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2004242538 31 Dec 2004

Dowel Assembly for Concrete Slabs

Abstract

An assembly (10) to be at least partially embedded within a concrete slab (30), the assembly (10) including: a first bar (12) to be embedded within the concrete slab (30) and located on a first side of a joint (40); a second bar (14) to be embedded within the concrete slab (30), the second bar (30) extending substantially parallel to and transversely spaced from the first bar (12), the second bar (14) to be located on said first side of said joint (40); and a plurality of dowels (16) extending substantially parallel to and transversely spaced from each other, the dowels (16) being attached to the first and second bars (12, 14) so as to be substantially perpendicular thereto, the dowels (16) being provided to extend across said joint (40).

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2004242538 31 Dec 2004

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COMPLETE SPECIFICATION

FOR A STANDARD PATENT

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Invention Title:	Dowel assembly for concrete slabs

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

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Dowel Assembly for Concrete Slabs

Field of the Invention

The present invention relates to a dowel assembly for concrete slabs on ground.

Background of the Invention

Newly laid concrete shrinks as it matures. Hardened concrete expands and contracts with moisture and temperature changes. These volume changes can produce cracks in a concrete slab unless provisions are taken to allow for such volume changes. Such provisions include control joints, which are straight grooves formed in the concrete slab surface to "control" the cracking. The groove depth can be 1/8th to the full length of the slab thickness, as required. The control joints can be formed with a tool during concrete hardening or sawcut soon after the slab has hardened.

Control joints are placed at regular intervals in the slab, typically at 6 to 8 meter regular intervals in both longitudinal and transverse directions, thus forming a grid (see control joints 40 in slab 30 of Fig. 3). The resulting slab panels (42 in Fig. 3) between control joints are kept as square as possible. The control joints provide a zone of weakness between slab panels where the forces which are pulling on the slab panels will relieve themselves. This substantially prevents the concrete cracking on its own, in an uncontrolled manner. Ideally, the concrete will not crack between the joints, but such unaesthetic cracks do happen.

Control joints typically include dowels to increase slab strength in the joint. Such dowelled joints include steel dowels, embedded within the concrete at half the slab depth, and extending across a control joint (perpendicular thereto) to connect slab panels on both sides of a control joint. The dowels are spaced at regular intervals along the length of the control joint, parallel to each other. The dowels improve load transfer across the control joint and maintain the vertical alignment of adjacent slabs.

The dowels are typically steel round bars with a bond breaker (such as grease, shrink wrap or plastic sleeve) applied to one end. The dowels are placed at half the required slab height across the expected location of the control joint, prior to pouring of the concrete to from the slab. During hardening of the concrete or shortly thereafter, the control joint is formed. The bond breakers at one end of the dowels provide a debonding effect to the concrete of the slab panel at that end, whilst the other end of the dowel is

2004242538 31 Dec 2004

bonded to the concrete of the adjacent slab panel. This allows one end of the dowels to be movable within the slab panel, allowing expansion of the slab panels relative to each other without generating stresses within the slab panels.

Recently, square cross-section dowels, flat bar dowels and plate dowels have also been used as they provide a greater load transfer capability than round bar dowels.

The difficulty with dowelled joints is that the dowels must be installed in a single plane, aligned and parallel with each other if they are to work as intended. Any misaligned dowel or a dowel which is not parallel to the others along a control joint will usually result in a 'locked' joint and the slab panel will often crack between the control joints along one end of the dowels. Generally, stresses in the slab panels will be concentrated between the unparallel dowels which results in undesirable unaesthetic cracks (see for example crack 55 in Fig. 3b).

Several manufacturers are now providing dowels in pre-fabricated cradles or cages to overcome the majority of the problems associated with installation. Such dowel cradles/cages include a fabricated wire-frame which rests on the ground and supports dowels on one side and bond breakers (sleeves) at the other side. The cradles position the dowels and sleeves at the correct half-slab height and ensure that the dowels remain substantially parallel to each other at the correct dowel intervals. They are however expensive. Further, the prefabricated dowel cradles do not allow for installation of the cradles prior to the use of a Somero Laser Screed machine as shown in Fig. 4 (from Somero Enterprises, www.somero.com).

