April 20, 1948. A. M. GRAHAM 2,440,009

DRILL PIPE PROTECTOR APPLYING AND INSTALLING APPARATUS

Filed Oct. 18, 1940 4 Sheets-Sheet 1

Fig. 1

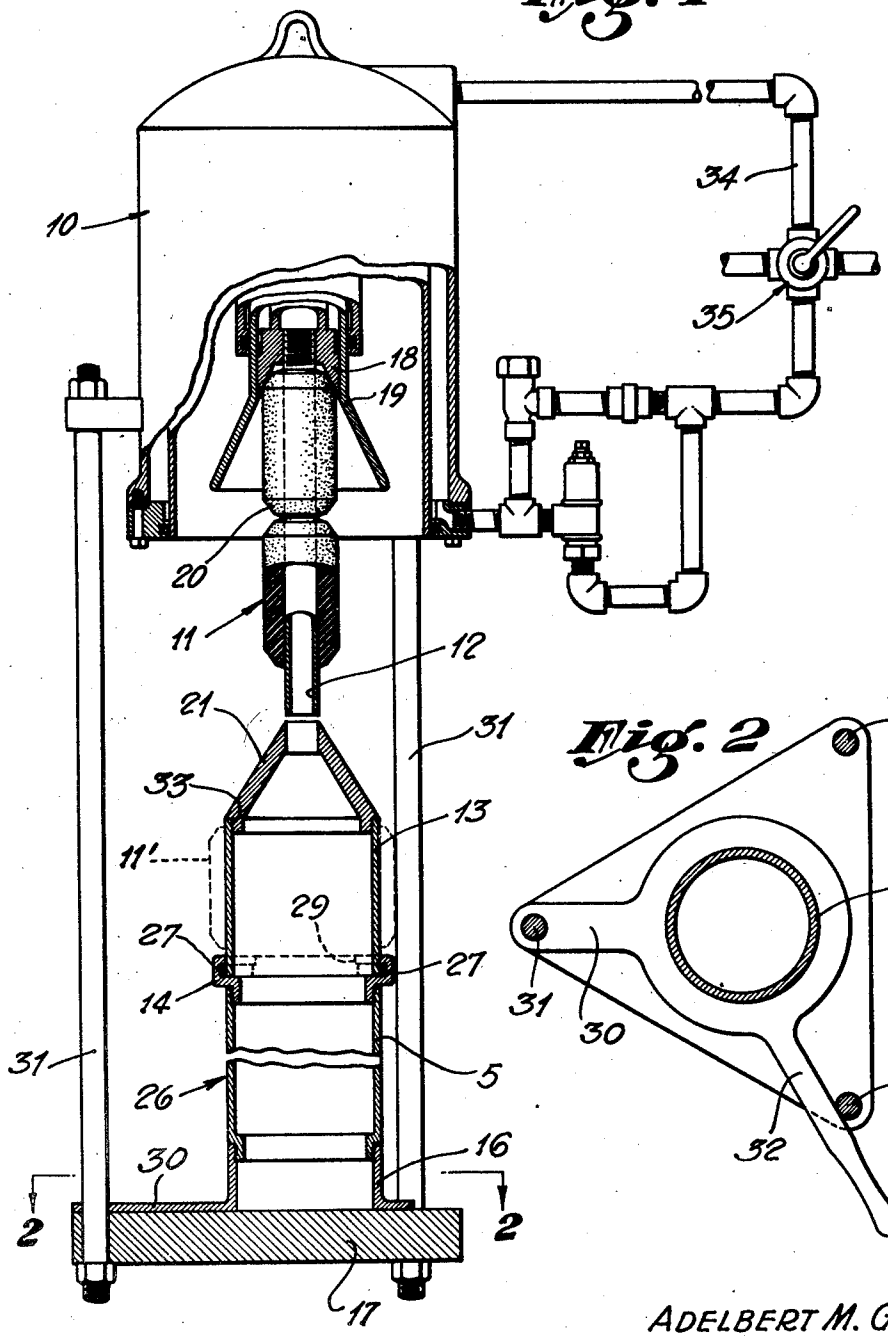

Fig. 2

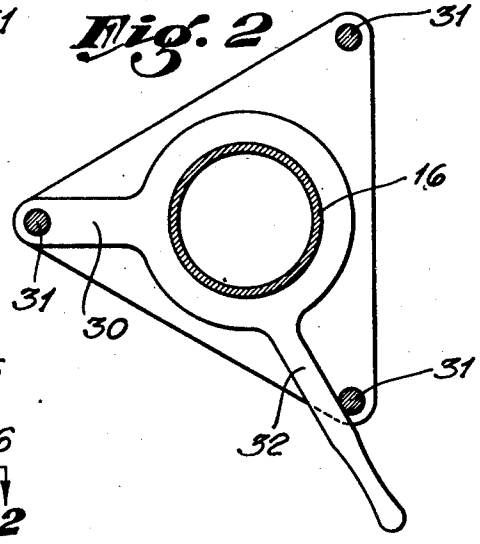

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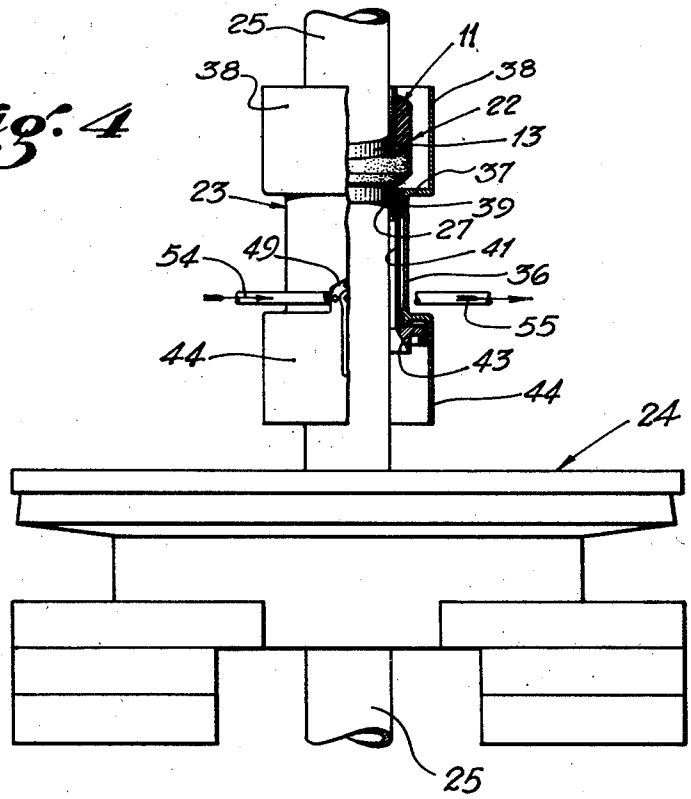
Fig. 4



