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(54) **PNEUMATIC TRENCH COMPACTION WHEEL ATTACHMENT FOR AN EXCAVATOR**

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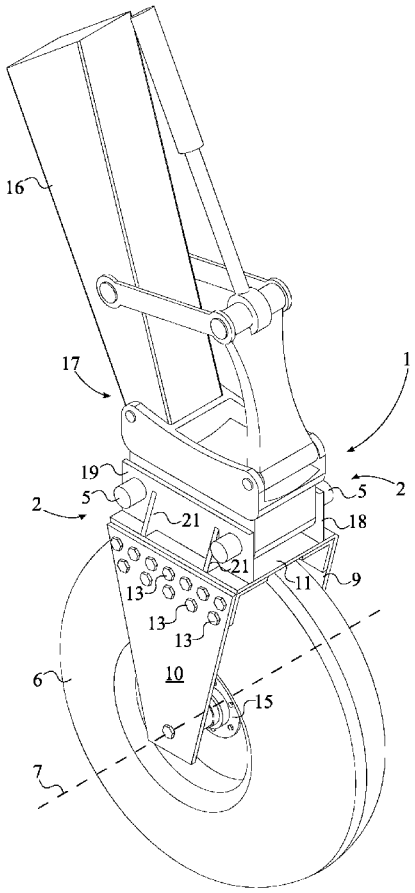
(57) **ABSTRACT**

A pneumatic wheel attachment for an excavator boom that provides an efficient means for trench compaction. The pneumatic wheel attachment includes a pneumatic compaction wheel, a wheel yoke, and a boom mounting assembly. The pneumatic compaction wheel is a large tire with a large foot print. The wheel yoke holds and supports the pneumatic compaction wheel and includes a first leg, a second leg, and a connecting plate. The first leg and the second leg are positioned opposite to each other. The first leg is connected perpendicular to the connecting plate while the second leg is mounted perpendicular to the connecting plate. The pneumatic compaction wheel is rotatably mounted in between the first leg and the second leg with a rotation axis being oriented perpendicular to the first leg. The boom mounting assembly is adjacently connected to the connecting plate, opposite the first leg and the second leg.



