

[54] PERMAFROST INSULATION
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[56] References Cited
UNITED STATES PATENTS
895,612 8/1908 Baker 166/57
3,271,710 9/1966 Leonard 165/45 X
3,319,202 5/1967 Lockie.....165/128 X
3,380,530 4/1968 McConnell et al. 166/303

3,498,381 3/1970 Earlougher 166/57 X

FOREIGN PATENTS OR APPLICATIONS

184,205 1/1967 U.S.S.R. 166/57

OTHER PUBLICATIONS

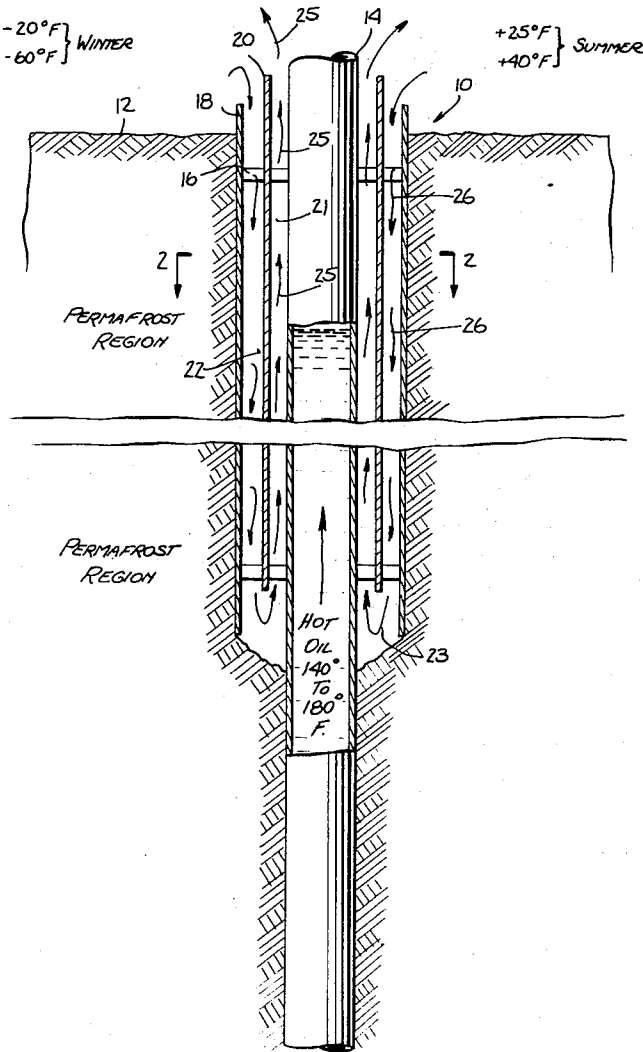
Dunlap, Carl H., et al., Transformers, Chicago, Am. Technical Soc'y., 1948, p. 83. TK2551.D8
Slope Operators Plan Subsidence Fight in Oil & Gas J., Dec. 8, 1969, pp. 69- 72.

