Aug. 19, 1958 B. J. WOOLLEY 2,848,050

REMOVING CASING AND THE LIKE FROM A WELL BORE

Filed March 25, 1955 2 Sheets-Sheet 1

Fig. 1

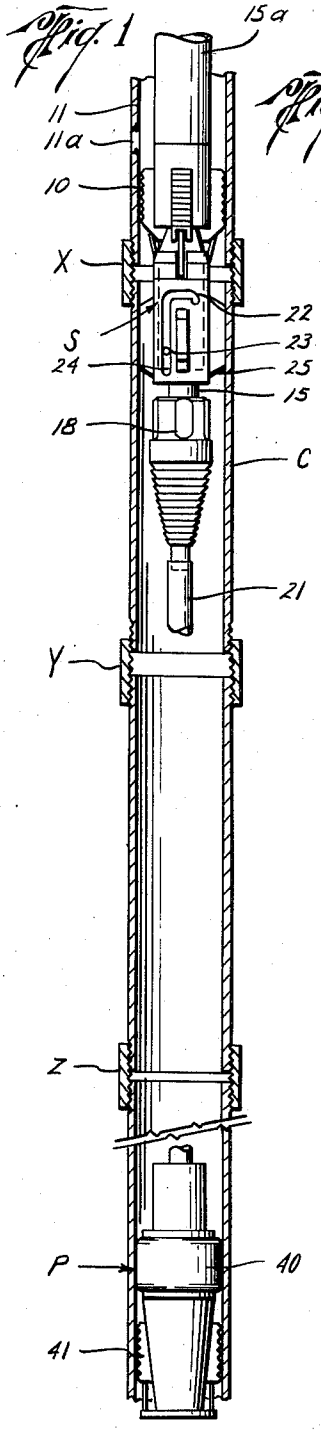


Fig. 2

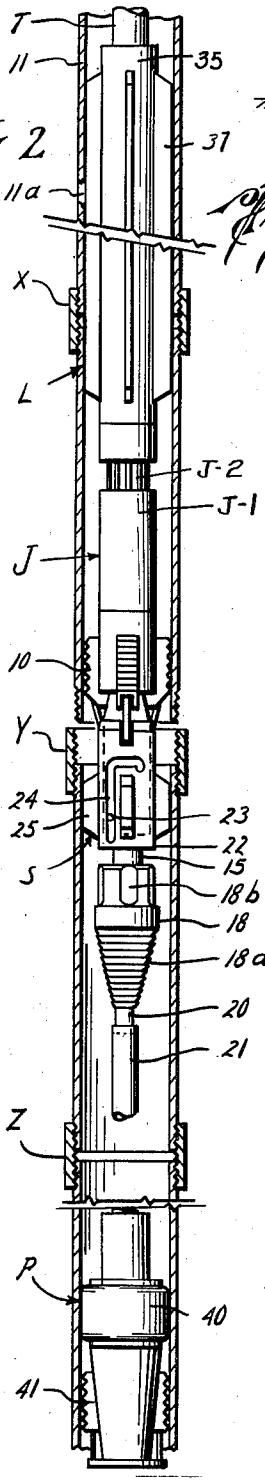
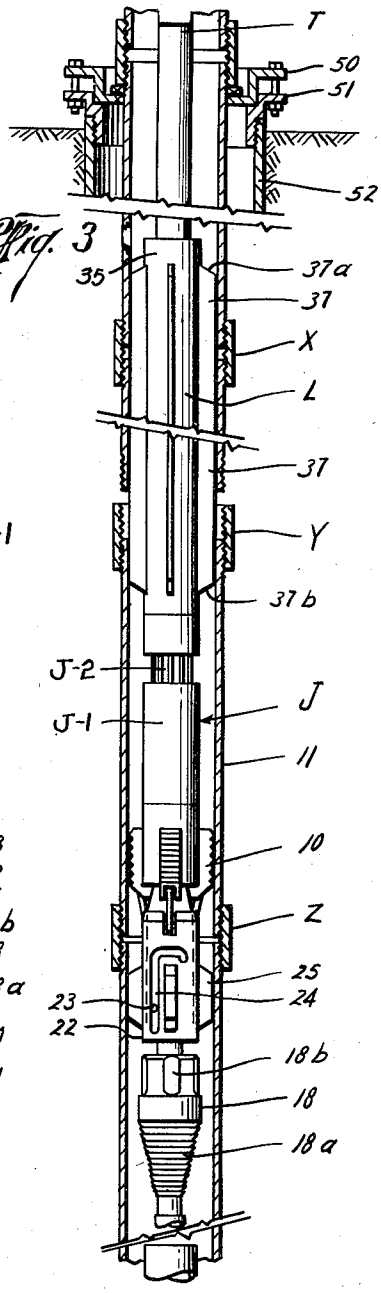