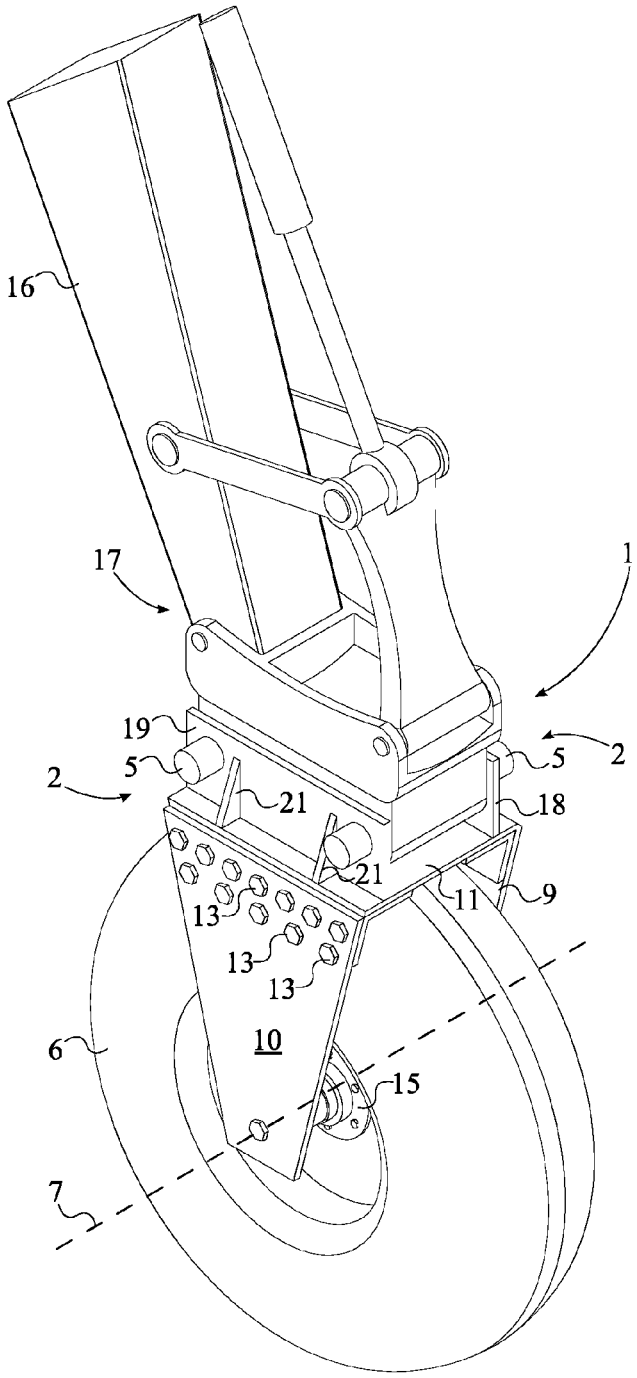


FIG. 1

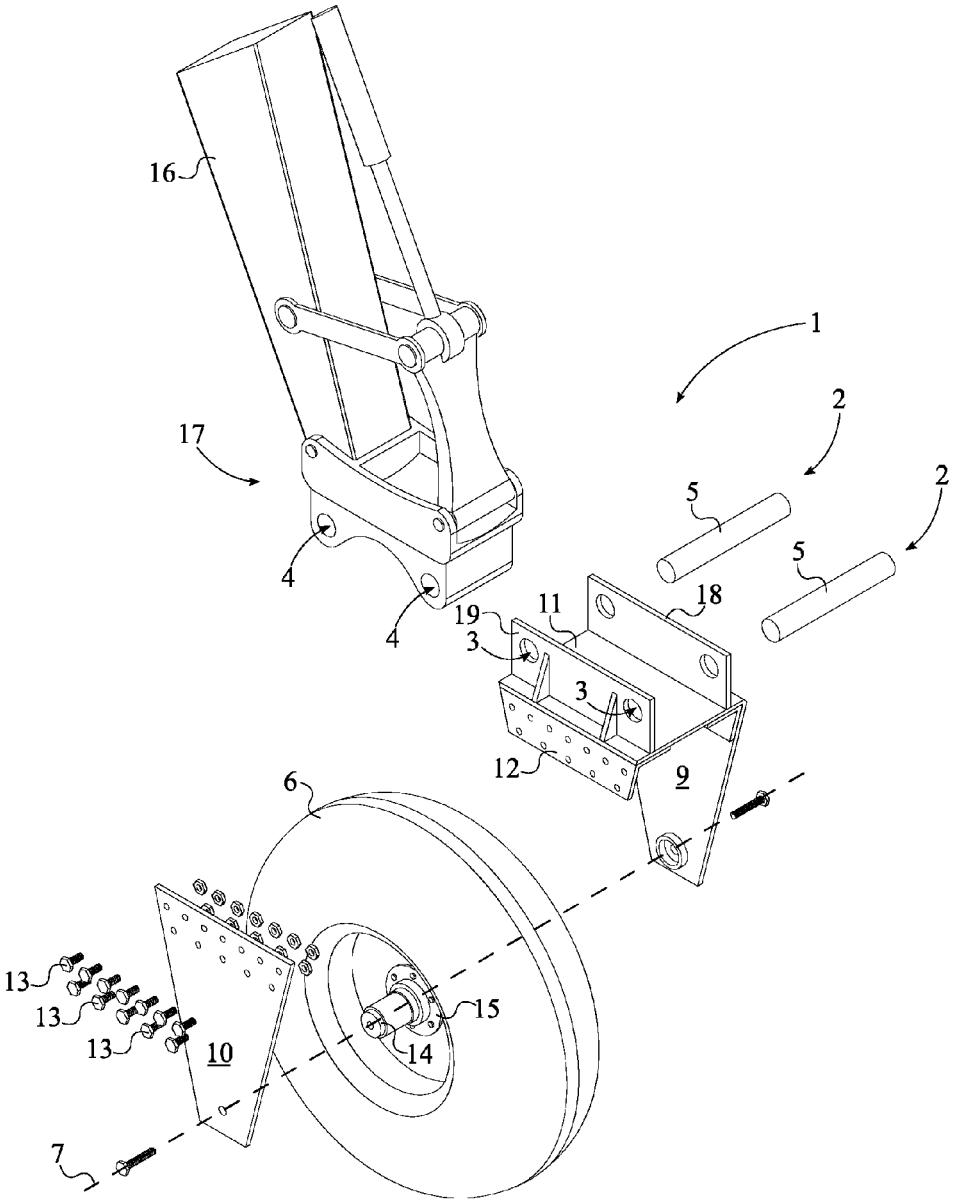


FIG. 2

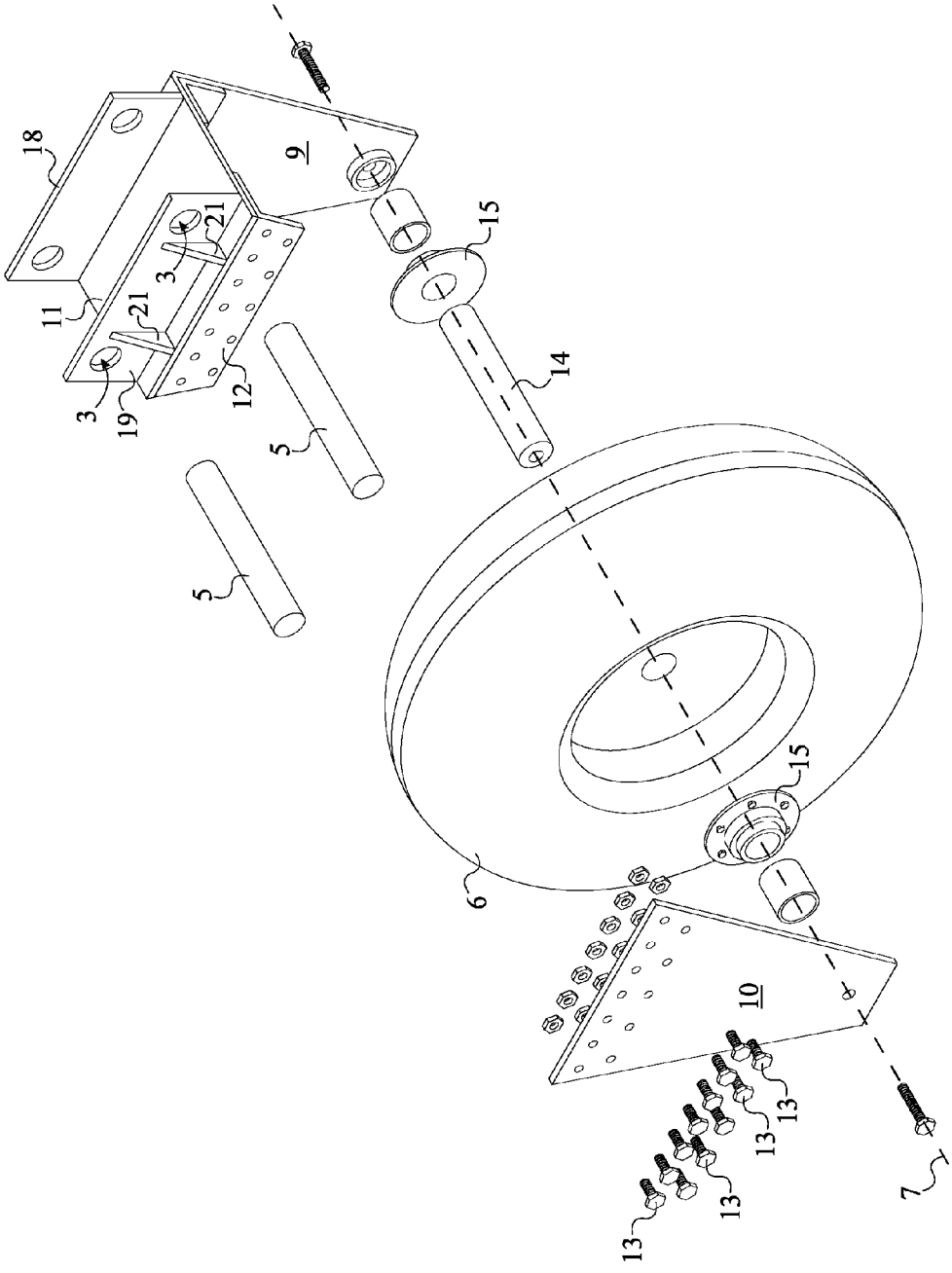


FIG. 3

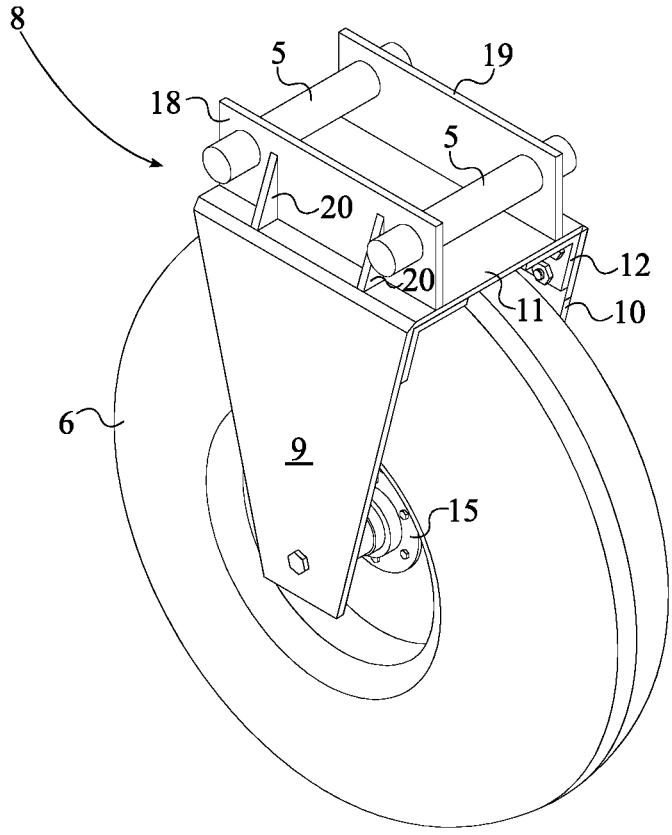


FIG. 4

PNEUMATIC TRENCH COMPACTION WHEEL ATTACHMENT FOR AN EXCAVATOR

[0001] The current application claims a priority to the U.S. Provisional Patent application Ser. No. 62/319,196 filed on Apr. 6, 2016.

FIELD OF THE INVENTION

[0002] The present invention relates generally to a construction device. More specifically, the present invention is a pneumatic wheel attachment for an excavator which provides a more efficient level of trench compaction than conventional methods.

BACKGROUND OF THE INVENTION

[0003] Trench compaction is required for areas in the ground where construction and other similar type of work has been implemented as the backfill is initially low in density and is susceptible to depression. Additionally, wet and sticky soils have commonly been a problem for trench compaction with traditional means. Pad-foot type steel compaction wheels clog with dirt and quickly become ineffective. Vibratory plate compactors, while effective, are very expensive and require additional hydraulic plumbing on an excavator to operate the vibratory plate compactor. The present invention is designed to operate in soft wet soils