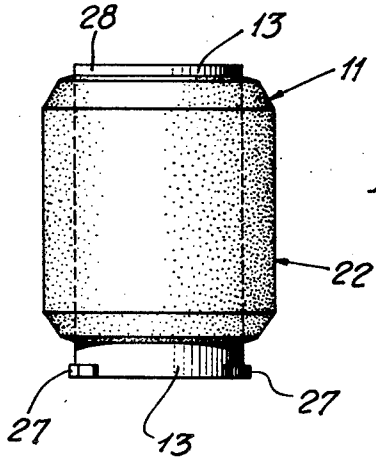


Fig. 3

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DRILL PIPE PROTECTOR APPLYING AND INSTALLING APPARATUS

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Fig. 6

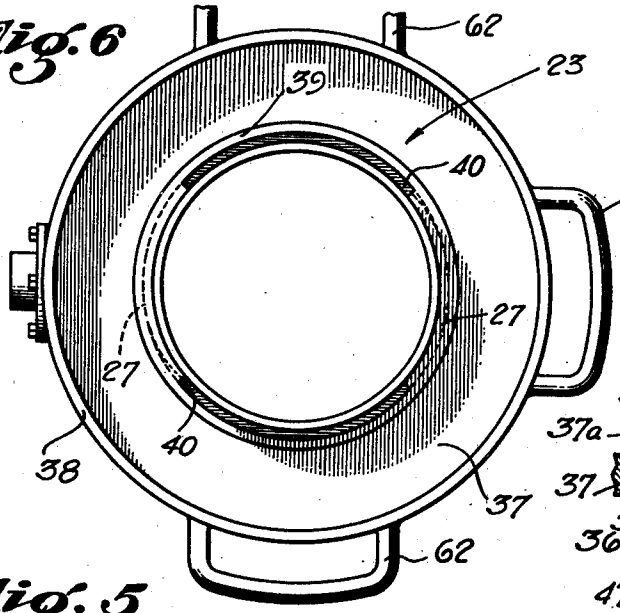


Fig. 7

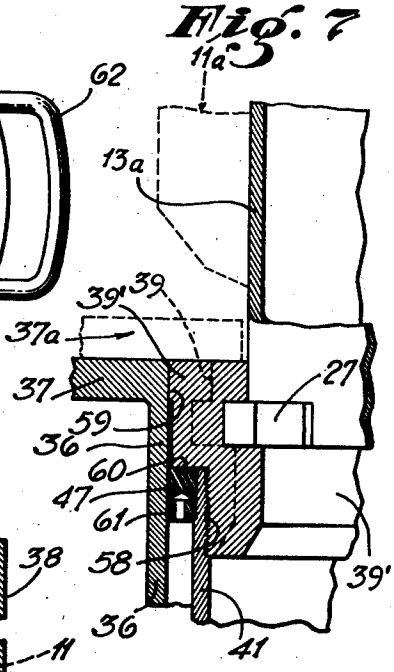


Fig. 5

