SUMMARY OF THE INVENTION: Horizontal Well Line Drive (HWLD), US Patent 21030133884

An ideal oil recovery processes for recovering oil from an underground reservoir has a high sweep efficiency, uses a free (no cost) and infinitely available injectant, requires no purchased fuel, generates heat precisely where it is needed at the oil face, and scavenges heat from the reservoir when heating of a reservoir is used. Additionally, a high oil production rate, especially in the initial stage of the exploitation, is critical to the viability and/or profitability of an oil recovery process.

The present invention, a horizontal-well-line-drive process for recovery of oil from hydrocarbon-containing underground reservoirs, has two advantages over a "Staggered Well" pattern configuration of oil recovery, the latter being a non-public method of oil recovery conceived by the inventor herein and more fully disclosed below, which "Staggered Well" method in many respects is itself an improvement, in certain respects and to varying degrees, over other prior art methods and configurations.

Specifically, for a comparable volumetric sweep area and identical total cumulative oil recovery in regard to a hydrocarbon-containing subterranean reservoir (formation), the horizontal well line-drive (hereinafter "HWLD") process of the present invention has been experimentally shown, as discussed herein, to provide a greater initial rate of recovery of oil than the "Staggered Well" method discussed herein. Thus a greater and more rapid initial return on investment for oil companies incurring large expenditures in developing subterranean reservoirs may be achieved. This is a significant advantage, since investment in developing oil reservoirs is very high, and the time in which a return on investment may be realized is frequently a very real and substantial consideration as to whether the investment in such a capital project is ever made in the first place.

In addition, the HWLD process of the present invention, for a comparable volumetric sweep area and near identical total oil recovery, has been experimentally shown to require only half the number of wells of the "Staggered Well" configuration, and the drilling is staged, thus significantly reducing the capital costs to an oil company to develop and produce oil from an underground hydrocarbon-containing formation.

Accordingly, by way of broad summary, in one broad embodiment of the HWLD oil recovery process of the present invention, a first horizontal well is drilled high in a subterranean hydrocarbon-containing reservoir, and a medium such as a gas is injected into the reservoir via perforations in a well liner in such first horizontal well. Oil, water and gas are co-produced via a second parallel laterally offset horizontal well, placed low in the reservoir. When the oil rate at the second horizontal (production) well falls below an economical limit, a third parallel horizontal well is drilled low in the reservoir laterally spaced apart from the second horizontal well, and used to produce oil, while at the same time the second horizontal well (initially a production well) is converted to an injection well, and such gas likewise injected into the formation via such second horizontal well so as to allow the combustion front to be continually supplied with oxidizing gas to permit continued progression of the combustion front and thus continued heating of oil ahead of the advancing combustion front, which drains downwardly and is collected by the horizontal wells drilled low in the formation ahead of (or at least below) the advancing combustion front. The steps of drilling further horizontal, parallel, laterally spaced apart wells low in the formation, and successively converting "exhausted" production wells to injection wells to further the recovery of oil from remaining production wells is continued in a substantially linear direction along the reservoir in order to exploit the reservoir in a single direction as a 'line-drive-process' that achieves high reservoir sweep efficiency. The injectant, if a gas, may be a solvent gas such as carbon dioxide or light hydrocarbon or mixtures thereof, steam or an oxidizing gas such as oxygen, air or mixtures thereof. Alternatively the injectant may be any mixture of solvent, steam or oxidizing gas. A favoured embodiment utilizes steam injectant and the most favoured embodiment utilizes oxidizing gas as the injected medium.

See also:

US 20130146284 Staggered horizontal well oil recovery process.

Horizontal injection wells are placed high in the reservoir and between them, horizontal production wells are placed low in the reservoir.

US 20130146283 Oil recovery process using crossed horizontal wells.

Injection wells are placed high in a reservoir and horizontal production wells are placed perpendicular and low in the reservoir.

US 20130074470 In situ combustion recovery process using a single horizontal well to produce oil and combustion gasses to the surface

A series of vertical injection wells are placed high in a reservoir over top of a parallel production well placed low in the reservoir. Alternatively, the vertical injection wells may be replaced by a horizontal well, so that the wells have the Steam Assisted Gravity Drainage (SAGD) configuration.

