Aug. 26, 1969 D. L. HINKLE 3,463,229

TRANSPORTER AND ANCHOR FOR WELL CASING INTERLINER OR BOOT

Filed June 27, 1967 3 Sheets-Sheet 1

FIG. 1

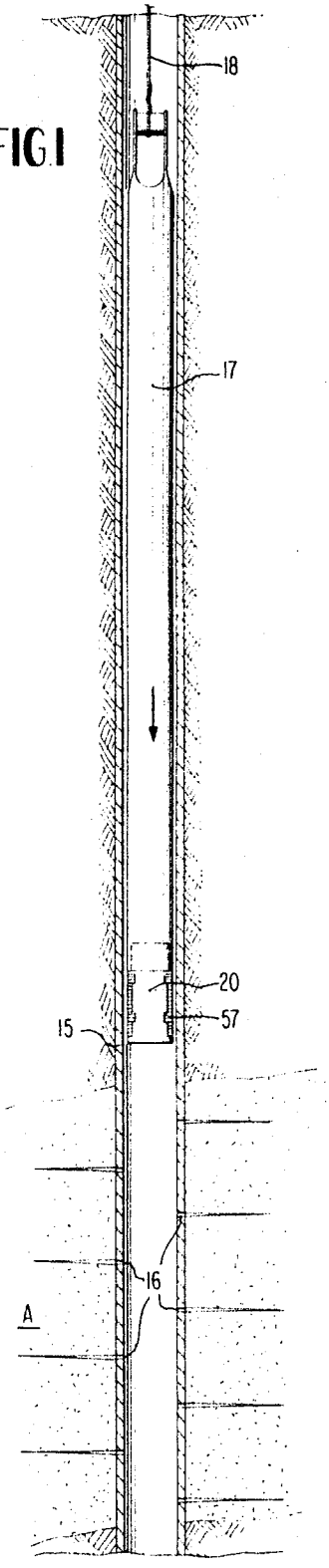


FIG. 2

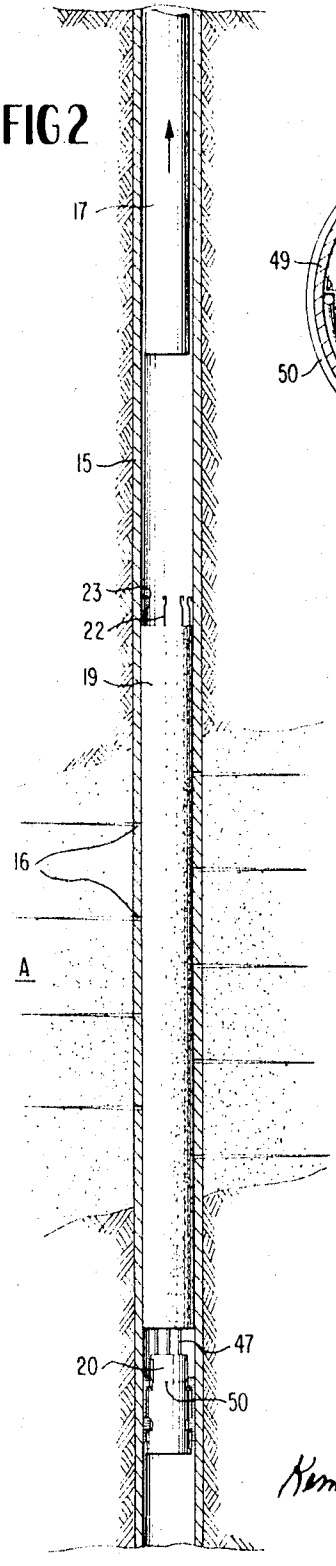


FIG. 5

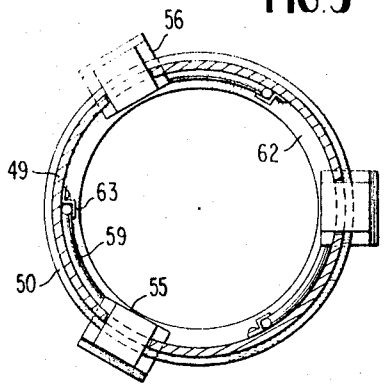
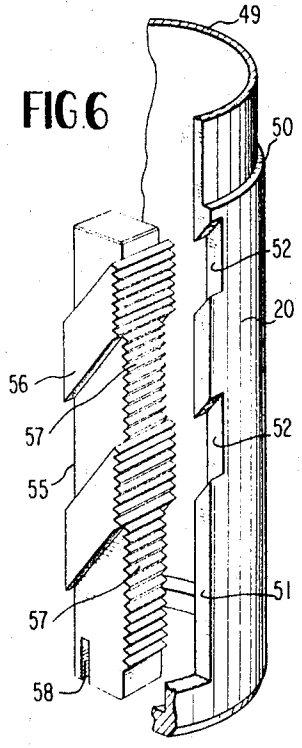


