United States Patent [19]

Allen et al.

[11] **3,794,358**

[45] **Feb. 26, 1974**

[54] **WELL PRODUCTION**

[75] Inventors: **William G. Allen; James A. LeVelle; Frank J. Schuh**, all of Dallas, Tex.

[73] Assignee: **Atlantic Richfield Company**, New York, N.Y.

[22] Filed: **Sept. 21, 1972**

[21] Appl. No.: **290,897**

Related U.S. Application Data

[62] Division of Ser. No. 241,131, April 5, 1972, Pat. No. 3,720,267, Division of Ser. No. 77,647, Sept. 2, 1970, Pat. No. 3,680,631.

[52] **U.S. Cl.**.................... **285/47,** 285/138, 285/286

[51] **Int. Cl.**... **F161 59/14**

[58] **Field of Search**.......... 285/47, 286, 133 R, 138; 138/114; 166/DIG. 1

[56] **References Cited**

UNITED STATES PATENTS

3,654,691	4/1972	Willhite et al.	285/138
3,275,345	9/1966	Woldron et al.	285/47

FOREIGN PATENTS OR APPLICATIONS

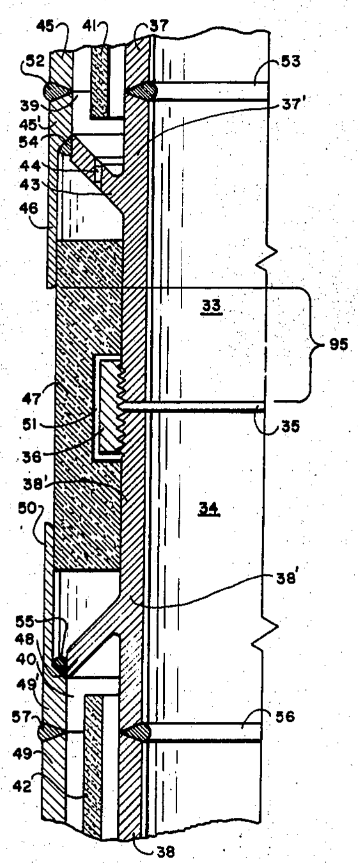
6,506,101	11/1965	Netherlands	285/133 R

Primary Examiner—Dave W. Arola
Attorney, Agent, or Firm—R. W. MacDonald

[57] **ABSTRACT**

A method and apparatus for producing a warm fluid from a well through casing, the casing passing through a permafrost zone, wherein the permafrost is insulated from melting by the combined use of vacuum and solid thermal insulation.

