July 27, 1965 B. R. FAIRCHILD 3,197,262

PIPE PROTECTOR

Filed Nov. 5, 1962 3 Sheets-Sheet 1

Fig. 1

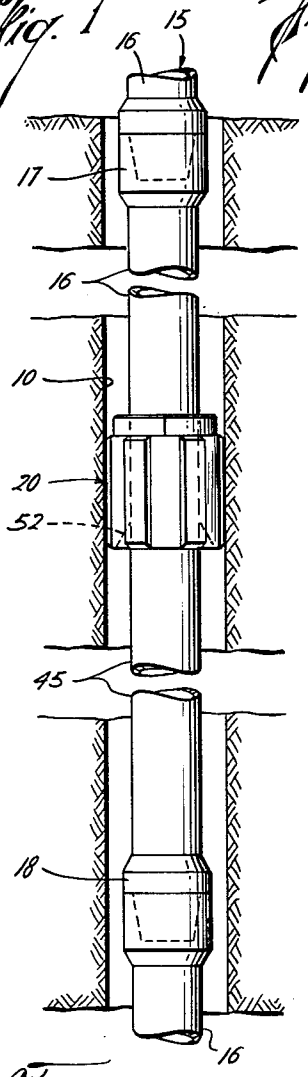


Fig. 2

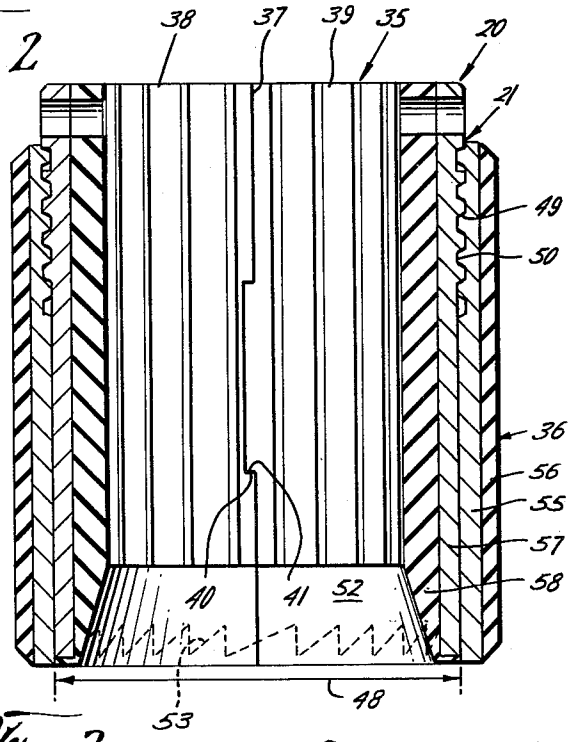


Fig. 3

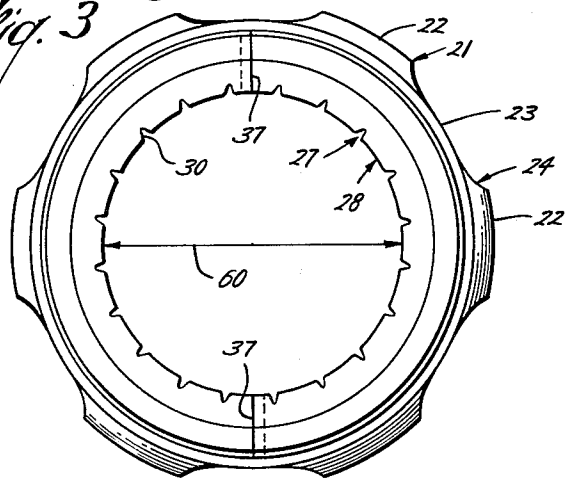
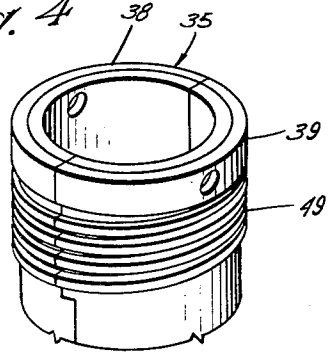


