

June 30, 1942.

T. A. CREIGHTON

2,288,124

DRILLING STRING PROTECTOR

Filed Nov. 13, 1939

2 Sheets-Sheet 1

*Fig. 1.*

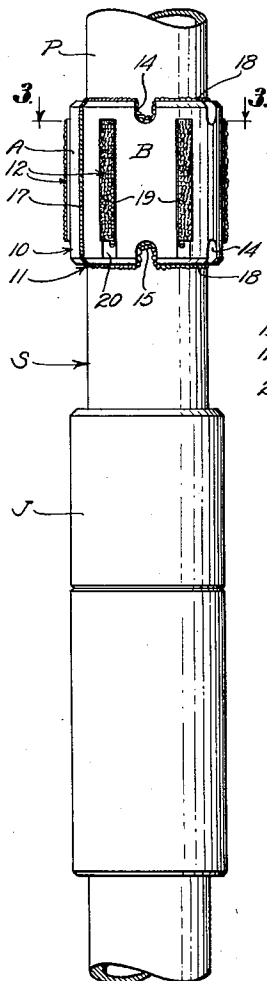


*Fig. 2.*

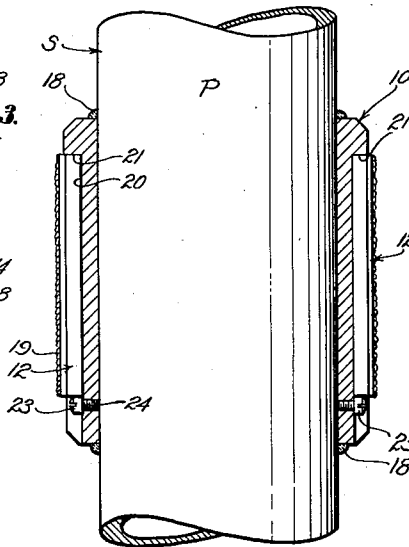


*Fig. 3.*

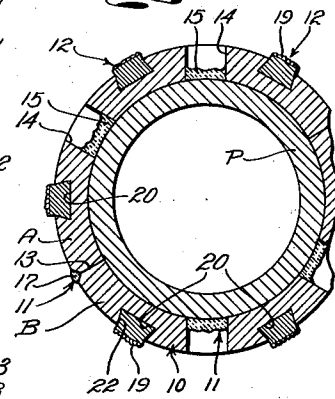


*Fig. 4.*

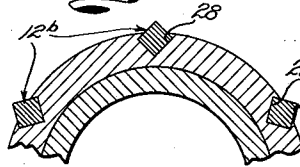


*Fig. 5.*

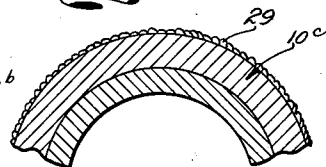


*Fig. 6.*

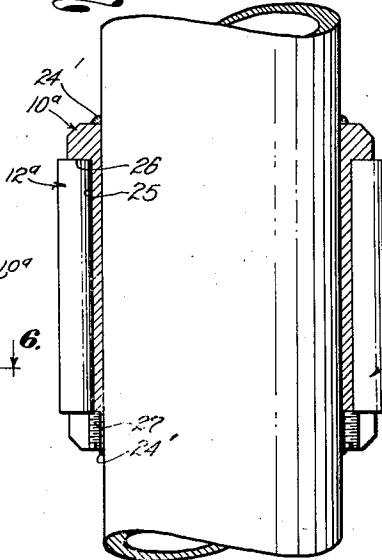


*Fig. 7.*

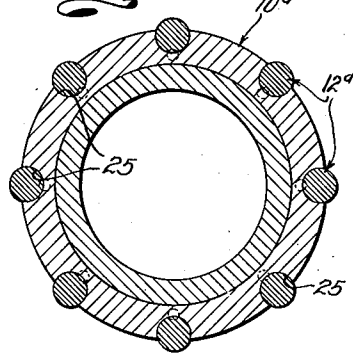
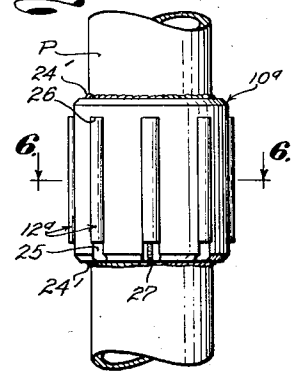