4 Claims, 5 Drawing Figures



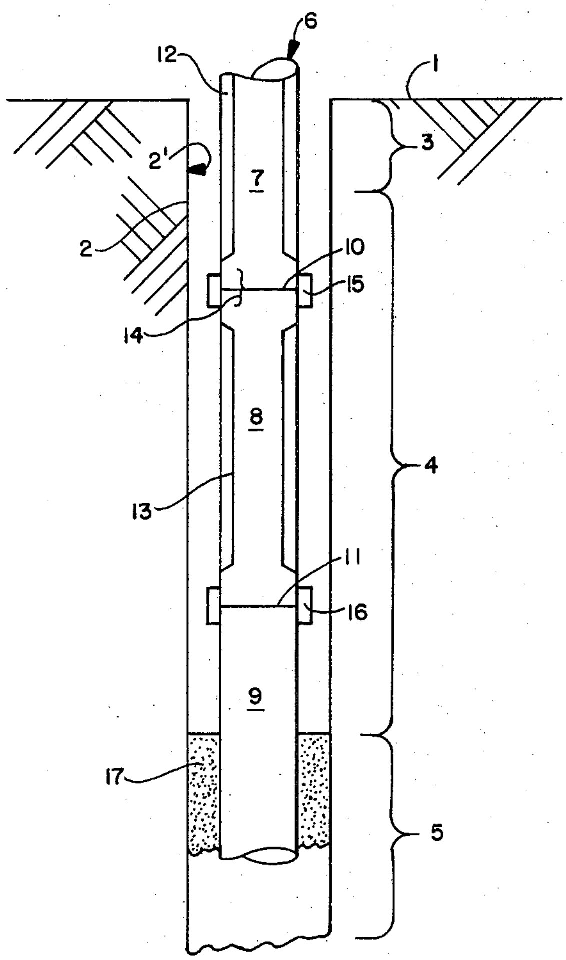

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FIG. 1

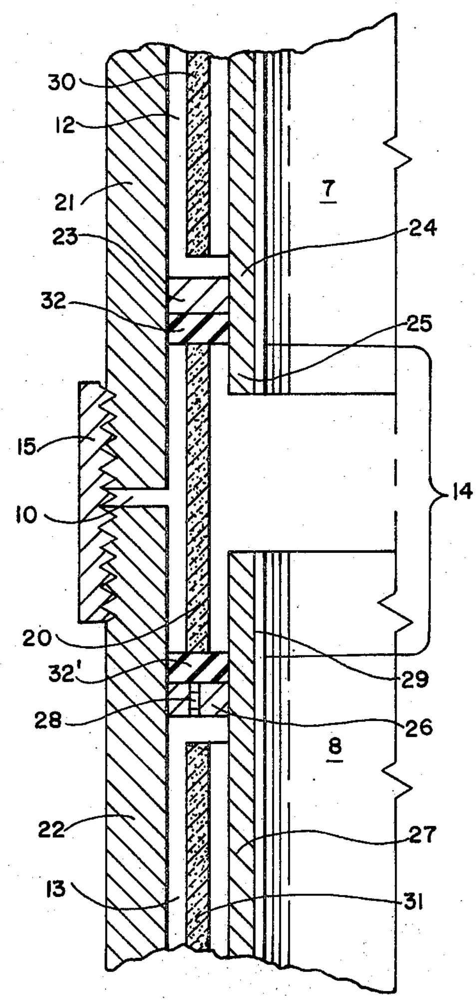
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FIG. 2

