

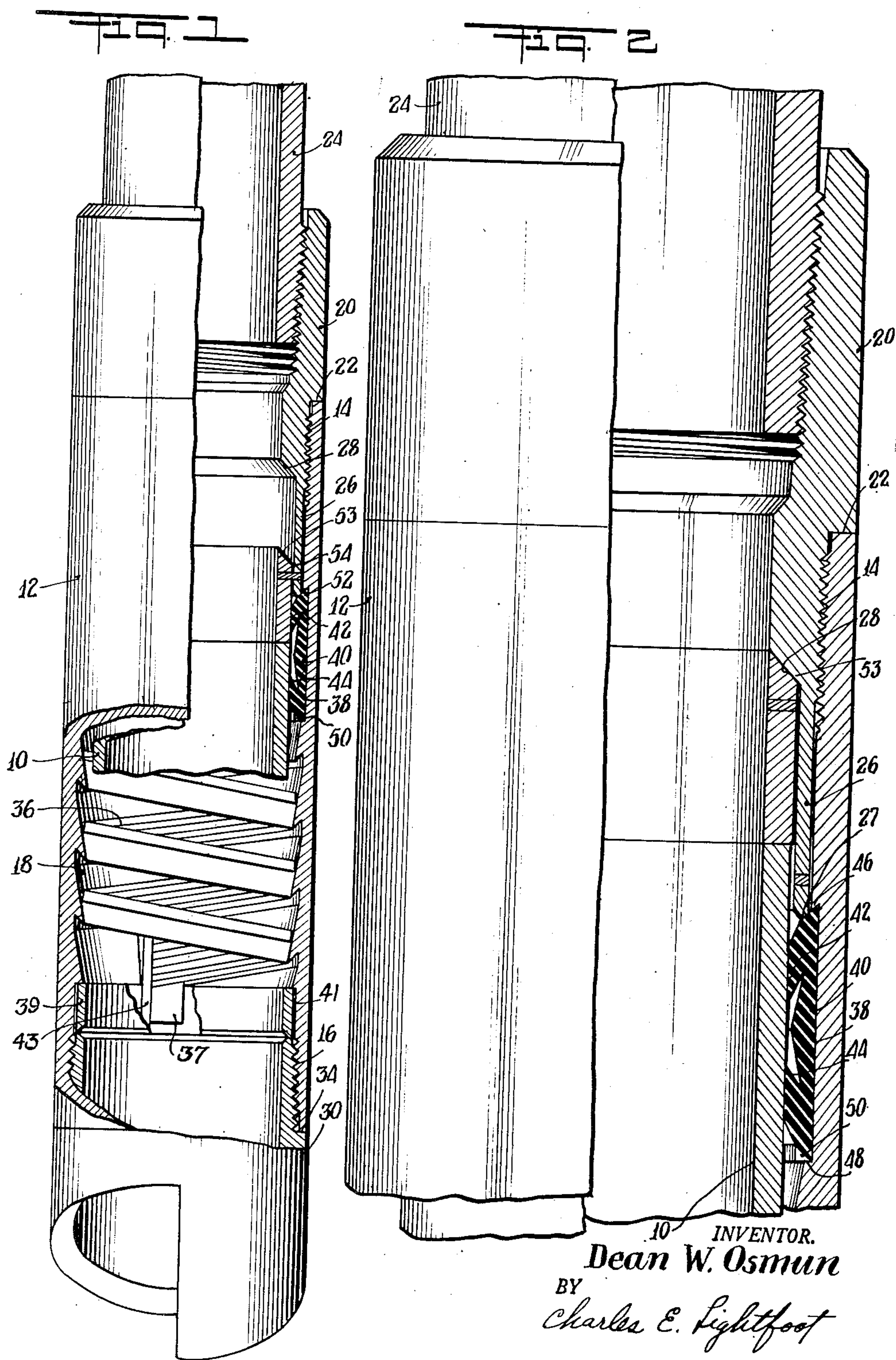
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CASING REPAIR TOOL

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CASING REPAIR TOOL

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This invention relates to a casing repair tool, and more particularly to a tool for use in effecting a repair in a string of casing or pipe in the bore of a well such as an oil well.