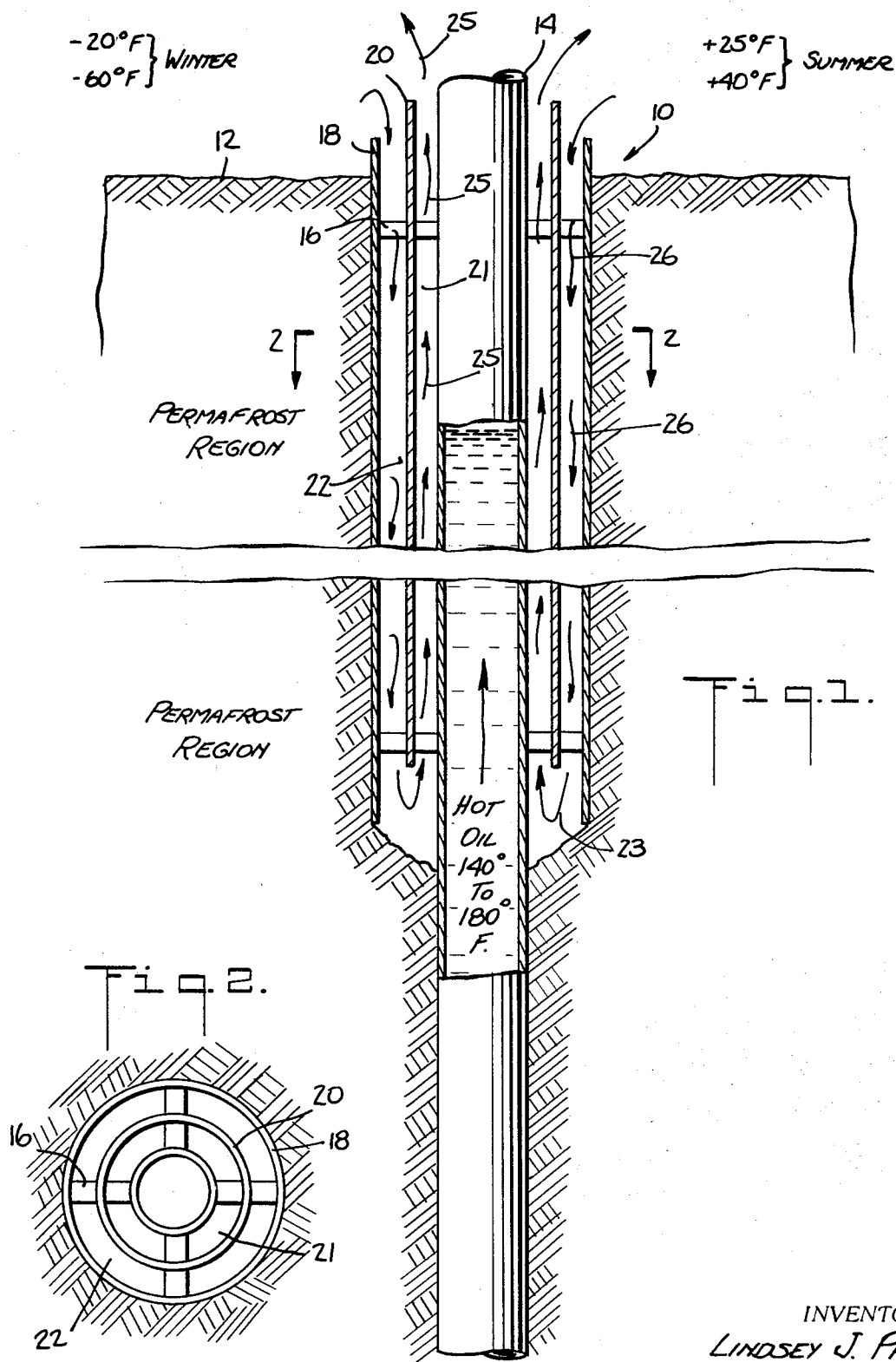
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[57] ABSTRACT

Oil pipelines through permafrost regions in the earth are thermally insulated therefrom by atmospheric air flow passageways arranged to direct atmospheric air down along a first path close to the permafrost soil and then back up between the first path and the oil pipeline.

3 Claims, 2 Drawing Figures





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PERMAFROST INSULATION

This invention relates to heat transfer control and more particularly, it concerns novel thermal insulating arrangements for maintaining a substantial temperature difference between two closely positioned objects.

The present invention is particularly advantageous in connection with the transmission of oil and other fluids, which may be quite warm, through a permafrost region in the earth. With the present invention, such transfer may be effected without destroying the surrounding permafrost conditions.