*Fig. 8.*



Inventor  
THOMAS A. CREIGHTON  
By *W. H. McFarrell*  
His Attorney

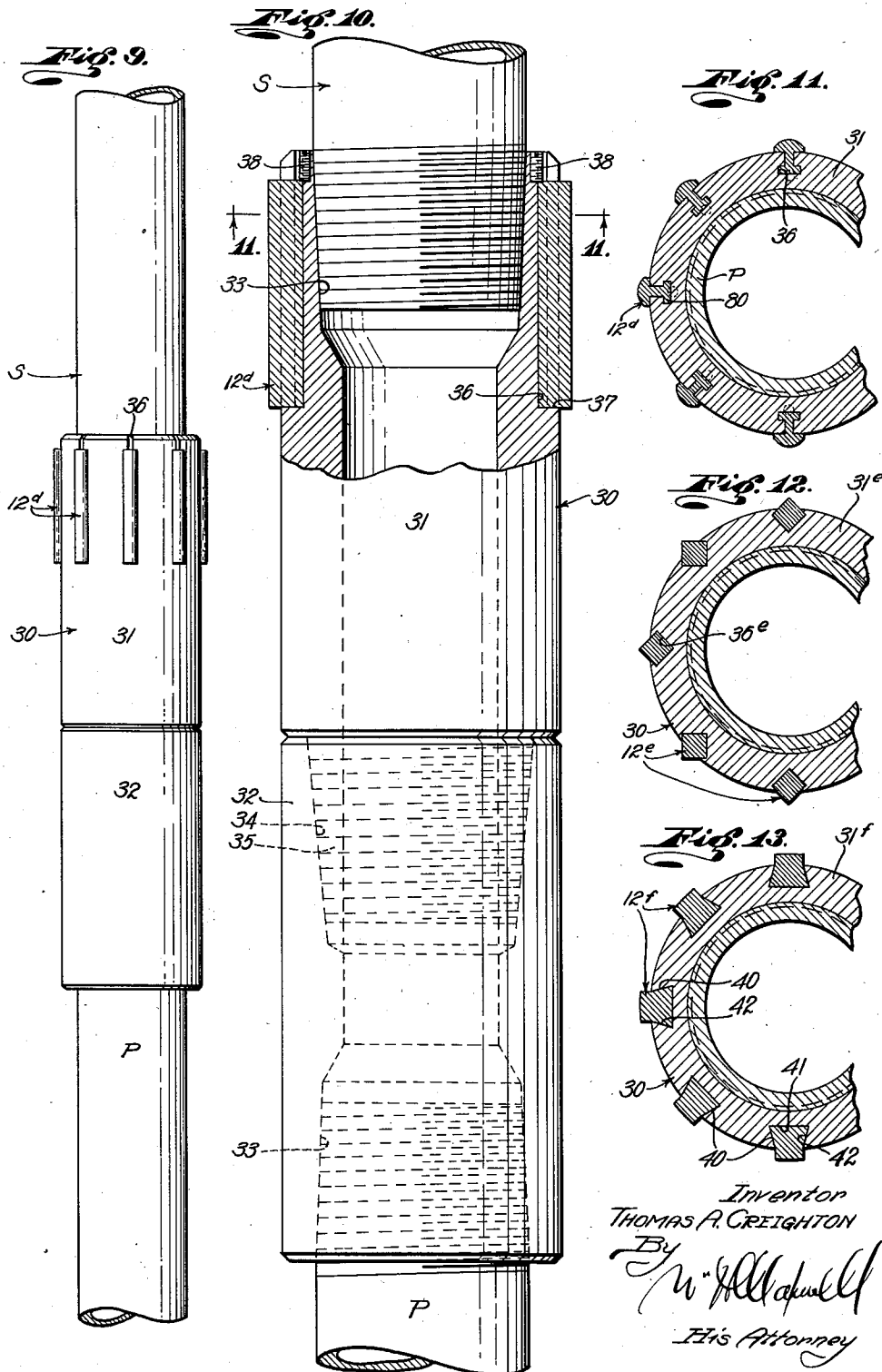
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2 Sheets-Sheet 2



Inventor  
THOMAS A. CREIGHTON

By *W. H. Hall*  
His Attorney

## UNITED STATES PATENT OFFICE

2,288,124

## DRILLING STRING PROTECTOR

Thomas A. Creighton, Long Beach, Calif., assign-  
or of one-half to Martha H. Wright, Los An-  
geles, Calif.

