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(54) **BLADE HANDLING TRAY INSERT**

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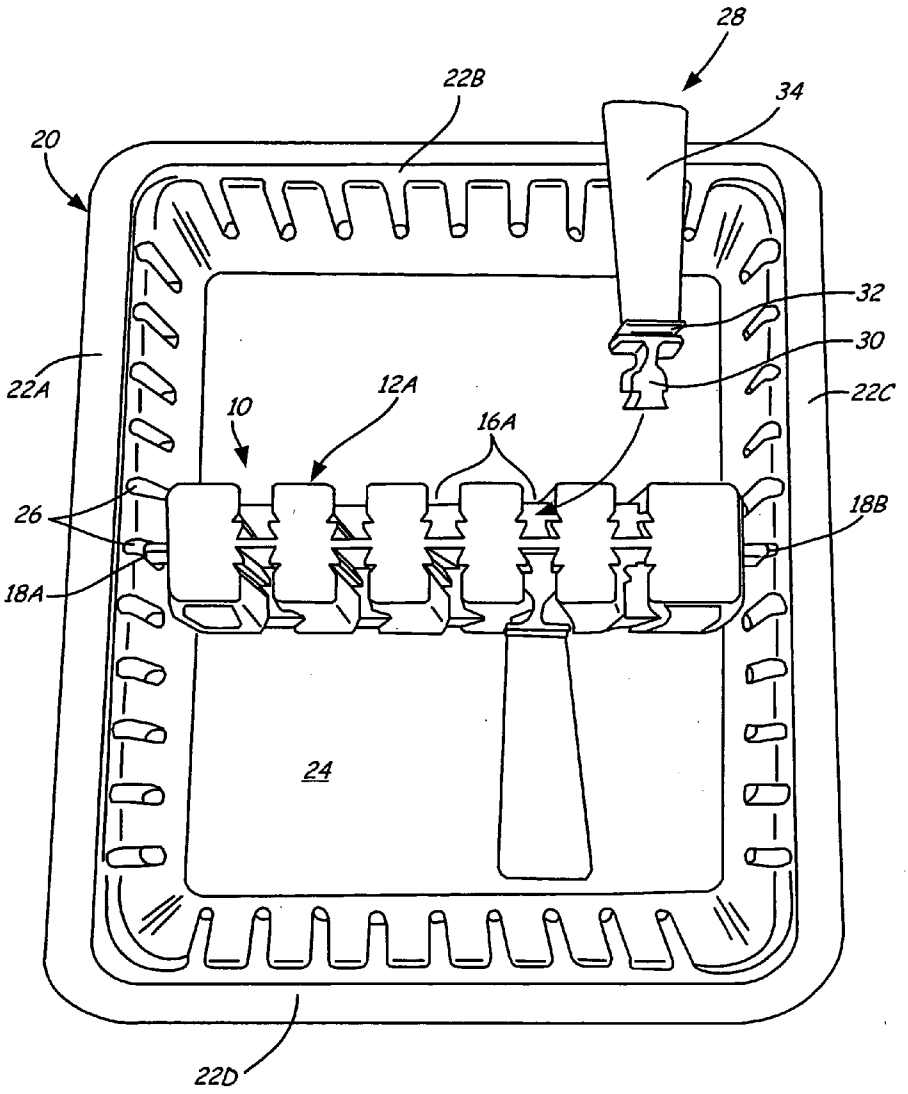
(57) **ABSTRACT**

A tray insert for securing fluid reaction members in a handling tray includes a body having first and second major surfaces, first and second ends, sliding members disposed on the first and second ends, which are configured to engage with a plurality of slots formed in the handling tray, and a first plurality of sockets extending into the first major surface, which are spaced from one another to receive and support a plurality of fluid reaction members. The tray insert is configured to hold the fluid reaction members in a suspended state, which prevents them from coming into contact with each other or a surface of the handling tray.



