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JP 2002138410 A **US 3906737 A**

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Other: **EPODOC, WPI**

(54) Title of the Invention: **Pipe laying apparatus**
Abstract Title: **Apparatus for pipe laying in a trench**

(57) An apparatus for laying a pipe in a trench comprises a placement assembly 2 for placing the pipe in the trench and a compactor mechanism 3 for compacting of aggregate about the pipe, the compactor mechanism being coupled to the placement assembly. The placement assembly comprises an extendable member which is inserted inside a pipe and withdrawn when the pipe is in place in a trench. The placement assembly may also comprise a means for controlling alignment which may further comprise a laser or other beam emitting device, and a target. The compactor may comprise a pair of reciprocating elongate members which may be moved between a position parallel to the pipe and a position perpendicular to the pipe for compaction. The compactor may be carried on a telescopic arm 11 by means of which it moves along the length of the pipe. The apparatus may be adjusted to cater for a range of pipe sizes.

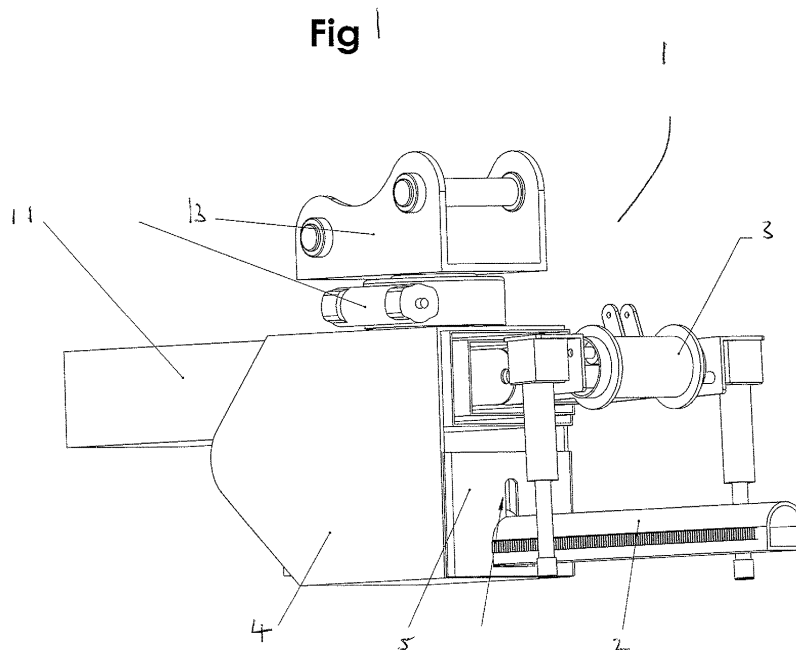


Fig 1

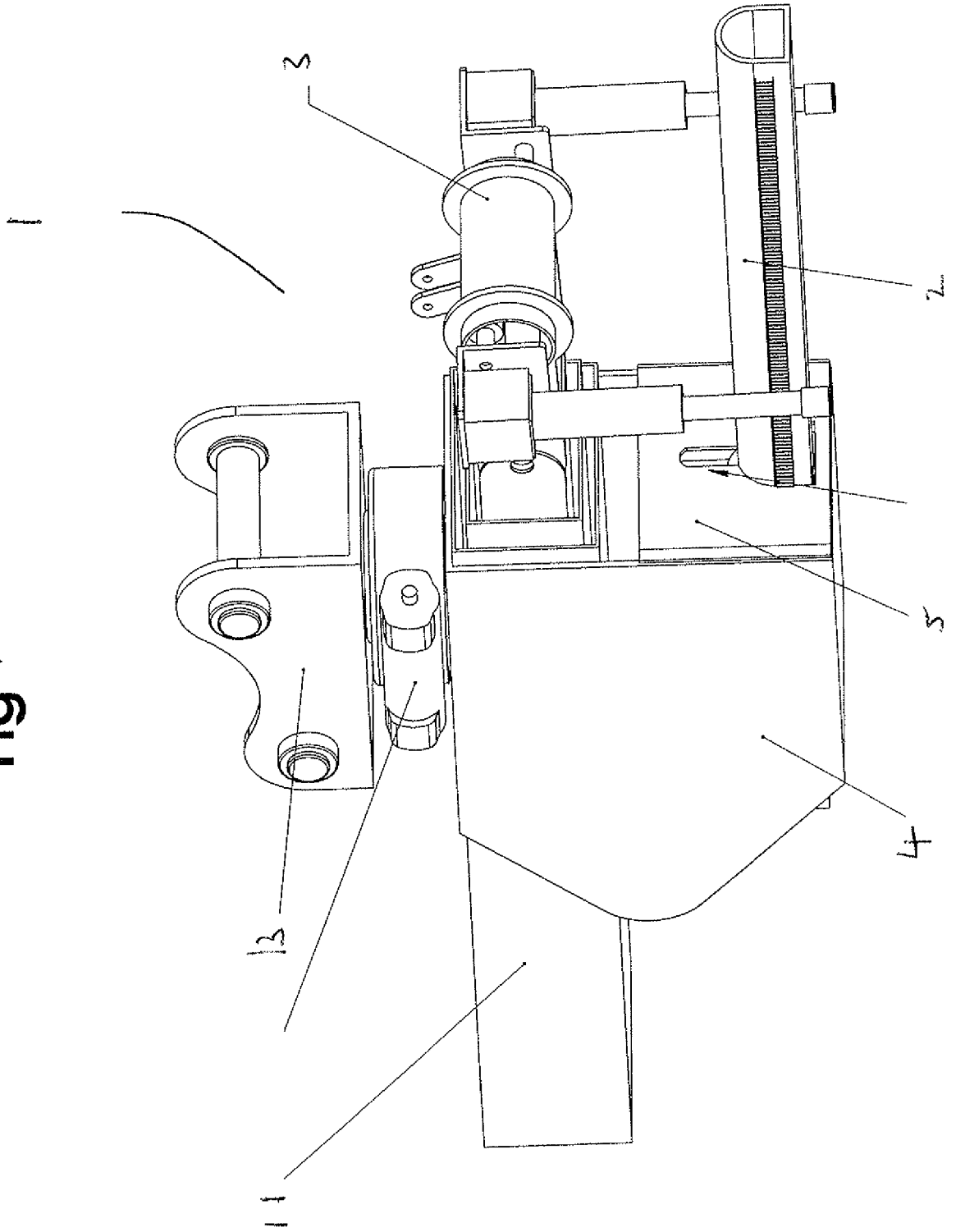


Fig 2

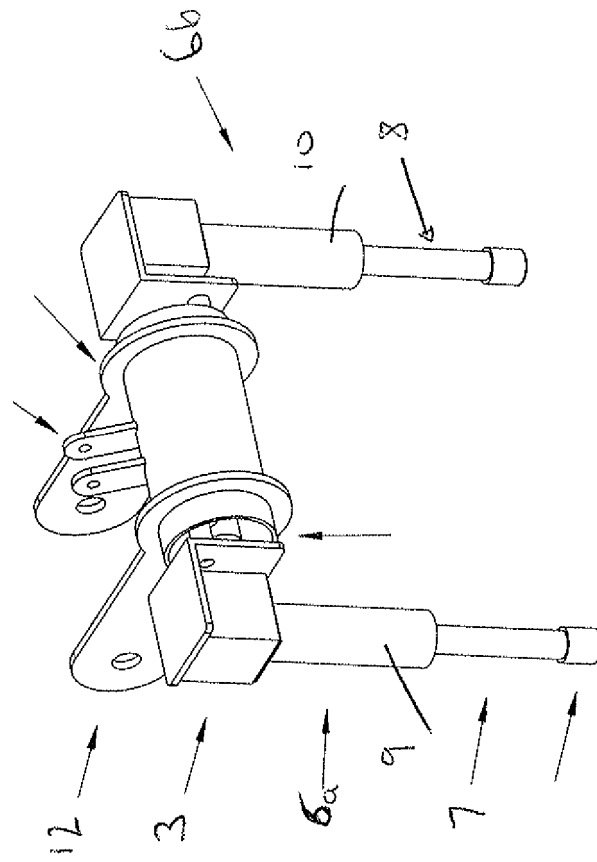


Fig 3

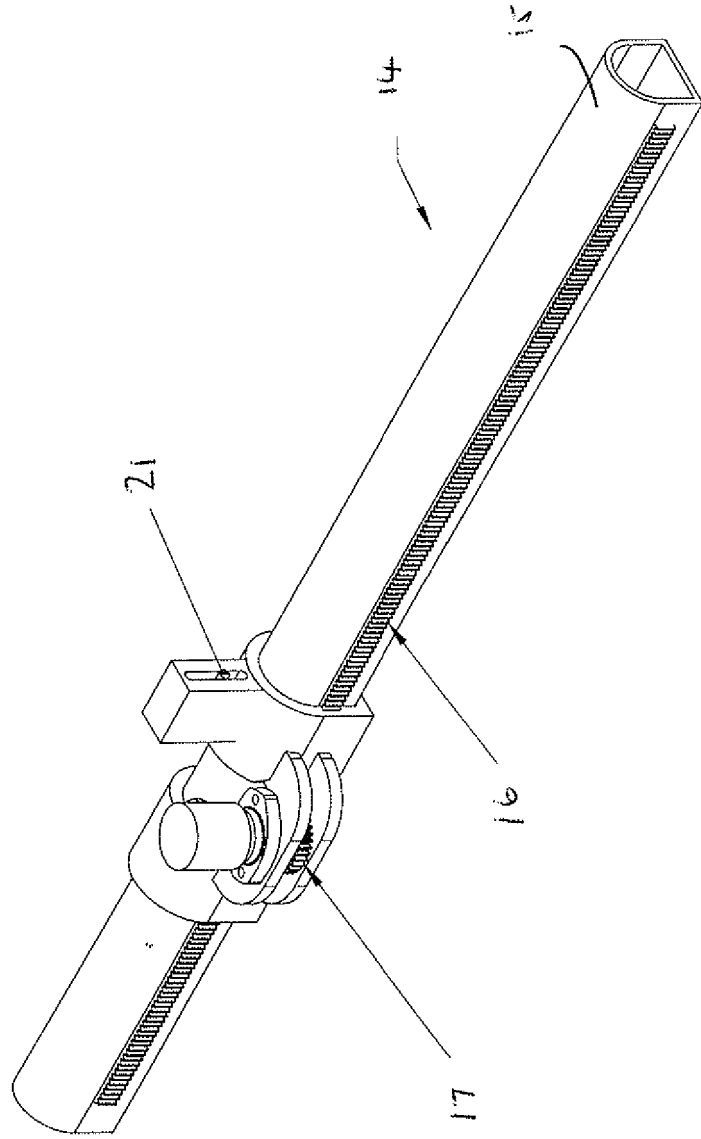


Fig. 4

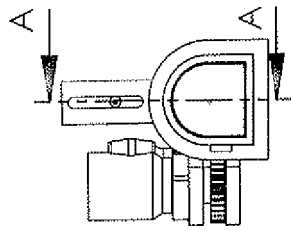
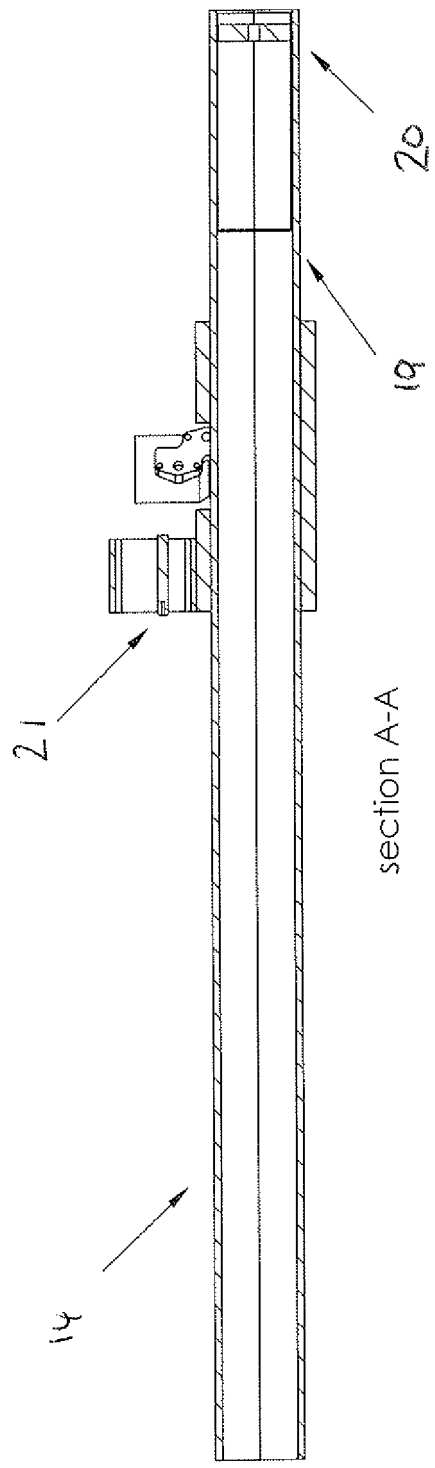
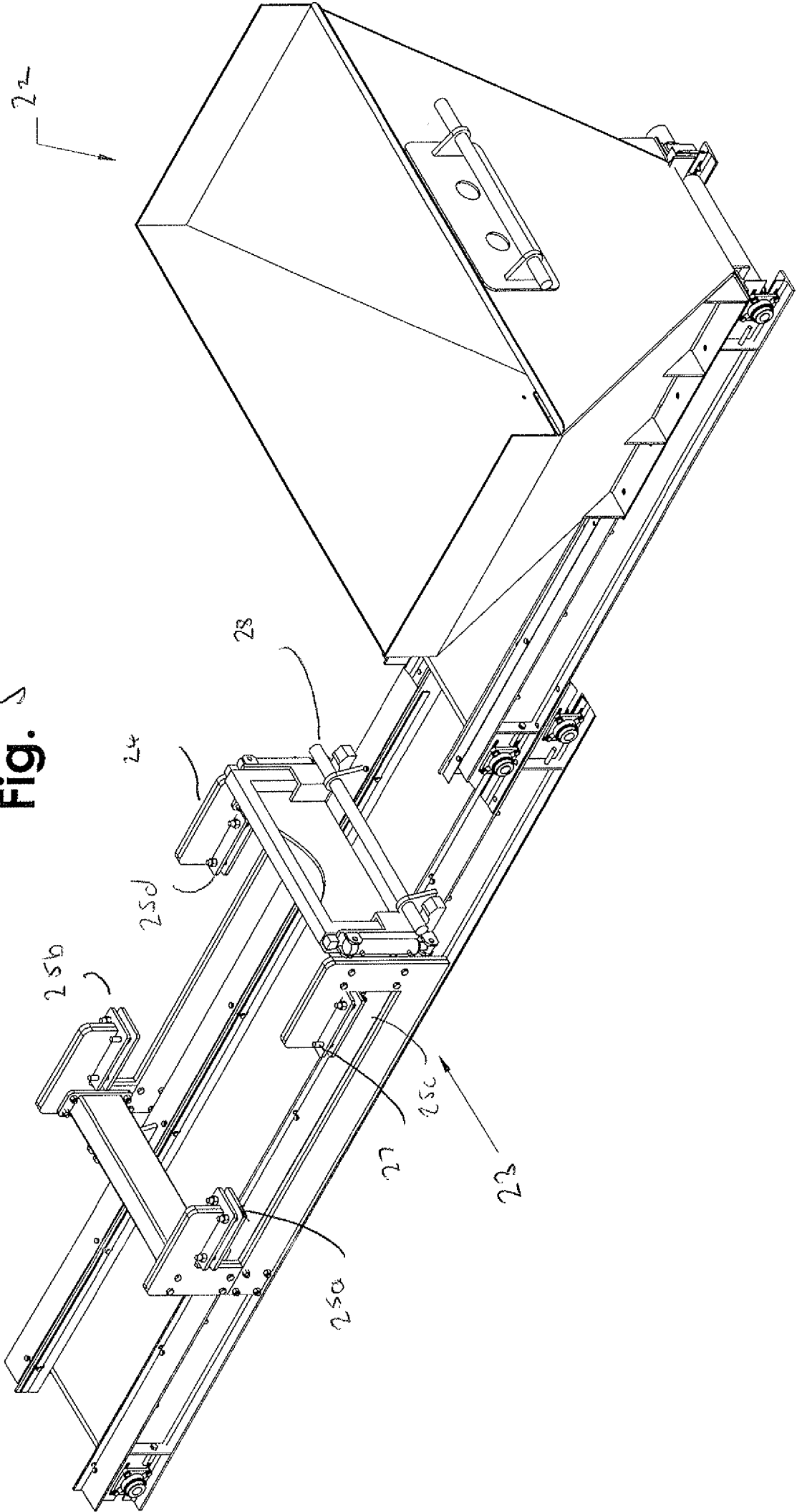


Fig. 5



Pipe Laying Apparatus

Field of the Invention

The present invention relates to an apparatus for laying a pipe in a trench and in particular to the laying and subsequent covering of the pipe.