PATENTED FEB 26 1974 3,794,358

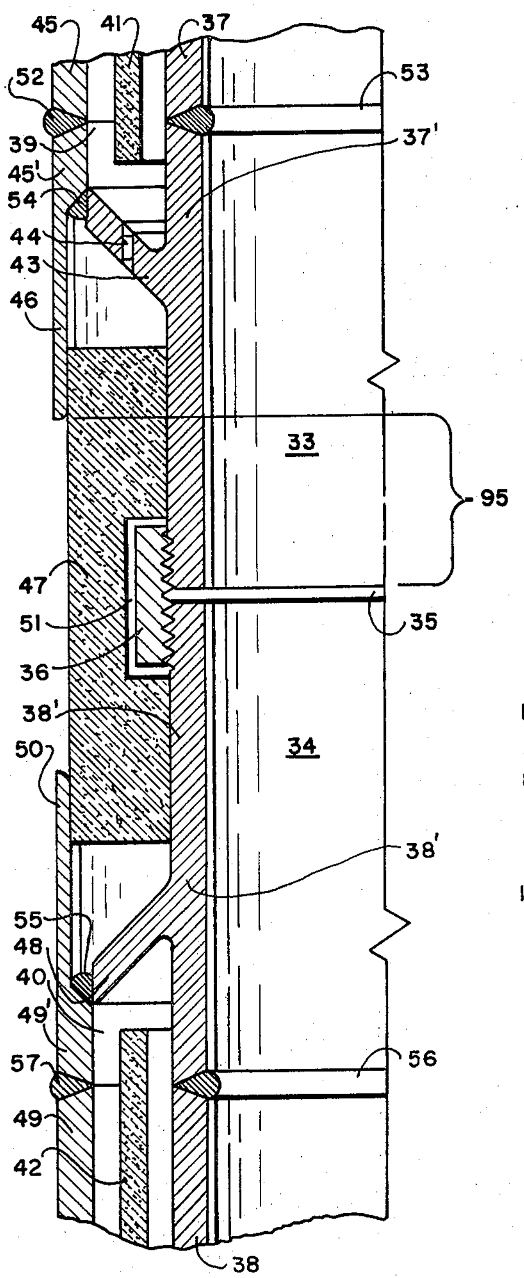

FIG. 3

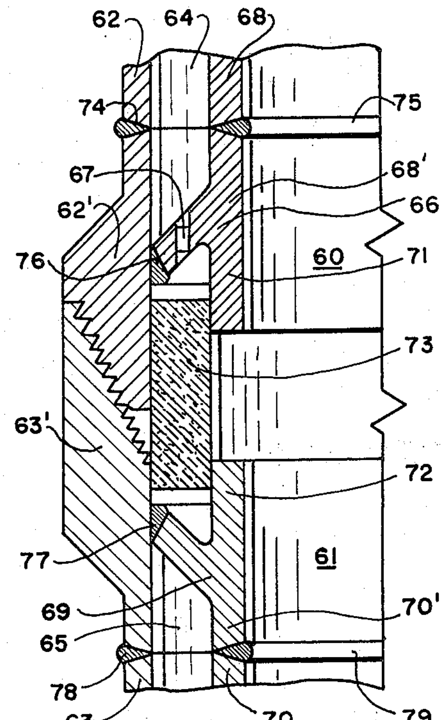

FIG. 4

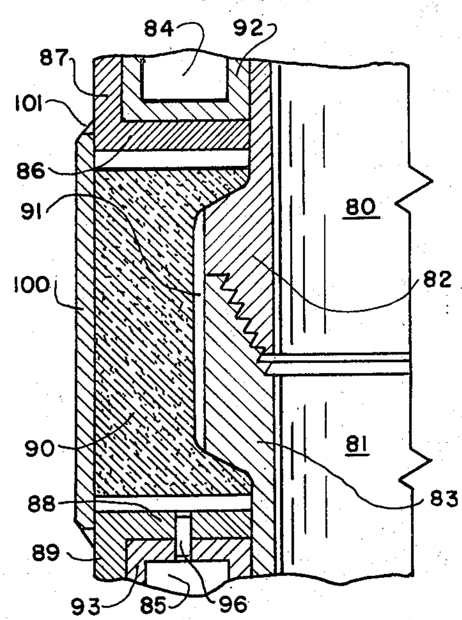

FIG. 5

WELL PRODUCTION

CROSS REFERENCES TO RELATED APPLICATIONS

This application is a division of application Ser. No. 241,131, now U.S. Pat. 3,720,267 filed Apr. 5, 1972, which in turn is a division of application Ser. No. 77,647, filed Oct. 2, 1970, now U. S. Pat. No. 3,680,631.

BACKGROUND OF THE INVENTION

Heretofore in the production of warm fluid such as petroleum gas and/or petroleum liquid from a wellbore in the earth through a permafrost zone whereby part of the permafrost could be melted upon continued exposure to the warm fluid, it has been proposed to coat or otherwise surround the casing or tubing (pipe) in the wellbore with solid thermal insulation such as polyurethane foam. The insulation normally extends from the earth's surface down to the bottom of the permafrost zone in a continuous cylindrical form.

Thermal insulation applied in this manner to the outside of casing or tubing is expensive to apply to each joint of the pipe as it passes into the wellbore because it takes up the time of the rig and the workmen to apply the insulation. The insulation is quite fragile under the normal conditions in which pipe of any type is inserted into a wellbore and, therefore, is likely to be at least partially scraped or otherwise broken off from the pipe before the pipe is set into its final position in the wellbore. Further, some insulation, particularly the porous type of insulation, does not act as efficiently in a wellbore if liquid, which is almost always present in a wellbore, penetrates the pores of the insulation.

Thus, it is highly desirable to have an efficient type of insulation which is quite durable under normal operating and pipe emplacement conditions on a well so that one can be certain that the insulation is intact when the pipe is emplaced in its final position in the wellbore and which does not take up an undue amount of time of the rig and personnel when running the pipe into the wellbore.

SUMMARY OF THE INVENTION

According to this invention all of the above requirements are met by minimizing the amount of solid insulation used and physically protecting the minor amount of solid insulation that is used.

According to this invention, apparatus wherein each section of casing, tubing, or other pipe which is desirably insulated in the permafrost zone of the wellbore, hereinafter referred to collectively as casing, is provided with a vacuum chamber for substantially the complete length of each section of casing but which vacuum chamber terminates a finite distance short of either end of each section of casing so that when sections of casing are joined one to another there is an area of relatively uninsulated space where the two sections of casing are joined one to another. Solid insulation is employed in these relatively small uninsulated spaces, and is protected by the configuration of the vacuum chamber itself or holding members or both.

This invention also relates to a method of producing a warm fluid through a casing zone in a wellbore in the earth, the wellbore passing through a zone of permafrost that can be melted in part upon continued exposure to the warm fluid wherein there is provided a plurality of spaced apart vacuum zones along the length of the casing zone in the permafrost zone. There is thus established a plurality of vacuum zones wherein each pair of adjacent vacuum zones has an uninsulated space therebetween and there is provided in at least one of these uninsulated spaces a solid insulation material to provide substantially continuous insulation of the vacuum or solid type throughout the permafrost zone. Thereafter the warm fluid is produced through the thus insulated casing zone to the earth's surface.

This invention provides a method and apparatus whereby fluids hot enough to melt permafrost can be continuously produced through a permafrost zone for a long period of time such as 20 years without substantially melting the permafrost itself.

Accordingly, it is an object of this invention to provide a new and improved method and apparatus for producing wells through a permafrost zone. It is another object to provide a new and improved method and apparatus for thermally insulating pipe in a wellbore. It is another object to provide a new and improved method and apparatus for producing hot fluid through permafrost without substantially melting the permafrost. It is another object to provide a new and improved method and apparatus for thermally insulating at least part of a wellbore in a manner wherein the insulation will stand up under normal handling and emplacement of casing and the like in the wellbore.

Other aspects, objects, and advantages of this invention will be apparent to those skilled in the art from this disclosure and the appended claims.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows a cross-section of a wellbore containing a permafrost zone and with casing emplaced therein in accordance with this invention.

