POWER TROWELLING AGGREGATE DECORATIVE STONE

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ABSTRACT

Manually trowelling floor toppings, such as aggregate decorative stone, can be labor-intensive and costly. The present disclosure includes a power rotary trowel that includes a hub rotatably attached to an electric motor via a swivel. A plurality of arms extend from the hub, and a trowel blade assembly is attached to each of the arms. The trowel blade assemblies support an operating weight that includes, at least, a weight of the hub, the arms, the electric motor, the swivel and the trowel blade assemblies. A ratio of the operating weight to a combined trowel blade assembly length is less than 1.3 pounds per inch.
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TECHNICAL FIELD

[0001] The present invention relates generally to trowel blade assemblies for power rotary trowels. Trowel blade assemblies and more specifically to power rotary trowels used to trowel aggregate decorative stone including about \( \frac{3}{16} \) to \( \frac{3}{8} \) inch stone in a (often transparent) resin matrix.

BACKGROUND

[0002] Aggregate decorative stone has become a popular finish for interior floors and exterior places, and as such, has many applications. For instance, in order to improve the appearance of a pool and its surroundings, aggregate decorative stone can be laid over a concrete patio and/or walkways around the pool.

[0003] Laying the aggregate decorative stone can be costly, labor intensive and complicated. Aggregate decorative stone generally includes stones that are \( \frac{3}{16} \) to \( \frac{3}{8} \) inch distributed within a resin. After the aggregate decorative stone is mixed and laid over the substrate to be covered, the aggregate decorative stone must be smoothed and leveled prior to the resin hardening.

[0004] In order to smooth the aggregate decorative stone, a worker(s) will trowel, by hand, the entire surface. The worker(s) must be careful to apply a consistent amount of pressure and not to vary his technique in order to be certain that the aggregate decorative stone is smooth, uniform and without marks from the trowel. Thus, the worker must have skill, stamina and experience to provide a smooth finished product. Moreover, the worker’s position within the aggregate decorative stone limits the worker’s view of the floor, thereby affecting the quality of the finished product.

[0005] A skilled worker can, at typically most, properly complete one hundred and twenty (120) square feet per hour. The production rate decreases as the worker becomes fatigued. Further, because the worker must also position himself within the aggregate decorative stone in order to trowel, the worker is in close proximity to the resin for a substantial amount of time, possibly increasing exposure to fumes.

[0006] Although power rotary trowels can overcome the problems associated with manual trowelling, there are no power rotary trowels that can adequately trowel aggregate decorative stone. Concrete power rotary trowels generally include a plurality of trowel blades rotatably attached to a motor or an engine via a hub. As the hub rotates, the trowel blades spin about a center axis. The operator can operate the trowel via a handle while standing out of the mixture. However, concrete rotary power trowels generally weigh far too much to be able to trowel aggregate decorative stone.

[0007] A power rotary trowel used to trowel an aggregate/resin mixture, such as a quartz/resin mixture, is disclosed in U.S. Pat. No. 5,205,669, issued to Neff on Apr. 27, 1993. Although the Neff power rotary trowel includes the same basic structure as the concrete rotary trowels, the Neff power rotary trowel is much lighter than the concrete trowels. In fact, Neff claims that the power trowel must weigh between twenty and forty pounds to work as described. The Neff power rotary trowel includes an air motor operable to rotate the plurality of rigid blades about a center axis. Further, the Neff power rotary trowel teaches an adjustment means in order to adjust an attack angle of the trowel blades during operation of the power rotary trowel. However, the operator or a fluid-driven, angle sensing means, and not contact with the work surface, adjusts the attack angles. Thus, once the attack angle is set, the attack angle remains constant unless the operator or the fluid-driven, angle sensing means readjusts the angle.

