April 30, 1968 A. D. TIMMONS 3,380,528

METHOD AND APPARATUS OF REMOVING WELL PIPE FROM A WELL BORE

Filed Sept. 24, 1965 3 Sheets-Sheet 1

Fig. 1

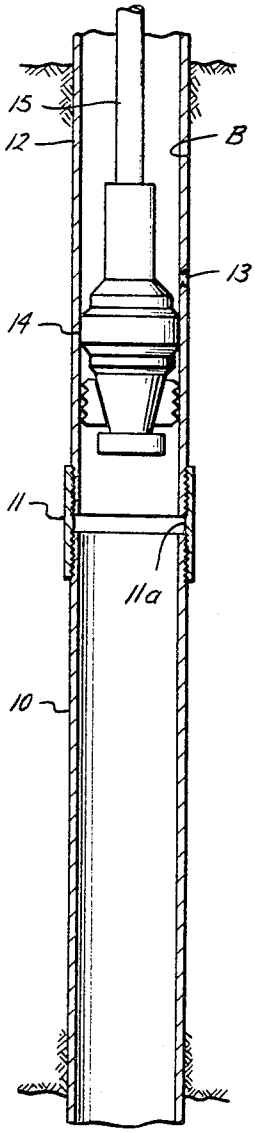


Fig. 2

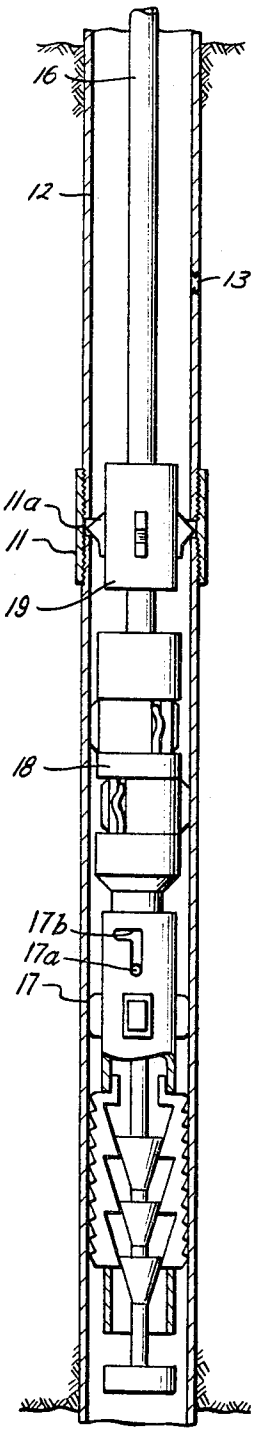


Fig. 3

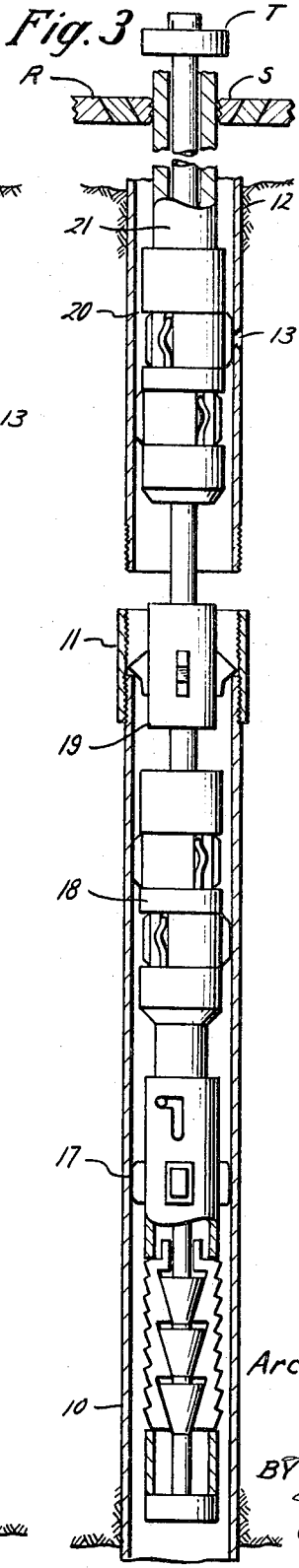
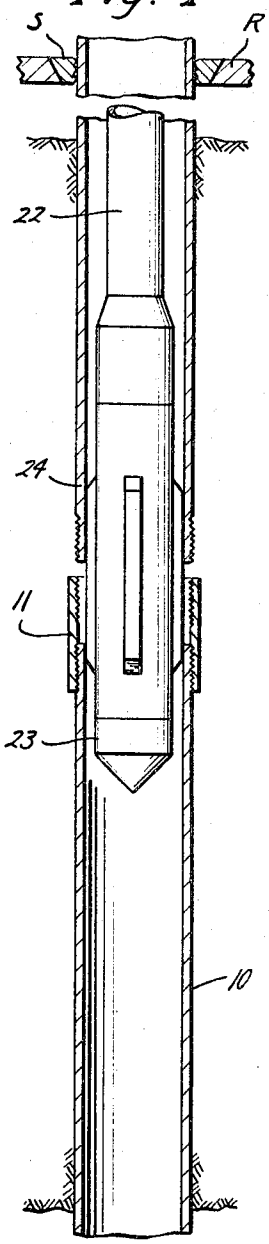


Fig. 4



Archie D. Timmons
INVENTOR.