FIGS. 2 through 5 show cross-sections of various embodiments within this invention for arranging the vacuum chambers, the solid insulation in the uninsulated areas where two sections of casing are joined, and various coupling means.

More specifically, FIG. 1 shows the earth's surface **1** with a wellbore **2** drilled therein, the bottom of the wellbore not being shown for sake of brevity. Wellbore **2** passes through a tundra zone **3** at the earth's surface which extends downwardly a short distance of, for example, 2 feet to a permafrost zone **4**. Below zone **4** is unfrozen earth zone **5**.

A casing string **6**, which can be one or more strings of concentric pipe, is shown to be composed of, for simplicity, three individual sections of casing denoted by references numerals **7**, **8**, and **9**. Casing section **7**, the top of which is not shown, is fixed to a conventional wellhead (not shown) which is well known in the art and which extends downwardly into the permafrost zone and terminates at joint line **10**.

Casing section **8** starts at line **10** and extends downwardly to joint line **11**. Casing sections **7** and **8** contain annular vacuum chambers **12** and **13**, respectively. These chambers terminate a finite distance from the ends of each section so that, for example, when sections **7** and **8** are joined as represented by line **10** there is a finite distance **14** of substantially uninsulated casing space. Uninsulated space **14** contains solid insulation, as will be shown hereinafter in detail.

Casing sections 7 and 8 are joined to one another by each threading into a conventional sleeve type coupling 15 which is well known in the art. Casing sections 8 and 9 are also joined at line 11 by sleeve coupling 16.

Casing section 9 starts at line 11 and extends downwardly out of the permafrost zone 4 into the unfrozen zone 5 and there is cemented in by way of cement 17 so that it supports casing sections 7 and 8 and the wellhead.

FIG. 2 shows an enlarged cross-section of the bottom portion of casing section 7 and an upper portion of casing section 8 including uninsulated section 14. Space 14 is shown in FIG. 2 to contain an annular, right cylindrical section 20 of solid thermal insulation to provide continuity of insulation from vacuum chamber 12 to vacuum chamber 13.

In FIG. 2 casing sections 7 and 8 are shown to have main walls 21 and 22, respectively. Vacuum chambers 12 and 13 extend inwardly from main walls 21 and 22 as provided by an inwardly extending annular ring 23 which defines the lower end of chamber 12 and which has a matching member (not shown) enclosing the top of chamber 12. The inner surface of chamber 12 is closed between the lower and upper annular rings by way of annular, right cylindrical sleeve 24.

Sleeve 24 has an extension member 25 which extends from the lower end 23 of vacuum chamber 12 towards the nearest end of casing section 7, i.e., line 10. Member 25 is spaced inwardly from main wall 21 to provide a slot for insertion of insulation 20. This slot holds insulation 20 in place and protects the insulation from material passing through the interior of the casing. Depending upon the amount of protection desired, member 25 can extend substantially to line 10 or any desired distance from ring 23 towards line 10.

Insulation 20 can extend into contact with either or both of rings 23 and 26. Alternatively an annular insulation material such as rubber can be inserted between insulation 20 and rings 23 and 26 as represented by annular ring inserts 32 and 32'. Inserts 32 and 32' can provide a seal against thermal convection currents.

Vacuum chamber 13 is similarly configured with an inwardly extending, upper, annular ring 26 which is the same type of ring which constitutes the upper ring for chamber 12. Ring 25 has a ring similar to ring 23 (not shown) forming the bottom end of chamber 13 and these two rings are joined by innersleeve 27 to define closed chamber 13. Ring 26 has openable port 28 therein by means of which a vacuum can be pulled in the interior of chamber 13. This is also true for the upper ring of chamber 12. Innersleeve 27 also has an extension member 29 which provides the same functions as described hereinabove for member 25.

It should be noted that insulation 20, instead of occupying only part of the lateral space between members 25 and 29 and main walls 21 and 22, respectively, can be sized to substantially completely fill this space.

Vacuum chambers 12 and 13 can be substantially vacant of any matter or can have placed therein additional solid or liquid thermal insulating material or other types of insulating material, such as radiant insulating material, as desired. For example, one or more layers of solid insulating material can be emplaced in chambers 12 and 13 as represented by 30 and 31. This additional insulation at least partially fills the vacuum chambers. The one or more layers of insulating material can be alternated with thermal insulation and other types of insulation as desired.

FIG. 3 shows the joined area of two adjacent sections of casing such as that shown in FIGS. 1 and 2 and as represented by upper and lower casing sections 33 and 34 joined at line 35 by conventional sleeve type coupling 36.

