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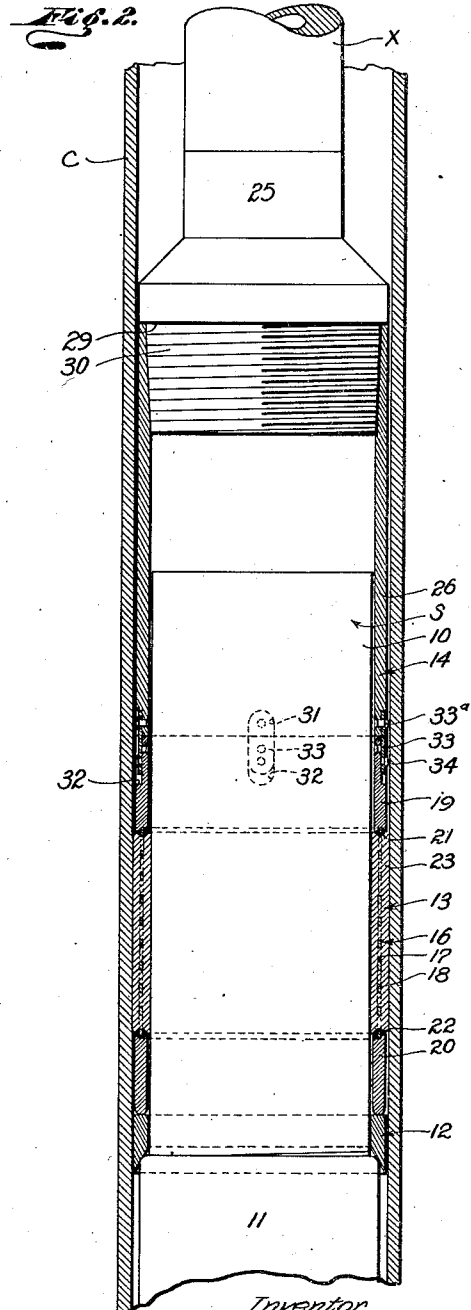
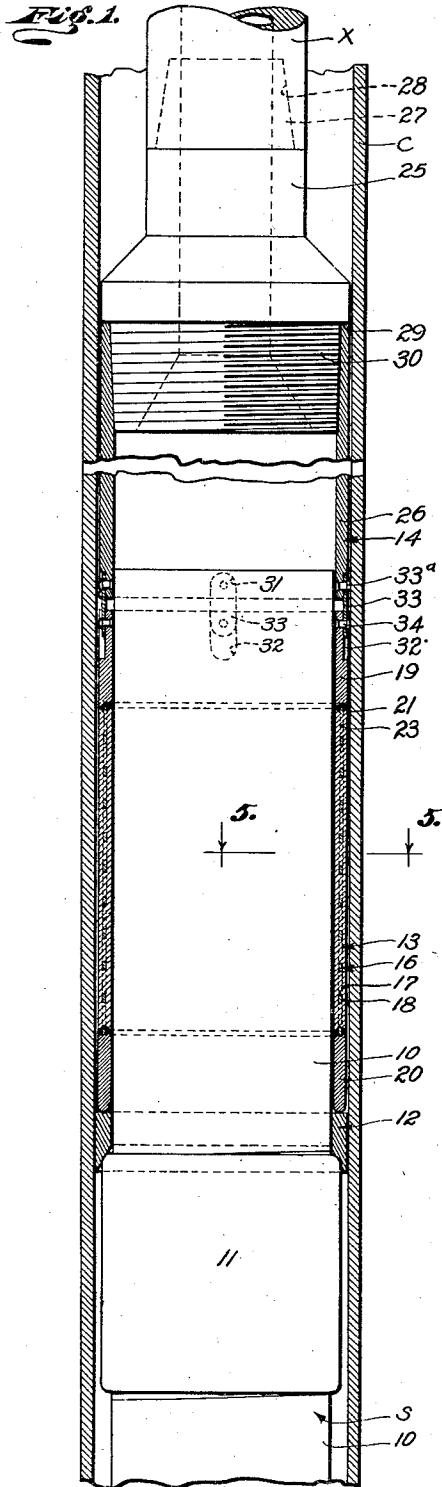
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2,137,997