[0008] Although the Neff power rotary trowel assists in trowelling certain types of aggregate/resin mixtures, such as the quartz/resin mixture, the Neff power rotary trowel flatly fails in trowelling aggregate/resin mixtures, such as aggregate decorative stone. Aggregate decorative stone includes stones generally from \( \frac{3}{16} \) to \( \frac{3}{8} \) inches, and may include more aggregate to resin than the mixtures trowelled by the Neff power trowel. Quartz/resin mixtures as per Neff have small solids on the order of grains of sand. The trowel blades of the Neff power trowel also lack the flexibility and angular responsiveness needed to trowel the stones within the resin. Moreover, the Neff power rotary trowel can unacceptably dig into the aggregate decorative stone, especially during the start of the trowelling process at lower angles of attack. The Neff device has also been characterized as unacceptably loud.

[0009] The present disclosure is directed at overcoming one or more of the problems set forth above.

SUMMARY OF INVENTION

[0010] According to one aspect of the present disclosure, a power rotary trowel used with aggregate decorative stone includes a plurality of arms that extend from a hub rotatably attached to an electric motor via a swivel that permits relative rotation about axes perpendicular to a hub rotation axis. A trowel blade assembly is attached to each one of the arms, and the plurality of the trowel blade assemblies support an operating weight that includes, at least, a weight of the hub, the arms, the electric motor, the swivel and the trowel blade assemblies. A ratio of the operating weight to a combined trowel blade length is less than 1.3 pounds per inch.

[0011] According to another aspect of the present disclosure, a trowel blade assembly for attachment to a power rotary trowel includes a trowel blade with a trowelling portion and a lead portion. A stiffener is attached to the trowelling portion between the lead portion and a mid-line of the trowelling portion. The trowelling portion includes an angle of attack that is less than an angle of attack of the lead portion. The trowel blade is relatively rigid about an x-axis of the trowel blade and relatively flexible about a y-axis of the trowel blade.

[0012] According to yet another aspect of the present disclosure, aggregate decorative stone that includes a mixture of \( \frac{3}{16} \) to \( \frac{3}{8} \) inch stone and resin is trowelled by rotating a plurality of trowel blades over a work surface about a hub axis. A downward force of less than 1.3 pounds/inch of combined trowel blade length is applied on the mixture. A force from blade contact with the work surface is allowed to rotate the trowel blades within a predetermined limited range of attack angles.
BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic representation of a side view of a power rotary trowel blade, according to the present disclosure;

FIG. 2 is a diagrammatic representation of a top view of a hub attached to a plurality of trowel blade assemblies of the power rotary trowel of FIG. 1;

FIG. 3 is a diagrammatic representation of a top view of a trowel blade assembly of the power rotary trowel of FIG. 1; and

FIG. 4 is a diagrammatic representation of an end view of an arm down a line extending radially from the hub of the power rotary trowel of FIG. 1.

DETAILED DESCRIPTION

Referring to FIG. 1, there is shown a diagrammatic representation of a side view of a power rotary trowel 10, according to the present disclosure. Although the power rotary trowel 10 may be useful in trowelling various types of floor toppings and materials, the power rotary trowel 10 will be illustrated for use with aggregate decorative stone. The power rotary trowel 10 includes a hub 11 rotatably attached to an electric motor 12 via a swivel 13 that permits relative rotation about the vertical. The electric motor 12 is attached to a support plate 21, preferably aluminum, that defines a shaft hole (not shown) through which a motor shaft extends. The motor shaft is coupled to the hub 11 via the swivel 13. The swivel 13, and thus the hub 11, rotate about a hub axis 14 that is also the center axis of the power rotary trowel 10. The electric motor 12 preferably includes a center of gravity that is offset from the hub axis 14 in a direction away from handle 22. This allows for the operating weight of the machine, which includes a fraction of the handle weight, to be centered over the hub rotation axis. Those skilled in the art will appreciate that the swivel 13 can be any type of gear that allows the hub 11 to swivel about an axis 15 perpendicular to the hub axis 14.

