

In another contemplated mode of use, a stand can be used to allow safe floor assembly of the bit breaker to the drill bit, and subsequent hoisting of both (by a lifting sub) into the rotary table.

The following publications, all of which are hereby incorporated by reference, provide additional detail regarding possible implementations of the disclosed embodiments, and of modifications and variations thereof. Kate Van Dyke, *The Bit* (4.ed. 1995), together with all other volumes in the Rotary Drilling Series from Petroleum Extension Service; Jim Short, *Introduction to Directional and Horizontal Drilling* (PennWell 1993); J.-P. Nguyen, *Drilling* (Technip 1996); Wilson Chin, *Wave Propagation in Petroleum Engineering* (Gulf 1994); Bourgoyne et al., *Applied Drilling Engineering* (S.P.E. 1991); and the proceedings volumes of all of the IADC/SPE Drilling Conferences.

According to a disclosed class of innovative embodiments, there is provided: A bit breaker for connecting and disconnecting threaded connections comprising: a base having at least one open side, and having a chuck opening portion, and having a pair of chocks extending into the chuck opening; and a gate removably located against the open side of the base, and having a chock extending into the chuck opening.

According to another disclosed class of innovative embodiments, there is provided: A bit breaker, comprising: a base having at least one open side, and having a chuck opening portion, and having a pair of chocks extending into the chuck opening; and a gate removably located against the open side of the base, and having a chock extending into the chuck opening; wherein said base and said gate contain cutouts which reduce the weight of said bit breaker; wherein said base has first, second, and third outer edges, said first and third outer edges being substantially parallel and said second outer edge being substantially parallel with the outer edge of said gate, when said gate is in a closed position.

According to another disclosed class of innovative embodiments, there is provided: A bit breaker, comprising: a base having at least one open side, and having a chuck opening portion, and having a pair of chocks extending into the chuck opening; and a gate removably located against the open side of the base, and having a chock extending into the chuck opening; at least one handle attached to said base; wherein said base has first, second, and third outer edges, said first and third outer edges being substantially parallel and said second outer edge being substantially parallel with the outer edge of said gate, when said gate is in a closed position; wherein said chocks of said base and said gate are equidistant from each other when said gate is in a closed position.

According to another disclosed class of innovative embodiments, there is provided: A rock drill bit, comprising three breaking slots.

According to another disclosed class of innovative embodiments, there is provided: A rock drill bit, comprising: three arms in a fixed spatial relationship; rotatable subassemblies mounted on ones of said arms, and having rock-cutting elements mounted thereon; and three breaking slots, each positioned between two of said arms.

According to another disclosed class of innovative embodiments, there is provided: A rock drill bit, comprising: three arms in a fixed spatial relationship with a body which

includes a thread; rotatable subassemblies mounted on ones of said arms, and having rock-cutting elements mounted thereon; jets mounted in and extending from said body; and three breaking slots, each positioned between two of said arms.

According to another disclosed class of innovative embodiments, there is provided: A drilling system, comprising: a drill string containing at least one section of pipe; a drill bit comprising three breaking slots and a threaded connector for attachment to said drill string; surface equipment capable of turning said drill bit in relation to said drill string; and a bit breaker, attached to said surface equipment, for connecting and disconnecting threaded connections, said bit breaker comprising: a base having at least one open side, and having a chuck opening portion, and having a pair of chocks extending into the chuck opening; and a gate removably located against the open side of the base, and having a chock extending into the chuck opening.

According to another disclosed class of innovative embodiments, there is provided: A method for connecting a drill bit to a drill string member on a drilling rig, comprising the steps of: placing a bit breaker having an open end and a pair of inwardly directed chocks onto a drill bit having three slots; attaching a gate having an inwardly directed chock, across the open end of the bit breaker; placing a drill string member onto the drill bit such that a lower tool joint connection of the drill string member is positioned for threaded connection to the tool joint of the bit breaker; and, applying opposing torque between the bit breaker and the drill string member to connect the drill string member to the drill bit.

According to another disclosed class of innovative embodiments, there is provided: A method for disconnecting a drill bit from a drill string member on a drilling rig comprising the steps of: placing a bit breaker having an open end and a pair of inwardly directed chocks onto a drill bit having three slots; attaching a gate having an inwardly directed chock across the open end of the bit breaker; and applying opposing torque between the bit breaker and the drill string member to disconnect the drill string member from the drill bit.

According to another disclosed class of innovative embodiments, there is provided: A method of drill rig operation, comprising the steps of: (a.) using a first bit breaker which has at least three chocks, including a torque-transmitting chock mounted on an openable gate, during makeup/breakout operations to define the rotational position of bits which have slots complementary to said chocks, including both roller-cone and fixed-cutter type bits.

#### Definitions:

Following are short definitions of the usual meanings of some of the technical terms which are used in the present application. (However, those of ordinary skill will recognize whether the context requires a different meaning.) Additional definitions can be found in the standard technical dictionaries and journals.

Fixed-cutter bit: a drill bit with no moving parts that drills by intrusion and drag, also called a drag bit.

Mud: the liquid circulated through the wellbore during rotary drilling operations, also referred to as drilling fluid. Originally a suspension of earth solids (especially clays) in water, modern "mud" is a three-phase mixture of liquids, reactive solids, and inert solids.