PACKING DEVICE FOR USE IN WELLS

Filed Dec. 28, 1936

2 Sheets-Sheet 1



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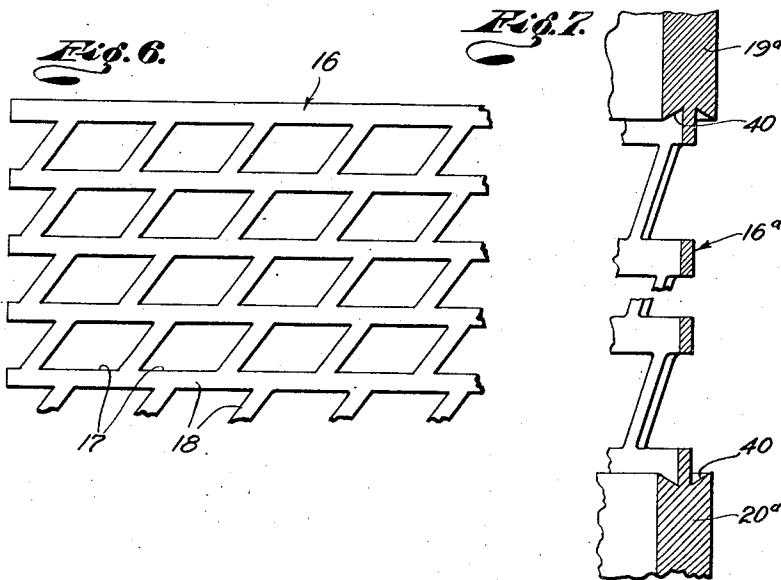
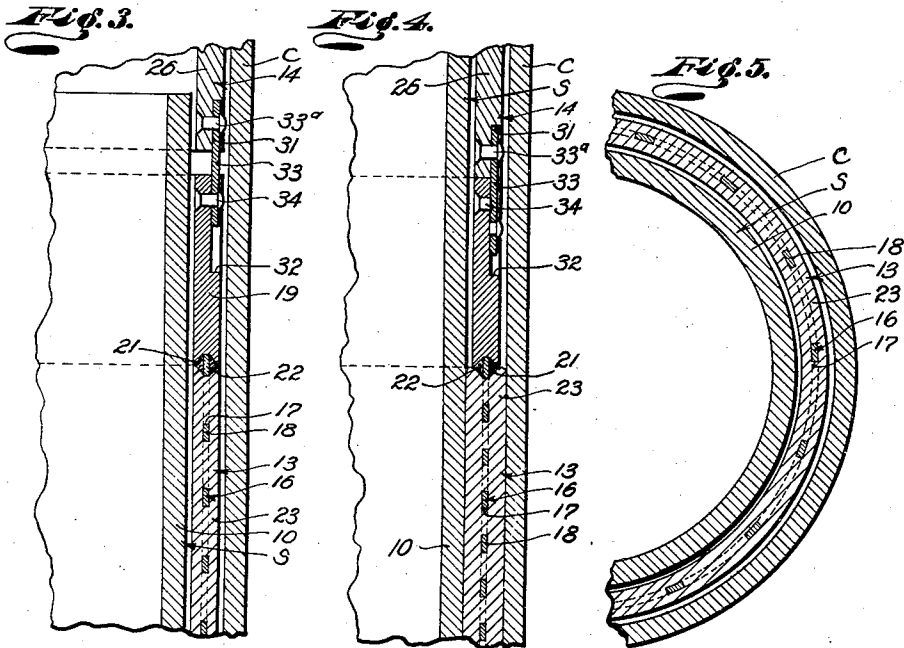
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PACKING DEVICE FOR USE IN WELLS

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18 Claims. (Cl. 166—10)

This invention relates to a well tool and relates more particularly to a packing device for effecting a seal between two telescopically related parts in a well. A general object of the invention is to provide a simple, dependable and practical device for packing between two telescopically associated parts in a well.

