Nov. 16, 1943. O. A. BROWN 2,334,309

WELL TOOL CONSTRUCTION

Filed Feb. 28, 1941

Fig. 1.

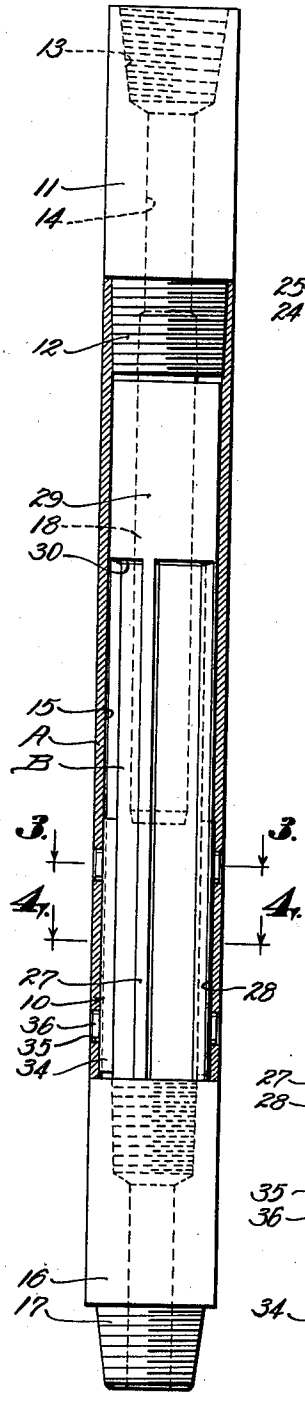


Fig. 2.

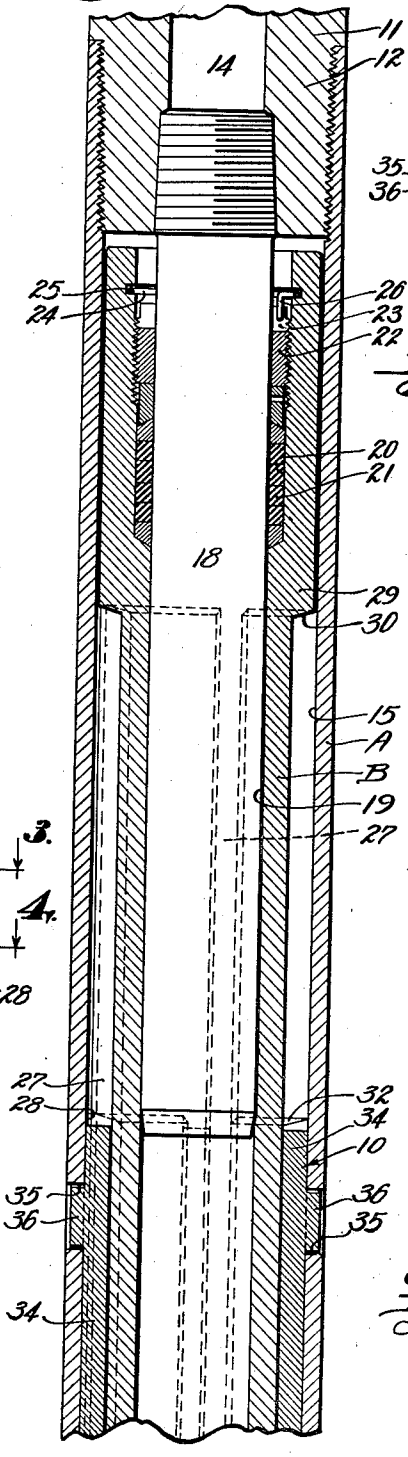


Fig. 3.

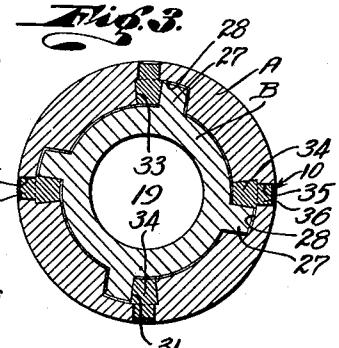
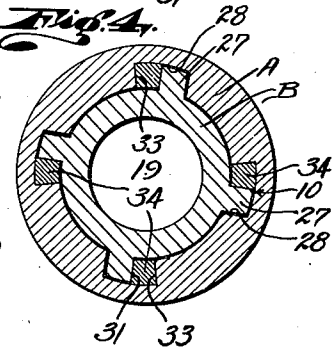


Fig. 4.