Background to the Invention

In conventional practice, pipe laying comprises the steps of excavating a trench and reinforcing the structural integrity of the trench by fitting a trench box therein. The floor of the trench may then be levelled with pea-gravel or other suitable material. A pipe is subsequently lowered into the trench, whereupon labourers disposed within the trench manipulate the lowered pipe so as to engage the pipe with previously laid pipe sections. The remainder of the trench is infilled to completely cover the laid pipe.

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Principal amongst the difficulties associated with the traditional pipe laying techniques is that trench work is extremely hazardous. The threat of injury or death to workers resulting from trench cave-ins is a recurrent possibility. Moreover, the costs associated with enacting protective measures to prevent workers in the trenches from being trapped or seriously injured in the event of trench wall collapse are considerable.

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A summary of current best practice for the laying of pipes is as follows: a trench is dug to a depth of circa 150mm below the design bottom level of the pipe to allow for the placement of a layer of crushed stone pipe bedding material beneath the pipe.

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A steel protection box is placed in the trench to prevent the trench walls collapsing on the workers.

A crushed stone bedding material is then poured into the trench using an excavator or other means and the workers in the trench then manipulate this material to form the bedding layer for the pipe.

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Great care must be taken to ensure that the top level of this bedding material is accurately aligned with the designed pipe gradient and the designed bottom level of

the pipe and this is commonly achieved by measuring from an in pipe laser beam which is pre aligned to the pipe line and gradient.

5 The pipe is then lowered into the trench and the workers insert this pipe into a previously laid pipe and carefully adjust the pipe so as it is correctly aligned along the design line and gradient.

10 Additional crushed stone is then lowered into the trench and the workers place this stone either side and along the length of the pipe up to the halfway level on the pipe diameter.

This side fill stone is manipulated with a shovel or rod by inserting the tool into the gravel along both sides of the pipe thus ensuring that any voids that may exist within the stone are replaced with stone.

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This is a key facet of the installation as the pipe relies on this stone to provide structural support to the pipe in the bedding and haunch zones, the bedding zone being the area underneath the pipe and the haunch zone being the area at either side of the pipe up to a level halfway up the circumference of the pipe to a level known as the springline. Improperly supported pipes may move or dislodge during and after
20 infilling of the trench leading to additional excavation or realignment of pipes which adds considerable time and expense to the pipe laying process.

25 There remains a need for alternative devices capable of minimising human intervention in placing materials in a trench, thereby reducing the potential for injury resulting from trench collapse. Moreover, the device should be capable of setting a pipe secured therein to a specific slope or gradient and further provide for automated delivery and compaction of additional aggregate material such as crushed stone along either side and along the length of the pipe to ensure proper support of the laid pipe
30 without requiring workers to operate in the trench in the manner described above.

Summary of the Invention

According to an aspect of the present invention, there is provided an apparatus for laying a pipe in a trench, the apparatus comprising: a placement assembly for placing

the pipe in the trench; a compactor mechanism for compacting of aggregate material about the pipe; such that the compactor mechanism is coupled to the placement assembly.

5 An advantage of this arrangement is that a single integrated apparatus is provided which provides for both the placement of a pipe in a trench and the subsequent delivery and compaction of aggregate material about the pipe. This greatly increases the efficiency of the pipe laying process meaning that a given length of piping may be laid in considerably reduced time compared to laying of the pipe and manual compaction of aggregate by workers operating in the trench. It also results in a much
10 safer process as workers are not required to be in the trench to carry out the pipe installation. The compactor mechanism operates to ensure that no voids are left beneath the pipe in the bedding area which is sometimes a problem with manual compaction. Furthermore, compaction is provided about the haunch of the pipe. In this manner, a reliably compacted bed and haunch layer is provided to support the
15 pipe without the intervention of workers in the trench.

The compactor mechanism may be moveable along the length of the pipe at a predetermined speed for compacting of the aggregate about about the bed and sides of the pipe along the length of the pipe.

20 This is advantageous as it provides that aggregate may be compacted to a pre-defined minimum density along the full length of a pipe being laid to achieve pipe bed and pipe haunch support. The density required for a given pipe type may be calculated prior to pipe laying and the compactor mechanism may be suitably calibrated to ensure such a density is achieved.

25 The speed of movement of the compactor mechanism along the length of the pipe may be adjustable. The speed of movement of the compactor mechanism along the length of the pipe is adjustable to different speeds calibrated to ensure the required compaction density about a number of different pipe sizes.

30 Adjusting the speed allows for optimal compaction for a given pipe diameter to be achieved. For example, when being compacted, aggregate has further to travel about the surface of a pipe of wider circumference than about the surface of a narrower circumference. As such, it is advantageous for the compactor mechanism to move

more slowly along the length of a pipe of wider circumference compared to a pipe of narrower circumference. The speed of movement of the compactor mechanism along the length of the pipe may adjustable to a first speed in metres per second which would be suitable for compaction about a pipe with a first diameter. The speed of

5 movement of the compactor mechanism along the length of the pipe may adjustable to a second speed in metres per second which would be suitable for compaction about a pipe with a second diameter. The speed may be set to one of a series of predetermined set points suitable for a particular pipe diameter.

