WHAT IS CLAIMED IS:

1. A gate valve assembly (40) comprising:

a body (42);

a gate (54) moveable in the body (42) between an open and a closed position; and

a resilient annular valve seat (48, 52) mounted in the body (42) and changeable from an elongate configuration with an end in static sealing contact with the body (42) and an opposite end in dynamic sealing contact with the gate (54) to a compressed configuration with the end in static sealing contact with the body (42) and the opposite end in dynamic sealing contact with the gate (54) and having a mid portion between the end and the body (42) that defines a pressure barrier.

2. The gate valve assembly (40) of claim 1, further comprising slots (72, 76) in the mid portion of the valve seat (48, 52) extending radially outward from an inner circumference of the valve seat (48, 52) that circumscribe an axis of the valve seat (48, 52).

3. The gate valve assembly (40) of claim 2, further comprising slots (70, 75) in the valve seat (48, 52) extending radially inward from an outer circumference of the valve seat (48, 52) that circumscribe an axis of the valve seat (48, 52).

4. The gate valve assembly (40) of claim 2, further comprising shims (100, 102) disposed in the slots (72, 70).

5. The gate valve assembly (40) of claim 1, further comprising a recess (61, 65) formed along a portion of an inner circumference of the valve seat (48, 52) and extending from the body (42) to a shoulder (62, 66) on the inner circumference of the valve seat (48, 52) and a sleeve (63,

67) disposed in the recess (61, 65), wherein a gap (64, 68) exists between the sleeve (63, 67) and the valve seat (48, 52), so that when the valve seat (48, 52) is compressed, compression of the valve seat (48, 52) is limited when the sleeve (63, 67) becomes wedged between the shoulder (62, 66) and the body (42).

6. The gate valve assembly (40A) of claim 5, wherein the sleeve is an inner sleeve (63, 67) and the recess is an inner recess (61, 65), the gate valve assembly (40) further comprising an outer recess formed along a portion of the outer circumference of the valve seat (48A, 52A) and extending from the valve seat (48A, 52A) to an outer shoulder on the outer circumference of the valve seat (48A, 52A) and an outer sleeve (96, 98) disposed in the outer recess, wherein a gap exists between the outer sleeve (96, 98) and the valve seat (48A, 52A), so that when a force is applied that compresses the valve seat (48A, 52A), compression of the valve seat (48A, 52A) is limited when the outer sleeve (96, 98) becomes wedged between the outer shoulder and the body (42A).

7. The gave valve assembly (40A) of claim 1, further comprising a recess formed along a portion of the outer circumference of the valve seat (48A, 52A) and extending from the base to a shoulder on the outer circumference of the valve seat (48A, 52A) and a sleeve (96, 98) disposed in the recess, wherein a gap exists between the sleeve (96, 98) and the valve seat (48A, 52A), so that when a force is applied that compresses the valve seat (48A, 52A), compression of the valve seat (48A, 52A) is limited when the sleeve (96, 98) becomes wedged between the shoulder and the body (42A).

8. The gate valve assembly (40A) of claim 7, wherein the sleeve is an outer sleeve (96, 98) and the recess is an outer recess, the gate valve assembly (40A) further comprising an inner recess (61, 65) formed along a portion of the outer circumference of the valve seat (48A, 52A)

and extending from the valve seat (48A, 52A) to an inner shoulder on the outer circumference of the valve seat (48A, 52A) and an inner sleeve (63, 67) disposed in the inner recess (61, 65), wherein a gap (64, 68) exists between the inner sleeve (63, 67) and the valve seat (48A, 52A), so that when a force is applied that compresses the valve seat (48A, 52A), compression of the valve seat (48A, 52A) is limited when the inner sleeve (63, 67) becomes wedged between the inner shoulder (62, 66) and the body (42A).

9. The gate valve assembly (40) of claim 1, wherein the body (42) further comprises a cavity (45) in which the gate (54) travels and a flow passage (44) through the body (42) that intersects the cavity (45), the gate valve assembly (40) further comprising a bypass (79, 86) through the body (42) between the flow passage (44) and the cavity (45) and a check valve (81, 88) in the bypass (79, 86).

10. The gate valve assembly (40) of claim 9, wherein the flow passage (44) is an upstream flow passage on one side of the cavity (45) and a downstream flow passage on an opposite side of the cavity (45) and wherein the bypass (79, 86) is an upstream bypass (79) and extends between the upstream flow passage and the cavity (45), the gate valve assembly (40) further comprising a downstream bypass (86) in the body (42) extending between the cavity (45) and the downstream flow passage and a check valve (88) in the downstream bypass (86).