to achieve optimum compaction without clogging with dirt or requiring the extra hydraulic plumbing. Currently, field trials are being conducted with the present invention's prototype. Initial results show performance improvement over traditional pad-foot type steel compaction wheels of 300% in terms of daily productivity.

[0004] The present invention is a pneumatic compaction wheel attachment for the boom of a hydraulic excavator. The pneumatic compaction wheel provides a wide and flat surface to press against a significantly large surface area of backfill and compact said backfill. The rolling motion required for the present invention is smooth and yields a large foot print, thus increasing efficiency for trench compaction relative to traditional methods. The present invention is attached to the end of an excavator boom such that the boom may provide the down force required to compact the backfill. The present invention is then rolled back and forth in the trench to achieve the desired compaction. The present invention does not clog with dirt, get stuck, or have mechanical issues. The motion of the present invention is very smooth with very little stress being placed upon the excavator as can be experienced by impact type compaction. A minimum of two back and forth passes with the present invention achieves the standard desired compaction. The resultant speed is nearly three times faster than with other traditional means. Typical application involves backfilling a trench with one foot of material, then rolling with two passes. This is followed by a nuclear density test to verify that moisture and density requirements are met. Then, the process is repeated again with another backfill lift.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIG. **1** is a perspective view of the present invention.

[0006] FIG. **2** is an exploded view of the present invention.

[0007] FIG. **3** is an exploded view of the present invention without the excavator boom.

[0008] FIG. **4** is a rear perspective view of the present invention without the excavator boom.

DETAIL DESCRIPTIONS OF THE INVENTION

[0009] All illustrations of the drawings are for the purpose of describing selected versions of the present invention and are not intended to limit the scope of the present invention.

[0010] The present invention generally relates to trench compaction mechanisms. More specifically, the present invention is a pneumatic wheel attachment for an excavator boom **16**. The present invention provides a more efficient means for trench compaction when compared to traditional means such as vibratory plates and pad-foot steel compaction wheels.

