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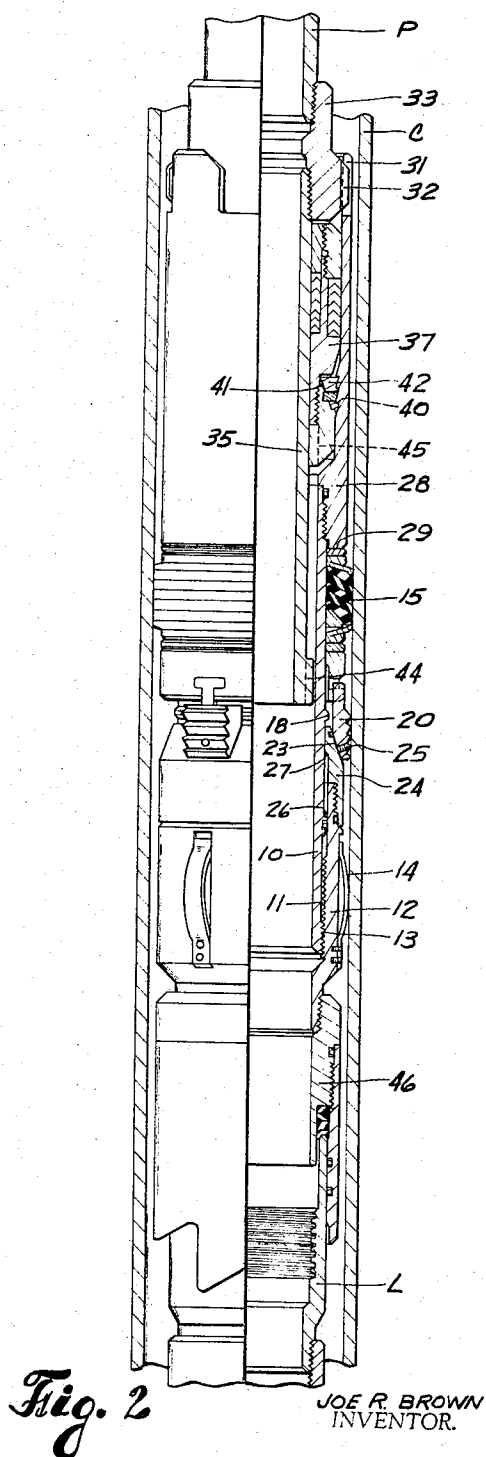
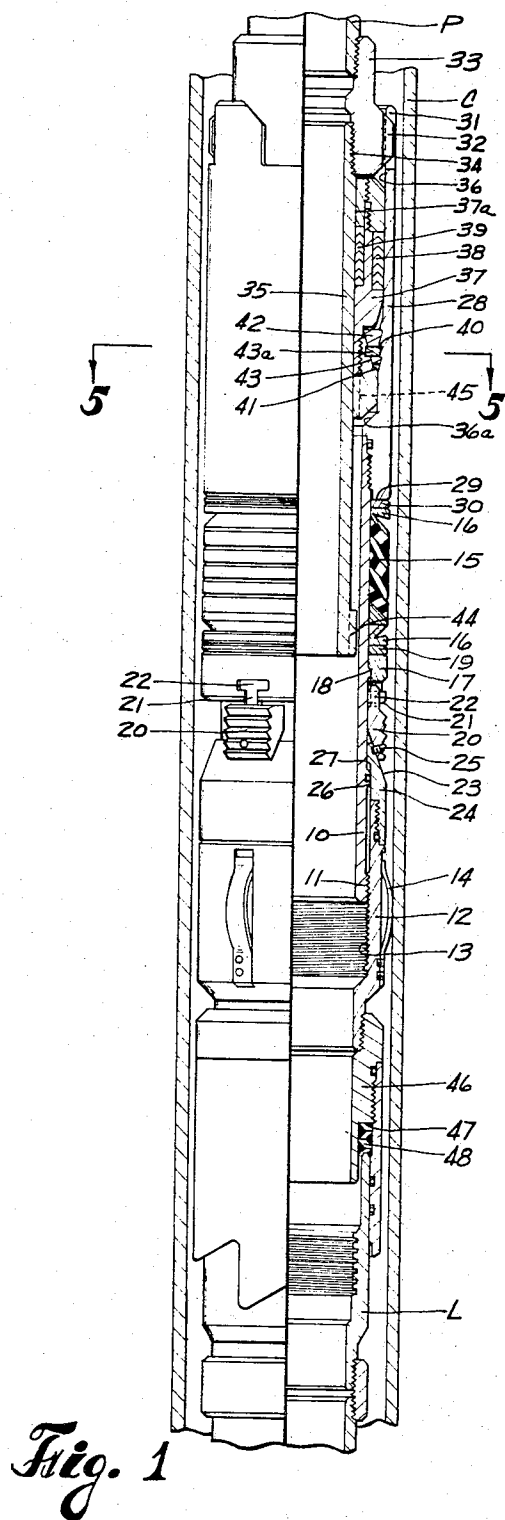
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3,342,268

