

[54] COMBINATION RELEASE MECHANISM FOR DOWNHOLE WELL APPARATUS

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[52] U.S. Cl. 166/120; 166/182; 166/124; 166/134

[58] Field of Search 166/120, 138-140, 166/237, 123, 124, 181, 182, 143; 277/34

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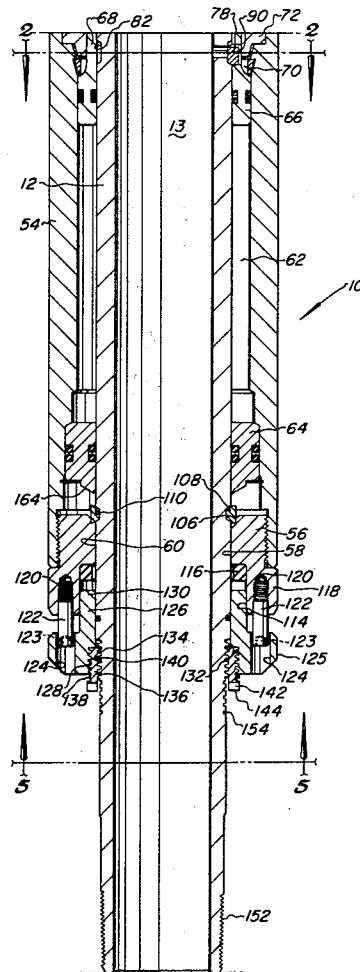
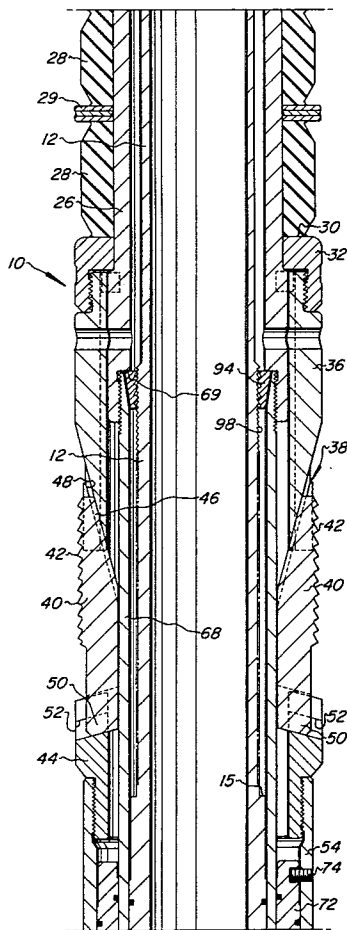
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Assistant Examiner—Hoang C. Dang
Attorney, Agent, or Firm—Norvell & Associates

[57] ABSTRACT

A well packer or other downhole tool is provided with a combination shear and rotational release mechanism comprising a release member having a set of internal threads selectively engageable with a predetermined number of external threads formed on an elongated tubular mandrel. The release member is keyed to the packer outer housing which in turn is cooperable with the slip and packing element assemblies. The mandrel may be selectively subjected to a predetermined upward pulling force to shear the threads on the release member or, alternatively, the mandrel may be rotated a predetermined number of turns to disengage the cooperating threads on the release member to effect release of the packer from its set position.

