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METHOD AND APPARATUS FOR INSTALLING SUPPORTING ELEMENTS IN PERMAFROST

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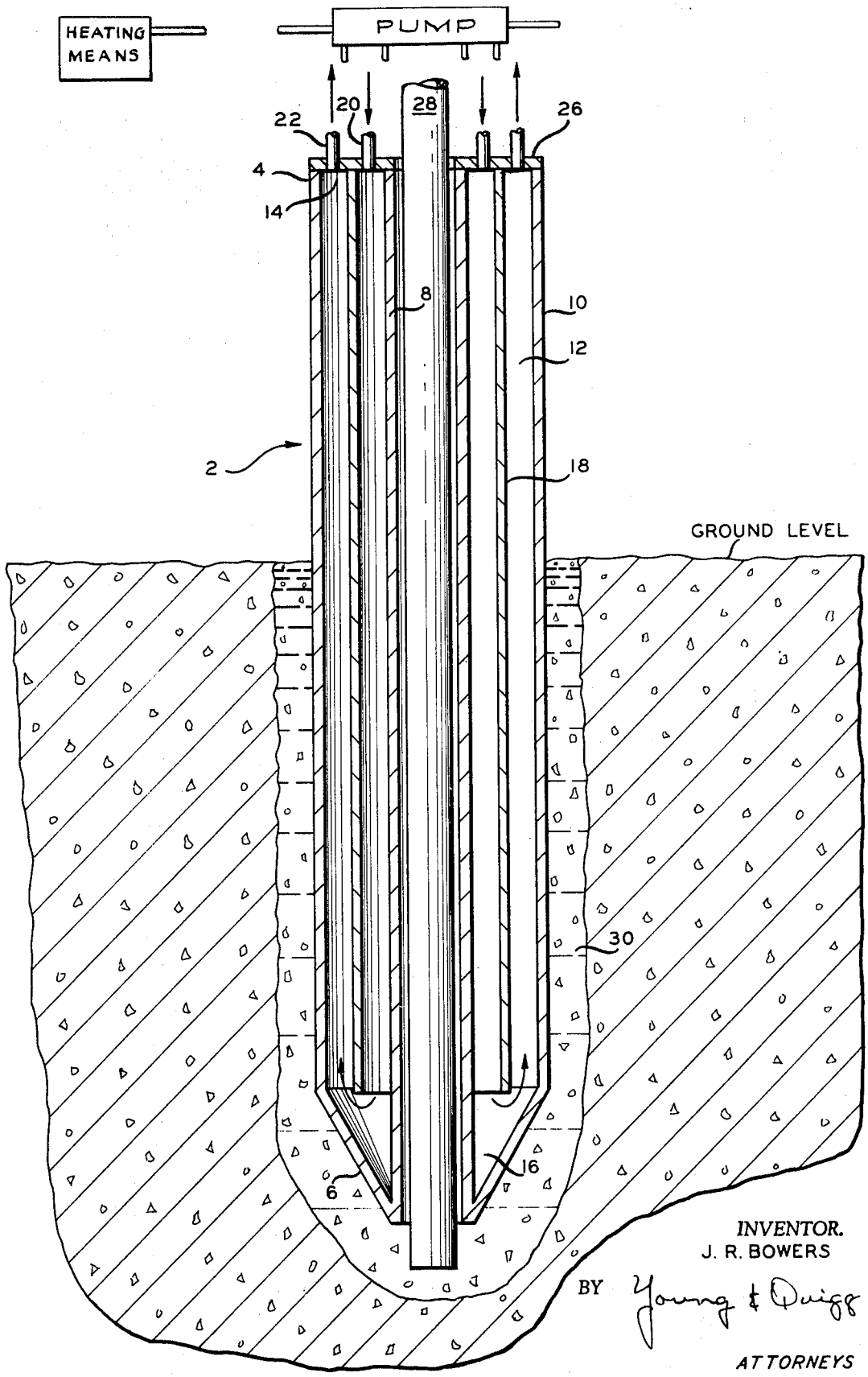

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METHOD AND APPARATUS FOR INSTALLING SUPPORTING ELEMENTS IN PERMAFROST

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ABSTRACT OF THE DISCLOSURE

A method and apparatus for thawing permafrost and installing an elongated supporting element therein.

