COMPRESSION APPARATUSES, SYSTEMS AND METHODS FOR SCREENING MATERIALS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Application Serial No. 63/464,982, filed May 9, 2023, the entire contents of which are hereby incorporated by reference and the priority of which is hereby claimed.

FIELD

[0002] The present disclosure relates generally to material screening. More particularly, the present disclosure relates to apparatuses and methods for compressing screening assemblies to screening machines.

SUMMARY

[0002a] In a first aspect, the present disclosure refers to a method of securing a screening assembly to a vibratory screening machine, comprising: placing a screening assembly on a screen receiving portion of a vibratory screening machine, where the screening assembly comprises a support member and a screening surface, the support member having front and rear edges, first and second sides, a top surface, a bottom surface and a first plurality of mounting apertures located on the first side of the support member, each of the first plurality of mounting apertures including at least one compression surface, wherein the screening surface is attached to the top surface of the support member, wherein placing the screening assembly on the screen receiving portion of the vibratory screening machine comprises locating the screening assembly such that a first plurality of compression pistons of compression mechanisms on the vibratory screening machine are aligned with corresponding ones of the first plurality of mounting apertures; and causing the first plurality of compression pistons to move from a retracted position to an extended position located closer to a centerline of the support member than the retracted position, wherein each of the compression pistons includes first and second compression surfaces that meet at a compression corner, and wherein when each of the first plurality of compression pistons move from the retracted position to the extended position, the at least one compression surface of each of the first plurality of mounting apertures ride along one of the first and second

compression surfaces of a corresponding one of the first plurality of compression pistons until the at least one compression surface of each of the first plurality of mounting apertures rest against the corresponding compression corners, and wherein resultant compressive forces applied to the first plurality of mounting apertures by the first plurality of compression pistons cause the screening assembly assume a concave shape and to be pushed into engagement with underlying concave support surfaces of the vibratory screening machine.

[0002b] In a second aspect, the disclosure refers to a method of securing a screening assembly to a vibratory screening machine, comprising: placing a screening assembly on a screen receiving portion of a vibratory screening machine, where the screening assembly comprises a support member and a screening surface, the support member having a front and a rear, first and second sides, a top surface, a bottom surface, a plurality of flow through apertures and a first plurality of mounting apertures along the first side, each of the first plurality of mounting apertures including at least one compression surface located on an inner side of the mounting aperture relative to a centerline of the support member, wherein the screening surface is attached to the top surface of the support member, wherein placing the screening assembly on the screen receiving portion of the vibratory screening machine comprises locating the screening assembly such that a first plurality of compression pistons of compression mechanisms on the vibratory screening machine are aligned with the first plurality of mounting apertures; and causing the first plurality of compression pistons to advance toward a centerline of the support member, wherein each of the first plurality of compression pistons has at least one compression surface that is configured to bear against a compression surface of a mounting aperture such that when the first plurality of compression pistons advance toward the centerline of the support member, resultant compressive forces applied to the compression surfaces of the first plurality of mounting apertures include a first component that is oriented horizontally toward the centerline of the support member and a second component that is oriented vertically downward, wherein the resultant compressive forces cause the screening assembly flex into a concave shape where a center of the support member is lower than the first and second sides of the support member, and wherein the resultant compressive forces cause the support member to be pushed into engagement with underlying concave support surfaces of the vibratory screening machine.

[0002c] In a third aspect, the disclosure refers to a screen assembly configured to be mounted on a receiving portion of a vibratory screening machine that includes a plurality of compression mechanisms, each of the compression mechanisms including a respective compression piston, the screen assembly comprising: a support member having a front and a rear, first and second sides, a top surface, a bottom surface, a plurality of flow through apertures and a first plurality of mounting apertures located along the first side, each of the first plurality of mounting apertures including: at least one compression surface located on an inner side of the mounting aperture relative to a centerline of the support member, wherein the at least one compression surface is configured to contact a corresponding compression surface of one of the plurality of compression pistons as the respective compression piston is advanced toward the centerline of the support member such that a resultant compressive force applied to the at least one compression surface of the mounting aperture includes a first component that is oriented horizontally toward a centerline of the support member and a second component that is oriented vertically downward, and an alignment slot configured to receive an alignment finger of one of the plurality of compression pistons; and a screening surface mounted on the top surface of the support member.