In well drilling and producing operations it is often necessary to arrange one or more strings of pipe, tubing or casing within an outer casing. For example, when a well has been deepened beyond the lower end of a set of cemented-in casing it is customary to arrange a string of tubing or casing through the set outer casing from the surface of the ground to extend into the portion of the well below the outer casing. In most instances the major portion of such an inner string of casing or tubing extending through the set outer casing is unnecessary and useless except that it may be employed to contain or conduct fluids.

Another object of this invention is to provide a packing device for sealing between a casing in a well and a string of pipe, tubing or the like, extending through or into the casing whereby the major portion of said string may be recovered from the well. When the device of the present invention is properly set and actuated it provides a fluid tight and pressure tight seal between the casing or outer tubular member and a second tubular member or string entering the lower end of the outer member so that the portion of the said outer member above the device may perform all the functions that the continuation of the inner string would otherwise perform, making it unnecessary to leave the major upper portion of the inner string in the well. As the use of the packing device permits the recovery of the major portion of the inner member or string from the well it effects a great economy in the pipe, tubing, etc. employed in the well.

Another object of this invention is to provide a packing device of the character mentioned that is capable of forming a dependable and substantially permanent fluid tight and pressure tight seal between the casing or outer part and the inner string.

Another object of this invention is to provide a packing device of the character mentioned that may be easily and quickly positioned and actuated.

Another object of this invention is to provide a packing device of the character mentioned that embodies a reinforced tubular packer of lead or the like capable of forming a dependable and

substantially permanent seal between the outer part or casing and a string within the casing.

Another object of this invention is to provide an improved packing device of the character mentioned that embodies a spacing and centering element to assure the setting of the packer in the desired position and in an undamaged state, and the proper centering of the packer and the inner string within the outer string or casing.

Another object of this invention is to provide a packing device of the character mentioned that embodies a novel means for setting or arranging the packer in position and for actuating the packer.

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

Fig. 1 is a central longitudinal detailed sectional view of the packing device provided by this invention showing it in position within an outer tubular member and surrounding an inner tubular member prior to being actuated. Fig. 2 is a view similar to Fig. 1 showing the packer being compressed or actuated by the setting tool. Fig. 3 is an enlarged fragmentary vertical detailed sectional view of a portion of the packer before actuation. Fig. 4 is a view similar to Fig. 3 showing the position and condition of the parts during or following actuation of the packer. Fig. 5 is an enlarged fragmentary horizontal detailed sectional view taken substantially as indicated by line 5—5 on Fig. 1. Fig. 6 is an enlarged fragmentary side elevation of the reinforcement embodied in the packer illustrated in the figures described above, and Fig. 7 is a fragmentary vertical detailed sectional view of another form of reinforcing means.

The packing device of the present invention may be employed in various situations and may be modified in construction to adapt it for various uses. In the drawings I have illustrated a typical form of the invention and have shown one manner of employing the device to seal between two tubular telescoped members as found in a well. It is to be understood that the invention is not to be construed as limited or restricted to the specific form of the invention about to be described but that it is to be taken as including any features or modifications that may fall within the scope of the following claims.

The drawings illustrate an outer tubular member which I will term a casing C and which may

be considered as set or cemented in a well. This outer member or casing C may be considered as extending to the surface of the ground and as being imperforate to contain and conduct fluid.