Although the present disclosure contemplates various types of electric motors, the electric motor 12 must be relatively light weight, preferably between 12.5 to 18 pounds, and be capable of producing a relatively constant high torque at varying low speeds. In the illustrated embodiment, the electric motor 12 is a 230 Volt, 60 Hertz, 1.0 Amp, 1720 RPM, three-phase induction motor/gear box combination weighing 14.6 pounds and producing 178 inch-pound torque, manufactured by Brother International Corporation of New Jersey. The gear box is illustrated as gear box 12a and has a 20:1 ratio. The electric motor 112 is preferably in electrical communication with a conventional control box 16 via communication line 17. Those skilled in the art will appreciate that the control box 16 allows the three-phase electric motor 12 to operate on electricity that can be supplied through a standard outlet in a wall. The control box 16 also includes a speed controller 18 with which the operator can vary the speed of the motor 12.

A handle assembly 22 is also attached to the support plate 21 at an opposite end of the support plate 21 than the motor 12. The handle assembly includes a pole 24 of a predetermined length. The predetermined length is preferably large enough that an operator can stand off of the decorative aggregate stone while small enough that the operator can control the movement of the power rotary trowel. An attachment piece 25, illustrated as an aluminum pipe, is perpendicularly attached, preferably welded, to one end of the pole 24. The attachment piece 25 is positioned between two blocks on the support plate 21 and preferably bolted such that the handle assembly 22 can be locked into position by tightening the bolts. On the other end of the pole 24, a handle 26 is attached. Although the present invention contemplates various types of handles, the illustrated handle 26 is an aluminum bar welded perpendicularly to the pole 24 at a center point of the bar. Thus, the handle 26 is preferably a floating handle that can be pivoted among a variety of positions between an upright storage position in which the handle assembly 22 rests against the electric motor 12 and an operation position (as shown) in which the handle assembly 22 is, in part, supported by an operator. In the illustrated embodiment, the control box 16 is attached to and moves with the pole 24. Because the center of gravity of the motor 12 is offset from the hub axis 14, the weight of the handle assembly 22 and the control box 16 in the operation position can be, in part, offset by the weight of the motor 12.

A plurality of arms 20 extend radially from the hub 11. A trowel blade assembly 19 is attached to each arm 20 via a fastener assembly 37 including an attachment block 30. An operator is protected from the plurality of trowel blade assemblies 19 by a conventional safety guard 32 known in the art surrounding the trowel blade assemblies 19. The plurality of trowel blade assemblies 19 support an operating weight that includes a weight of the hub 11, the arms 20, the electric motor 12, the swivel 13, and the trowel blade assemblies 19. In the illustrated embodiment, the operating weight also includes a portion of the weight of handle assembly 22 not support by the operator. Generally, a portion of the handle assembly 22 positioned over the trowel blade assemblies 19 will be supported by the trowel blade assemblies 19 rather than the operator holding the handle assembly 22 during operation of the power rotary trowel blade 10. Although the present disclosure contemplates various operating weights depending on the size of the trowel blade assemblies 19, in the illustrated preferred embodiment, the operating weight is about 40-44 pounds.

Referring to FIG. 2, there is shown a diagrammatic representation of a top view of the plurality of trowel blade assemblies 19 coupled to the hub 12 of the power rotary trowel 10 of FIG. 1. It should be appreciated that the hub 11 and blade assemblies 19 are illustrated without the safety guard 32 for simplicity. Although three equiangular arms 20 are illustrated in the present disclosure, it should be appreciated that the present disclosure contemplates three to five arms evenly spaced about the hub axis 14. Each trowel blade assembly 19 is separated from the hub 11 by a predetermined distance (D). Although the distance (D) can vary, the distance (D) is generally substantially smaller than a length (L) of each trowel blade assembly 19. The trowel blade assemblies 19 and the circumference of the hub 11 create a central collection area 34 in which excess aggregate can gather.

Each trowel blade assembly 19 includes length (L). Although length (L) can vary, in the illustrated preferred embodiment, the length (L) is 14 inches. Thus, because each trowel blade assembly 19 is of the same length (L), there is a combined trowel blade assembly length of 42 inches.
Because the operating weight supported by the trowel blade assemblies is 40-44 pounds, a ratio of operating weight to combined trowel blade assembly length is preferably about one pound per inch, meaning that the ratio can vary from 0.9 to 1.1 pounds per inch. However, it should be appreciated that the present disclosure contemplates any ratio of operating weight to combined trowel blade assembly length less than 1.3 pounds per inch. The ratio of operating weight is preferably light enough that the trowel blade assemblies do not deflect the stones within the mixture, but heavy enough to sufficiently pack and smooth the aggregate decorative stone.

