

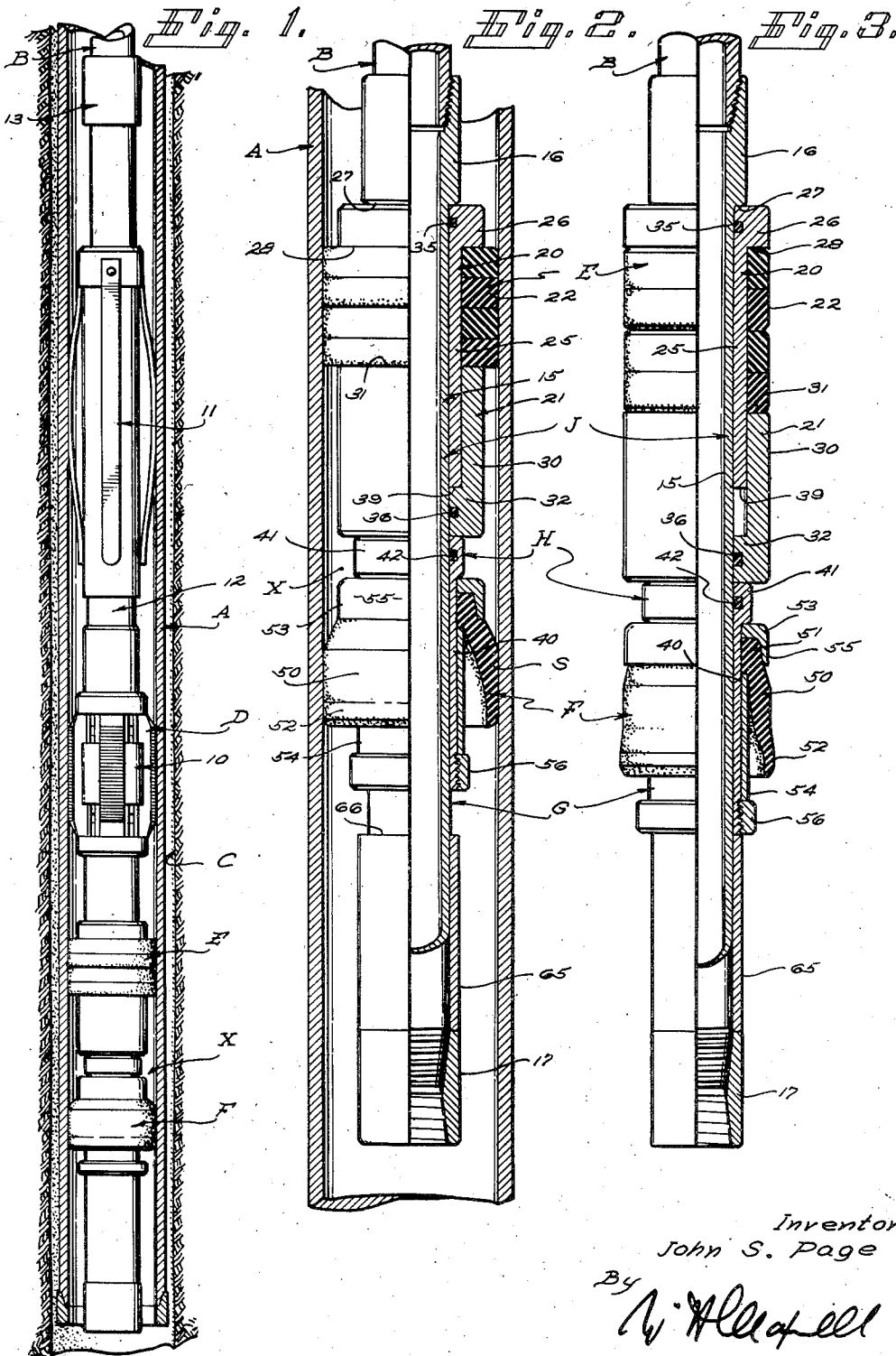
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WELL PACKER

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WELL PACKER

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This invention has to do with a well packer and is more specifically concerned with a structure useful in a well to cooperate with well parts such as a casing and a string of tubing, or the like. It is a general object of the present invention to provide a packer of simple, practical, inexpensive construction which is particularly practical and effective for handling high pressures.