Fig. 3



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Fig. 4A

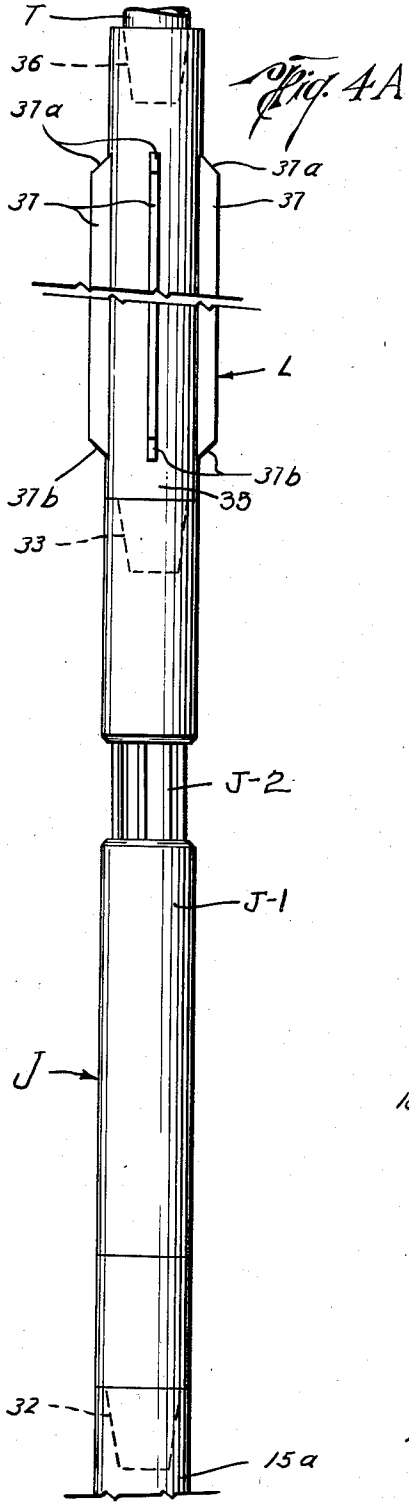
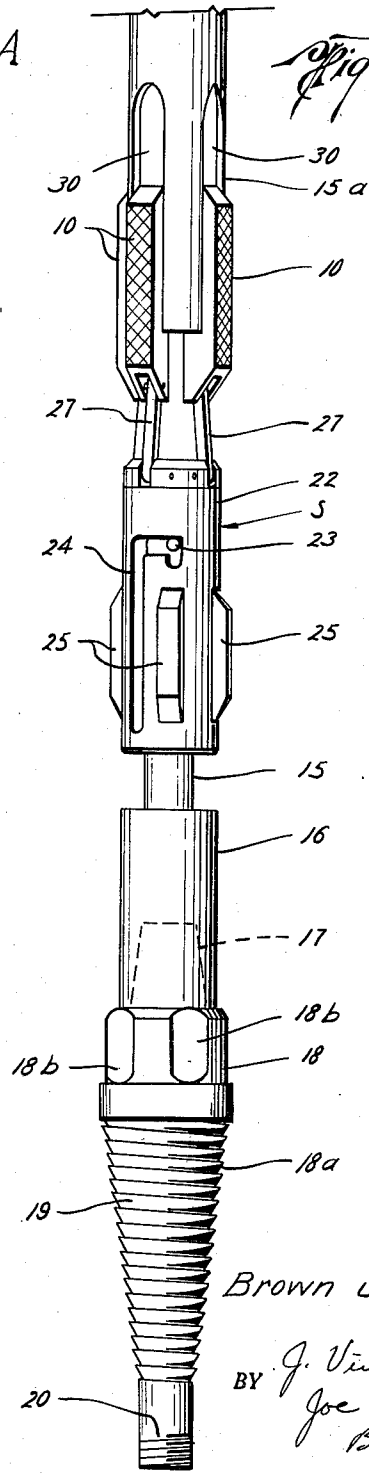


Fig. 4B



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REMOVING CASING AND THE LIKE FROM A WELL BORE

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14 Claims. (Cl. 166—14)

This invention relates to new and useful improvements in methods and apparatus for removing casing and the like.

