VAREL
OIL & GAS DRILL BITS
(/)

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SLIPSTREAM®

View the embedded image gallery online at:
http://www.vareloilandgas.com/index.php/en/roller-cone-bits/slipstream-bits#sigProId fd6ed31778
(http://www.vareloilandgas.com/index.php/en/roller-cone-bits/slipstream-bits#sigProId fd6ed31778)

Patent pending hybrid roller cone technology to drill frac plugs with both a steel tooth and TCI cutting structure utilized on the bit. The steel teeth attack the composite material usually found in the center of a frac plug and the tungsten carbide inserts on the gauge area of the bit are for the cast iron and ceramic slips found in frac plugs.

Features / Benefits

Bearing Package
High performance journal bearing with silver plated elements along with advanced lubricant, and and HSN bearing seal provide an over designed bearing package for both motor and standard rotary applications.

Canister Compensator
Designed to extend bit life and maintain grease supply for the length of the run. Over twice the grease capacity of previous models ensures critical lubrication to the bearing.

DuraClad Hard Metal
Critical tooth hard facing process are continually monitored and updated to ensure the highest quality hard facing deposit using a Varel's DuraClad hard facing.

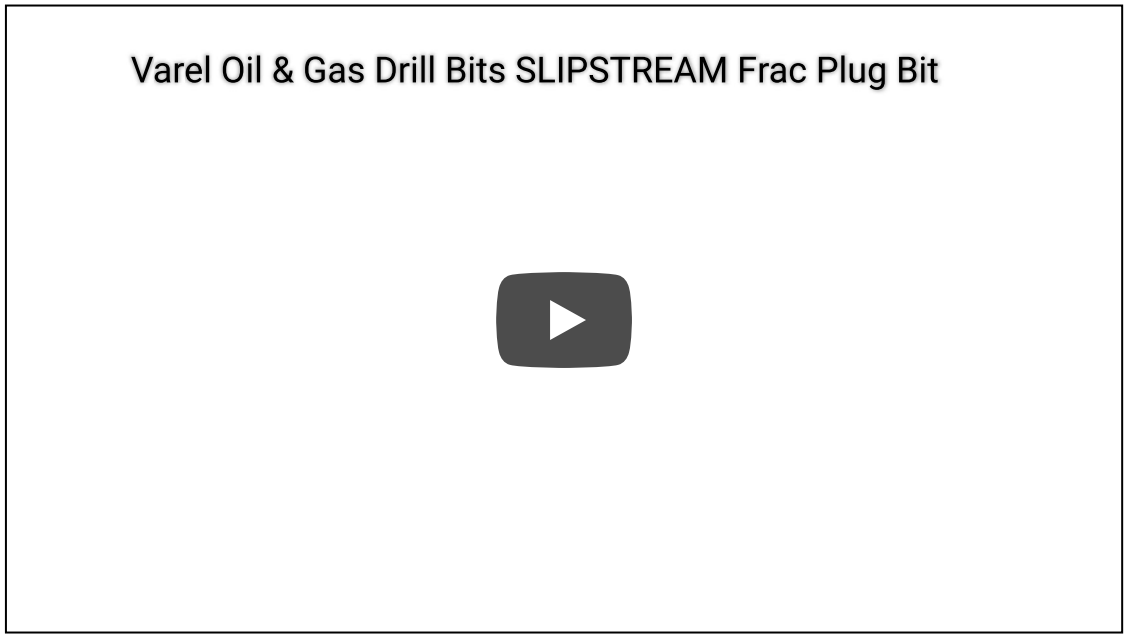
Shirttail Protection
Reinforced shirttail to maximize seal protection and provide stability in horizontal wells. Tungsten carbide inserts up the leg and below the reservoir provide near gauge stabilization and enhanced bit performance.

For specifications, application solutions, and SLIPSTREAM bit availability please contact (/index.php/en/about-varel/contact-us?layout=searchcsv) your local Varel Oil & Gas representative.