10 The compacting mechanism comprises at least one pair of compacting elements wherein the compacting elements are configured such that with a pipe in a trench, the first of a pair of compacting elements is about a first side of the pipe length and the second of a pair compacting elements is about an opposite side of the pipe length. Such a configuration is advantageous as it provides for compaction of aggregate along

15 both sides of the pipe being laid. Furthermore, it provides that compaction may be performed simultaneously about both sides of the pipe. Simultaneous compaction about both sides in this manner ensures regularity of compaction and ensures that even and balanced support is provided by the compacted aggregate, especially about the bed and haunch area of the pipe. More than one pair of

20 compacting elements may also be provided thus providing a series of compacting elements along each side of a pipe in a trench.

The compacting elements may comprise elongate members extendable along their length. The elongate members may be hingeable at least one point along their length.

25 The separation between the first and second compacting elements of a pair may be adjustable. This provides for the compacting elements to be suitable for use with a wide variety of pipe widths.

The compacting elements may be moveable in a reciprocating motion for compacting

30 of the aggregate about the pipe. The reciprocating motion provides a series of strikes or blows from the compacting elements to the aggregate.

The frequency of the reciprocating motion may be adjustable wherein the frequency of the reciprocating motion is adjustable between a first frequency in strikes per minute which provides optimum compaction about a pipe of a first diameter and a

second frequency in strikes per minute which provides optimum compaction about a pipe of a second diameter. This is advantageous as it provides that the frequency of the reciprocating motion may be set to correspond to a predetermined movement of the compactor mechanism along the pipe for optimal compaction of aggregate material for a particular pipe diameter.

The compacting elements are moveable from a first position wherein the elements are substantially parallel to a pipe in the trench to a second position wherein the elements are substantially perpendicular to a pipe in the trench. This is advantageous as it provides that when in the substantially parallel position, the compacting elements will not interfere with the placement assembly for placing the pipe. When the pipe has been placed in the trench, the compacting elements may then move to the second position wherein the elements are substantially perpendicular to a pipe in the trench and the compacting action may begin.

The placement assembly may comprise an extendible elongate member wherein the member is extendible into the hollow of a pipe for holding and placement of the pipe in a trench. Providing an extendible member in this manner allows for full retraction of the elongate member from the pipe hollow once pipe installation is complete, thereby avoiding contact between the pipe and the elongate member. In addition, providing an extendible member in this manner allows for more delicate placement of a pipe in a trench compared to, for example, gripping a pipe about its outer circumference. Furthermore, damage to the pipe exterior is avoided.

The elongate member may be extendible by means of a rack and pinion gear arrangement. This provides for accurate control over the extension and retraction of the elongate member from the hollow of the pipe. Any suitable means for extending the elongate member may be used.

The placement assembly may comprises an extendible member for urging an open end of a first pipe into a socket end of a second pipe. The extendible member may further comprise a flat surface or plate on the extendible member for engaging the end of a pipe and for urging or pushing the pipe into a desired position.

The placement assembly may further comprise an alignment means for alignment of the pipe in trench. The alignment means may comprise a target which may be coupled to the elongate member wherein the target is housed within the elongate member and a camera coupled to the elongate member for viewing of the target. The target may be a “bullseye” type target. This is advantageous as the target allows for the centre of a pipe to be accurately aligned with the centre of a previously laid pipe by viewing when an in pipe laser beam (located in a guide pipe laid in the trench) coincides with the target within the elongate member. This ensures that connected pipes are correctly aligned to each other.

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The alignment means may further comprise a beam emitting means, such as a laser, which may be coupled to the elongate member such that the laser is coupled atop the elongate member. The in pipe laser beam and target may be for alignment of the centre hollow of consecutive pipes being laid. The beam emitting means may be for alignment of the top collars of two consecutive pipes, with one of the consecutive pipes being in the trench. A combined in-pipe laser/target and beam emitting means is thus provided which allows for verification that both the near end and far end of a pipe are aligned with a previously laid pipe.

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The apparatus may further comprise an aggregate delivery assembly for delivery of aggregate about the pipe in the trench. The aggregate delivery assembly may comprise a hopper for storage of aggregate material and a conveyor for transport of aggregate material from the hopper to a trench. This provides a significant time saving benefit as aggregate material may be placed about the pipe in significant volumes as soon as the pipe has been placed in the trench. In addition, no additional labour or external machinery is required to place the aggregate material. A further advantage is that the aggregate material may be delivered about the pipe at sufficient speed such that it is delivered along the length of the pipe. The speed of the conveyor may be adjustable. Furthermore, the aggregate material may be delivered in sufficient volume to fill about both sides of the pipe simultaneously.

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The aggregate delivery assembly further comprises a mounting frame for attachment of the aggregate delivery assembly to a vehicle. This is advantageous as it provides

that the aggregate delivery assembly may be readily retro-fitted to a suitable vehicle, for example an excavator type vehicle.

5 The placement assembly and a compactor mechanism are attachable to a dipper arm of a vehicle. This is advantageous as it provides that the placement assembly and a compactor mechanism can be readily retro-fitted to a suitable vehicle, for example an excavator type vehicle. A placement assembly may be attached to one vehicle and a compactor mechanism may be attached to a second vehicle.

10 In a further aspect there is provided a system for pipe laying comprising: a placement assembly for placing the pipe in a trench; an aggregate delivery assembly for delivery of aggregate about the pipe in the trench; a compactor mechanism for compacting of aggregate material about the pipe.