However, one difference in configuration in FIG. 3 is that main walls 37 and 38 carry outwardly extending vacuum chambers 39 and 40 instead of inwardly extending chambers 12 and 13 of FIGS. 1 and 2. Chambers 39 and 40 can also be empty or contain one or more layers of solid and/or liquid insulation materials 41 and 42.

Chamber 39 is defined by an outwardly extending lower, annular, end ring 43 which contains a vacuum port 44 and which before welding is integral only with transition piece 37' of wall 37. Sleeve 45 extends from weld 52 to a similar upper weld (not shown).

Member 46 extends downwardly from sleeve 45 towards the nearest end of casing section 33 to provide a holding and protection member for an annular, right cylindrical ring of solid insulation material 47.

Outwardly extending chamber 40 is composed of an upper annular ring 48 which before welding is integral only with transition piece 38' of inner sleeve 38, outer sleeve 49 being welded at the bottom of a weld similar to weld 52 to form the enclosed chamber 40. Ring 48 is substantially the same as the upper ring which closes chamber 39. Extension member 50 is provided in the same manner and for the same reasons as member 46. Here again members 46 and 50 can extend toward line 35 any desired length, depending upon the desired amount of protection for insulation 47 and the ease with which insulation 47 can be put in place. It should be noted also that insulation 47 has a notched out portion 51 which accommodates coupling 36.

FIG. 3 also shows welds 52 through 57, inclusive. This makes parts 45', 37', 38', and 49' severable from the casing section walls 45, 37, 38, and 49, respectively. Parts 45', 37', 38', and 49' are transition pieces which constitute a type of tool joint, parts 45' and 49' being in addition transition piece spacers due to the spacing function of members 43 and 48.

There are distinct advantages in the fabrication of the overall casing section by having severable tool joints. In assembling casing section 33, wall section 45 and 37 are initially separate and are composed of a conventional casing steel whose strength and other desirable metallurgical characteristics deteriorate when exposed to extreme heat such as that encountered in welding operations. In the first step of assembly pieces 45' and 37' are welded at 52 and 53 to 45 and 37, respectively, but are not yet welded at 54. Similar steps are taken at the opposite end (not shown) of section 33. After making welds 52 and 53, the still separate sections 45 and 37 with transition pieces at both ends are both heat treated at both ends to restore the strength and other desired metallurgical characteristics to the portions of 45 and 37 adversely affected by the heat of welding at 52 and 53. Thereafter insulation 41 can be wrapped around the outside of 37 between ring 43 and the opposing ring at the opposite end of 37 (not shown but the same as ring 48) if it is desired to have additional insulation in chamber 39. Then separate subassemblies 45 and 37 with their transition pieces are assembled as shown in FIG. 3 and final weld 54 made, a similar final weld such as 55 being made at the opposite end of 33. The metallurgical composition of transition pieces 45′ and 37′ is chosen so that deterioration, if any, of strength or other desired properties brought about by the heat involved in making weld 54 does not fall below the minimum strength and other properties of walls 45 and 37. Insulation 41 can be protected from the heat of final welds such as 54 by spacing the insulation 41 away from the end rings such as 43, inserting insulation rings such as asbestos between insulation 41 and the end rings, and the like.

It can be seen from the above that by use of severable, weldable transition pieces of selected metallurgical composition the fabrication of each casing section can be greatly facilitated with adverse effect on the strength etc., of the casing used in the fabrication operation. Thus, commercially available casing pipe can be used in making the casing sections of this invention.

FIG. 4 shows yet another embodiment within the scope of this invention wherein upper and lower casing sections 60 and 61 are threadably joined with one another by means of a pin 62′ and box means 63′ in lieu of the separate couplings 15 or 36.

FIG. 4 shows internally extending, empty vacuum chambers 64 and 65. Chamber 64 is defined by a lower ring 66, with vacuum port 67, part of transition piece 68′, the top of chamber 64 being enclosed by a similar upper annular ring. It should be noted that the upper and lower annular rings can be substantially perpendicular to the main wall of the casing section as shown in FIG. 2 or at any desired inclination such as that shown in FIG. 4. Similarly, chamber 65 is defined by an upper annular ring 69 an integral part of transition piece 70′ and enclosed by means of a lower annular ring similar to ring 66. Both sleeves 68 and 70 carry extension members 71 and 72 as means for protecting solid insulation 73 and for holding that insulation in place.