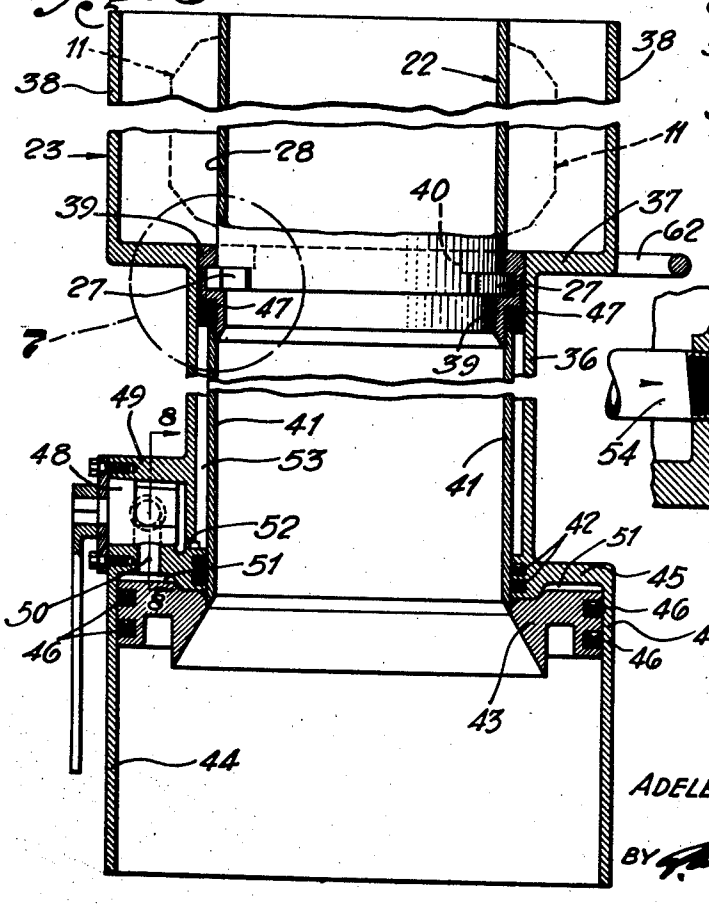
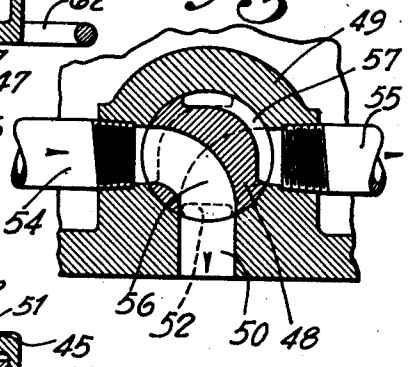


Fig. 8



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DRILL PIPE PROTECTOR APPLYING AND INSTALLING APPARATUS

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Fig. 10

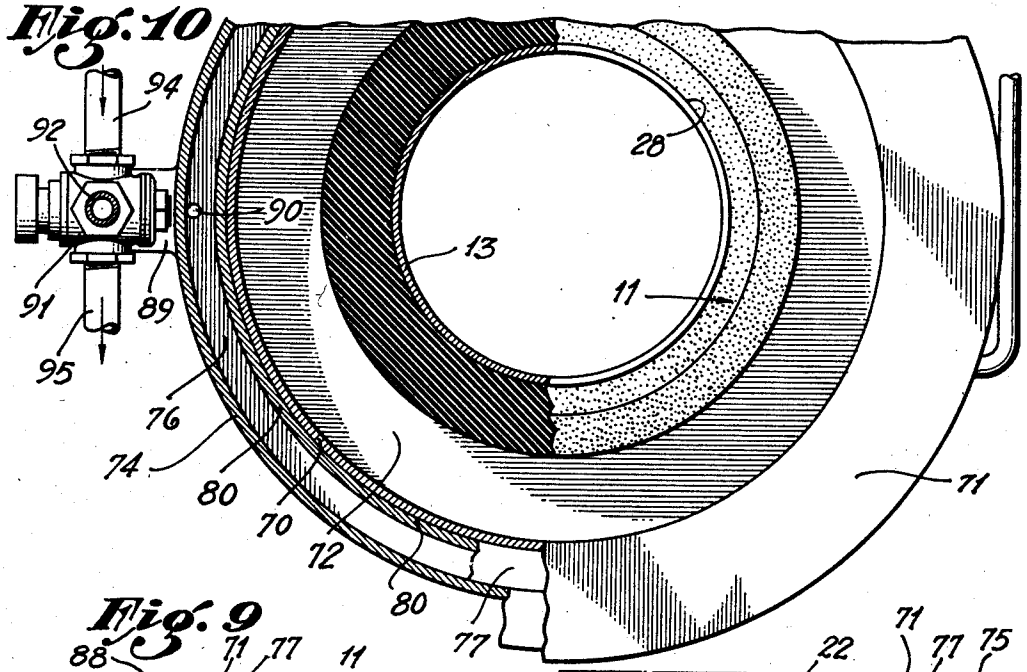
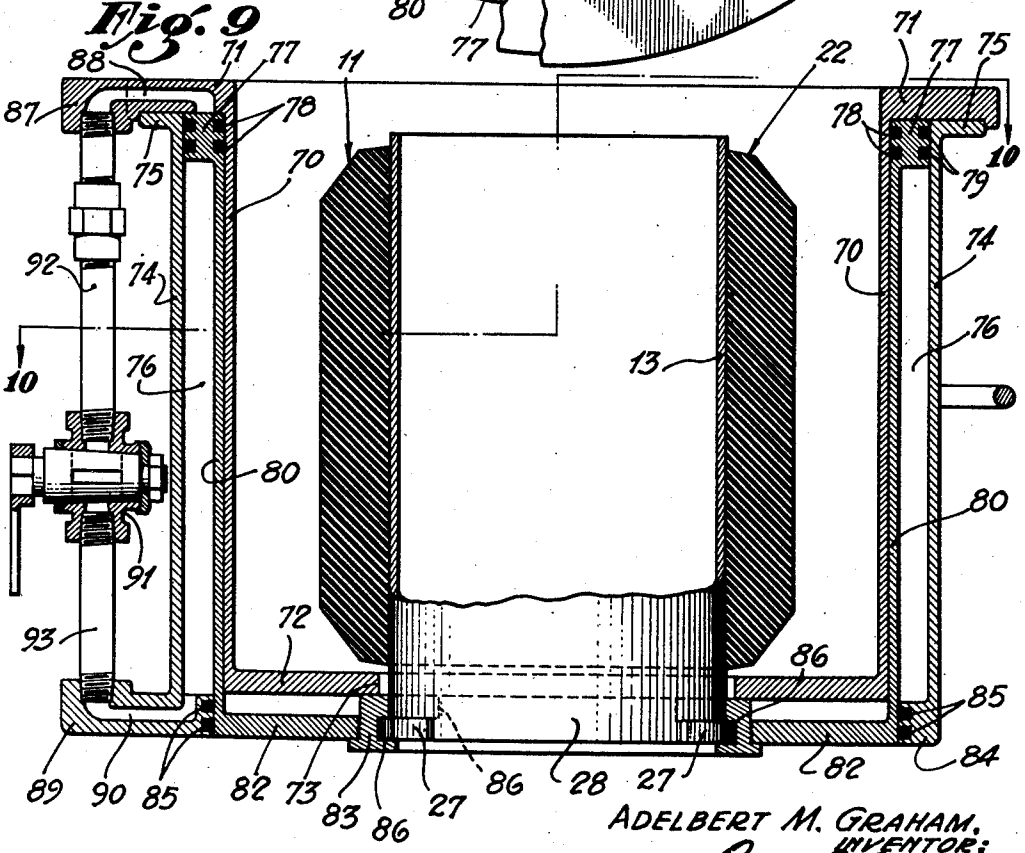


