This invention relates to well drilling tools and relates more particularly to shoes or guides for well drilling tools. A general object of this invention is to provide simple, practical and particularly efficient guides for well drilling bits.

Deep wells, such as oil wells and gas wells usually have offset, non-vertical or crooked portions. When a drilling tool or bit is run into a well on the lower end of the drilling string it engages the wall of the offset or the part of the well, often breaking away or scarring the wall. It is customary, in the rotary method of well drilling, to employ a mud laden drilling fluid. This drilling fluid in addition to performing other functions forms a layer or cake on the wall of the well and in locations where unconsolidated earth formations are encountered special rotary mud is used which penetrates the formation to provide a better seal and coating on the well wall and thus prevent caving of the loose formation. When a drilling bit moving downwardly, in a well, scours or carries away the mud cake from the well wall, the foundation often breaks loose and caves in behind the bit causing considerable trouble. The mud layer or cake from the well wall often accumulates on the well bit as the bit is run into the well, and mud up or "balls up" the cutting parts so that the bit cannot operate effectively when it reaches the bottom of the well.

It is an object of this invention to provide a well bit guide that prevents the bit from scattering or scraping away the mud filter cake on the well wall when the bit is lowered into the well, and that prevents mud from the well wall from accumulating on the cutting parts of the bit.

Another object of this invention is to provide a well bit guide that does not injure or break loose the mud filter cake from the well wall.

Another object of this invention is to provide a bit guide of the character mentioned that is easily and quickly applied to the bit when the bit is to be run into the well.

Another object of this invention is to provide a well bit guide that does not interfere with the free circulation of fluid through the drilling string and bit and that does not interfere with or materially delay the drilling action of the bit when the bit reaches the bottom of the well.

Another object of this invention is to provide a bit guide of the character referred to that is readily broken up, drilled up, dissolved, or reduced to fragments when the bit is put into operation at the bottom of the well.

Another object of this invention is to provide a friable, frangible or drillable bit guide formed of a material having a low specific gravity or a specific gravity comparable to that of the drilling fluid, so that its fragments or cuttings are quickly flushed from the well by the circulation fluid employed in the usual drilling operations.

Another object of this invention is to provide a bit guide of the character referred to that may be easily and inexpensively constructed for use on practically all types and forms of well drilling bits.

A further object of this invention is to provide a bit guide of the character referred to that is easy to install and that is simple and inexpensive to manufacture.

The various objects and features of my invention will be fully understood from the following detailed description of typical preferred forms and applications of the invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a side elevation of a typical drag bit for use in the rotary method of well drilling equipped with one form of guide of the invention. Fig. 2 is an enlarged, horizontal detailed sectional view taken substantially as indicated by line 2—2 on Fig. 1. Fig. 3 is a side elevation of a roller bit or rock bit for use in the rotary method of well drilling provided with another form of guide of the invention. Fig. 4 is an enlarged, horizontal, detailed sectional view taken as indicated by line 4—4 of Fig. 3 and Fig. 5 is an enlarged fragmentary sectional view illustrating an alternative means for securing a guide to a bit.

The bit guides of the present invention may be varied and modified greatly in construction, design and materials to adapt them for use under different conditions and on bits of various types.

In the following detailed disclosure I will describe typical forms and applications of the invention, it being understood that the invention is not to be construed as limited to the particular forms or applications about to be described, as it broadly contemplates the provision of a guide formed for attachment to a well bit, shaped to prevent the bit from breaking away or disturbing the mud cake on the well wall when the bit is run into the well, and constructed to be readily drilled up, broken away, dissolved, or
otherwise destroyed when the bit is put into operation.