[0002d] In a fourth aspect, the disclosure refers to a method of securing a screening assembly to a vibratory screening machine, comprising: placing a screening assembly on a screen receiving portion of a vibratory screening machine, where the screening assembly comprises a support member and a screening surface, the support member having a front and a rear, first and second sides, a top surface, a bottom surface, a plurality of flow through apertures and a first plurality of mounting apertures located along the first side, each mounting aperture including a compression surface located on an inner side of the mounting aperture relative to a centerline of the support member, wherein the screening surface is attached to the top surface of the support member, wherein placing the screening assembly on the screen receiving portion of the vibratory screening machine comprises locating the screening assembly such that a first plurality of compression pistons of compression mechanisms on the vibratory screening machine are aligned with the first plurality of mounting apertures; and causing the first plurality of compression pistons to advance toward the centerline of the support member, wherein each of the first plurality of compression pistons has at least one compression surface configured to bear against a compression surface of a mounting aperture, the at least one compression surfaces of the compression pistons being configured such that when the first plurality of compression pistons

are advanced toward the centerline of the support member and bear against the compression surfaces of the first plurality of mounting apertures, resultant compressive forces applied to the compression surfaces of the first plurality of mounting apertures include a first component that is oriented horizontally toward a centerline of the support member and a second component that is oriented vertically downward, wherein the resultant compressive forces cause the screening assembly to flex into a concave shape where a center of the support member is lower than the sides of the support member, wherein the resultant compressive forces cause the support member to be pushed into engagement with underlying concave support surfaces of the vibratory screening machine, and wherein the resultant compressive forces are sufficient to hold the screening assembly against the support surfaces of the vibratory screening machine while the screening assembly is subjected to vibratory forces that apply between 3G and 9G of acceleration to the screening assembly.

BACKGROUND

[0003] Material screening includes the use of vibratory screening machines. Vibratory screening machines provide the capability to excite an installed screen such that materials placed upon the screen may be separated to a desired level. Oversized materials are separated from undersized materials. Over time, screens wear and require replacement. As such, screens are designed to be replaceable.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIG. 1A shows a perspective view of a dual-trough vibratory screen machine with installed replaceable screen assemblies, in an embodiment.

[0005] FIG. 1B shows a perspective view of the dual-trough vibratory screen machine of FIG. 1A with one of the replaceable screen assemblies removed, in an embodiment.

[0006] FIG. 1C shows a side view of the vibratory screen Emachine of FIG 1A, in an embodiment.

[0007] FIG. 1D shows a perspective view of a single-trough vibratory screening machine with an installed replaceable screen assembly, in an embodiment.

WHAT IS CLAIMED IS:

1. A method of securing a screening assembly to a vibratory screening machine, comprising:

placing a screening assembly on a screen receiving portion of a vibratory screening machine, where the screening assembly comprises a support member and a screening surface, the support member having front and rear edges, first and second sides, a top surface, a bottom surface and a first plurality of mounting apertures located on the first side of the support member, each of the first plurality of mounting apertures including at least one compression surface, wherein the screening surface is attached to the top surface of the support member, wherein placing the screening assembly on the screen receiving portion of the vibratory screening machine comprises locating the screening assembly such that a first plurality of compression pistons of compression mechanisms on the vibratory screening machine are aligned with corresponding ones of the first plurality of mounting apertures; and

causing the first plurality of compression pistons to move from a retracted position to an extended position located closer to a centerline of the support member than the retracted position, wherein each of the compression pistons includes first and second compression surfaces that meet at a compression corner, and wherein when each of the first plurality of compression pistons move from the retracted position to the extended position, the at least one compression surface of each of the first plurality of mounting apertures ride along one of the first and second compression surfaces of a corresponding one of the first plurality of compression pistons until the at least one compression surface of each of the first plurality of mounting apertures rest against corresponding compression corners, and wherein resultant compressive forces applied to the first plurality of mounting apertures by the first plurality of compression pistons cause the screening assembly assume a concave shape and to be pushed into engagement with underlying concave support surfaces of the vibratory screening machine.