[0023] Each trowel blade assembly 19 includes a trowel blade 28 to which a stiffener 27 is attached. In the illustrated embodiment, the stiffener 27 is bolted to each blade 28. Each stiffener 27 is attached to one of the arms 20 via the fastener assembly 37 includes an attachment block 30 bolted to the arm 20 and at least one pin 33. The stiffener 27 and the arm 30 extend through a stiffener receiving slot 31 (shown in FIG. 4) and an arm bore 29 (shown in FIG. 4) of the attachment block 30, respectively. A line 23 extends radially from the hub 11 and through each arm 20.

[0024] Referring to FIG. 3, there is shown a top view of one of the plurality of trowel blade assemblies 19 of the power rotary trowel 10 of FIG. 1. Although only one trowel blade assembly 19 is illustrated, it should be appreciated that each trowel blade assembly 19 within the plurality is similar. The trowel blade 28 preferably includes a trowelling portion 44 and a lead portion 43. In the illustrated embodiment, the lead portion 43 has a substantially smaller width than the trowelling portion 44. The stiffener 27 is preferably attached to the trowelling portion 44 between a mid-line 40 of the trowelling portion 44 and the lead portion 43, thereby allowing the arm 20 attached via the stiffener 27 to pull, rather than push, the trowelling portion 43 of the trowel blade 28. The trowel blade 28 also includes a y-axis 41 and an x-axis 42. The trowel blade 28 is relatively flexible about the y-axis 41, and relatively rigid about the x-axis 42. Thus the trowel blade is made from a robust material, preferably spring steel, that can withstand the repeated contact with the work surface but with substantial flexibility about the y-axis, which is aligned with the respective arm.

[0025] Referring to FIG. 4, there is shown a diagrammatic illustration of an end view down the line 23 extending through one of the arms 20 attached to one of the trowel blade assemblies 19. Preferably, the lead portion 43 of the trowel blade 28 is angled with respect to the trowelling portion 44 which is planar. In the illustrated embodiment, the lead portion 38 includes a 15° angle with respect to the plane of the trowelling portion 44, which are joined by a bend 45. Thus, the trowelling portion 44 includes an angle of attack that is less than an angle of attack of the lead portion 38. Those skilled in the art will appreciated that the angle of attack of the blade is the angle at which the blade contacts a work surface. The angle of attack of the lead portion 38 is greater to assure that the trowel blade 28 will not dig into the aggregate decorative stone, especially upon start-up.

[0026] The arm bore 29 of the attachment block 30 is positioned between the stiffener receiving slot 31 and the lead portion 43 to help pull, rather than push, the trowel blade assembly 19. The stiffener receiving groove 31 includes a predetermined angle (θ₁) greater than 0° with respect to a vertical plane 38. When the stiffener 27 is tilted at the predetermined angle (θ₁) in order to received into the receiving slot 31, the trowel blade 28 attached to the stiffener 27 will also be tilted at a corresponding attack angle (θ₂) with respect to a horizontal plane 35. Thus, the attack angles of the blade 28 are, in part, a result of the predetermined angle of the slot 31. Two pins 33 (only one shown) extend through the pin receiving bores (not shown) of the attachment block 30 and the stiffener 27. Because the pin receiving bores include a greater diameter than the pins 33, the stiffener 27 has limited movement within the stiffener receiving groove 31. The trowel blade 28 is rotatable within a predetermined limited range of angles 36 with respect to the line 23 and responsive to an interaction between the trowel blade 28 and the work surface. Thus, the blade 28 is rotatable within a predetermined limited range of attack angles. Blade position 28a illustrates the blade 28 at the smallest angle of attack whereas blade position 28b illustrates the blade at the greatest angle of attack. In other words, as the trowel blades 28 rotate over the decorative aggregate stone, the trowel blades 28 are not rigid, but rotatable based on contact with the work surface. Thus, the predetermined angle (θ₁) of the stiffener 27 receiving groove 31 corresponds with the range of attack angles that can best trowel the aggregate decorative stone. In the illustrated embodiment, 11-13° is a preferred range of the angle of attack of the trowelling portion 44 of the blade 28. The blade assembly 19 is preferably unbiased with regard to the range of attack angles.