15 In a further aspect there is provided a method of laying a pipe in a trench comprising: placing a pipe in the trench using a placement assembly; delivering aggregate material about the pipe; compacting the aggregate material using a compactor mechanism wherein the compacting mechanism provides an automated reciprocating action for compaction of the aggregate material about the bed and the sides of the pipe.

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Description of the Drawings

Figure 1 is a schematic representation of the pipe laying apparatus of the invention

Figure 2 is a schematic representation of the compactor mechanism of the invention

Figure 3 is a schematic representation of the extendible mechanism of the placement

25 assembly

Figure 4 is a cross section representation of the extendible mechanism of the placement assembly

Figure 5 is a schematic representation of the aggregate delivery assembly of the invention

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Detailed Description of the Drawings

Figure 1 is a schematic representation of the pipe laying apparatus 1 of the invention. The apparatus comprises a placement assembly 2 and compactor mechanism 3. The compactor mechanism 3 is coupled to the placement assembly 2 and both the

compactor mechanism 3 and the placement assembly 2 reside in a single housing 4. In the arrangement shown, the compactor mechanism is positioned above the placement assembly. A push connect plate 5 is extendible outwards to push a second pipe end into the socket of a first pipe.

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Figure 2 is a schematic representation of the compactor mechanism 3 of the invention. The compactor mechanism comprises a pair of compacting elements 6a, 6b. The compacting elements are configured as a pair of piston rods 7, 8, each within a housing and moveable within the housings 9, 10. The rods 7, 8 perform a

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reciprocating action to strike or blow aggregate material which has been placed about the pipe. The reciprocating action may be hydraulically powered or alternatively may be pneumatically powered. The reciprocating action may be electrically powered.

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The compactor mechanism is moveable at a predetermined speed along the length of a pipe for compacting of the aggregate about the length of the pipe. The compactor mechanism is moveable via a telescopic arm 11 (Figure 1). The compactor mechanism comprises a bracket 12 for attachment to the telescopic arm 11. The speed of movement of the compactor mechanism along the length of the pipe is adjustable

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by adjustment of the extension and retraction speed of the telescopic arm 11.

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The compacting elements are configured such that with a pipe in a trench, the first 6a of the pair of compacting elements is about a first side of the pipe length and the second 6b of the pair of compacting elements is about an opposite side of the pipe length. As such, the pipe is positioned between the rods. The frequency of the reciprocating motion is adjustable. The frequency of the reciprocating motion is adjustable through controls coupled to the compacting elements which allow for the motion of the elements to be pre-set for an appropriate frequency for a given pipe

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diameter. For example, the frequency is adjustable between a first frequency in strikes per minute which provides optimum compaction about a wide diameter pipe and a second frequency in strikes per minute which provides optimum compaction about a narrower diameter pipe.

The compacting elements are moveable from a first position wherein the elements are substantially parallel to a pipe in the trench to a second position wherein the elements are substantially perpendicular to a pipe in the trench. The compacting elements are rotatable about a bracket 12. In a further embodiment, the compacting elements may have an additional hinging element about the upper end of the housings 9, 10 such that the housings are hingeable inwards towards the base of a pipe. With the rods hinged in this manner, additional compaction about the base of the pipe and the bed area is possible.

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The placement assembly and compactor mechanism is connectable to the end of an excavator dipper arm at bracket 13. The bracket may be a quick hitch coupling bracket. In an alternative embodiment, a placement assembly is connected to one excavator and a compactor assembly is connected to a second excavator. In this embodiment, the placement assembly and the compactor assembly may be operated independently of each other.

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Figure 3 is a schematic representation of the extendible mechanism 14 of the placement assembly 2 and **Figure 4** is a cross sectional representation of the extendible mechanism 14 of the placement assembly 2. The extendible mechanism comprises an elongate member 15. The member is extendible into the hollow of a pipe for holding and placement of the pipe in a trench. The elongate member 15 is extendible by means of a rack 16 and pinion 17 gear arrangement. The rack gear 16 runs substantially along the length of the elongate member. The pinion gear 17 mechanism is coupled to the rack gear of the elongate member and resides within the housing. The placement assembly further comprises an alignment means 18 for alignment of the pipe in trench. The alignment means comprises a bullseye target 19 coupled to the elongate member wherein the target is housed within the elongate member. In a given pipeline construction, the first pipe to be laid may be termed a guide pipe and contains an in pipe laser which emits a beam of laser light through the centre of the hollow of the pipe. This in pipe laser, which is set to shine along a predetermined design line and gradient, may serve as a guide to ensure that

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subsequent laid pipes are properly aligned with the pre-determined line and gradient of the initial guide pipe.

The target is thus used for alignment of a pipe being placed with the in pipe laser from the guide pipe. The elongate member is hollow with one open end and one closed end. The target 19 is fixed to the closed end of the elongate member such that laser light from the in pipe laser may shine internally along the length of the elongate member. A camera 20 is further coupled to the closed end of elongate member to provide a visual guidance for alignment of the bullseye of the target 19 with the beam from the in-pipe laser. A laser 21 is coupled to the top outer surface of the elongate member. While the in pipe laser beam and target 19 serve for alignment of the centre hollow of consecutive pipes being laid, the laser 21 serves for alignment of the top collars of two consecutive pipes, with one of the consecutive pipes being in the trench. A pipe being laid may be considered to be in alignment with the previously laid pipe, once the in pipe laser beam is aligned with the target 19 of the elongate member and the laser 21 of the elongate member is aligned with the top collar of the previously laid pipe.