Application November 13, 1939, Serial No. 303,955

3 Claims. (Cl. 308—4)

This invention relates to rotary well drilling equipment and relates more particularly to protectors for protecting rotary well drilling strings against excessive wear. A general object of this invention is to provide practical, dependable and long wearing drilling string protectors.

Oil wells and gas wells are being drilled to great depths by the rotary method of drilling and with the present day practice it is customary to rotate the drilling string rapidly and to drill as far ahead of the set casing as possible before setting another casing. When the drilling tools are operated in this manner a substantial portion of the drilling string is rotating at a high speed in the open, uncased part of the well and the tool joints and upset end portions of the pipe sections are subjected to excessive wear through contact with the side wall of the bore. The tool joints and the upset end parts of the pipe rapidly wear out of round, requiring expensive replacements and this wear sometimes causes failure of the string through unbalanced stresses at the couplings. Rubber protectors are often provided on the portion of the drilling string that operates in the cased part of the well to protect both the well casing and the drill pipe against wear, but such rubber protectors are incapable of withstanding the hard usage to which they would be subjected in the open uncased part of the well.

Another object of this invention is to provide drilling string protectors for application to the portion of the drilling string operating in the open uncased part of the well that fully protect the tool joints and the pipe against wear through contact with the well wall.

Another object of this invention is to provide protectors of the character mentioned embodying hard or hardened wear taking elements for engaging the wall of the well to protect the bodies of the devices against direct engagement with the well wall.

Another object of this invention is to provide drilling string protectors of the character mentioned that are easily and quickly secured to the drilling string in a dependable manner and without injuring or weakening the string.

Another object of this invention is to provide protectors of the character mentioned in which the wear taking parts of hard material may be easily and quickly replaced when worn.

Another object of this invention is to provide drilling string protectors that may be readily secured to previously assembled portions or strands of the string.

A further object of this invention is to provide drilling string protecting means that may be embodied in or applied to the tool joint sections of the drilling string making it unnecessary to secure protective parts directly on the pipe.

A still further object of this invention is to provide drilling string protective means that are inexpensive to manufacture and to apply to the drilling string.

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 portion of a rotary well drilling string showing one form of protector of the invention secured thereon. Fig. 2 is an enlarged side elevation of a portion of the drill pipe with the protector of Fig. 1 in longitudinal cross section. Fig. 3 is an enlarged fragmentary transverse detailed sectional view taken as indicated by line 3—3 on Fig. 1. Fig. 4 is a side elevation of another form of protector of the invention secured to a drill pipe. Fig. 5 is an enlarged longitudinal detailed sectional view of the protector of Fig. 4 in position on the pipe, showing the pipe in side elevation. Fig. 6 is an enlarged transverse detailed sectional view taken as indicated by line 6—6 on Fig. 4. Figs. 7 and 8 are fragmentary transverse sectional views illustrating alternative forms of wear taking elements that may be applied to the protectors illustrated in Figs. 1 and 4. Fig. 9 is a side elevation of a portion of a rotary well drilling string showing a protective means of the invention embodied in a tool joint of the string. Fig. 10 is an enlarged fragmentary side elevation of the drilling string shown in Fig. 9 with the upper portion of the tool joint in longitudinal cross section. Fig. 11 is a fragmentary transverse detailed sectional view taken as indicated by line 11—11 on Fig. 10 and Figs. 12 and 13 are views similar to Fig. 11 illustrating alternative forms of hard wear taking elements that may be embodied in the structure of Figs. 9 to 11.

The form of the invention illustrated in Figs. 1, 2 and 3 of the drawings may be said to comprise, generally, a sectional body 10 for application to the drilling string S, means 11 for securing the body 10 to the string S and hard wear taking elements 12 on the body 10 for contacting the side wall of the well bore.