BY J. Vincent Martin
Joe E. Edwards
Jack L. Spriggs
ATTORNEYS

April 30, 1968 A. D. TIMMONS 3,380,528

METHOD AND APPARATUS OF REMOVING WELL PIPE FROM A WELL BORE

Filed Sept. 24, 1965 3 Sheets-Sheet 2

Fig. 5

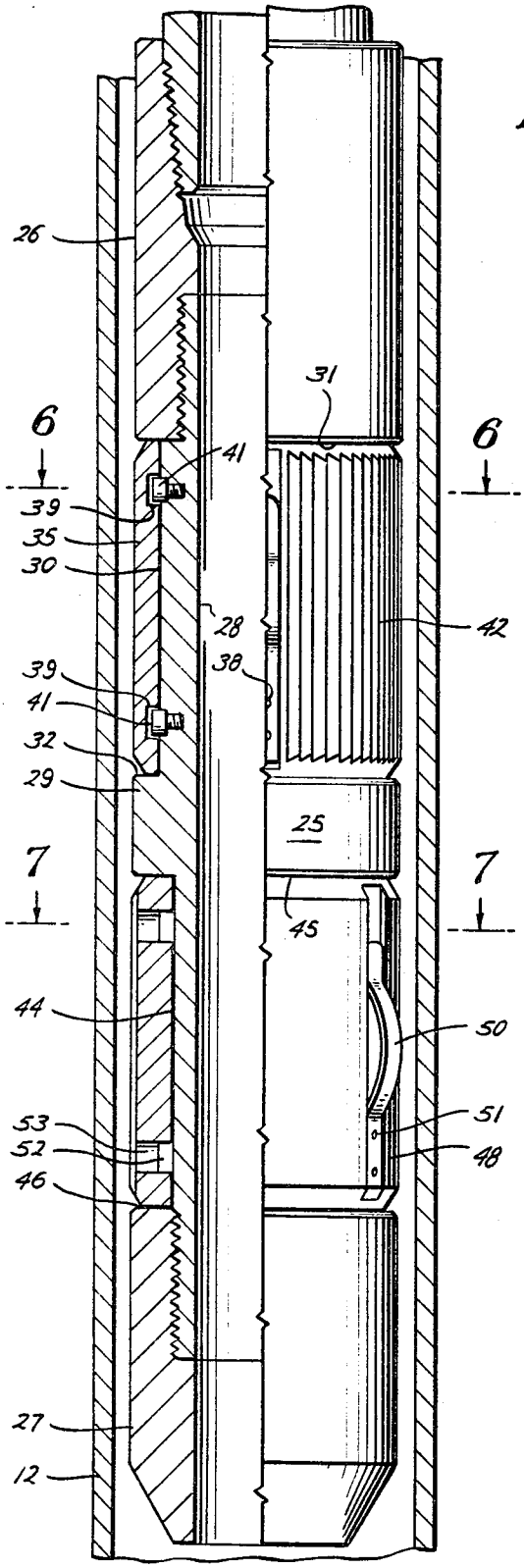
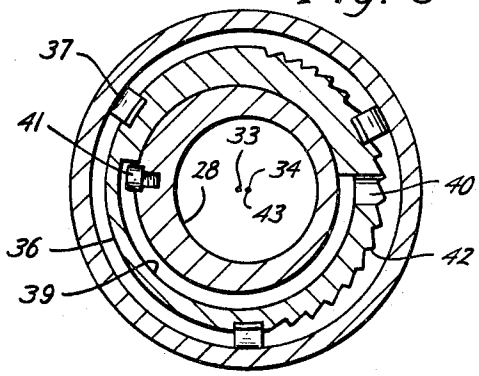


Fig. 6



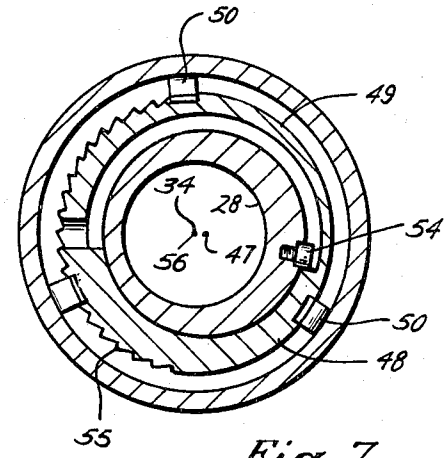


Fig. 7

Archie D. Timmons
INVENTOR.