Fig. 9



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BY [signature]

ATTORNEY.

Patented Apr. 20, 1948 2,440,009

UNITED STATES PATENT OFFICE

2,440,009

DRILL PIPE PROTECTOR APPLYING AND INSTALLING APPARATUS

Adelbert M. Graham, Beverly Hills, Calif., assignor, by mesne assignments, to Thermoid Company, Trenton, N. J., a corporation of Delaware

Application October 18, 1940, Serial No. 361,736

11 Claims. (Cl. 29—236)

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My invention relates to method and means for applying expansible annular protectors to drill pipe or other members which are to be employed in a well.

As example of the utility of my invention, its use in conjunction with the rotary system of well drilling will be explained. In rotary well drilling a drilling tool is secured to the lower end of a string of pipe and rotation is transmitted from a rotary machine at the top of the well through the drill pipe to the tool. To reduce wear on the drill pipe and also on the metal wall of such casing as may be installed in the well, and also to act as centralizing means for the drill pipe, it is now a practice to place on the drill pipe at suitable intervals protectors comprising annular bodies of resilient and yieldable material, such as rubber or rubber compound. These protectors are molded with their internal diameter smaller than the external diameter of the pipe so that the protectors must be stretched in order to apply them to the drill pipe, the result being that tension acting in the walls of the protectors will cause them to tightly grip the pipe. So as to minimize the possibility of the protectors slipping over couplings and tool joints forming a part of the drill string, it is desirable to so make these protectors that the tension forces acting therein will be quite large so as to produce a near maximum gripping effect. It will be recognized that a correspondingly heavy force is required to expand these protectors so as to place them upon the drill pipe. In my co-pending application for Drill pipe protector applicator, Serial No. 346,615, filed July 20, 1940, issued Dec. 1, 1942, as Patent No. 2,303,689, I have disclosed power operated apparatus for stretching drill pipe protector and for placing the same at selected positions on a drill pipe. This apparatus is quite heavy and involves considerable expense in the manufacture thereof.

It is an object of my present invention to improve methods and apparatus for applying protectors to drill pipe, of the general character disclosed in my co-pending application above identified. Rubber drill pipe protectors are customarily applied to the drill pipe in the derrick, prior to the making up of the continuous drill pipe string and accordingly it is necessary to transport the relatively heavy equipment, often over a considerable distance, to the derrick of the well in which the string of drill pipe is to be used. My present invention makes it possible to reduce the amount of equipment which must be transported to the well for purpose of stretching the protectors and then applying them to the drill pipe.

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It is a further object of the invention to provide a method and apparatus whereby the drill pipe protectors are expanded at a plant or location selected for this operation, are transported in expanded condition to the well or wells and thereat placed upon and allowed to contract upon the drill pipe which is to be protected. In my present invention the heavy equipment constituting the device for expanding the protector is maintained at a central or selected plant or location. By use of this expanding equipment the protectors are expanded and placed upon simple cylindrical holders. The holders, with the expanded protectors thereon, are then transported to the location, generally the derrick of a well, and they are individually placed in or connected to a simple applying device which is operative to remove the protectors from the holders so that the protectors may contract upon and around selected portions of the drill pipe to be protected.

