Claims:

1. An automatic dry sprinkler assembly comprising:

a tubular outer housing extending along a longitudinal sprinkler axis including:

a first end portion having an internal surface circumscribed about the longitudinal sprinkler axis to define an inlet opening of the tubular outer housing, an annular sealing surface axially spaced from the inlet opening, and an enlarged conduit portion;

a second end portion having an internal surface circumscribed about the longitudinal sprinkler axis to define an outlet opening of the tubular outer housing; and

an internal conduit extending from the first end portion to the second end portion along the longitudinal sprinkler axis to axially space the annular sealing surface from the outlet opening;

a fluid deflection member coupled to the tubular outer housing via a pair of frame arms to locate the fluid deflection member at a fixed distance from the outlet opening and centered on the longitudinal sprinkler axis;

a thermally responsive trigger seated between the fluid deflection member and the outlet opening to define an unactuated state of the sprinkler assembly, the thermally responsive trigger having a thermal response defining an actuated state of the sprinkler assembly; and

a fluid control assembly disposed coaxially within the internal conduit, the fluid control assembly including:

a seal subassembly having a first position in fluid tight sealed contact with the annular sealing surface in the unactuated state of the sprinkler assembly and a second position axially spaced from the annular sealing surface in the actuated state of the sprinkler assembly;

a fluid flow tube having a fluid intake end coupled to the seal subassembly and a discharge orifice end opposite the fluid intake end supported by the thermally responsive trigger so as

to locate the seal subassembly in the first position, the discharge orifice end defining a nominal K-factor of 25.2 gpm/(psi)$^{1/2}$ (360 [L/min/(bar)$^{1/2}$]), and

an ejectable support member having a support surface and a seat surface, the ejectable support member being disposed in the outlet opening of the tubular outer housing in the unactuated state of the sprinkler assembly with the support surface abutting a terminal end of the discharge orifice end of the fluid flow tube and the seat surface engaging the thermally responsive trigger so as to locate the seal subassembly in the first position,

wherein the fluid deflection member is a planar member having a plurality of tines defining a plurality of spaced apart slots and a diameter of the planar member,

wherein the plurality of spaced apart slots comprises a first group of opposed slot pairs aligned along a first bisecting plane aligned with the pair of frame arms, a second group of opposed slot pairs aligned along a second bisecting plane that is perpendicular to the first bisecting plane, and at least three additional groups of opposed slot pairs disposed symmetrical about each of the first bisecting plane and the second bisecting plane,

wherein the at least three additional groups of opposed slot pairs comprise a central opposed slot pair and two lateral opposed slot pairs,

wherein each of the slots of the central opposed slot pair comprises a central slot length and each of the slots of the two lateral opposed slot pairs comprises a lateral slot length,

wherein the lateral slot length is greater than the central slot length,

wherein the discharge orifice end comprises a discharge orifice defining a discharge orifice diameter and wherein a deflector-diameter to discharge-orifice-diameter ratio ranges from 2:1 to 1.5:1, the fluid deflection member providing suppression performance for a minimum operating pressure of firefighting fluid provided to the inlet opening in the actuated state of the sprinkler assembly,

wherein the enlarged conduit portion is symmetrical about the longitudinal sprinkler axis,

wherein the seal subassembly engages the fluid intake end to axially translate with the fluid intake end, and wherein the seal subassembly is disposed along and about the longitudinal sprinkler axis in both the unactuated state and the actuated state,

wherein the ejectable support member comprises a side surface with a varying diameter between the support surface and the seat surface of the ejectable support member,

wherein a majority of the side surface is disposed within the tubular outer housing in the unactuated state of the sprinkler assembly so that a maximum diameter of the varying diameter is disposed between the outlet opening of the tubular outer housing and the discharge orifice end of the fluid flow tube, and

wherein, at the second position of the seal subassembly, the seal subassembly is located within the enlarged conduit portion of the first end portion, and the terminal end of the discharge orifice end is located between the outlet opening and the fluid deflection member.

2. The automatic dry sprinkler assembly of claim 1, wherein the terminal end of the discharge orifice end comprises a tapered outer surface, wherein the support surface and the seat surface define a height along the longitudinal sprinkler axis, and, wherein the height is greater than a length of the tapered outer surface of the discharge orifice end along the longitudinal sprinkler axis.

3. The automatic dry sprinkler assembly of claim 1, wherein the ejectable support member comprises an impact surface configured to alter the center of gravity of the ejectable support member in the actuated state of the sprinkler assembly.

4. The automatic dry sprinkler assembly of claim 3, wherein the impact surface comprises a first portion and a second portion, wherein the first portion comprises a first distance to the support surface and the second portion comprises a second distance to the support surface, and wherein the first distance is greater than the second distance.