FIG. 4 shows that pin and box type connections are amenable to the tool joint welding fabrication procedure disclosed in FIG. 3. In FIG. 4 a conventional tool joint composed of pieces 62′ and 63′ is welded to 62 and 63 with welds 74 and 78. Similarly, transition spacer pieces 68′ and 70′ are welded to 68 and 70 with welds 75 and 79. The two subassemblies are welded to one another with final welds 76 and 77. The steps of fabrication are the same as explained for FIG. 3 in that heat treating after welding subassemblies such as at 74, 75, 78, and 79, etc. is carried out to restore strength etc. lost by the welding after which the subassemblies are joined with final welds such as 76 and 77 to complete the casing section with welding, without further heat treating, and without adversely reducing the physical properties of the transition pieces below the same properties of 62, 68, 63, and 70.

FIG. 5 shows upper and lower casing sections 80 and 81 having pin and box joinder members 82 and 83, respectively. Outer vacuum chambers 84 and 85 are defined in the same manner as prior chambers, the bottom portion of chamber 84 being defined by an annular ring 86 extending laterally outward from the main wall of pin 82 and joined at its outer end to sleeve 87. Similar explanation applies to the upper portion of chamber 85 with upper perpendicular ring 88 and sleeve 89. The uninsulated space along members 82 and 83 between rings 86 and 88 carries annular, right cylindrical insulation 90 having a cutout portion 91 for members 82 and 83. Ring 88 has a vacuum port 96.

FIG. 5 shows that the outer walls 87 and 89 of chambers 84 and 85, respectively, can provide protection for insulation 90 so that insulation 90 can be glued, taped or otherwise attached to the casing sections without the use of extension members. The extension members such as members 46 and 50 can be eliminated because of the protective function of the outwardly extending vacuum chambers themselves.

An alternative holding member for insulation 90 or the insulation of any of FIGS. 1 through 4, can be a metal sleeve around the periphery of 90 and overlapping walls 87 and 89. In this manner a relatively fragile insulation can be used for 90 and still not be damaged during transportation or emplacement. If it is desired to keep fluids from 90 an outer heat shrinkable sleeve of, for example, polyethylene or polypropylene can be shrunk around the outside of insulation 90 or a metal sleeve surrounding 90.

One or more of the interior surfaces of the vacuum chambers can be coated with a gas diffusion barrier such as a plating of nickel or chromium or alloys thereof. This barrier prevents gas from diffusing through one or more of the walls of the vacuum chamber into its evacuated interior. Gas diffusion into the interior of a vacuum chamber could reduce the magnitude of the vacuum in the chamber. Chambers 84 shows a diffusion barrier 92 on all the interior surfaces thereof. Chamber 85 shows a diffusion barrier 93 on two of the three interior surfaces shown. All or any lesser number of interior surfaces can be coated with one or more diffusion barriers as desired.

If desired, a corrosion barrier such as stainless steel can be employed on the outside and/or inside surfaces of the casing section which will contact packer fluids, cement, drilling mud, and the like to prevent, for example, corrosion of the casing and the formation of hydrogen which may diffuse into the vacuum chamber.

The apparatus shown in FIGS. 1 and 5 can be fabricated and welded in the same manner disclosed for FIGS. 3 and 4, if desired.

The solid insulation employed in this invention in the interior of the vacuum chambers or the uninsulated space between adjacent casing section can be any material which is substantially nonporous, or contains pores, bubbles, voids, and the like, or is composed of 2 or more separate layers of materials, etc. By "solid" what is meant therefore is any insulating material which will maintain its shape although not confined on all sides. This is shown in FIGS. 2 through 5 for insulation 20, 47, 73, and 90. Suitable insulation include polymers such as polyvinyl chloride, polyethylene, polypropylene, foamed polyethylene, foamed polypropylene, nylon, polytetrafluoroethylene, polyurethane, asbestos, and the like.

Rings 23, 26, 43, 48, 66, 86, etc. and any other element which provides a path for heat flow around the vacuum chambers can be made of low thermal conductivity metal such as certain stainless steels or even of nonmetal thermal insulation or a combination thereof.

When the vacuum chambers extend inwardly from the main wall of the casing section they can extend quite close to both ends of the casing section although there is always some slight space where two adjacent sections of casing are joined in which space there is no vacuum chamber coverage. For this space there should be provided solid insulation as disclosed hereinabove.

When the vacuum chambers extend on the outside of the main wall of the casing section the ends of the vacuum chambers can not as closely approach the ends of the casing section as when the vacuum chambers extend inwardly from the main wall. This is so because in the normal handling of casing for emplacement of same in the wellbore, various tools such as slips, tongs, and the like are employed which grip the external surface of the casing in a rough and forceful manner. In order to prevent damage to the outwardly extending vacuum chambers, these chambers terminate a finite distance from both ends of a given casing section to provide an exposed length of main casing wall, such as length **95** in FIG. **3,** so that either end of the casing section can be grasped with slips, and the like without damaging the external vacuum chamber. This requirement will have a limiting value on the length of extension members **46** and **50.** Thus, allowance should be made at both ends of outwardly extending vacuum chambers for the emplacement of working tools on the main wall of the casing section adjacent both ends of that section.