INDUSTRIAL APPLICABILITY

[0027] Referring to FIGS. 1-4, a method of trowelling aggregate decorative stone that includes a mixture of resin and 3/4 to 5/6 inch stone will be discussed. Although the method will be discussed for aggregate decorative stone, it should be appreciated that the same method may find application in trowelling other floor toppings and substrates with consistencies similar to the discussed aggregate decorative stone.

[0028] The plurality of trowel blades 28 are rotated over the work surface, being that aggregate decorative stone, about the hub axis 14. Generally, only the trowelling portion 44 will contact the aggregate decorative stone, but the lead portion 43 may also make contact occasionally. Because the stiffeners 27 are positioned between the mid-line 40 and the lead portion 43 of the blades 28 and the arm 20 is positioned between the lead portion 43 and the stiffener 27, the arms 20 will pull rather than push the trowel blade assemblies 19.

[0029] In order to rotate the trowel blades 28, an operator, who is standing out of the aggregate decorative stone, will connect the electric motor 12 to a source of electricity, generally through a wall outlet, and turn a control switch to start the motor 12. The motor 12 will rotate the trowel blades 28 about the hub axis 14 via the swivel 13. Because the motor 12 is coupled to the hub 11 via the swivel 13, the hub 11 is allowed to swivel about the axis 15 perpendicular to the hub axis 14. Thus, as the hub 11, along with the trowel blades 28 rotate, the hub 11 is not rigid, but rather flexible to swivel due to contact with the uneven aggregate decorative stone. The swivel action of the hub 11 allows the trowel blades 28 to go over the stones, thereby reducing the risk of stones being thrown by the interaction between the trowel blades 28 and the aggregate decorative stone.
Preferably the operator begins trowelling at a relatively fast speed of rotation of the hub 11 about the hub axis 14. It has been discovered that by beginning the trowelling process at the relatively fast speed of rotation, the aggregate decorative stone is packed and laid. Once the initial packing of the aggregate decorative stone is completed, trowelling speed is typically stepwise reduced and the trowelling is ended at a relatively slow speed of rotation of the hub 11 about the hub axis 14. It has further been discovered that the trowel blades 28 at the slower speed of rotation enhances the ability of the power rotary trowel 10 to smooth and gloss the aggregate decorative stone.

While the trowel blades 28 rotate, a downward force of less than 1.3 pounds per inch of combined trowel blade length is applied to the aggregate decorative stone mixture. Because the operator is controlling the power rotary trowel 10 at a distance with the handle assembly 22, the operator is supporting some of the weight of the handle assembly 22. The center of gravity of the electric motor 12 is offset from the hub axis 14 in order balance out the weight of the handle assembly 22 in the operating position. (i.e., center the operating weight over the hub rotation axis) During operation of the power rotary trowel 10, the operating weight being supported by the trowel blade assemblies 19 includes the weight of the trowel blade assemblies 19, electric motor 12, the hub 11, the arms 20, the swivel 13 and a portion of handle assembly 22. In the illustrated, preferred embodiment, the ratio is about one pound per inch because the combined trowel blade assembly length is 42 inches. The ratio is sufficient to pack the aggregate decorative stone without causing the stones to be deflected or thrown by the blades 28.