In Figs. 1 and 2 I have illustrated a rotary well drilling bit of the drag type equipped with one form of guide of the invention. The bit in Figs. 1 and 2 comprises a body 18 secured to the lower end of a rotary well drilling string 8 and blades 11 projecting downwardly and outwardly from the body 10. In the particular case illustrated there are four substantially equally spaced cutting blades 11. The blades 11 have sharpened or beveled lower parts 13 for acting on the formation at the bottom of the well and have substantially vertical outer edge 13. Circulation ports 14 are provided in the lower end of the bit body 10 to discharge the circulation fluid or rotary mud.

The bit guide shown in Figs. 1 and 2 may be said to comprise, generally a guide body 15 for application to the bit, and means 16 for attaching the body 15 to the bit.

The guide body 15 is designed for ready attachment to the well bit and is formed to prevent the cutting blades 11 and other parts of the bit from entering the mud cake layer on the wall of the well when the bit is run down through the well. The guide body 15 may be varied greatly in construction and configuration without departing from the invention. In the typical case illustrated the guide body 15 is a generally annular or tubular element having a continuous annular side wall. The upper and lower ends of the tubular or annular body 15 are open to permit a free movement and flow of fluid through the guide. As illustrated the interior of the guide body 15 may be substantially uniform in diameter throughout. The exterior of the guide body 15 is shaped to assure the downward movement of the bit and guide through the well with a minimum of injury to the well wall. The upper portion of the guide body 15 may be generally cylindrical while the lower portion or major portion of the guide body is tapered downwardly and inwardly or is provided with a surface 17 that rounds or curves downwardly and inwardly. This tapered or curved surface 17 may extend to the lower extremity of the guide body 15 and may approach or merge with the internal wall of the body. The tapered or rounded surface 17 is preferably, though not necessarily, smooth and is such that its engagement with the well wall results in a minimum of damage to the mud filter cake. It will be seen that the tapering or curved surface 17 may wipe or slide along the well wall without scarring, breaking loose or disturbing the mud cake.

The upper end of the guide body 15 may be shaped to conform to the lower portion of the well bit. In the construction illustrated the upper end 18 of the body 15 is flat and generally horizontal and is provided with spaced notches 19 for receiving the lower end portions of the blades 11. The notches 19 may be shaped to rather accurately conform to the active lower parts 12 of the blades 11. The guide body 15 is proportioned so that its external surface or at least the internal surface of its upper portion is outside of or flush with the outer edges 13 of the cutting blades 11. This proportioning of the body 15 positively prevents contact of the cutting edges 12 with the wall of the well when the bit is moved through the well. It may be preferred to form or shape the lower part of the guide body 15 in such a manner with its engagement with the bottom of the well prevents turning of the guide. Thus, as illustrated in Fig. 1, the lower 18 of the body 15 may have serrations or teeth 20 for engaging the bottom wall of the well to resist turning of the guide body 15 when the bit is set down and rotated.

In accordance with the invention the guide body 15 is frangible, friable, drillable or soluble to be readily broken up, shattered, drilled up or dissolved when the bit reaches the bottom of the well and is put into operation. Considering the invention in its broader aspect the guide body 15 may be constructed of any material that is brittle, crushable, or friable so that it breaks up when the bit is set down on the bottom of the well, that readily cracks, parts or divides into reasonably small parts when the bit is set down on the bottom of the well, that is softer than the material of the bit to be readily drilled up when the bit is rotated at the bottom of the well, or that is soluble in the water or other fluid in the well to readily dissolve so that it does not interfere with the bit operation. The material of which the bit body 18 is formed may, of course, have two or more of the characteristics mentioned. Further, it may be preferred to employ the body 15 of two or more materials having the selected characteristics. It is contemplated that the guide body 15 be formed of wood, phenolic compositions such as Bakelite and other plastics, ceramic materials, cement, drillable metals such as aluminum, aluminum alloys, copper, copper alloys, pewter, Dow metal or cast iron, rubber, rubber compositions with or without fabric, natural or artificial stone, paper mâché, pressed fiber, glass, or soluble material capable of being shaped by casting or working and that is water or oil soluble. In most cases it is preferred to employ a material of the class referred to that is inexpensive, easily cast, worked or shaped, and that has a relatively low specific gravity. When the guide body 15 is formed of metal, a plastic, cement, rubber, or the like, it may be easily molded or cast to have the desired shape, and if formed of wood, stone or the like, it may be turned or otherwise shaped or fabricated. While I have shown the guide body 15 constructed in one piece it is to be understood that it may be sectional or fabricated from a number of suitably connected sections.

