This invention relates to drill collars such as are used to connect a rotary tool string to a drill bit when drilling a well. A drill bit is subjected to very severe strains while cutting its way through a rock stratum, and these strains are transmitted from the bit to the tool string through the drill collar. Many breakages of drill collars occur by reason of their lack of flexibility. As usually constructed in practice, these drill collars are relatively expensive to manufacture and they have also an undesirable rigidity.

The general object of the invention is to produce a drill bit having a high degree of flexibility with sufficient strength to impart the torsion forces from the drill bit to the tool string, so constructed as to enable it to be very economically produced. The invention includes the method of constructing the drill collar as well as the drill collar itself.

Further objects of the invention will appear hereinafter.

As regards the drill collar itself, the invention consists in the novel parts and combination of parts to be described hereinafter, all of which contribute to produce an efficient drill collar; as regards the method of constructing the drill collar, the invention consists in those novel steps and combination of steps to be described hereinafter.

A preferred embodiment of the invention is described in the following specification, while the broad scope of the invention is pointed out in the appended claims.

In the drawing:

Fig. 1 is a side elevation of a drill bit embodying our invention, the middle portion of the same being broken away and the lower portion being shown partially in section.

Fig. 2 is a fragmentary longitudinal section taken through the wall of the upper head and illustrating its connection to the body of the drill collar. This view is upon an enlarged scale.

Fig. 3 is a horizontal cross section taken on the line 3—3 of Fig. 1, but upon a larger scale.

Fig. 4 is a side elevation and partial section, broken away, and illustrating another embodiment of the invention.

In practicing our method, we produce a built-up drill collar having a body comprising an inner tube with an outer tube surrounding it. On the intermediate portion of the body, the walls of these telescoped tubes are disposed apart so that there is an annular space between them, but the wall of the drill collar is constructed so that the walls of the tubes come together at each end of the drill collar, at which points we attach the heads to the body. The walls of the tubes are rigidly connected together. The connections of the body to the heads may be made in any desired manner.

We shall now describe a preferred construction for producing this built-up drill collar, referring especially to Figs. 1 to 3.

The body 1 of the drill collar, as indicated above, is composed of an inner tube 2 and an outer tube 3; one end of the inner tube, for example the upper end, is attached to a head 4. In order to attach the head, we prefer to provide a tapered screw connection 5 which enables the inner tube to be screwed into the lower end of the head 4. We prefer also to provide a reinforced or thickened wall 6 for the inner tube in the vicinity of the screw connection and extending a short distance below the lower end 7 of the head 4.

After the inner tube has been attached in this way, we slip over it the outer tube 3 which telescopes with the inner tube as indicated, and we then attach the adjacent end of the outer tube to the inner tube. We also secure the end of the outer tube to the lower end or adjacent end of the head 4.

In order to accomplish this and at the same time to form an annular space 8 between the inner tube and outer tube, we prefer to place a spacer ring 9 between the walls of the tubes and adjacent to the head 4 (see Fig. 2). This spacer ring substantially fills the annular space 8. We then spot-weld the inner tube and outer tube together at the spacer ring 9.

In order to increase the strength in forming the weld, we form it so that there is virtually a key-connection formed through the connected walls. This is accomplished by drilling a tapered socket 10 through the wall of the outer tube 3 and through the spacer ring 9 and extending into the thickened portion 6 of the inner tube. We may provide any number of these sockets that may be desired, for example, four. After the sockets are formed we burn in keys 11 into these sockets by means of an acetylene flame or with an electric welding apparatus.
The result of this is that the metal of the key or plug 11 is burned in or fused into the metal of the adjacent parts, forming an integral part of the walls which are in contact with this plug or key.

We also prefer to produce a butt-weld 12 between the adjacent end of the outer tube and the head, as indicated.

The upper end of the head 4 is provided with means such as a boss with a thread 13 to which a tapered pin at the lower end of the drill string may be attached.

After attaching the inner and outer tubes to the upper head, we attach the lower head to these tubes in any suitable manner. We prefer, however, to provide screw threads 14 on the lower end of the inner tube similar to the threads which occur at the screw connection 5. By means of these threads 14 we attach the lower end of the inner tube to the other head 15. The outer tube 3 should be of sufficient length so that its other end will be adjacent to the upper end 16 of the lower head.

When head 16 is screwed into place, a distance ring similar to the distance ring 9 is placed over the adjacent end of the inner tube and a welded connection is formed at this point, and this connection is preferably made in the same manner as at the other end of the body in connecting the inner tube and outer tube together. The adjacent end of the head 15 is also preferably connected by a butt-weld 17 to the adjacent end of the outer tube 3.

It will be evident that a drill tube collar constructed as described will have relatively great strength and at the same time it will be flexible and will operate without breaking, to permit the vertical axis of the drill bit to tilt or assume an inclined position under the reaction of the forces occasioned by the rock being drilled.

The key connections between the inner and outer tube tie these tubes very rigidly together adjacent the heads so that the torsion forces transmitted through the two walls of the body will be imparted to the head 4 as though the drill collar were made in one piece.

If it is desired to practice the invention without the use of welding, this can be done by constructing the drill collar as illustrated in Fig. 4. In this instance, the inner tube 18 has a thread connection 19 by means of which it is attached to the upper head 20. The outer tube 21 is telescoped over this inner tube and the walls of the two tubes come together at a seat 22 adjacent the head; below this seat the walls of the tubes separate so as to form an annular space 23 between the tubes.