2. The method of claim 1, wherein the resultant compressive forces applied to the first plurality of mounting apertures by the first plurality of compression pistons include a first component that is oriented horizontally toward a centerline of the support member and a second component that is oriented vertically downward.

3. The method of claim 1, wherein each of the first plurality of mounting apertures includes an alignment slot, wherein an end portion of each of the first plurality of compression pistons includes an alignment finger, and wherein when the first plurality of compression pistons move from the retracted position to the extended position, the alignment finger of each of the first plurality of compression pistons is received in a corresponding alignment slot of one of the first plurality of mounting apertures.

4. The method of claim 1, wherein a plurality of mounting ramps are provided on at least one sidewall of the vibratory screening machine, and wherein placing the screening assembly on the screen receiving portion of the vibratory screening machine comprises sliding a side of the support member along the plurality of mounting ramps, and wherein when the side of the support member slides along the plurality of mounting ramps, the side of the support member is pushed inward to a center of the screen receiving portion of the vibratory screening machine.

5. A method of securing a screening assembly to a vibratory screening machine, comprising:

placing a screening assembly on a screen receiving portion of a vibratory screening machine, where the screening assembly comprises a support member and a screening surface, the support member having a front and a rear, first and second sides, a top surface, a bottom surface, a plurality of flow through apertures and a first plurality of mounting apertures along the first side, each of the first plurality of mounting apertures including at least one compression surface located on an inner side of the mounting aperture relative to a centerline of the support member, wherein the screening surface is attached to the top surface of the support member, wherein placing the screening assembly on the screen receiving portion of the vibratory screening machine comprises locating the screening assembly such that a first plurality of compression pistons of compression mechanisms on the vibratory screening machine are aligned with the first plurality of mounting apertures; and

causing the first plurality of compression pistons to advance toward a centerline of the support member, wherein each of the first plurality of compression pistons has at least one compression surface that is configured to bear against a compression surface of a mounting aperture such that when the first plurality of compression pistons advance toward the centerline of the support member, resultant compressive forces applied to the compression surfaces of the first

plurality of mounting apertures include a first component that is oriented horizontally toward the centerline of the support member and a second component that is oriented vertically downward, wherein the resultant compressive forces cause the screening assembly flex into a concave shape where a center of the support member is lower than the first and second sides of the support member, and wherein the resultant compressive forces cause the support member to be pushed into engagement with underlying concave support surfaces of the vibratory screening machine.

6. The method of claim 5, wherein the compressive forces applied to the compression surfaces of the first plurality of mounting apertures combine to apply a holding pressure to the screening assembly that pushes the screening assembly into engagement with the concave support surfaces of the vibratory screening machine, wherein the holding pressure is between approximately 2,000 psi and approximately 4,000 psi.

7. The method of claim 5, wherein causing the first plurality of compression pistons to advance toward the centerline of the support member comprises causing the first plurality of compression pistons to move both inward toward the centerline of the support member and vertically downward.

8. The method of claim 5, wherein each of the first plurality of mounting apertures includes an alignment slot, wherein an end portion of each of the first plurality of compression pistons includes an alignment finger, and wherein when the first plurality of compression pistons advance toward a centerline of the support member the alignment finger of each of the first plurality of compression pistons is received in a corresponding alignment slot of one of the first plurality of mounting apertures.