The means 16 for securing or attaching the guide body 15 to the bit is preferably such that the guide may be quickly secured in its operative position on the bit. The securing means 16 may be varied greatly without departing from the invention. In the construction being described transverse openings 21 are formed in the bit blades 11 and openings 22 are formed in the body 15 to register with the openings 21. Rods or pins 23 are passed into the openings 22 to extend through the openings 21. The guide body 15 is formed so that the character of which the body 15 is formed, permits, the body may be secured to the bit by molding or casting the body on the bit. If the body 15 is formed of or includes rubber or other resilient material, the resiliency of the material may secure the guide to the bit. In other cases the guide may be cemented or adhesively secured to the bit or may be welded, soldered or brazed to the bit.
In the use or operation of the bit guide illustrated in Figs. 1 and 2, the body 15 is engaged against the lower end of the bit to have the notches 19 receive the lower parts of the blades 14. The pins 23 are then passed through the openings 22 to cooperate with the openings 21. This attaches the guide to the bit and conditions the assembly for running into the well. The bit is run into the well on the lower end of the string S in the usual manner. During the downward pass of the bit through the well the guide body 15 directs or guides the bit and prevents the bit parts from contacting or injuring the lining or mud cake on the wall of the well. The sloping or curved guide surface 17 may engage the bit in the drilled or offset parts of the well to guide the bit through such well portions. The engagement of the guide surface 17 with the lining or mud cake on the well wall does not result in detachment, scoring, or scraping of the lining or mud. The guide body 15 projecting downwardly from the outer side of the bit and covering or engaging under the cutting parts positively prevents the cutting parts from digging into or scraping the well wall. The bit may be run to the lower end of the well without digging into or injuring the side wall of the well at any point. When the bit has reached the bottom of the well it is set down, that is, the weight, or a portion of the weight of the drilling string S is applied to the bit. This weight is, of course, transmitted to the bottom of the well through the guide body 15. Where the body 15 is formed of friable, fragile or brittle material of the character referred to above, the weight imposed on the guide body may cause the body to break or crumble.

When the bit has reached the bottom of the well and is in condition to begin the drilling operation the string S is rotated with a suitable feed pressure or load applied to the bit. The bit operated in this manner soon crushes or drills up the guide body 15. If the bit body 15 is formed of a drillable material such as a soft metal, rubber, fibrous materials, stone, or the like, the cutting parts of the bit rapidly drill the guide into small fragments or particles. When the body 15 is constructed of a brittle, friable, or fragile material such as glass, Bakelite, cement or the like the rotating bit soon breaks the guide into small fragments. The circulation fluid discharged from the ports 14 of the well bit flushes away the particles of the broken up or drilled up guide and the circulation fluid flowing upwardly in the well carries the guide fragments to the ground surface. The guide effectually guides the bit through the well to its operative position and is then broken up or drilled out, leaving the bit exposed for free operation. The guide in addition to preventing the bit from injuring the well prevents mud from the well wall from accumulating or gathering on the cutting parts of the bit and the bit is clear and ready for operation when the guide is broken up or drilled out. The well bit illustrated in Figs. 3 and 4 comprises a bit body 30 secured to the lower end of the drilling string S and provided with sets of downwardly projecting legs 31. Outer roller cutters 32 are rotatably supported between outer pairs of legs 31 to cut the bore to gauge and to form the outer portion of the well. A series of cross cutters or inner cutters 33 is rotatably supported between another set or pair of legs 31 and serve to drill away the inner portion of the well bore. The toothed roller cutters 32 and 33 project downwardly beyond the legs 31 and the other body parts to act freely on the formation at the bottom of the well.