If desired, conventional gas absorbing material sometimes called getter materials can be employed in the interior of the vacuum chambers to absorb any gas that may leak or diffuse into the vacuum chamber during use so that the magnitude of vacuum initially imposed upon that chamber can be substantially maintained. Any conventional getter can be employed, e.g., PdO on a dessicant, molecular sieve, and the like.

According to the method of this invention, a warm fluid such as petroleum gas and/or liquid which is at a temperature which can melt permafrost upon continued exposure, i.e., at a temperature greater than 32°F., preferably at least about 100°F., is pumped from the bottom of the well to the earth's surface through the casing, including that part of the casing that passes through the permafrost zone. The pumping can be carried out for an extended length of time while the temperature at the permafrost face **2'** of the wellbore is no greater than 32°F., more generally in the range of from about 14° to about 32°F.

The improvement in this production method comprises providing a plurality of spaced apart vacuum zones such as zones **12** and **13** of FIG. **1** along the length of the casing zone in the permafrost zone thereby establishing a plurality of vacuum zones wherein each pair of adjacent vacuum zones has therebetween an uninsulated space such as area **14** of FIG. **1.** Thereafter providing in at least one of these uninsulated spaces between adjacent vacuum zones a solid insulation material for substantially continuous insulation by either vacuum or solid insulation throughout the length of the permafrost zone, and producing the warm fluid through the casing zone to the earth's surface.

The vacuum employed can vary widely depending upon the desired insulating effect but will generally be in the range of from about 100 to about 10^{-5}, preferably from about 10 to about 10^{-5}, millimeters of mercury.

EXAMPLE

Steel casing for an oil well having a pin and box type connections and interiorly extending empty vacuum chambers substantially as shown in FIG. **4** is employed. In the casing, 9 5/8 inch outside diameter C-75 API casing in 40 foot lengths is used as the outside walls while the inner-sleeves **68** and **70** of FIG. **4** are 7 inch outside diameter C-75 API casing steel. The 9 5/8 inch casing has a 0.395 inch wall thickness while the 7 inch casing has a 0.317 inch wall thickness. The annular space between the 7 inch and 9 5/8 inch casings, being the annular space for vacuum chambers **64** and **65** is 1.835 inches. A vacuum of about 10^{-4} millimeters of mercury is imposed in these chambers with only air remaining.

Solid insulation **73** is a right cylindrical block of solid polyvinyl chloride having a wall thickness of about 1 inch and a height of about 4 3/4 inches.

This apparatus is employed in a permafrost zone having a temperature at the face of the permafrost in the wellbore in the range of 14° to 32°F. Liquid petroleum oil at a temperature of about 160°F. is pumped through the interior of the 7 inch casing for at least 1 year without substantial melting of the permafrost face which is approximately 5 inches from the 9 5/8 inch casing.

Reasonable variations and modifications are possible within the scope of this disclosure without departing from the spirit and scope of this invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A section of pipe having a closed annular zone defining a chamber along a substantial portion of the length of said section, said chamber being composed of two concentric, spaced apart inner and outer sleeves whose desired metallurgical properties tend to deteriorate when exposed to the extreme heat of welding but which properties if deteriorated can be restored by heat treating, the first of said sleeves having welded thereto at both ends an elongated transition spacer piece with an integral annular ring extending laterally therefrom toward the second and opposing sleeve, said spacer piece having metallurgical properties that do not tend to deteriorate when exposed to the extreme heat of welding, the second of said sleeves having a threaded spacer piece welded thereto at both ends, and said ring is welded to said second sleeve, said section of pipe having desired metallurgical properties notwithstanding the welding it was subjected to.

2. Apparatus according to claim **1** wherein said first sleeve is the inner sleeve and said second sleeve is the outer sleeve.

3. Apparatus according to claim **1** wherein said first sleeve is the outer sleeve and said second sleeve is the inner sleeve.

4. Apparatus according to claim **1** wherein there is at least one extension member carried by at least one of said spacer pieces, said extension member extending away from the end of said spacer piece and being spaced from said second sleeve to thereby provide a socket for holding and protecting solid insulation inserted therein.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,794,358 Dated February 26, 1974

Inventor(s) William G. Allen et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Insert Figure 6, as shown on the attached sheet.

