Nov. 5, 1957 R. C. WEST ET AL 2,812,160

RECOVERY OF UNCONTAMINATED CORES

Filed June 30, 1953 2 Sheets-Sheet 1

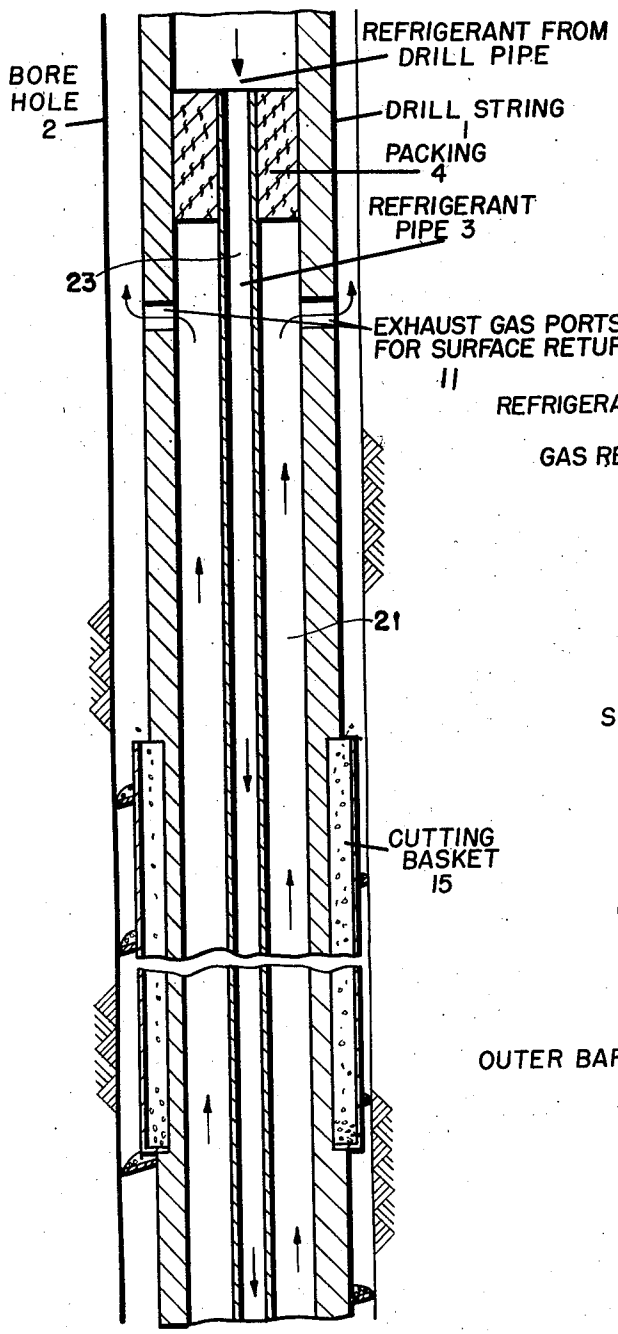


FIG.-1

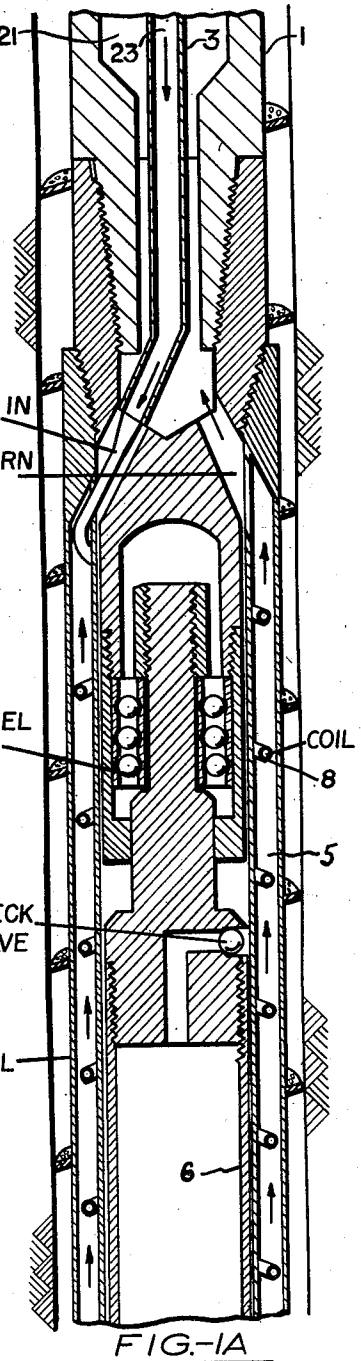


FIG.-1A

ROBERT C. WEST
GEORGE G. BINDER, JR.
WILLIAM A. FREEMAN, JR. INVENTORS

BY W. O. Feilman ATTORNEY

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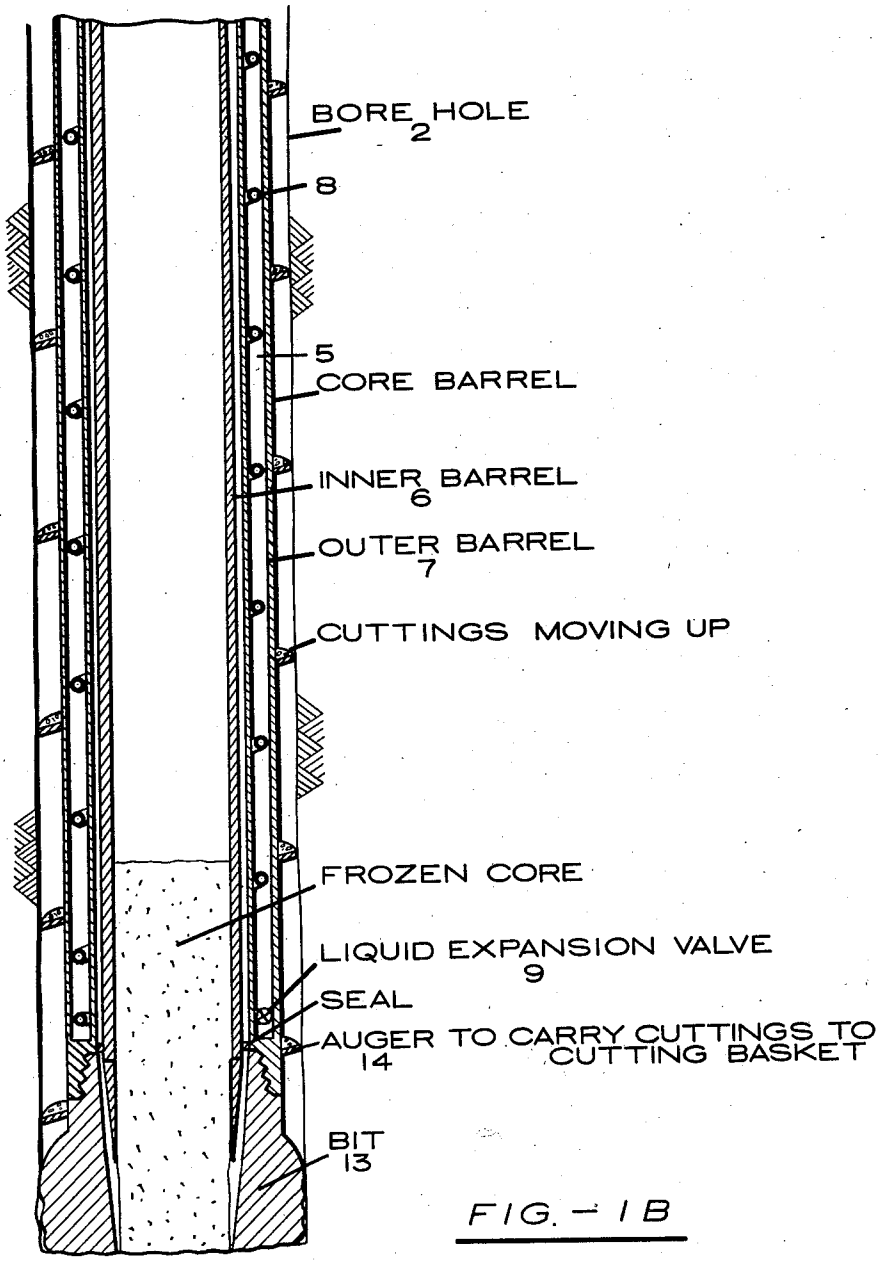


FIG. - 1B

ROBERT C WEST INVENTORS
GEORGE G. BINDER, JR.
WILLIAM A. FREEMAN, JR
BY ATTORNEY

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RECOVERY OF UNCONTAMINATED CORES

Robert C. West, George G. Binder, Jr., and William A. Freeman, Jr., Tulsa, Okla., assignors to Esso Research and Engineering Company, a corporation of Delaware

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2 Claims. (Cl. 255—1.4)

The present invention is concerned broadly with the production of oil. The invention is more specifically concerned with the recovery of uncontaminated cores during a coring operation. In oil well drilling practice, a sample of subsurface rock penetrated in the course of drilling operations is referred to as a core. The operation by which such a sample is obtained in order to ascertain the properties of a given formation is known in the art as coring. The devices employed to collect these cores are known as core barrels and are usually so constructed as to be attached to the lower end of a drill pipe. In accordance with the present invention, an uncontaminated core is secured by freezing the core as it is being recovered from the earth's substrata.