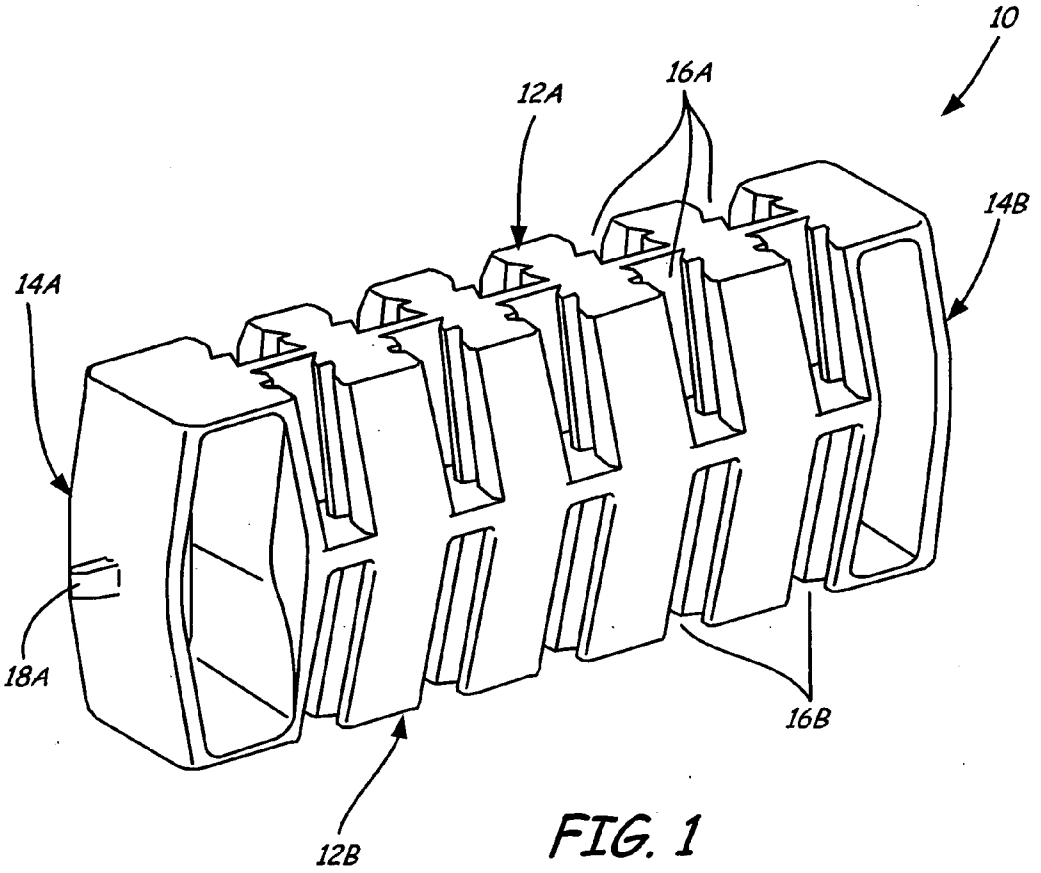


FIG. 1

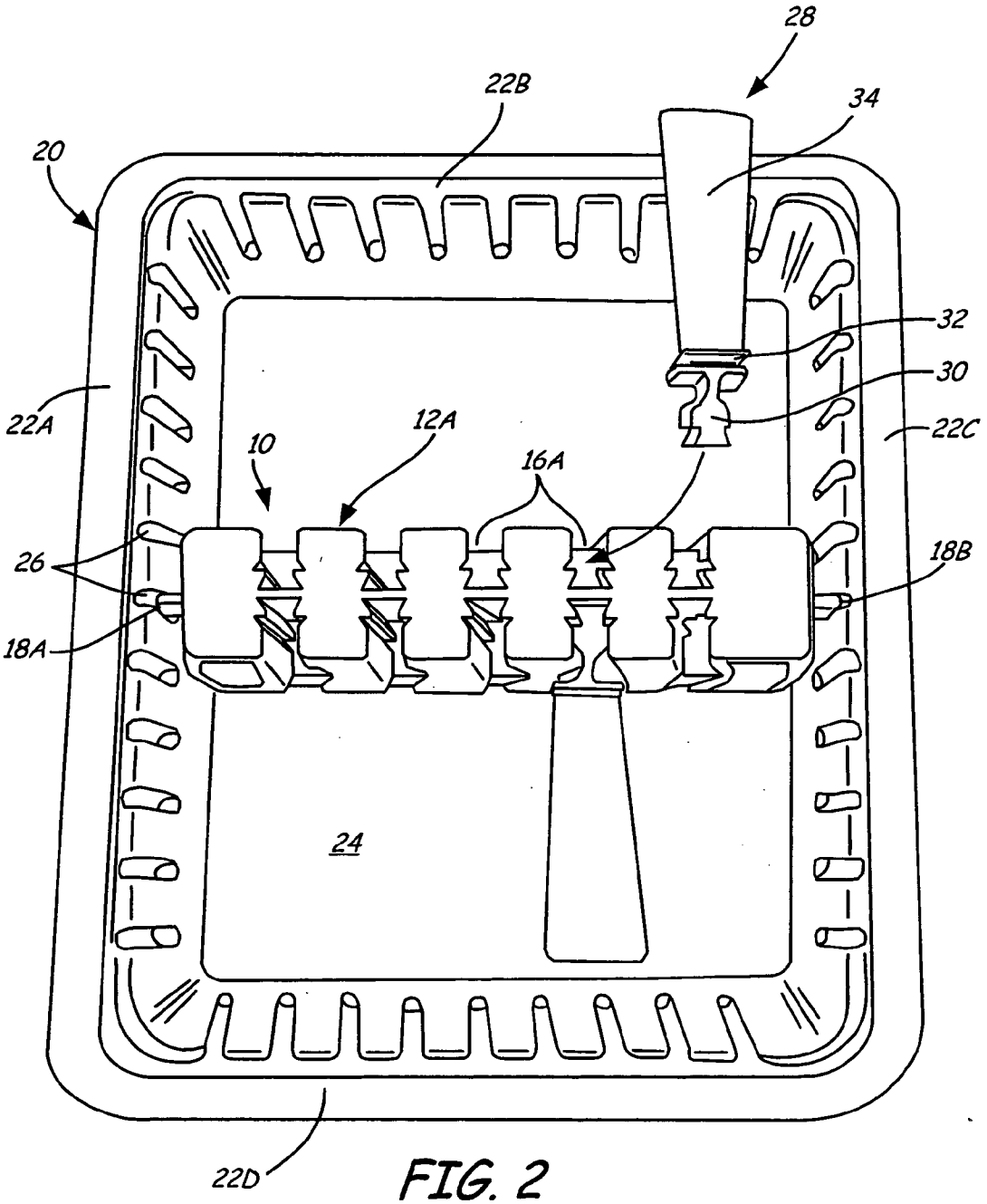


FIG. 2

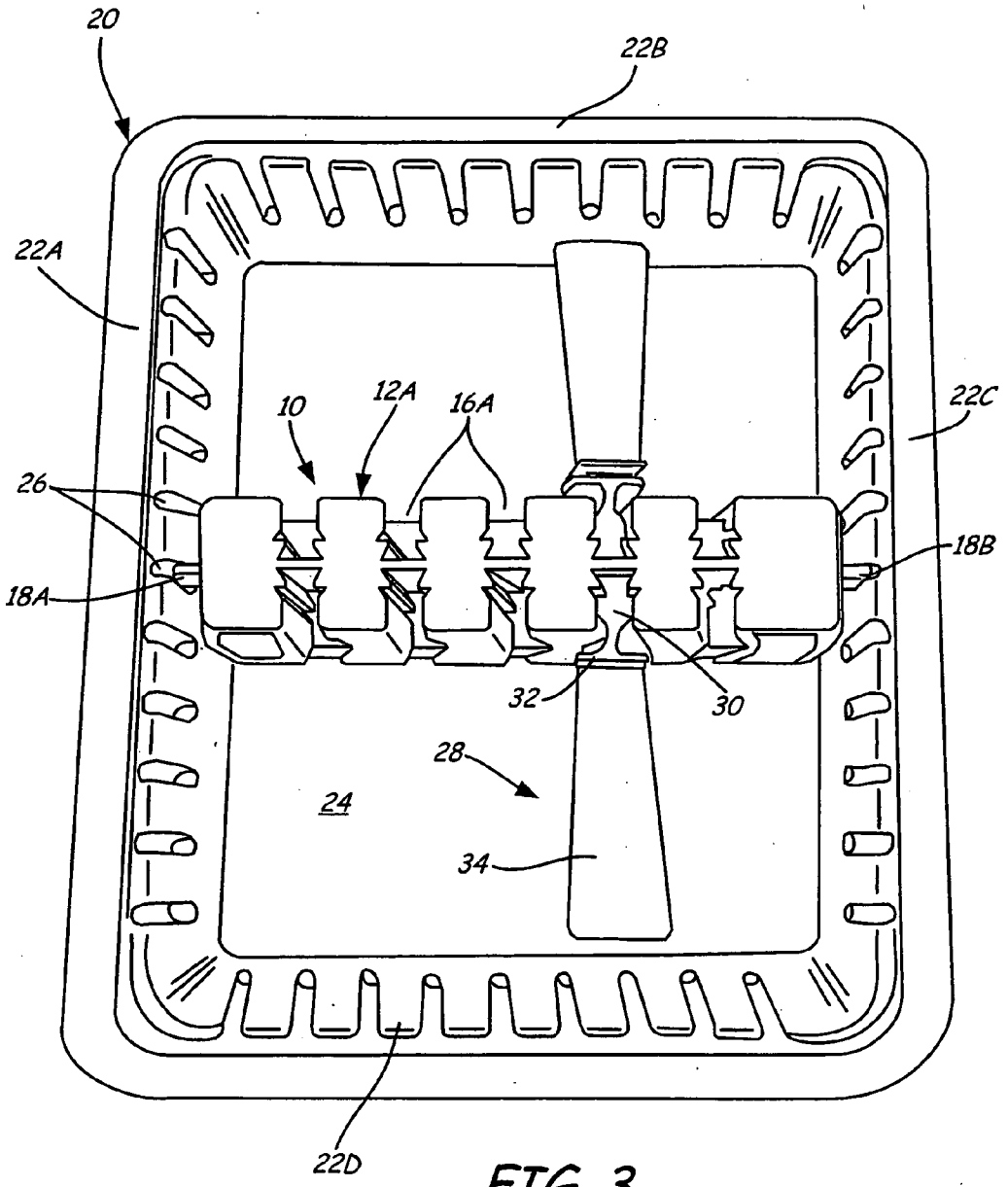


FIG. 3

BLADE HANDLING TRAY INSERT

BACKGROUND OF THE INVENTION

[0001] This invention relates generally to a tray insert. More particularly this invention relates to a tray insert for securing gas turbine engine blades in a handling tray.

[0002] During operation of a gas turbine engine, fuel is combusted in compressed air created by a compressor to produce heated gases. The heated gases move in a downstream/aft direction past stator vanes and are used to turn turbine blades to produce rotational power for, among other things, operating the compressor. Turbine blades include a root portion, which is commonly shaped like a "fir tree," for engaging with a rotor disk and an airfoil portion for positioning within the gas path of the engine.

[0003] Due to design complexity, gas turbine engines have high manufacturing costs. Therefore, fluid reaction members, such as blades and vanes, are expensive. In addition, the elongated configuration of the airfoil portion of gas turbine engine blades makes them fragile and susceptible to damage. As a result, when moving or transporting gas turbine engine blades, the handler must be extremely careful.