WELL PACKER FOR USE WITH HIGH TEMPERATURE FLUIDS

Filed Sept. 7, 1965

2 Sheets-Sheet 1



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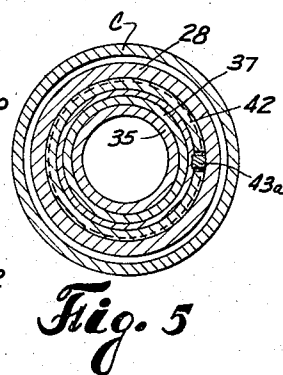
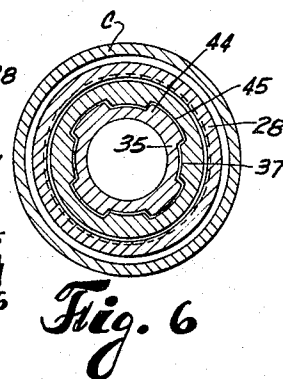
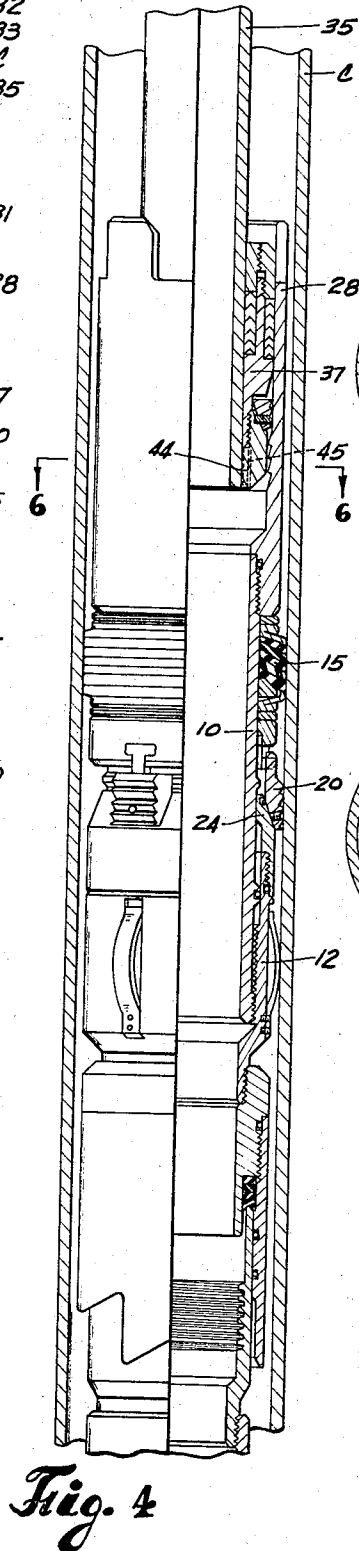
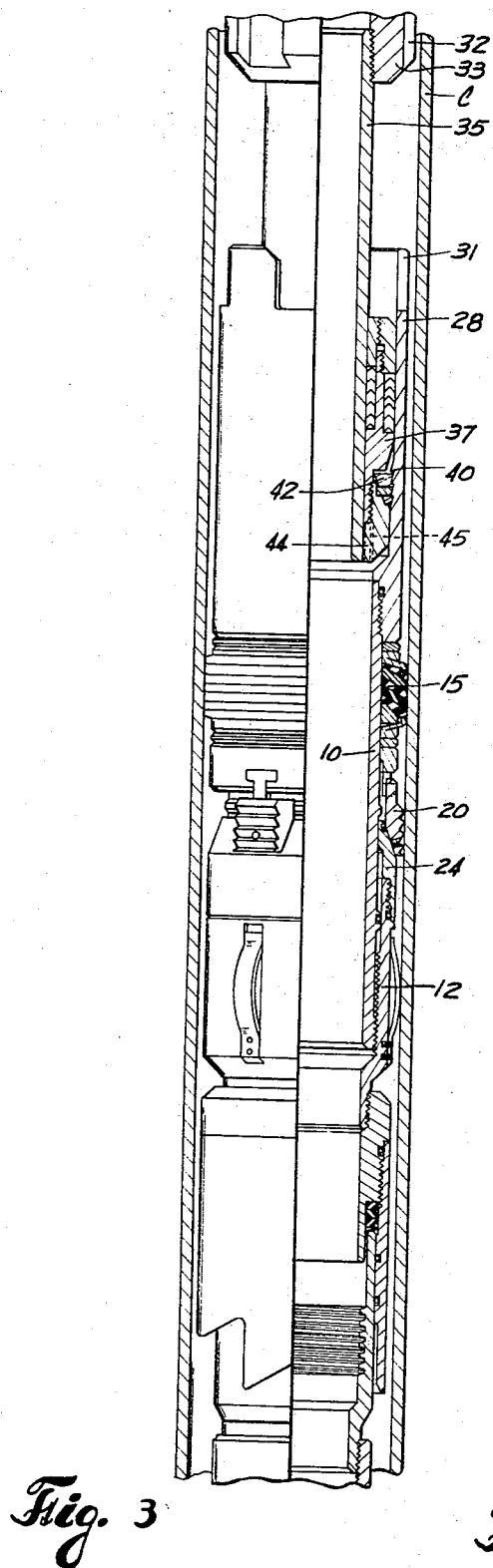
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3,342,268