I have also illustrated a string of tubing, pipe, or casing extending through the casing C which I will term a string S. The string S may have been run through the casing C from the surface of the ground to extend into the lower portion of the well drilled beyond the lower end of the set casing C. It will be assumed that the inner string S has been landed, set or cemented in the well in any of the well known manners. In accordance with the usual practice the string S is made up of lengths or sections 10 of pipe or tubing connected by suitable collars or couplings 11.

Preparatory to employing the packing device of the present invention and following the setting or cementing of the string S a pipe cutter or casing cutter is lowered through the casing C to pass downwardly into the string S. This cutter (not shown) is preferably lowered to a position a slight distance above the lower end of the casing C. The casing cutter is preferably provided with a collar finder or device for engaging against a collar or coupling 11 to locate the cutter some distance above a selected coupling 11. In practice this finder preferably positions the cutter about 18 inches above a selected coupling 11. The cutter is actuated to cut or part the string S at the desired point and the cutter is then withdrawn from the well. The freed upper portion of the string S is then removed or recovered from the well. As mentioned above, it is preferred to actuate the cutter a relatively short distance above the lower end of the casing C so that the major portion of the string S extending through the casing C may be recovered. This recovered portion of the string S is, of course, undamaged and is suitable for further use. As this portion of the recovered string S is usually the major portion of the string, a great economy is thus effected. Figs. 1, 2 and 3 of the drawings illustrate the string S after it has been cut as described above, and illustrate the upper end portion of the remaining or set string S extending upwardly into the casing C.

The packing device provided by the present invention includes, generally, a spacing and centering ring 12 to be lowered downwardly over the string S to rest on its uppermost coupling 11, a packer 13 adapted to be passed downwardly over the upper portion of the string S, and a setting and driving tool 14 for lowering the packer 13 into place and for actuating or expanding the packer.

The ring 12 is provided to properly center the upper portion of the string S in the casing C so that the packer 13 may be readily passed downwardly over its upper end portion without injury. In practice the ring 12 may be a simple annular member of steel or the like. The ring 12 is proportioned to rather closely fit within the casing C and to rather closely fit about the cut uppermost section 10 of the string S. The upper end of the centering ring 12 may be flat and normal while the lower end of the ring 12 may be slightly tapered downwardly and outwardly to readily pass over the cut upper end of the uppermost string section 10. The centering and spacing ring 12 may be lowered into the casing C and passed downwardly over the uppermost section 10 of the string S in any suitable manner and with any of the setting tools or devices known to those skilled in the art. The

ring 12 seats on or comes to rest on the upper end of the uppermost coupling 11 of the string S. Owing to the rather close fit of the ring 12 in the casing C and its slight clearance with the string S the ring serves to properly center the casing C, providing a substantially uniform annular space around the uppermost section of the string S to receive the packer 13.

The packer 13 is of novel design and construction and is capable of forming a fluid tight and pressure tight seal between the inner surface of the casing C and the outer surface of the uppermost section 10 of the string S. The packer 13 includes a tubular reinforcement 16. The reinforcement 16 may be formed in various manners and may be of various constructions. In the drawings I have illustrated two typical forms of reinforcements for the packer 13, it being understood that the invention is not to be restricted to the typical preferred forms of reinforcing means illustrated.

The reinforcement 16 illustrated in Figs. 1 to 6, inclusive, of the drawings is formed of a body or piece of sheet metal having a multiplicity of perforations 17. The perforations 17 are relatively large and are relatively close together to leave a webbing or screen-like structure of narrow webs 18. The particular perforations 17 illustrated have the configuration of parallelograms, it being apparent that the perforations of the reinforcement may be of various shapes. The piece of perforated metal of which the reinforcement 16 is to be formed may be initially flat and is shaped or rolled into tube form. The longitudinal edges of this tube are then welded together to maintain the reinforcement 16 in the form of a tube of the proper diameter.