It is an object of the invention to provide as an article of manufacture an expanded drill pipe protector held upon a holder equipped for cooperation with a device for removing the protector from the holder.

The further object of the invention is to provide a protector applying device which may be readily transported to a desired location, this applying device having means for receiving a protector unit comprising a holder with an expanded protector thereon and having means for removing the expanded protector from the separate protector holder so that the protector will be allowed to contract around a selected portion of a drill pipe, and it is also an object of the invention to provide as a means for applying drill pipe protectors to drill pipe, a protector applying device and a plurality of holders to cooperate therewith whereby the holders with the protectors thereon may be consecutively brought into juxtaposition with the operating mechanism of the applying device.

Further objects and advantages of the invention will be brought out in the following part of the specification wherein I have shown the broad concept of my invention embodied in the details of construction of a selected apparatus for the practice of the invention.

Referring to drawings which are for illustrative purposes only:

Fig. 1 is a partly sectioned view showing the protector expanding device forming a part of my invention.

Fig. 2 is a cross section taken as indicated by the line 2—2 of Fig. 1.

Fig. 3 is an enlarged elevational view showing that part of my invention constituting an article of commerce comprising an expanded drill pipe protector on a holder.

Fig. 4 is a partly sectioned view showing the holder and expanded protector in place in the applying device which forms a part of my present invention.

Fig. 5 is an enlarged sectional view of the applying device shown in Fig. 4.

Fig. 6 is a plan view corresponding to Fig. 5.

Fig. 7 is an enlarged fragmentary sectional view of the area indicated by the circle 7 of Fig. 5 showing an adaptor insert of different size in use.

Fig. 8 is an enlarged fragmentary section taken as indicated by the line 8—8 of Fig. 5.

Fig. 9 is an enlarged sectional view of an alternative form of applying device expressly suited for use in removing large size protectors from their holders.

Fig. 10 is a fragmentary partly sectioned plan view of the device shown in Fig. 9.

In Fig. 1 I show my expanding device 10 with a drill pipe protector 11 on the holding mandrel 12 in readiness for expansion and placement on a cylindric holder or sleeve 13 carried in operative position by an adaptor 14 disposed at the upper end of the tubular support 15 which is mounted on a swingable platform 16 supported by the base 17 of the expanding device 10.

The expanding device 10 may be constructed in accordance with the details disclosed in my copending application, Serial No. 346,615, and includes a pusher element 18 which operates in a guide 19 to forcibly move downward around the mandrel 12 a protector 20 in pusher position, so that the protector 11 will be forced down over an expanding cone to a position on the holder 13 indicated by dotted lines 11'. The cylindric holder 13 is a separate unit which is employed in multiplicate so that any desired number of the protectors 11 may be expanded and placed upon a corresponding number of holders, the holders 13 with the expanded protectors 11 thereon then constituting articles of commerce which may be transported as required from their place of assembly or manufacture. In Fig. 3 I show another holder 13 with an expanded protector 11 thereon, the member 11 and 13 constituting which may be referred to as a protector unit 22. In Fig. 4 I show a protector unit 22 in place in an applying device 23 supported above a rotary machine table 24 so as to surround a drill pipe 25 and to hold the protector unit 22 in a position surrounding the drill pipe 25 and in such position that the operation of the applying device 23 will result in the transfer of the protector 11 from the holder 13 onto the surface of the drill pipe 25.

Each cylindric holder 13 has means whereby it may be connected in cooperating relation to the support 26 consisting of parts 14, 15, and 16 of Fig. 1, and whereby it may be connected in operating relation to the applying device 23, Fig. 4. Such means of operative connection I have shown as arcuate lugs 27, Fig. 3, projecting from the lower end of the cylindric wall 28 of the holder 13. The adaptor ring 14, Fig. 1, has therein bayonet notches 29 to receive the lugs 27 when the holder 13 is mounted in the ring 14, as shown. In the expanding device 10 a number of adaptor rings 14 of different sizes are employed, corresponding to the diameters of the holders 13 required for different pipe sizes. The adaptor ring 14 is threaded into the upper end of the tubular support 15 which is also provided in multiplicate to take care of different conditions of operation. The platform 16 is shown with an extending arm 30 having pivotal engagement with one of the vertical bars 31 of the expanding device, and has a lever 32 whereby it may be swung in clockwise direction from its position of Fig. 2, to carry the support 26 out to one side of the expanding device 10, for convenience in placing the holders 13 on the support 26 and subsequently removing them. The expanding cone 21 is also provided in multiplicate in accordance with different diameters of holders 13, and this cone 21 has a shoulder 33 at its lower end for centralizing engagement with the upper end of the cooperating holder 13. In Fig. 1 I have shown a fluid piping system 34, in accordance with the disclosure of my co-pending application, Serial No. 346,615, this fluid piping system 34 having a control valve 35 for the control of fluid under pressure to actuate the expanding device 10.