An object of this invention is to provide a new and improved method and apparatus for disconnecting a defective portion of a casing from the remainder thereof so as to permit the removal of the defective portion from the well bore and for also providing for the lining up of the portion of casing remaining in the well bore with a replacement section of casing, whereby the replacement casing section can be substituted for the defective casing portion without removing the apparatus from the well bore.

An important object of this invention is to provide a new and improved method and apparatus for the replacement of defective casing, wherein a combination casing separating tool and a casing line-up assembly is lowered into a well casing for initially disconnecting one joint of the casing in the well bore at a point such that a defective section of the casing is disconnected from the remaining portion of the casing below said joint, and for thereafter positioning the line-up assembly in said remaining portion of the casing so as to span said joint to provide for the longitudinal alignment of a replacement section of casing with said remaining casing section to thereby facilitate the connection of said sections.

Another object of this invention is to provide a new and improved apparatus for the replacement of a defective section of well casing, which includes a combination casing back-off tool and a casing line-up assembly which is adapted to be used for the disconnection of a defective casing section and the replacement therewith of a replacement section, such apparatus being so constructed that it reduces the chances of error in the positioning of the replacement casing section for connection with the remainder of the casing.

Another object of this invention is to provide a new and improved method for effecting the replacement of a defective section of casing in a casing string which includes the steps of lowering a combination back-off tool and a line-up device into the casing, setting the back-off tool in the defective section of casing and rotating same for disconnecting a joint of the casing below said defective section of the casing, and thereafter positioning the line-up device so as to span the disconnected joint of the casing, whereby upon the removal of the disconnected portion of the casing, a replacement section of casing is adapted to be guided into position for connecting to the portion of the casing which remains in the well bore by means of the line-up device.

Another object of this invention is to provide a new and improved apparatus for removing defective casing, including a guide means which is adapted to guide the apparatus through distorted sections of the casing and which is also capable of being attached to a distorted casing section for the disconnection of such casing section from the casing therebelow.

The construction designed to carry out the invention

will be hereinafter described, together with other features thereof. The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings, forming a part thereof, wherein an example of the invention is shown and wherein:

Figure 1 is a view, partly in elevation and partly in section, illustrating the first phase of the method of this invention;

Figure 2 is a view similar to Figure 1, but illustrating the second phase of a method of this invention;

Figure 3 is a view similar to Figures 1 and 2 but illustrating the third phase of the method of this invention.

Figures 4A and 4B are elevations which together illustrate the apparatus of this invention in its preferred form, with Figure 4A illustrating the upper portion thereof and Figure 4B illustrating the lower portion thereof.

In the drawings, the letter S designates generally the back-off tool or spear which is adapted to be set in gripping engagement with the well casing at various predetermined points in the casing, as will be explained. A line-up assembly or device L is connected to the back-off spear S and in the usual case, a jar J is connected between the line-up assembly L and the back-off spear S (Figures 4A and 4B). The method of this invention briefly involves the lowering of the aforesaid apparatus on a tubing string or drill pipe string T from the surface of a well bore in which a casing C is disposed.

As will be hereinafter explained in detail, the point or elevation at which a leak has occurred in the casing C is first detected by any known type of leak detector equipment and this advises the operator that all casing above the point of leakage or other defect should be removed and replaced. The defective section of casing is indicated at **11** in the drawings with the hole **11***a* being shown as the defect.

After the elevation at which the defect has occurred has been located, the back-off spear S and the line-up assembly L are lowered on the tubing or drill pipe T and it is desirable to initially position the back-off spear within the damaged or defective section **11** of said casing. By means of the drill pipe T, the back-off spear S is manipulated from the surface of the well so as to set the slips **10** into gripping engagement with the interior of the defective casing section **11**. Thereafter, several turns or revolutions are imparted to the tubing or drill pipe T and are transmitted to the casing through the spear, this rotation being in a left hand direction to unscrew the casing at one of its collars; of course, unscrewing of one of the collars will be either the first collar immediately below the spear S, which is indicated at X in Figure 1, or it might be at the next below collar Y or a still further lower collar Z. Initially the operator does not know which collar will uncouple because this will depend on which one of the collars below the defective joint is the easiest to release or unscrew.