BY J. Vincent Martin
Joe E. Edwards
Jack R. Springgett
ATTORNEYS

April 30, 1968 A. D. TIMMONS 3,380,528

METHOD AND APPARATUS OF REMOVING WELL PIPE FROM A WELL BORE

Filed Sept. 24, 1965 3 Sheets-Sheet 3

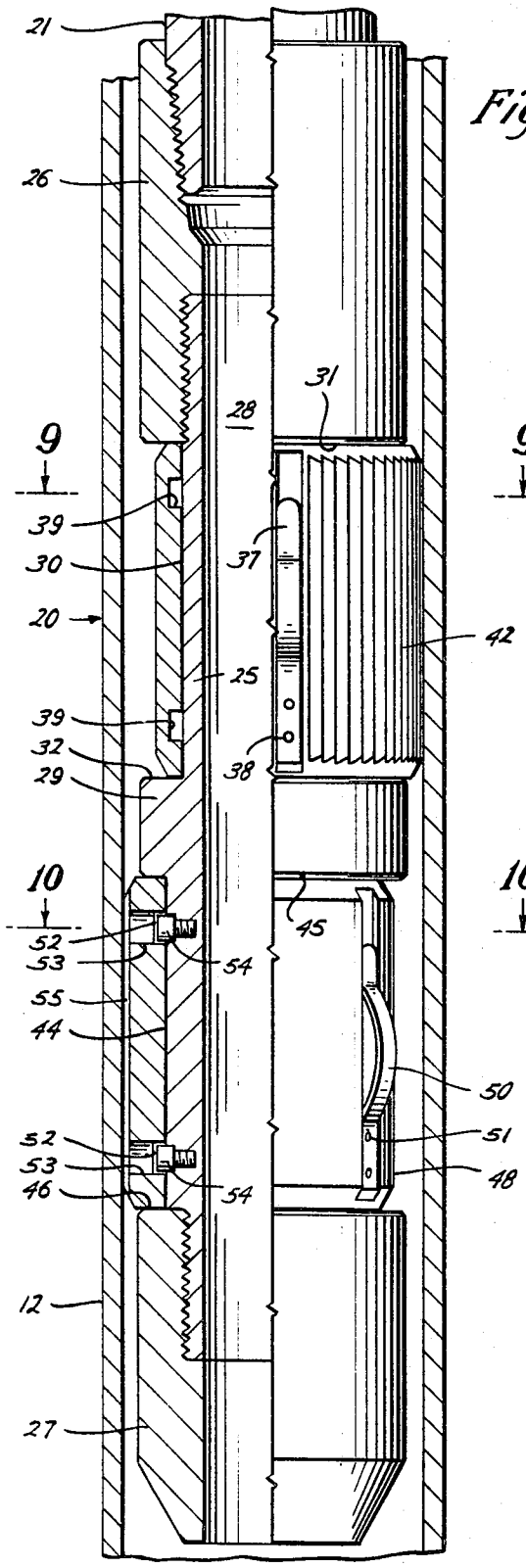


Fig. 8

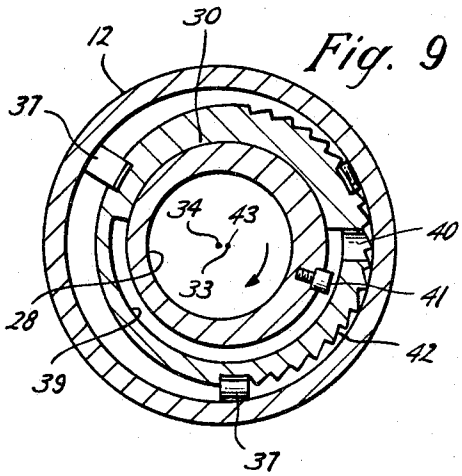


Fig. 9

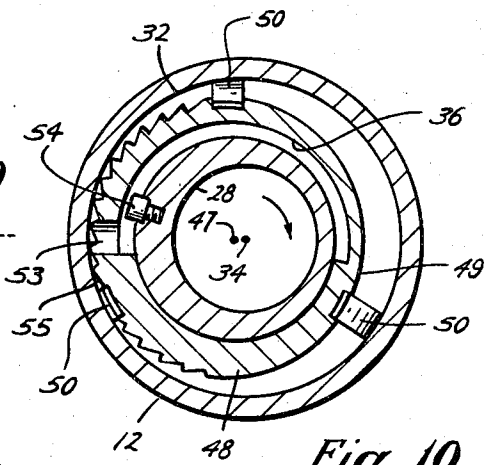


Fig. 10

Archie D. Timmons
INVENTOR.

BY J. Vincent Martin
Jac E. Edwards
Jack R. Scruggs
ATTORNEYS

United States Patent Office 3,380,528
Patented Apr. 30, 1968

3,380,528

METHOD AND APPARATUS OF REMOVING WELL PIPE FROM A WELL BORE

Archie Durwood Timmons, Morgan City, La., assignor to Tri-State Oil Tool Industries, Inc., Bossier City, La., a corporation of Delaware

Filed Sept. 24, 1965, Ser. No. 489,975
14 Claims. (Cl. 166—14)

ABSTRACT OF THE DISCLOSURE

The method of removing a section of casing from a well bore and a gripping tool. The method includes the steps of positioning a first gripping tool supported on a first string in a well bore below the casing joint to be unthreaded, lowering a second gripping tool on a second string downwardly over the first string and positioning the second tool above the joint to be unthreaded, rotating the tubing strings in opposite directions to cause the tools to engage the casing and transmit torque thereto whereby the joint is unthreaded and the string above the joint may be removed after removal of the tools and their respective strings. The gripping tool includes a mandrel having cam surfaces spaced longitudinally apart on its exterior and gripping members mounted on the mandrel with each such member engaging one of the cam surfaces. This abstract is neither intended to define the invention of the application which, of course, is measured by the claims, nor is it intended to be limiting as to the scope of the invention in any way.

The present invention relates generally to an improved method of and means for repairing a well pipe or casing section in a well bore. Such repair is accomplished by removing a defective section of casing or well pipe from the well bore and replacing the casing section in the well bore. Specifically the present invention contemplates the removal of the defective section by running two gripping tools into the well bore supported on separate strings, engaging the tools to the casing above and below a joint and unthreading the joint by torque transmitted from the strings through the tools to the casing. Also, the gripping tool includes a cam means so that rotation of the string supporting the tool in one direction sets the tool and transmits torque while rotation in the opposite direction releases the tool.

An object of the present invention is to repair a well pipe or casing string having a defective section within a well bore by unthreading the string at a joint below the defective section using tools extending to the surface of the well bore to affect such unthreading, removing the disconnected sections and replacing nondefective sections in the well bore.

Another object of the present invention is to provide a method of unthreading a joint of well pipe or casing in a well bore with two gripping tools extending to and controlled from the surface of the well bore.

A further object of the present invention is to provide an improved well tool adapted to grip a well pipe within a well bore and apply a torque to such well pipe when supported on a tubing string by manipulation of the tubing string at the surface of the well bore.