9. The method of claim 5, wherein a second plurality of mounting apertures is provided on the second side of the support member, wherein a second plurality of compression pistons are provided on the vibratory screening machine, each of the second plurality of compression pistons being configured such that they do not move inward toward the centerline of the support member, and wherein advancement of the first plurality of compression pistons toward the centerline of the support member causes compression surfaces of the second plurality of mounting apertures to be

pushed into engagement with compression surfaces of the second plurality of compression pistons such that resultant compressive forces are applied to the compression surfaces of the second plurality of mounting apertures, the resultant compressive forces applied to the second plurality of mounting apertures including a first component that is oriented horizontally toward the centerline of the support member and a second component that is oriented vertically downward.

10. The method of claim 9, wherein each of the second plurality of compression pistons is movably mounted on the vibratory screening machine, and wherein when the compression surfaces of the second plurality of mounting apertures are pushed into engagement with the compression surfaces of the second plurality of compression pistons, the second plurality of compression pistons move relative to the vibratory screening machine.

11. The method of claim 10, wherein when the compression surfaces of the second plurality of mounting apertures are pushed into engagement with the compression surfaces of the second plurality of compression pistons, the second plurality of compression pistons move relative to the vibratory screening machine in a direction away from a center of the screen receiving portion of the vibratory screening machine.

12. A screen assembly configured to be mounted on a receiving portion of a vibratory screening machine that includes a plurality of compression mechanisms, each of the compression mechanisms including a respective compression piston, the screen assembly comprising:

a support member having a front and a rear, first and second sides, a top surface, a bottom surface, a plurality of flow through apertures and a first plurality of mounting apertures located along the first side, each of the first plurality of mounting apertures including:

at least one compression surface located on an inner side of the mounting aperture relative to a centerline of the support member, wherein the at least one compression surface is configured to contact a corresponding compression surface of one of the plurality of compression pistons as the respective compression piston is advanced toward the centerline of the support member such that a resultant compressive force applied to the at least one compression surface of the mounting aperture includes a first component that is oriented

horizontally toward a centerline of the support member and a second component that is oriented vertically downward, and

an alignment slot configured to receive an alignment finger of one of the plurality of compression pistons; and

a screening surface mounted on the top surface of the support member.

13. The screen assembly of claim 12, wherein the at least one compression surface of each mounting aperture includes first and second compression surfaces located on opposite sides of the alignment slot.

14. The screen assembly of claim 12, wherein the support member comprises a metal plate, and wherein the first plurality of mounting apertures extend through an entire thickness of the metal plate.

15. The screen assembly of claim 12, wherein the support member comprises a plurality of support elements that are joined together, the support elements being formed from a plastic or synthetic material.

16. The screen assembly of claim 15, wherein the first plurality of mounting apertures comprise apertures located along the first side of the support member do not extend through an entire height of the support member such that when compression pistons of compression mechanisms advance toward the centerline of the support member, end faces of the compression pistons are received in the first plurality of mounting apertures.

17. The screen assembly of claim 16, wherein the support member includes a binder bar that is coupled to the plurality of support elements and that forms the first side of the support member, the first plurality of mounting apertures being formed in the binder bar.

18. A method of securing a screening assembly to a vibratory screening machine, comprising:

placing a screening assembly on a screen receiving portion of a vibratory screening machine, where the screening assembly comprises a support member and a screening surface, the

support member having a front and a rear, first and second sides, a top surface, a bottom surface, a plurality of flow through apertures and a first plurality of mounting apertures located along the first side, each mounting aperture including a compression surface located on an inner side of the mounting aperture relative to a centerline of the support member, wherein the screening surface is attached to the top surface of the support member, wherein placing the screening assembly on the screen receiving portion of the vibratory screening machine comprises locating the screening assembly such that a first plurality of compression pistons of compression mechanisms on the vibratory screening machine are aligned with the first plurality of mounting apertures; and