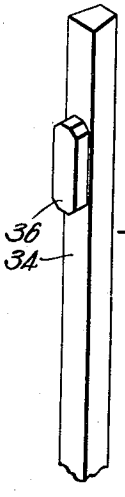


Fig. 5.

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2,334,309

WELL TOOL CONSTRUCTION

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5 Claims. (Cl. 255—27)

This invention relates to well tools and relates more particularly to rotary well drilling tools of the class embodying parts associated for relative longitudinal movement and for the transmission of torque. A general object of the invention is to provide dependable long wearing well tools of the character mentioned.

Various well tools which are to be connected in rotary well drilling strings embody elements splined or keyed together for relative axial movement and for the transmission of rotation. During the well drilling operations the string is subjected to heavy constantly varying torsional strains. These varying torsional strains subject the key or spline parts of the tools to severe wear and, in many instances, the key or spline parts are so badly worn after only a few hours of operation that they must be remachined or discarded. It has been the general practice to form the key or spline parts directly on the body elements of the tools and when the parts are excessively battered or worn it sometimes becomes necessary to discard the entire body elements.

Another object of this invention is to provide a well drilling tool of the class embodying slidably engaging torque transmitting spline parts that is characterized by long wearing torque transmitting parts. The sliding torque transmitting parts of the tool provided by this invention withstand severe and extended usage.

Another object of this invention is to provide a well tool of the character mentioned in which the cooperating slidably engaging torque transmitting elements are of dissimilar materials reducing the wear and materially prolonging the active life of the parts.

Another object of this invention is to provide a tool construction of the character mentioned in which the torque transmitting parts, or at least the wear taking elements, are replaceable so that the tool may be inexpensively reconditioned by simply replacing these parts when the same become worn.

Another object of this invention is to provide a well tool construction of the character referred to in which the replaceable torque transmitting parts are formed of a material which will assume the greater part of the wear so that the permanent parts are subjected to a minimum of wear and may remain effective for the life of the tool. In the construction of the present invention practically all of the wear is assumed by the replaceable parts and the tool is readily and inexpensively reconditioned by the replacement of these parts, retaining all of the other elemnts for further use.

A further object of this invention is to provide a tool of the character referred to in which the replaceable parts are easily and quickly replaced when worn and are dependably retained in their active positions without the employment of screws or like securing members which might become broken or displaced.

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

Fig. 1 is a side elevation of a rotary well drilling tool embodying the features of the present invention with a portion of the outer section in longitudinal cross section. Fig. 2 is an enlarged fragmentary vertical detailed sectional view of a major portion of the tool. Figs. 3 and 4 are enlarged transverse detailed sectional views taken as indicated by lines 3—3 and 4—4, respectively, on Fig. 1 and Fig. 5 is a fragmentary perspective view of one of the replaceable parts.

The construction of the present invention is adapted for embodiment in well tools varying greatly in design and intended use, being suitable for embodiment in practically all well tools requiring or employing relatively shiftable torque transmitting members. In the following detailed disclosure I will describe the embodiment and use of the invention illustrated in the drawing, it being understood that the invention is not to be construed as limited or restricted to this particular form or application.

The well tool illustrated in the drawing and embodying the present invention may be said to comprise, generally, two sections A and B associated for relative longitudinal movement, and means 10 for transmitting torque or rotary forces from one section to the other.