Another object is to provide an improved method of and means for replacing a defective section of casing in a well bore by unthreading a casing joint below the defective section of casing without unthreading any other joint of the casing, removing the disconnected casing sections and replacing the casing sections in the well bore with nondefective sections.

Another object is to manipulate well tools at the surface of a well bore to disconnect, by unthreading sections

of casing within a well bore, and to remove the disconnected sections of casing from the well bore.

Still a further object is to remove a portion of a casing string from a well bore without having to cut the casing or make a separate determination of which joint is unthreading by providing a positive unthreading of the casing at a preselected joint which, in the case of removal of a defective casing section, will be a joint below the defective casing section.

These and other objects of the present invention are hereinafter more fully explained and set forth in relation to the accompanying drawings wherein:

FIGURE 1 is a view partly in elevation and partly in section of a portion of a well bore and illustrates a preliminary step of the method of the present invention.

FIGURE 2 is another view similar to FIGURE 1 and illustrates a stage in the use of the method of the present invention.

FIGURE 3 is another view similar to FIGURES 1 and 2 and illustrates a further stage in the use of the method of the present invention and also the operation of the apparatus of the present invention.

FIGURE 4 is a similar view and illustrates the last stage in the repair method of the present method.

FIGURE 5 is a view partly in section of an improved well tool illustrated in position as it is run into a well bore.

FIGURE 6 is a sectional view of the well tool taken along line **6—6** in FIGURE 5.

FIGURE 7 is a sectional view of the well tool taken along line **7—7** in FIGURE 5.

FIGURE 8 is a view partly in section of the tool illustrated in FIGURE 5 after it has been actuated into gripping engagement with the well pipe in which it is positioned.

FIGURE 9 is a sectional view of the tool taken along line **9—9** in FIGURE 8.

FIGURE 10 is a sectional view of the tool taken along line **10—10** in FIGURE 8.

The method of the present invention is directed to the repair of a casing string in a well bore B. The casing string is composed of a plurality of sections which are threadedly connected at joints by couplings. As shown in FIGURES 1, 2 and 3 the portion of the casing string in the well bore B includes the section **10** joined by the coupling **11** to the defective section **12**. The defect in the section **12** is illustrated as the perforation **13** which extends completely through the wall of the section.

The casing string is repaired by the method of the present invention by lowering gripping tools into the well bore and manipulating the tools to engage the casing above and below a coupling, such as coupling **11**, and thereafter imparting opposite torques to the tools to cause the upper engaged section to be unthreaded from the coupling and to allow its removal from the well bore. A new section of casing will then be lowered in the well bore and connected to the upper end of the casing string which remains in the well bore. In this manner the casing string is repaired and the well tools of the present invention are supported and manipulated at the surface of the well bore to perform the unthreading of the joint within the well bore.

A preliminary step in the repair of a casing string having a defect is to locate the defect as by any well-known pressure testing method. In the illustrated example, a well packer **14** is lowered on a tubing string **15** within the casing string and is set at intervals with the casing being pressured each time the packer is set. When the casing holds pressure, it is known that the well packer **14** is above the defect **13**, and when the casing pressure drops, it is known that the well packer **14** is below the defect **13**.

With the defect **13** located, the joint at the lower end of the defective casing section is located by any suitable

means. This is accomplished in the illustrations by lowering an inner tubing string **16** into the well bore in supporting relation to a support device **17**, a gripping tool **18** and a joint locator **19**. When the joint **11** has been located, the joint locator **19** will be in engagement with the recess **11***a* between the casing sections **10** and **12** at the coupling **11**. Support device **17** is illustrated to be a usual spear which has been connected in an inverted position to the tubing string **16** below the tool **18**. The pin **17***a* is connected to the internal portion of the device **17** and extends into J-slot **17***b*. The device **17** is in released position in FIGURE 3 for running into the well bore. It is set by a slight left-hand rotation of the tubing string **16** and allowing the tubing weight to be placed in the device **17**. Downward movement of the internal mandrel of the device **17** will set the device **17** into gripping engagement with the walls of casing section **10** as shown in FIGURE 2.

The support device **17** is then set to support the tool **18**, the locator **19** and the inner tubing string **16** at the position in the well bore B as shown in FIGURE 2. When supported by device **17**, the surface support of tubing string **16** can be released to allow the upper gripping tool **20** supported by the tubing string **21** to be threaded onto the upper end of the tubing string **16**. The tool **20** is lowered on tubing string **21** into position within the defective casing **12** as shown in FIGURE 3. The upper end of outer tubing string **21** is supported and engaged by the rotary table R. The upper end of the inner tubing string **16** extends above the rotary table R and is engaged by the usual tongs T. In this manner the gripping tools can be set and impose a torque on the casing sections by relative manipulation of the upper ends of the tubing strings **16** and **21** by the rotary table R and the tongs T. The rotary table R is provided with suitable insert slips S or other device to engage and support the tubing string **21**.

Gripping tools **18** and **20** are of substantially similar design except for two features: gripping tool **18** is designed to move into gripping engagement and exert a torque against the casing section in which it is engaged solely responsive to right-hand rotation and to release responsive to left-hand rotation, while gripping tool **20** is designed to move into gripping engagement and exert a torque against the casing section in which it is engaged solely responsive to left-hand rotation and to release responsive to right-hand rotation; further, gripping tool **20** is provided with a central bore which is sufficiently large to thread over and be run downwardly in surrounding relation to the inner tubing string **16**.