Referring to Fig. 4, the Somero Laser Screed machine 50 is a self-propelled four wheel drive unit which has a telescoping boom 52 with a screeding/compacting head 54. When forming a slab floor, concrete is discharged in strips to match the width of the screeding/compacting head 54, up to a height approximately 1" higher than the final slab thickness required. The Somero machine 50 moves into position and the telescopic boom 52 is extended over the discharged concrete. The screeding/compacting head 54 is then lowered to the slab thickness required as determined by a laser-level transmitter. Retraction of the boom 52 causes the screed head 54 to be drawn across the fresh concrete which is leveled and compacted in a single pass. Once a pass is completed, the machine 50 is moved to a position for forming the adjacent slab panel with some overlap on the previously screeded concrete.

2004242538 20 Mar 2007

The dowel cradles mentioned have to be placed in a grid arrangement corresponding to the control joints to be formed. As these cradles include a wire frame for locating the dowels and sleeves at the correct height, a Somero machine cannot be driven over these cradles without damaging them. It is thus necessary to remove the cradles to allow the Somero machine to move onto the adjacent slab panel to be formed, or to place the dowel cradles only immediately prior to forming of the slab panel. This significantly slows forming of the slab floor.

Further (referring to Fig. 3b) such cradles are only available in 3m lengths, which requires the use of two dowel cradles 44 for each control joint of a 6m x 6m slab panel 42. This allows the possibility that the dowels of cradles along the same control joint 40 will be misaligned and increases the chance of undesired cracks forming in the slab panel.

It is the object of the present invention to substantially overcome or at least ameliorate one or more of the prior art disadvantages or at least provide a useful alternative.

Summary of the Invention

In a first aspect, the present invention provides an assembly to be at least partially embedded within a concrete slab having a joint separating a first slab panel from a second slab panel, the assembly including:

a first bar to be embedded within the first slab panel so as to be located on a first side of said joint;

a second bar to also be embedded within the first slab panel so as to be located on said first side of said joint, the second bar extending substantially parallel to and transversely spaced from the first bar; and

a plurality of dowels extending substantially parallel to and transversely spaced from each other, the dowels being attached to the first and second bars so as to be substantially perpendicular thereto, the dowels being provided to extend across said joint so as to extend into the second panel.

In the preferred embodiment, the first and second bars are substantially co-extensive with each other. The dowels are also preferably substantially co-extensive with each other.

The dowels are preferably spaced at regular intervals along the first and second bars. Preferably, the dowels include a sleeve covering the dowel portions to extend across said joint. The dowels are preferably attached to the first and second longitudinal bars by welding.

Each dowel preferably includes a first end and a second end and the first bar is attached adjacent the dowel first ends. Preferably, the distance between the first and second bars is less than half the length of each dowel. The first and second bars and the dowels are preferably steel bars, of a round, square or rectangular cross-section.

In another aspect, the present invention provides a concrete slab having the assembly of the above at least partially embedded therein. The slab is preferably a slab on ground. The bars and dowels are preferably substantially parallel to a top surface of said concrete slab. The assembly is preferably embedded within the concrete at a depth lower than 40 mm from the top surface of the concrete slab, and higher than 40 mm from the lower surface of the concrete slab. The assembly is preferably embedded at half the concrete slab thickness.

In a yet further aspect, the present invention provides a method of forming a concrete slab having a joint, the method including the steps of:

(1) providing at least one assembly as defined in the first aspect above, with a sleeve enclosing a portion of each dowel;

(2) placing the assembly on a surface that is to be covered with concrete so that each dowel is positioned to extend across the joint to locate the sleeves in said second panel when the slab is formed;

(3) placing reinforcing mesh over the assembly while on said surface and attaching the assembly to the mesh; and

(4) pouring concrete over the mesh and assembly to cover the mesh and assembly after the mesh and assembly has been raised and supported at a raised position relative to said surface.