Nomenclature (/index.php/en/roller-cone-bits/nomenclature)

OTHER RESOURCES

Downhole Products (http://www.downhole.org/)



Brochures | Editorials | Technical Papers | Technical References

Brochures

- (/index.php/en/product-data-sheets/115-slipstream)SLIPSTREAM Product Data Sheet (/index.php/en/product-data-sheets/137-slipstream-rc-pro-product-data-sheet)

ROLLER CONE BITS (/INDEX.PHP/EN/ROLLER-CONE-BITS)

EVEREST® - Large Diameter (/index.php/en/roller-cone-bits/everest)

HIGH ENERGY™ (/index.php/en/roller-cone-bits/high-energy)

COMPASS® - SlimHole (/index.php/en/roller-cone-bits/compass)

SLIPSTREAM® - Completion (/index.php/en/roller-cone-bits/slipstream-bits)

A-FORCE® - Air Bits (/index.php/en/roller-cone-bits/a-force)

Workover Bits (/index.php/en/roller-cone-bits/workover-bits)

Features (/index.php/en/roller-cone-bits/features)

VAREL
OIL & GAS DRILL BITS

SLIPSTREAM®

Hybrid Cutting Structure Frac Plug Drill Bit

SLIPSTREAM bits are specifically designed to target non-homogeneous downhole components such as bridge and frac plugs and are capable of handling the cast iron or ceramic slips as well as the softer core of those plugs. Tungsten carbide inserts and hardfaced steel teeth are arrayed in the cutting structure to cut both hard and soft materials found in frac plugs. High performance journal bearing and shirttail protection allow for both motor and rotary applications when drilling plugs or other downhole equipment.

Application

- Frac plug drill out of any conventional type plug used in well fracking.
- Clean out producing well bores.
- For all motor and rotary applications.

Features / Benefits

- Patented hybrid cutting structure - steel teeth located in the center for drilling composite materials and tungsten carbide inserts located on the outside to drill the cast iron or hard ceramic slips found in plugs used in well fracturing.
- Patent pending journal seal design - keeps the seal protected and provides the best design for each size in the SLIPSTREAM product offering.
- High speed sealed journal bearing - silver plated elements and advanced synthetic bearing grease provide for motor or rotary applications.
- Shirttail protection - maximizes seal protection and provides bit stability when drilling.

SRP # # #

Cutting Structure Number System

Engineering Research Bit Design Series

VAREL
OIL & GAS DRILL BITS

Cutting Structure Number System

First Digit:
- Steel Tooth Cutting Structure
- Softest-to-Hardest (1-6)

Second and Third Digits:
- TCI Cutting Structure
- Softest-to-Hardest (00-99)
  - Even Numbers - Predominately chisel shaped inserts
  - Odd Numbers - Predominately conical shaped inserts

Hybrid Cutting Structure

Patented cutting structure feature of tungsten carbide inserts along the outside of the cone for hard materials, such as cast iron or ceramic slips. Steel teeth for drilling the composite core material that typically makes up most of a frac plug.

Shirttail Protection

Shirttail protection is provided by hardfacing and leading edge TCI's. Inserts up the leg and below the reservoir provide near gage stabilization and enhanced stability in directional and lateral applications.

Cone Targeted Steel Treatment

A hybrid cutting structure calls for a unique process of heat treating the cone. Varel has a patent pending process that enhances the cone steel of the SLIPSTREAM bit providing for a hardened cone surface. This treated surface protects the cone steel allowing the SLIPSTREAM bit to drill more plugs per run than any competitive product.

Hydraulics / Shirttail

Hydraulics combined with shirttail modifications are done to optimize cuttings removal and allow larger plug components to pass by the bit. Ports are provided instead of nozzles for full volume flow to improve the flow characteristics around the shirttail of the bit.

Journal Bearing Package

High operating parameter journal bearing with silver plated bearing elements, thermally stable bearing lubricant, and patented o-ring seal design combine to give long life for motor or rotary applications.