The packer 13 includes end rings 19 and 20 at the upper and lower ends, respectively, of the reinforcement 16. The rings 19 and 20 are formed of steel or the like and are preferably in the nature of relatively short tubes or sleeves. The upper end of the ring 19 is preferably flat and normal and the lower end of the lower ring 20 is preferably rounded or slightly bevelled to guide the packer 13 over the uppermost section 10 of the string S. The rings 19 and 20 are proportioned to freely pass downwardly between the inner wall of the casing C and the external surface of the uppermost section 10. The rings 19 and 20 are preferably of less wall thickness than the centering ring 12. The inner ends or opposing ends of the rings 19 and 20 are provided with annular grooves 21. The grooves 21 are inwardly tapered or of inwardly diminishing width. The grooves 21 are provided to receive the end portions of the reinforcement 16 to facilitate the securing of the rings 19 and 20 to the reinforcement. In practice it has been found desirable to braze the ends of the reinforcement 16 to the rings 19 and 20 at the grooves 21. In the drawings I have shown bronze or brazing material 22 occupying the grooves 21 and securing the rings 19 and 20 to the ends of the reinforcement 16. The brazing at 22 is preferably annular and may extend some distance inwardly on the reinforcement 16. The brazing at 22 forms secure connections between the reinforcement 16 and the rings 19 and 20 and yet is capable of limited flexure or movement when the packer 13 is actuated as will be hereinafter described.

The packer 13 further includes a tubular body 23 of sealing material. The body 23 is preferably cast or molded on the reinforcement 16 to com-

pletely enclose the same and to occupy its numerous perforations 17. Being cast on the reinforcement 16 the body 23 has its ends at or cast to the inner ends of the rings 19 and 20.

5 The body 23 of the packer 12 is in the form of an elongate cylindrical tube and its internal and external surfaces may be flush with the corresponding surfaces of the end rings 19 and 20. Thus the body 23 is proportioned to readily pass

10 between the internal surface of the casing C and the peripheral surface of the section 10. In accordance with the invention the packer body 23 is formed of a deformable material substantially unaffected by the fluids in the well. The body

15 23 is preferably formed of lead or a similar relatively soft deformable and relatively non-resilient material such as zinc or certain relatively soft alloys. Being molded on the reinforcement 16 the body 23 is sufficiently strong to be run

20 into the well and passed over the string S without injury. The portions of the body 23 occupying the perforations 17 in the reinforcement 16 securely tie together the opposite wall portions of the body. As will be noted in the drawings,

25 the body 10 with its reinforcement 16 is normally or initially comparatively long.

The setting and driving tool 14 is provided to facilitate the positioning of the packer 13 and the deforming of the packer into sealing contact

30 with the inner wall of the casing C and the outer surface of the string S. The tool 14 is adapted to be secured to the lower end of a string X of rod or pipe. In accordance with the preferred form of the invention the tool 14 includes an

35 adapter or sub 25 and a tubular section 26 on the sub. The sub 25 is suitably connected with the lower end of the driving string X. In the particular case illustrated a pin 27 is provided on the upper end of the sub 25 and is threaded into a

40 socket 28 in the lower end of the string X to secure the sub to the string. The lower portion of the sub 25 is preferably of enlarged diameter to present an annular downwardly facing shoulder 29 and to carry a threaded pin 30 of relatively

45 large diameter. The tubular section 26 of the tool 14 is threaded on the pin 30 to have its upper end bear against the shoulder 29. The tubular section 26 is proportioned to pass through the casing C with suitable clearance and to pass

50 downwardly over the upper end of the uppermost section 10 of the string S with suitable clearance.