Brief Description of the Drawings

Preferred forms of the present invention will now be described by way of examples only, with reference to the accompanying drawings, wherein:

Fig. 1 is a perspective view of an assembly according to a preferred embodiment of the present invention;

Fig. 2 is a cross-section of a floor slab with the assembly of Fig. 1 embedded therein, the cross-section being along line 2-2 of Fig. 3;

Fig. 3a is a schematic top view of part of a slab panel having control joints and with assemblies according to Fig. 1 embedded therein;

Fig. 3b is a schematic top view of part of a slab panel having control joints and with prior art cradle assemblies embedded therein; and

Fig. 4 is a photograph of a commercially available Somero Laser Screed machine.

Detailed Description of the Preferred Embodiments

Fig. 1 shows an assembly 10 according to a preferred embodiment of the present invention. The assembly 10 includes a first bar 12, a second bar 14 and a plurality of dowels 16. The first and second bars 12 and 14 extend substantially parallel to and

2004242538 31 Dec 2004

transversely spaced from each other. The first and second bars 12 and 14 are also substantially co-extensive with each other.

The dowels 16 extend substantially parallel to and transversely spaced from each other. The dowels 16 are also substantially co-extensive with each other and each dowel 16 includes a first end 19 and a second end 20. The dowels 16 are attached to the first and second bars 12 and 14 at regular distance intervals 21 by welding as indicated at 17, and are substantially perpendicular to the first and second bars 12 and 14, as indicated at 18. The first bar 12 is attached adjacent the dowel first ends 19, such that each dowel 16 extends from the first bar 12 and past the second bar 14. The distance 22 between the first and second bars 12 and 14 is less than half the length 24 of each dowel 16.

The first and second bars 12 and 14 and dowels 16 are preferably steel bars, of a round, square or rectangular cross-section.

The use of the assembly 10 will now be described with reference to Figs. 2 and 3a. The assemblies 10 are placed on the ground prior to pouring of the concrete at locations specified by engineers. The assemblies 10 are located such that the first and second bars 12 and 14 will be located on one side of a (to be formed) control joint 40 and substantially parallel thereto. The dowels 16 are located to extend across the (to be formed) control joint 40 and substantially perpendicular thereto. The dowel second ends 30 are inserted into individual plastic sleeves 25 which will act as concrete bond breakers.

Reinforcement mesh 32 is then placed over the assemblies 10 and the assemblies 10 are tied by wire to the reinforcement mesh 32. Workers and the Somero Laser Screed machine can then walk or drive over the mesh 32 and assembly 10 without substantial risk of damaging or moving the bars 12 and 14 and dowels 16 out of alignment. Prior to pouring of concrete for forming a slab section, the mesh and assembly 10 are 'chaired up' (raised via spacers to (preferably) about half the slab depth) as one unit. The actual height the unit is chaired up is determined by engineering requirements, but is generally at a depth lower than 40 mm from the top surface of the concrete slab, and higher than 40 mm from the lower surface of the concrete slab. Concrete is then poured and the Somero machine is used to screed the laid concrete to compact and level same as described above. In fiber reinforced concrete which does not include the reinforcement mesh 32, the assemblies 10 are chaired by themselves prior to pouring of the concrete.

During hardening of the concrete, the bars 12 and 14 and dowel first ends 19 are bonded to the concrete of slab panel 42a whilst the sleeves 25 are bonded to the slab panel

2004242538 31 Dec 2004

42b. The slight shrinking of the concrete during hardening moves the sleeves 25 slightly away from the bars 12 and 14. This creates a small space between the second end 20 of the dowels 16 and the closed end of the sleeves 25, which allows the dowels 16 to move longitudinally inside sleeve 25. This allows expansion of the slab panels 42a and 42b relative to each other without generating stresses within the slab panels 42a and 42b. The sleeve 25 can be made of metal, plastics material or shrink wrap. The assembly 10 will be typically supplied with the sleeves 25 installed over the dowel second ends 20. During or after hardening of the concrete, the control joint 40 is formed.