[0011] Referring to FIG. **1**, the present invention comprises a pneumatic compaction wheel **6**, a wheel yoke **8**, and a boom mounting assembly **1**. The pneumatic compaction wheel **6** is a relatively large pneumatic wheel with a preferred width nearly equal to the width of the trench to be backfilled. The pneumatic compaction wheel **6** has a relatively large diameter that creates a smooth rolling compaction with a large foot print. The large foot print allows the present invention to engage and press against a large surface area, thus decreasing the number of passes required to effectively compact a trench. The wheel yoke **8** holds and supports the pneumatic compaction wheel **6** and allows the pneumatic compaction wheel **6** to rotate freely. Additionally, the wheel yoke **8** transmits the downward force from the excavator to the pneumatic compaction wheel **6**. The wheel yoke **8** comprises a first leg **9**, a second leg **10**, and a connecting plate **11**. The first leg **9** and the second leg **10** are each an elongated plate with a height greater than a radius of the pneumatic compaction wheel **6**. The first leg **9** and the second leg **10** are positioned opposite to each other across the connecting plate **11**. The first leg **9** is connected perpendicular to the connecting plate **11**. Similarly, the second leg **10** is mounted perpendicular to the connecting plate **11**, resulting in a U-shape as seen in FIG. **1** that is sized to receive the pneumatic compaction wheel **6**. The connecting plate **11** is wider than the width of the pneumatic compaction wheel **6**. The pneumatic compaction wheel **6** is positioned in between the first leg **9** and the second leg **10** with a rotation axis **7** of the pneumatic compaction wheel **6** being perpendicular to the first leg **9** and the second leg **10**. Additionally, the pneumatic compaction wheel **6** is rotatably mounted to the first leg **9** and the second leg **10**, thus allowing the relative movement between the wheel yoke **8** and the pneumatic compaction wheel **6**. The boom mounting assembly **1** allows the excavator boom **16** to attach to the wheel yoke **8** and the pneumatic compaction wheel **6** of the present invention. In particular, the boom mounting assembly **1** is adjacently connected to the connecting plate **11**, opposite the first leg **9** and the second leg **10**.

[0012] Referring to FIG. **2**, in the preferred embodiment of the present invention, the boom mounting assembly **1** comprises a pair of pin-lock mechanisms **2**, a first ear **18**, and a second ear **19**. The first ear **18** and a second ear **19** are each an elongated plate that are sized and positioned to compliment the traditional design of the excavator boom **16**. The first ear **18** and the second ear **19** are positioned adjacent to the connecting plate **11**, opposite the pneumatic compaction wheel **6**. Additionally, the first ear **18** and the second ear **19**

are positioned offset and parallel to each other. Furthermore, the first ear **18** and the second ear **19** are connected perpendicular, preferably welded, to the connecting plate **11** such that an excavator boom-receiving cavity is outlined by the first ear **18**, the second ear **19**, and the top surface of the connecting plate **11**. The first ear **18** and the second ear **19** are preferably composed of a metal material such as steel and are thick enough to withstand the bearing pressure associated with the operations of the present invention. The pair of pin-lock mechanisms **2** attach the first ear **18** and the second ear **19** to a free end **17** of the excavator boom **16**, similar to traditional fastening means for excavator attachment devices such as a bucket. More specifically, the free end **17** of the excavator boom **16** is positioned in between the first ear **18** and the second ear **19**, opposite the pneumatic compaction wheel **6**. Each of the pair of pin-lock mechanisms **2** is mechanically integrated in between the first ear **18**, the second ear **19**, and the excavator boom **16** in order to attach the free end **17** of the excavator boom **16** to the wheel yoke **8**. For rotational stability, the pair of pin-lock mechanisms **2** are positioned offset to each other, thus ensuring that the wheel yoke **8** does not rotate relative to the excavator boom **16**.

[0013] Referring to FIG. **2**, each of the pair of pin-lock mechanisms **2** comprises a first hole **3**, a second hole **4**, and a locking pin **5**. The first hole **3** laterally traverses through the first ear **18** and the second ear **19**, preferably oriented parallel to the rotation axis **7** of the pneumatic compaction wheel **6**. The second hole **4** laterally traverses through the excavator boom **16**, adjacent to the free end **17** of the excavator boom **16**. The first hole **3** and the second hole **4** are the same size and, furthermore, sized receive to the locking pin **5**. The locking pin **5** is a steel pin which interlocks the first ear **18**, the second ear **19**, and the excavator boom **16** through an interference connection. In order to attach the wheel yoke **8** to the excavator boom **16**, the locking pin **5** is positioned traversing through the first hole **3** and the second hole **4**. This mechanically couples the excavator boom **16** to the wheel yoke **8**, and thus the pneumatic compaction wheel **6**.