As shown in Figs. 5 and 6, the applying device 23 comprises a cylindrical wall or sleeve 36 having the shoulder 37 at the upper end thereof, and in such position that when a protector unit 22 is installed in the applying device 23 in the position shown, the shoulder 37 will lie in a position surrounding the lower part of the holder 13 and below the lower end of the protector 11. The applying device 23 has means for producing relative axial movement of the shoulder 37 and the holder 13 to accomplish separation of the protector 11 and the holder 13. In the preferred form of the applying device 23 disclosed in Figs. 5 and 6, the shoulder 37 is maintained stationary and the holder 13 is pulled downward from the position in which it is shown, so that when the lower end of the protector 11 engages the shoulder 37 and is thereby held against further downward movement, the holder 13 will be pulled downward out of the protector 11 so that the protector may contract around and upon that portion of the drill pipe lying within the guard 38 which comprises a cylindric wall projecting upward from the periphery of the shoulder 37.

The means which I have provided for pulling the holder 13 downward out of the protector 11 includes an adaptor ring 39 of a size to receive the lower portion of the holder 13 and having bayonet notches 40 therein for interlocking engagement with the arcuate lugs 27 of the holder 13. The adaptor ring 39 is detachably secured in the upper end of a cylindric wall 41, smaller than and slidable within the cylinder 36. The lower portion of the wall 41 projects through packing means 42 held at the lower end of the cylinder 36 and is connected to an annular piston 43 which is slidable in a cylinder 44 of larger diameter than the cylinder 36 and connected to the lower end of the cylinder 36 by means of a radial wall 45. The peripheral portion of the annular piston 43 carries packing means 46 in engagement with the cylinder 44, and at the upper end of the cylindric wall 41 there is packing means 47 to engage the cylinder 36. A four way valve 48 is rotatably held in a casing 49 having a port 50 which communicates with the annular space 51 between the radial wall 45 and the piston 43, and the port 52 which communicates with the space 53 between the cylinder 36 and the cylindrical wall 41. As shown in Fig. 8 a pressure fluid pipe 54 communicates with one side of the casing 49, and the fluid return pipe 55 leads out from another part of the casing 49. When the

valve 48 is in the position thereof as shown in Figs. 5 and 8, one of its passages 56 will connect the pressure fluid piping 54 with the port 50, and its other passage 57 will connect the port 52 with the return piping 55. Accordingly, pressure fluid may pass through the port 50 into the space 51 and exert its pressure downward against the annular piston 43 to force the cylindrical wall 41, the adaptor ring 39 and the holder 13 downward, and at the same time fluid may flow out of the space 53 as the volume of the space 53 is reduced as a result of downward movement of the packing 47 at the upper end thereof. Movement of the valve 48 in anti-clockwise direction through an angle of 90° will reverse the direction of flow of fluid through the ports 50 and 52 so that pressure will be applied in the space 53 to return the movable parts of the device to the positions in which they are shown in full line in Fig. 5, and to permit passage of fluid out from the space 51.

In Fig. 7 I show an adaptor ring 39' of smaller internal diameter than the adaptor ring 39, to receive the lower end of a holder 13a of smaller diameter than the holder 13 as shown in Fig. 5. In all other respects the adaptor ring 39' is the same as the adaptor ring 39. It is threaded at 58 for attachment to the upper end of the cylindrical wall 41 and has a peripheral portion 59 for engagement with the inner face of the cylinder 36 and to provide an annular shoulder 60 to serve as an annular piston back of the packing 47 which is placed in the annular space above a retaining ring 61 which is threaded onto the upper portion of the cylindrical wall 41. When holder 13a, Fig. 7, is of small diameter and the protector 11a thereon is relatively small diameter, it is advisable to place a supplementary shoulder element 37a, comprising a diametrally split ring, in the position shown in dotted lines.

A preferred manner of use of the invention is as follows: A selected number of protector units 22, Fig. 3, are made up by use of the expanding device 10. As explained in the foregoing, the holders 13 for these units are individually placed on the support 26 of the expanding device 10 and the protectors 11 are expanded and placed thereon. A selected or required number of these units are transported to the location of the pipe to be protected, for example the derrick of a well having suitable hoisting equipment for the pipe. The applying device 23, which is a relatively light piece of equipment, is also taken to the location of the pipe, and in conjunction with suitable handling of the pipe the protector units 22 are individually placed in the applying device 23 and are transferred to the pipe. A convenient and acceptable practice is to employ the applying device 23 in a position above the rotary table 24 wherein the pipe 25, Fig. 4, may be lowered therethrough to a desired position relative to the protector unit 22. The protector unit 22 is first placed within the guard 38 and is engaged with the adaptor ring 39 after which the drill pipe 25 is lowered through the protector unit 22 and the applying device 23. By means of the handle 62 thereof, the workmen hold the applying device 23 in a position raised from the rotary table 24. Fluid pressure is then applied to the space 51 to pull the holder 13 down out of the protector 11. An advantage of the invention is that there is minimum delay in applying the protectors 11 to the drill pipe 25, since the protector units 22 may be placed consecutively in the applying device 23 as fast as the operations are conducted without the necessity of waiting for a protector to be expanded. Likewise, the single expanding device, employed at a central location, may serve a plurality of applying devices 23, employed at widely separated locations.

