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[54] **TILE EMBEDDING MACHINE**

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[58] **Field of Search** ..... 61/72.5, 72.6, 72.1, 72.2, 61/72.7, 63, 41 A

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[57] **ABSTRACT**

A tile and gravel embedding machine to operate alone along a trench bottom comprises a hopper with throat, means to direct a line of tile to bottom depth below the throat, combined with machine-controlled propelling means comprising a winch at the front of the machine with cable thereon extending for anchor ahead of the machine, the propelling means driving the winch at extremely reduced speed.

8 Claims, 2 Drawing Figures

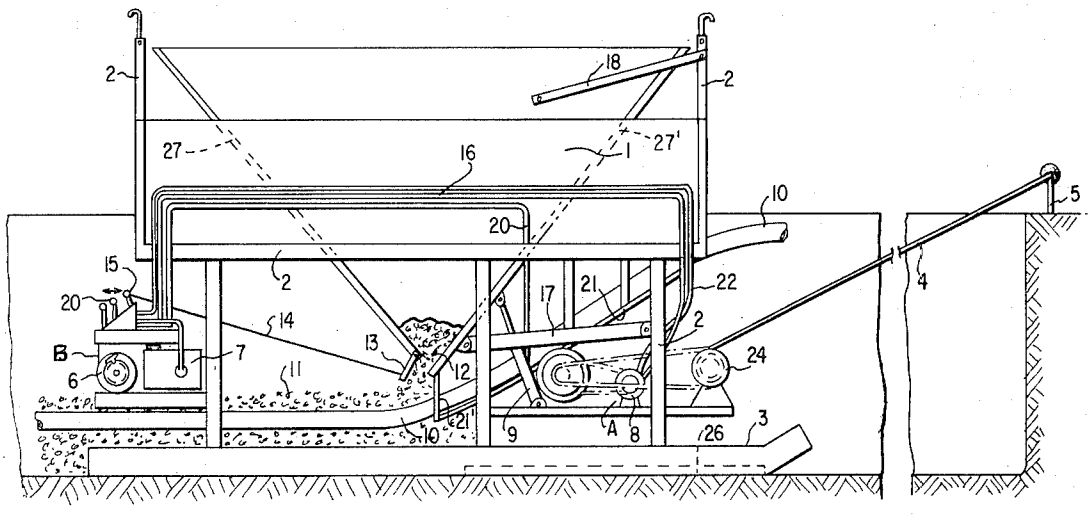


FIG. 1

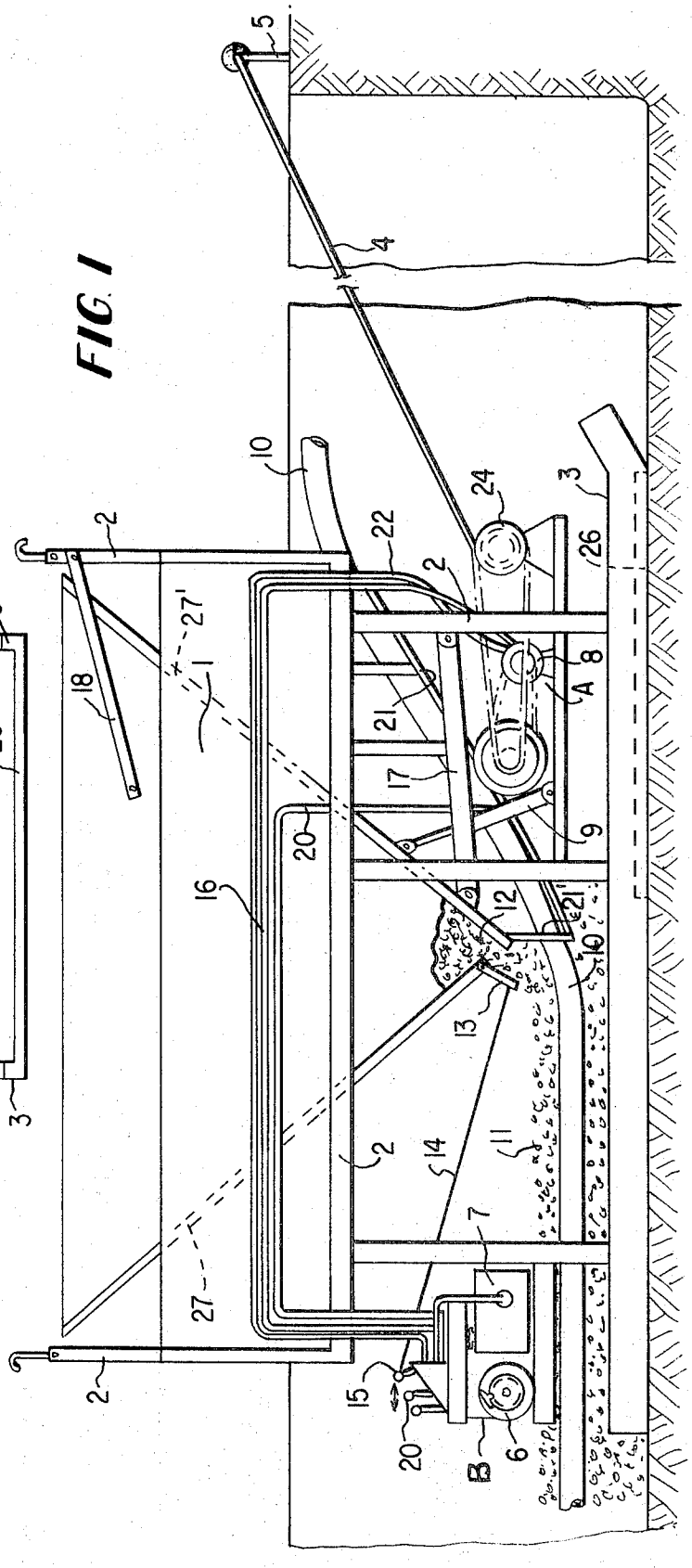
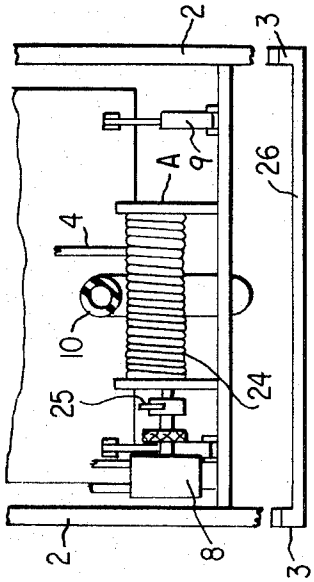

5
4
10
2
22
24
3
26
18
27'
1
21
8
A
17
9
20
16
12
21'
13
14
11
7
27
15
20
B
6

FIG. 2


2
3
A
9
26
4
10
25
24
8
2
3

TILE EMBEDDING MACHINE

This invention relates to improvements in constructing tile fields in the earth under strict controls governing seepage. Such situations arise, for example, from enforcement of health ordinances, especially in regions where growing population density induces increasing inspection. Other pressures are imposed by growing awareness of ecology problems and of far-reaching pollution through water veins and ponds, or likewise by concentrated disposal of agricultural wastes or of industrial disposal of chemicals. Generally the bottom of a trench or ditch is sloped with the exactness of a transit, but corresponding exactness in placing tile and gravel together in the ditch has not been effected. Such are some of the considerations involved in drain-fields, so-called, for gradual dispersal of septic sewage liquids by percolation into the earth on outflow from tile and gravel lines at trench bottoms. Generally, dwelling waste effluent runs first into septic tanks (which are anaerobic, bio-degrading collectors) from which polluting septic liquid moves slowly into the trench lines. The liquid may accumulate in the pores of the gravel bed until it oozes out and gradually seeps into the earth bottom.