The guide of the invention illustrated in Figs. 3 and 4 may be said to comprise, generally, a guide body 34 and means 35 for securing the guide body to the well bit. The guide body 34 is constructed and shaped to be easily applied to the well bit and to prevent contact of the rollers 32 or 33 with the wall of the well. The guide body 34 may be varied in shape and construction depending upon the kind of material used. In the case illustrated the guide body 34 embodies a minimum of material to be light in weight and cheap, and yet has ample strength. The body 34 includes a pair of aligned horizontally projecting wings 36 for engaging under the cross or inner cutters 33. The wings 36 have concave upper sides to receive the projecting lower portions of the cutters 33 and have convex or conforming under sides. The outer ends of the wings 36 project beyond or are flush with the outer ends of the cutters 33 and the adjacent ends of the inner legs 31. Rather heavy or thick parts 37 extend outwardly at opposite sides of the wings 36 and join substantially vertical legs or wings 38. The upper sides of the vertical wings 36 are concave or provided with notches 39 located and shaped to receive the lower parts of the cutters 33 and the outer legs 31 of the bit. The outer surfaces of the wings 38 are beyond or at least flush with the outer ends of the cutters 32 and their legs 31 to prevent these parts from contacting the side wall of the well bore when the bit is run into the well. The outer surfaces 40 of the wings are preferably convex and, as best illustrated in Fig. 3 of the drawing, slope or curve downwardly and inwardly with respect to the longitudinal axis of the bit. These convex curved surfaces 40 effectually guide the bit through offset or crooked portions of the well while preventing the protruding into or injuring the well wall. A transverse web or brace 41 may extend between and connect the spaced wings 38 to strengthen the construction. As shown in Fig. 4 of the drawing the bracing web 41 may be quite strong. The web 41 operates under compression to brace or support a wing 38 when the wing strikes or engages against the side wall of the well bore. The supporting or bracing web 41 may or may not extend downwardly to the lower ends of the wings 38. Spaced ports 42 may be provided in the parts 38 to permit a free discharge of the circulation fluid through the guide. The guide body 34 constructed as just described may be an integral casting or may be fabricated from several pieces.

In Figs. 3 and 4 of the drawing the means 35 for attaching the guide to the bit includes flexible elements for binding or tying the guide to the bit. These flexible elements may be rubber bands, rope, cords, straps or wires. In the case illustrated the flexible securing elements are in the nature of wires 43. The wires 43 have their lower ends fixed to the guide body 34 and the upper portions of the wires are adapted to extend about selected parts of the bit. As shown the wires 43 may pass upwardly around the bit to engage over the legs 31 and the end portions of oppositely extending wires 45 may be twisted together as at 44. The wires 45 may be bent in the guide body 34 or may be secured to the guide body by pins, screws, or the like.

The guide body 34 illustrated in Figs. 3 and 4 of the drawing is constructed to be readily
broken up, crushed, drilled up or dissolved when the bit has reached the bottom of the well. The guide of Figs. 3 and 4 may be constructed of any suitable or selected friable, fragile, drillable or soluble material. For example, it may be formed of any of the materials mentioned in the description of the guide body 15. The securing means 16 illustrated in Figs. 1 and 2 of the drawing may be utilized to secure the guide body 34 of Figs. 3 and 4 to the bit or the wires 43 illustrated in Figs. 3 and 4 may, if desired, be driven into the cutting parts comprising a body shaped to engage under said cutting parts to prevent the cutting parts from contacting the wall of the well when the tool is run into the well, and means for securing the body to the tool, the body being fragile to be readily broken up or drilled up by the tool when the tool is operated in the well.