FIG. 6



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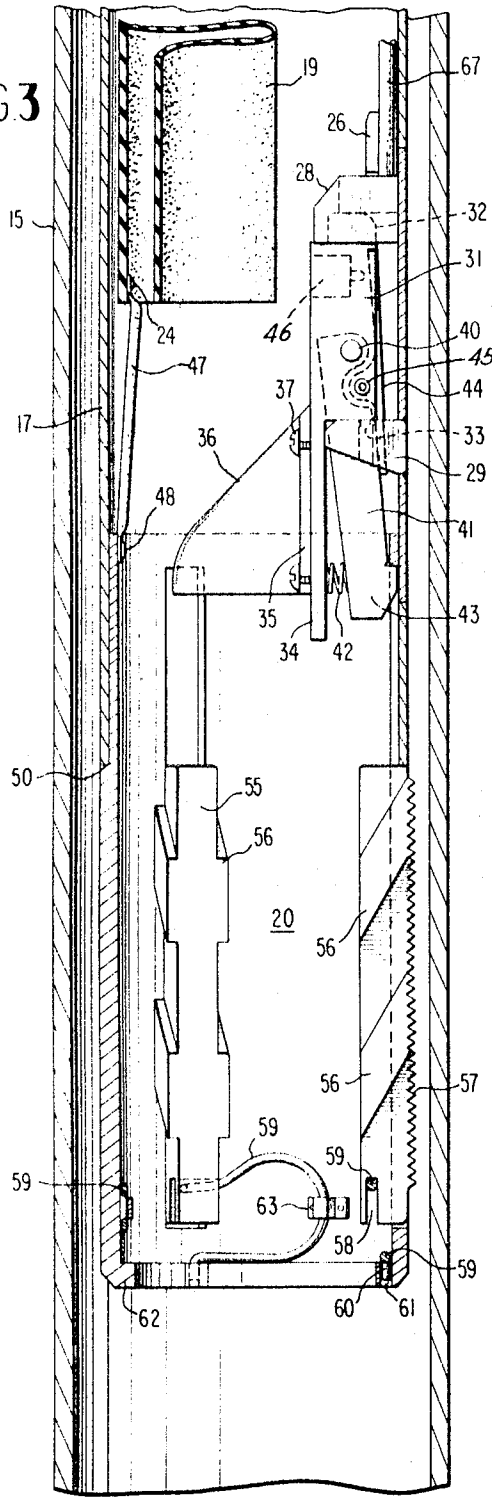
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Aug. 26, 1969 D. L. HINKLE 3,463,229