[0014] Referring to FIG. **4**, the first ear **18** and the second ear **19** are further supported by a plurality of first support braces **20** and a plurality of second support braces **21** to ensure that the first ear **18** and the second ear **19** can withstand the pressures and forces associated with trench compaction. Each of the plurality of first support braces **20** is a triangularly shaped piece of metal that is designed to act as a support rib for the first ear **18**. More specifically, the plurality of first support braces **20** is distributed along the first ear **18** with each of the plurality of support braces being connected in between the first ear **18** and the connecting plate **11**. Similarly, each of the plurality of second support braces **21** is a triangularly shaped piece of metal that is designed to act as a support rib for the second ear **19**. More specifically, the plurality of second support braces **21** is distributed along the second ear **19** with each of the plurality of second support braces **21** being connected in between the second ear **19** and the connecting plate **11**.

[0015] Referring to FIG. **3**, the pneumatic compaction wheel **6** is connected inside and to the wheel yoke **8** through an axle **14** and an at least one wheel hub bearing **15**. The axle **14** supports and carries the pneumatic compaction wheel **6**. Thus, the axle **14** is positioned coincident with the rotation axis **7** of the pneumatic compaction wheel **6** and is positioned in between the first leg **9** and the second leg **10**. More specifically, the axle **14** is connected perpendicular to the first leg **9** and is attached perpendicular to the second leg **10**. In the preferred embodiment of the present invention, the second leg **10** is removable in order to allow the pneumatic compaction wheel **6** to be removed, repaired, or replaced; thus, the axle **14** is attached to the second leg **10** as seen in FIG. **3**. The axle **14** traverses through the pneumatic compaction wheel **6** and is mechanically coupled to the pneumatic compaction wheel **6** by the wheel hub bearing **15**. The wheel hub bearing **15** attaches the pneumatic compaction wheel **6** to the axle **14** while simultaneously allowing the pneumatic compaction wheel **6** to rotate relative and about the axle **14**. The wheel hub bearing **15** is positioned concentric with the axle **14** and is connected in between the pneumatic compaction wheel **6** and the axle **14**. It is preferred that the at least one wheel hub bearing **15** comprises a first wheel hub bearing and a second wheel hub bearing to ensure adequate support and stability for the pneumatic compaction wheel **6**. The first wheel hub bearing is positioned on a first lateral side of the pneumatic compaction wheel **6**, while the second wheel hub bearing is positioned on a second lateral side of the pneumatic compaction wheel **6**. Thus, ensuring symmetrical stability for the pneumatic compaction wheel **6**. In alternative embodiments of the present invention, alternative mechanisms and devices may couple the pneumatic compaction wheel **6** to the axle **14** such as roller bearings and bushings.

[0016] It is preferred that the pneumatic compaction wheel **6** is a pneumatic wheel and is composed of rubber. A pneumatic design provides uniform and lateral dispersion of compaction forces that cannot be achieved by a steel wheel. Additionally, the solid surface of the pneumatic compaction wheel **6** ensures that no clogging occurs when the pneumatic compaction wheel **6** rolls on the trench floor repeatedly, unlike metal pad foot wheel designs. The pneumatic design also conforms to the floor of the trench as the pneumatic compaction wheel **6** flexes. This achieves excellent ground penetration and the interlocking of particles in the soils. Compaction is about removing the voids. This is why asphalt pavers use pneumatic rollers to drive upon in conjunction with their steel wheel roller. The steel wheel gives a smooth surface, but the drive-on pneumatic creates the desired density quicker. Since, appearance doing trench backfill lifts is not a concern, only the pneumatic design needed to be introduced to the process. As a result, the present invention is much faster, simpler, and does not clog.

[0017] The critical point of the present invention is the large diameter, heavy, pneumatic-based pneumatic compaction wheel **6**. Any other adaptations of this element which have the same characteristics should be viewed as similar in concept. These elements are the critical pieces that have not been previously employed, given the size and capability to quickly achieve compaction which is unique to pneumatic surfaces. In the preferred embodiment of the present invention, the height to width ratio of the pneumatic compaction wheel **6** is 2.5 to 1, yielding a smooth application of pressure with minimal point loading.