Substantial subterranean resources, particularly oil, have been found to exist in arctic regions. However, due to the environmental conditions of these arctic regions, difficulties have been encountered in extracting these resources. One such difficulty results from the fact that the resources exist beneath a permafrost region. This permafrost region is an upper earth layer whose water content remains substantially permanently frozen. The nature of the soil containing this permanently frozen water is such that the load-bearing capability of the soil is severely reduced whenever any melting occurs. Thus, if an oil well pipeline is driven down through a permafrost layer, the layer will experience melting in regions adjacent the pipeline and as a result the earth becomes incapable of supporting the pipeline and allows it to slip downwardly.

Prior techniques of providing insulation between the pipeline and the surrounding permafrost soil have been inadequate since the heat from the pipeline eventually passes through the insulation and makes its way to the surrounding soil.

The present invention overcomes these difficulties of the prior art and permits warm materials to be handled in or adjacent to permafrost regions without destruction of the condition of the surrounding soil through melting. This is achieved, moreover, in a simple and efficient manner requiring a minimum of equipment and no moving parts or expenditure of energy.

According to the present invention, warm materials within permafrost regions are thermally isolated from the surrounding soil by continuously passing air, from the atmosphere above the soil, successively along a first path between the warm materials and the adjacent soil, then back along a second path between the warm materials and the first path and back out to the atmosphere. The permafrost soil is contacted by a continuously moving stream whose source is the atmosphere which maintains the permafrost condition of the soil. This air then passes along and adjacent to the warm materials and because of its movement, the air does not conduct heat laterally to the permafrost soil, but instead it transmits this heat longitudinally by convection to the atmosphere.

As illustratively embodied, the present invention is employed in an oil well pipeline by means of a pair of intermediate and outer casings which surround the oil well pipeline from the surface of the earth to a point below the permafrost region. The casings are open at their upper end and are in communication with each other at their lower end. The warm oil in the pipeline heats the air between the pipeline and the intermediate casing and this warm air beings to rise. The resulting upward movement of air in the region between the oil pipeline and the intermediate casing produces a cor-

responding downward movement of fresh atmospheric air down through the region between the intermediate and outer casings.

Various further and more specific objects, features and advantages of the invention will appear from the description given below, taken in connection with the accompanying drawings, illustrating by way of example a preferred form of the invention.

In the drawings:

FIG. 1 is a section view taken in elevation, and partially cut away, illustrating an oil well casing installation in which the present invention is embodied; and

FIG. 2 is a section view taken along line 2—2 of FIG. 1.

As shown in FIG. 1, an oil well installation, indicated generally at 10, extends down through the earth 12. The upper regions of the earth 12 are indicated as being in a "permafrost" condition. This condition, which is characteristic of arctic regions, results from the substantially permanent freezing of soil due to the low ambient temperatures which remain substantially below freezing nearly continuously. Because of this condition, the water in the soil does not flow or drain; and, so long as the water content remains frozen, the soil behaves in a mechanically stable manner. That is, it is capable of supporting loads and is capable of frictionally restraining elements such as piles and the like which are driven into it. However, if melting conditions occur, the water content in the soil then begins to flow and the soil becomes mechanically unstable.

A well casing 14 is driven down through the earth 12 past the permafrost region to a source (not shown) of oil or other material to be extracted. As can be seen in FIGS. 1 and 2, the oil well casing 14 is supported by means of spaced-apart radial ribs 16 inside a tubular outer conductor casing 18. The ribs 16 allow free longitudinal movement of air between the casings. The conductor casing 18 is driven into the earth 12 and provides support for the oil well casing 14 by virtue of its frictional engagement with the surrounding earth. It is, of course, necessary that the surrounding earth be capable of providing the necessary frictional restraint to support the conductor casing and its oil well casing load, and the conductor casing 18 may extend, for example, several hundred feet in order to enable the buildup of the necessary frictional restraint.

An intermediate supplemental casing 20, having a diameter intermediate the diameters of the well casing 14 and the conductor casing 18, is positioned coaxially with and between these two casings and is supported on the radial ribs 16. The supplemental casing, as can be seen in FIGS. 1 and 2, cooperates with the well casing 14 to define an inner annular chamber 21, and with the outer conductor casing 18 to define an outer annular chamber 22. It will be appreciated that the air in the chambers forms a pair of insulating layers between the well casing 14 and the surrounding permafrost earth 12.