The foregoing simple practice is a marked improvement over the method disclosed in my copending application, Serial No. 346,615, which is illustrative of a general practice now being employed. In the old method, it was customary to employ at the location of the pipe to be protected an expanding device and an applying unit. The expanding device was first employed to expand the rubber protector on or in the applying device having means for holding the protector in expanded condition. The applying device was then carried to the rotary table and employed to apply or transfer the expanded protector onto the surface of the pipe. My present invention avoids the necessity of transporting the relatively heavy expanding device with its associated compressor equipment to the location of the well, and also avoids the delay occasioned by the necessity of individually expanding the protectors onto the support of an applying device while the pipe handling crew stands idle. In addition to the foregoing and other advantages the present method disclosed herein saves more than half of the time formerly required for the placing of protectors on a drill pipe by use of equipment such as shown in my co-pending application above referred to.

In the alternative form of applying device shown in Figs. 9 and 10 I provide an inner cylinder 70 having an outwardly projecting flange 71 at its upper end and an inwardly projecting flange 72 at its lower end, this lower flange defining an opening 73. Around the cylinder 70 an outer cylinder 74 is placed, which outer cylinder 74 has a flange 75 secured to the flange 71 at the upper end of the inner cylinder 70. The outer cylinder 74 is larger than the inner cylinder 70 and an annular cylinder space 76 is formed therein in which an annular piston 77 is movable. The annular piston 77 has packing means 78 and 79 to respectively engage inner and outer cylinders 70 and 74.

A cylindric wall 80 extends downward from the annular piston 77 in sliding contact with the cylinder 70, and at the lower end thereof which projects below the lower end of the cylinder 70 the cylindric wall 80 has an inwardly projecting flange 82 in which an adaptor ring 83 is secured. The lower end of the outer cylinder 74 carries an annular wall 84 which closes the lower end of the cylinder space 76 and carries packing means 85 to cooperate with the external surface of the cylindric wall 80.

When a protector unit 22 is placed within the device as shown in Fig. 9, the lower end of its cylindric holder 13 will project through the opening 73 and be supported by the adaptor ring 83 which has bayonet slots 86 to receive the arcuate lugs 27 of the holder 13. The upper flange 71 of the inner cylinder 70 has a projection 87, and a passage 88 is extended from the lower face of the projection 87 through the flange 71 to communicate with upper end of the cylinder space 76. The lower end of the outer cylinder 74 has a projection 89 thereon in which there is formed a passage 90 leading from the upper face of the lug 89 to the lower end of the cylinder space 76 outside the wall 80. A four way valve 91, as shown in Fig. 9, has two of its ports connected by piping 92 and 93 with the passages 88 and 90, and as shown in Fig. 10, a pressure fluid pipe 94 and a return pipe 95 are respectively con-

nected to the remaining ports of the valve 91. When the valve 91 is manipulated so as to direct the pressure fluid through the passage 88 into the upper end of the cylinder space 76, the pressure thereof will force the annular piston 77 downward, with the result that the holder 13 of the protector assembly 22 will be moved downward. When the expanded protector 11 of the protector unit 22 engages the flange 72 it will be held stationary and downward movement of the holder 13 will result in its being pulled from the interior of the expanded protector 11 whereupon the protector 11 may contract around a pipe extended through the holder 13. The return of the piston 77 and its associated parts to the initial position thereof shown in Fig. 9 may be accomplished by manipulating the valve 91 so as to direct the pressure fluid through the passage 90 so that the pressure thereof will be exerted against the lower face of the annular piston 77.

I claim as my invention:

1. In a drill pipe protector applying device for separating an expanded protector from a cylindric holder, the combination of: annular cylinder and piston means defining an opening to receive the drill pipe which is to be protected; a support connected to one of said means, said support having parts to lock said holder thereto; an annular shoulder connected to the other of said means, to confront an end of said protector when the holder on which it is mounted is locked to said support; and means to apply fluid pressure to said cylinder and piston means to produce relative movement of said support and said shoulder to separate said protector and said holder.

2. In a drill pipe protector applying device for separating expanded protectors from cylindric holders, the combination of: a pair of annular walls disposed in axially movable relation and each slidably engaging the other and defining an opening to receive the drill pipe which is to be protected; a support connected to one of said walls, said support having parts to lock one of said holders thereto; an annular shoulder connected to the other of said walls, to confront an end of one of said protectors when the holder on which it is mounted is locked to said support; and means to apply relative axial movement to said walls whereby pressure of said shoulder against said protector and movement of said holder will separate said holder and said protector.

3. In a drill pipe protector applying device for separating an expanded protector from a cylindric holder, the combination of: double acting annular cylinder and piston means defining an opening to receive the drill pipe which is to be protected; a support connected to one of said means, said support having parts to lock said holder thereto; an annular shoulder connected to the other of said means, to confront an end of said protector when the holder on which it is mounted is locked to said support; and means to apply fluid pressure to said cylinder and piston means to produce relative movement of said support and said shoulder to separate said protector and said holder, and to apply fluid pressure to said cylinder and piston means to return them to their original position of cooperation.

4. In a drill pipe protector applying device for separating an expanded protector from a cylindric holder, the combination of: inner and outer cylindric walls defining an annular cylinder space closed at one end and open at the other, said inner cylindric wall having an inwardly projecting shoulder defining an opening; an annular piston in said annular cylinder space; means extending from said piston through said open end of said cylinder space, said means comprising parts for engaging an end of a holder situated within said inner cylindric wall with said end thereof projecting through said opening defined by said shoulder; and means to apply fluid pressure to said annular cylinder space to move said piston so as to carry said parts away from said shoulder and pull said holder through said opening.