TRANSPORTER AND ANCHOR FOR WELL CASING INTERLINER OR BOOT

Filed June 27, 1967 3 Sheets-Sheet 2

FIG 3



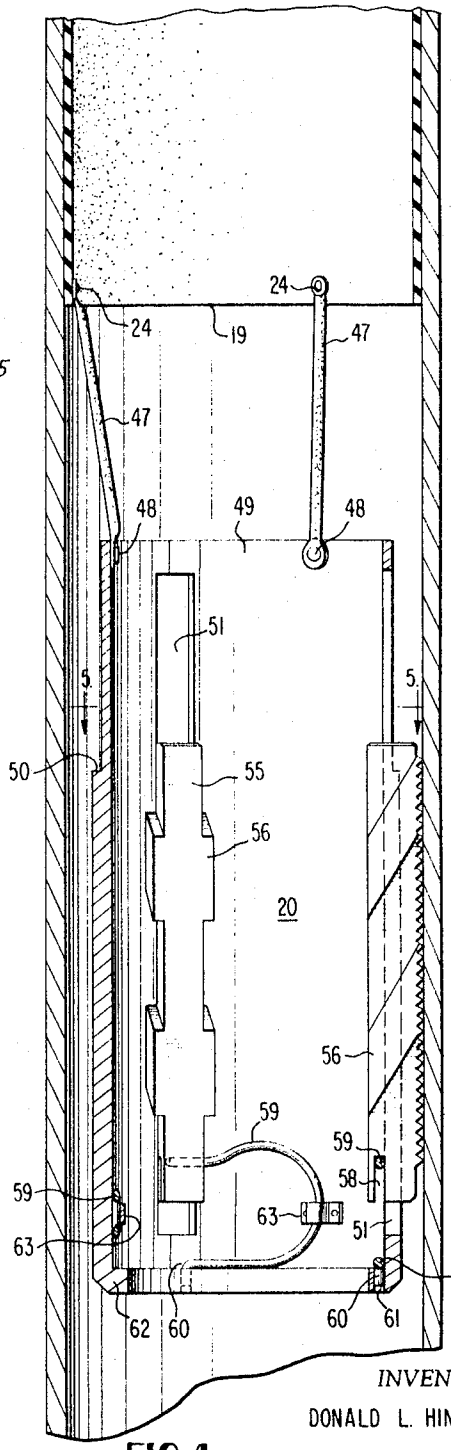


FIG 4

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Aug. 26, 1969 D. L. HINKLE 3,463,229