The cross-section shape and dimensions of the bars 12 and 14 and dowels 16, length 24 of dowels 16, distance 22 between the bars 12 and 14 and distance 21 between the dowels 16 are determined by an engineer depending on the environment and expected loads of the floor slab to be laid. The distances 21 and 22 can be set at any from 10 mm to five meters, and the dowel length 24 can be set at any from 10 mm to one meter, as specified by an engineer. The present invention allows flexibility to the engineer's requirements for any such distances 21 and 22 and dowel length 24.

The assembly 10 provides accurate dowel spacing and alignment and maintains this accuracy even after being walked on or driven over by a Somero machine. The dowels can be placed in their intended position in conventional or fiber reinforced slabs, prior to the use of the Somero machine. The Somero machine can be driven over the assemblies 10 without causing damage and/or misalignment of the dowels 16. This, decreases the risk of cracking in the slab panels due to dowel misalignment. The present invention can be used with a Somero machine or with conventional methods of concrete pouring and finishing.

The assemblies 10 are typically stacked inside a rectangular steel frame, which allows for a greater mobility around the building site. The assemblies 10 are thus easier to handle than the dowel cradles presently available.

The assembly 10 has been primarily described above with reference to control joints. The assembly 10 can however also be used for other types of concrete joints, such as stop work joints, expansion joints and edge joints.

Stop work joints are formed at an edge of a laid concrete slab. Edge boards are erected to support the laid concrete on such edges, and the assembly 10 is located such that the bars 12 and 14 will be embedded in the laid concrete, with the sleeved dowels 16 extending through holes formed in the edge board. Once the concrete slab hardens and the edge board is removed, an adjacent slab embedding the sleeved dowels 16 can be laid. An expansion joint is similar to a stop work joint, with the addition of a compressible board material between the slabs. Holes are provided in the material for the dowels 16 to extend through.

An edge joint is formed at an edge of a laid concrete slab adjacent a structure, such as a wall. In this case, holes are formed in the structure for the dowels 16 to be inserted into prior to pouring concrete. The bars 12 and 14 are then embedded in the laid concrete.

The assemblies 10 can be fabricated in standard six (6) meter lengths but can be varied to suit any required control joint and or saw cut specifications, providing flexibility to tailoring the length of the assembly 10 to each individual requirement. The standard six (6) meter lengths also provides higher accuracy of dowels remaining parallel over longer distances, resulting in less cracking, when compared to the 3 meter dowel cradles described.

The assembly 10 is fabricated off-site by welding the dowels 16 to the bars 12 and 14 by a qualified welder to the required engineering dimensions. They are then transported to site for installation only, without requiring further assembly. Welding of the dowels to the bars 12 and 14 substantially guarantees that the dowels 16 will remain substantially perpendicular to the bars 12 and 14, and that the dowels 16 will remain substantially parallel throughout the placement process and the pouring of concrete. This also lessens the chance of having unparallel dowel by human installation error. Further, efficiency on site is improved as no further assembly is required, thus requiring less labor. Accurate placement and installation of the dowels becomes easier.

The preferred embodiment of the present invention thus provides the following advantages:

- Time saving on dowel installation and placement;
- No further assembly required;
- Significant cost savings in comparison to other prefabricated dowel cradle systems;
- Somero machine can be driven over assemblies 10, which cannot be done to other prefabricated dowel cradle systems;
- The assemblies 10 can be stacked;

2004242538 31 Dec 2004

- The assemblies 10 remain stable under concrete placement.
- Easier handling of dowels on site leading to fewer injuries as less work is required.
- No need for wire cage as opposed to prefabricated dowel cradle systems

The claims defining the invention are as follows:

1. An assembly to be at least partially embedded within a concrete slab having a joint separating a first slab panel from a second slab panel, the assembly including:

a first bar to be embedded within the first slab panel so as to be located on a first side of said joint;

a second bar to also be embedded within the first slab panel so as to be located on said first side of said joint, the second bar extending substantially parallel to and transversely spaced from the first bar; and

a plurality of dowels extending substantially parallel to and transversely spaced from each other, the dowels being attached to the first and second bars so as to be substantially perpendicular thereto, the dowels being provided to extend across said joint so as to extend into the second panel.