WELL PACKER FOR USE WITH HIGH TEMPERATURE FLUIDS

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5 Claims. (Cl. 166-124)

This invention relates to well packers and more particularly to well packers especially adapted for use with high temperature fluids.

In certain types of oil well production operations, production of the oil is aided by injecting hot fluids, such as steam or hot gases, into the oil-containing formations to render the oil sufficiently fluid to flow readily from the formations into the well bore.

Due to the temperatures of the heating fluids, conventional production equipment, particularly the well packers are subjected to severe conditions, including thermal expansion and contraction, which adversely affect their normal functioning.

Accordingly, it is a primary object to provide an improved form of well packer adapted particularly for use in the presence of high temperature fluids.

An important object is the provision of a well packer employing a slidable connection means between the packer and the operating pipe string especially adapted to accommodate longitudinal expansion and contraction of the pipe string due to substantial changes in temperature of fluids conducted therethrough.

A more specific object is the provision of a well packer for high temperature service in which said slidable connection means includes a tubular mandrel slidably extending into the bore of the packer body and connected at its outer end to the operating pipe string and carrying on its inner end clutch elements cooperable with complementary clutch elements in the packer bore to be connected and disconnected therefrom by relative longitudinal movement of the mandrel.

A further object is the provision of slidable connection means between the packer and an operating pipe string which includes a tubular mandrel carrying two longitudinally spaced clutch elements, one of which is operable at one axial position of the mandrel to set and release the packer in response to rotation of the operating string and the other of which is operable at a second axial position of the mandrel to effect release of the operating pipe from the packer in response to rotation of the operating string without unsetting the packer.

Other and more specific objects and advantages of this invention will become more readily apparent from the following detailed description when read in conjunction with the accompanying drawing which illustrates a useful embodiment in accordance with this invention.

In the drawing:

FIG. 1 is a longitudinal, quarter-sectional view showing the packer as run into a well bore;

FIG. 2 is a view similar to FIG. 1 showing the packer in set position in the well;

FIGS. 3 and 4 are views similar to FIGS. 1 and 2, showing the packer at different stages of operation;

FIG. 5 is a cross-sectional view taken along line 5-5 of FIG. 1; and

FIG. 6 is a cross-sectional view taken along line 6-6 of FIG. 4.

Referring to the drawing, the well packer comprises a tubular body 10 externally threaded at 11 at its lower end to be received in a friction collar 12 having internal threads 13 mating with threads 11. Collar 12 carries outwardly bent springs 14 on its exterior for frictionally engaging the wall of a well bore, such as a well casing. The friction springs 14 function in the conventional manner