In accordance with the invention the body 10 of the protector shown in Figs. 1, 2 and 3, is sec-

tional so that it may be readily assembled about the string S or about a section of pipe P of a made-up stand of the string S. The body 10 is preferably constructed of steel or other metal or metals. In the preferred construction the body 10 is an elongate tubular member longitudinally divided into two halves or sections A and B. The body 10 is proportioned to snugly fit about the pipe P, that is, the opening in the tubular body rather accurately receives the pipe. The longitudinal edges 13 of the body sections A and B are preferably flat and radial to evenly abut. It is preferred to proportion the body 10 so that its external diameter is not greater than the external diameter of the tool joints J or the other couplings of the string S so that the protector does not interfere with the circulation of fluid through the well. The upper and lower outer corners of the body 10 may be bevelled off, as illustrated.

The means 11 for securing the body 10 to the pipe P is such that the body may be quickly secured to the pipe after the string S or the stand of the string S has been made up. The securing means 11 includes one or more pockets or notches 14 in the ends of the sections A and B. In the case illustrated there are circumferentially spaced notches 14 in each end of each body section A and B. The notches 14 are preferably, though not necessarily, partially cylindrical. The means 11 further includes blocks or lugs 15 on the pipe P engaging in the sockets 14. The lugs 15 may be secured to the drill pipe P by welding or may be in the nature of material built up by the welding operation.

The cooperation of the lugs 15 and the notches 14 dependably holds the body 10 against both longitudinal and turning movement relative to the pipe. Following the assembling of the sections A and B about the pipe P the sections are welded together so that the body forms a single rigid unit on the pipe. Lines of welding 17 may be formed to extend along the longitudinal edges 13 of the sections A and B to join or connect the two sections. Following the welding together of the sections A and B the lugs 15 are formed or are welded to the pipe to cooperate with the notches 14. If desired, the securing means 11 may further include welding 18 at the ends of the body 10 securing the body to the pipe P. The welding 18 is not essential where the lugs 15 and notches 14 are employed. It is to be observed that the protector body 10 may be easily and quickly assembled about the pipe section of a previously made up stem of the drilling string.

The wear taking elements 12 are secured to the body 10 and are formed and positioned to contact the wall of the well to protect the body 10 and, of course, the pipe and joints J, against excessive wear. The wear taking elements 12 may take various forms or shapes as will be later described. In the case illustrated in Figs. 1, 2 and 3 the elements 12 are elongate parts having outwardly converging sides. The elements 12 may be formed of any suitable wear and abrasion resisting material. The wear taking elements 12 may be formed of hardened or tempered steel, hard alloys, or the like. If desired, the outer sides of the hard elements 12 may be hard faced or provided with hard material as indicated at 19. The hard wear taking elements 12 are removably secured to the body 10 to project from the periphery of the body. A plurality of circumferentially spaced longi-

tudinal grooves 20 is provided in the periphery of the protector body and each groove is adapted to receive an element 12. The grooves 20 extend upwardly in the body 10 from its lower end and have upper end walls 21 spaced from the upper end of the body. The side walls 22 of the grooves 20 are outwardly convergent. The elements 12 are passed upwardly in the grooves 20 from their lower ends and the upper ends of the elements may bear against the end walls 21. The converging sides of the elements 12 cooperating with the converging walls 22 dependably hold the elements 12 against outward displacement.

Means are provided for holding the elements 12 against longitudinal movement and displacement. Screws 23 are threaded in radial openings 24 in the body 10 and are positioned so that their heads engage the lower ends of the elements 12. The screws 23 hold the elements 12 against downward movement in the grooves 20 and retain the elements where their upper ends engage the walls 21. The hard wear taking elements 12 are proportioned to have their outer parts project beyond the peripheral surface of the body 10 to engage the wall of the well in the event the drilling string is crooked or gyrates. These projecting portions of the elements 12 protect the body 10 against excessive wear. It will be observed that the longitudinal forces on the elements 12 resulting from the downward movement of the drilling string in the well are directly transmitted from the elements 12 to the body 10 through the engagement of the elements with the end walls 21 of the grooves 20.