TRANSPORTER AND ANCHOR FOR WELL CASING INTERLINER OR BOOT

Filed June 27, 1967 3 Sheets-Sheet 3

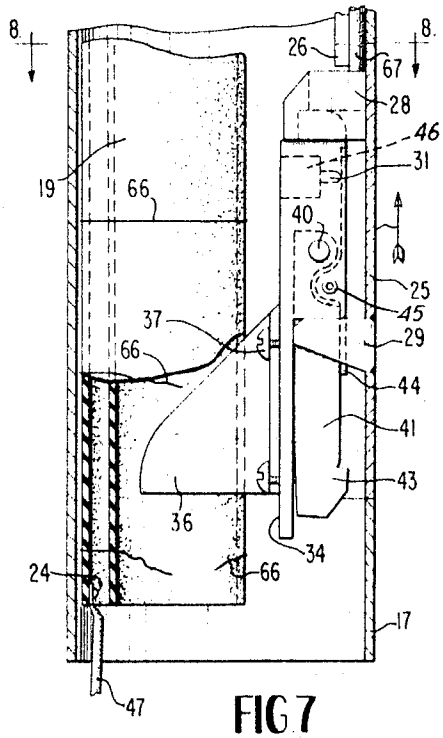


FIG.7

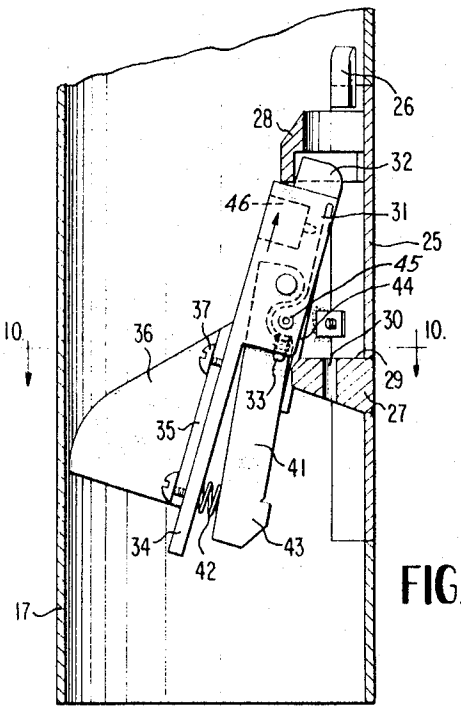


FIG.9

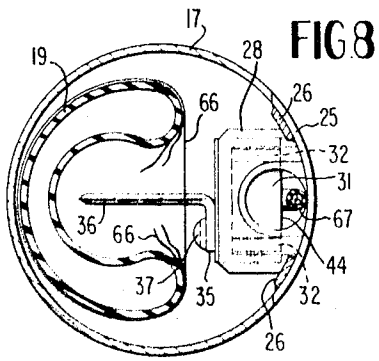


FIG.8

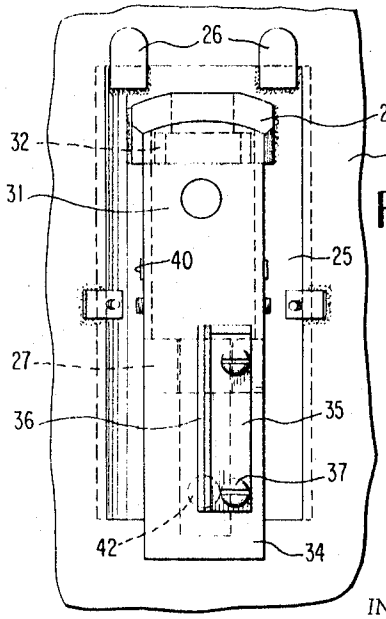


FIG.11

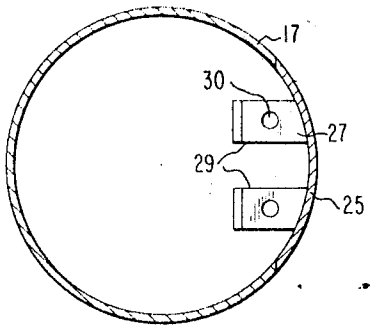


FIG.10

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3,463,229

TRANSPORTER AND ANCHOR FOR WELL CASING INTERLINER OR BOOT

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U.S. Cl. 166—207 14 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for introducing into and positioning within a perforated well casing an elongated tubular interliner or boot for engaging and effectively sealing the perforations in the casing. The interliner or boot, which is formed of resilient material, is crimped throughout its length and placed within a transporter that also carries an anchor member which is connected to the lower end of the boot or interliner. The anchor member is released from the transporter and engages the well casing to effect the removal of the boot or interliner from the transporter during the positioning of the boot or interliner to seal the perforated well casing.

Field of the invention

The present invention relates to oil or gas wells wherein a casing interliner or boot is positioned or anchored within said casing for sealing a perforated area of the casing. The interliner or boot as well as the anchoring means for positioning the interliner or boot within the casing, are configured and designed so as to permit various and sundry operations to be carried out within the well casing either above or below the area wherein the boot or interliner is positioned.

Prior art

Heretofore, perforated areas of a well casing have been closed off by conventional well packers, bridges, or plugs whenever a multizone operation was undertaken. There have been, in recent times, certain instances wherein expansible liners or sleeves were employed in sealing off perforated areas within a well casing. These devices have not proven to be entirely acceptable and satisfactory for various reasons, one of which was that operations within a casing having one of the expansible liners or sleeves mounted therein would not permit the carrying on of any mechanical operations in the area of the casing below the linear or sleeve such as perforating, logging, etc. Another difficulty frequently encountered with prior devices was the positioning of the liner or sleeve within a perforated area of the casing and the ability of effectively anchoring or securing the liner within the desired area of the casing to prevent down hole movement. The ability to remove the sleeve or liner in a most efficient and expeditious manner has not been found to be one of the attributes of prior devices, thus the liners or sleeves, as typified by the prior art, have been found from experience to contain many shortcomings as regards the effective sealing of a casing having a single perforated zone or one having a plurality of perforated zones.

Summary of the invention

The present invention is directed to an apparatus for positioning and anchoring within a perforated area of a well casing an interliner or boot. An object of the present invention is to provide a transporter having a resilient interliner or boot and an anchor member carried thereby with the anchor member connected to the interliner or boot and releasable from the transporter for engaging the inner surface of a well casing to effect the removal of the interliner from the transporter and its positioning and anchoring within the casing. Another object is to provide a transporter for receiving an interliner or boot wherein binding means are employed for crimping or compressing the interliner to facilitate its positioning within the transporter and an anchor member connected to the interliner and carried by the transporter with means in the transporter for releasing the anchor member and the severing of the binding means during the withdrawal of the interliner from the transporter.