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to hold collar 12 stationary in the casing so as to permit relative rotation of packer body 10. An annular seal packing 15 of generally conventional flexible, resilient construction, adapted to be radially expansible by endwise compression, is mounted about the exterior of body 10 above collar 12. The ends of packing 15 are enclosed by metal end rings 16-16, the seal packing having longitudinally slidable relation to body 10. A lower abutment ring 17 surrounds body 10 at a point below packing 15 and is initially supported against relative downward movement on body 10 by engagement with an external shoulder 18 on the exterior of the packer body. A spacer ring 19 is mounted between lower end ring 16 and abutment ring 17. A plurality of pipe-gripping wedges or slips 20 are pendently secured to the lower end of abutment ring 17 by means of T-head connections 21 mounted in correspondingly shaped slots 22 in the abutment ring, so as to permit radial movement of the slips relative to body 10. The lower portions of slips 20 overlie the upwardly tapering conical surface 23 of an expander 24 slidably surrounding body 10 and threadedly secured to the upper end of collar 12. Slips 20 are initially secured in retracted relation to expander 24 by means of shear pins 25 which are breakable in response to relative longitudinal movement between the slips and the expander, as will appear subsequently. Downward movement of expander 24 relative to body 10 is limited by means of an external shoulder 26 on body 10 engageable by an internal shoulder 27 in the bore of expander 24. The upper end of body 10 is threadedly received in the lower end of a setting sleeve 28 which extends about the exterior of body 10 to define a downwardly facing annular shoulder 29 overlying upper end ring 16. An anti-friction ring 30 is disposed between shoulder 29 and upper end ring 16. The bore of setting sleeve 28 is counterbored from its upper end to provide an enlarged bore 36 terminating in an internal shoulder 36a near the lower end of the sleeve.

With the arrangement so far described, it will be seen that setting sleeve 28 and body 10 constitute a unitary structure which is rotatable relative to the packing and anchoring elements arranged exteriorly of body 10. Thus, it will be seen that when setting sleeve is rotated in the right-hand direction, collar 12 being held stationary by frictional engagement between wiper springs 14 and the wall of casing C, the downward movement of body 10 will transmit downward pressure through shoulder 29 of the setting sleeve against the packing and anchor slip assemblies, forcing the latter downwardly relative to expander 24. As a result of the thus downwardly exerted pressure, shear pins 25 will be broken causing the slips to move downwardly and outwardly on conical surface 23 into gripping engagement with the wall of casing C, as seen in FIG. 2. When the slips have thus been firmly seated in casing C, further downward movement of the seal packing will be resisted, with the result that the continued rotation of setting sleeve 28 will cause packing 15 to be axially compressed and thereby expanded into sealing engagement with the wall of casing C, also as seen in FIG. 2.

To enable rotation of setting sleeve 28, a first clutch means is provided between the operating pipe string P and the setting sleeve. This clutch means comprises a plurality of circumferentially spaced notches 31 opening to the upper end of sleeve 28 adapted to receive cooperating radially extending lugs 32 mounted on the exterior of a collar 33 threadedly secured to the lower end of operating pipe string P. The lower end of collar 33 has an internally threaded socket 34 which receives the upper end of a tubular mandrel 35 which extends slidably through the bores of setting sleeve 28 and body 10. The external diameter of mandrel 35 is made substantially less than the internal diameter of bore 36 of the setting sleeve to define

therebetween a substantial annular space in which is inserted a tubular connector sleeve 37 having a bore 37a adapted to slidably receive mandrel 35. Connector sleeve 37 is provided with internal and external packings 38 and 39, respectively, arranged to form slidable seals, respectively, with the exterior of mandrel 35 and the wall of bore 36 of setting sleeve 28. The wall of bore 36 of the setting sleeve is provided a short distance above shoulder 36a with a section of downwardly facing buttress threads 40. The exterior of connector sleeve 37 below packing 38 is provided with a downwardly and outwardly sloping wedging surface 41 about which is mounted a split wedge ring 42 carrying on its outer face threads 43 complementary to buttress threads 40. Wedge ring 42 is held against rotation on conical surface 41 by means of a pin 43a. The arrangement of the wedge ring is such that when connector sleeve 37 is inserted in the bore of setting sleeve 28 the ring will ratchet over threads 40 and will be locked thereto and may be released therefrom by relative rotation between connector sleeve 37 and setting sleeve 28. Buttress threads 40 will be left-hand threads so that right-hand rotation of connected sleeve 37 will result in the unscrewing of ring 42 from the threads. Mandrel 35, which may be of any desired length for purposes to be described more fully hereinafter, carries about its lower end a series of clutch teeth or longitudinal splines 44 receivable in corresponding spline grooves 45 provided in the bore of the lower end of connector sleeve 37. These clutch elements are so arranged that when mandrel 35 is drawn upwardly to engage splines 44 in grooves 45, right-hand rotation of the operating pipe will drive through the clutch thus formed to correspondingly rotate connector sleeve 37 relative to setting sleeve 28 to thereby effect the release of ring 42 from threads 40 and to thereby release connector sleeve 37 from the setting sleeve when desired.

