into the bore.

17. A valve assembly according to claim 15, wherein the gator is formed from compressed woollen fibres.