[0004] Known devices and methods for handling gas turbine engine blades are potentially problematic because it is possible for the airfoil portions of the blades to come into contact with each other, causing damage to one or multiple blades. Also, since the airfoil portions of the blades are in contact with surfaces of the receptacle containing the blades, such as a tray, damage to the blades may be incurred when the tray is inappropriately handled. When Process Incidental Damage (PID) occurs, both time and money are lost, as the blades then need to be replaced.

[0005] Therefore, it is desired to provide a blade handling tray insert, which enables gas turbine engine fluid reaction members, especially blades and vanes, to be safely and easily handled, thereby reducing PID.

BRIEF SUMMARY OF THE INVENTION

[0006] The present invention is a tray insert for securing fluid reaction members in a handling tray. The tray insert includes a body having first and second major surfaces and first and second ends, sliding members disposed on the first and second ends, which are configured to engage with a plurality of slots formed in the handling tray and a first plurality of sockets extending into the first major surface, which are spaced from one another to receive and support a plurality of fluid reaction members. The tray insert is configured to hold the fluid reaction members in a suspended state, which prevents them from coming into contact with each other or a surface of the handling tray.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1**A is a perspective view of an exemplary embodiment of a blade handling tray insert.

[0008] FIG. **2** is a top view of a handling tray containing the tray insert securing a first blade and receiving a second blade.

[0009] FIG. **3** is a top view of the handling tray containing the tray insert securing two blades.

DETAILED DESCRIPTION

[0010] In general, the present invention provides a tray insert for securing fluid reaction members in a handling tray. The tray insert is designed to hold the fluid reaction members, in particular gas turbine engine blades, in a suspended state. This prevents the fluid reaction members from being damaged during handling and/or shipping.

[0011] FIG. **1** is a perspective view of an exemplary embodiment of blade handling tray insert **10**. Tray insert **10** includes first major surface **12**A, second major surface **12**B, first end **14**A and second end **14**B. First plurality of sockets **16**A extend into first major surface **12**A. Second plurality of sockets **16**B extend into second major surface **12**B. Sliding member **18**A is disposed on first end **14**A. (A second sliding member, sliding member **18**B, is disposed on second end **14**B, but cannot be seen from this perspective.)

[0012] Tray insert **10** is configured to securely hold a plurality of gas turbine engine blades. Sockets **16**A, **16**B are each designed to receive a portion of a blade. The spacing of sockets **16**A, **16**B can vary depending upon the size of the blades (or other types of fluid reaction members) which need to be secured for handling. In the exemplary embodiment shown in FIG. **1**, there are ten sockets **16**A and ten sockets **16**B. However, it should be understood that the number of sockets will vary according to the desired application.

[0013] In addition, in the exemplary embodiment shown in FIG. **1**, tray insert **10** includes first major surface **12**A, into which sockets **16**A extend, and second major surface **12**B, into which sockets **16**B extend. Sockets **16**A are spaced to receive and secure a first type of gas turbine engine blade, such as a first stage blade. Sockets **16**B are configured to receive and secure a second type of gas turbine engine blade, such as a second stage blade. Tray insert **10** may be seated in a handling tray such that first major surface **12**A is oriented in an upward direction. In contrast, tray insert **10** may also be seated in a handling tray such that second major surface **12**B is oriented in an upward direction. As a result, an appropriate major surface **12**A, **12**B may be selected depending upon which plurality of sockets **16**A, **16**B corresponds to the shape and size of the blade to be handled. However, if it is desired that only one type of blade be handled, it should also be understood that plurality of sockets **16**A or **16**B may extend into only one major surface **12**A or **12**B of tray insert **10**.

[0014] While tray insert **10** may be comprised of any suitable material, in particular, tray insert **10** may be comprised of a polymeric material, such as polyethylene. When comprised of a plastic type material, tray insert **10** may be produced by an injection molding process.