18 Claims, 7 Drawing Figures



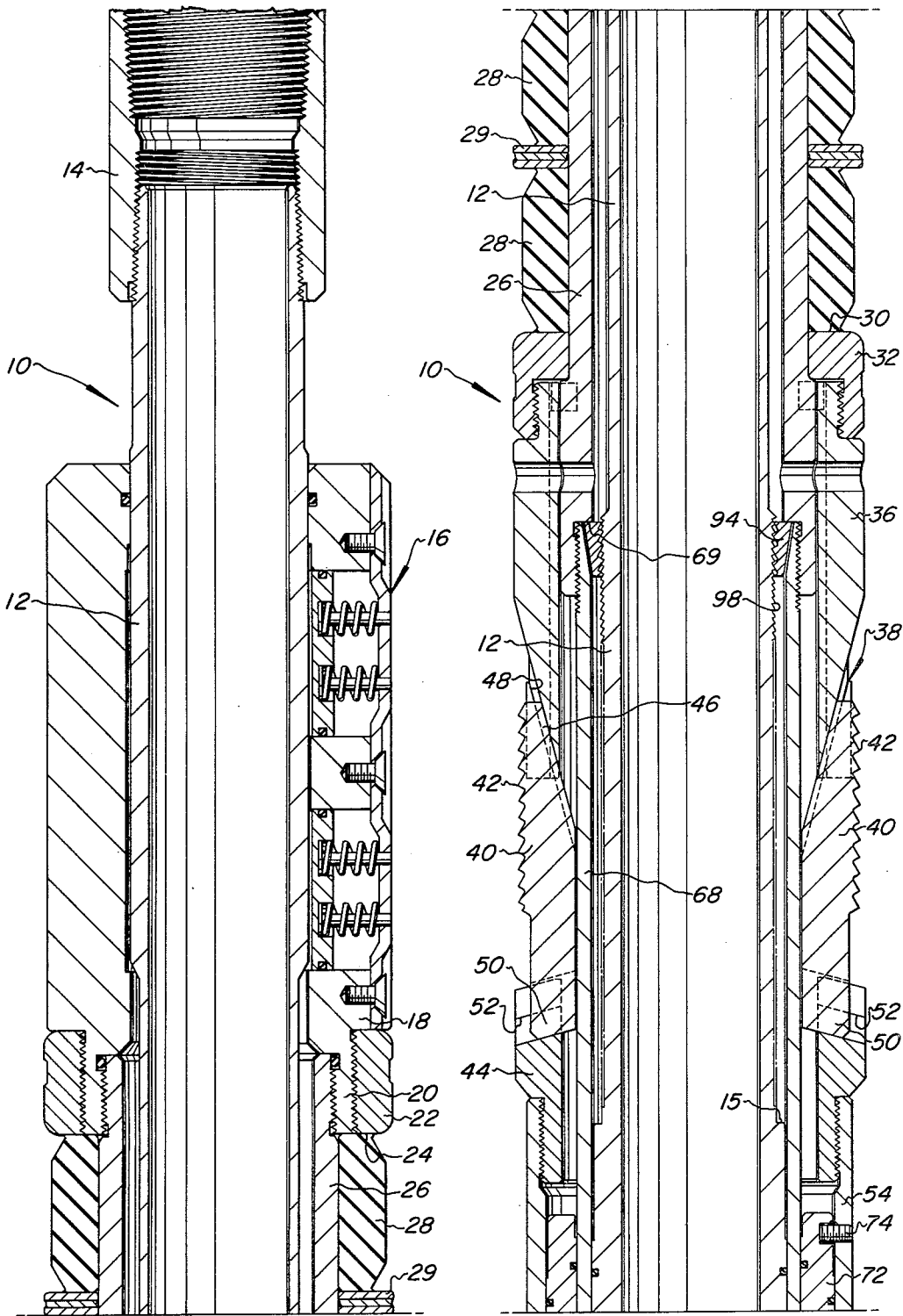


Fig. 1a

Fig. 1b

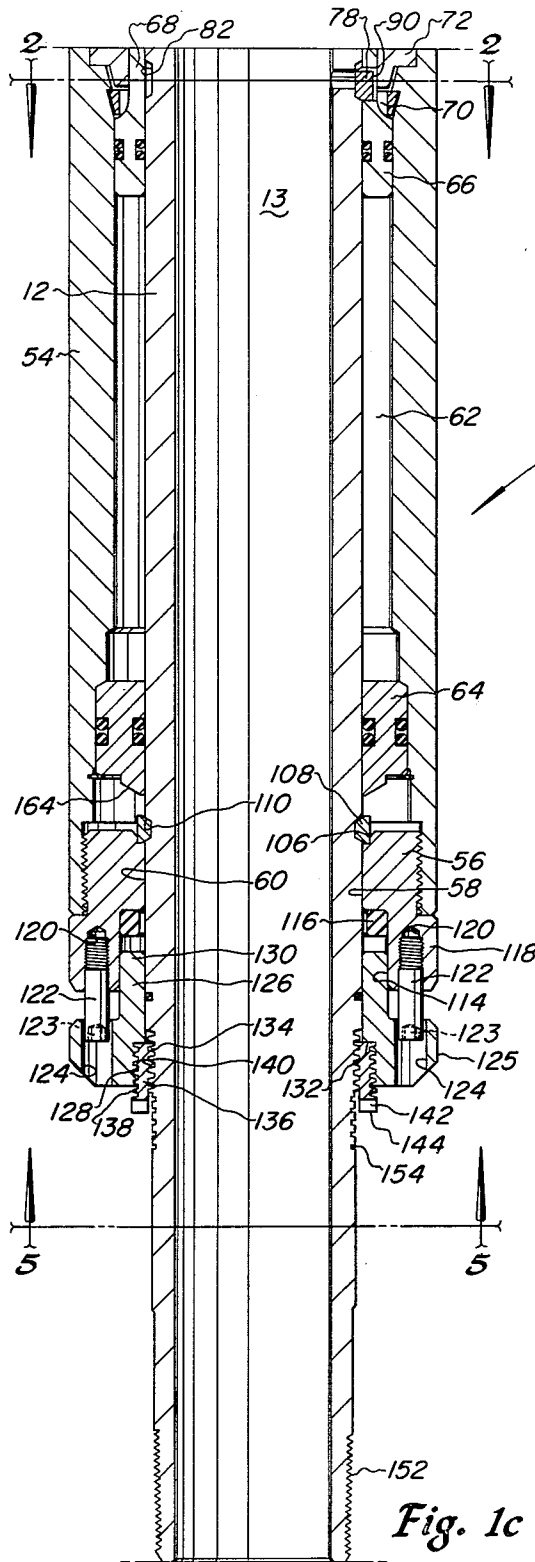


Fig. 1c

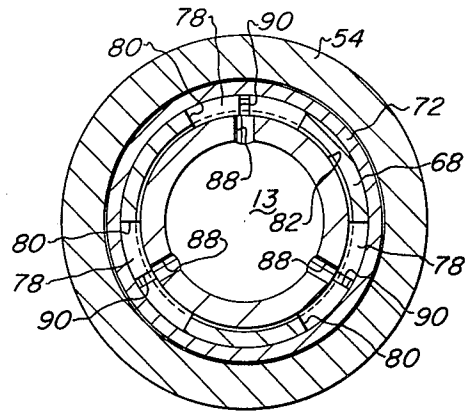


Fig. 2

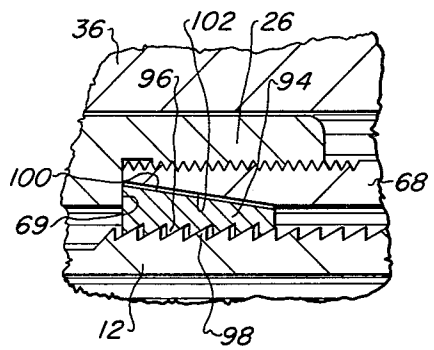


Fig. 3

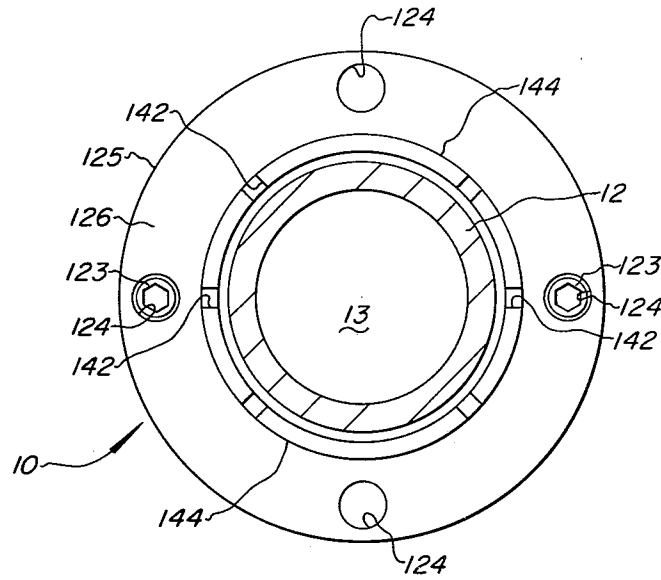


Fig. 5

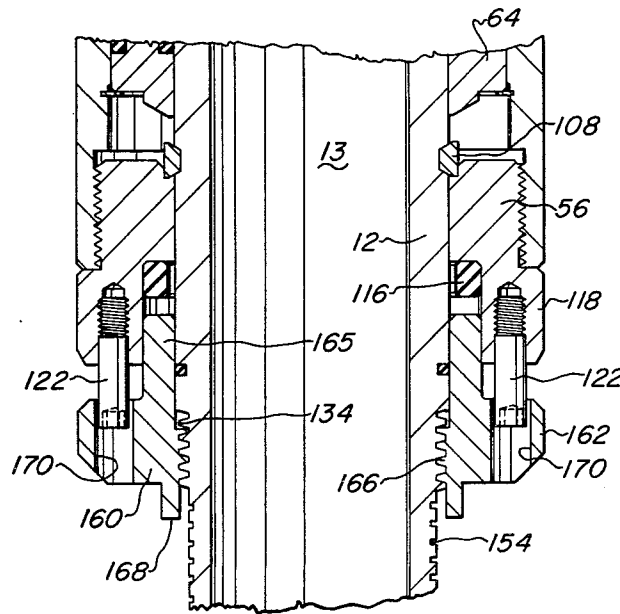


Fig. 4

COMBINATION RELEASE MECHANISM FOR DOWNHOLE WELL APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention pertains to downhole tools typically used in the development of oil and gas wells for providing an annular seal and/or anchoring means between one conduit disposed in another and, in particular, the present invention pertains to a combination shear type and rotational type release mechanism for such tools.