Figure 5 is a schematic representation of the aggregate delivery assembly of the invention. The aggregate delivery assembly comprises a hopper 22 for storage of aggregate material and a conveyor 23 for transport of aggregate material from the hopper to a trench. The speed of the conveyor 23 is adjustable so that an optimum speed of aggregate material delivery for a given pipe width may be achieved. The speed of delivery and the volume of aggregate should be sufficient that the aggregate material can quickly fill both sides along the length of a pipe. The aggregate delivery assembly further comprises a mounting frame 24. A clamp section 25 is used to attach the mounting frame 24 of the aggregate delivery assembly to a vehicle, for example to a typical excavator vehicle. The clamp section comprises four clamps 25a, 25b, 25c and 25d. The four clamps are for attachment to the undercarriage of the vehicle. The aggregate delivery assembly thus is connected to the excavator undercarriage frame by first attaching mounting frame 24 via the clamps 25a, 25b, 25c and 25d to the excavator undercarriage and securing each of the clamps in place with a number of attaching members 27, for example with bolts. Similarly, the mounting frame may be detached from a vehicle by removing the bolts 27 and thus de-clamping the frame

from the vehicle. With the mounting frame 24 clamped in place, the conveyor 23 may be attached to the mounting frame. The conveyor is slotted beneath the mounting frame and is secured to the frame with pin 28. The hopper 22 is then connected to one end of the conveyor such that aggregate material fed into the hopper 22 is transferred
 5 from the hopper to the conveyor 23.

In use, the apparatus functions as follows: The pipe laying apparatus 1 including the placement assembly and compactor mechanism is connected to the end of the excavator dipper arm via the coupler bracket. The aggregate delivery assembly is
 10 connected as described above to the excavator undercarriage frame by first attaching mounting frame 24 to the excavator undercarriage and clamping it thereon using clamps 25a, 25b, 25c and 25d and then inserting pin 28 to retain the conveyor and hopper.

15 A trench is excavated to a depth of circa 150 mm below the design bottom level of the pipe to be laid. A first guide pipe having an in pipe laser as described above is then placed in the trench to the desired design depth and gradient.

Typically, the excavator will be manoeuvred such that its tracks or wheels straddle the
 20 open trench, with one set of tracks or wheels on one side of the trench and the opposing set of tracks or wheels on the other side of the trench such that the placement assembly, compactor mechanism and the conveyor of the aggregate delivery assembly are substantially in-line with the trench.

25 Using the excavator controls, the elongate member 15 is inserted into the end of the next pipe to be laid. The member is extended beyond halfway along the pipe length using rack 16 and pinion 17 gear mechanism. The pipe is then lowered into the trench using the excavator controls.

30 The near end (i.e. end nearest the excavator) of the pipe is offered up to the socket end of the guide pipe (or a subsequently laid pipe). Using the laser 21 as a guide and by observing when this laser beam strikes the top of the guide pipe, it is then known that the near end of the pipe is aligned with the guide pipe. The pipe is then partly inserted into the guide pipe.

Using the excavator controls and a viewing feed from the camera 20 housed within the elongate member 15, the far end (i.e. the end farthest the excavator) of the pipe is then moved laterally and vertically until the in pipe laser line from the guide pipe
5 coincides with the bullseye target as viewed by the camera 20. The pipe is now aligned along the in pipe laser line and is then pushed into the previously laid pipe using the push connect plate 5 to complete the pipe to pipe connection. The push connect plate 5 extends outward from the housing 4 and the face of the plate 5 meets the pipe face at the far end of the pipe. The push plate then extends further pushing
10 against the far end pipe face thus urging the near end of the pipe into the socket of the guide pipe.

With the pipe still held in aligned position by the elongate member 15, aggregate material such as crushed stone bedding is then discharged from the hopper 22 via
15 discharge conveyor 23 onto and along the top centre line of the pipe. The aggregate material falls down the sides and underneath the pipe, thus providing partial fill of the pipe bed and haunch zones. The aggregate material is ejected at sufficient speed from the discharge conveyor 23 into the trench such that it is delivered along the length of the pipe and not just at the point where the conveyor overhangs the trench.
20 Furthermore, the aggregate material is delivered in sufficient volume that upon striking the top centre line of the pipe, it is subsequently directed by the curved top surface of the pipe into the trench about both sides of the pipe simultaneously.

The compactor mechanism 3 then activated. The reciprocating compactors 6a, 6b are
25 orientated into the perpendicular position relative to the pipe bed and moved along the entire length and both sides of the pipe. The compactors 6a, 6b produce a reciprocating motion to blow or strike the aggregate material thereby simultaneously pushing the stone aggregate material under the pipe from both sides. This forms a suitable compacted bed and haunch layer for the pipe which is at the required level for
30 alignment with the guide pipe. The reciprocating motion compacts the aggregate material at the sides and under the pipe at the same time thus providing a reliably compacted bedding and haunch layer and sufficient support about the pipe sides to prevent settlement or subsequent lateral movement of the pipe. The elongate member 15 is extracted from the pipe and using the excavator controls and the pipe laying

apparatus is manoeuvred away from the freshly laid pipe. The pipe installation is now complete and the process may begin again with a further pipe. The above is described in relation to a pipe being laid subsequent to the guide pipe. The same process is followed for each subsequent pipe to be laid.

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Testing up to pipe diameters of 600mm has been performed using the above apparatus as described. It has been evidenced that once the above process had been followed and when the pipe was thereafter removed, the bedding stone was compacted entirely around the lower half circumference of the pipe. Furthermore when the bedding stone was removed, it was observed that the stone was embedded into the bottom and the sides of the trench. This demonstrated that high levels of pipe support and bedding compaction were achieved by the mechanism.

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The words “comprises/comprising” and the words “having/including” when used herein with reference to the present invention are used to specify the presence of stated features, integers, steps or components but do not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof.