This invention resides in a method and apparatus for installing an elongated supporting element in permafrost. In another aspect, this invention resides in the method and apparatus for melting permafrost and inserting an elongated supporting element within the permafrost.

In the area of permafrost formation, it has heretofore been difficult and time consuming to insert elongated supporting elements into the permafrost. Examples of the supporting elements that are often desired to be installed are pilings, guy line anchors, stakes, pipeline supports, foundation anchors, and the like. Heretofore these supporting structures were installed in the permafrost by a variety of different methods. The presently generally adopted method is to drill a hole, insert the supporting structure, fill the hole with loose, unfrozen soil, and then maintain said element until the filling material freezes. This method requires a great deal of time, labor and the utilization of expensive equipment. When using this method it generally requires about one week for the supporting structure to be rigidly maintained by the permafrost. Another method that has been tried is to use a steam needle for thawing a portion of the permafrost, inserting a supporting structure, and thereafter maintaining the supporting structure until the permafrost refreezes. This method was unsatisfactory because the permafrost could not be thawed for a small areal extent and was, in fact, melted or thawed excessively and therefore often required up to two months before the permafrost would refreeze and maintain the supporting element. Generally the supporting element is desired to be used soon after installation.

It is therefore an object of this invention to provide a method and apparatus for inserting a supporting structure into permafrost with reduced labor, equipment, and time requirements. Other aspects, objects, and advantages of the present invention will become apparent from a study of the disclosure, the appended claims, and the drawing.

The drawing is a diagrammatic frontal view in partial longitudinal section of the apparatus of this invention and the supporting element to be installed.

In the drawing, the heating element **2** is an elongated structure having first and second end portions **4**, **6**. First and second spaced apart coaxial walls **8**, **10** form an annular chamber **12** of the heating element **2** with first and second ends **14**, **16** of the chamber **12** being sealed and a central opening extending longitudinally through the element **2**. A coaxial dividing member **18** is positioned between the first and second walls **8**, **10** within the chamber **12** and is attached at one end to the first end portion of the element **2** with the opposed end of the said member **18** being spaced from the walls **8**, **10** at the second end of the chamber **12**. At least one separate fluid line **20** opens into communication with a portion of the first end **14** of the chamber **12** between the first wall **8** and the dividing member **18** and at least one separate fluid line **22** opens into communication with a portion of the first end **14** of

the chamber **12** between the second wall **10** and the dividing member **18**. Fluid heating and recovery means (not shown) are attached to the lines **20**, **22** for passing heated fluid into the chamber **12** and forcing said fluid through the heating element **2** in one direction in contact with one wall and the dividing element, returning said fluid back through the element **2** in an opposed direction in contact with the other wall and the dividing member **18** and recovering said fluid for heating.

In order to more easily pass the heating element **2** into the permafrost, it is preferred that the second wall **10** of the heating element be angled inwardly toward and annularly connected to the first wall **8** at the second end portion **6** for providing a second end portion **6** of smaller diameter than the first end portion **4** of element **2**. In order to simplify construction of the apparatus, it is preferred that the first end **14** of the chamber **12** be sealed by sealably attaching an end plate **26** to the first and second walls **8**, **10** and the dividing member **18** at the first end portion **4** of the heating element **2**.

The central longitudinal opening of element **2** should be of slightly larger diameter than the diameter of the supporting element **28** to be inserted into the permafrost. It is also preferred (as later described) that line **20** be an inlet line and line **22** be a line for recovering fluid from the element **2**.

In the operation of this apparatus, the supporting element **28** is inserted through the longitudinal opening of the heating element **2** and the second end portion **6** of the element **2** and the supporting element **28** are placed in contact with the permafrost with the supporting element **28** positioned at the desired angle relative to said permafrost. Heated fluid is then passed from the fluid reservoir preferably through line **20** and into a portion of the chamber defined by the first wall **8** and the dividing member **18**. The heated fluid is forced from the first end portion **4** of the heating element **2** to the second end portion **6** in contact with the first wall **8** and dividing member **18** and thereafter from the second end portion **6** to the first end portion **4** of the heating element **2** in contact with the second wall **10** and the dividing element **18**, through line **22** and into remotely located fluid recovery apparatus. By directing the heated fluid through the element **2** in the preferred direction, the areal extent of the heated portion **30** of permafrost is maintained at a lower range than if the heated fluid first entered the portion of the chamber **12** immediately adjacent the permafrost. This preferred fluid pathway also maintains the thawed permafrost in an annulus between the supporting element **28** and the first wall **8** of the element **2** at a higher temperature for conduction of heat through the supporting element **28** and against the permafrost about the longitudinal axis of the supporting element **28**. This is particularly advantageous where the supporting element to be installed is constructed of metal.