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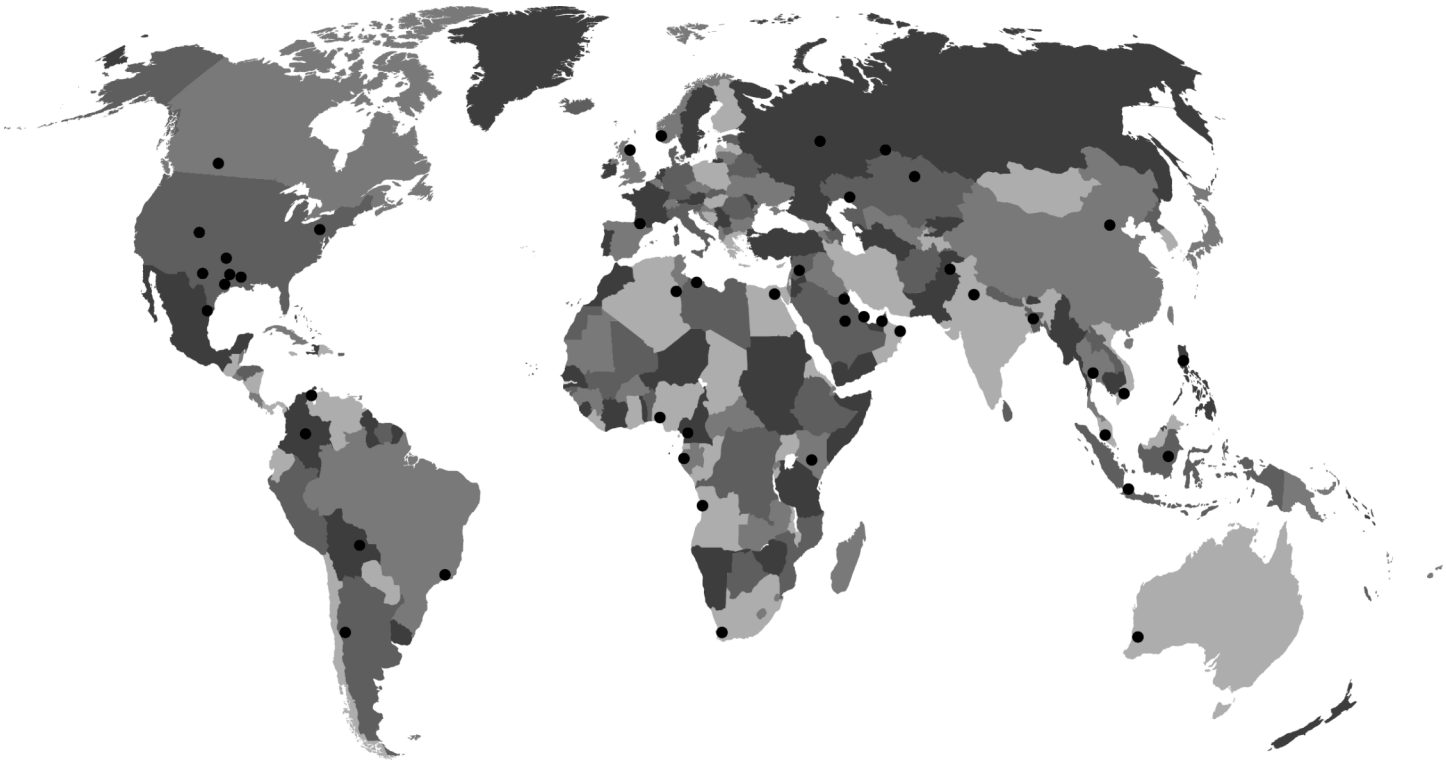

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OTHER RESOURCES

Downhole Products (http://www.downhole.org/)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor Kyle Nobile	§	
	§	Group Art Unit: 3676
Serial No.: 15/018,542	§	
Confirmation No.: 4675	§	Examiner: Steven A MacDonald
Filed: February 8, 2016	§	
For: Method for Drilling Out a Plug Using a Hybrid Rotary Cone Drill Bit	§	

DECLARATION UNDER 37 C.F.R. § 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Karl Rose, hereby state as follows:

1. I am a citizen of the United States.

2. I have a Bachelor of Science in Mechanical Engineering from Texas Tech University in Lubbock, Texas.

3. I have been employed since 2009 within Varel International Energy Services, Inc. (VIES). Between 2014 and 2018, I was Engineering Operations Manager for the Western Hemisphere. From 2018 to the present, I have had the position of Regional Sales Manager for the Southern United States. Prior to being employed by VIES, I was employed by Smith International, Inc. as a Field Engineer between 1996 and 2005 and by Ulterra Drilling Technologies, L.P. as a Product Manager between 2005 and 2009.

4. In my positions at VIES (and with former employers), I have been involved with the design, manufacturing, testing, and sales of oilfield drill bits for over 20 years.

5. I have carefully studied and understand the disclosure and claims in the present patent application, United States Patent Application No. 15/018,542, entitled

"Method for Drilling Out a Plug Using a Hybrid Rotary Cone Drill Bit," filed February 8, 2016, which is a divisional application of United States Patent No. 9,376,866, filed August 23, 2013. I am a co-inventor of this application.