The outer tube 21 has a screw connection 24 connecting it to the head 20. After the two tubes have been attached to the upper head in this way, the incomplete drill collar is then put in a lathe and a thread 25 chased on the end of the inner tube, which projects beyond the end 26 of the outer tube at the lower end, as shown in Fig. 4. A thread 27 is chased on the outer side of the outer tube. These threads 25 and 27 have the same pitch and they also start at the same point, that is to say, they start on the same radius from the axis of the drill collar. The lower head has threads similar to the threads 25 and 27, which also start at points on the same radius line. This enables the lower head to be screwed into place on the threads 25 and 27. The walls of the two tubes 18 and 21 come together at 28 near the lower head, just as at the point 22.

The lower end of the head 15 is provided with means such as threads 29 for attaching it to the tapered pin of the drill bit.

A drill collar constructed in this way will have very desirable flexibility, but necessitates carefully conducted threading operations. However, in some situations it may be more feasible to construct a drill collar in this way than by the use of welding, as described in connection with Fig. 1.

It is understood that the embodiment of the invention described herein is only one of the many embodiments this invention may take, and we do not wish to be limited in the practice of the invention, nor in the claims, to the particular embodiment set forth.

What we claim is:

1. A built-up drill collar having a body comprising an inner tube with an outer tube telescoped over the inner tube, and a head at each end connected to the two tubes, said heads having means for connecting the same respectively to the drill string and the drill bit.

2. A built-up drill collar having a body comprising an inner tube with an outer tube telescoped over the inner tube, and a head at each end connected to the two tubes, said heads having means for connecting the same respectively to the drill string and the drill bit, the wall of said drill collar being constructed so that the walls of said tubes are rigidly connected together at each end of the drill collar adjacent the heads, said walls having an annular space between them at the intermediate portion of the body.

3. A built-up drill collar having a head at each end, and having a body consisting of an inner tube connecting the said heads, with an outer tube surrounding the inner tube and having a weld at its ends connecting it to said heads.

4. A built-up drill collar having a head at each end, and having a body consisting of an inner tube with a thread connection at each end connecting the same to the heads, and an outer tube surrounding the
inner tube and having a weld at its ends connecting it to said heads.

5. A built-up drill collar having a head at each end, and having a body consisting of an inner tube with a thread connection at each end connecting the same to the heads, and an outer tube surrounding the inner tube and having a weld at its ends connecting it to said heads.

10. A built-up drill collar having a head at each end and a body consisting of an inner tube with an outer tube surrounding the inner tube, and connected to the heads, and key-connections between the inner tube and the outer tube adjacent each head.

15. A built-up drill collar having a head at each end and having a body consisting of an inner tube with an outer tube surrounding the inner tube, the wall of said drill collar being constructed so that the walls of said tubes come together at each end of the drill collar adjacent the heads, the walls of said tubes having an annular space between them at the intermediate portion of the body, and key-connections between the inner tube and the outer tube adjacent the heads.

20. A built-up drill collar having a head at each end and having a body consisting of an inner tube with an outer tube surrounding the inner tube, a spacer ring separating the inner tube from the outer tube adjacent the head, and key-connections seated in the walls of the tubes and the ring.

25. A built-up drill collar having a head at each end and having a body consisting of an inner tube with an outer tube surrounding the inner tube, a spacer ring between the walls of the tubes adjacent the head, and key-connections burned into the walls of the tubes and passing through the spacer ring.

30. A built-up drill collar having a head at each end and having a body consisting of an inner tube with an outer tube surrounding the inner tube, a spacer ring between the walls of the tubes adjacent the head and welded to the walls of the tubes, and keys burnt into the walls of the inner and outer tube and passing through the spacer ring.

35. A built-up drill collar having a head at each end and having a body consisting of an inner tube having a thread connection at each end connecting the same to the heads, and an outer tube surrounding the inner tube and having a weld at its ends connecting the same to the heads, a spacer ring between the walls of the tubes adjacent each head, and connecting keys burnt into the walls of the tubes and the spacer ring.

40. The method of making a built-up drill collar which consists in attaching an inner tube to a head, telescoping an outer tube over the inner tube and welding the same to the head, attaching another head to the other end of the inner tube, and welding the same to the other end of the outer tube.

45. The method of making a built-up drill collar, which consists in connecting an inner tube to a head by a screw connection, telescoping an outer tube over the inner tube, welding the end of the outer tube to the head, attaching another head to the other end of the inner tube, and welding the same to the other end of the outer tube.

50. The method of making a built-up drill collar, which consists in attaching a head to an inner tube, placing a spacer ring over the inner tube adjacent the head, telescoping an outer tube over the inner tube with its end over the spacer ring, and welding the walls of the tubes to the spacer ring.

55. The method of making a built-up drill collar, which consists in attaching a head to an inner tube, placing a spacer ring over the inner tube adjacent the head, telescoping an outer tube over the inner tube with its end over the spacer ring, welding the walls of the tubes to the spacer ring, and welding the end of the outer tube to the head.

60. The method of making a built-up drill collar, which consists in attaching a head to one end of an inner tube, placing a spacer ring over the inner tube adjacent the head, telescoping an outer tube with its end over the spacer ring, forming a socket through the wall of the outer tube through the spacer ring and extending into the inner tube, and burning a key into the socket.

Signed at Torrance, Calif., this 4th day of April, 1925.

EDWARD TIMBS.

GEORGE D. WATSON.