Fig. 4



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PIPE PROTECTOR

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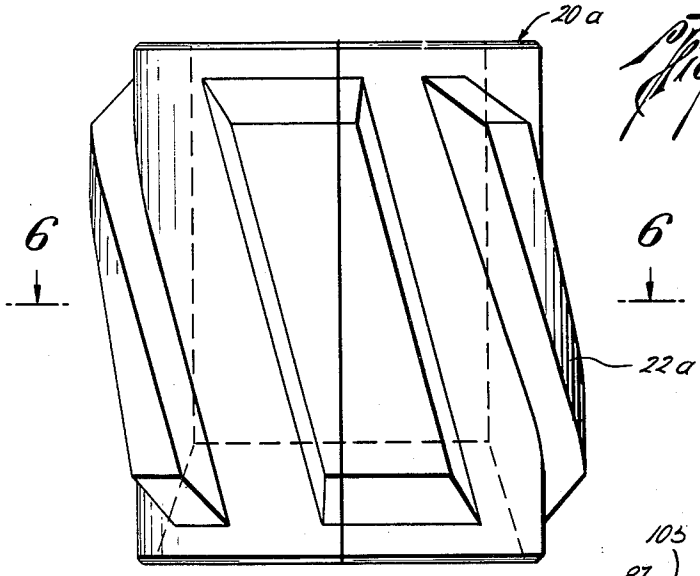

Fig. 5

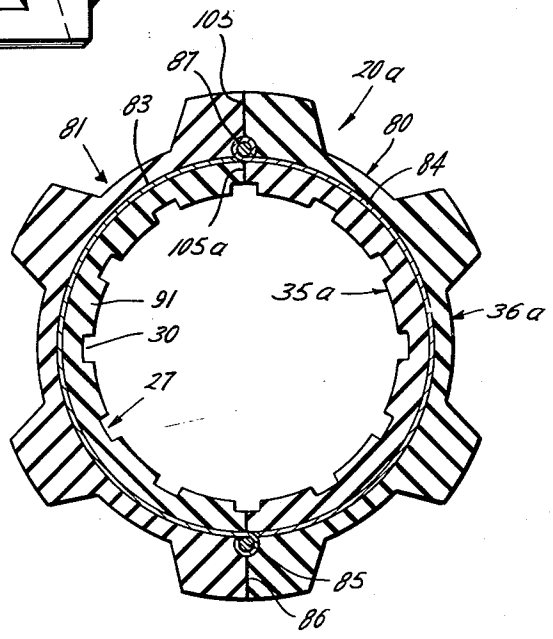

Fig. 6

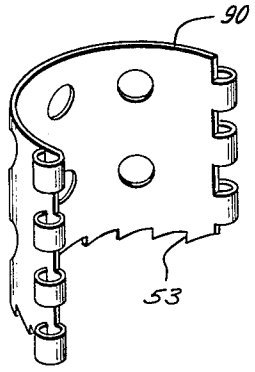

Fig. 7

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PIPE PROTECTOR

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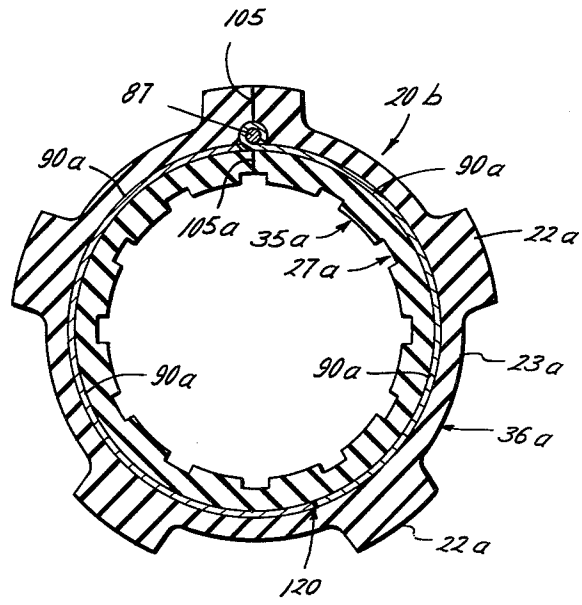