2. The assembly of claim 1 wherein the first and second bars are substantially co-extensive with each other.

3 The assembly of claim 1 or 2 wherein the dowels are substantially co-extensive with each other.

4. The assembly of any one of the preceding claims wherein the dowels are spaced at regular intervals along the first and second bars.

5. The assembly of any one of the preceding claims wherein the dowels include a sleeve covering the dowel portions to extend across said joint.

6. The assembly of any one of the preceding claims wherein the dowels are attached to the first and second longitudinal bars by welding.

7. The assembly of any one of the preceding claims wherein each dowel includes a first end and a second end and the first bar is attached adjacent the dowel first ends.

8. The assembly of any one of the preceding claims wherein the distance between the first and second bars is less than half the length of each dowel.

9. The assembly of any one of the preceding claims wherein the first and second bars and the dowels are steel bars, of a round, square or rectangular cross-section.

10. A concrete slab having the assembly of any one of the preceding claims at least partially embedded therein.

11. The concrete slab of claim 10 wherein the slab is a slab on ground.

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2004242538 20 Mar 2007

12. The concrete slab of claim 11 wherein the bars and dowels are substantially parallel to a top surface of said concrete slab.

13. The concrete slab of claim 11 or 12 wherein the assembly is embedded within the concrete at a depth lower than 40 mm from the top surface of the concrete slab.

14. The concrete slab of claim 11, 12 or 13 wherein the assembly is embedded within the concrete at a depth higher than 40 mm from the lower surface of the concrete slab.

15. The concrete slab of any one of claims 10 to 14 wherein the assembly is embedded at half the concrete slab thickness.

16. The concrete slab of any one of claims 10 to 15 wherein the joint is a control joint, an edge joint, a stop work joint or an expansion joint.

17. The concrete slab of any one of claims 10 to 16 wherein the bars are substantially parallel to said joint and the dowels are substantially perpendicular to said joint.

18. An assembly substantially as hereinbefore described with reference to Figs. 1 to 3a of the accompanying drawings.

19. A concrete slab substantially as hereinbefore described with reference to Figs. 2 and 3a of the accompanying drawings.

20. A method of forming a concrete slab having a joint, the method including the steps of:

(1) providing at least one assembly according to any one of claims 1 to 9, with a sleeve enclosing a portion of each dowel;

(2) placing the assembly on a surface that is to be covered with concrete so that each dowel is positioned to extend across the joint to locate the sleeves in said second panel when the slab is formed;

(3) placing reinforcing mesh over the assembly while on said surface and attaching the assembly to the mesh; and

(4) pouring concrete over the mesh and assembly to cover the mesh and assembly after the mesh and assembly has been raised and supported at a raised position relative to said surface.

21. The method of claim 20, wherein the mesh and assembly is supported above said surface by being "chaired up".

Dated 19 March, 2007
Materix Pty Ltd
Patent Attorneys for the Applicant/Nominated Person
SPRUSON & FERGUSON

