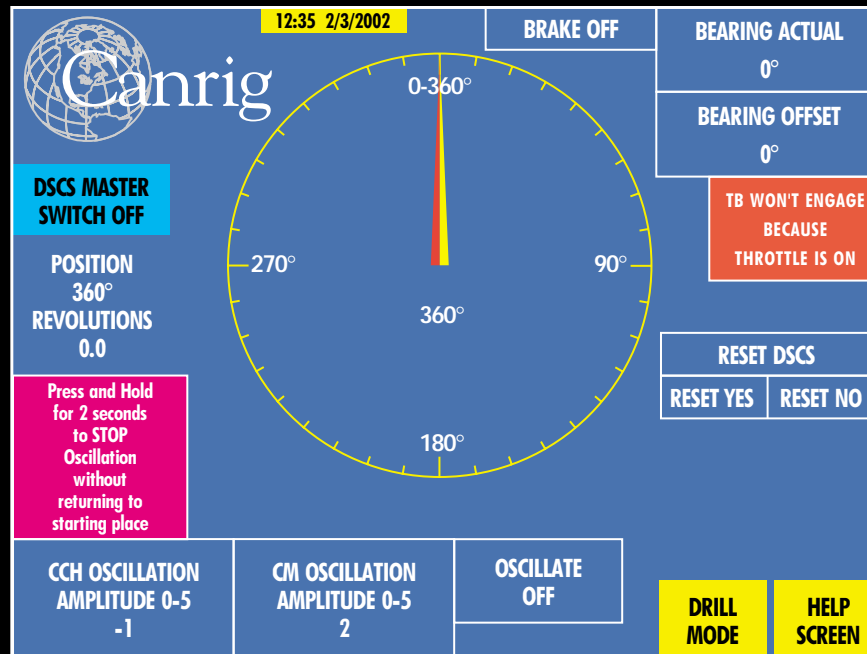


DIRECTIONAL STEERING CONTROL SYSTEM (DSCS)

U.S. PATENT NO. 6050348



Directional Steering Control System

CANRIG Drilling Technology Ltd.'s Directional Steering Control System (DSCS) has demonstrated the ability to save time and money during drilling operations. It achieves this by increasing total on-bottom drilling time, sometimes by as much as 15 percent, and by significantly improving sliding performance. These accomplishments are the result of two unique functions, Oscillation Control and Tool Face Orientation.

DIRECTIONAL STEERING CONTROL SYSTEM (DSCS)

Oscillation Control System

The Problem:

Reduced weight on bit due to friction

During sliding operations, hole friction reduces the amount of weight that can be put on the drill bit, resulting in a slower drilling operation.

The Solution:

Oscillation Control

Using the DSCS, we can oscillate the drill string from the surface to dramatically reduce friction. The oscillation can be programmed from a fraction to several revolutions, precisely executed by the PLC. The oscillation amplitude is selected by the operator so that it provides maximum drill string rotation without affecting tool face orientation.

Other features include:

- Graphic indication of the oscillation position and its neutral azimuth setting on the Man-Machine Interface (MMI)
- User-adjustable oscillation amplitude and speed
- Enable/Disable capability and Auto Neutral Return

Tool Face Orientation

The Problem:

Accurately steering drilling to the target

While performing directional drilling operations, one of the challenges is to orientate the "downhole" tool in the correct rotation to "steer" the progress of drilling in a desired direction. At present, this can only be obtained by feel, timing, experience and estimation, because a certain amount of rotation at the surface may not necessarily result in equal rotation at the downhole tool. This is due to the "spring" effect caused by the drill pipe.

When repositioning the tool to a new orientation, the current method is to release the brake on the top drive or rotary table while at the same time increasing the throttle to an amount sufficient to overcome the stored energy of the spring wind-up, but without rotating too far. This is a "trial and error" approach – not advancing enough or overshooting are far more common than rotating to just the right point. Backlash, where the pipe is turning counter-clockwise, is also experienced frequently.

The Solution:

Accurate rotation at the surface

DSCS will remove the guesswork and eliminate the need for precise timing and "just the right amount of throttle." Because the rotation is always at the same speed, the computer controls the amount of rotation (via a

position feedback signal) and the wind-up factors of the drill pipe can be entered into the computer to assist the directional driller in positioning the downhole tool in the desired orientation. Combined with the standard CANRIG Top Drive control features, the DSCS provides a valuable aid for the directional driller to orientate downhole tools.

How the DSCS Works

The DSCS comprises five components:

1. The Programmable Logic Controller (PLC), a state-of-the-art computer specifically designed to perform in harsh environments. CANRIG uses the same PLC for the DSCS that is already incorporating the controls of the Top Drive.
2. A Position Feedback Signal informs the PLC of the exact quill position.
3. A Torque Sensor that measures the torque necessary to rotate the quill and memorizes this information for any future manipulations.
4. The Man-Machine Interface (MMI) comprises a video display unit and touch screen input device. In some cases, there may be several MMIs, depending on the location of operators needing the information displayed and access to the input provided (i.e., drill floor, directional driller's shack, toolpusher's office, etc.)
5. The downhole tool information feedback unit, a device linking the information from the downhole tool to the DSCS (under development.)

These five components operate together to smoothly and efficiently accomplish a task that, in the past, required several attempts to obtain the proper results.

System General Characteristics

The DSCS offers several value-added features including:

- Enhanced software for slow-speed rotation of the drill pipe at surface.
- Drill pipe position instrumentation.
- Elimination of "back-spin" when the brake is released for repositioning.
- User-friendly with graphic azimuth position indication.
- Local (rig floor) and Remote (directional driller's work station.)
- Single switch enable/disable of the DSCS feature.

The Directional Steering Control System from CANRIG is available on all new top drives manufactured by the company. It is also retrofittable to all existing CANRIG top drives.