5. The automatic dry sprinkler assembly of claim 3, wherein the impact surface defines an asymmetric surface about a central axis of the ejectable support member.

6. The automatic dry sprinkler assembly of claim 5, wherein the asymmetric surface comprises a skewed surface with respect to the central axis of the ejectable support member.

7. The automatic dry sprinkler assembly of claim 1, wherein the plurality of spaced apart slots comprises an even number of total slots.

8. The automatic dry sprinkler assembly of claim 7, wherein the even number of total slots comprises twenty slots or less.

9. The automatic dry sprinkler assembly of claim 7, wherein each of the slots of the central opposed slot pair comprises a central slot width and each of the slots of the two lateral opposed slot pairs comprises a lateral slot width, and wherein the lateral slot width comprises a common slot width at a perimeter of the planar member.

10. The automatic dry sprinkler assembly of claim 1, wherein the thermally responsive trigger comprises a strut, a lever and a thermally responsive link coupling the strut and lever, and a loading member comprising a load screw.

11. The automatic dry sprinkler assembly of claim 1, wherein the first end portion comprises an external thread circumscribed about the longitudinal sprinkler axis between the inlet opening and the annular sealing surface.

12. An automatic dry sprinkler assembly comprising:

a tubular outer housing extending along a longitudinal sprinkler axis including:

a first end portion having an internal surface circumscribed about the longitudinal sprinkler axis to define an inlet opening of the tubular outer housing, an annular sealing surface axially

spaced from the inlet opening, and an enlarged conduit portion symmetrical about the longitudinal axis,

a second end portion having an internal surface circumscribed about the longitudinal sprinkler axis to define an outlet opening of the tubular outer housing, and

an internal conduit extending from the first end portion to the second end portion along the longitudinal sprinkler axis to axially space the annular sealing surface from the outlet opening;

a fluid deflection member coupled to the tubular outer housing to locate the fluid deflection member at a fixed distance from the outlet opening and centered on the longitudinal sprinkler axis, the fluid deflection member comprises a planar member having a plurality of tines defining a plurality of spaced apart slots and a deflector diameter of the fluid deflection member;

a thermally responsive trigger seated between the fluid deflection member and the outlet opening to define an unactuated state of the sprinkler assembly, the thermally responsive trigger having a thermal response defining an actuated state of the sprinkler assembly; and

a fluid control assembly disposed coaxially within the internal conduit, the fluid control assembly including:

a seal subassembly having a first position in fluid tight sealed contact with the annular sealing surface in the unactuated state of the sprinkler assembly and a second position axially spaced from the annular sealing surface in the actuated state of the sprinkler assembly;

a fluid flow tube having a fluid intake end coupled to the seal subassembly and a discharge orifice end defining a discharge orifice at a terminal end of the discharge orifice end supported by the thermally responsive trigger to locate the seal subassembly in the first position, the discharge orifice defining a discharge orifice diameter, and

an ejectable support member having a support surface, a seat surface, and a side surface extending between the support surface and the seat surface, the ejectable support member being disposed in the outlet opening in the unactuated state of the sprinkler assembly with the support surface abutting the terminal end of the discharge orifice end of the fluid flow tube and the seat surface engaging the thermally responsive trigger to locate the seal subassembly in the first position,

wherein the plurality of tines defining a plurality of spaced apart slots of the fluid deflection member are configured to provide suppression performance for a minimum operating pressure of firefighting fluid provided to the inlet opening in the actuated state of the sprinkler assembly,

wherein the discharge orifice defines a nominal K-factor of 25.2 gpm/(psi)$^{1/2}$ (360 [L/min/(bar)$^{1/2}$]),

wherein a ratio of the deflector diameter to the discharge orifice diameter ranges from 2:1 to 1.5:1,

wherein the seal subassembly engages the fluid intake end to axially translate with the fluid intake end, and wherein the seal subassembly is disposed along and about the longitudinal sprinkler axis in both the unactuated state and the actuated state,

wherein the side surface comprises a varying diameter between the support surface and the seat surface of the ejectable support member, and

wherein, in the unactuated state of the sprinkler assembly, a maximum diameter of the varying diameter is disposed between the outlet opening of the tubular outer member and the terminal end of the discharge orifice end of the fluid flow tube.

13. The automatic dry sprinkler assembly of claim 12, wherein a majority of the side surface is disposed within the tubular outer housing in the unactuated state of the sprinkler assembly.

14. The automatic dry sprinkler assembly of claim 13, wherein the ejectable support member comprises an impact surface configured to alter the center of gravity of the ejectable support member in the actuated state of the sprinkler assembly, and wherein the impact surface defines an asymmetric surface about a central axis of the ejectable support member.