[0015] FIG. **2** is a top view of handling tray **20** containing tray insert **10** and demonstrates the blade insertion process. Tray insert **10** includes first major surface **12**A, second major surface **12**B, first end **14**A and second end **14**B, first plurality of sockets **16**A and sliding members **18**A, **18**B. Handling tray **20** includes side portions **22**A-**22**D, bottom portion **24** and receiving slots **26**. Gas turbine engine blades **28** include root **30**, platform **32** and airfoil **34**.

[0016] Tray insert **10** may be seated in handling tray **20** by engaging sliding members **18**A, **18**B with receiving slots **26**, which are formed into the inside surface of side portions **22**A-**22**D of handling tray **20**. As can be seen in FIG. **2**, side

portions **22**A-**22**D of handling tray **20** may comprise a number of receiving slots **26**. As a result, tray insert **10** may be placed in numerous positions with respect to handling tray **20** in order to accommodate a variety of blade lengths.

[0017] Once tray insert **10** is firmly seated within handling tray **20**, gas turbine engine blade **26** may be inserted into plurality of sockets **16**A. (Although FIG. **2** shows tray insert **10** seated in handling tray **20** such that major surface **12**A is oriented in an upward direction, as explained with reference to FIG. **1**, tray insert **10** may also be seated in handling tray **20** such that major surface **12**B is oriented in an upward direction and plurality of sockets **16**B are accessible.) Root **30** of gas turbine engine blade **26** is designed to have a "fir tree" configuration, which engages with a rotor disk. Plurality of sockets **16**A are configured to engage with root **30** and therefore, have a corresponding "fir tree" shape. Since root **30** and plurality of sockets **16**A have a dovetail relationship, as shown in FIG. **2**, gas turbine engine blade **26** is inserted into plurality of sockets **16**A by matching up the corresponding shapes and lowering blade gas turbine engine blade **26** downward to engage with plurality of sockets **16**A like a puzzle piece. Once gas turbine engine blade **26** and plurality of sockets **16**A are properly engaged, gas turbine engine blade **26** may only be disengaged through the same angle of insertion.

[0018] FIG. **3** is a top view of handling tray **20** containing tray insert **10** as it secures two gas turbine engine blades **26**. Tray insert **10** includes first major surface **12**A, second major surface **12**B, first end **14**A and second end **14**B, first plurality of sockets **16**A and sliding members **18**A, **18**B. Handling tray **20** includes side portions **22**A-**22**D, bottom portion **24** and receiving slots **26**. Gas turbine engine blades **28** include root **30**, platform **32** and airfoil **34**.

[0019] As described with respect to FIG. **2**, gas turbine engine blades **26** are engaged with plurality of sockets **16**A by inserting root **30** into a corresponding socket **16**A. When root **30** is properly placed within socket **16**A, platform **32** of gas turbine engine blade **26** will sit securely against the surface of tray insert **10**. Since root **30** fits snuggly within socket **16**A, airfoil **34** is held in a suspended state. This prevents airfoil **34** from coming into contact with other gas turbine engine blades **28** and also prevents airfoil **34** from contacting any surface of handling tray **20**. As a result, when handling tray **20** is transported, Process Incidental Damage (PID) is unlikely to occur to gas turbine engine blades **28** because airfoil **34** protected from potential breakage and awareness to the handler is increased due the highly visible state of airfoil **34**.

[0020] Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.

1. A tray insert for securing fluid reaction members in a handling tray, the tray insert comprising:

a body having first and second major surfaces and first and second ends;

sliding members disposed on the first and second ends, the sliding members being configured to engage with a plurality of slots formed in the handling tray; and

a first plurality of sockets extending into the first major surface and being spaced from one another to receive and support a first plurality of fluid reaction members, wherein the tray insert is configured to hold the first plurality of fluid reaction members in a suspended state, which prevents the fluid reaction members from coming into contact with each other or a surface of the handling tray.

2. The tray insert of claim **1**, comprising a second plurality of sockets extending into the second major surface and being spaced from one another to receive and support a second plurality of fluid reaction members.