In the operation of wells, and especially oil wells in which a string of casing is set in the well bore, such casing is subject to damage due to such agencies as electrolysis, chemical action, shifting of the formation surrounding the casing, or caused by the operation of an operating string or other pipe inside of the casing or other causes. The casing is often damaged to the extent to cause leakage or severance of the same, making it necessary to remove the damaged portion, which must then be replaced. In accomplishing such a repair of the casing the same is customarily cut below the bad section and all of the casing above the cut is removed. It is then considered good practice to make a round trip with a short section of pipe or rotary shoe having an outside diameter the same as the outside diameter of the repair tool and whose inside diameter is just large enough to cover the casing to be repaired, such operation being for the purpose of removing any obstruction which might prevent the repair tool from passing over the end of the casing far enough to properly engage the same and affect a complete seal.

After the end portion of the casing in the well bore has been so conditioned a repair tool is inserted which fits over the end of the casing and operates to connect a new section of casing to the severed end. Heretofore, such a repair tool has usually included a floating compression sleeve with slips inside the sleeve for engaging the outside of the end of the casing in the well, these parts being so arranged that an upward pull on the new casing section results in setting the slip in the sleeve and causing the sleeve to compress a packer element into sealing engagement with the lower casing section. Such a construction, however, has proved in many instances to be of insufficient strength to properly maintain the repair connection in sealed condition, and to enable a proper tension to be maintained on the casing string.

The present invention has for an important object the provision of a casing repair tool of improved construction whereby the above mentioned disadvantages are eliminated, and wherein full advantage is taken of the existing well section to impart maximum strength in the main body of the tool.

Another object of the invention is the provision of a casing repair tool which is easily positioned over the cut end of the casing in the well bore, and which can be readily released in the event that a satisfactory seal is not obtained, or if another leak takes place and it becomes necessary to carry out another repair operation.

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A further object of the invention is to provide a casing repair tool constructed to accomplish effective sealing of the repair connection without the use of the customary compression sleeve, and which has a self-sealing packer operable to automatically seal the connection upon positioning of the repair tool over the end of the casing.

A further object of the invention is to provide a casing repair tool wherein a self-sealing packer of the lip type is employed, and which has a sliding sleeve operable upon movement of the repair tool into position over the end of the casing to protect the packing from damage by contact with the cut end of the casing.

Another object of the invention is the provision of a casing repair tool having means for indicating when the patch is in proper position over the end of the casing, and when the repair connection is complete.

A still further object of the invention is to provide a casing repair tool of the type referred to, which is of improved strength and durability, and which is capable of long withstanding the severe conditions of strain and hard usage resulting from continued operation of a well in which such a repair connection has been employed.

The annexed drawing and the following description, constituting a specification of the invention, sets forth in detail the preferred embodiment of the repair tool.

In the drawing, Figure 1 is a vertical elevational view, partly broken away, and partly in section, showing the repair tool of the invention positioned over the cut end of the casing which is being repaired; and

Figure 2 is a view similar to Figure 1, on a somewhat enlarged scale, showing the repair tool in final position at the completion of the repair operation.

Referring now to the drawing in greater detail, the numeral 10 designates the end portion of a casing string, located in the bore of a well, after a defective section of the casing has been cut off and removed, above the severed end, and to which a new section of casing or patch is to be applied. The casing repair tool has a bowl 12, which is internally threaded at its opposite ends as indicated at 14 and 16, and is provided with an internal spiral groove 18, best seen in Figure 1 of the drawing. A top connector member 20 is threaded into the upper end of the bowl, and has an external shoulder 22 which abuts against the bowl end. This upper connector member is internally threaded at its upper end to receive the lower end of the new section of tubing 24, and at its lower end is formed with an internal sleeve portion 26, provided with a lower beveled end portion 27. The beveled end 27 engages the upper margin of the packing

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element 40 to retain the same in engagement with the internal annular groove 38 of the bowl as hereinafter described. The upper connector member also has an internal shoulder 28, which tapers inwardly and upwardly, forming an annular seat for a purpose to be made apparent hereinafter.

At its lower end the bowl is attached to a guide 30 in the form of a tubular section having an internal diameter sufficient to pass over the end of the severed casing. The guide 30 is provided with an external shoulder 34 which abuts the lower end of the bowl when the guide is attached thereto.

Inside the bowl and seated on the spiral groove 18 there is a spiral grapple member 36, which is adapted to be brought into gripping engagement with the outside of the casing upon rotation of the repair tool to the right, whereby the repair tool may be securely connected to the casing. This grapple may also be released by rotation of the repair tool to the right, thus enabling the repair joint to be disconnected in the event that it is necessary to remove the same, for purposes of making additional repairs or otherwise.