6. I have carefully studied and understand the disclosure in IADC Society of Petroleum Engineers; SPE-173127-MS; Frac Plug Drill Out Benefits from Hybrid Roller Cone Bit Design; Karl Rose and Kyle Nobile, Varel International; Victor Rodriguez and Randy Rose, EOG Resources; © 2015, SPE/IADC Drilling Conference and Exhibition. I am a co-author of this paper.

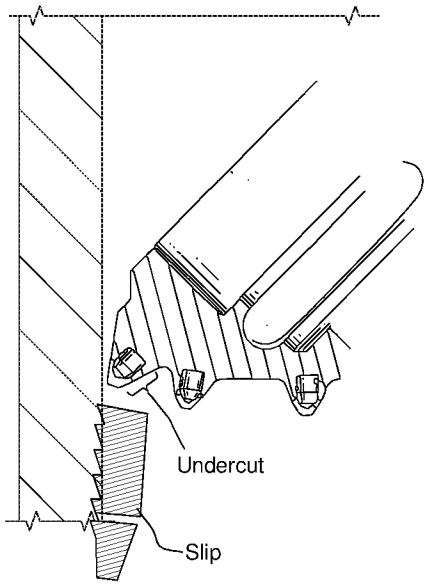
7. I have carefully studied and understand the disclosure in United States Patent No. 3,126,067 to Schumacher, which is cited in the USPTO Final Office Action dated August 19, 2019.

8. I have carefully studied and understand the disclosure in United States Patent No. 3,401,759 to White, which is cited in the USPTO Final Office Action dated August 19, 2019.

9. I have carefully studied and understand the English translation of the disclosure in the Russian drill bit catalog excerpt KORNEEV K. E. et al. Burovve dolota. Moskva, Izdateistvo "Nedra", 1965, p. 69, 70, 72, 73, drawings 76, 77 (hereinafter "KORN").

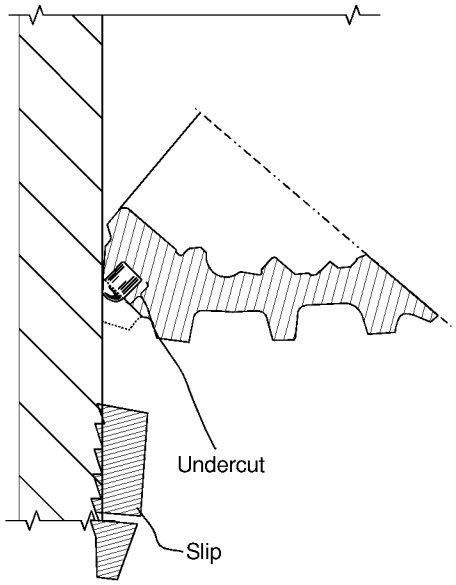
No Reasonable Expectation of Success

10. Schumacher discloses a drill bit having cones with teeth 17 and inserts 18 on the gage rows, the inserts being disposed in gaps between the teeth. The teeth extend beyond the inserts (col. 2, lines 15-17 and Figure 3) and the inserts will not engage the formation until the teeth have worn down to expose the inserts (col. 2, lines 21-40). Use of Schumacher's bit to drill a plug having hard slips will not have success, as illustrated below:



In the above figure, attempting to drill the hard slip will result in wear of the cone steel in the Undercut region before the insert is sufficiently exposed to drill through the slip. Once the Undercut region has worn away, the insert will dislodge from the cone, thereby rendering the cone useless.

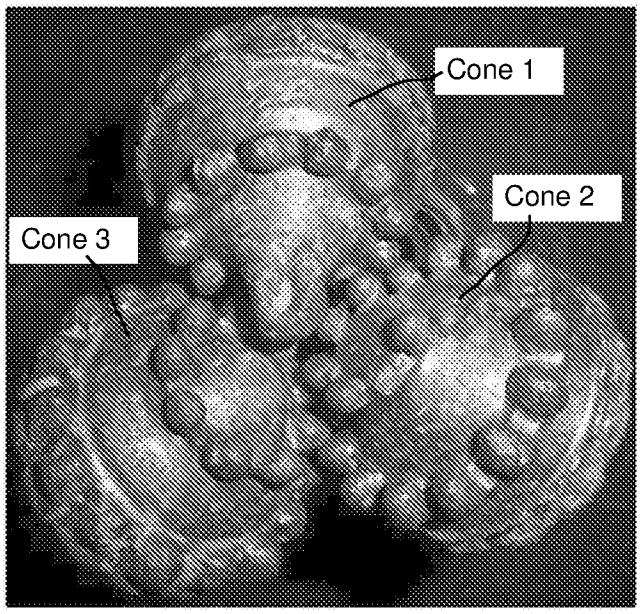
11. White discloses a heel pack rock bit where every third tooth on the gage row has been partially cut-away and inserts are disposed in the cut-away portions. The inserts engage the sidewall of the borehole at all times but do not engage the bottomhole unless the teeth become worn. Use of White to drill out a plug having hard slips would not have success due to the inserts becoming dislodged from undercutting as illustrated below:



