CLAIMS

What is claimed:

1. A system, comprising:

a turbine; and

a recuperative heat exchanger system, wherein the recuperative heat exchanger system is configured to receive exhaust gases from the turbine, and the recuperative heat exchanger system comprises:

a precool section to cool the exhaust gases,

a major heating section to receive the cooled the exhaust gases, and

a minor heating section to receive the cooled the exhaust gases.

2. The system of claim 1, wherein the precool section further comprises one or more shell and tube heat exchangers with an annular distributor, and wherein the system is configured such that a fluid exiting an end of the minor heating section enters the precool section.

3. The system of claim 1, wherein the major heating section operates at a higher temperature then the minor heating section.

4. The system of claim 1, wherein the major heating section further comprises at least two heat exchangers in series, and the at least two heat exchangers are a printed circuit type heat exchanger and arrayed vertically.

5. The system of claim 1, wherein the minor heating section further comprises at least two heat exchangers in series, and the at least two heat exchangers are a printed circuit type heat exchanger and arrayed vertically stacked.

6. The system of claim 1, wherein the recuperative heat exchanger system further comprises a heat recovery section configured to add heat to the recycle heating section.

7. The system of claim 1, wherein the major heating section is a recycle heating section and the minor heating section is an oxidant heating section.

8. The system of claim 1, further comprising one or more valves configured to balance a flow between the major heating section and the minor heating section.

9. The system of claim 1, further comprising a manifold configured to split a flow from the precool section to the major heating section and the minor heating section.

10. A method, comprising:

producing exhaust gas via a turbine;

feeding the exhaust gas into a precool section of a recuperative heat exchanger system to cool the exhaust gas;

splitting the cooled exhaust gas into a major flow path feeding into a major heating section of the recuperative heat exchanger system and a minor flow path feeding into a minor heating section of the recuperative heat exchanger system;

flowing, in the minor flow path the cooled exhaust gas through a first minor heat exchanger of the minor heating section and a second minor heat exchanger of the minor heating section;

flowing, in the major flow path the cooled exhaust gas through a first major heat exchanger of the major heating section, a second major heat exchanger of the major heating section, and a third major heat exchanger of the major heating section; and

providing a combustor, coupled to the turbine, with fluid flow from the major flow path and the minor flow path.

11. The method of claim 10, further comprising cooling the exhaust gas in the precool section to a temperature of 575°C.

12. The method of claim 10, further comprising heating the minor flow path to a temperature of 350—500°C.

13. The method of claim 10, further comprising heating the major flow path to a temperature of 520—650°C.

14. The method of claim 10, further comprising adding heat to the major flow path via a heat source.

15. The method of claim 10, further comprising balancing the splitting of the cooled exhaust gas into the major flow path and the minor flow path with one or more valves.

16. A precool heat exchanger, comprising:

a first annular shell forming a pressure boundary, the first annular shell comprises:

an exhaust gas inlet configured to receive exhaust gas from a turbine, and

one or more exhaust outlets configured to exhaust the exhaust gas,

a second annular shell provided within the first annular shell;

a tube bundle provided within the second annular shell; and

an annular distribution device provided within the second annular shell, wherein the annular distribution device is configured to control an exhaust gas flow entering the tube bundle.

17. The precool heat exchanger of claim 16, wherein the tube bundle is a U-tube bundle.

18. The precool heat exchanger of claim 17, further comprising a support plate within the first annular shell configured to support a weight of the U-tube bundle.

19. The precool heat exchanger of claim 16, further comprising a stationary head channel at an end of the first annular shell, the stationary head channel comprises an inlet configured to receive oxidant from a minor heating section; and an outlet configured to exit the oxidant.

20. The precool heat exchanger of claim 19, wherein the stationary head channel further comprises a pass partition configured to split flow between the inlet and the outlet.

21. A recuperative heat exchanger system, comprising:

a precool section within a first rigid framework, wherein the precool section comprises one or more heat exchangers to receive and cool exhaust gases;

a minor section within a third rigid framework, wherein the minor section comprises a first minor heat exchanger and a second minor heat exchanger; and

a first major section within a second rigid framework, wherein the first major section comprises a first major heat exchanger, a second major heat exchanger, and a third major heat exchanger.