With the tools positioned as illustrated in FIGURE 3, the inner tubing string **16** is rotated to the right by the tongs T. This rotation will move the gripping tool **18** into gripping engagement with the interior of casing section **10**. Once the gripping tool **18** has moved to set position, the torque imposed on the tubing string **16** by the tongs T will be transmitted to the casing section **10**. Also, the outer tubing string **21** is rotated to the left by the rotary table R to move the gripping tool **20** into gripping engagement with the interior of casing section **12**. Once the gripping tool **20** is set, additional torque imposed on the outer tubing string **21** by the rotary table R will be transmitted to the casing section **12**. Since this torque is in the left-hand direction and with the section **10** being held in the right-hand direction, the threaded connection between coupling **11** and section **12** will be unthreaded. It is assumed, for purposes of this illustration, that the threaded connections of the couplings of the casing string will be the usual right-hand threads; but, if left-hand threads are used, then the tools **18** and **20** and device **17** will have to be reversed to set and release responsive to movements in the opposite directions.

When the section **12** has been disconnected by unthreading from coupling **11**, the support device **17** will again be set by left-hand rotation which will release tool **18**. With tubing string **16** supported by device **17**, the tubing string **21** and the tool **20** are removed from the well bore B after tool **20** has been unset by right-hand rotation of outer tubing string **21**. Thereafter, support device **17** will be released and tubing string **16** will be pulled from the well bore.

When the inner tubing string and the tools which it supports are out of the well bore B, the disconnected portion of the casing string is pulled to the surface. The defective section **12** will be removed and replaced, and sections of casing will be run or lowered into the well bore B until the lower end of the lowest section is immediately above the coupling **11**. In this position, the casing is suspended by suitable means at the surface, such as the rotary table R and slips S. The tubing string **22** with alignment tool **23** on its lower end is run into the well bore within the new casing sections. When the tool **23** is positioned as shown in FIGURE 4, partly within the upper end of casing section **10** and partly within the lower end of the new casing section **24**, then the new casing sections are lowered and rotated until completely threaded into the coupling **11**. The casing string repair is completed by pulling alignment tool **23** and the tubing string **22** from the well bore.

The details of structure of gripping tool **20** are shown in the FIGURES 5, 6 and 7 in its unset position as it would be run into the well bore and in FIGURES 8, 9 and 10 in set position in gripping engagement with the interior of the casing section **12**. The gripping tool **20** includes a mandrel **25** which is secured to the lower end of outer tubing string **21** by the upper sub **26**. Lower sub **27** is secured to the lower end of mandrel **25**. Since the tool **20** is to be threaded over and run in surrounding relation to the inner tubing string **16**, the central bore **28** through mandrel **25** must be larger than the largest outside diameter of the tubing string **16** to allow a relative free movement of the tool **20** with respect to the tubing string **16**.

The flange **29** extends outwardly from the mandrel **25** approximately half way between upper and lower subs **26** and **27**. An annular groove is defined by the outer surface **30** of mandrel **25** extending from the downwardly facing shoulder **31** of the upper sub **26** to the upwardly facing shoulder **32** on the flange **29**. The outer surface **30** of mandrel **25** between the shoulders **31** and **32** is a cam surface and may be of any suitable shape to perform its function. As shown, it is circular with its center **33** offset to one side of the center of axis **34** of the mandrel **25**. In this way the surface **30** at one side of the mandrel **25** will be farther from the axis **34** than at the other side of the mandrel **25**.

The gripping member or sleeve **35** is positioned in the groove defined between shoulders **31** and **32** and has its inner surface in engagement with the cam surface **30**. The outer surface **36** on the member **35** is eccentric to the inner surface of the member **35**. As shown in FIGURE 6, the center **34** will be the center of the inner surface of member **35**, and center **33** will be the center of the outer surface **36** of the member **35** when unset. Because of the eccentricity of the outer surface **36** with respect to the inner surface of the member **35**, the member **35** is thicker on one side than the other. As shown in FIGURES 5 and 6, when unset, the member **35** is positioned relative to the cam surface **30** so that it does not extend radially outward beyond the flange **29** or the upper sub **26**.

The member **35** includes the drag springs **37** which are suitably secured to the member **35** as by screws **38**. The interior of the member **35** is provided with two grooves **39** which extend slightly more than halfway around its interior and are in communication through the ports **40** with the exterior of the member **35**. The ports **40** are used to install the pins **41** into threaded engagement with the mandrel **25**, the heads of the pins **41** being positioned within the grooves **39**. The portion of the exterior of member **35** which is farthest offset from the center of the

inner surface of the member 35 is provided with gripping teeth 42.

Referring to FIGURES 8 and 9, it can be seen that in comparison to FIGURES 5 and 6 the mandrel 25 has been rotated almost 180 degrees with respect to the gripping member 35. This relative rotation is possible since the drag springs 37 will engage against the interior of the casing section 12 to hold the member 35 while the mandrel 25 is being rotated. Such rotation moves the outer cam surface 30 of the mandrel 25 to cam the member 35 outwardly into gripping engagement with the interior of casing section 12. This relative rotation actuates the camming by displacing the center of the outer surface of member 35 from alignment with axis 34 to the displaced position indicated by the number 43. This moves the teeth 42 into gripping engagement with the casing section 12.

In the form of the gripping tool illustrated in FIGURES 5 through 10, the mandrel 25 is provided with two cam surfaces and two gripping members. The second cam surface 44 is postioned between the shoulder 45 on flange 29 and the shoulder 46 on lower sub 27. As seen in FIGURE 6 the cam surface 44 is circular having a center 47 displaced from the center or axis 34 of mandrel 25 in the opposite direction from the displacement of the center 33 of surface 30.