2. Background Art

In the art of downhole tools used in the well drilling industry of the type which provide for a seal to be established in the annulus between one conduit and another in the well bore it is preferred to design such tools to have an inner elongated tubular member, sometimes referred to as the mandrel, on which are mounted sealing and anchoring mechanisms which are operated to be set in and released from the working position by effecting relative axial movement between the mandrel and the mechanism components disposed therearound. One specific type of tool of the general type discussed herein is known as a packer. Many applications of well packers require that the packer be retrieved from the well after serving its purpose or for performing certain operations on the well. In this regard it is usually necessary to effect relative axial movement between the mandrel and the associated components in a direction opposite to that which resulted in setting of the packer. To this end a number of different release mechanisms have been developed which require specific mechanical operations to be performed from the surface or by mechanisms disposed in the tubing string to which the packer is connected. For example, packer release mechanisms are known which require the exertion of an axial force on the tubing string, or rotation of the tubing string to effect operation of the release mechanism.

It has been determined that it is highly desirable in the application of well packers and the like that the option be available to the equipment operator to effect release of the packer from the set position by more than one type of releasing action. In this regard the present invention has been developed to meet a long felt need for a combination releasing mechanism for well packers and the like which is economical to manufacture and is reliable in operation. Moreover, the combination release mechanism of the present invention provides for releasing a well packer or the like from a set position by one of two relatively simple mechanical operations which can be effected by basically fundamental and easily accomplished movements of the packer mandrel.

SUMMARY OF THE INVENTION

The present invention provides an improved combination releasing mechanism for a downhole retrievable tool such as a well packer or the like wherein the packer may be selectively released from the set or working condition by effecting axial movement of the mandrel to cause the failure of a frangible member interconnecting the mandrel and the anchoring, sealing and setting assemblies, or by effecting rotation of the mandrel with respect to these mechanisms.

In accordance with the present invention there is provided a well packer or the like having an elongated mandrel which is coupled to an outer housing, includ-

ing radially movable anchoring and sealing members, by mechanism which provides for release of the anchoring and sealing members by either effecting relative rotation between the mandrel and the outer housing components or by axially pulling the mandrel to effect failure of a frangible shear sleeve interconnecting the mandrel and the outer housing.

In one preferred embodiment of the present invention an externally threaded portion is provided on the mandrel adjacent the lower end thereof and which is adapted to be threadedly engaged with a sleeve-like member having cooperating internal threads as well as external threads which are engageable with a nut. The nut may be nonrotatably secured to the packer outer housing after being selectively positioned with the sleeve member on the mandrel. In the setting operation of the packer the sleeve member prevents relative axial movement between the mandrel and one member of the housing but, upon exertion of a predetermined axial force in excess of the forces experienced during the setting operation, the internal threads on the sleeve member are sheared to permit axial movement of the mandrel to effect release of the packer from its working position. The aforementioned abutment or nut member is also nonrotatably secured to the outer housing in a manner whereby the packer may be released from the set position by merely rotating the mandrel to disengage the cooperating internal and external threads between the shear sleeve and the mandrel.

The present invention also provides a unique combination rotation or shear type release mechanism for a well packer wherein the shear sleeve and a cooperating nut or abutment member adapted to interconnect the shear sleeve and the outer housing are provided as separate elements thereby simplifying the manufacture and selective testing of the shear sleeve material to determine the ultimate shear strength thereof. Alternatively, the shear member and the nut may be formed as a single part.

Those skilled in the art will appreciate that the improved release mechanism for a downhole tool such as a well packer or the like in accordance with the present invention adds a degree of operating flexibility for such tools which has heretofore not been enjoyed. Those skilled in the art of well packers and the like will also appreciate that the present invention provides a mechanically simple yet reliable release mechanism which may be easily adjusted in the field prior to deployment of the packer into the well. Moreover, the combination release mechanism of the present invention provides for selecting one of two optional modes for effecting release of the packer after it has been deployed in its working position. Other advantages and superior features of the mechanically simple and reliable release mechanism of the present invention will be further appreciated upon reading the detailed description which follows in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1A through 1C together comprise a vertical elevation view, in central longitudinal section, of a downhole well apparatus including the combination release mechanism of the present invention;

FIG. 2 is a transverse section view taken along the line 2—2 of FIG. 1C;

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