The number of turns imparted to the casing at this time are limited so that they are insufficient to completely disconnect any of the couplings or joints in the casing C but are sufficient to begin unscrewing or releasing of the threads at one of said collars or joints below the defective casing section **11**. Thereafter, and as is further described in detail, it is possible by releasing the spear and moving it down one joint and then taking a torque to determine whether the collar X or the collar Y has started to release. If the spear is reset just above collar Y and the torque indicates that turning is easy, this means that either collar Y or collar Z has begun to unscrew. If this condition exists, the spear is again reset in the casing section just above the collar Z and if the torque indicates that collar Z is still tight, then this indicates to the operator that the unscrewing has begun at

collar Y. Subsequently the spear is reset adjacent the loosened collar and the disconnection at this joint is completed.

The disconnected portion of the casing C is then handled at the surface of the well by elevators or other conventional equipment for raising and removing the same; however, prior to the actual lifting of the disconnected portion of the casing C, the spear S and the apparatus connected therewith are lowered with the drill pipe or the tubing T so as to support the apparatus including spear S, jar J and line-up assembly L in that portion of the casing below the point of separation. Although not essential, it is preferable to position the line-up assembly L spanning the disconnected joint (Figure 3). With such arrangement the disconnected portion of the casing C can be readily removed with elevators or the like at the surface of the well and thereafter upon the lowering of a replacement section of casing around the tubing or drill pipe T, such replacement section is guided into the proper position above the joint previously disconnected by means of the line-up assembly L. It is noted that if the apparatus is supported in the lower portion of the well casing with the line-up joint L below the point of separation during the removal of the separated section and during lowering of the replacement section, the apparatus is reset to locate the line-up joint in a position spanning the point of separation just prior to the time that the replacement section is subsequently reconnected to the casing remaining in the well.

Considering first the apparatus of this invention (Figures 4A and 4B), the back-off spear S has a mandrel **15** extending substantially for the full length thereof and which has its lower end secured to a box member **16** which has a threaded connection with a conventional threaded pin **17** which is formed on a guide element **18**. The guide element **18** has a tapered lower portion **18***a* which is formed with buttress-type threads **19** which are preferably left-hand threads, which are used to assist in guiding the apparatus through restricted areas in the casing or for retrieving casing in some cases, as will be explained. To further facilitate the passage of a guide member **18** through flattened or distorted sections of the casing C, the guide element **18** is formed with flat surfaces **18***b* on the cylindrical upper end thereof. The lower end of the guide element **18** has right-hand threads **20** for connection with a tail pipe **21** (Figures 1–3) which extends downwardly through the casing to provide an entry for the guide member **18** through restricted casing sections which have become twisted, collapsed, or otherwise distorted. A housing or sleeve **22** surrounds the mandrel **15** and is normally slideable or movable longitudinally relative to the mandrel **15**, but the mandrel **15** carries one or more pins **23** which extend into a J-slot **24** in the housing or sleeve **22** so that when the pin **23** is in the longitudinal portion of the slot **24**, relative movement between the mandrel **15** and the housing **22** is permitted. When the pin **23** is in the lateral leg of the J-slot **24**, the housing **22** and the mandrel **15** are held against longitudinal movement relative to each other. The housing or sleeve **22** carries friction shoes **25** which are of conventional construction and are resiliently urged outwardly for constant frictional engagement with the interior of the casing C.