Fig. 8

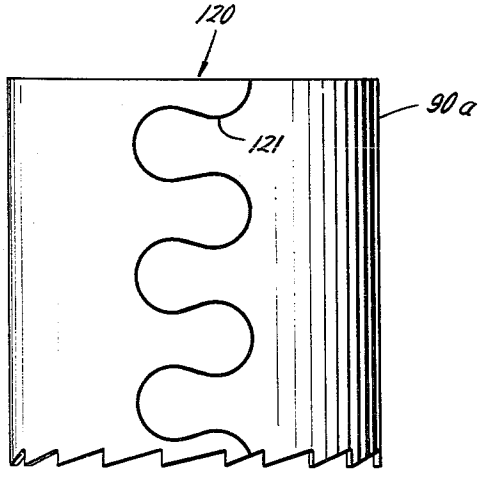

Fig. 9

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United States Patent Office 3,197,262 Patented July 27, 1965

3,197,262

PIPE PROTECTOR

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4 Claims. (Cl. 308—4)

The present invention relates to a protector for tubular members, and more particularly, to a protector particularly adapted for use with drill pipe sections.

In the drilling of oil, gas, and water wells by the rotary method, the well bore or hole in the earth's surface is formed by means of a drill bit which is secured on the end of what is called a drill string. The drill string is formed of a plurality of drill pipe sections which are connected or coupled together in any suitable manner and more generally by means of male and female threaded portions at each end of each drill pipe section to enable the drill pipe sections to be connected together.

As the well bore is progressively deepened by drilling operations, additional pipe sections are added to the drill string at the earth's surface so that the drill bit or cutting tool at the lower end of the drill string will be maintained in proper engagement with the bottom of the well bore until it is drilled to the desired depth. During the drilling operations, the drill string is rotated at the earth's surface, and this rotation is transmitted to the bottom of the drill string to effect the drilling action by the bit.

Since the drill pipe sections may be reused, it is desirable to inhibit excessive wear or damage thereto, and one means employed to prevent excessive wear or damage to the drill pipe section is to position on the drill pipe devices termed pipe protectors which aid in centralizing the drill pipe section within the well bore, thereby inhibiting unnecessary rubbing action against the wall of the well bore as the drill string is rotated. Where the drill string is rotated in a portion of a well bore which is provided with a surrounding casing, it can be appreciated that excessive rubbing or wearing by the drill string on the casing may damage it to an extent so that it is not safe for future use.

The pipe protectors heretofore employed generally are of the type which are adapted to be positioned on the drill pipe section by inserting the drill pipe over the end of the section and thereafter seating it on the drill pipe section at any desired location. Such drill pipe protectors normally are formed of a material such as hard rubber with the tubular body thereof having an opening which is somewhat smaller than the normal diameter of the drill pipe section on which it is to be positioned so that after the drill pipe protector is positioned on the drill pipe section, it will firmly grip the drill pipe section and rotate with the pipe section as it is rotated in the well string.

The connecting or coupling means formed at each end of the drill pipe section is generally of a larger outer diameter than the outer diameter of the drill pipe section itself, and it can be appreciated that in order to position the drill pipe protectors on the drill pipe section, it is necessary to initially expand them sufficiently so that they may be first positioned over the enlarged area at the end of the drill pipe section and thereafter permitted to collapse on the smaller diameter portion of the drill pipe section.

This construction of the drill pipe section and the manner of positioning the drill pipe protectors on the drill pipe section creates undesirable problems in connection with the use of protectors. For example, it is extremely expensive and time consuming to initially position the pipe protector on the drill string and to remove the protector from the drill string when desired.

Also, the construction of present pipe protectors and

their arrangement on drill pipe sections creates certain stresses and tensions in the protector itself so that it tends to rupture more readily or wear more readily during normal use thereof. It can be appreciated that the drill pipe string is rotated at times at a fairly high rate of speed, and since the drill pipe protector rotates with the drill string, it may be subjected to substantial shock bumping against the sides of the well bore in addition to the ordinary frictional engagement of the protector with the well bore wall during rotation of the rotating drill string.

One of the objects of the present invention is to provide a pipe protector for tubular member such as a drill string which may be positioned on a drill string in a manner to accomplish its desired function without setting up any stresses or strains in the protector which might cause the protector to wear or rupture more readily.

Still another object of the present invention is to provide a free floating pipe protector for a drill string which is constructed and arranged so that it may move longitudinally relative to the pipe on which it is positioned.

Yet a further object of the present invention is to provide a pipe protector adapted to be positioned on a drill string to inhibit wear to the drill string, which pipe protector is constructed and arranged so that it may be readily drilled off the drill pipe section in the event the drill pipe becomes stuck during drilling operations.