CUMULATIVE OIL RECOVERY WITH HWLD (A) compared with STAGGERED WELLS (B)

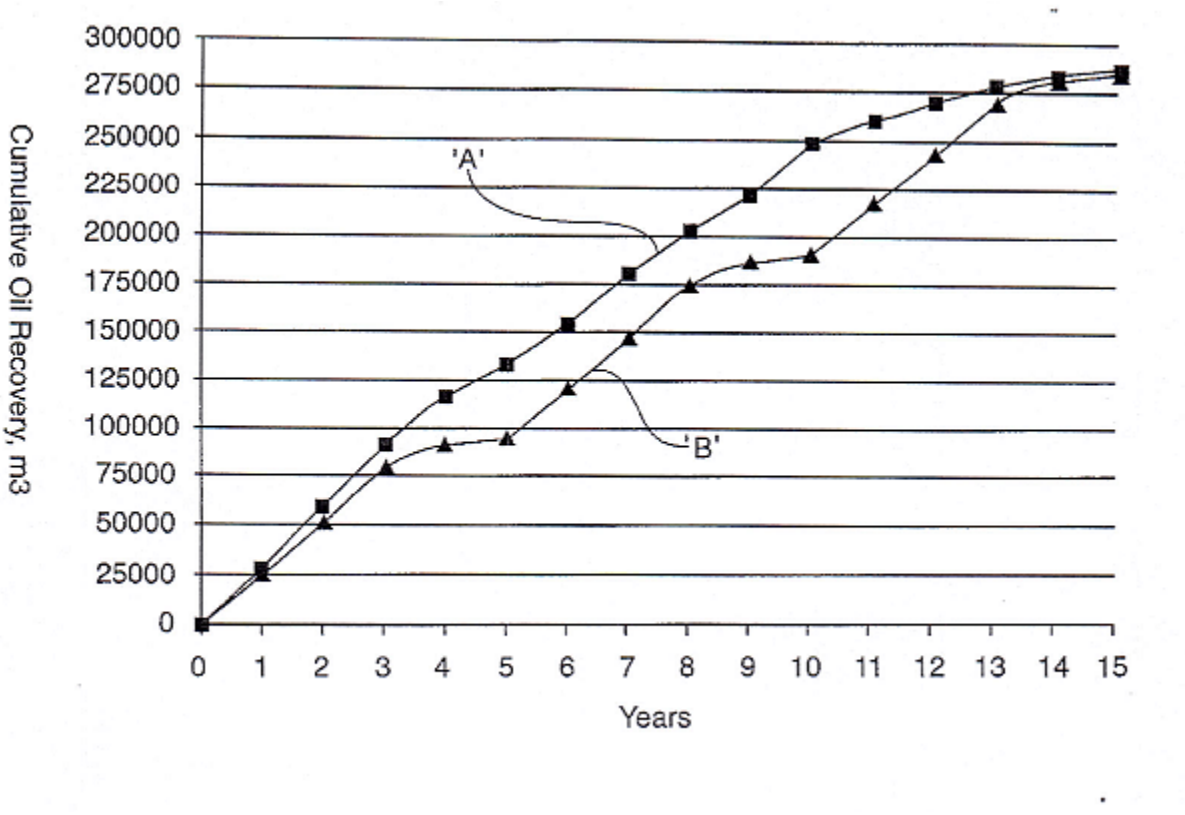


Fig. 4c (i)

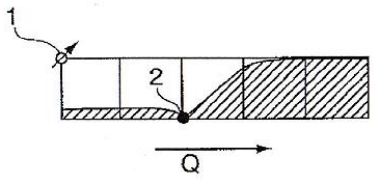


Fig. 4c (ii)

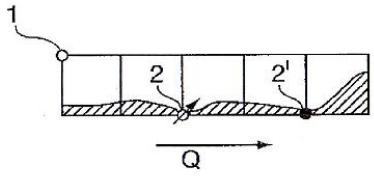


Fig. 4c (iii)

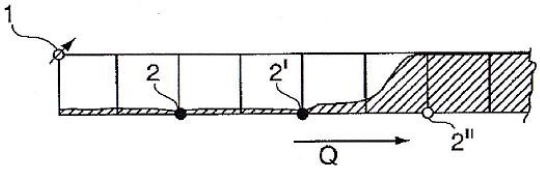
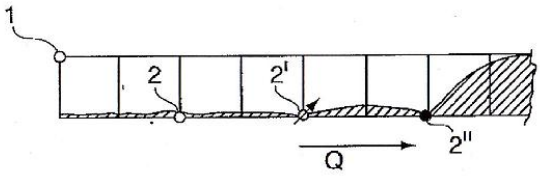


Fig. 4c (iv)



Legend

- Active injector well
- Active production well
- Inactive well

TABLE 2

		Phase 1 [FIG. 4b (i)]	Phase 2 [FIG. 4b (ii)]	Phase 3 [FIG. 4b (iii)]	Total
Time (years)		5	5	5	15
# New Wells for	Staggered*	5	5	5	15.0
each Phase	HWLD	4.5	3.0	0	7.5
Air Rate,	Staggered*	50	50	50	—
$m^3/d \times 10^3$	HWLD	50	78	22	—
Cumulative Air,	Staggered*	91.25	91.25	91.25	274
$m^3 \times 10^6$	HWLD	91.25	142.35	40.15	274
Cumulative Oil,	Staggered*	95,126	95,126	95,126	285,378
m^3	HWLD	133,278	125,646	26,646	285,570
Cumulative	Staggered*	959	959	959	959
Air-Oil Ratio,	HWLD	685	1133	1507	959
m^3/m^3					

*Not part of the invention claimed herein