The sections A and B constitute an assembly adapted to be interposed in a well drilling string or in a tool carried by or embodied in such a string. The sections A and B are arranged in axial alignment and are telescopically related. The section A, which in the case illustrated, is the upper section, forms the outer element of the telescopic assembly and receives the inner or mandrel section B. The section A is an elongate tubular element preferably of substantial length. Means is provided at the upper end of the section A for facilitating the connection of the section with the drilling string or an adja-

cent tool. In the case illustrated a sub or connecting member 11 has a pin 12 screw threaded in the upper end of the section A and the upper end of the member 11 has a tapered screw threaded socket 13 for receiving a threaded connecting pin of the well string, not shown. A longitudinal fluid passage 14 extends through the member 11 from the socket 13 to the lower end of the pin 12.

The section B is in the nature of a mandrel or stem. The stem section B is a tubular member received in the opening 15 of the section A with substantial clearance. The section B extends downwardly beyond the lower end of the section A and is provided at its lower end with means for connection with the well string or with a tool in the well string. In the construction illustrated a sub or connecting member 16 is screw threaded on the lower end of the section B and the member carries a downwardly projecting screw threaded pin 17 for connection with the well string. The member 16 is tubular to conduct the circulation fluid.

It is preferred to provide means for conducting the circulation fluid from the connecting member 11 directly to the lower section B so that the circulation fluid does not flow into or through the interior of the section A. A wash pipe 18 is threaded in the lower portion of the passage 14 of the member 11 and extends downwardly to enter the opening 19 of the section B. The wash pipe 18 is sufficiently long to have a substantial portion received in the opening 19 when the sections A and B are in their most extended relative positions. Means is provided for sealing about the wash pipe. A socket 20 is formed in the upper portion of the section B and contains packing 21 for sealing with the pipe 18. A gland or follower 22 is threaded in the upper portion of the socket 20 to actuate or compress the packing 21. Notches 23 are provided in the upper end of the gland or follower 22. A spring ring 24 is sprung or latched into an annular groove 25 in the wall of the socket 20 and the ring 24 has a finger 26 for engaging in a notch 23 to lock the follower 22 against unthreading. It will be seen that the wash pipe 18 receives the circulation fluid from the passage 14 and discharges it directly into the opening 19 so that the circulation fluid is prevented from entering the section A.

The means 10 serves to transmit torque or rotary forces between the sections A and B while allowing free relative longitudinal movement of the sections. The means 10 is in the nature of a spline means embodying cooperating slidably engaging parts on the telescopically related portions of the sections A and B. In the arrangement illustrated there are spaced longitudinal splines 27 on the section B received in longitudinal grooves 28 in the section A, it being understood that this relationship may be reversed if desired. The splines 27 are preferably, though not necessarily, integral parts of the section B and are of substantial length. In the particular tool illustrated the splines 27 extend upwardly from the connecting member 16 to a head 29 on the upper end of the section B. The head 29 contains the packing 21, the gland 22, etc. and is received in the section A with suitable clearance to assist in guiding the sections for relative longitudinal movement. The splines 27 may integrally join the head 29. The lower end of the head 29 presents a series of downwardly facing abutment shoulders 30 spaced apart by the splines 27. The shoulders 30 may be pitched downwardly and inwardly. The sides of the splines 27 are preferably smooth and vertical. In the particular formation illustrated the rear sides 31 of the splines 27, relative to the right hand direction of rotation, are radial with respect to the longitudinal axis of the tool, while the forward sides of the splines are parallel with the rear sides 31. The splines 27 are quite thick and there is a sufficient number of splines to dependably transmit the heavy torsional strains. In the embodiment illustrated, there are four equally spaced splines 27.

The grooves 28 for receiving the splines 27 are formed in the lower half or lower portion of the section A. The wall of this lower portion of the body section A is thickened to provide ample material at the grooves 28. The thickened wall portion of the section A provides an upwardly facing annular shoulder 32 on the interior of the section, which is interrupted by the grooves 28. The shoulder 32 is engageable with the shoulders 30 to limit the upward movement of the section A relative to the section A and the lower end of the section A may engage against the upper end of the connecting member 16 to limit the downward movement of the section A with respect to the section B. In some applications the shoulders 30 and 32 may constitute jar shoulders, that is, the shoulders may be forcibly brought together to provide a jarring action. In a like manner, the lower end of the section A may be jarred down against the connecting member 16.