Yet a further object of the present invention is to provide a drill pipe protector for drill pipe which may be quickly and easily positioned in place on a tubular member.

Still another object of the present invention is to provide a drill pipe protector which creates a minimum of interference with the normal operation of a drill pipe string and causes a minimum of flow interference with drilling fluids used in the drilling of the well but which accomplishes its intended function.

Other advantages and objects of the present invention will become more readily apparent from a consideration of the following description and drawings wherein:

FIG. 1 is a vertical sectional view of a portion of a well bore illustrating a form of the present invention positioned on a drill string;

FIG. 2 is a vertical sectional view illustrating a form of the invention;

FIG. 3 is a top end view of the form of the invention illustrated in FIG. 2;

FIG. 4 is a fragmentary perspective view of an inner portion of the pipe protector shown in FIGS. 2 and 3 of the drawings;

FIG. 5 is a side view of an alternate form of the present invention;

FIG. 6 is a sectional view on the line 6—6 of FIG. 5 illustrating in further detail the form of the invention there illustrated;

FIG. 7 is an isometric view of a portion of the structure of the device shown in FIGS. 5 and 6;

FIG. 8 is a sectional view of still another form of the present invention; and

FIG. 9 is a side view of a portion of the structure illustrated in FIG. 8 of the drawings.

Attention is first directed to FIG. 1 of the drawings wherein a portion of a well bore 10 extending downwardly into the earth's surface is illustrated in vertical section. The drill string is represented generally by the numeral 15 and includes the drill pipe sections 16 which are connected or coupled together at their ends. As shown in the drawings, each drill pipe section 16 includes a female tool joint 17 and a male tool joint 18 at the opposite end, which female and male tool joints are respectively adapted to be engaged with the male and female tool joints formed on adjacent drill pipe sections 16 thereabove and therebelow.

The device of the present invention is illustrated by the numeral 20 in FIG. 1 and is shown as being positioned on the drill pipe section 16. The well bore 10 is illustrated as being open hole, but it can be appreciated that the present invention is adapted to be used on drill pipe or tubular well strings in well bore which is provided with casing that surrounds the tubular wall string as well as in open hole.

During normal drilling operations, rotation is imparted to the well string 15 and thus to the drill string section 16 so that rotation may be imparted to the drilling bit on the lower end of the well string or drill string 15. The present invention is constructed and arranged so that it aids in preventing the drill pipe section 16 from rubbing against the wall of the well bore 10 whether the well bore is cased or uncased. Also, the present invention is constructed so that it does not interfere with the normal flow of drilling fluid in the well bore 10 during drilling operations and is constructed so that it may move longitudinally of the drill pipe section on which it is positioned. Thus, during normal drilling operations with the well fluid circulating upwardly in the well bore, the upper end of the drill pipe protector 20 would abut against the lower end of the pipe joint on the upper end thereof and since the pipe protector is of a larger diameter than the diameter of the joint, this would inhibit rubbing of the joint against the well bore wall. It can be appreciated that one or more pipe protectors can be provided on each section of the drill string as desired in order to inhibit damage to the drill pipe during drilling operations.

In FIG. 1 of the drawings, the form of the device illustrated in FIGS. 2–4 is shown as being positioned on the drill pipe section 16; however, it can be appreciated that this is for purposes of illustration and any other embodiment of the present invention may be similarly employed without departing from the scope hereof.

In FIG. 2, and FIG. 3, the pipe protector designated generally by the reference numeral 20 includes a tubular member designated generally by the numeral 21 which is adapted to be positioned on the drill pipe sections 16. The tubular body 21 includes the longitudinally extending and radially projecting portions 22 which are separated by the longitudinally extending pressed or recessed areas 23 on the exterior surface designated generally by the numeral 24 of the tubular member whereby the drilling fluid circulated in the well bore may be conducted around the device with a minimum of interference. Similarly, fluid passage means designated generally by the numeral 27 are provided on the inner surface designated generally at 28 of the tubular member 21, such passage means being in the form of the grooves or recesses 30 which extend lonigtudinally of the inner surface 28 and are spaced circumferentially in any suitable manner in order that fluid flow between the drill pipe section 16 on which the device 20 is positioned, and the inner surface 28 of the device may be effected.