Above the sleeve **22** the mandrel is formed with inclined expander surfaces **30** along which the slips **10** are slidable. The slips **10** are of conventional construction and have the usual dove-tailed sliding connection with the expander surfaces **30**. Said slips are connected to the housing **22** by pivoted links **27** whereby the slips **10** are supported by the housing **22** and are movable therewith, but the slips **10** are adapted to move radially or laterally relative to the surfaces **30** in the usual well known manner. Normally, during the running in of the spear S into the well casing, the slips **10** are in the retracted position illustrated in Figure 4B and the inclined surfaces **30** are raised upwardly relative to the slips **10** with the slips at the lower or smaller end of said surfaces. Since the surfaces **30** are carried by the mandrel **15** and are movable therewith a relative movement of the mandrel **15** with respect to the housing **22** results in a similar relative movement between the surfaces **30** and the slips **10**, so as to radially move the slips **10** into gripping engagement with the interior of the casing C. Above the inclined surfaces **30** the mandrel has an enlarged portion **15A** which is formed with a box for receiving the threaded pin **32** on the lower end of the jar or jarring device J. Such jarring device J is of conventional construction, one suitable type being illustrated in the patent to Dougherty No. 1,617,303 and is provided to set the slips **10** and also to jar them loose in the event they become stuck in engagement with the casing C. As is well known, the conventional jar J comprises interconnected members **J1** and **J2**, which are keyed together for telescoping or longitudinal movement with respect to each other; as shown, the jar member **J1** has connection with the spear S, while the jar member **J2** is connected with the line-up assembly L, and through said line-up assembly with the drill pipe T. Thus, if the spear S encounters any obstruction during lowering movement, the spear S and the jar member **J1** would be momentarily held stationary; by reciprocating the drill pipe T, the inner jar member **J1** may be reciprocated in the usual manner with respect to the jar member **J1** to apply a jarring force to the guide member **18** to force same through distorted or restricted sections of the casing as the apparatus is being lowered for use. Above the jar J, the line-up assembly L is connected by the threaded pin **33** so that the line-up assembly L is connected to the back-off spear S through said jar. The line-up assembly includes an elongate body **35** which is generally tubular and which has a box formed at its upper end for receiving the threaded pin **36** of the drill pipe or tubing T, which, as previously pointed out extends to the surface of the well so that the apparatus can be manipulated from the surface. Longitudinally extending ribs **37** which are welded or otherwise secured to the body **35** extend outwardly from the body **35** so as to be in contact with, or substantially in contact with the interior of the casing C at all times. It will be noted that the upper ends **37***a* of the ribs **37** are inclined or tapered downwardly and outwardly and the lower ends **37***b* of the ribs **37** are inclined or tapered upwardly and outwardly. The inclined surfaces **37***a* serve to assist in the guiding of the replacement casing, as will be explained, and the surfaces **37***b* assist in guiding the ribs **37** as they move downwardly relative to the casing C.

Although one type of spear S is illustrated herein, it is evident that any type of back-off spear which is capable of being selectively re-set within the pipe and which is now in general use in the industry may be employed in the assembly.

Considering the method of this invention in detail, the section of the casing **11** which has the hole **11***a* or other defect therein is first detected by any known type of leak detector equipment. Thereafter, a plug P (Figures 1 and 2) of conventional construction, which includes basically a packing element **40** formed of rubber or other resilient material, and casing engaging slips **41** are set in the casing C about five hundred to a thousand feet below the damaged casing section **11**. The setting string of tubing or drill pipe (not shown) for such packer P is removed therefrom in the known manner so as to leave only the packer P in the casing. Such packer P may be eliminated in instances in which the well can be maintained under control with drilling mud or other drilling fluid, but ordinarily a packer such as the packer P is employed to close off the fluid flow from the well formations.

Thereafter, the apparatus illustrated in Figures 4A and 4B is lowered into the casing C on the drill pipe or tubing T to position the slips **10** inside the section **11** of defective or damaged casing. The guide member **18**

serves to guide the apparatus as it is being lowered through the casing to reach the defective casing section **11**. In the event a distorted or restricted area in the casing C is encountered prior to reaching the section **11** with the spear S, the jarring device J can be actuated by raising and lowering the drill pipe T to apply a jarring force on the guide member **18**. Since the threads **18***a* are butress threads, they assist in the downward sliding action of the guide member **18**. If such jarring action is not effective, then the tubing T is rotated to cause the threads **18***a* to engage the interior of the restricted portion of the casing so as to thread the guide member downwardly.

When the back-off tool S does reach the casing section **11**, drill pipe T is turned sufficiently to move the J pin **23** out of the lateral portion of the J-slot **24** and into the longitudinal portion thereof so as to permit relative movement between the mandrel **15** and the housing **22** which is frictionally held in engagement with the casing by the friction shoes **25**. Such longitudinal movement of the mandrel downwardly relative to the housing **22** effects a lowering of the cone surfaces **30** relative to the casing gripping slips **10** so as to urge the slips **10** radially outwardly into gripping engagement with the damaged or defective section **11** of the casing C. With the slips **10** thus set in gripping engagement with the casing section **11**, a left-hand torque or rotation is imparted to the drill pipe or tubing T at the surface of the well with suitable tongs or other similar equipment. Initially, the drill pipe T is turned only about two to five revolutions so as to just loosen the threads at one of the joints such as indicated by the numerals X, Y and Z in the drawings.