The grooves 28 extend from the lower end of the section A to the shoulder 32 and are formed and spaced to receive the splines 27. The grooves 28 are considerably wider than the splines, for example, they may be approximately twice as wide as the splines. Where the tool is intended to normally transmit right hand torsional forces the splines 27 occupy the forward portions of the grooves 28 relative to the right hand direction of rotation. The forward walls of the grooves 28 may be tangent to a circle concentric with the longitudinal axis of the tool to be parallel with and to cooperate with the forward sides of the splines. The rear walls 33 of the grooves 28 are radial relative to the longitudinal axis of the tool. The outer walls of the grooves 28 are preferably concentric to the central longitudinal axis of the tool.

The means 10 further includes wear taking members or parts 34 engaged between the splines 27 and certain walls of the grooves 28. The wear taking parts 34 are in the nature of replaceable blocks arranged between the torque transmitting surfaces and walls of the splines 27 and grooves 28. Where the tool is intended to transmit right hand torque the parts 34 are arranged in the grooves 28 to occupy positions between the rear sides 31 of the splines 27 and the rear walls 33 of the grooves 28. The parts 34 are elongate elements and extend throughout almost the entire length of the grooves 28. It is preferred to make the parts 34 slightly shorter than the grooves 28 so that their upper ends are below the shoulder 32 where they cannot be engaged with the shoulders 30 and so that their lower ends are above the bottom of the section A where they cannot strike the member 16. The wear taking parts 34 are shaped and proportioned to seat in the grooves 28 and to occupy those portions of the grooves not occupied by the splines 27. The forward and rear sides of the parts 34 are radial with respect to the central vertical axis of the tool to respectively co-

operate with the rear sides of the splines 27 and the rear walls 33 of the grooves 28. The outer faces of the parts 34 are preferably curved to bear against the curved outer walls of the grooves 28 and the inner sides of the parts 34 are curved or concave to have suitable clearance with the cylindrical exterior of the section B. It will be observed that the rear sides of the parts 34 engage against the rear walls of the grooves 28 so that the parts positively turn with the section A when the same is rotated in the right hand direction and the forward sides of the parts 34 bear against the rear sides 31 of the splines 27 to transmit the rotation to the splines and the section B.

In accordance with the invention the wear taking parts 34 are formed of a material different than the material of the splines 27. The parts 34 are constructed of a material of such character that the parts 34 will assume or receive the major portion of the wear, relieving the splines 27 of excessive wear. It is customary to construct the main elements of a well tool of steel and in such cases the parts 34 are formed of a material which will assume the major share of the wear when cooperating with steel. In some cases I have found it desirable to construct the wear taking parts 34 of bronze but in other cases it may be found desirable to form the parts 34 of a material harder than steel.

The invention includes novel and very effective means for removably securing the parts 34 in the grooves 28. Radial or lateral openings 35 are provided in the wall of the section A to communicate with the grooves 28. In the construction shown in the drawing there is an opening 35 communicating with the upper and lower portion of each groove 28, the openings 35 being suitably spaced from the ends of the grooves. I prefer to elongate the openings 35 in the direction of the longitudinal axis of the well tool. Each wear taking part 34 is provided with projections or lugs 36 to engage in the openings 35 in its respective groove 28. The lugs 36 may be integral with the parts 34 and project from the outer faces of the parts to extend into the openings 35. The lugs 36 are shaped to correspond to the openings 35 and may have their corners bevelled off as best shown in Fig. 5. It is preferred to proportion the lugs 36 so that they do not project from the external surface of the section A. In assembling the construction, the wear taking parts 34 are arranged in their grooves 28 with the lugs 36 engaged in the openings 35. The sections A and B are then assembled in the telescopic relation and the section B extending through the section A retains the parts 34 in the grooves 28. The lugs 36 engaged in the openings 35 positively hold the parts against longitudinal movement, while the telescopically related sections A and B positively prevent lateral movement or displacement of the parts.