2. A guide for a well drilling tool having cutting parts comprising a body shaped to engage under said cutting parts to prevent the cutting parts from contacting the wall of the well when the tool is run into the well, the body tapering downwardly and inwardly to guide the tool through the well, and means for attaching the body to the tool, the body being formed of drillable material to be drilled up by said cutting parts when the tool is operated in the well.

3. A guide for a rotary well drilling-bit having fluid discharge means, the guide comprising a guide body to be arranged on the lower end of the bit and including portions for covering the active bit parts to prevent them from digging into the side wall of the well when the bit is being run down through the well, said body having a passageway for passing said fluid means in communication with the well, the guide being formed of drillable material of a specific gravity comparable with that of the drilling fluid to be readily reduced to fragments by operation of the bit in the well, which fragments are carried by the guide body with the guide body.

4. A guide for a rotary well drilling tool having roller cutters on its lower end comprising a guide body to be arranged on the lower end of the tool and including upper portions recessed to receive said roller cutters, and a lower portion tapering downwardly and inwardly to guide the tool and body downwardly through the well, and means for attaching the body to the tool, the body being formed of drillable material to be readily drilled up by the tool when the tool reaches its operative position in the well.

5. A guide for a well bit having cutting blades on its lower end, the guide including a tubular guide body having recesses in its upper end for receiving and substantially conforming to the blades, and means for attaching the body to the bit, the external diameter of the guide body being substantially the same as the cutting gauge of the blades.

6. A guide for a rotary rock bit having roller cutters exposed at its lower end, the guide comprising a guide body to be arranged at the lower end of the bit, to extend downwardly and inwardly therefrom and provided at its periphery with channels to allow the flow of fluid past the body and bit; parts on the body for fitting under the exposed parts of the roller cutters and designed to prevent the cutters from digging into the wall of the well when the bit is lowered into the well, and means for facilitating the attachment of the body to the bit.

7. A guide for a rotary rock bit having roller cutters exposed at its lower end, the guide comprising a guide body to be arranged at the lower end of the bit, the body being formed of drillable material and including wings for fitting under the exposed portions of the cutters, and a web extending between the wings.

8. A guide for a rotary well drilling tool having a cutting part and fluid discharge means, the guide comprising a body having a portion for

Having described my invention, I claim:

1. A guide for a well drilling tool having roller cutters for cutting the well bore to gauge, the guide comprising a body shaped to receive the lower portion of said roller cutters to prevent the cutters from contacting the wall of the well when the tool is run into the well, and means for securing the body to the tool, the body being fragile to be readily broken up or drilled up by the tool when the tool is operated in the well.
covering the lower side of the cutting part and shaped to guide the tool through the well without digging into the well wall, the body having a passage for maintaining said fluid discharge means in communication with the well bore, and means for securing the body to the tool, said means including a pin received in openings in the tool and guide body.

9. A guide for preventing the cutting parts of a rotary well drilling tool from injuring the wall of the well when the tool is lowered through the well, the guide comprising a guide body to be arranged at the lower end of the tool and comprising parts for underlying and generally conforming to the cutting parts and presenting guide surfaces for contacting the wall of the well to prevent injurious contact of the tool with the well wall, the body and its said parts lying entirely within the circle defined by the outermost portion of the tool when the tool is rotated, and means for securing the body to the tool.

10. A guide for a well drilling tool having an exposed roller cutter at its lower end, the guide comprising a body of drillable material arranged at the lower end of the tool and having a portion generally conforming to and protruding below the exposed lower side of the roller cutter to prevent the cutter from contacting the wall of the well when the tool is lowered through the well, and means for securing the body to the tool, the peripheral portion of the body being shaped to leave generally vertical passages for the flow of fluids.

11. A guide for a well bit having cutting parts on its lower end and a circulation opening comprising a guide body for arrangement on the lower end of the bit to cover its cutting parts, the body having a rounded lower end for guiding the bit downwardly in the well and having a port for maintaining said opening in communication with the well, and means for securing the body to the bit, the body being formed of a readily drillable material to be drilled up by the bit.

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