Various devices or packings are used to handle pressures in wells and in some cases it is desirable that the pressures be great. For example, high pressures are desirable in the course of carrying out so-called "squeeze" operations in wells. A typical situation of this kind is where a tubing is lowered into a casing and a packer is set between the lower end portion of the tubing and the interior of the casing so pressure may be communicated through the tubing to the fluid in the lower end portion of the casing. Various forms or types of packers have been used for this general purpose, for example, cup-type packers are commonly used. Cup-type packers are effective in establishing tight sealing engagement and work effectively under moderate pressures, but they fail under high pressures. Other ordinary sealing devices used vary widely in efficiency and are generally subject to failure for various reasons. With the devices heretofore available it has been difficult and in many cases impossible to gain the pressures desired for the operations to be performed.

It is a general object of this invention to provide a well packer such as may be used in connection with a tubing and well casing and which are handled to establish a tight leak-proof seal or connection that will withstand very high pressures.

It is another object of the invention to provide a packer of the general character referred to which employs a cup-type packer to gain a leak-proof seal but does not rely solely upon such packer or upon that type of packer to hold high pressures.

A further object of the invention is to provide a packer of the general character referred to combining a compression type packing unit and a cup-type packing unit so that their sealing action combines to positively prevent leakage and so that they act in such manner that the cup-type packer remains effective even under very high pressures.

It is a further object of this invention to provide a packer of the general character referred to which combines packing elements such as a

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compression type packing and a cup-type packing with an anchor so that the anchor establishes a fixed abutment while the pressure held serves to actuate the packing elements.

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

Fig. 1 is a longitudinal sectional view of a well showing a casing located therein and showing a tubing extending into the casing and carrying the structure provided by the present invention.

Fig. 2 is an enlarged view of a portion of the structure shown in Fig. 1, parts being shown in section to illustrate their construction and arrangement and being shown fully set or engaged, forming a positive, effective, seal between the tubing and the casing.

Fig. 3 is a view of the elements of the packer, as shown in Fig. 2, showing them apart from the casing and in an unactuated condition.

The packing structure provided by the present invention is useful, generally, in wells where it is desired to hold or handle high pressures, and for example, it will be referred to as applied to two common or similar well elements such as a casing A and a tubing B, the casing being located in a well bore C and the tubing being extended into the casing to the lower portion thereof, as will appear from Fig. 1 of the drawings. The structure of the present invention can be applied to or used in connection with parts such as I have just referred to in a situation where it is desired to hold or apply pressure to the lower end portion of the casing, and in such case the desired high pressure may be applied through the tubing B and may be prevented from escaping upward between the casing and the tubing.

In applying the invention to a situation such as I have just referred to it is desirable to provide an anchor D operable to set the lower end portion of the tubing B against shifting axially in the casing A and in the preferred arrangement the anchor D is located either in the lower end portion of the string of tubing or on the lower end portion thereof, as shown in the drawings, and the packing or sealing parts are located below the anchor.

In the drawings I have illustrated a typical anchor D involving an expansible slip mechanism under control of a frictional resistance unit which slidably engages the interior of casing A. The anchor is shown as including or involv-

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ing a central tubular body 12 carrying the parts 10 and 11 and a coupling 13 is provided joining the body 12 to the lower end of the casing B so that it depends therefrom and is, in effect, an extension or continuation thereof.

The present invention is not specifically concerned with the details employed in the anchor, as for instance, the details of either the slip mechanism 10 or the resistance unit 11, as these parts may be of any suitable construction familiar to those skilled in the art. The particular slip mechanism 10 indicated in the drawings is of the form and construction which is more fully set forth and which is claimed in my co-pending application entitled "Anchor," Serial No. 69,677, filed on even date herewith, now Patent No. 2,603,292.