The manner in which the above-described arrangement operates to preserve permafrost conditions of the surrounding soil, as well as the soil's mechanical restraining capabilities, will now be described.

As indicated in FIG. 1, the atmosphere immediately above the surface of the earth 12, remains substantially below freezing for the major portion of each year.

Thus, in the winter, the temperature of the atmosphere immediately above the earth, ranges from -20° to -60° F, whereas in the summer, the temperature of the atmosphere ranges from $+25^{\circ}$ to $+40^{\circ}$ F. Actually, the temperature even in the summer never rises above freezing for a sufficient duration to allow substantial melting of the frozen water in the soil 12 so that the soil retains its permanently frozen or "permafrost" condition.

As indicated in FIG. 1, oil is withdrawn from a source deep within the earth and passes upwardly within the well casing 14. This oil may be at a temperature between 140° and 180° F as it passes up through the well casing 14. If the heat of this oil were to transfer to the adjoining earth 12, it would melt the water in the soil and destroy its permafrost condition. This, however, does not occur in the arrangement shown.

As heat passes laterally from the oil within the well casing 14, it heats the air in the inner annular chamber 21 causing this air to expand and rise upwardly toward the atmosphere, as indicated by the arrows 25. This upward movement of air within the inner annular space is accompanied by a corresponding downward movement of air from the atmosphere through the outer annular chamber 22, as indicated by the arrows 26. As indicated by the arrows 25 and 26, there is thus set up, by virtue of the heat flow from the well casing 14, a natural air circulation system by which cold air from the atmosphere passes downwardly through the outer annular chamber 22 and reverses to pass upwardly through the inner annular chamber 21. This continuous movement of air acts as a convection system to carry heat from the well casing 14 out to the atmosphere and away from the surrounding earth. At the same time, cold air below freezing is continuously ingested from the atmosphere and passes along the inner surface of the conductor casing 18. The movement of this cold atmospheric air along the wall of the casing 18 serves to maintain the casing at below freezing temperatures so that no heat will be transmitted to the surrounding earth 12. Accordingly, the permafrost condition of the soil is preserved and the soil remains sufficiently stable

to support the conductor casing 18 and in turn the supplemental casing 20 and the well casing 14.

Having thus described the invention with particular references to the preferred form thereof, it will be obvious to those skilled in the art to which the invention pertains, after understanding the invention, that various changes and modifications may be made therein without departing from the spirit and scope of the invention as defined by the claims appended hereto.

What is claimed is:

1. A method of transferring warm fluid through a permafrost region of the earth without destroying the permafrost conditions of said region, said method comprising the steps of, passing said fluid from a subterranean zone through a conduit in said permafrost region to the surface, and causing a continuous flow of air at atmospheric pressure and ambient temperature from the atmosphere above the surface of said permafrost region to pass in a first path downwardly along between a casing concentric with said conduit and said permafrost region, then upwardly between said conduit and said casing, and back to the atmosphere.

2. In combination with an oil well which includes an oil conduit extending from above the surface of the earth down through a permafrost region in the earth to a source of oil below said permafrost region, a tubular outer casing displaced from and surrounding said conduit and frictionally engaging the surrounding earth, rib means mechanically supporting said conduit on said outer casing and an intermediate tubular casing extending down between said outer casing and said conduit and defining therewith a pair of concentric annularly-shaped air passageways, each of said air passageways being fully and directly open at their upper end to the atmosphere whereby there is produced an automatic self-regulating flow of coolant air from the atmosphere down between the outer and intermediate casings and back up to the atmosphere between the intermediate casing and said oil conduit.

3. A combination according to claim 2, wherein said intermediate casing extends down to the lower limit of said permafrost region.

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