The laying of tile by machinery is shown extensively in the art, including filling with gravel or the like. Some apparatus for these purposes has been attached to ditching machines and moved along by the ditching machine. In other cases a tiling machine is pulled in an open ditch by hitch from a tractor. Some proposals have been made to drive the tiling machine one wheels. In addition, it is still a widespread practice for laborers to shovel the gravel on a ditch bottom, sometimes shaping something of a trough, laying the tile in that and shoveling more gravel to cover the tile. This is expensive. Also it is inaccurate and it is awkward, for the ditch usually is narrow and often four to 6 feet deep.

These various means tend to a common fault. They leave pockets and irregularities between the gravel and the tile; looseness of fill that can cause tile to sag or form pools of undrained liquid. Such faults are easily overlooked or can grow because the line is soon covered with earth to the surface.

Many faults that develope in a tile field can be traced to the practice of pulling or pushing the tile and gravel machine in a ditch by hitch to some other machine. The controls of such other machines are usually of gross nature, suitable for a powerful tractor itself or the travel of a farm loader, and usually subject to the varying judgment and decisions of an operator. Such are not instantly sensitive to the captive machine being pushed or pulled.

Pushing or pulling the tile machine by others results in irregular and erratic movements of the tile machine. A powerful pulling tractor encountering a projecting stone simply lunges through with the tile machine following with a jerk. Or at some low spot or soft spot the machines plunge ahead; vice versa at some overly narrow passage or at some accumulation of dirt. Though the overall travel proceeds, these variations of movement are adverse to the feed and placement of both tile and gravel and especially to their correlation. Results are undetected erratic placement and lack of firmness or compactness between the tile and the fill. Similar faults result if the second machine encounters slippery terrain, or a steep ground surface, or poor traction.

This invention is to provide a tile machine that will embed tile and gravel together in consistently compact correlation. A purpose is to obtain smooth action despite local irregularities even in the ditch itself, such as projecting stones, rough dirt accumulations and the like; indeed to eliminate much of the influence of such obstacles. A further purpose is to provide simplicity in such a machine, to minimize adjustments and attention of an operator; even to avoid need for an operator for long intervals while the tile machine functions alone. Reduced labor charge enhances utility of this type of machine.

The tiling machine of this invention operates alone and is primarily self-controlled, with constancy in respect to time interval factors. One time interval of importance is the rate of travel of the machine in a ditch, with constancy of the rate being reflected in correlated, dependable placing of both gravel and tile along the bottom. Another time factor of importance is controlled variability in rate of spread of gravel from a hopper to a firm position under and around the tile being placed. This effects accuracy of positioning the incoming tile in a desired even, constant slope at a point of con-joint placement of tile and gravel. Reliability in these respects is quite different from jerky, irregular time intervals of travel. The present invention provides in a simple placement machine something of a "servo" self-control with respect to flow operations. What may be termed the time-displacement error of this machine becomes minimal, with respect to the tile and the gravel joint placement.

Various objects and advantages of this invention are shown in an illustrative form in the accompanying drawings.

FIG. **1** is a schematic side view of an illustrative machine with sides removed from a frame to show an arrangement of a gravel hopper or bin with a line of tile feeding under the hopper with system self-control means combined therewith to promote the machine operations.

FIG. **2** is a schematic front end view of the same machine showing a vertical relationship between tile and hopper, with a group of motion-control elements.

The drawings show a bin or hopper **1** having walls **27, 27'** sloped front and back to a bottom throat mounted cross-wise and centrally in a frame **2** on a pair of runners **3** with upturned front ends to ride on the bottom of a ditch. A plate **26** formed to ride upon trench bottom extends on ground level between the fore part of the runners, say a third or half the length of the machine. Metal sheet normally covers the frame sides. Supported from the frame at the front is unitary regulating and propelling means A to control the machine, including a cable **4** attached to anchor means **5** established at a distant point in the ditch line. Mounted at the rear of the frame is a power unit B shown as comprising a small conventional engine **6** to operate a hydraulic (say oil) pump **7.** This pump connects by conventional tubing **16** and valves to reversible hydraulic motor **8** in the regulating means A and also to hydraulic jacks **9** operative against the bottom of bin **1.** Shown also in the drawings is means **21'** to direct a tile line **10** inclined to a bottom position just back of the throat, being placed with gravel **11** at the bottom of the ditch. The drawing shows gravel being fed through variable cross-throat **12** at the bottom of bin **1.** Also shown at throat **12** is an adjustable gate **13** hinged as a flap to