In use or operation the body sections A and B are assembled about the pipe in the selected plane. The body 10 may be provided with the elements 12 either before or after the attachment of the body to the pipe P. When the body sections A and B are correctly assembled about the pipe P the welds 17 are made to join the sections and the lugs 15 are then applied or formed to cooperate with the notches to secure the body 10 to the pipe P. This assembling of the protector and its attachment to the pipe P does not necessitate disturbing the tool joint parts or the collars of the string or the assembled stand of the string. When the drilling string is in operation in the well, the contour of the well, the rate of rotation of the string, and other factors may tend to cause the string to wear or bear against the side wall of the well. The protectors of the invention prevent the pipe or any parts of the string S from engaging the side wall of the well and thus prevent wearing of the string. The protectors may be secured to the string in spaced adjacent relation to the tool joints J and as many protectors may be employed as believed necessary. The protectors spaced along the string in the open uncased part of the well effectively prevent the pipe from wearing against the side of the well. The wear taking elements 12 project from the surfaces of the protector bodies 10 and thus are adapted to engage against the wall of the well. The hard elements 12 serve to protect the bodies 10 and to prevent excessive wearing of the bodies.

After extended use it may be desired or necessary to replace the elements 12. The screws 23 may be removed so that the elements 12 may be slid or driven from the grooves 20. New or reconditioned wear taking elements 12 of any selected material may be inserted in the grooves 20 to recondition the protector for further use. This replacing of the elements 12 may be accom-

plished without removing the protector from the drilling string S or the pipe P.

The form of the invention illustrated in Figs. 4, 5 and 6 may be said to comprise, generally, a body 10<sup>a</sup> secured to the drill pipe P and hard wear taking elements 12<sup>a</sup> carried by the body.

The body 10<sup>a</sup> is an elongate tubular member of steel or other metal proportioned to be readily slid onto the pipe P. It is preferred to proportion the body 10<sup>a</sup> so that its external diameter is no greater than the external diameter of the tool joints of the drilling string. It is preferred to rigidly fix the body 10<sup>a</sup> to the pipe P. Welding 24' at the upper and lower ends of the body 10<sup>a</sup> may serve to secure the body to the pipe P. If desired, the notches 14 and lugs 15 described above may be employed to assist in securing the body 10<sup>a</sup> to the pipe P. The body 10<sup>a</sup> may be secured on the pipe at any selected point.

The wear taking elements 12<sup>a</sup> are provided to engage or cooperate with the side wall of the well bore to protect the body 10<sup>a</sup> against excessive wear. The elements 12<sup>a</sup> are formed of a hard abrasion resisting material. In the particular construction illustrated in Figs. 4, 5 and 6 the wear taking elements 12<sup>a</sup> are elongate cylindrical parts. The elements 12<sup>a</sup> are arranged in longitudinal grooves 25 in the body 10<sup>a</sup>. The walls of the grooves 25 extend for more than 180° so that the elements 12<sup>a</sup> are dependably held against outward displacement. The grooves 25 extend upwardly from the lower end of the body 10<sup>a</sup> and terminate at downwardly facing walls 26. The upper ends of the elements 12<sup>a</sup> cooperate with the walls 26 to limit the upward movement of the elements. Screws 27 are threaded in openings in the lower end of the body 12<sup>a</sup> and engage the lower ends of the elements 12<sup>a</sup> to hold the elements against downward displacement. The wear taking elements 12<sup>a</sup> extend from the mouths or outer sides of the grooves 25 to project from the periphery of the body 10<sup>a</sup>. The wear taking elements 12<sup>a</sup> arranged as just described may rotate about their individual axes through contact with the wall of the well.

In employing the protectors illustrated in Figs. 4, 5 and 6 of the drawings the protector bodies 10<sup>a</sup> carrying the elements 12<sup>a</sup> may be secured to the drilling string at selected spaced points to operate in the open uncased portion of the well. When the drilling string is operating in the well the circumferentially spaced wear taking elements 12<sup>a</sup> may engage the side wall of the well to prevent the pipe P and the joints and couplings of the string from wearing against the earth formation. The hard elements 12<sup>a</sup> projecting from the periphery of the body 10<sup>a</sup> protect the body against excessive wear. The elements 12<sup>a</sup> being formed of a very hard material are long wearing. After extensive use it may be found desirable or necessary to replace the elements 12<sup>a</sup>. Upon removal of the screws 27 the elements 12<sup>a</sup> may be readily removed from the grooves 25 and new or replacement elements may be arranged in the grooves.