The setting and driving tool 14 further includes an effective frangible connection between its section 26 and the packer 13. This frangible connection includes or provides a plurality of circumferentially spaced grooves 31 in the exterior

55 of the section 26. The grooves 31 extend longitudinally of the section 26 and extend upwardly from its lower end. Similar and aligned grooves 32 are provided in the upper ring 19 of the packer 13. Links or straps 33 extend between and connect the tool section 26 and the upper ring 19

60 of the packer 13. The straps 33 are received in the grooves 31 and 32 so that they do not form protuberances on the outer surface of the assembly. The upper ends of the straps 33 may bear on the upper walls of the grooves 31. Suitable rivets 33^a or the like secure the straps 31 to the

65 section 26 of the tool 14. The lower ends of the straps 33 are spaced a substantial distance above the lower walls of the grooves 32. Frangible shear pins or rivets 34 secure the straps 33 to the ring 19. The pins or rivets 34 secure the straps

70 33 to the ring 19 to space the upper end of the ring 19 some distance below the lower end of the

tool section 26. The distance between the lower ends of the straps 33 and the lower walls of the grooves 32 is greater than the space between the opposing ends of the ring 19 of the section 26. The frangible pins or rivets 34 are sufficiently

5 strong to support the packer 13 on the tool section 26 during the lowering of the packer through the casing C but may be intentionally broken by the imposition of a relatively heavy force or load.

Fig. 7 of the drawings illustrates a form of reinforcement 16^a for the packer body 23 that differs from the reinforcement 16 in that it is

10 integral with the end rings 19^a and 20^a. In other respects the reinforcement 16^a may be similar to or identical with the above described reinforcement 16. When the reinforcement 16^a is formed

15 integral with the end rings 19^a and 20^a its opposite ends integrally join the opposed inner ends of the rings which may be concaved or grooved as at 40 to assure an effective bond between the

20 body of the packer 13 and the end rings.

Assuming that the string S has been set or landed and then cut, as described above, the ring 12 is lowered or run through the casing C to pass

25 downwardly over the cut upper end of the uppermost section 10 of the string S. The ring 12 may be lowered to seat against the upper end of the uppermost coupling 11. As described above, the ring 12 is proportioned to substantially center the

30 upper end portion of the string S in the casing C thus providing a regular annular space around the uppermost section 10 of the string. The sub

35 25 carrying the packer 13 is then connected with the lower end of the string X and the assembly is run downwardly through the casing on the string. The packer 13 is lowered through the casing C to

40 pass downwardly over the uppermost section 10 of the string S. The string X is lowered until the lower ring 20 of the packer 13 engages or rests on the centering ring 12. The packer 13 may be

45 readily passed downwardly over the cut upper section 10 of the string S without injury. The straps 33 secure the packer 13 to the sub 25 for movement through the casing C on the string X.

Following the above described setting or locating

50 of the packer 13 the packer is subjected to expanding or deforming compression. The string X is driven downwardly, or forced downwardly, or is allowed to settle to impose a comparatively heavy downward pressure on the frangible pins

55 or rivets 34. The pins or rivets 34 fall under this relatively heavy pressure allowing the string X and the tool 14 to move downwardly relative to the packer 13. The lower end of the tool section 26 is adapted to come into engagement with the

60 upper end of the ring 19 while the lower ends of the straps 33 are still spaced above the upper ends or grooves 22. Accordingly, the weight of the string X, a portion of the weight of the string X, or a downward force exerted on the string X

65 may be imposed on the packer 13 to expand or deform the same. When the packer 13 is subjected to this deforming compressional strain its length is decreased and its wall thickness increased. In practice the packer 13 is distorted

70 or expanded by the compressional force to have its external surface tightly seal against the internal surface of the casing C and to have its internal surface tightly seal against the external surface of the uppermost section of the string S. During this lateral deforming or expansion of the packer body 23 the length of the body 23 may be materially decreased. Fig. 2 of the drawings illustrates the packer 23 in its actuated state where it tightly seals between the interior of the casing 75

C and the outer surface of the uppermost section 10 of the string S. It is to be understood that sufficient weight or downward force may be imposed on the packer 23 to expand or deform it into positive fluid tight and pressure tight sealing engagement with the interior of the casing C and the external surface of the section 10.