ride to the rear on the emerging gravel, but to fall downward when the bin is empty. This gate is connected, as by rod **14,** to a valve **15** in hydraulic line **16** from pump **7** to hydraulic motor **8** to hold the valve open when gravel flows from the bin but to close the valve and stop motor **8** when the gravel bin is empty.

A preferred arrangement of the bottom throat **12** and of the tile line **10** is shown in FIG. **1.** The rear wall **27** of the bin at the throat is somewhat shorter with higher opening than the front wall **27'**, for several purposes. One is to provide a somewhat open throat to promote gravel discharge to the rear. This aids in lifting the valve-control plate **13** for full flow of hydraulic fluid to the hydraulic motor **8,** together with more sensitive cut-off of that flow as the gravel outflow diminishes. Thus close correlation is obtained between power from the pump **7** and gravel flow. The tile line **10** reaches its lowest position just rearwardly of throat **12** at a constant depth therefrom, by means of cradle **21** hung by a support **21'** means from bin front side **27'** at throat **12.** Further, close correlation of the amount and height of gravel flow results from combining this form of throat **12** with means to regulate the height of the throat and tile above the earth bottom.

Means to regulate the throat and tile height comprises hydraulic jack **9** mounted to bear against the front bottom **27'** of the bin. Preferably a jack is mounted at each side of the bottom, as indicated in FIG. **2,** with valved connection **20** from the pump **7** to raise or lower the jack. As jack means **9** elevates bin **1** the bin **1** would tilt except that supporting and restraining links or arms **17** and **18** keep the bin level. Each link **17** and **18** is mounted pivotally at its ends to the frame **2** and to bin **1,** as shown in FIG. **1.** These links are equal in length and in angle of mounting and thus move in equal arcs, each about its own fixed center. These links by reason of their own strength and that of the (preferably metal) bin restrain the bin to rise level (thus rise vertically over the tile) rather than to tilt under thrust by jacks **9.** These factors not only keep the throat **12** direction constant but also provide at the opposite or rear side of the bin readily accessible space for a compact arrangement of the prime mover group B.

In this invention the elements themselves may be selected from the prior art or be improvements. The machine operates through an extreme speed-reduction torque-increase system powered by a conventional small engine, say two to five horsepower, gasoline engine, through a hydraulic system. The engine through this pump-motor-reducer combines to drive winch **24** mounted over the plate **26** and with the plate distribute major weight at the front of the machine. Preferably the speed reduction is of the order of about 1:150 peripheral speed of the cable on the winch to corresponding speed of the hydraulic motor; or a range of the order of about 1:125 to 1:175. This may be made to amount substantially to relative rotary speeds of winch and motor. The hydraulic motor and the speed reducer are of reversible types, acting according to appropriate valve action in the hydraulic fluid-circulating piping **22.**

The winch winds suitable wire rope **4** or the like. The remote or free end of this rope is arranged, as by hook or loop, to fasten to a convenient anchor **5** well ahead of the machine in line, whether in the ditch or ahead of the ditch. This anchor may be moved ahead from time to time if a given ditch is to be extended. The cable **4,** wound on the winch during machine advance, is readily unwound on pulling a pin **25** in the winch axle or some slack may be obtained by valving the fluid to reverse motor **8.** A ditch may be of length usual in septic drain fields, say 50 to 100 feet, or may be lengthened from time to time indefinitely as the machine advances in placing tile or cable or the like.