The spiral grapple member is provided at its lower end with a projecting tang 37 which is received in an external groove formed in a ring 39 seated in a recess 41 in the bowl. The ring 39 has a finger 43 extending in the opposite direction to the tang 37, and both the finger and tang are received in an internal groove in the bowl.

An internal annular groove 38 is also provided in the bowl 12, for the reception of a dual-lip packing element 40, having the opposed lips 42 and 44.

The groove 38 is preferably formed with its upper margin 46 undercut and the lower margin of the groove is defined by an internal annular shoulder 48, adapted to receive and retain a retaining ring 50. Packing member 40 is of a size and configuration to closely fit the groove, the upper margin of the packing element entering the undercut marginal portion 46 of the groove, and the lower marginal portion of the packing element being retained in the groove by contact with the retaining ring 50. The retaining ring 50 may be of triangular shape in cross-sections, in order to more securely engage the packing member and retain the same in the groove, and is severed at some point in its circumference so that it may be contracted for convenient insertion into the groove.

An inner sleeve member 52 is disposed in the bowl and supported therein from the sleeve portion 26 of the upper connector member 20 by a shear pin 54, or similar frangible means. This sleeve, in the condition of the tool shown in Figure 1 extends beyond the upper lip 42 of the packing member 40, and serves to maintain the lip in a retracted position, so that the lip will not engage the severed end of the casing 10, which is thereby prevented from damaging the lip by cutting the same, or reversing or turning the lip inside out. The sleeve preferably has an outside diameter slightly greater than the outside diameter of the casing 10, so that no projection or upwardly facing shoulder is formed by the casing, which would be likely to engage and damage the lip 42 of the packing when the severed end of the casing passes the packing member. At its upper end the sleeve may be

formed with a tapered end surface 53 for seating engagement with the internal seat 20 of the bowl.

After the well casing has been severed, and the damaged portion removed from the bore, the repair tool in assembled condition, as seen in Figure 1 is attached to the new section of casing 24 and lowered into the well. The guide 30 at the lower end of the repair tool then engages the severed end of the casing 10 and guides the tool into position over the end of the casing. By continuing to lower the tool the same is moved downwardly over the casing 10 until the severed end of the casing engages the sleeve 52. Further downward movement of the tool then results in shearing the pin 54, indicating by a sudden downward movement or change in the weight of the new casing section and tool that the casing has engaged the sleeve. Immediately after the shearing of the pin 54 the sleeve 52 is moved by the casing 10 into engagement with the internal seat 28, and the connection is then completed.

In the completed condition of the connection the grapple is in gripping engagement with the tubing 10 and upward pull on the tool will result in increasing the grip of the grapple on the tubing.

In moving from the position of the tool shown in Figure 1 to that shown in Figure 2, it will be noted that the casing 10 passes the upper lip 42 of the packing member, so that the upper and lower lip of the packing are brought into sealing engagement with the outside of the casing. Thus an effective seal is accomplished between the casing and the bowl 12, so that leakage will not take place through the repair joint.

In order to release the repair joint, should this be necessary, the repair tool need only be rotated to the right resulting in releasing the grapple 36 from the casing 10, whereupon the tool may be withdrawn from the casing.

It will be apparent that the invention as described above provides a casing repair tool of simple design, having few moving parts, and which is easily assembled and applied when making repairs to a well casing. The repair tool also presents the advantage that the same is easily recovered from the well, and its parts are readily displaceable for reuse.

The invention has been disclosed in connection with a specific embodiment of the same, but it is to be understood that this is intended by way of illustration only, and numerous changes may be made in the construction and arrangement of the various parts without departing from the spirit of the invention, or the scope of the appended claims.

Having thus clearly shown and described the invention, what is claimed as new and desired to secure by Letters Patent is:

1. A casing repair tool comprising a cylindrical bowl, means connecting the bowl to an upper casing section for lowering the bowl in the bore of a well to position the bowl about a lower casing section located in said bore, said bowl having an internal annular groove, an annular packing member immovably seated in said groove in position to engage the lower casing section to form a seal between said lower section and the bowl, said connecting means having a portion engageable with the packing member to retain the packing member in the groove, an annular retainer in the bowl releasably engaging the packing mem-

ber and retaining said member in position for sealing engagement with the lower casing section, said retainer being movable by the lower casing section to release said packing member.