~~22. The recuperative heat exchanger system of claim 21, further comprising a manifold configured to split a cooled exhaust gas flow from the precool section to the first major section and the minor section.~~

~~23. The recuperative heat exchanger system of claim 22, wherein the manifold is positioned in a space between the first rigid framework and the second rigid framework and the third rigid framework.~~

~~24. The recuperative heat exchanger system of claim 21, further comprising a second major section within a fourth rigid framework, wherein the second major section comprises a fourth major heat exchanger, a fifth major heat exchanger, and a sixth major heat exchange.~~

~~25. The recuperative heat exchanger system of claim 24, further comprising one or more valves to balance a split of the cooled exhaust gas flow to the first major section, the second major section, and the minor section.~~

~~26. The recuperative heat exchanger system of claim 24, further comprising a heat recovery section connected to the first major section and the second major section.~~

~~27. The recuperative heat exchanger system of claim 24, wherein each of the first rigid framework, the second rigid framework, the third rigid framework, and the fourth rigid framework are formed by a plurality of vertically oriented structural members and a plurality of horizontally oriented structural members interconnected together.~~

~~28. The recuperative heat exchanger system of claim 21, wherein the one or more shell and tube heat exchangers comprises precooler inlets on a shell-side to receive the exhaust gases.~~

~~29. The recuperative heat exchanger system of claim 21, further comprising a first recycled CO2 manifold to provide recycled CO2 within the recuperative heat exchanger system.~~

~~30. The recuperative heat exchanger system of claim 29, further comprising a second recycled CO2 manifold to exit the recycled CO2 within the recuperative heat exchanger system.~~

31. The recuperative heat exchanger system of claim 21, wherein the one or more shell and tube heat exchangers comprises oxidant inlets on a tube side to receive oxidant from the minor section.

32. The recuperative heat exchanger system of claim 21, wherein the one or more shell and tube heat exchangers comprises oxidant inlets on a tube side to receive oxidant from the minor section.

33. A method, comprising:

cooling exhaust gases with a precool section within a first rigid framework;

splitting the exhaust gases, with a manifold positioned outside of the first rigid framework, to flow into a first major section within a second rigid framework, a second major section within a third rigid framework, and a minor section within a third rigid framework;

flowing the exhaust gases, in the minor section, through a first minor heat exchanger of the minor section and to a second minor heat exchanger of the minor section via one or more curved flow loops;

flowing the exhaust gases, in the first major section, through a first major heat exchanger of the first major section and to a second major heat exchanger of the first major section and then a third major heat exchanger of the first major section via one or more curved flow loops;

flowing the exhaust gases, in the second major section, through a first major heat exchanger of the second major section and to a second major heat exchanger of the second major section and then a third major heat exchanger of the second major section via one or more curved flow loops;

flowing the exhaust gases from the second minor heat exchanger, the third major heat exchanger of the first major section, and the third major heat exchanger of the second major section to an exhaust gas manifold via secondary curved flow loops.

34. The method of claim 33, further comprising operating the first minor heat exchanger at a higher temperature than the second minor heat exchanger.

~~35. The method of claim 33, further comprising operating the first major heat exchanger of the first major section at a higher temperature than the second major heat exchanger of the first major section, and operating the second major heat exchanger of the first major section at a higher temperature than third major heat exchanger of the first major section.~~

~~36. The method of claim 33, further comprising operating the first major heat exchanger of the second major section at a higher temperature than the second major heat exchanger of the second major section, and operating the second major heat exchanger of the second major section at a higher temperature than third major heat exchanger of the second major section.~~

~~37. The method of claim 33, further comprising distributing recycled CO2, via a first recycled CO2 manifold, to the first major section and the second major section.~~

~~38. The method of claim 37, further comprising heating the recycled CO2 with the first major section and the second major section and exiting the heated recycled CO2 with a second recycled CO2 manifold.~~

~~39. The method of claim 33, further comprising providing oxidant to the precool section via an oxidant manifold.~~

~~40. The method of claim 33, further comprising providing heat to the first major section and the second major section via a heat recovery section.~~

~~41.~~1. A heat exchanger system, comprising:

a rigid framework;

a first heat exchanger coupled to a first support structure on a top of the rigid framework;

a second heat exchanger positioned below the first heat exchanger, wherein the second heat exchanger is coupled to a second support structure, the second support structure hanging from the rigid framework via a first set of tethers, wherein the first set of tethers is configured to vertically and horizontally move the second support structure;

a second set of tethers connected to the second support structure and extend downward to hang a support beam;

a third set of tethers connected to the support beam and extend downward to hang a third support structure, wherein the third set of tethers is configured to vertically and horizontally move the third support structure; and

a third heat exchanger coupled to the third support structure,

wherein the vertically and horizontally movement of the second support structure is based on a thermal expansion of the second heat exchanger, and

wherein the vertically and horizontally movement of the third support structure is based on a thermal expansion of the third heat exchanger.