The breaking of the frangible pins or rivets 34 to effect the actuation or compression of the packer 13 as described above, releases the connection between the tool 14 and the packer 13. Accordingly, following the proper actuation of the packer 13 the string X may be raised through the casing C to withdraw the tool 14 from the well without in any way disturbing the set or actuated packer 13. Following the removal of the string X with the tool 14 thereon any desired operations may be carried on in the well. The packer 13 forms an effective and substantially permanent seal between the upper end portion of the parted or cut string S and the interior of the casing C so that the upper portion of the casing C in effect constitutes a continuation of the string S for the passage of tools and for the containing and conducting of fluid. Accordingly, where the device of the present invention is employed the major portion of the inner string S, that is customarily run through the casing C to the upper end of the well, may be recovered from the well for other use. The device is simple and inexpensive to manufacture and may be easily and quickly installed and actuated.

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 device for sealing between two telescopically related parts in a well including a packer proportioned to be lowered through the outer part and down over the inner part to a position between said parts when the parts are in the well, and a tool for imposing a downward force on the packer when in said position to expand it inwardly against the inner part and outwardly against the outer part to seal with both of said parts.

2. A device for sealing between two telescopically related parts in a well including, a deformable annular packer proportioned to be lowered through the outer part and down around the inner part to a position between said parts when the parts are in the well, and means for applying compression to the packer to deform it into sealing contact with the inner surface of the outer part and the outer surface of the inner part.

3. A device for sealing between two telescopically related parts in a well including, a deformable tubular lead packer proportioned to be lowered through the outer part and down around the inner part to a position between said parts when the parts are in the well, and means for applying compression to the packer to deform it into sealing contact with the inner surface of the outer part and the outer surface of the inner part.

4. A device for sealing between two telescopically related parts in a well, one an outer casing forming a permanent part of the well and the other a tubing fitting in the casing with clearance and having its upper end within the casing and below the top of the well including, a tubu-

lar packer of deformable non-resilient material shiftable relative to the two parts from above the tubing to a position between the two parts to bear against a protuberance on one of the parts, and means for compressing the packer axially to expand it laterally to bear directly against opposing surfaces of said parts.

5. A device for sealing between two telescopically related parts in a well including, a tubular deformable packer proportioned to be passed downwardly between said parts when the parts are in the well to have its lower end bear on a projection on one of them, and means for applying compression to the packer to expand it laterally against the opposing surfaces of the parts, said means including a member to be run into the well to pass downwardly between said parts and press downwardly against the upper end of the packer.

6. A device for sealing between two telescopically related parts in a well including, a tubular deformable packer proportioned to pass downwardly in the outer part and over the inner part to a position between said parts where its lower end bears on a projection on one of them, and means for applying compression to the packer to expand it laterally against the opposing surfaces of the parts, said means including a member to be run into the well on an actuating string to pass downwardly between said parts and apply a downward force to the upper end of the packer, and a releasable connection between the member and the packer whereby the packer may be lowered into position on said string.

7. A device for sealing between two telescopically related parts in a well including, a tubular deformable packer proportioned to pass downwardly in the outer part and over the inner part to a position between said parts where its lower end bears on a projection on one of them, and means for applying compression to the packer to expand it laterally against the opposing surfaces of the parts, said means including a member to be run into the well on an actuating string to pass downwardly between the said parts adapted to apply a downward force to the upper end of the packer, and a frangible connection between the member and the packer whereby the packer may be lowered into position on said string.

8. A device for packing between two telescopically related parts in a well one of which has a projection, said device including, two elements, one element being a tubular expansible packer to be entered downwardly between the parts when the parts are in the well to have its downward travel limited by said projection, the other element being a member to be run into the well on an actuating string and entered between said parts and capable of transmitting downward force to the packer to expand it into sealing contact with the opposing surfaces of the parts, and means releasably connecting the elements whereby the packer may be run into the well on the string, said means including a tie secured to one element, and a connection between the tie and the other element releasable by force applied by the string whereby the string and member may be withdrawn from the well following expansion of the packer.