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It is appreciated that certain features of the invention, which are, for clarity, described in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention which are, for brevity, described in the context of a single embodiment, may also be provided separately or in any suitable sub-combination.

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CLAIMS

- 5 1. An apparatus for laying a pipe in a trench, the apparatus comprising:
- a placement assembly for placing the pipe in the trench;
- a compactor mechanism for compacting of aggregate material about the pipe;
such that the compactor mechanism is coupled to the placement assembly.
- 10 2. The apparatus of claim 1 wherein the compactor mechanism is moveable at a predetermined speed along the length of a placed pipe for compacting of the aggregate about the bed and sides of the pipe along the length of the pipe.
3. The apparatus of claim 2 wherein the predetermined speed of movement of the
15 compactor mechanism along the length of the pipe is adjustable.
5. The apparatus of any preceding claim wherein the compactor mechanism comprises at least one pair of compacting elements.
- 20 6. The apparatus of claim 5 wherein the compacting elements comprise elongate members extendable along their length.
7. The apparatus of claim 6 wherein the elongate members are hingeable at least one point along their length.
- 25 8. The apparatus of any of claims 5 to 7 wherein the compacting elements are configured such that with a pipe in the trench, the first compacting element of a pair is about a first side of the pipe length and the second compacting element of a pair is about an opposite side of the pipe length.
- 30 9. The apparatus of any of claims 5 to 8 wherein the separation between the first and second compacting elements of a pair is adjustable.

10. The apparatus of any of claims 5 to 9 wherein compacting elements are moveable in a reciprocating motion for compacting of the aggregate about the pipe.

5 11. The apparatus of claim 10 wherein the frequency of the reciprocating motion is adjustable.

12. The apparatus of any of claims 5 to 11 wherein the compacting elements are moveable from a first position wherein the elements are substantially parallel to a pipe in the trench to a second position wherein the elements are substantially perpendicular
10 to a pipe in the trench.

13. The apparatus of any preceding claim wherein the placement assembly comprises an extendible elongate member wherein the member is extendible into the hollow of a pipe for holding and placement of the pipe in a trench.
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14. The apparatus of claim 13 wherein the elongate member is extendible by means of a rack and pinion gear arrangement.

15. The apparatus of any preceding claim wherein the placement assembly
20 comprises an extendible member for urging an open end of a first pipe into a socket end of a second pipe.

16. The apparatus of any preceding claim wherein the placement assembly further comprises an alignment means for alignment of the pipe in trench.
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17. The apparatus of claim 16 wherein the alignment means comprises:
- a target coupled to the elongate member, for aiding alignment with an alignment beam wherein the target is housed within the elongate member; and
- a camera coupled to the elongate member for viewing of the target.
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18. The apparatus of claim 17 wherein the alignment means further comprises a beam emitting means coupled atop the elongate member.

19. The apparatus of claim 17 or 18 wherein the target is for alignment of the centre hollow of a first pipe with the centre hollow of a second pipe, the second pipe being in the trench.
- 5 20. The apparatus of claim 19 wherein the beam emitting means is for alignment of the top collar of the first pipe with the top collar of the second pipe, the second pipe being in the trench.
21. The apparatus of any preceding claim further comprising an aggregate delivery
10 assembly for delivery of aggregate about the pipe in the trench.
22. The apparatus of claim 21 wherein the aggregate delivery assembly comprises a hopper for storage of aggregate material and a conveyor for transport of aggregate material from the hopper to a trench.
- 15 23. The apparatus of claim 21 or 22 wherein the aggregate delivery assembly further comprises a mounting frame for attachment of the aggregate delivery assembly to a vehicle.
- 20 24. The apparatus of any preceding claim wherein the placement assembly and a compactor mechanism are attachable to a dipper arm of a vehicle.
25. A system for pipe laying comprising:
- a placement assembly for placing the pipe in a trench;
 - 25 - an aggregate delivery assembly for delivery of aggregate about the pipe in the trench;
 - a compactor mechanism for compacting of aggregate material about the pipe.
26. A method of laying a pipe in a trench comprising:
- 30 - placing a pipe in the trench using a placement assembly;
 - delivering aggregate material about the pipe;
 - compacting the aggregate material using a compactor mechanism wherein the compacting mechanism provides an automated

reciprocating action for compaction of the aggregate material about the bed and the sides of the pipe.

27. An apparatus substantially as described herein and with reference to the
5 accompanying drawings.



Application No: GB1522663.2

Examiner: Mr Philip Osman

Claims searched: 1-24, 27

Date of search: 10 June 2016

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

| Category | Relevant to claims | Identity of document and passage or figure of particular relevance |
|----------|---------------------------|---|
| X | 1-3, 5, 6, 8-11, 16, & 21 | US3906737 A (BROWN) See abstract and figures |
| A | - | WO2010/126983 A1 (BENNINGTON) See abstract and figures |
| A | - | JP2002138410 A (ASAHI) See English language abstract and figures |
| A | - | JP08027721 A (NIPPON STEEL) See English language abstract and figure |

Categories:

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| X | Document indicating lack of novelty or inventive step | A | Document indicating technological background and/or state of the art. |
| Y | Document indicating lack of inventive step if combined with one or more other documents of same category. | P | Document published on or after the declared priority date but before the filing date of this invention. |
| & | Member of the same patent family | E | Patent document published on or after, but with priority date earlier than, the filing date of this application. |

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X :

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Worldwide search of patent documents classified in the following areas of the IPC

E01C; F16L

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI

International Classification:

| Subclass | Subgroup | Valid From |
|----------|----------|------------|
| F16L | 0001/036 | 01/01/2006 |
| F16L | 0001/09 | 01/01/2006 |
| F16L | 0001/10 | 01/01/2006 |