3. The tray insert of claim **2**, wherein the tray insert is insertable into the handling tray such that the first major surface is positioned in an upward orientation allowing the first plurality of sockets to be utilized.

4. The tray insert of claim **2**, wherein the tray insert is insertable into the handling tray such that the second major surface is positioned in an upward orientation allowing the second plurality of slots to be utilized.

5. The tray insert of claim **2**, wherein the first plurality of sockets are configured to receive a plurality of fluid reaction members having a first configuration and the second plurality of sockets are configured to receive a plurality of fluid reaction members having a second configuration which is different than the first configuration.

6. The tray insert of claim **2**, wherein the first and second pluralities of sockets each comprises ten sockets.

7. The tray insert of claim **2**, wherein the first and second pluralities of sockets are further configured to receive the plurality of fluid reaction members from a defined angle of insertion.

8. The tray insert of claim **7** wherein the plurality of fluid reaction members may only be disengaged from the first and second pluralities of sockets from the defined angle of insertion.

9. The tray insert of claim **1**, wherein the tray insert is further configured to hold the plurality of fluid reaction members in a suspended state in which the fluid reaction members are suspended in an orientation parallel to a bottom surface of the handling tray.

10. The tray insert of claim **1**, wherein the tray insert is composed of a polymeric material.

11. A tray insert for securely handling gas turbine engine blades, the tray insert comprising:

a body comprising first and second receiving surfaces and first and second ends wherein the first and second receiving surfaces each comprise a plurality of cavities each configured to mate with and being spaced to support a root portion of a gas turbine engine blade;

sliding connectors located on the first and second ends configured for sliding engagement with a plurality of slots formed in a handling tray; and

wherein the tray insert is configured to hold a plurality of gas turbine engine blades in an orientation which prevents an airfoil portion of each gas turbine engine blade from coming into contact with any surface.

12. The tray insert of claim **11**, wherein the tray insert may be seated in the handling tray such that the first receiving surface is positioned in an upward orientation which allows the first plurality of cavities to each receive a root portion of a gas turbine engine blade.

13. The tray insert of claim **11**, wherein the tray insert may be seated in the handling tray such that the second receiving surface is positioned in an upward orientation which allows the second plurality of cavities to each receive a root portion of a gas turbine engine blade.

14. The tray insert of claim **11**, wherein the first plurality of cavities are configured to each receive a root portion having a first shape and the second plurality of cavities are configured to each receive a root portion having a second shape which is different than the first shape.

15. The tray insert of claim **11**, wherein the tray insert is further configured to hold the root portions so that the airfoil portions are suspended in an orientation parallel to a bottom surface of the handling tray.

16. The tray insert of claim **11**, wherein the first and second pluralities of cavities are further configured to receive the plurality of gas turbine engine blades from a defined angle of insertion.

17. The tray insert of claim **16** wherein the plurality of gas turbine engine blades may only be disengaged from the first and second plurality of cavities from the defined angle of insertion.

18. The tray insert of claim **11**, wherein the tray insert is composed of a polymeric material.

19. A method for securing and handling gas turbine engine blades in a tray insert of a handling tray, the method comprising:

seating the tray insert in the handling tray by inserting sliding members disposed on first and second end of the tray insert into a plurality of slots formed in the handling tray so that a first receiving surface is positioned in an upward orientation; and

inserting root portions of a plurality of gas turbine engine blades into a plurality of cavities extending into the first receiving surface which each have a configuration corresponding to the specific configuration of the root portions and are spaced from each other such that airfoil portions of the gas turbine engine blades are suspended in an orientation which prevents them from coming into contact with each other or any surface of the handling tray.

20. The method of claim **19** wherein root portions of a plurality of gas turbine engine blades may be inserted into a plurality of cavities extending into a second receiving surface depending on the specific configuration of the root portions of the plurality of gas turbine engine blades to be secured.

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