The cores obtained by all types of core barrels known at present are essentially similar in the respect that these cores are exposed to a constantly diminishing pressure from the moment the core begins its upward movement until it arrives at the surface. Mineral oil and gas found in subsurface foundations are generally under a high pressure which is commonly referred to as the formation pressure. The extent of this pressure depends upon the depth of the formation and in general is proportional to the hydrostatic pressure exerted on the formation in which oil or gas is found. It is a well known fact that when oil or gas-bearing formations are exposed to a pressure lower than the formation pressure, the oil or gas contained in them has a tendency to expand and leave the formation. Consequently, the reduction in pressure on a core obtained by present methods of coring during its travel to the surface brings about a considerable change in the oil and gas content of the core, thereby rendering the core unreliable.

Thus, one difficulty has been to secure a core accurately representing the exact nature of the earth's substrata from which it was removed. This is particularly critical in view of a growing interest in water flooding and other secondary recovery methods, since it is essential that a direct and accurate measurement of residual oil and water saturations be determined prior to employing a selected secondary recovery operation.

At the present time estimates of residual oil saturation in the reservoir can be obtained from past production records, data on crude oil, interstitial water content, porosity, pay sand, and the like. However, lack of knowledge of some of the above factors, together with such features and oil migration and water influx, make estimating residual oil saturation in the depleted reservoir prior to secondary recovery operations uncertain. In accordance with the present invention, a core is frozen or cooled in situ as it is being cored, thus preventing or substantially reducing the migration of oil and water from the core, or the adsorption of oil and other contaminants from sources foreign to the core.

The process of the present invention may be more fully understood by reference to the drawings illustrating one apparatus which is satisfactory for freezing or chilling the core in situ as it is being recovered.

Fig. 1 is a sectional view in elevation showing a portion of the drill string of the apparatus.

Fig. 1*a* is a vertical sectional view of a portion of the outer barrel and core barrel members of the apparatus.

Fig. 1*b* is a vertical sectional view of another portion of the core barrel and outer barrel members of the apparatus and also the coring bit.

Referring specifically to the drawings, a drill stem or string 1 is shown disposed within the borehole 2 penetrating from the earth's surface to substrata. A refrigerant pipe 3 is shown concentrically disposed within the string 1. A packing element 4 closes off the area below the packing from the area above the packing without the refrigerant pipe 3, and within the drill stem. In operation one method is to use a selected refrigerant such as sulfur dioxide, ammonia, freon, and the like, which is pumped down within the drill stem from the earth's surface. This refrigerant flows down passageway 23 in refrigerant pipe 3 into a coil 8, positioned in area 5 which is a hollow annular space disposed within the wall portion of the outer barrel 7 of the coring element. The refrigerant flows through this wound coil element 8 in area 5 and is discharged from the core element through liquid expansion valve 9 into area 5. The refrigerant is vaporized and flows upwardly in area 5, thus chilling the inner barrel 6. The refrigerant flows upwardly through gas return port 10 and passes via annular passageway 21 between refrigerant pipe 3 and the drill string 1 and thence through ports 11 into the area between the drill string and the borehole. A swivel element 12 permits the inner barrel 6 to remain stationary while the outer barrel 7 rotates in the coring operation. Coring bit 13 is positioned at the lower end of the bit element. An auger element 14 is positioned around the outer barrel which causes the cuttings to flow upwardly in the borehole and to be discharged into cutting basket 15.

The process of the present invention is concerned with an operation wherein the core is frozen in situ as it is being recovered. This prevents contamination of the core and also prevents loss of valuable fluids from the core as it is being raised to the earth's surface.

What is claimed is:

1. An improved coring apparatus for obtaining an uncontaminated core sample from the earth substrata which comprises in combination a string of drill pipe, an outer barrel member attached to the lower end of the drill string and provided with a coring bit, an inner core receiving barrel concentrically disposed within said outer barrel, means permiting rotation of said outer barrel relative to said inner barrel, a cooling chamber disposed within said outer barrel, a spiral coil conduit within said cooling chamber and surrounding said inner barrel, first conduit means arranged to transmit a vaporizable liquid refrigerant from the drill string to one end of said coil, expansion valve means at the opposite end of said coil arranged to vaporize said refrigerant and to discharge the vapors into said cooling chamber, second conduit means for conveying said vapors from said cooling chamber to the annular space between the drill string and the surrounding earth strata, an auger attached to the outer periphery of the outer barrel and arranged to transport drill cuttings upward from the coring bit.

2. An apparatus as defined in claim 1 including a cutting basket arranged to receive said cuttings.

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