The lower end of sleeve 12 carries a connector fitting 46 of any suitable design or shape adapted to effect a connection between the packer and a well liner or other well tool. The particular form of such fitting or coupling device does not form a part of this invention and may, as indicated, be of any conventional form suitable for this purpose.

In operation, the packer, mounted on operating pipe P, as illustrated in FIG. 1, will be lowered into well casing C and connected to liner L, for example, by means of the fitting 46 which, in the illustrative embodiment, is provided with an annular recess 47 at its lower end to receive the upper end of liner L and to seal therewith by means of packing 48 suitably disposed in recess 47.

As the packer assembly is thus being lowered into the well, the resistance offered by the friction between wiper springs 14 and the wall of casing C will have caused lugs 32 to be engaged in notches 31 of the setting sleeve, also as seen in FIGS. 1 and 2. When the packer has attained its position on liner L, pipe P may be rotated in the right-hand direction and this rotation will be transmitted through the engagement of lugs 32 in notches 31 to setting sleeve 28. As clutch elements 44 and 45 will be disengaged when lugs 32 are seated in notches 31, connector sleeve 37 will remain latched to the setting sleeve, and as rotation continues body 10 will be caused to move downwardly relative to collar 12, transmitting endwise compression of shoulder 29 through seal packing 15 to slips 20, breaking shear pins 25 and urging the slips outwardly over surface 23 into engagement with the wall of casing C to effect the anchoring of the packer to casing C and compression of seal packing 15, whereby to seal off the annulus between body 10 and casing C, as seen in FIG. 2.

When the packer is thus set, then in accordance with usual practice, an upward pull is taken on the operating pipe string to place the latter in tension. As shown in FIG. 3, this upward movement will sequentially disengage the upper clutch means by pulling lugs 32 out of notches 31 and engage clutch elements 44 and 45. This will be the normal relation of the pipe string to the packer

when the latter has been set and connector sleeve 37 will also be effective to maintain fluid-tight seals between the mandrel and the setting sleeve, so that fluid flow will be confined to the bore of the pipe string and packer, and thence into the liner or other tool string to which the packer may be connected in the well bore.

When used in a steam injection process or other process in which highly heated fluid will be conducted through pipe P and the interior of the packer to the liner or the well bore below the packer, the use of a connection, such as that afforded between the mandrel and connector sleeve 37, will allow elongation of the pipe string in response to thermal expansion to take place by merely causing mandrel 35 to move downwardly through the bore of the packer in accordance with the amount of elongation which may occur in the operating pipe, since the upper end of the pipe will ordinarily be fixedly secured at the surface. The longitudinally releasable connection thus provided between the mandrel and the connector sleeve will permit this elongation to occur without causing the operating pipe to bend or kink, which would be the condition if a fixed connection, as is conventional, were provided between the lower end of the pipe string and the packer. With the pipe string in tension, as is the normal condition, the heating of the pipe will first tend to relieve the tension. Thereafter, further elongation, due to increases in temperature, will be accommodated by the downward movement of the free end of mandrel 35 into the bore of the packer, without unsettling the packer.

When it becomes necessary to replace packings 38 and 39, which is frequently required in the high-temperature operations in which these packers are employed, it is only necessary to pull up the operating string to engage lower clutch elements 44 and 45. This movement will, of course, withdraw lugs 32 from notches 31, whereupon right-hand rotation of the pipe string will cause release of wedge ring 42 from threads 40, as best seen in FIG. 4, and permit connector sleeve 37 to be withdrawn from the bore of setting sleeve 28. When the seal packing has been replaced, the mandrel carrying the connector sleeve will be slidably re-inserted into the bore 36 of the setting sleeve and wedge ring 42 will ratchet over and re-engage threads 40, restoring the sealed connection between the operating pipe and the packer. This operation can be conducted without unsettling the packer.

When release of the packer itself is required, the operating pipe will be lowered sufficiently to re-engage lugs 32 and notches 31, thereby disconnecting clutch elements 44 and 45. Thereupon rotation in the left-hand direction will retract body 10 relative to collar 12 and expander 24, thereby retracting the setting sleeve relative to seal packing 15, allowing the latter to contract and, at the same time, retracting slips 20 out of engagement with the wall of casing C, thereby freeing the packer for withdrawal from the well.