The gripping member or sleeve 48 is positioned to have its inner surface engaged with surface 44 and is identical with gripping member 35 except that it is reversed in position. The outer surface 49 of the gripping member 48 is illustrated to be circular and has its center coincident with the axis 34 of the mandrel 25 when positioned as shown in FIGURES 5 and 7. The grippinfi member includes drag springs 50 secured by screws 51 to the member 48. Two grooves 52 extend partially around the interior of member 48, and ports 53 provide communication to the exterior of the member 48 from the grooves 52. The ports 53 are used to install the pins 54 so that they will engage the mandrel 25 and be partially positioned in grooves 52.

Gripping member 48 is moved to gripping position to have the teeth 55 on the offset portion of its exterior surface engage the interior of casing section 12 by a relative movement of the mandrel 25. This movement is a left-hand rotation of the mandrel 25 with respect to the gripping member 48. Such rotation will move the outer cam surface 44 of the mandrel 25 to cam the member 48 outwardly into gripping engagement with the interior of casing section 12. This relative rotation actuates the camming by displacing the center of the outer surface 49 of the member 48 from alignment with axis 34 to the displaced position indicated at 56. From FIGURES 7 and 10 it can be seen that the relative rotation moving the lower member 48 to set or gripping position requires a rotation of the mandrel of slightly less than a half turn.

Thus, the gripping members 35 and 48 are both moved to set or gripping engagement by a left-hand rotation of the mandrel 25. Because of the opposite positioning of the cam surfaces 30 and 44, the gripping member 35 will be displaced radially outward in one direction, and gripping member 48 will be displaced radially outward in the opposite direction. This opposite movement of the two members provides an improved gripping engagement since each member will provide a reaction force holding the other member in gripping engagement.

Release of the tool 20 is accomplished by a right-hand rotation of the mandrel which will retract the gripping members 35 and 48 radially inward until they are positioned as shown in FIGURES 5, 6 and 7. In this position the head of the pins 41 and 54 will engage the ends of the grooves 39 and 52, respectively, to prevent any further relative rotation of the mandrel and the gripping members.

The gripping tool 18 is substantially identical with the gripping tool 20 which has been described and illustrated except that it will have its gripping members and camming surfaces in opposite relationship so that it will set and transmit torques from a right-hand rotation and will release upon a left-hand rotation of the tubing string 16. The internal bore through the tool 18, since it does not thread over an inner tubing string, will not have to be as large as the bore through the gripping tool 20. Also, since the support member 17 is to be connected below the gripping tool 18, it is desirable to have some form of connection available on the lower portion of the mandrel or lower sub of the tool 18. This is easily accomplished by providing internal threads for the lower sub and allowing the support member 17 to be threaded directly into the lower sub.

The operation of the gripping tools 18 and 20 is therefore relatively simple. They are positioned within a casing or well pipe string at the desired position with tool 20 above the joint to be disconnected and tool 18 below the joint to be disconnected. Tool 20 is set by a left-hand rotation of the outer tubing string 21 supporting the tool 20. Tool 18 is set by a right-hand rotation of the inner tubing string 16. When the tools are set, when their members have moved into gripping engagement with the casing section, further left-hand rotation of outer tubing string 21 will unthread the joint, the casing section below the joint being securely held by engagement and the application of a torque by the gripping tool 18 and inner tubing string 16. These torques are transmitted from the surface to the gripping tools and allow the disconnections to be made by manipulation of the inner and outer tubing strings 16 and 21 at the surface of the well bore.

Thus, defective casing may be readily repaired by the method and means of the present invention. Once the defective section is located, the tools 18 and 20 will be run into the casing to position the lower tool 18 in a section below the defective section and the tool 20 in the defective section. Opposite torques applied to the inner and outer tubing strings 16 and 21 at the surface will disconnect the defective casing section from the remainder of the casing string below. Repairs are completed by removal of the tools and the defective casing from the well bore, and by running new non-defective casing sections into the well bore and by threading the new casing into the casing which remains in the well bore, all of the steps of the method are performed by simple manipulations at the surface of the well bore.

It is contemplated that, even though the gripping tools 18 and 20 described each have an upper and a lower gripping member, a gripping tool could be constructed having only a single gripping member which could be cammed into gripping engagement with the interior of a casing section. This could be done simply if the amount of radial movement of the gripping member was sufficient to cause the mandrel to move in the opposite direction into engagement with the casing to provide support and reaction force to assure adequate gripping engagement of the interior of the casing section by the gripping member. Any other suitable means of assuring such adequate gripping engagement utilizing single or multiple gripping members in a gripping tool is herein contemplated.

What is claimed is:

1. The method of removing a defective casing section of a well casing located in a well bore, which casing includes a plurality of well pipe sections coupled together by threaded coupling joints, comprising the steps of

running into the well bore a first tubing string having a support device, a first gripping tool and a joint locator supported thereby,

locating the joint at the lower end of the defective casing section and positioning said first gripping tool in the casing section below said defective casing section,

setting the support device to support said first tubing string, said first gripping tool and said joint locator within said well bore,

lowering a second gripping tool on a second tubing string in surrounding relation to said first tubing string and positioning said second gripping tool within said defective casing section,

rotating said first tubing string to set said first gripping tool and maintaining a torque on said first tubing string to prevent rotation of the casing sections below said located joint,

rotating said second tubing string to set said second gripping tool within said defective casing and to rotate said casing above the located joint to unthread the defective casing section therefrom,

releasing said second gripping tool and removing said second tubing string from said well bore while said first tubing string remains supported by said support device,

releasing said support device and removing said first tubing string from said well bore, and

removing the disconnected casing section from said well bore.