Functioning of this machine-mounted hydraulic-reduction-winch system is to provide an operating time-torque control in conjunction with a simple prime mover source. This source may have its own throttle control, though usually this will not be called on to vary appreciably as the tiling machine operates. As the winch slowly winds the anchor cable, the advance will be slow; that is, the space: time factor will be relatively low. This will be as previously designed, say the order of 5 to 10 feet a minute forward. The corresponding force or torque on the winch, however, will have increased considerably because of the high reduction of speed through the hydraulic motor and pump to the prime mover. Thus if the slowly advancing machine encounters a resistance, say a stone extending from a side wall of the ditch or the bottom, or loose dirt, the closely-pressing machine sides or bottom sheet **26** repress the stone or clear the wall or the bottom without jerking or stalling the machine or the gravel feed. The overcoming force is available gradually as needed as machine speed drops through the considerable reduction ratio at the hydraulic motor **8** as well as the hydraulic pump **7,** and vice versa. Should an obstacle tend to impose observable change of speed in the hydraulic motor, or in the prime mover itself, reaction of the prime mover will be only small and gradual and well within usually minor ultimate throttle control of the prime mover. The resulting side walls and bottom of the ditch contacted by the tile machine will be substantially evened. The resulting time and power components of the advancing machine as well as of the descending gravel flow remain steady. The gravel thus retains constant time intervals to spread itself under the tile beneath the throat **12** even to say a 2 foot width and then to cover the tile to desired depth, for example, 6 inches. The constancy and compactness of this conjoint placement of tile and gravel, once a given setting is begun, are attributable to the constant and smooth speed factor of the tile machine, as ample force or torque factor adapts to ditch obstacles. This is in effect a self-actuated system control to provide a practical simplified machine for one-man labor.

It may be added that this machine is readily put into a ditch for drain-tile or cable placement, for example by pick-up chain from a front-end loader. The machine once started moves unattended. The operator can use his time and tractor to move gravel as needed from a supply to the gravel bin of the machine.

Other useful functions also become available. Thus the slow, steady gravel flow itself now serves as a reliable means to limit the work of the prime mover. If the gravel bin becomes empty, effective drive of the hydraulic motor **8** ceases, even though the prime mover continues to operate. As already described, it is now evident that if movement of the tile machine itself were erratic or jerky and so likewise the gravel flow, then control plate **13** would fluctuate and render the prime

mover or the hydraulic motor ineffective when not intended.

This invention provides conditions for constant gravity flow of filler through a bottom throat and positioning in conjunction with a declining line of tile. The combinations of controlling forces if erratic or jerky, as an outside vehicle or too rapid travel would impose, would leave a trail of loose pockets or shallow bedding under the finished line of tile. These are potentially inferior seepage spots, largely undetected and likely to grow when the ditch is filled in later. This invention is to minimize matters of operator judgment and to obtain automatically reliably compact and constant placement.

In some situations the tile must be bedded at a higher or a lower distance above the bottom of the ditch then in other situations. In other words, the gravel discharge throat must be set to travel at various selected heights, as inspector requirements or as operator appraisal of the ditch bottom terrain may indicate, or likewise a condition of more or less moisture in the filler or the nature of a filler such as sand. Flow of filler by this invention can meet various demands for firm, consistent deposit, as the conjunction of tile and gravel travel from desired heights is controlled by the jacks and the level control means described.

It will be evident that reference to gravel in this description and claims likewise applies to other fillers that flow, for instance dry sand, and that reference to a line of tile includes not only the illustrated continuous tile, for instance plastic, but to other applicable types of conduit for which various guide mechanisms are known in the art.

In the foregoing I have set forth my best mode of application of this invention, in terms of description but not of limitation. Those skilled in the art can now perceive modifications and equivalents within the scope of the appended claims.

I claim:

1. Improvement in a machine to operate alone for embedding a line of tile and gravel together in a trench for dispersal of polluting liquids, the machine comprising a frame and supporting means therefor to move along the trench bottom, a hopper for gravel movably mounted for adjustment of its height within the frame and having front and rear walls sloped to a bottom throat cross-wise of the trench centrally of the frame, the said supporting means comprising a bottom plate covering and formed to ride upon the trench bottom under the front wall of the hopper, in combination with means forwardly of the throat to direct a line of tile to decline beneath the throat to a lowest bottom position rearwardly of the throat, and in combination with means for slow, smooth advance of the machine, comprising prime mover means mounted on the frame, a winch mounted on the forward end of the frame and adapted to receive a cable to anchor ahead of the machine and to wind on the winch to advance the machine, and hydraulic means operatively connected to the prime mover means and to the winch to drive the winch, and means connected to the winch to reduce the speed of advance of the machine as the cable winds.