My present invention provides, generally, two cooperatively related packings, one a compression type packing E and the other a cup-type packing F. In the preferred form of the invention the two packings E and F are assembled or are carried by a common body G and they are so related axially of the structure that the cup-type packing F is directly exposed to and is arranged to face the fluid being held so that it is expanded into sealing engagement by the pressure of such fluid while the compression type packing E is beyond or above the cup-type packing and is not directly exposed to the fluid being handled. The cup-type packing F is operated by the fluid pressure handled as employed primarily to gain a dependable tight seal preventing leakage or escape of the fluid being handled while the compression type packing E is operated by axial pressure or thrust and seals with the packing A so that a body of fluid is confined in the chamber X between the two packings. In the preferred form of carrying out the present invention a thrust member H is included in the structure and is operated to impart the desired pressure or thrust to the compression packing E. In the arrangement illustrated the thrust member H is so related to the cup-type packing F as to be operated thereby, that is, it is so related to the cup-type packing that pressure applied to this packing is communicated to the thrust member and, in turn, is applied by the thrust member to the compression packing.

It is desirable, in practice, that the packings and the elements directly related thereto be provided as an assembly or unit, in which case it is practical to provide the structure with a central tubular body J which carries the parts just described as clearly shown in Figs. 2 and 3 of the drawings.

The body J may be a simple element with a straight tubular main portion 15 provided at its upper end with an enlargement or coupling part 16 by which the body may be joined to a part such as a tubing B or a part 12 which is joined to the tubing and is, in effect, a part or continuation thereof. In the particular case illustrated the body 15 has the coupler 16 formed integrally on its upper end while the stop collar 17 is threaded onto the lower end of the main body portion 15.

The compression type packing E in the form illustrated involves two relatively movable parts or carriers 20 and 21 and a body or assembly of packing 22. The carriers 20 and 21 are relatively movable and are preferably supported directly upon the body 15.

The carrier 20 is shown as including a tubular collar portion 25 engaged on the body 15 and

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provided at its upper end with a head or enlargement 26 stopped against an abutment or shoulder 27. It is convenient in practice that the shoulder 27 be established by the lower end of the coupling 16 on the upper end of the body. The assembly or body of packing 22 is mounted directly on collar portion 25 of carrier 20 and is confined to the upper end portion thereof to abut the shoulder 28 established by the head 26.

The carrier 21 is the lowermost of the two carriers and has a sleeve portion 30 engaged over the lower end portion of the collar 25 so that the carriers are telescopically related. The upper end 31 of the sleeve 30 forms a shoulder opposing the shoulder 28 and engaging the lower end of the packing assembly. At the lower end of the sleeve 30 the carrier 21 is provided with an enlargement or inwardly projecting part 32 having sliding engagement with the body 15.

Suitable seal means or packing rings 35 and 36 seal the carriers 20 and 21, respectively, with the body 15.

The packing body 22 may, in practice, vary widely in form and construction. However, it is preferred, ordinarily, that it be a body of rubber or rubber-like material that can be operated by relative movement between the carriers 20 and 21 so as to be expanded outwardly in such manner as to engage with and form an effective seal with the interior of casing A. In the case illustrated the packing 22 is shown as involving a plurality of rings or annular bodies of rubber or rubber-like material abutting one against the other engaged snugly around the collar 25 and confined between the shoulders 28 and 31. With this construction upward movement of the carrier 30 from a position such as is shown in Fig. 3 applies pressure to the packing 22 causing it to expand outwardly. It will be apparent that the carrier 21 may be moved upwardly to a position where the packing 22 is fully expanded at which time the enlargement or head 32 on carrier 21 engages or is stopped by the lower end 39 of collar 25.

The thrust member H in its preferred form is a simple tubular part with a main portion 40 slidably carried on the body 15 and having an enlarged upper end or head 41 engaging or abutting the head 32 of carrier 21. The main portion 40 of the thrust member is of sufficient length to carry or support the cup-type packer E. It is preferred in practice that a sealing or packing ring 42 be provided to seal between the thrust member and the body part 15, as shown throughout the drawings.

The cup-type packer, in accordance with the broader aspects of the invention, is related to the compression type packer to operate it and in the particular case illustrated this actuation occurs through the thrust member H. The cup-type packer may be operatively coupled or related to the thrust member in any desired manner, it being preferred, in practice, that it be mounted on the thrust member so that it is, in effect, carried thereby.