More particularly, the tubular member 21 is shown in the form of the invention illustrated in FIGS. 2–4 of the drawings as including an inner bushing designated generally by the numeral 35 which is adapted to be secured in position in the outer sleeve represented generally by the numeral 36. The inner bushing 35 is split as illustrated at 37 to form a plurality of longitudinally extending sections 38 and 39. If desired, the split 37 may define a recess 40 in one of the longitudinally extending sections 38 and a projection 41 on the other section so as to interfit with the recess 40 and thereby position the sections 38 and 39 together for reception in the outer sleeve 36 as will be described in greater detail hereinafter. As illustrated in FIG. 3 and FIG. 4 of the drawings, the inner bushing 35 is shown as being split in two semicylindrical sections; however; it can be appreciated that the inner bushing 35 may be split into as many lon-

gitudinally extending sections as desired without departing from the scope of the present invention.

Suitable means are provided for connecting the inner bushing 35 with outer sleeve 36 whereby the device 20 illustrated in FIGS. 2–4 may be quickly and easily secured in position on a drill pipe section 16 in a manner so as to inhibit dislodging of the drill pipe protector 20 from its position on the normal diameter portion 45 of the drill pipe section 16 which extends between the raised tool joint areas 17 and 18 at each end of the drill pipe section 16 as illustrated in FIG. 1 of the drawings. The outer sleeve 36 has an inner diameter 48 which is slightly larger than the outer diameter of the tool joint 17 or 18 provided at each end of the drill pipe section 16. Thus, the outer sleeve member may be readily slipped over the end of the drill pipe section 16 without stretching it or applying any other unusual force or pressure thereto. After the outer sleeve 36 has been slipped over the end of the drill pipe section 16, the inner bushing 35 comprised of the longitudinally extending portions 38 and 39 may then be positioned around the drill pipe for seating coaxially in the outer sleeve 36. This may be accomplished by moving the longitudinally extending sections 38 and 39 and outer sleeve relative to each other so that they may be engaged together. Suitable means is provided for locking or engaging the inner bushing 35 on the outer sleeve 36, and as illustrated in FIGS. 2 and 4 of the drawings, such means comprises the threaded portion 49 formed on the inner bushing 35 which is adapted to engage with the threaded portion 50 formed on the outer sleeve 36. Thus, the inner bushing 35 and outer sleeve 36 may be connected together, and when connected together, form the integral pipe protector 20 as illustrated in FIG. 2 of the drawings.

The inner lower end of the inner bushing 35 is tapered as illustrated at 52, such taper extending outwardly and longitudinally as illustrated in FIGS. 1 and 2 of the drawings. When the drill string is removed from the well bore, the upward movement of the well string or drill string 15 will cause the pipe protector 20 to move longitudinally downwardly relative to the drill pipe section 16 on which it is positioned and engage the coupling or enlarged portion at the lower end thereof. Thus, the pipe protector 20 will be positioned adjacent the portion of the drill string 15 which is of largest diameter, thereby inhibiting damage to the drill string as it is removed from the well bore.

Also, if the drill string becomes stuck in the well bore and it becomes necessary to "fish" the stuck drill string, the taper 52 will seat on the enlarged bore end of the drill pipe section 16 on which it is positioned, and a pipe cutting tool may be telescoped downwardly over the pipe protector 20 and drill or cut it off the pipe so that proper engagement with the stuck pipe may be attained. To enable cutting or drilling of the pipe protector 20, serrations 53 are formed on the lower end of the pipe protector, which serrations are normally covered as indicated in FIG. 2 of the drawings, but which serrations upon the application of unusual pressure, such as would be encountered by the application of a force from a cutter tool to the top of the pipe protector, move through the covering and engage the enlargement or tool joint 18 so as to stop relative rotation of the pipe protector 20 as it is cut or reamed off the drill pipe section 16.

The drill pipe protector 20 is formed of material such as metal, plastic, or rubber which is preferably softer than the material of the drill pipe string 16, and in the form of the invention illustrated in FIG. 2 of the drawings, it can be seen that the outer sleeve 36 includes a metal portion 55 with an outer hard rubber covering 56 formed thereon. The projections 22 and recesses 23 are formed in the outer rubber covering 56 of the outer sleeve 36 as illustrated in the drawings.