~~42.~~2. The heat exchanger system of claim ~~41~~1, wherein the first heat exchanger is configured to operate at a higher temperature than the second heat exchanger, and the second heat exchanger is configured to operate at a higher temperature than the third heat exchanger.

~~43.~~3. The heat exchanger system of claim ~~41~~1, wherein the first set of tethers, the second set of tethers, and the third set of tethers are selected from a structural tension member, a steel rod, chain links, or a wire rope.

~~44.~~4. The heat exchanger system of claim ~~41~~1, wherein the first set of tethers and the third set of tethers are angled.

~~45.~~5. The heat exchanger system of claim ~~41~~1, wherein the rigid framework comprises two columns spaced a distance from each other.

~~46.~~6. The heat exchanger system of claim ~~45~~5, wherein the first heat exchanger, the second heat exchanger, and the third heat exchanger are between the two columns.

~~47.~~7. The heat exchanger system of claim ~~45~~5, wherein a first end of each of the two columns is removably fixed to a floor.

~~48.~~8. The heat exchanger system of claim ~~47~~7, wherein the first support structure is movably coupled to a second end of each of the two columns distal to the first end.

~~49.~~9. The heat exchanger system of claim ~~41~~1, further comprising one or more protrusions extending from the rigid framework, wherein an end of the first set of tethers is connected to the one or more protrusions.

~~50.~~10. The heat exchanger system of claim ~~41~~1, wherein the first heat exchanger is thermally decoupled from the second heat exchanger, and the second heat exchanger is thermally decoupled from the third heat exchanger.

~~51.~~11. A heat exchanger system, comprising:

a rigid framework;

a first heat exchanger coupled to a first support structure on a top of the rigid framework; and

a second heat exchanger positioned below the first heat exchanger, wherein the second heat exchanger is coupled to a second support structure, the second support structure hanging from the rigid framework via a first set of tethers, wherein the first set of tethers is configured to vertically and horizontally move the second support structure,

wherein the vertically and horizontally movement of the second support structure is based on a thermal expansion of the second heat exchanger.

~~52.~~12. The heat exchanger system of claim ~~51~~11, wherein the first heat exchanger is thermally decoupled from the second heat exchanger.

~~53.~~13. The heat exchanger system of claim ~~51~~11, wherein the first set of tethers is angled.

~~54.~~14. The heat exchanger system of claim ~~53~~13, wherein ends of the first set of tethers are connected to the rigid framework and the second support structure via a rack and pinion or a gear driven cam.

~~55.~~15. The heat exchanger system of claim ~~53~~13, wherein an angle of the first set of tethers is selected based on a predetermined thermal expansion or contraction.

~~56.~~16. The heat exchanger system of claim ~~51~~11, wherein the first heat exchanger is configured to operate at a higher temperature than the second heat exchanger.

~~57.~~17. A heat exchanger system, comprising:

a rigid framework;

a first support structure hanging from the rigid framework via a first set of tethers having one end coupled to the rigid framework and another end coupled to the first support structure, wherein the first set of tethers is configured to vertically and horizontally move the first support structure;

a first heat exchanger coupled to the first support structure;

a second set of tethers connected to the first support structure and extend downward to hang a support beam;

a third set of tethers connected to the support beam and extend downward to hang a second support structure, wherein the third set of tethers is configured to vertically and horizontally move the second support structure; and

a second heat exchanger coupled to the second support structure,

wherein the vertically and horizontally movement of the first support structure is based on a thermal expansion of the first heat exchanger, and

wherein the vertically and horizontally movement of the second support structure is based on a thermal expansion of the second heat exchanger.

~~58.~~18. The heat exchanger system of claim ~~57~~17, wherein the first heat exchanger is thermally decoupled from the second heat exchanger.

~~59.~~19. The heat exchanger system of claim ~~57~~17, wherein the first set of tethers and the third set of tethers are angled.

~~60.~~20. The heat exchanger system of claim ~~57~~17, wherein the first heat exchanger is configured to operate at a higher temperature than the second heat exchanger.