Assuming that such turning of the drill pipe T to the left the two to five turns has loosened the joint indicated by the letter Y, it must be determined that such joint is the one that has been loosened. Such is accomplished by releasing the slips **10** from their gripping contact with the casing section **11** and then lowering the spear S and the related parts into the next casing section. The slips **10** of the tool S are again reset in gripping engagement with the section of casing next below the damaged section **11** and above the next joint Y. Then a torque or turning force is applied by pipe tongs or the like at the surface of the well to the tubing string or drill pipe T. If substantially no resistance is encountered during such turning, the operator at the surface of the well is advised that either the joint Y or some joint therebelow is loosened. He then proceeds to again lower the tool S and the connected apparatus downwardly into the next section of the casing C so as to again set the slips **10** in the casing section which is above the joint Z. Since the joint Z is not free, upon the application of a turning force or torque to the drill pipe T at the surface of the well, the operator will encounter resistance which will advise him that the joint Y above the joint Z is the one that has been loosened.

Thereafter, the tool S and the related structure are raised to set the slips **10** in gripping engagement with the section of the casing above the loosened joint Y (Figure 2). Then a left-hand torque is applied at the surface of the well with pipe tongs or the like to the drill pipe T to completely disconnect the portion of the casing above the joint Y so as to free that portion of the casing thereabove including the damaged or defective casing section **11** from the remaining section of the casing below the joint Y.

During the foregoing steps of the method, the casing C is ordinarily removed from the usual split support ring **50** mounted on a casinghead **51** at the upper end of the surface casing **52** (Figure 3). Prior to the lifting of the casing section which has been disconnected at the joint Y from the portion therebelow, the drill pipe or tubing T is first raised to release the slips **10** from their gripping engagement with the casing C, then turned to position the pin **23** in the lateral leg of the slot **24**, and then the tubing or drill pipe T is lowered a sufficient distance to position the line-up assembly L so that it spans or extends across the joint Y (Figure 3) said joint Y being in its disconnected position. The extreme upper end of the drill pipe T above the casing head is then removed so that the pipe T terminates at substantially the points shown in Figure 3, with said pipe being supported by the tool S. Thereafter, the casing portion above the joint which has been disconnected is lifted by elevators or the like (not shown) at the derrick at the surface of the well and is removed in the usual manner by progressively disconnecting the joints or sections of the casing and swinging each such disconnected joint or section into the usual pipe rack at one side of the derrick (not shown). The portion of the casing C above the joint Y is thus stripped or pulled while the drill pipe or tubing T extends to the surface of the well. Ordinarily such tubing or drill pipe T projects several feet above the casing head at the surface of the well at all times during such removal of the disconnected portion of the casing C.

When it is desired to replace the disconnected portion of the casing with a new or repaired replacement casing section, the replacement section of casing is lowered on elevators or the like with the drill pipe or tubing T serving as a guide for the replacement section of the casing as it is lowered in the well bore. When the replacement casing reaches the line-up assembly L, the upper inclined guide surfaces **37***a* of the ribs **37** guide the lower section of the replacement casing around the line-up device L so as to center such replacement casing to properly position the threads thereof for connection to the joint Y. Since the ribs **37** are disposed within the upper section or end of the portion of the casing C remaining in the well bore and extend thereabove, it will be appreciated that the threads of the lower end of the replacement section of the casing C necessarily are guided into a proper position for a connection to the joint Y. It is therefore only necessary to then reconnect the replacement casing to the joint Y by turning the replacement casing at the surface of the well with tongs or the like, or by positioning the tool S in the lower section of the replacement casing and imparting a right-hand rotation thereto from the surface of the well.

Although it is preferable to support the spear S and line-up point in the lower portion of the well casing with the line-up joint spanning the point of separation, as above described, it is not necessary to accurately locate the line-up joint at this time. The spear S and line-up assembly may be supported with that portion of the casing still in the well with the line-up joint wholly within such casing. The defective casing may be removed and the replacement section then run in, being guided by pipe T; however, as the lower end of the replacement section approaches the upper end of the casing still in the well, the pipe T is utilized to manipulate the spear S and to raise the line-up joint into a position spanning the point of separation whereby said line-up joint will effectively guide the replacement section into proper alignment. Although the latter procedure involves a resetting of the spear and line-up joint, it has the advantage of not requiring accurate positioning of the line-up joint prior to removal of the defective casing.