11. The gate valve assembly (40) of claim 10, wherein the check valve (81) in the upstream bypass (79) allows flow from the upstream flow passage to the cavity (45) and blocks flow from the cavity (45) to the upstream flow passage and wherein the check valve (88) in the downstream bypass (86) allows flow from the downstream flow passage to the cavity (45) and blocks flow from the cavity (45) to the downstream flow passage.

12. A valve seat (48, 52) for use in a gate valve assembly (40) comprising:

an annular body (48) having a rearward end for mounting to a body (42) of a valve assembly (40) and a forward end distal from the rearward end;

a face (73) on the rearward end of the annular body for forming a static sealing interface with a valve body pocket (46);

a face (74) on the forward end of the annular body for forming a sliding sealing interface with a valve member (54); and

a resilient mid portion disposed between the forward end and the rearward end that exerts an axial force on the forward end for maintaining the static sealing interface and the sliding sealing interface and that defines a pressure barrier between an inner circumference and an outer circumference of the annular body.

13. The valve seat (48, 52) of claim 12, further comprising slots (70, 75) in the mid portion for providing axial resiliency in the annular body, wherein the slots (70, 75) extend from an outer terminal radius of the annular body towards an axis of the annular body.

14. The valve seat (48, 52) of claim 13, further comprising slots (72, 76) that extend from an inner terminal radius of the annular body towards the outer terminal radius of the annular body.

15. The valve seat (48, 52) of claim 12, further comprising a shoulder (62, 66) on the inner terminal radius of the annular body, a recess (61, 65) that extends on the inner terminal radius of the annular body from the shoulder (62, 66) to the rearward end, and a sleeve (63, 67) in the recess (61, 65).

16. The valve seat (48, 52) of claim 12, further comprising a shoulder on the outer terminal radius of the annular body, a recess on the outer terminal radius of the annular body having an end defined by the shoulder, and a sleeve (96, 98) in the recess.

17. The valve seat (48, 52) of claim 12, wherein the shoulder is a forward shoulder (62, 66) and the end of the recess (61, 65) is a forward end, the valve seat (48, 52) further comprising a rearward shoulder on the outer terminal radius of the annular body distal from the forward shoulder and defining a rearward end of the recess and a sleeve (96, 98) in the recess having a length less than the length of the recess.

18. The valve seat (48, 52) of claim 12, further comprising shims (100, 102) disposed in the slots (70, 72), the shims (100, 102) having a thickness less than a thickness of the slots (70, 72).

WHAT IS CLAIMED IS:

1. A gate valve assembly comprising:

a body having a valve seat pocket;

a gate moveable in the body between an open and a closed position;

a resilient annular metal valve seat mounted in the body, having a bore with a flow passage axis and changeable from an elongate configuration with a rearward end in static sealing contact with the valve seat pocket in the body and a forward end in dynamic sealing contact with the gate to a compressed configuration with the rearward end in static sealing contact with the valve seat pocket in the body and the forward end in dynamic sealing contact with the gate and having a mid-portion between the forward end and the body that defines a pressure barrier;

wherein the rearward end, the mid-portion and the forward end of the valve seat are integrally formed from a single piece of metal;

at least two circumferentially extending inner slots in the bore within the mid-portion of the valve seat;

at least two circumferentially extending outer slots on an outer circumference of the mid-portion of the valve seat, the inner slots and the outer slots alternating with each other, defining a serpentine wall of the valve seat that has an axial thickness greater than an axial width of each of the inner and outer slots;

an annular bore recess on a curved surface of the bore of the mid-portion of the valve seat, the bore recess defining an inner forward shoulder on the valve seat that faces toward the valve seat pocket in the body;

an inner sleeve in the bore recess and coaxial with the valve seat, the inner sleeve having a forward end and a rearward end;

an annular outer recess on a curved surface of the outer circumference of the mid-portion of the valve seat, the outer recess defining an outer forward shoulder on the valve seat that faces toward the valve seat pocket in the body;

an outer sleeve in the outer recess, the outer sleeve having a forward end and a rearward end;

wherein the inner sleeve and the outer sleeve each have a length less than a distance from the inner and outer forward shoulders to the valve seat pocket when the valve seat is in the elongate configuration; and

wherein the forward ends of the inner sleeve and the outer sleeve contact the inner forward shoulder and the outer forward shoulder, respectively, and the rearward ends of the inner sleeve and the outer sleeve engage the valve seat pocket when the valve seat is in the compressed configuration.

2. The gate valve assembly of claim 1, wherein:

the rearward end of the inner sleeve and the rearward end of the valve seat are axially movable relative to each other.

3. The gate valve assembly of claim 1, wherein:

the rearward end of the outer sleeve and the rearward end of the valve seat are axially movable relative to each other.