[0018] Referring to FIG. **2**, in order to allow the pneumatic compaction wheel **6** to be removed from the wheel yoke **8**, the second leg **10** is removably mounted to the connecting plate **11**. More specifically, the second leg **10** is mounted to the connected plate through a mounting flange **12** and a plurality of fastening mechanisms **13**. The mounting flange

12 is an elongated plate which is shaped and sized complimentary to the second leg 10. The mounting flange 12 is connected perpendicular to the connecting plate 11, opposite the first leg 9, in order to receive the second leg 10. In particular, the second leg 10 is positioned parallel and adjacent to the mounting flange 12, opposite the first leg 9 and is secured through the plurality of fastening mechanisms 13. The plurality of fastening mechanisms 13 attach the second leg 10 to the mounting flange 12. The plurality of fastening mechanisms 13 is distributed about the mounting flange 12 with each of the fastening mechanisms traversing through the mounting flange 12 and the second leg 10. It is preferred that each of the fastening mechanisms is a nut-and-bolt fastener in order to allow for the easy attachment and detachment of the second leg 10. Although, alternative mechanisms may be used for each of the plurality of fastening mechanisms 13. In an alternative embodiment of the present invention, the first leg 9 and the second leg 10 are each welded to the connecting plate 11.

[0019] Although the invention has been explained in relation to its preferred embodiment, it is to be understood that many other possible modifications and variations can be made without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. A pneumatic trench compaction wheel attachment for an excavator comprises:
- a boom mounting assembly;
- a pneumatic compaction wheel;
- a wheel yoke;
- the wheel yoke comprises a first leg, a second leg, and a connecting plate;
- the first leg and the second leg being positioned offset and opposite to each other, across the connecting plate;
- the first leg being connected perpendicular to the connecting plate;
- the second leg being mounted perpendicular to the connecting plate;
- a rotation axis of the pneumatic compaction wheel being oriented perpendicular to the first leg and the second leg;
- the pneumatic compaction wheel being positioned in between the first leg and the second leg;
- the pneumatic compaction wheel being rotatably mounted to the first leg and the second leg; and
- the boom mounting assembly being adjacently connected to the connecting plate, opposite the first leg and the second leg.

2. The pneumatic trench compaction wheel attachment for an excavator as claimed in claim 1 comprises:
- a mounting flange;
- a plurality of fastening mechanisms;
- the mounting flange being connected perpendicular to the connecting plate, opposite the first leg;
- the second leg being positioned parallel and adjacent to the mounting flange, opposite the first leg;
- the plurality of fastening mechanisms being distributed about the mounting flange; and
- each of the plurality of fastening mechanisms traversing through the mounting flange and the second leg.

3. The pneumatic trench compaction wheel attachment for an excavator as claimed in claim 2, wherein each of the plurality of fastening mechanisms is a nut-and-bolt fastener.

4. The pneumatic trench compaction wheel attachment for an excavator as claimed in claim 1 comprises:
- an axle;
- an at least one wheel hub bearing;
- the axle being positioned coincident with the rotation axis of the pneumatic compaction wheel;
- the axle being positioned in between the first leg and the second leg;
- the axle being connected perpendicular to the first leg;
- the axle being attached perpendicular to the second leg;
- the axle traversing through the pneumatic compaction wheel;
- the wheel hub bearing being positioned concentric with the axle; and
- the wheel hub bearing being connected in between the pneumatic compaction wheel and the axle.

5. The pneumatic trench compaction wheel attachment for an excavator as claimed in claim 1 comprises:
- an excavator boom;
- the boom mounting assembly comprises a pair of pin-lock mechanisms, a first ear, and a second ear;
- the first ear and the second ear being positioned adjacent to the connecting plate, opposite the pneumatic compaction wheel;
- the first ear and the second ear being positioned offset and parallel to each other;
- the first ear and the second ear being connected perpendicular to the connecting plate;
- a free end of the excavator boom being positioned in between the first ear and the second ear, opposite the pneumatic compaction wheel;
- each of the pair of pin-lock mechanisms being mechanically integrated in between the first ear, the second ear, and the excavator boom; and
- the pair of pin-lock mechanisms being positioned offset to each other.