If, for some reason, the replacement section has not been properly reconnected at the joint Y due to defective threads or for any other reason, the tool S is still in the casing C and can readily be used for disconnecting a section of the casing below the joint Y.

During the foregoing process while turning the pipe T to disconnect one of the casing joints, the casing may be parted or sheared at some defective part. When such occurs, the portion of the casing C above the sheared joint is removed from the well bore, and then the tool S is lowered down and set in one of the upper sections of the portion of the casing remaining in the well bore so

as to disconnect such upper portions in the same manner as described above, whereby the removal of all of the defective casing is accomplished. The guide member **18** serves to guide the apparatus into the upper end of the casing at the point of shearing. Sometimes such sheared end is extremely jagged and even bent so the guiding action of the guide member is very important. Further, in some cases, even with jarring by the jar J, the guide member cannot be forced below the sheared end due to its extreme distortion but the teeth **18***a* can be forced to thread into and grip the interior of the casing in the vicinity of such sheared end sufficiently to permit a disconnection of the defective casing with the sheared end by simply rotating the tubing T, without the necessity for setting the slips **10**. Since the threads **18***a* are left-hand threads and the rotation of the tubing T is to the left to release the right-hand threaded casing sections, the guide member tends to tighten as the tubing T is rotated to release the damaged casing with the sheared end.

The foregoing method has been described as employing the spear S for the purpose of unscrewing or disconnecting that portion of the casing which is to be removed. It is pointed out, however, that the casing may be cut or severed in order to disconnect the upper portion and in such event a casing cutter of conventional design would be employed, being preferably connected in the assembly below the jar J; thus, instead of imparting rotation to the casing to unscrew the upper portion thereof, the casing would be actually cut, after which the assembly would be lowered to properly locate the line-up joint to extend from the upper end of the lower section of well casing in the manner hereinbefore described. Reconnection of the new casing with the old is in this case made by conventional patch methods. Obviously, the method is the same except that the casing is cut or severed instead of being disconnected by unscrewing at one of the joints.

Any standard type of casing cutter which employs supporting slips may be substituted for the back-off spear in the assembly and examples of such cutters are shown in the prior patents to Lewis 1,638,494, Church Re. 21,234 and Reed 1,906,416.

From the foregoing, it is believed evident that a novel method and apparatus has been provided for disconnecting and replacing sections of casing without the necessity for removing the apparatus from the well bore during such replacement.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof and various changes in the size, shape and materials, as well as in details of the illustrated construction, may be made within the scope of the appended claims without departing from the spirit of invention.

What is claimed is:

1. A method of replacing a defective casing section of a well casing located in a well bore, comprising the steps of lowering a combination casing back-off tool and line-up assembly into a well casing on a pipe string, setting said back-off tool in gripping engagement with the casing, rotating said tool to disconnect said casing at a joint below said defective section of the casing, releasing said tool from its set position, lowering said tool below the disconnected joint to position said line-up assembly so as to span said joint, setting said back-off tool in the casing to support said line-up assembly, and thereafter removing the portion of said casing above said joint, and then lowering a replacement section of casing into the well bore, said line-up assembly guiding said replacement section into position for readily connecting same to said joint.

2. In a method of removing a defective section of well casing from the rest of the casing in the well bore, the steps of, determining the elevation of the defective casing section, closing off fluid flow in said casing a considerable distance below said defective casing section, lowering a combination casing back-off tool and line-up assembly into the well casing to position the back-off tool in said defective casing section, setting said tool in said defective casing section, turning said tool to loosen without disconnecting a joint of the well casing below said defective casing section, thereafter locating the loosened joint and setting the tool in the casing immediately thereabove, then rotating said tool to disconnect said casing at said loosened joint, and releasing said tool and lowering same to position said line-up assembly at said joint without having previously removed said back-off tool from the well casing, setting said tool within the casing below the loosened joint to support the line-up assembly, and thereafter removing the disconnected portion of the casing.

3. In an apparatus for removing a defective casing section from a well casing in a well bore, a combination back-off tool and line-up assembly adapted to be lowered into the well casing as a unit on a well pipe, said back-off tool having casing gripping slips and means for setting said slips in gripping engagement with the well casing upon a manipulation of said well pipe, whereby rotation of the pipe will impart rotation to the casing to effect a separation thereof, said line-up assembly being disposed above said back-off tool and including a plurality of longitudinally extending guide ribs which are adapted to normally substantially engage the inside wall of said well casing, and a conical guide member on the lower end of said apparatus below the back-off tool for guiding same downwardly through the well casing.