It is believed that the utility of the well tool construction of the present invention will be readily understood from the foregoing detailed description. When the tool is in operation the sections A and B are free for relative longitudinal movement, this movement being limited by the cooperation of the shoulders 30 and 32 and by the engagement of the section A with the upper end of the connecting member 16. When torque is being transmitted through the well string, as during well drilling operations, the forward sides of the wear taking parts 34 bear against the rear sides 31 of the splines 27 to transmit the rotary forces from the section A to the section B. The engagement of the parts 34 with the splines 27 is such that the engaging surfaces may slide freely one on the other, thereby permitting relative longitudinal movement between the sections. The means 10 provides for the positive transmission of rotation between the sections without interfering with the free relative longitudinal movement. With the parts 34 constructed as above described, these elements assume or take practically all of the wear resulting from the transmission of torque and resulting from relative longitudinal movement of the sections A and B when torque is transmitted through the tool. Accordingly, the splines 27 are relieved of practically all of the wear. For this reason, the tool may remain in operation for a long period before requiring reconditioning.

After extended use the parts 34 may become excessively worn. When this occurs the tool is taken apart and the worn parts 34 are removed from the section A. New or replacement parts 34 are installed in the grooves 28 and the tool is again assembled. This conditions the tool for further extended service. The tool construction of the present invention is inexpensive and long wearing and may be reconditioned by merely replacing the readily removable parts 34.

Having described only a typical preferred form and application of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear to those skilled in the art or fall within the scope of the following claims.

Having described my invention, I claim:

1. A well tool to be interposed in a well string including two sections telescopically related for relative longitudinal movement and having opposing elongate longitudinally extending surfaces, a separate elongate wear taking part positioned within the outer telescopic section to be held against lateral displacement by the telescopic sections and having its opposite side extremities opposing said surfaces for the transmission of torque between the sections, one section having an opening, and a lug on said part engaging in said opening to hold the part against longitudinal movement so that the part has sliding cooperation with said surface of the other section.

2. A telescopic well tool to be interposed in a well string including two sections related for relative longitudinal movement, one section having a longitudinal groove, a longitudinal spline on the other section received in the groove to be in spaced relation to a side wall of the groove, means for connecting the sections in a well string, a wear taking part contained entirely within the groove to bear on said wall and to slidably cooperate with the spline for the transmission of rotation between the sections, the first named section having spaced openings joining the groove, and lugs on the wear taking part cooperating with said openings to hold the part against longitudinal movement relative to said first named section.

3. A well tool to be interposed in a well string including two telescopically engaged sections related for relative longitudinal movement, one section having longitudinal grooves and an abutment shoulder at one end of the grooves, splines on the other section received in grooves, a shoul-

der on said other section engageable with the first named shoulder to limit relative longitudinal movement between the sections in one direction, elongate wear taking parts in the grooves slidably engaging the splines for the transmission of torque between the sections, and means for holding said parts against longitudinal movement relative to said first named section in a position where they are clear of said first named shoulder so that they are not engaged by the second named shoulder.

4. A well tool to be interposed in a well string comprising a tubular outer section having spaced longitudinal grooves, an inner section received in the outer section, the sections being related for relative longitudinal movement, spaced longitudinal splines on the inner section directly received in the grooves, the splines being of less width than the grooves leaving spaces in the grooves, and replaceable wear taking strips in said spaces, each strip having one side bearing on a side wall of a groove and its other side slidably cooperable with a side surface of the spline which occupies the groove, the inner surface of each strip opposing the external surface of the inner section and the outer surface of each strip bearing on the outer wall of its groove.

5. A well tool to be interposed in a well string comprising a tubular outer section having spaced longitudinal grooves, an inner section received in the outer section, the sections being related for relative longitudinal movement, spaced longitudinal splines on the inner section directly received in the grooves, the splines being of less width than the grooves leaving spaces in the grooves, replaceable wear taking strips in said spaces, each strip having one side bearing on a side wall of a groove and its other side slidably cooperable with a side surface of the spline which occupies the groove, the inner surface of each strip opposing the external surface of the inner section and the outer surface of each strip bearing on the outer wall of its groove, the outer section having openings communicating with the grooves at the outer walls thereof, and lugs on the outer sides of the strips engaged in said openings to hold the strips against longitudinal movement.

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