2. The method of repairing a defective casing section of a well casing located in a well bore, which casing includes a plurality of well pipe sections coupled together by threaded coupling joints, comprising the steps of

running into the well bore a first tubing string having a support device, a first gripping tool and a coupling locator supported thereby,

locating the coupling at the lower end of the defective casing section and positioning said first gripping tool in the casing section below said defective casing section,

setting the support device to support said first tubing string, said first gripping tool and said coupling locator within said well bore,

lowering a second gripping tool on a second tubing string in surrounding relation to said first tubing string and positioning said second gripping tool within said defective casing section,

rotating said first tubing string to set said first gripping tool and maintaining a torque on said first tubing string to prevent rotation of the casing sections below said located coupling,

rotating said second tubing string to set said second gripping tool within said defective casing and to rotate said casing above the located coupling joint to unthread the defective casing section therefrom,

releasing said second gripping tool and removing said second tubing string from said well bore while said first tubing string remains supported by said support device,

releasing said support device and removing said first tubing string from said well bore,

removing the disconnected casing sections from said well bore,

running replacement casing sections in said well bore and supporting said replacement casing sections in position with the lower end thereof slightly above the disconnected coupling joint,

running an alignment tool through said replacement casing sections and into the upper end of the casing sections remaining in said well bore and setting said alignment tool partly within the upper portion of the remaining casing sections and partly within the lower portion of said replacement casing sections,

lowering and rotating said replacement casing sections into threaded engagement with said coupling joint while guiding said replacement casing sections with said alignment tool, and

removing said alignment tool from said well bore.

3. A gripping tool adapted to be used in a well bore to engage the interior of a well pipe or casing within said well bore comprising,

a mandrel,

said mandrel having a pair of sleeve-receiving grooves on its exterior,

a pair of sleeves, each positioned within one of said sleeve-receiving grooves surrounding said mandrel,

the centers of said sleeve-receiving grooves of said mandrel being offset in opposite directions from the axis of said mandrel,

the center of each of the exterior surface of said sleeves being offset from the center of the interior surface of its respective sleeve,

the exterior of each of said sleeves being provided with a pipe-engaging surface, and

cam means allowing partial rotation of said mandrel relative to said sleeves to offset the center of the outer surface of each of said sleeves from the axis of said mandrel to thereby move the pipe-engaging surface of each of said sleeves into gripping engagement with the interior of the casing and providing engagement between said mandrel and said sleeves for transmitting additional torque applied to said mandrel to said sleeves after sleeves are in gripping gripping position.

4. A tool according to claim 3 including,

friction means secured to each of said sleeves adapted to engage the interior surface of a well pipe to hold said sleeves against rotation during setting and unsetting rotation of said mandrel.

5. The method of removing a section of casing from a well bore comprising,

engaging the casing section below the casing section to be removed within the well bore with a first gripping tool supported at the surface of the well bore,

threading a second tool and its support over the support for said first tool whereby said supports may readily be rotated in either direction from the surface without interfering with the rotation of the other support,

engaging the casing section to be removed within the well bore with said second gripping tool supported at the surface of the well bore,

disconnecting the joint between said casing section to be removed and the next lower casing section by manipulating said tools at the surface of said well bore to cause the joint to unthread,

releasing and removing said tools from the well bore, and

removing the disconnected section of the casing from the well bore.

6. An apparatus for unthreading a coupling joint between sections of casing or well pipe within a well bore comprising,

a lower gripping tool supported by a first tubing string and adapted to be set into gripping engagement within the casing section below the coupling joint to be unthreaded, said lower gripping tool including an eccentric sleeve mounted on a mandrel and movable thereabout for a portion of a revolution, and

an upper gripping tool supported by a second tubing string in surrounding relation to said first tubing string and adapted to be set into gripping engagement within the casing section above the coupling joint to be unthreaded, said upper gripping tool including an eccentric sleeve mounted on a mandrel and movable thereabout for a portion of a revolution,

said upper gripping tool having coacting means on its mandrel and sleeve responsive to rotation of the mandrel in a direction with respect to its sleeve which will unthread the upper casing section from the coupling joint for first moving its sleeve into gripping engagement with said casing and thereafter exerting a torque on said casing, and responsive

to relative rotation in the opposite direction for moving its sleeve out of gripping engagement with said casing,

said lower gripping tool having coacting means on its mandrel and sleeve responsive to rotation of the mandrel in a direction with respect to its sleeve opposite said direction of setting rotation of said upper gripping tool for first moving its sleeve into gripping engagement with said casing and thereafter exerting a torque on said casing to hold the casing section immediately below said coupling joint while said upper gripping tool is unthreading the casing section above said coupling joint and responsive to rotation in the opposite direction for moving its sleeve out of gripping engagement with said casing.

7. An apparatus for unthreading a coupling joint between sections of casing or well pipe within a well bore comprising,

a lower gripping tool supported by a first tubing string and adapted to be set into gripping engagement within the casing section below the coupling joint to be unthreaded, said lower gripping tool including a pair of first sleeves eccentrically mounted for limited relative rotational movement on a first mandrel,

an upper gripping tool supported by a second tubing string in surrounding relation to said first tubing string and adapted to be set into gripping engagement within the casing section above the coupling joint to be unthreaded, said upper gripping tool including a pair of second sleeves eccentrically mounted for limited relative rotational movement on a second mandrel,

said upper gripping tool having coacting means in its mandrel and sleeves responsive to rotation of the second mandrel in a direction with respect to its sleeves which will unthread the upper casing section from the coupling joint for first moving its sleeves into gripping engagement with said casing and thereafter exerting a torque on said casing and responsive to relative motion in the opposite direction for moving its sleeves out of gripping engagement with said casing,

said lower gripping tool having coacting means on its mandrel and sleeve responsive to rotation of the first mandrel in a direction with respect to its sleeves opposite said direction of setting rotation of said upper gripping tool for first moving its sleeves into gripping engagement with said casing and thereafter exerting a torque on said casing to hold the casing section immediately below said coupling joint while said upper gripping tool is unthreading the casing section from said coupling joint and responsive to rotation in the opposite direction for moving its sleeves out of gripping engagment with said casing.