The form of protector illustrated in Figs. 1, 2 and 3 may be provided with hard wear taking elements 12<sup>a</sup> of the kind shown in Figs. 4, 5 and 6 and the protector illustrated in the last named figures may be provided with wear taking elements 12 of the kind shown in Figs. 1, 2 and 3. Fig. 7 of the drawings illustrates another form of wear taking element 12<sup>b</sup> that may be employed in either of the above described protectors. The elements 12<sup>b</sup> are elongate parts con-

structed of a very hard wear resisting material. The elements 12<sup>b</sup> are polygonal or square in transverse cross section and are adapted to be removably arranged in longitudinal grooves 28 in the protector body. The grooves 28 are partially square in transverse cross section to cooperate with the flat sides of the elements 12<sup>b</sup>. The grooves 28 are formed and arranged so that the elements 12<sup>b</sup> have diagonal lines substantially radial with respect to the longitudinal axis of the protector and two opposite longitudinal corner portions of each element 12<sup>b</sup> are received in a groove 28 so that the grooves serve to hold the elements against outward displacement. The elements 12<sup>b</sup> may be held against longitudinal displacement in the same manner as the elements 12. There is a plurality of circumferentially spaced grooves 28 provided to receive the elements 12<sup>b</sup> and the elements 12<sup>b</sup> projecting from the periphery of the protector serve to protect the protector body against excessive wear through engagement with the wall of the well.

While I have described the wear taking elements 12, 12<sup>a</sup> and 12<sup>b</sup> as formed of hard abrasion resisting material, it may be found desirable to form these elements of rubber, rubber and fabric, or the like, to adapt the protectors for use under different conditions or for use in other situations.

Fig. 8 of the drawings illustrates another manner in which a protector body 10<sup>c</sup> of the invention may be provided with hard wear taking parts. In this construction the body 10<sup>c</sup> is provided with one or more rows or stripes of hard facing 29. The hard facing 29 may extend either circumferentially or longitudinally of the body 10<sup>c</sup> or may cover the entire surface of the body. The hard facing 29 may consist of pieces or particles of very hard material welded to the surface of the protector body 10<sup>c</sup> and serves to protect the body against excessive wear through engagement with the well wall.

The embodiment of the invention illustrated in Figs. 9, 10 and 11 of the drawings may be said to comprise, generally, a tool joint 30 connected in a drilling string S and hard wear taking elements 12<sup>d</sup> carried by the joint 10 to protect it against wear through engagement with the wall of the well. The tool joint 30 comprises a pin section 31 and a box section 32. The sections 31 and 32 have threaded sockets 33 in their outer ends receiving threaded end portions of the pipe P. The box section 32 has a tapered threaded socket 34 for receiving the tapered threaded pin 35 of the pin section 31. The sections 31 and 32 are formed with rather heavy walls to provide ample stock for carrying the threads and, therefore, are considerably larger in external diameter than the pipe P. The sections 31 and 32 may be of standard or conventional design except that one or both of the sections may be considerably longer than usual.

The hard wear taking elements 12<sup>d</sup> may be provided on either one or both of the tool joint sections 31 and 32. In the simple case illustrated the elements 12<sup>d</sup> are provided on the pin section 31 which constitutes the upper section of the joint 30 and the box section 32 is of typical construction. The elements 12<sup>d</sup> may be varied in shape. In the construction shown in Figs. 9, 10 and 11 the elements 12<sup>d</sup> are elongate parts removably arranged in circumferentially spaced grooves 36 in the section 31. The elements 12<sup>d</sup> are I-shaped in transverse cross section and the grooves 36 are of corresponding shape. The grooves 36 may extend downwardly from the

upper end of the section 31 to terminate in upwardly facing end walls 37. The elements 12<sup>d</sup> are passed downwardly into the grooves 36 so that their lower ends may bear on the walls 37. As best illustrated in Fig. 11 the inner flanges 80 of the elements 12<sup>d</sup> cooperate with the walls of the grooves 36 to hold the elements 12<sup>d</sup> against outward displacement. Set screws 38 are threaded in openings in the upper portion of the section 31 and engage the upper ends of the elements 12<sup>d</sup> to hold the elements against upward displacement. The wear taking elements 12<sup>d</sup> extend from the outer sides of the grooves 36 to project from the periphery of the joint section 31.