Further, during trowelling, the force from blade contact with the work surface, being the aggregate decorative stone, is allowed to rotate the trowel blades 28 within the predetermined limited range of the attack angles 36. Although there are various methods of allowing flexibility of the trowel blades 28 within the limited range of attack angle 36, preferably the predetermined range of attack angles 36 is set by the predetermined angle (θ₁) of the stiffener receiving slot 31 of the attachment block 30. Because the stiffener 27 must be tilted to be received within the receiving slot 31, the angle (θ₁) of the trowel blade 19 with respect to the horizontal plane 35 will correspond to the predetermined angle (θ₁) of the slot 31. Moreover, the fact that the pin bores of the attachment block 30 have a greater diameter than the pins 33 allows limited movement of the stiffener 27 within the stiffener receiving slot 31, which in turn, allows the trowel blade 28 to rotate within the limited range of attack angles 36 due to contact with the aggregate decorative stone. Thus, during trowelling, the trowel blades 28 can go over the top of the stone rather than deflect the stone.

The trowel blades 28 are also preferably prevented from digging into the work surface, being the aggregate decorative stone, by angling the lead portion 43 of each trowel blade 28 away from the aggregate decorative stone. In the illustrated embodiment, the lead portion 43 includes a 15° angle with respect to the plane of the trowelling portion 44.

As the trowelling proceeds and a location of excess material is encountered, excess aggregate will collect in the central collection area 34 towards the hub axis 14. The central collection area 34 is the area between the trowel blade assemblies 19 and the hub 11. The excess aggregate can be drug to a new location by moving the hub 11 with respect to the work surface. In other words, the operator can drag the collected excess aggregate by moving the rotary trowel 10 to a different location, and then return to the original spot to continue trowelling.

The present disclosure is advantageous because the use of the power rotary trowel 10 provides an attractive finished surface that is relatively inexpensive. Because the operator can control the power rotary trowel 10 via the handle assembly 22 while standing outside of the aggregate decorative stone, the operator can easily see and determine what areas of the work surface need to be further trowelled. Because of the operator’s view, the finished surface will be of superior quality without trowel marks and uneven areas. Moreover, because the operator is standing out of the mixture supporting only part of the weight of the handle assembly 22, the risk that the operator will become fatigued or uncomfortable is reduced, thereby enhancing the quality of the finished product. The operator’s position outside of the mixture also reduces any safety risk possibly posed by close exposure to resin within the aggregate decorative stone mixture.

The use of the power rotary trowel 10 also significantly reduces the cost and time of trowelling aggregate decorative stone. With the use of the power rotary trowel 10, the operator can trowel approximately 1,200 square feet of floor per hour, which is about ten times the amount of flooring that could be trowelled manually. The reduction in man hours significantly reduces the cost of the aggregate decorative stone.

The power rotary trowel 10 is able to trowel the aggregate decorative stone because it is light and flexible. The power rotary trowel 10 preferably includes the ratio of operating weight to combined trowel blade length of about one pound per inch. Further, the hub 11 can rotate about the axis 15 perpendicular to the hub axis 14, and the each blade 28 can rotate within the limited range of attack angles 36. Further, each blade 28 is flexible about the y-axis 41. Thus, the blades 28 can go over the stones within the mixture rather than deflect or kick up the stones or dig into the aggregate mixture. The combination of the light weight of the power rotary trowel 10 and its flexibility create a desired friction between the aggregate decorative stone and the trowelling portions 44 of the blades 28 such that the sticking of the resin to the blades 28 is reduced, further reducing man hours required to trowel.

The present disclosure is advantageous because the method of using the power rotary trowel 10 is relatively simple. The rotation of the trowel blades 28 is relatively fast in order to pack the aggregate decorative stone and relatively slow in order to smooth the aggregate decorative stone. Excess mixture can be moved from one position to another with ease. Thus, the skill of the operator will have less impact on the finished product than if the aggregate decorative stone was being manually trowelled.

It should be understood that the above description is intended for illustrative purposes only, and is not intended to limit the scope of the present invention in any way. Thus, those skilled in the art will appreciate that other aspects,
objects, and advantages of the invention can be obtained from a study of the drawings, the disclosure and the appended claims.