Similarly, the inner bushing 35 includes a metal portion 57 and a rubber covering 58 of suitable thickness

thereon, the rubber 58 being of suitably hard rubber to withstand normal wear and tear.

The inner diameter of the bushing 35 as represented by the dimension 60 is slightly greater than the outside diameter of the portion 45 of the drill pipe 16, but it is smaller than the outer diameter of the pipe joints 17 and 18 so that it will not move from one drill pipe section 16 to the next during rotation of the well string 15 in the well bore.

In FIGS. 5 through 7, an alternate modification of the device is represented by the numeral 20*a*. The device includes portions which may be termed as the outer sleeve 36*a* and the inner bushing 35*a*. It will be noted that the outer sleeve 36*a* and the inner bushing 35*a* are illustrated as being formed into two semicircular portions represented generally by the numerals 80 and 81, respectively. In the modification illustrated in FIGS. 5 through 7 of the drawings, the outer sleeve 36*a* is formed entirely of a surfacing material such as plastic, rubber, or some metal softer than the material from which the drill string 15 is formed, and the projections 22*a* are shown as extending circumferentially and at an angle relative to the longitudinal axis of the outer sleeve 36*a*, the angle of inclination varying as desired and as shown in the drawings approximates 15 to 18 degrees.

The inner bushing 35*a* is formed by the semicircular metal portions 83 and 84 which are hinged or pivoted together at 85, and it is to be noted that the outer sleeve 36*a* is split as indicated at 86 to conform with the longitudinal pivot or hinge arrangement of the inner bushing 35*a*. This permits the device 20*a* to be opened so that it may be positioned about the drill pipe and thereafter it may be closed whereupon a pin 87 may be inserted through the hinge or pivot arrangement at the other end or side of the semicircular portions of the outer sleeve 36*a* and inner bushing 35*a* for retaining them in position on the drill pipe section 16.

It is to be noted that an inner bushing 35*a* which is formed by the two semicircular portions 83 and 84 includes the metal member 90 which is provided with a surfacing material thereon such as hard rubber or the like as illustrated at 91. Fluid conducting means 27 are illustrated as being provided in the form of grooves 30 which are spaced circumferentially of each of the semicircular portions 83 and 84 of the inner bushing 35*a* for conducting fluid in a manner as described with regard to the FIGS. 2–4 modification of the invention. Similarly, serrations 53 are provided on the lower end of the semicircular metal portions 90 of the inner bushing 35*a* for engaging the upper surface of the tool joint when the pipe protector is reamed out, as previously described herein.

In order to place the form of the invention shown in FIGS. 5–7 inclusive on the drill pipe section, the hinge pin 87 will be removed whereupon the pipe protector 20*a* may be spread apart. It is to be noted that a longitudinal split 105 is formed in the outer sleeve 36*a* and mates with the longitudinal split 105*a* formed in the covering 91 on the inner bushing 35*a* and is axially aligned with the hinge portion formed in the metal portions 90 of the inner bushing 35*a* as shown in FIG. 6 of the drawings. After the device 20*a* is spread apart, it can be readily positioned about the drill pipe section 16 whereupon it may be closed and a pin 87 inserted through the hinge as illustrated in FIG. 6 of the drawings. This serves to retain the device 20*a* in position on the drill pipe section and yet provides a device which functions in a manner as previously described with the modification illustrated in FIGS. 2–4 of the drawings.