In the use or operation of the construction illustrated in Figs. 9, 10 and 11, the tool joint 30 may be connected in the drilling string S in the usual manner to couple the adjacent ends of two stands of pipe. The joint 30 provided with the wear taking parts 12<sup>d</sup> and similar joints 30 are provided at points where they will operate in the open uncased portion of the well. During the drilling operations the circumferentially spaced elements 12<sup>d</sup> projecting from the periphery of the section 31 may contact the side wall of the well, if the string tends to buckle or gyrate to protect the joint 30 and the other parts of the string against wear. The elements 12<sup>d</sup> effectively protect the tool joint against wear. After extensive use it may be found desirable to replace the elements 12<sup>d</sup>. Upon removing the screws 38 the worn elements 12<sup>d</sup> may be readily removed from the grooves 36 and replacement elements inserted in the grooves.

Figs. 12 and 13 of the drawings illustrate hard wear taking elements 12<sup>e</sup> and 12<sup>f</sup>, respectively, that may be embodied in the tool joint 30. The wear taking elements 12<sup>e</sup> are polygonal or square in transverse cross section and are formed of a hard abrasion resisting material. Where the elements 12<sup>e</sup> are employed in the section 31<sup>e</sup> of the joint is provided with a plurality of circumferentially spaced grooves 36<sup>e</sup> shaped to receive the polygonal elements. The grooves 36<sup>e</sup> are partially square in transverse cross section and the engagement of their walls with the elements 12<sup>e</sup> holds the elements against outward displacement. The elements 12<sup>e</sup> project from the mouths of the grooves 36<sup>e</sup> to form wear taking ribs or ridges on the periphery of the section 31<sup>e</sup>.

The wear taking elements 12<sup>f</sup> of Fig. 13 are elongate parts having outwardly diverging sides 40. The joint section 31<sup>f</sup> for carrying the elements 12<sup>f</sup> is provided with spaced longitudinal grooves 41 whose side walls 42 are outwardly convergent. The elements 12<sup>f</sup> are inserted in the ends of the grooves 41 and the engagement of their sides with the convergent walls 42 holds the elements against displacement. The elements 12<sup>f</sup> are proportioned to protrude from the grooves 41 so that the elements form longitudinally extending wear taking ridges on the periphery of the joint section 31<sup>f</sup>. The wear taking elements 12<sup>e</sup> and 12<sup>f</sup> may be removably held in their respective grooves in the same manner as the elements 12<sup>d</sup>.

In certain uses of the protectors the elements 12<sup>d</sup>, 12<sup>e</sup> and 12<sup>f</sup> may be replaced by similar ele-

ments formed of rubber, synthetic rubber, rubber and fabric, etc., secured in their respective grooves.

Having described only typical preferred forms and applications 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 protector for a rotary well drilling string comprised of threadedly connected parts, the protector including a body threaded at its opposite ends to be connected between two threaded parts of the string, the body having spaced longitudinal grooves of polygonal transverse cross section extending from one end thereof, the ends of the grooves at said end of the body being open when the body is connected between said parts of the string, hard wear resisting elements of polygonal transverse cross section removably inserted into said open ends of the grooves to project from the exterior of the body, the sides of the polygonal elements cooperating with the walls of the grooves to hold the elements against lateral displacement, and screws threaded into said end of the body and extending into the grooves to removably retain the elements therein.

2. A protector for a rotary well drilling string made up of threadedly connected parts, the protector comprising a one piece tubular body threaded at its ends to be secured between two parts of the string to extend longitudinally of the string and to form an interposed part thereof, the body having external grooves extending longitudinally from one end thereof, the ends of the grooves at said end of the body being clear and open when the body is secured between said parts of the string, elements of hard wear resisting material passed into the grooves from said end of the body and projecting from the exterior of the body, and means on the body for retaining the elements in the grooves and removable to allow removal of the elements without necessitating detachment of the body from the adjacent string parts.

3. A tool joint for connecting two lengths of well drill pipe comprising threadedly engaged pin and box sections threaded at their outer ends for connection with the drill pipe, said sections each being integral and of greater external diameter than the drill pipe, at least one of said sections having spaced longitudinal grooves in its exterior extending from its outer end, the grooves having under cut side walls and closed inner ends, elements of hard wear resisting material inserted into the grooves from their outer ends and flanged to conform to the side walls of the grooves to be held against lateral displacement thereby, and screws threaded into said section and engaging the outer ends of the elements to retain the elements in the grooves, said elements being insertable and removable without disconnecting the pipe from said section when the screws are removed.

THOMAS A. CREIGHTON.