1. A power rotary trowel used with aggregate decorative stone comprising:
   - a hub rotatably attached to an electric motor via a swivel that permits relative motion about axes perpendicular to a hub rotation axis;
   - a plurality of arms extending radially from the hub;
   - a plurality of trowel blade assemblies, each attached to one of the arms, and the plurality of trowel blade assemblies supporting an operating weight including, at least, a weight of the hub, the arms, the electric motor, the swivel and the trowel blade assemblies; and
   - a ratio of the operating weight to a combined trowel blade assembly length being less than 1.3 pounds per inch.

2. The power rotary trowel of claim 1 wherein the operating weight being about 40-44 pounds, the combined trowel blade length being about 42 inches, the electric motor is a three phase gear box motor, and the ratio of the operating weight to the combined trowel blade length being about one pound per inch.

3. The power rotary trowel of claim 1 wherein the electric motor includes a center of gravity offset from a center axis of the rotation of the hub.

4. The power rotary trowel of claim 1 wherein each trowel blade assembly includes a trowel blade being rotatable within a predetermined limited range of attack angles with respect to a line extending radially from the hub and through the arm; and
   - the rotation of each trowel blade within the predetermined limited range of attack angles being responsive to an interaction between the trowel blade and a work surface.

5. The power rotary trowel of claim 4 wherein each trowel blade assembly includes a stiffener attached to the arm via a fastener assembly including an attachment block and at least one pin;
   - the attachment block defines a stiffener receiving groove including a predetermined angle greater than 0° with respect to a horizontal plane and a pin receiving bore including a diameter greater than the pin, which permits the rotation within the predetermined limited range of attack angles.

6. The power rotary trowel of claim 5 wherein each trowel blade includes a trowelling portion and a lead portion; and
   - the trowelling portion including an angle of attack less than an angle of attack of the lead portion.

7. The power rotary trowel of claim 6 wherein the trowelling portion of the trowel blade includes a mid-line, and the stiffener being attached to the trowelling portion between the mid-line and the lead portion.

8. The power rotary trowel of claim 7 wherein each trowel blade includes an x-axis and a y-axis that aligns with a respective one of the arms, and the trowel blade being relatively flexible about the y-axis and relatively rigid about the x-axis.

9. The power rotary trowel of claim 8 wherein the electric motor includes a center of gravity offset from a center axis of the rotation of the hub; and
   - the operating weight being about 40-44 pounds, the combined trowel blade length being about 42 inches, the electric motor is a three phase gear box motor, and the ratio of the operating weight to the combined trowel blade length being about one pound per inch.

10. A trowel blade assembly for attachment to a power rotary trowel comprising:
    - a trowel blade including a trowelling portion, a lead portion, an x-axis and a y-axis;
    - a stiffener attached to the trowelling portion parallel to the x-axis of the trowel blade between a mid-line of the trowelling portion and the lead portion; and
    - the trowelling portion including an angle of attack less than an angle of attack of the lead portion, and the trowel blade being relatively rigid about the x-axis and relatively flexible about the y-axis.

11. The trowel blade assembly of claim 10 wherein the trowel blade is composed of spring steel.

12. A method of trowelling aggregate decorative stone that includes a mixture ½ to ¾ inch stone and resin comprising the steps of:
    - rotating a plurality of trowel blades over a work surface about a hub axis;
    - applying a downward force on the mixture of less than 1.3 pounds/inch of combined trowel blade length; and
    - allowing a force from blade contact with the work surface to rotate the trowel blades within a predetermined limited range of attack angles.

13. The method of claim 12 wherein the step of rotating includes a step of allowing a hub coupling the trowel blades to a motor to swivel about axes perpendicular to the hub rotation axis.

14. The method of claim 12 including the steps of collecting excess aggregate in a collection area towards the hub axis; and
    - dragging the excess to a new location, at least in part, by moving the hub with respect to the work surface.

15. The method of claim 12 wherein the step of rotating includes the steps of starting trowelling at a relatively fast speed of rotation; and
    - ending trowelling at a relatively slow speed of rotation.

16. The method of claim 12 including a step of preventing the trowel blades from digging into the work surface by angling a lead portion of each trowel blade away from the work surface greater than the trowelling portion.