4. The gate valve assembly of claim 1, wherein:

the rearward end of the inner sleeve and the rearward end of the valve seat are axially movable relative to each other; and

the rearward end of the outer sleeve and the rearward end of the valve seat are axially movable relative to each other.

5. The gate valve assembly of claim 1, wherein the body further comprises a cavity in which the gate travels and a flow passage through the body that intersects the cavity,

the gate valve assembly further comprising a bypass through the body between the flow passage and the cavity and a check valve in the bypass.

6. The gate valve assembly of claim 5, wherein the flow passage is an upstream flow passage on one side of the cavity and a downstream flow passage on an opposite side of the cavity and wherein the bypass is an upstream bypass and extends between the upstream flow passage and the cavity, the gate valve assembly further comprising a downstream bypass in the body extending between the cavity and the downstream flow passage and a check valve in the downstream bypass.

7. The gate valve assembly of claim 6, wherein the check valve in the upstream bypass allows flow from the upstream flow passage to the cavity and blocks flow from the cavity to the upstream flow passage and wherein the check valve in the downstream bypass allows flow from the downstream flow passage to the cavity and blocks flow from the cavity to the downstream flow passage.

8. A valve seat for use in a gate valve assembly comprising:

a metallic annular valve seat body having an axis, a bore, a rearward end for mounting to a gate valve body of a gate valve assembly and a forward end distal from the rearward end;

the rearward end of the metallic annular valve seat body adapted to be in static sealing interface with a valve body pocket in the gate valve body;

a face on the forward end of the metallic annular valve seat body for sliding sealing interface with a gate;

a resilient mid-portion disposed between the forward end and the rearward end that exerts an axial force on the forward end for maintaining the static sealing interface

and the sliding sealing interface and that defines a pressure barrier between an inner circumference and an outer circumference of the metallic annular valve seat body;

outer slots formed in a curved outer surface of the mid-portion and inner slots formed in the bore, the outer and inner slots alternating with each other to define a series of cantilevers along an axial length of the body that are substantially parallel with the face on the forward end of the valve seat body;

the outer and inner slots having axial widths that are less than a wall thickness of each of the cantilevers;

outer shims disposed in the outer slots, the outer shims having a thickness less than the width of the outer slots to limit compression of the mid-portion before the outer slots completely close in response to axial compression of the mid-portion of the valve seat;

each of the outer shims having an outer diameter flush with an outer diameter of each of the outer slots;

each of the outer shims having an inner diameter spaced radially outward from an inner diameter of each of the outer slots;

inner shims disposed in the inner slots, the inner shims having a thickness less than the width of the inner slots to limit compression of the mid-portion before the inner slots completely close in response to axial compression of the mid-portion of the valve seat;

each of the inner shims having an inner diameter flush with an inner diameter of each of the inner slots; and

each of the inner shims having an outer diameter spaced radially inward from an outer diameter of each of the inner slots.

9. A gate valve assembly comprising:

a valve body having a central cavity intersected by upstream and downstream flow passages that are coaxial with each other along a flow passage axis;

a valve seat pocket formed in the valve body at each intersection of one of the flow passages with the central cavity;

a gate moveable in the cavity of the valve body between an open and a closed position;

a resilient annular metal valve seat mounted in each of the valve seat pockets, each of the resilient annular metal valve seats comprising:

a seat body having a bore, a rearward end secured with an interference fit in one of the pockets and a forward end in dynamic sealing contact with the gate, the seat body, including the rearward end and forward end being integrally formed from a single piece of metal;

at least two circumferentially extending inner slots within the bore;

at least two circumferentially extending outer slots on a circumference of the seat body, the inner slots and the outer slots alternating with each other along the axis, the inner and the outer slots allowing contraction and expansion of the seat body in response to engagement of the forward end by the gate;

an outer supporting device on the seat body that provides a limit for contraction of the seat body; and

an inner supporting device on the seat body that is separate from the outer supporting device and which provides another limit for contraction of the seat body; and

wherein the inner supporting device is located radially inward from the outer supporting device.

10. The gate valve according to claim 9, wherein:

the outer supporting device comprises an outer sleeve surrounding the seat body; and

the inner supporting device comprises an inner sleeve located in the bore.

11. The gate valve according to claim 9, wherein:

the outer supporting device comprises outer shims located in the outer slots, the outer shims having a radial dimension less than a radial dimension of the outer slots; and having outer diameters flush with outer diameters of the outer slots; and

the inner supporting device comprises inner shims located in the inner slots, the inner shims having a radial dimension less than a radial dimension of the inner slots and having inner diameters flush with inner diameters of the inner slots.