2. Improvement in a machine to operate alone for embedding a line of tile and gravel in a trench for dispersal of polluting liquids, as claimed in claim **1**, in which the hydraulic means for slow, smooth advance of the machine and of the bottom plate upon the trench bottom comprises a hydraulic motor, a winch driven thereby and speed reduction means to diminish the winch speed to the order of 1:125 to 1:175 of corresponding speed of the hydraulic motor.

3. Improvement in a machine for operating alone to embed a line of tile and gravel in a trench for disposal of polluting liquid, as claimed in claim **1**, having jack means supported by the frame and positioned to thrust up against the sloping front wall of the hopper and move the hopper to adjust the hopper throat height.

4. Improvement in a machine to operate alone to prepare a line of tile and gravel in a trench for disposal of polluting liquid, as claimed in claim **3**, in which the jack means is hydraulic, hydraulic means adjustably connect the jack means to the stated prime mover for operation thereby, the stated hopper is mounted within the frame for height adjustment free from direct contact with the frame, and arms pivotally mounted on the frame and on the hopper to swing with the hopper and restrain the hopper in its height adjustment.

5. Improvement in a machine to operate alone to prepare a line of tile and gravel in a trench for disposal of polluting liquid, as claimed in claim **3**, in which the stated jack means and the hopper are supported on the same side of the hopper and the hopper support comprises two arms of equal length, each having one end pivotally mounted on the hopper and one end pivotally mounted on the frame to swing together with the hopper.

6. Improvement in a machine to operate alone for embedding a line of tile and gravel together in a trench for dispersal of polluting liquids, comprising a frame, a gravel hopper with rearwardly open throat, a winch for anchor cable, means to operate the winch comprising prime mover means mounted on the frame and a control flap hinged beneath the hopper to swing up to the rear with flow of gravel from the hopper and to swing down with lack of flow of the gravel, and means connecting the flap with the winch operating means to stop the winch on lack of flow of gravel.

7. Improvement in a machine to operate alone for embedding a line of tile and gravel together in a trench for dispersal of polluting liquids, the machine comprising a frame and support means therefor adapted to move along the trench bottom, a hopper for gravel movably mounted free of the frame for adjustment of hopper height within the frame and having front and rear walls sloped to a bottom throat crosswise of the trench centrally of the frame, and comprising means forwardly of the throat to direct a line of tile to bottom position rearwardly of the throat, in combination with lifting means supported by the frame and positioned to act upwardly on the sloping front wall of the hopper and move the hopper free from the frame to adjust the hopper throat height from the bottom of the trench, and arms pivotally mounted on the frame and on the hopper to swing with the hopper and restrain the hopper to a substantially vertical path over the tile in the hopper height adjustment.

8. Improvement in a machine to operate alone for embedding a line of tile and gravel together in a trench for dispersal of polluting liquids, the machine comprising a frame and supporting means therefore to move along the trench bottom, a hopper for gravel movably mounted for adjustment of its height within the frame and having front and rear walls sloped to a bottom throat cross-wise of the trench centrally of the frame,

the said supporting means comprising a bottom plate covering and formed to ride upon the trench bottom under th front wall of the hopper, in combination with means forwardly of the throat to direct a line of tile to bottom position rearwardly of the throat, and combination with means for slow, smooth advance of the machine, comprising prime mover means mounted on the frame, a winch mounted on the forward end of the frame and adapted to receive a cable to anchor ahead of the machine and to wind on the winch to advance the machine, and hydraulic means operatively connected to the prime mover means and to winch to drive the winch and means connected to the winch to reduce the speed of advance of the machine as the cable winds.

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