5. In an applicator for placing a relatively thick one-piece rubber pipe protector ring upon a pipe of substantially larger diameter than the inside diameter of the ring, the combination of: a relatively thin, smooth surfaced, metallic first sleeve of an inside diameter which is sufficient for ready telescoping clearance by said sleeve of such a pipe and of a length greater than but approximating that of such a protector ring for concentrically mounting the protector ring on said first sleeve under heavy circumferentially acting tensile stresses in the protector ring; a metallic ring of a diameter to loosely encircle the pipe; detachably inter-engaging elements on said metallic ring and the adjacent end of said first sleeve for locking them in axial alignment against forces acting to relatively displace them longitudinally; a second metallic sleeve of an inside diameter greater than the outside diameter of said first sleeve and longitudinally slidably engaging said metallic ring; radially extending annular means on said second sleeve of sufficient radial extent for substantial annular endwise thrust engagement with such a mounted protector ring outwardly from a circle adjacent the inner face of said protector ring, said first sleeve, including the inter-engaging element thereon, being longitudinally slidable within said second sleeve, including said radially extending means thereon, a distance sufficient for the outer end portion of said first sleeve to pass said radially extending means on said second sleeve; means for holding said second sleeve stationary with respect to a pipe disposed within said applicator; and means for moving said metallic ring longitudinally relative to said stationarily held second sleeve from an initial position in a direction and for a distance sufficient to draw said first sleeve toward, within, and substantially through said radially extending means.

6. In an applicator for placing a relatively thick one-piece rubber pipe protector ring upon a pipe of substantially larger diameter than the inside diameter of the ring, the combination of: a relatively thin, smooth surfaced, metallic first sleeve of an inside diameter which is sufficient for ready telescoping clearance by said sleeve of such a pipe and of a length greater than but approximating that of such a protector ring for concentrically mounting the protector ring on said first sleeve under heavy circumferentially acting tensile stresses in the protector ring; a metallic ring of a diameter to loosely encircle the pipe; detachably interengaging elements on said metallic ring and the adjacent end of said first sleeve for locking them in axial alignment against forces acting to relatively displace them longitudinally; a second metallic sleeve of an inside diameter greater than the outside diameter of said first sleeve and longitudinally slidably engaging said metallic ring; radially extending

annular means on said second sleeve of sufficient radial extent for substantial annular endwise thrust engagement with such a mounted protector ring outwardly from a circle adjacent the inner face of said protector ring, said first sleeve, including the inter-engaging element thereon, being longitudinally slidable within said second sleeve, including said radially extending means thereon, a distance sufficient for the outer end portion of said first sleeve to pass said radially extending means on said second sleeve; means for holding said second sleeve stationary with respect to a pipe disposed within said applicator, said ring and second sleeve having relatively spaced axially elongated walls and relatively spaced radially extending walls respectively providing a longitudinally expansible chamber; and hydraulic means cooperating with said expansible chamber to move said metallic ring longitudinally relative to said stationarily held second sleeve from an initial position in a direction and for a distance sufficient to draw said first sleeve toward, within, and through said radially extending means.

7. The combination defined in claim 6 in which said relatively spaced axially elongated walls are concentric cylindric walls coaxial with said applicator.

8. The combination defined in claim 6 in which said relatively spaced axially elongated walls are concentric cylindric guard walls coaxial with said applicator and extend from said shoulder in a direction opposite the aforesaid direction, a distance approximately equal to the length of said first sleeve.

9. The combination defined in claim 6 in which said holding means is a manual grip secured to and extending laterally outwardly from said second sleeve.

10. In an applicator for placing a relatively thick one-piece rubber pipe protector ring upon a pipe of substantially larger diameter than the inside diameter of the ring, the combination of: a thin walled sleeve of an internal diameter to slide over said pipe, said sleeve being adapted to receive an expanded rubber protector thereon; a first cylindric member of larger internal diameter than the external diameter of said pipe, said member having means to connect it to one end of said sleeve; a second cylindric member also of

larger diameter than said sleeve, in sliding engagement with said first cylindric member and cooperating therewith so as to form an annular fluid receiving chamber in which fluid pressure will cause relative movement of said first and second cylindric members; a third cylindric member surrounding said protector when it is in place on said sleeve, having a shoulder to engage the inner end of said protector, said third cylindric member being rigidly connected to said second cylindric member; and means for applying fluid pressure to said chamber so as to produce movement of said first cylindric member relatively to said second and third cylindric members and to produce relative movement of said sleeve and said shoulder whereby said sleeve will be withdrawn from said protector.

11. In a drill pipe protector applying device for separating an expanded protector from a cylindric holder having a locking member at one end thereof, the combination of: annular cylinder and piston means defining an opening to receive the drill pipe which is to be protected; a support connected to one of said means, said support having parts to engage said locking member of said holder thereto; an annular shoulder connected to the other of said means, to confront an end of said protector when the holder on which it is mounted is locked to said support, said annular shoulder defining an opening of such size that said locking member of said holder may pass therethrough.

ADELBERT M. GRAHAM.

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