4. The structure set forth in claim 3, including an elongate tailpipe extending downwardly from the lower end of said guide member for providing an entry for the guide member through flattened or distorted portions of the casing.

5. The structure set forth in claim 3, including flat areas formed in the outer surface of the upper end of said guide member to facilitate the lowering of said guide member through flattened or distorted portions of the casing.

6. The structure set forth in claim 3, including left-hand buttress threads on said guide member for threading into a deformed portion of the casing to establish a connection of the apparatus with said deformed portion of the casing, whereby rotation can be imparted to the casing by rotating the well pipe to thereby disconnect a portion of the casing from the remainder therebelow.

7. The method of replacing a defective casing section in a well casing located within a well bore including the steps of, lowering a combination casing-separating tool and line-up assembly into the well casing on an inner pipe string to locate the casing-separating tool at a point below the defective casing section, operating said casing-separating tool to separate the casing at a point below the defective section, thereafter supporting the tool and line-up assembly and the inner pipe within that section of the casing below the point of separation and in such position that the line-up assembly spans the point of separation, the inner pipe extending axially within the well casing to the surface, then removing the well casing which is above the point of separation from the well by stripping said casing upwardly over the inner pipe, and thereafter lowering a replacement section of well casing downwardly into the well over said inner pipe and line-up assembly which properly locates said replacement section relative to the well casing remaining in the well.

8. The method as set forth in claim 7, together with the additional steps of connecting the replacement section of casing to the well casing in the well and removing the casing-separating tool and line-up assembly from said casing.

9. An apparatus for removing a defective casing section and for guiding a replacement section of casing into place including, a casing-separating tool, a line-up assembly connected to the upper end of said tool and

having radially projecting guide elements adapted to fit within the bore of the well casing, an inner pipe connected to the upper end of the line-up assembly for lowering said assembly and tool into the well casing to a point below the defective section, means forming part of said casing-separating tool for effecting a separation of the casing when said tool is operated by manipulation of the inner pipe, and means for supporting the tool, line-up assembly and inner pipe within that section of the well casing below the point of separation, whereby the upper separated section of casing may be removed by stripping the same over the inner pipe and also whereby said inner pipe and line-up assembly function to guide a replacement section of well casing into proper position within the well.

10. An apparatus as set forth in claim 9, together with a tapered guide member secured to the lower end of the tool, and an elongate guide pipe extending downwardly from the guide member.

11. An apparatus as set forth in claim 9, together with a jar device connected between the upper end of said tool and the lower end of the line-up assembly.

12. A method of replacing a defective casing section of a well casing located in a well bore, comprising the steps of lowering a combination casing-separating tool and line-up assembly into a well casing on an inner pipe string to locate the casing-separating tool at a point below the defective casing section, operating said casing-separating tool to separate the casing at a point below said defective casing section, thereafter lowering the tool and line-up assembly into the casing below the point of separation, supporting said tool and line-up assembly therein whereby the inner pipe attached thereto is supported at its lower end, thereafter removing the casing above the point of separation while the tool, line-up assembly and inner pipe remain in the well bore, thereafter lowering a replacement section of casing into the well bore by threading the same over the inner pipe, and locating the line-up assembly to span the joint between the replacement section of casing and the casing in the well bore to guide the replacement section into position for connection with said casing in the well bore.

13. The method set forth in claim 12, together with the additional steps of connecting the replacement section of casing to the well casing in the well bore, and finally removing the casing-separating tool and line-up assembly from said casing.

14. In an apparatus for removing a defective casing section from a well bore, a combination back-off tool and line-up assembly adapted to be lowered into the well casing as a unit on a well pipe, said back-off tool including a mandrel adapted to be connected with the well pipe, casing-gripping slips slidably mounted on the mandrel and having means for holding said slips against movement when the mandrel is moved relative to said slips, and expander means on the mandrel arranged to co-act with the slips to move the slips into gripping engagement with the casing when the well pipe is manipulated to move the mandrel relative to said slips, said line-up assembly being located above the back-off tool and forming the connection between the mandrel and well pipe, said line-up assembly including an elongate body having longitudinal radially projecting guide elements formed on its external surface, the extent of the radial projection of said guide elements being such that the outer surfaces of the elements are contiguous to the wall of the bore of the casing into which the tool is lowered.

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