In FIGS. 8 and 9, still another form of the invention is illustrated generally by the numeral 20*b*, and in this form of the invention a modified hinge arrangement is provided for the metal semicircular portions 90*a*, as more clearly shown in FIG. 9 of the drawings. It is to be noted that the hinge arrangement, designated generally by the numeral 120, is formed by cutting the sleeve in the manner as indicated along the line 121 which provides inner fitting portions which serve to retain or lock the metal semicircular portions 90*a* together, yet provides a means whereby they may be pivotally or hingedly connected together. In other respects, the form of the invention shown in FIGS. 8 and 9 is similar to that as described with regard to the FIGS. 5–7 modification. It will be noted that an outer sleeve 36*a* is provided which is formed of material such as hard rubber, metal, or plastic or other material which is softer than the drill pipe section or casing in which the device is to be used. Projections 22*a* are provided on the device which are separated by the recesses 23*a* to accommodate fluid flow exteriorly of the device and similarly fluid passage means 27*a* are provided on the interior of the inner bushing designated generally at 35*a* for accommodating fluid flow between the drill string and the device on which it is positioned. The initial positioning of the device illustrated in FIGS. 8 and 9 on the drill pipe section 16 is similar to that as described with regard to the modification shown in FIGS. 5–7 in that a split 105 is provided longitudinally of the outer sleeve 36*a*, there being a split 105*a* in the covering material provided on the semicircular portions of the inner bushing 35*a* as previously described with regard to FIG. 6 of the drawings. In the form of the invention illustrated in FIGS. 8 and 9, the outer sleeve 36*a* is not provided with a longitudinal slot conforming axially with the hinge 120, nevertheless, the outer covering being formed of material such as hard rubber, will flex when the device is spread apart in a manner as described with regard to FIG. 6. After the device is spread apart, it may then be positioned around a drill pipe section 16 whereupon a hinge pin 87 may be inserted through the hinge formed at each edge of the semicircular portions 90*a*, respectively, whereupon the device is retained in position on the drill pipe section.

A particular advantage of a pipe protector of the form of the present invention is that the drill pipe may be more easily rotated than where the pipe protector is nonrotatably secured on the drill string.

It can be appreciated that other modifications of the present invention may be employed without departing from the scope of the invention, and the forms illustrated herein are for purposes of illustration only.

Broadly, the present invention relates to a pipe protector for tubular members, and more particularly, to an improved form of pipe protector adapted for use with drill pipe strings and other well strings.

What is claimed is:

1. A pipe protector for drill pipe sections which are adapted to be connected together by tool joints including,
   (a) a tubular member for positioning on the drill pipe section, the inner diameter of said member being slightly greater than the outer diameter of the drill pipe section and smaller than the outer diameter of the tool joints when mounted thereon,
   (b) fluid conducting passage means formed on the exterior surface of said member and fluid conducting passage means formed on the interior surface of said member for conducting fluid longitudinally of said interior and exterior surface of said member,
   (c) said tubular member including an inner bushing split into a plurality of longitudinally extending sections,
   (d) an outer sleeve extending coaxially with said inner bushing, and
   (e) thread means on said sections for securing said inner bushing in said outer sleeve.

2. A pipe protector for drill pipe sections which are adapted to be connected together by tool joints including,
   (a) a tubular member for positioning on the drill pipe section, the inner diameter of said member being slightly greater than the outer diameter of the drill

pipe section and smaller than the outer diameter of the tool joints when mounted thereon,

(b) fluid passage means for accommodating fluid flow around the drill pipe section on which the pipe protector is positioned,

(c) said tubular member including an inner bushing split longitudinally into a plurality of semicylindrical sections,

(d) an outer sleeve extending coaxially with said inner bushing, and

(e) thread means in said sections for securing said inner bushing in said outer sleeve.

3. A pipe protector for drill pipe sections which are adapted to be connected together by tool joints including,

(a) a tubular member for positioning on the drill pipe section, the inner diameter of said member being slightly greater than the outer diameter of the drill pipe section and smaller than the outer diameter of the tool joints when mounted thereon,

(b) fluid passage means for accommodating fluid flow around the drill pipe section on which the pipe protector is positioned,

(c) an annular outwardly directed taper on said interior surface at the lower end of said tubular member,

(d) said tubular member including an inner bushing split into a plurality of longitudinally extending sections,

(e) an outer sleeve extending coaxially with said inner bushing, and

(f) thread means on said sections for securing said inner bushing in said outer sleeve.

4. A pipe protector for drill pipe sections which are adapted to be connected together by tool joints including,

(a) a tubular member for positioning on the drill pipe section, the inner diameter of said member being slightly greater than the outer diameter of the drill pipe section and smaller than the outer diameter of the tool joints when mounted thereon,

(b) fluid passage means for accommodating fluid flow around the drill pipe section on which the pipe protector is positioned,

(c) an annular outwardly directed taper on said interior surface at the lower end of said tubular member,

(d) said tubular member including an inner bushing split longitudinally into a plurality of semicylindrical sections,

(e) an outer sleeve extending coaxially with said inner bushing, and

(f) thread means on said sections for securing said inner bushing in said outer sleeve.

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