12. Although the drawing quality is poor and the disclosure is minimal, KORN may illustrate that the carbide teeth are embedded in a flange, as follows from the reproduced and annotated portion of Figure 77 of KORN:

KORN's flanged configuration will not have success drilling out hard slips of the plug due to undercutting of the flange by the slip and dislodgment of the carbide teeth.

13. SPE/IADC 173127, which includes photographic evidence of extensive damage to milled steel teeth (hardfaced with tungsten carbide) when used to drill hard slips of a frac plug, further supports the above conclusions of undercutting. Figure 1 (with annotation) of SPE/IADC 173127 and pertinent description (pgs. 2-3) are reproduced below (emphasis added):



> In these conditions, experience running a steel tooth bit (IADC 216) on coiled tubing to drill out frac plugs… the cutting structure sustained damage… Over many applications, a common damage pattern began to emerge in this cutting structure… the outer rows of the cutting structure would be **severely worn** and the inner rows of cutting structure would be basically untouched. (Fig. 1)…
> The challenge was clearly demonstrated when a dull bit and a set of slips were physically lined up and they precisely matched where the cutting structure damage was occurring. Typical wear to the cutting structure is illustrated on a 4 ½-in. IADC 236 bit. The **gage teeth were worn to the root bottom** on cones one and two, and the cone three gage was worn with 0.25 to 0.30 in. of tooth remaining.

(See also Figure 3B). The reason that the gage teeth on cone 3 were not completely worn away like those of cones 1 and 2 is that they were offset further inward than were the gage teeth of cones 1 and 2 (illustrated in Figure 3B).

Commercial Success

14. Regarding claim 25 and its dependents, Applicant (or affiliates thereof) manufactures and sells the SLIPSTREAM® frac plug drill bit to oilfield service companies for performing the method recited therein. The following table includes sales numbers of the SLIPSTREAM® bit to prove commercial success:

	Units	Revenue
2014 - 9 Months	**669**	$2,156,745
2015	**1308**	$3,194,687
2016	**1442**	$3,092,457
2017	**4325**	$9,447,667
2018	**5379**	$12,927,027
2019 - Thru June	**2987**	$7,457,204

SLIPSTREAM® sales are about 30% of the US market from 2017 to June 2019.

15. The nexus between the commercial success and use of the hybrid cutting structure (milled teeth and cutter inserts) is the improvement in drilling speed and durability discussed in SPE/IADC 173127 (pg. 8, emphasis added):

> **Eagle Ford Field Study Results**
> A 57-well study of the hybrid bit design was conducted in the Eagle Ford shale play in south Texas. The study compared the performance of the first two generations of the 4.5-in. hybrid drill out bit in 25 wells to 4.5-in. standard roller cone bits in 32 wells. Throughout the study, the same operator ran each style of bit using the same drilling parameters and the same plugs. These studies determined that:
> • The hybrid bits drilled frac plugs 13.6% faster than standard tooth bits and averaged 3.3 more plugs per use.
> • The standard rock bits drilled an average 17.18 plugs per well with an average drill out time per plug of 9.66 minutes.
> • The hybrid bits drilled an averaged 20.36 plugs per well with an average drill out time per plug of 8.31 minutes.
> • All of these factors led to improved well efficiencies compared to the prior standard.
> The later two bit versions have been refined and applied in similar applications. Data from these applications support continued improvements in the hybrid bit performance. To date, 254 runs using all four generations of the hybrid bits and 160 standard rock bit drill out runs have been analyzed. **Current runs with the most recent hybrid bits have almost doubled the number of plug drill outs and the cutting structure is still coming out in excellent shape compared to standard bits in offset wells**.

16. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: 10/10/2019 /Karl Rose/

Karl Rose