The cup-type packer F in the form of the invention shown throughout the drawings is characterized by a sealing member 50 of the simple cup type, such member being an annular tapered body of rubber, or the like, having a small end 51 by which it is held or supported, and having a large or lip end 52 which is free and such that it may be expanded into sealing engagement with a part such as the casing A. This type of packing is familiar to those skilled in the art and it

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is to be understood that it may, if desired, be reinforced or protected by features of construction such as are commonly found in devices of this character and it is to be understood that the part 50 may be formed primarily of rubber, or rubber-like material, so that the lip portion or lip end 52 is expansible by fluid pressure and will have the desired sealing engagement with the casing A.

The cup 50, as shown in the drawings, is held by the upper and lower holders 53 and 54, respectively, the upper holder being a ring-like part carried on the portion 40 of the thrust member abutting the head 41 thereof, and it has a depending lip 55 which engages over the small end 51 of the cup confining it to the thrust member. The holder 54 is a tubular or sleeve-like part slidably engaged on the main part 40 of the thrust member and engaging the small end portion 51 of the cup to hold it tight against the holder 53. In the case illustrated a retainer 56 is threaded on the lower end portion of part 40 to hold the holders 53 and 54, and the cup 50 assembled, as shown throughout the drawings.

Where the packers E and F are arranged in series or one above the other on the body G, as above described, they are confined on the body part 15 by the coupler 16 at the upper end of the body and by the stop 17 engaged on the lower end of part 15. In the case illustrated in the drawings a stop sleeve 65 is interposed between the stop 17 and the lower end of the thrust member, the upper end 66 of sleeve 65 being spaced from the collar 27 to afford the desired clearance allowing the packers to operate in the desired manner.

It will be apparent from the foregoing description that when the tubing B is lowered into the casing A to the desired position the anchor D may be set or engaged, securing the lower end portion of the tubing in the casing so that it will not move upwardly when the structure is subjected to high pressure. Pressure introduced through the tubing B passes through the anchor and through the body carrying the packers. It will be apparent that such pressure acts upon the downwardly faced cup 50 of the packer F and causes the lip portion 52 of that packer to expand outwardly into effective sealing engagement with the inner wall of casing A. It is to be understood that ordinarily the parts are fully submerged in liquid. For instance, there is ordinarily liquid both above and below and between both packers. As pressure is applied to and taken by the cup-type packer the desired seal is established by the radial expansion of the lip 52 and such pressure causes the packer F to be moved or thrust upward, with the result that the thrust member H is moved upwardly causing operation of the compression type packer E. Upward thrusting or movement of the thrust member shifts the carrier 21 upwardly relative to the carrier 20 causing compression of the packing 22 so that it is expanded radially into tight sealing engagement with the interior of the casing A. As this operation occurs excess fluid that may be trapped or confined in the chamber X occurring between the cup 50 and the packing 22 may escape. However, when the packings are finally set the chamber X is full or loaded with fluid so that it forms a non-compressible mass or body of material between the cup 50 and the packing 22. The material confined in the chamber X

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backs up or positively reinforces the cup 50 preventing its failure. It will be apparent from consideration of the structure provided that the cup-type packer F, in effect, forms a dependable highly efficient leak-proof seal which need not, in and of itself, be so heavy or bulky as to be effective as against high pressures, but need only be so constructed as to be highly dependable in gaining the desired sealing engagement with the casing A. The compression type packing may be sturdy and heavy and such that when compressed it effectively seals with the casing A and remains effectively sealed therewith since the cup 50 checks any passage of fluid that might otherwise tend to cut out the packing 22. It is also significant to note that the cup-type packer, in effect, forms an actuator for the compression type packing, in that it is shiftable relative to the compression type packing and upon moving it operates the compression type packing causing the packing 22 to be expanded. When the desired operation has been completed the control of the anchor D may be released, disengaging the anchor from the casing and when the structure is relieved of pressure, or at least of high pressure, the packings may both be moved in or relative to the casing A. As the pressure is wholly relieved the tendency for the rubber or rubber-like packing 22 will thrust carrier 21 downwardly with the result that the parts will assume an unactuated position such as is shown in Fig. 3, it being understood that the cup 50 normally tends to assume a collapsed position such as is shown in Fig. 3.