8. An apparatus according to claim 7 including,

friction springs secured to and extending outwardly from said first and said second sleeves to engage within the casing sections to hold said sleeves against rotation during setting rotation of said first said second mandrels.

9. The method of removing a section of casing from a well bore, comprising

running into the well bore a first tubing string having an anchor and a first gripping tool supported thereby,

setting said anchor within the casing section below the casing joint to be disconnected to support said first tubing string,

lowering a second gripping tool on a second tubing string in surrounding relation to said first tubing string and positioning said second gripping tool in the casing section above said joint,

rotating said first tubing string to set said first gripping tool in said casing string,

rotating said second tubing string while holding said first tubing against rotation to set said second gripping tool in the casing section above said joint and to disconnect said casing at said joint,

removing said second tubing string from said well bore while said first tubing string remains supported in said well bore by said support device,

removing said first tubing string from said well bore, and

removing the disconnected casing section from said well bore.

10. In combination with a first gripping tool adapted to be lowered into a well bore on a tubing string, the subcombination of a second gripping tool comprising,

a mandrel having an internal bore of sufficient diameter to allow said mandrel to be lowered into the well bore in surrounding relation to the tubing string supporting said first gripping tool,

a cam surface on the exterior of said mandrel, a gripping member mounted on said mandrel, said member having an interior cam surface coacting with said cam surface on the exterior of said mandrel and an exterior surface eccentric relative to said interior cam surface whereby rotation of said mandrel in one direction shifts the member into retracted position with its exterior surface substantially concentric to the mandrel axis and rotation in the opposite direction shifts said member into a gripping position in which the outer surface of said member is eccentric with respect to the mandrel axis.

11. In combination with a first gripping tool adapted to be lowered into a well bore on a tubing string, the subcombination of a second gripping tool comprising,

a mandrel having an internal bore of sufficient diameter to allow said mandrel to be lowered into the well bore in surrounding relation to the tubing string supporting said first gripping tool,

a first cam surface on the exterior of said mandrel,

a first gripping member mounted on said mandrel,

a second cam surface on the exterior of said mandrel and spaced longitudinally from said first cam surface,

a second gripping member mounted on said mandrel,

each of said gripping members having an interior cam surface coacting with one of said cam surfaces on the exterior of said mandrel and an exterior surface eccentric relative to said interior cam surface whereby rotation of said mandrel in one direction shifts the gripping members into retracted position with their exterior surfaces substantially concentric to the mandrel axis and rotation in the opposite direction shifts said members into a gripping position in which the outer surface of said members is eccentric with respect to the mandrel axis, and

means connecting to said mandrel and adapted to engage said gripping members when said mandrel is rotated in said one direction and said gripping members are fully retracted for preventing further relative rotation of said mandrel in said one direction with respect to said gripping members.

12. The subcombination of a second gripping tool according to claim 11 wherein

said second cam surface is opposite to said first cam surface whereby on rotation of said mandrel to move said members into gripping position said first member will move radially outward in one direction and said second member will move radially outward in the opposite position so that each member provides a reaction force supporting the gripping engagement of the other member.

13. A gripping tool comprising,

a mandrel,

a pair of eccentric gripping sleeves mounted on said mandrel,

said gripping sleeves each including a gripping surface adapted to engage the interior surface of a tubular member,

an internal groove in each of said gripping sleeves extending around a portion of the interior of said gripping sleeves,

pins connected to said mandrel and positioned within said mandrel each of said pins extending into and being movable within one of said internal grooves and engageable with the shoulders formed at each end of said internal grooves,

said sleeves being eccentrically mounted on said mandrel,

cam means responsive to rotation of said mandrel in one direction with respect to said gripping sleeves for moving said gripping sleeves from released position to set or pipe-gripping position, responsive to further rotation of said mandrel in said one direction for transmitting torque from said mandrel to a pipe gripped by said sleeves, and responsive to rotation of said mandrel in the opposite direction with respect to said gripping sleeves for moving said gripping sleeves from set position to released position.

14. A tool according to claim **13** wherein

said mandrel includes a central bore of sufficient size to be lowered into a well bore in surrounding relation to a tubing string supporting an opposite gripping tool.

References Cited

UNITED STATES PATENTS

1,345,491	7/1920	Humason	166—216 X
1,392,650	10/1921	McMillian	294—86.25
1,687,808	10/1928	Thomas et al.	294—86.25
1,734,439	11/1929	Livergood	81—72
1,795,575	3/1931	Rasmussen	81—72
1,825,025	9/1931	Thomas et al.	294—86.25 X
2,739,654	3/1956	Kinley et al.	81—72 X
2,848,050	8/1958	Wooley	166—117.7 X
2,947,520	8/1960	Tappmeyer	166—117.7
3,087,546	4/1963	Wooley	166—98 X
3,149,676	9/1964	Ensminger.	

CHARLES E. O'CONNELL, *Primary Examiner.*

I. A. CALVERT, *Assistant Examiner.*