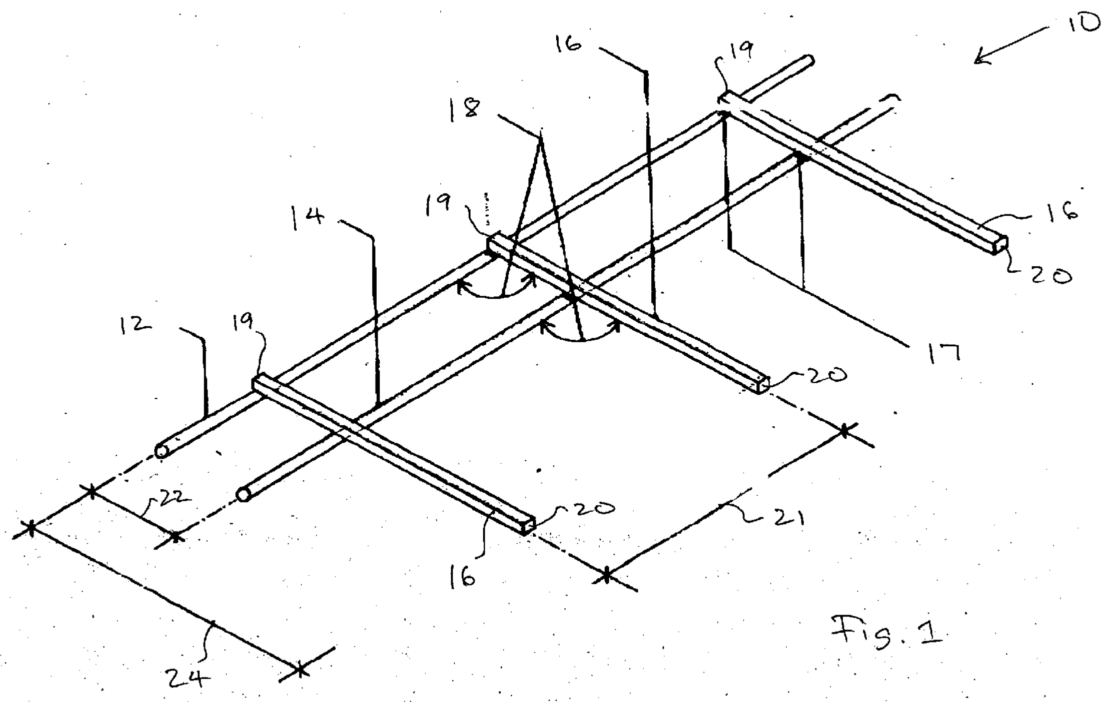

Fig. 1

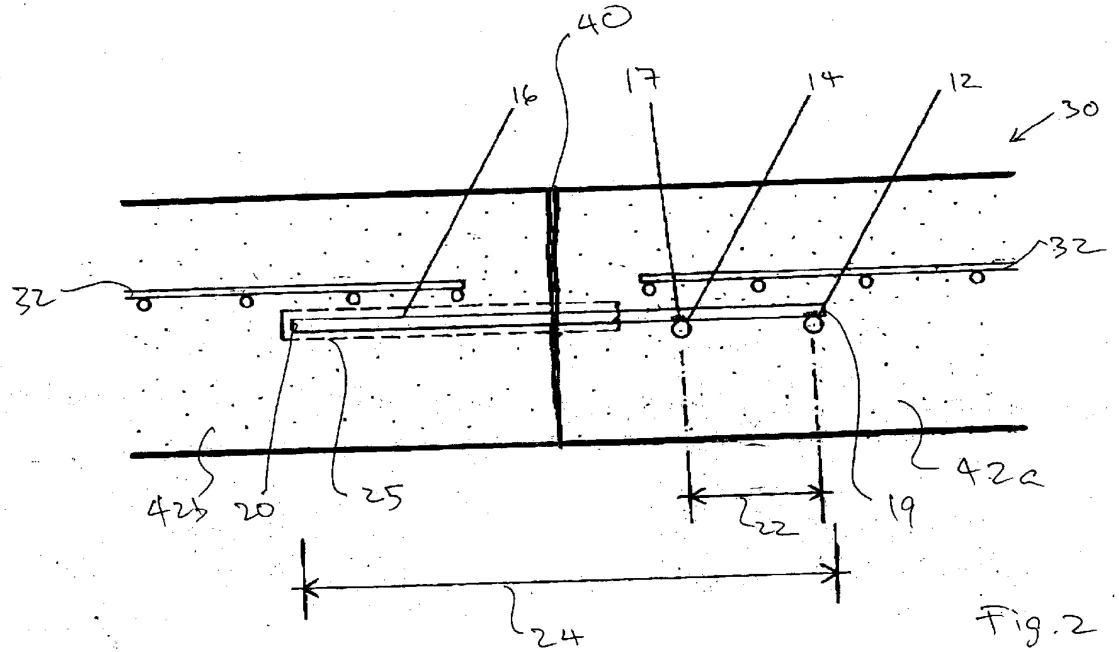

Fig.2