2. A casing repair tool comprising a cylindrical bowl having an internal annular groove, means connecting the bowl to an upper casing section for lowering the bowl in the bore of a well to position the bowl about a lower casing section in said bore, packing means in said groove engageable with the lower casing section to form a seal between said lower section and the bowl, said connecting means having a portion overlying said groove and engageable with the packing means to retain the packing means in the groove, a retainer member carried by the bowl and engaging the packing means to hold said means out of casing-engaging position, said member being engageable with the lower casing section to move said member out of engagement with the packing means to release the packing means for engagement with said lower casing section.

3. A casing repair tool comprising a bowl, means connecting one end of the bowl to an upper casing section for lowering the bowl in the bore of a well to position the bowl about a lower casing section located in said bore, guide means on the lower end of the bowl adapted to guidingly engage the lower casing section to guide the same into the bowl, grapple means in the bowl engageable with the lower casing section to releasably connect said lower section to the bowl, said bowl having an internal annular groove therein, packing means immovably seated in the groove engageable with the lower section to form a seal between said lower section and the bowl, said connecting means being engageable with said packing means to retain the packing means in the groove, and means in the bowl in engagement with the packing means and releasably retaining packing means in position for engagement with said lower section.

4. A casing repair tool comprising a cylindrical bowl, a coupling connecting the bowl to an upper casing section for lowering the bowl in the bore of a well to position the bowl about a lower casing section located in said bore, said bowl having an internal annular groove, a packing member in the groove engageable with the lower casing section to form a seal between said lower section and the bowl, said coupling having a portion overlying said groove and engageable with the packing member to retain the packing member in the groove, and an annular retainer in the bowl releasably engaging the packing member and holding the packing member in a position to be moved over said lower casing section, said retainer being movable by said lower casing section to release said packing member.

5. A casing repair tool comprising a cylindrical bowl, means connecting the bowl to an upper casing section for lowering the bowl in the bore of a well to position the bowl about a lower casing section located in said bore, grappling means in the bowl engageable with the lower casing section to releasably connect the lower casing section and bowl, said bowl having an internal annular groove, an annular packing member in the groove having a lower, upwardly directed, marginal lip and an upper, downwardly directed, marginal lip both adapted to sealingly engage the lower casing section, retainer means in the bowl in position to depress said upper lip out of the

path of the lower casing section, said retainer means being moveable by said lower casing section to a position to release said upper lip.

6. A casing repair tool comprising a bowl, coupling means connecting one end of the bowl to an upper casing section for lowering the tool in the bore of a well to position the bowl about the upper end of a lower casing section located in said bore, an internal annular groove in said bowl, packing means in said groove, means on said coupling means engaging said packing means to retain said packing means in the groove, said packing means being engageable with said lower casing section to form a seal between said lower section and said bowl, and retainer means in said bowl in engagement with said packing means and maintaining said packing means in a position to engage the exterior of the lower casing section, said retainer means being positioned for engagement with the upper end of the lower casing section to move the retainer to a position out of engagement with said packing means when said tool is moved to a position in which said packing means is below the upper end of said lower casing section.

7. A casing repair tool comprising a cylindrical bowl, a coupling connecting the bowl to an upper casing section for lowering the bowl in the bore of a well to position the bowl about a lower casing section located in said bore, said bowl having an internal annular groove, a packing member in the groove having opposed inwardly projecting upper and lower annular lips engageable with the lower casing section to form a seal between said lower section and the bowl, means on said coupling engageable with said member to retain the member in the groove, an annular retainer in the bowl, frangible means connecting the retainer to the bowl in position to depress said upper lip out of the path of the lower casing section, said retainer being moveable upon engagement with said lower casing section to break said frangible means and release said upper lip.

8. A casing repair tool comprising a cylindrical bowl, a coupling connecting the bowl to an upper casing section for lowering the bowl in the bore of a well to position the bowl about a lower casing section located in said bore, said bowl having an internal annular groove, a packing member in the groove, means on said coupling engaging said packing member to retain said member in the groove, said packing member being engageable with said lower casing section to form a seal between said lower section and said bowl, an annular retainer in the bowl and having a portion of greater external diameter than the external diameter of the lower casing section, said retainer being engageable in said packing member to hold said member out of the path of the lower casing section and being moveable upon engagement with said lower casing section to a position to release said packing member.

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