9. A device for packing between two telescopically related parts in a well one of which has a projection, said device including, two elements, one element being a tubular expansible packer to be entered downwardly between the parts when

the parts are in the well to have its downward travel limited by said projection, the other element being a member adapted to be run into the well on an actuating string and entered between said parts and capable of transmitting downward force to the packer to expand it into sealing contact with the opposing surfaces of the parts, and means releasably connecting the elements whereby the packer may be run into the well on the string, said means including a tie secured to one element, and a connection between the tie and the other element operating to hold the lower end of the member spaced from the upper end of the packer, said connection being releasable by force applied by the string whereby the string and member may be withdrawn from the well following expansion of the packer.

10. A device for packing between two telescopically related parts in a well one of which has a projection, said device including, a centering element to be entered downwardly between said parts to rest on said protuberance and proportioned to cooperate with the surfaces of the parts to substantially centralize the inner part in the outer part, a tubular laterally deformable packer proportioned to be entered downwardly between said parts when the parts are in the well to rest on the said element, and means for deforming the packer into sealing contact with the opposing surfaces of the parts.

11. A device for packing between two telescopically related parts in a well one of which has a projection, said device including, a ring to be passed downwardly between said parts to said protuberance and proportioned to cooperate with the surfaces of the parts to substantially concentrically space the inner part in the outer part, an expansible tubular packer to be passed downwardly between the parts when the parts are in the well to bear on said ring, and means for applying a downward force to the packer from its upper end to expand it into sealing contact with the opposing surfaces of the parts.

12. A device for packing between two telescopically related parts in a well one of which has a projection, said device including, a tubular packer of deformable substantially non-resilient material to be passed downwardly in the outer part and over the inner part to a position between the parts and resting on the projection when the parts are in the well, a reinforcement for the packer, and means for applying a downward force to the packer to expand it against the opposing surfaces of the parts.

13. In a device for packing between two telescopically related parts in a well one of which has a projection, an expansible packer to be passed downwardly between the parts to the projection, the packer including a tubular body

of readily deformable metal, and a tubular reinforcement cast in the body.

14. In a device for packing between two telescopically related parts in a well one of which has a projection, an expansible packer to be passed downwardly between the parts to the projection, the packer including a tubular body of readily deformable metal, rings of harder material at the ends of the body, and a tubular reinforcement extending through the body and connected with the rings.

15. A device for packing between two telescopically related parts in a well one of which has a projection, said device including, an expansible tubular packer to be passed downwardly between the parts to the projection, the packer including a body of readily deformable metal, rings of harder material at the ends of the body, and a tubular perforate reinforcement extending through the body and connected with the rings, and means for compressing the packer against the projection to expand it into sealing contact with the opposing surfaces of the parts.

16. In a device for packing between two telescopically related parts in a well one of which has a projection, an expansible tubular packer to be passed downwardly between the parts to the projection, the packer including a tubular body of readily deformable metal, rings of harder material at the ends of the body, and a tubular reinforcement extending through the body and integrally joining the rings.

17. In a device for packing between two telescopically related parts in a well one of which has a projection, an expansible tubular packer to be passed downwardly between the parts to the projection, the packer including a body of readily deformable metal, and a tubular foraminous metal reinforcement cast in the body.

18. A device for packing between two telescopically related parts in a well one of which has a projection, said device including, a ring to be passed downwardly between said parts to said projection and proportioned to substantially concentrically space the inner part in the outer part, an expansible tubular packer to be passed downwardly between the parts to bear on said ring, and means for applying a downward force to the packer from its upper end to expand it into sealing contact with the opposing surfaces of the parts, said means including a member to be run into the well on a setting string and adapted to apply a downward pressure to the upper end of the packer, and a releasable connection between the member and packer whereby the member and string may be withdrawn from the well following expanding of the packer.

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