15. The automatic dry sprinkler assembly of claim 12, wherein the plurality of spaced apart slots comprises a first group of opposed slot pairs aligned along a first bisecting plane, a second group of opposed slot pairs aligned along a second bisecting plane, and at least three additional groups of opposed slot pairs disposed symmetrical about each of the first bisecting plane and the second bisecting plane.

16. The automatic dry sprinkler assembly of claim 12, wherein, at the second position of the seal subassembly, the seal subassembly is located within the enlarged conduit portion of the first end portion, and the terminal end of the discharge orifice end is located between the outlet opening and the fluid deflection member.

17. An automatic dry sprinkler assembly comprising:

a tubular outer housing extending along a longitudinal sprinkler axis including:

a first end portion having an internal surface circumscribed about the longitudinal sprinkler axis to define an inlet opening of the tubular outer housing, an annular sealing surface axially spaced from the inlet opening, and an enlarged conduit portion symmetrical about the longitudinal axis,

a second end portion having an internal surface circumscribed about the longitudinal sprinkler axis to define an outlet opening of the tubular outer housing, and

an internal conduit extending from the first end portion to the second end portion along the longitudinal sprinkler axis to axially space the annular sealing surface from the outlet opening;

a fluid deflection member coupled to the tubular outer housing to locate the fluid deflection member at a fixed distance from the outlet opening and centered on the longitudinal sprinkler axis, the fluid deflection member comprises a planar member having a plurality of tines defining a plurality of spaced apart slots and a deflector diameter of the fluid deflection member;

a thermally responsive trigger seated between the fluid deflection member and the outlet opening to define an unactuated state of the sprinkler assembly, the thermally responsive trigger having a thermal response defining an actuated state of the sprinkler assembly; and

a fluid control assembly disposed coaxially within the internal conduit, the fluid control assembly including:

a seal subassembly having a first position in fluid tight sealed contact with the annular sealing surface in the unactuated state of the sprinkler assembly and a second position axially spaced from the annular sealing surface in the actuated state of the sprinkler assembly;

a fluid flow tube having a fluid intake end coupled to the seal subassembly and a discharge orifice end defining a discharge orifice at a terminal end of the discharge orifice end supported by the thermally responsive trigger to locate the seal subassembly in the first position, the discharge orifice defining a discharge orifice diameter, and

an ejectable support member having a support surface, a seat surface, and a side surface extending between the support surface and the seat surface, the ejectable support member being disposed in the outlet opening in the unactuated state of the sprinkler assembly with the

support surface abutting the terminal end of the discharge orifice end of the fluid flow tube and the seat surface engaging the thermally responsive trigger to locate the seal subassembly in the first position,

wherein the discharge orifice defines a nominal K-factor of 25.2 gpm/(psi)$^{1/2}$ (360 [L/min/(bar)$^{1/2}$]),

wherein a ratio of the deflector diameter to the discharge orifice diameter ranges from 2:1 to 1.5:1,

wherein the seal subassembly engages the fluid intake end to axially translate with the fluid intake end, and wherein the seal subassembly is disposed along and about the longitudinal sprinkler axis in both the unactuated state and the actuated state,

wherein the plurality of tines defining a plurality of spaced apart slots of the fluid deflection member are configured to provide suppression performance for a minimum operating pressure of firefighting fluid provided to the inlet opening in the actuated state of the sprinkler assembly,

wherein the plurality of spaced apart slots comprises a first group of opposed slot pairs aligned along a first bisecting plane, a second group of opposed slot pairs aligned along a second bisecting plane, and at least three additional groups of opposed slot pairs disposed symmetrical about each of the first bisecting plane and the second bisecting plane,

wherein the at least three additional groups of opposed slot pairs comprise a central opposed slot pair and two lateral opposed slot pairs,

wherein each of the slots of the central opposed slot pair comprises a central slot length and each of the slots of the two lateral opposed slot pairs comprises a lateral slot length, and

wherein the lateral slot length is greater than the central slot length.

18. The automatic dry sprinkler assembly of claim 17, wherein the side surface of the ejectable support member comprises a varying diameter between the support surface and the seat surface of the ejectable support member, and wherein a majority of the side surface is disposed within the tubular outer housing in the unactuated state of the sprinkler assembly so that a maximum diameter of the varying diameter is disposed between the outlet opening of the tubular outer member and the discharge orifice end of the fluid flow tube.

19. The automatic dry sprinkler assembly of claim 17, wherein, at the second position of the seal subassembly, the seal subassembly is located within the enlarged conduit portion of the first end portion, and the terminal end of the discharge orifice end is located between the outlet opening and the fluid deflection member.

20. The automatic dry sprinkler assembly of claim 17, wherein the seal subassembly engages the fluid intake end to axially translate with the fluid intake end, and wherein the seal subassembly is disposed along and about the longitudinal sprinkler axis in both the unactuated state and the actuated state.