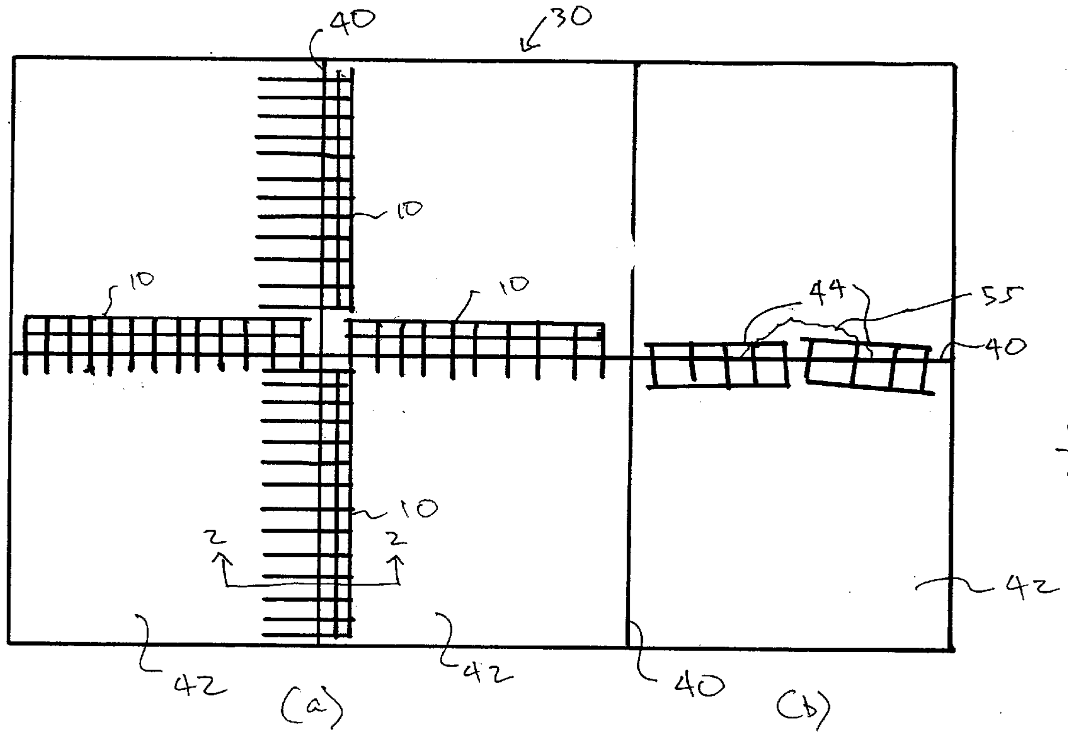

Fig. 3

2004242538 31 Dec 2004

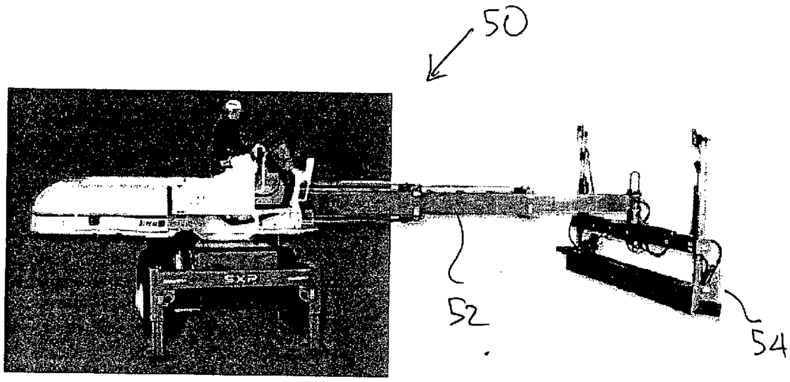

Fig. 4