On the cover sheet, under "ABSTRACT" cancel the entire paragraph and insert the following:

A section of pipe having a closed annular zone composed of two concentric, spaced apart sleeves, one of the sleeves carries a transition spacer piece with an annular ring extending therefrom toward the other sleeve, the other sleeve has a threaded spacer piece welded thereto, and the threaded spacer piece has the annular ring welded thereto. The metallurgical properties of the sleeves vis-a-vis all the transition pieces are such that the transition pieces do not tend to deteriorate when exposed to the extreme heat of welding even though the metallurgical properties of the sleeves may tend to deteriorate when exposed to the extreme heat of welding. Thus, the ring can be welded to the threaded spacer piece without adversely affecting the desired metallurgical

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
U.S. GOVERNMENT PRINTING OFFICE 869-930

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,794,358 Dated February 26, 1974

Inventor(s) William G. Allen et al. Page - 2

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

properties of the pipe section as a whole. --. Column 2, line 39, "5" should read -- 6 --. Column 6, after line 38, insert

-- FIG. 6 shows outer sleeve 100 having welded thereto at 101 an elongated transition spacer piece 102 with an integral annular ring 103 extending laterally therefrom. Inner sleeve 104 is welded at 105 to a threaded spacer piece 106. Laterally extending annular ring 103 is welded to spacer 106 at 107. --. Column 8, claim 1 should read

-- 1. A section of pipe having a closed annular zone defining a chamber along a substantial portion of the length of said section, said chamber being composed of two concentric, spaced apart inner and outer sleeves whose desired metallurgical properties tend to deteriorate when exposed to the extreme heat of welding but which properties if deteriorated can be restored by heat treating, the first of said sleeves having welded thereto at both ends an elongated transition spacer piece with an

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,794,358 Dated February 26, 1974

Inventor(s) William G. Allen et al. Page - 3

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

integral annular ring extending laterally therefrom toward the second and opposing sleeve, the second of said sleeves having a threaded spacer piece welded thereto at both ends, said transition and threaded spacer pieces having metallurgical properties that do not tend to deteriorate when exposed to the extreme heat of welding, and each said ring is welded to a threaded spacer piece, said sections of pipe having desired metallurgical properties notwithstanding the welding they were subjected to. --. On the cover sheet "5 Drawing Figures" should read -- 6 Drawing Figures --.

Signed and sealed this 24th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

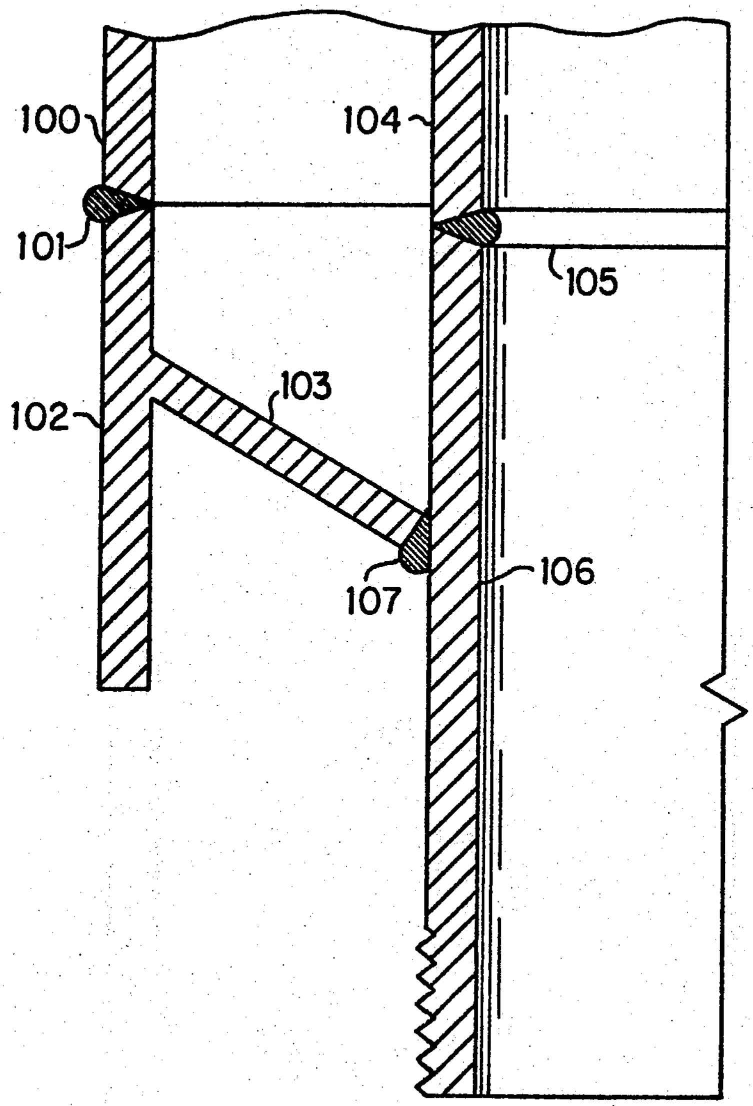

FIG. 6