6. The pneumatic trench compaction wheel attachment for an excavator as claimed in claim 5 comprises:
- each of the pair of pin-lock mechanisms comprises a first hole, a second hole, and a locking pin;
- the first hole laterally traversing through the first ear and the second ear;
- the second hole laterally traversing through the excavator boom, adjacent to the free end of the excavator boom; and
- the locking pin traversing through the first hole and the second hole.

7. The pneumatic trench compaction wheel attachment for an excavator as claimed in claim 5 comprises:
- a plurality of first support braces;
- the plurality of first support braces being distributed along the first ear; and
- each of the plurality of first support braces being adjacently connected to the first ear and the connecting plate.

8. The pneumatic trench compaction wheel attachment for an excavator as claimed in claim 5 comprises:
- a plurality of second support braces;
- the plurality of second support braces being distributed along the second ear; and
- each of the plurality of second support braces being adjacently connected to the second ear and the connecting plate.

9. A pneumatic trench compaction wheel attachment for an excavator comprises:
a boom mounting assembly;
a pneumatic compaction wheel;
a wheel yoke;
an excavator boom;
the wheel yoke comprises a first leg, a second leg, and a connecting plate;
the first leg and the second leg being positioned offset and opposite to each other, across the connecting plate;
the first leg being connected perpendicular to the connecting plate;
the second leg being mounted perpendicular to the connecting plate;
a rotation axis of the pneumatic compaction wheel being oriented perpendicular to the first leg and the second leg;
the pneumatic compaction wheel being positioned in between the first leg and the second leg;
the pneumatic compaction wheel being rotatably mounted to the first leg and the second leg;
the boom mounting assembly being adjacently connected to the connecting plate, opposite the first leg and the second leg;
the boom mounting assembly comprises a pair of pin-lock mechanisms, a first ear, and a second ear;
the first ear and the second ear being positioned adjacent to the connecting plate, opposite the pneumatic compaction wheel;
the first ear and the second ear being positioned offset and parallel to each other;
the first ear and the second ear being connected perpendicular to the connecting plate;
a free end of the excavator boom being positioned in between the first ear and the second ear, opposite the pneumatic compaction wheel;
each of the pair of pin-lock mechanisms being mechanically integrated in between the first ear, the second ear, and the excavator boom; and
the pair of pin-lock mechanisms being positioned offset to each other.

10. The pneumatic trench compaction wheel attachment for an excavator as claimed in claim **9** comprises:
a mounting flange;
a plurality of fastening mechanisms;
the mounting flange being connected perpendicular to the connecting plate, opposite the first leg;
the second leg being positioned parallel and adjacent to the mounting flange, opposite the first leg;
the plurality of fastening mechanisms being distributed about the mounting flange; and
each of the plurality of fastening mechanisms traversing through the mounting flange and the second leg.

11. The pneumatic trench compaction wheel attachment for an excavator as claimed in claim **10**, wherein each of the plurality of fastening mechanisms is a nut-and-bolt fastener.

12. The pneumatic trench compaction wheel attachment for an excavator as claimed in claim **9** comprises:
an axle;
an at least one wheel hub bearing;
the axle being positioned coincident with the rotation axis of the pneumatic compaction wheel;
the axle being positioned in between the first leg and the second leg;
the axle being connected perpendicular to the first leg;
the axle being attached perpendicular to the second leg;
the axle traversing through the pneumatic compaction wheel;
the wheel hub bearing being positioned concentric with the axle; and
the wheel hub bearing being connected in between the pneumatic compaction wheel and the axle.

13. The pneumatic trench compaction wheel attachment for an excavator as claimed in claim **9** comprises:
each of the pair of pin-lock mechanisms comprises a first hole, a second hole, and a locking pin;
the first hole laterally traversing through the first ear and the second ear;
the second hole laterally traversing through the excavator boom, adjacent to the free end of the excavator boom; and
the locking pin traversing through the first hole and the second hole.

14. The pneumatic trench compaction wheel attachment for an excavator as claimed in claim **9** comprises:
a plurality of first support braces;
the plurality of first support braces being distributed along the first ear; and
each of the plurality of first support braces being adjacently connected to the first ear and the connecting plate.

15. The pneumatic trench compaction wheel attachment for an excavator as claimed in claim **9** comprises:
a plurality of second support braces;
the plurality of second support braces being distributed along the second ear; and
each of the plurality of second support braces being adjacently connected to the second ear and the connecting plate.

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