Having described only a typical preferred form and application 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 and fall within the scope of the following claims:

Having described my invention, I claim:

1. A well packer including, a tubular body, a compression type packer on the body, and a cup-type packer on the body below the compression type packer and shiftable longitudinally on the body, the compression type packer including, an annular body of packing, two relatively movable tubular carriers slidably engaged on the body and telescopically engaged with each other and having opposed parts between which the annular body of packing is confined, means on the tubular body limiting upward movement of one of said carriers, the other carrier being shiftable axially of the tubular body and relative to the first-mentioned carrier to effect compression of the annular body of packing, the cup type packer engaging said other carrier and including a cup shaped packing element and a support slidable on the body and engaged by said element and operating said other carrier.

2. A well packer including, a tubular body, a compression type packer on the body, and a cup-type packer on the body below the compression type packer and shiftable longitudinally on the body, the compression type packer including, an annular body of packing, two relatively movable carriers slidably supported on the body and telescopically engaged with each other, the annular body of packing being engaged around one of the carriers, the carriers having opposed parts between which the annular body of packing is confined, sealing means between one of the carriers and the body, means on the body limiting upward movement of one

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of said carriers, the other carrier being shiftable axially of the body to effect compression of the annular body of packing, the cup-type packer engaging said other carrier and including a cup-shaped packing element and a support slidable on the body and engaged by said element and operating said other carrier.

3. A well packer including, a tubular body, a compression type packer on the body, and a cup-type packer on the body below the compression type packer and shiftable longitudinally on the body, the compression type packer including, an annular body of packing, two relatively movable carriers slidably engaged on the body and telescopically engaged with each other and having opposed parts between which the annular body of packing is confined, means on the body limiting upward movement of one of said carriers, the other carrier being shiftable axially of the body and relative to the carrier that is limited by said means to effect compression of the packing, the cup type packer engaging said other carrier and including a cup shaped packing element, a support slidable on the body and carrying said element and bearing upwardly against the said other carrier, and sealing means between said support and the body.

4. A well packer including, a tubular body, a compression type packer on the body, and a cup-type packer on the body below the compression type packer and shiftable longitudinally on the body, the compression type packer including, an annular body of packing, two relatively movable carriers on the body and telescopically engaged with each other, the annular body of packing being engaged around one of the carriers, the carriers having opposed parts between which the packing is confined, sealing means between one of the carriers and the body, means on the body limiting upward movement of one of said carriers, the other carrier being shiftable axially of the body to effect compression of the packing, the cup type packer engaging said other carrier and including a cup shaped packing element, a support slidable on the body and carrying said element and bearing upwardly against the said other carrier, and sealing means between said support and the body.

5. A well packer of the character described including, a downwardly opening tubular body with an enlargement at its upper end establishing a downwardly facing shoulder on the body, a compression type packer surrounding the upper end portion of the body including, a shouldered carrier abutting said shoulder on the body, an annular packing surrounding said carrier with one end engaging the shoulder thereof and a second carrier telescopically engaged with the first mentioned carrier and engaging the other end of the packing, a thrust member slidable on the body below the compression type packer and engaging the second carrier to shift it relative to the shouldered carrier to expand the packing, and a downwardly faced cup-type packer carried on the thrust member.

6. A well packer of the character described including, a downwardly opening tubular body with an enlargement at its upper end establishing a downwardly facing shoulder on the body, a compression type packer on the upper end portion of the body below said enlargement and including, a shouldered carrier surrounding the body and abutting said shoulder of the body, a packing sleeve on said shouldered carrier with one end engaging the shoulder of the carrier,

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and a second carrier telescopically engaged with the first mentioned carrier and engaging the other end of the packing and extending down therefrom, a tubular thrust member slidable on the body below the compression type packer and engaging the second carrier to shift it relative to the shouldered carrier to expand the packing, and a downwardly faced cup-type packer carried on the thrust member and including, an expansible cup and holders carrying the cup between them and supported on the exterior of the thrust member.

7. A well packer of the character described including, a downwardly opening tubular body with an enlargement at its upper end, a compression type packer on the upper end portion of the body including, a carrier abutting said enlargement and having a shoulder thereon, an annular packing on said carrier with one end engaging the shoulder of the carrier, and a second carrier telescopically engaged with the first mentioned carrier and engaging the other end of the packing, a thrust member slidable on the body below the compression type packer and engaging the second carrier to shift it relative to the shouldered carrier to expand the packing, a cup-type packer carried on the thrust member and faced away from the compression type packer, sealing means between the first mentioned carrier and the body, and sealing means between the thrust member and the body.