From the foregoing, it will be seen that mandrel 35 may be considered as carrying a pair of longitudinally spaced clutch elements, one of which is operable at one axial position of the mandrel relative to the packer to set and release the packer by rotation of the mandrel, and the other of which is operable by movement to a second axial position of the mandrel relative to the packer to connect an operating pipe to the packer and when so connected, to enable release of the operating string from the packer by right-hand rotation of the operating string. It will also be noted that the longitudinal spacing between the clutch elements on the mandrel is greater than that between the cooperating clutch elements on the setting sleeve and the connector sleeve. Thus, only one of the two clutches may be engaged at any axial position of the mandrel. Also, clutching engagement between the mandrel and the setting sleeve is effected by downward movement of the mandrel relative to the setting sleeve while clutching engagement between the mandrel and connec-

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tor sleeve is effected by upward movement of the mandrel relative to connector and setting sleeves.

It will be understood that various changes and modifications may be made in the details of the illustrative embodiment within the scope of the appended claims but without departing from the spirit of this invention.

What I claim and desire to secure by Letters Patent is:

1. In a well packer of the type including a tubular body carrying a radially expansible anchor-and-seal assembly and a tubular setting sleeve operable by rotation relative to said body for expanding and retracting said anchor-and-seal assembly, means for releasably connecting an operating pipe string to said setting sleeve, comprising, a connector sleeve having an axial bore slidably receivable in the bore of said setting sleeve, cooperating anchor means disposed between the connector sleeve and setting sleeve engageable in response to relative longitudinal movement of said connector sleeve and releasable by relative right-hand rotation thereof, a tubular mandrel connectible to an operating pipe string and slidably extendable through the bore of said connector sleeve, first and second longitudinally spaced clutch elements carried by said mandrel, said clutch elements being respectively engageable with longitudinally spaced first and second complementary clutch elements on said setting sleeve and on said connector sleeve by opposite relative longitudinal movements of said mandrel, the spacing between the clutch elements on said mandrel being greater than that between the clutch elements on said sleeves, whereby only one set of said clutch elements will be engaged at any axial position of said mandrel.

2. In a well packer according to claim 1, internal and external annular seal packings carried by said connector sleeve for sealing respectively with said mandrel and said setting sleeve.

3. In a well packer according to claim 1, wherein said anchor means comprises downwardly facing buttress threads in the bore of said setting sleeve, and a split wedge ring carried about the exterior of said connector sleeve, said wedge ring carrying external threads complementary to said buttress threads.

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4. In a well packer according to claim 1, wherein the clutch elements on said mandrel comprise angularly spaced radially extending lugs, and said complementary clutch elements on said connector and setting sleeves comprise circumferentially spaced notches opening to the opposite ends of the respective sleeves.

5. A well packer, comprising, a tubular body, collar means threadedly connected to the body carrying means frictionally engageable with a well wall to permit relative rotation of said body, an anchor-and-seal assembly mounted about the body for radial expansion and contraction in response to said relative rotation, a setting sleeve secured to said body for rotating the same, a connector sleeve concentrically disposed in the bore of said setting sleeve and having an axial bore, cooperating anchor means carried by the connector and setting sleeves arranged to anchor said connector sleeve to said setting sleeve in response to axial movement of the connector sleeve relative to said setting sleeve and releasable therefrom by right-hand rotation of the connector sleeve relative to the setting sleeve, a tubular mandrel connectible to an operating pipe string for rotation thereby and extending slidably through the bore of said connector sleeve, and first and second longitudinally spaced clutch elements being engageable with said setting sleeve at one axial position of said mandrel and the other of said clutch elements being engageable with said connector sleeve at a second axial position of said mandrel.

References Cited

UNITED STATES PATENTS

2,221,204	11/1940	Santiago	166—124
2,228,503	1/1941	Boyd et al.	166—208
2,877,850	3/1959	Burns	166—124
3,158,201	11/1964	Springer	166—208
3,171,491	3/1965	States	166—124
3,223,170	12/1965	Mott	166—153

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JAMES A. LEPPINK, *Examiner.*

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,342,268

September 19, 1967

Joe R. Brown

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 6, line 25, after "elements" insert -- carried by said mandrel, one of said clutch elements --.

Signed and sealed this 15th day of October 1968.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

EDWARD J. BRENNER

Commissioner of Patents