As the permafrost adjacent the heating element **2** and supporting element **28** thaws and become relatively plastic in character, the heating and supporting elements **2**, **28** are urged into said permafrost.

The circulation of heating fluid and urging of the elements **2**, **28** into the formation are continued until the supporting element **28** has been inserted into the permafrost a desired distance. That distance is dependent upon the type and use to be made of the supporting element **28**. At that time the passage of heating fluid through the heating element **2** is terminated and a supporting element **28** is maintained within the permafrost until the permafrost refreezes to a strength sufficient to support the supporting structure **28**. Depending upon the condition of the permafrost and the use to be made of the supporting structure, the heating element **2** can be withdrawn from the permafrost after

terminating the passage of the heating fluid therethrough or said element **2** can be maintained in place and both the heating element **2** and supporting structure **28** maintained until the permafrost refreezes. Depending upon the permafrost conditions, the heating fluid can be intermittently passed through the heating element or can be passed through the heating element in a continuous stream. Where the area is extremely cold and refeezing is rapid, it has been found that installation time can be reduced by utilizing a continuous stream of heating fluid. In warmer regions, however, the heating stream is preferably intermittently passed through the heating element in order to reduce the areal extent of thawing and thereby reduce the amount of time required for refreezing the permafrost and maintaining the supporting element **28**. Other modifications and alterations of this invention will become apparent to those skilled in the art from the foregoing discussion and accompanying drawing, and it should be understood that this invention is not to be unduly limited thereto.

What is claimed is:

1. An apparatus for installing elongated supporting elements in permafrost, comprising:

an elongated heating element having first and second spaced apart opposed end portions, inner and outer spaced apart coaxial walls connecting said end portions, said walls and said end portions forming a chamber therebetween, a coaxial dividing member within the chamber longitudinally separating said chamber, and a central opening defined by the inner wall extending longitudinally through the heating element for insertion of the supporting element therethrough; and

means for passing heating fluid into the chamber, through the heating element in one direction in contact with one wall and the dividing member, back through the heating element in an opposed direction in contact with the other wall and the dividing member, and out of the chamber.

2. An apparatus, as set forth in claim **1**, wherein the outer wall of the heating element is angled toward and annularly connected to the inner wall at the second end portion for providing a heating element with a second end portion of smaller diameter than the first end portion.

3. An apparatus, as set forth in claim **1**, including an end plate sealably attached to the inner and outer walls at the first end portion of the heating element and to a first end of the dividing member with a second end of the dividing member terminating adjacent and spaced from the second end portion of the heating element.

4. A method for inserting elongated supporting elements in permafrost, comprising:

providing an elongated heating element having first and second end portions, first and second spaced apart coaxial walls, a chamber, a dividing member within the chamber for providing a heating fluid pathway through the heating element in one direction in contact with one wall and the dividing member and returning the heating fluid back through the heating element in an opposed direction and in contact with the other wall and the dividing member, and a central opening defined by the first wall extending longitudinally through the heating element for inserting a supporting element therethrough;

inserting the supporting element within the opening of the heating element;

placing the second end portion of the heating element and the supporting element in contact with the permafrost;

passing heating fluid from a fluid heating means into a portion of the chamber of the heating element in contact with the first wall and the dividing member;

forcing the heating fluid from the first end portion of the heating element to the second end portion in contact with the first wall and the dividing member and from the second end portion to the first end portion of the heating element in contact with the second wall and the dividing member;

urging the heating element and the supporting element into the permafrost;

continuing passage of heating fluid through the heating element and urging the heating element and the supporting element into the permafrost until the supporting element has been inserted into the permafrost at a desired distance;

terminating the passage of heating fluid through the heating element; and

maintaining the supporting element within the permafrost until the permafrost adjacent the supporting element is frozen.

5. A method, as set forth in claim **4**, including the step of withdrawing the heating element from the permafrost after terminating the passage of fluid therethrough.

6. A method, as set forth in claim **4**, including forcing a continuous stream of heating fluid through the heating element.

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