8. A well packer of the character described including, a downwardly opening tubular body with an enlargement at its upper end establishing a downwardly faced shoulder on the body, a compression type packer on the upper end portion of the body below said enlargement and including, a shouldered carrier surrounding the body and abutting said shoulder of the body, a packing sleeve on said shouldered carrier with one end engaging the shoulder of the carrier, and a second carrier telescopically engaged with the first mentioned carrier and engaging the other end of the packing and extending down therefrom, a tubular thrust member slidable on the body below the compression type packer and engaging the second carrier to shift it relative to the shouldered carrier to expand the packing, sealing means between the thrust member and the exterior of the body, and a downwardly faced cup-type packer carried on the thrust member and including, an expansible cup and holders carrying the cup between them and supported on the exterior of the thrust member.

9. A well packer of the character described including, a downwardly opening tubular body with an enlargement at its upper end establishing a downwardly faced shoulder on the body, a compression type packer on the upper end portion of the body below said enlargement and including, a shouldered carrier surrounding the body and abutting said shoulder of the body, a packing sleeve on said shouldered carrier with one end engaging the shoulder of the carrier, sealing means between said carrier and the exterior of the body and a second carrier telescopically engaged with the first mentioned carrier and engaging the other end of the packing and extending down therefrom, a tubular thrust member slidable on the body below the compression type packer and engaging the second carrier to shift it relative to the shouldered carrier to expand the packing, and a downwardly faced cup-type packer carried on the thrust member and including, an expansible cup and holders carry-

ing the cup between them and supported on the exterior of the thrust member.

10. A well packer of the character described including, a downwardly opening tubular body with an enlargement at its upper end establishing a downwardly faced shoulder on the body, a compression type packer on the upper end portion of the body below said enlargement and including, a shouldered carrier surrounding the body and abutting said shoulder of the body, a packing sleeve on said shouldered carrier with one end engaging the shoulder of the carrier, sealing means between said carrier and the exterior of the body, and a second carrier telescopically engaged with the first mentioned carrier and engaging the other end of the packing and extending down therefrom, a tubular thrust member slidable on the body below the compression type packer and engaging the second carrier to shift it relative to the shouldered carrier to expand the packing, sealing means between the thrust member and the exterior of the body, and a downwardly faced cup-type packer carried on the thrust member and including, an expansible cup and holders carrying the cup between them and supported on the exterior of the thrust member.

11. A well packer of the character described including, a downwardly opening tubular body with an enlargement at its upper end establishing a downwardly faced shoulder on the body, a compression type packer on the upper end portion of the body below said enlargement and including, a shouldered carrier surrounding the body and abutting said shoulder of the body, a packing sleeve on said shouldered carrier with one end engaging the shoulder of the carrier, a second carrier telescopically engaged with the first mentioned carrier and engaging the other end of the packing and extending down therefrom, and sealing means between the said second carrier and the exterior of the body, a tubular thrust member slidable on the body below the

compression type packer and engaging the second carrier to shift it relative to the shouldered carrier to expand the packing, and a downwardly faced cup-type packer carried on the thrust member and including, an expansible cup and holders carrying the cup between them and supported on the exterior of the thrust member.

12. A well packer of the character described including, a downwardly opening tubular body with an enlargement at its upper end establishing a downwardly faced shoulder on the body, a compression type packer on the upper end portion of the body below said enlargement and including, a shouldered carrier surrounding the body and abutting said shoulder of the body, a packing sleeve on said shouldered carrier with one end engaging the shoulder of the carrier, sealing means between said carrier and the exterior of the body, a second carrier telescopically engaged with the first mentioned carrier and engaging the other end of the packing and extending down therefrom, and sealing means between the said second carrier and the exterior of the body, a tubular thrust member slidable on the body below the compression type packer and engaging the second carrier to shift it relative to the shouldered carrier to expand the packing, sealing means between the thrust member and the exterior of the body, and a downwardly faced cup-type packer carried on the thrust member and including, an expansible cup and holders carrying the cup between them and supported on the exterior of the thrust member.

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