causing the first plurality of compression pistons to advance toward the centerline of the support member, wherein each of the first plurality of compression pistons has at least one compression surface configured to bear against a compression surface of a mounting aperture, the at least one compression surfaces of the compression pistons being configured such that when the first plurality of compression pistons are advanced toward the centerline of the support member and bear against the compression surfaces of the first plurality of mounting apertures, resultant compressive forces applied to the compression surfaces of the first plurality of mounting apertures include a first component that is oriented horizontally toward a centerline of the support member and a second component that is oriented vertically downward, wherein the resultant compressive forces cause the screening assembly to flex into a concave shape where a center of the support member is lower than the sides of the support member, wherein the resultant compressive forces cause the support member to be pushed into engagement with underlying concave support surfaces of the vibratory screening machine, and wherein the resultant compressive forces are sufficient to hold the screening assembly against the support surfaces of the vibratory screening machine while the screening assembly is subjected to vibratory forces that apply between 3G and 9G of acceleration to the screening assembly.

19. The method of claim 18, wherein the compression mechanisms are configured such that end faces of the first plurality of compression pistons move downward as the compression pistons move inward toward the centerline of the support member.

20 The method of claim 18, wherein the at least one compression surface on each compression piston comprises a side compression surface and an upper compression surface that join at a compression corner.

21. The method of claim 20, wherein when the first plurality of compression pistons advance toward the centerline of the support member, the compression surface of each of the first plurality of mounting apertures slides along either the upper compression surface or the side compression surface of a corresponding compression piston until the compression surface of the mounting aperture abuts the compression corner of the compression piston.

22. The method of claim 18, wherein the support member of the screening assembly includes a second plurality of mounting apertures located along the second side of the support member, and wherein placing the screening assembly on the vibratory screening machine further comprises locating the screening assembly such that a second plurality of compression pistons are aligned with the second plurality of mounting apertures, and wherein the second plurality of compression pistons are not configured to move inward towards the centerline of the support member while the causing step is performed.

23. The method of claim 22, wherein advancement of the first plurality of compression pistons toward the centerline of the support member causes compression surfaces of the second plurality of mounting apertures to be pushed into engagement with compression surfaces of the second plurality of compression pistons such that resultant compressive forces are applied to the compression surfaces of the second plurality of mounting apertures, the resultant compressive forces applied to the second plurality of mounting apertures including a first component that is oriented horizontally toward the centerline of the support member and a second component that is oriented vertically downward.

24. The method of claim 18, wherein each of the first plurality of compression pistons includes an alignment finger, wherein the first plurality of mounting apertures include alignment slots, and wherein placing the screening assembly on the vibratory screening machine comprises locating the screening assembly such that the alignment slots of the first plurality of mounting apertures

are aligned with the alignment fingers of corresponding ones of the first plurality of compression pistons.

25. The method of claim 24, wherein each of the first plurality of compression pistons includes compression surfaces on opposite sides of the alignment finger, wherein each of the first plurality of mounting apertures includes compression surfaces on opposite sides of the alignment slot, and wherein when the first plurality of compression pistons advance toward the centerline of the support member, the compression surfaces on opposite sides of the alignment finger of each of the first plurality of compression pistons engage with corresponding compression surfaces on opposite sides of the alignment slot of a corresponding one of each of the first plurality of mounting apertures.

26. The method of claim 18, wherein the screening assembly does not include a compression flange located at or adjacent a side of the support member.

27. The method of claim 18, wherein when the support member of the screening assembly is pushed into engagement with underlying concave support surfaces of the vibratory screening machine the support member is bent into an arcuate shape having a radius of curvature of between approximately 70 inches and approximately 140 inches.

28. The method of claim 18, wherein the support member of the screen assembly comprises a metal support plate.

29. The method of claim 18 wherein the support member of the screen assembly comprises a plurality of support elements that are joined together, the support elements being formed from a plastic or synthetic material.

30. The method of claim 29, wherein the first plurality of mounting apertures comprise apertures formed in the first side of the support member that do not extend through an entire height or thickness of the support member such that when the first plurality of compression pistons advance toward the centerline of the support member, end faces of the first plurality of

compression pistons are received within corresponding ones of the first plurality of the mounting apertures.