Description of the drawings

FIGURE 1 is a vertical sectional view of a portion of a well casing showing a transporter and anchor member of the present invention;

FIGURE 2 is a vertical sectional view of a portion of a well casing showing a portion of the transporter of FIGURE 1 and a sealant member and anchor member positioned to overlie the perforations of a fractured zone of the casing;

FIGURE 3 is an enlarged detailed sectional view showing a segment of a well casing and the transporter and anchor member carried thereby with a portion of the boot or interliner sealant member within the transporter;

FIGURE 4 is an enlarged detailed sectional view showing a portion of the boot or interliner sealant member and the anchor member positioned within the well casing;

FIGURE 5 is a cross sectional view showing a portion of the anchor member, the view being taken on the line 5—5 of FIGURE 4;

FIGURE 6 is a vertical sectional view of a fragmentary portion of the anchor member shown in FIGURE 5;

FIGURE 7 is a vertical sectional view of the lower portion or end of the transporter with the boot or interliner sealant member positioned therein and a knife and latch assembly;

FIGURE 8 is a cross sectional view of the boot or interliner sealant member and transporter with the knife member employed for severing the members employed in holding the sealant member in a crimped position, the view being taken on the line 8—8 of FIGURE 7;

FIGURE 9 is a vertical sectional view of the transporter with the knife member partially positioned therein;

FIGURE 10 is a cross sectional view showing the bottom support members for the knife member, the view being taken on the line 10—10 of FIGURE 9; and

FIGURE 11 is an elevational view of the knife member positioned within the transporter with portions of the transporter being removed in the interest of clarity.

Description of the preferred embodiment

Referring to FIGURE 1 of the drawings, there is shown a conventional well bore that has been walled by a production casing string **15**, which in turn has been subjected to a perforating action to produce the perforations **16** at the formation A to permit appropriate treatment of the producing zone through the perforations, and after the well is completed, to permit adequate production flow to the well bore. In order to effectively seal the casing in the area of formation A, a resilient sealant boot or interliner must be so positioned within the casing **15** as to overlie and seal the perforations **16**. Once the perforations have been effectively sealed within the area of formation A, the casing **15** may then be perforated within another formation or production zone that might be disposed either above or below the formation A within the well bore.

A cylindrical transporter tube or carrying member **17** of elongated configuration is lowered through the casing string **15** by means of an armored electrical cable or wire line **18** and constitutes the means for delivering a

resilient sealant boot or interliner 19, FIGURE 2, as well as an anchor member 20 to the area of the perforations 16 in the well casing. The upper end of the boot or interliner 19 has secured thereto a plurality of wire or rod like elements 22 that are arranged in circumferentially spaced relation to one another and project or protrude beyond the upper end of the boot or interliner. The elements 22 may be secured to the upper end of the boot in any suitable manner but it has been found that if said elements are placed in the boot during its formation and vulcanization that they become firmly anchored in the upper end of the boot and tend to provide a reinforcement for the upper end portion of said boot. The protruding portions of the elements 22 are bent to form hook-like members 23, and said members are designed to engage a suitable tool, not shown, for the purpose of retrieving or removing the boot or sealant member from the interior of the casing string 15. The lower end of the boot or sealant member 19 is provided on its innersurface with a plurality of spaced eyelets 24, FIGURE 4, which constitutes part of the means that is employed in securing the anchor member 20 to the lower end of the boot or interliner 19.

The transporter tube 17 is formed, adjacent to its lower end, with a removable segment or section 25 which is formed with a pair of spaced lugs 26 that extend into suitable recesses in the transporter tube for properly positioning or mounting the segment or section in the transporter. In addition, suitable retaining screws are employed for securing the segment or section 25 in the transporter tube so that with the segment or section in place, the transporter tube has a relatively smooth and continuous outer surface. The segment or section 25 has mounted on its inner surface a knife and latch assembly with the knife portion of the assembly being positioned to sever the binding tapes that have been employed to retain the boot or interliner in its crimped condition within the transporter tube. The latch portion of the assembly is designed to engage and hold the anchor member 20 within the lower end of the transporter tube 17 during the lowering and positioning of the tube within the casing string 15. The knife and latch assembly is removably mounted upon a multipart bracket structure that is provided on the inner surface of the segment or section 25 and which consists of a lower or seat portion 27, FIGURES 9 and 10, and a top or yoke portion 28, FIGURES 8 and 9. The lower or seat portion 27 may be secured to the removable segment 25 by any suitable means, such as welding, and said seat portion includes a pair of spaced parallel members or arms 29 each of whiuh is formed with a suitable aperture 30. The top or yoke portion 28 of the bracket structure may also be secured to the removable segment or section 25 in spaced relation to the seat portion 27 by any suitable means, such as welding. The knife and latch assembly includes a housing or body portion 31 which is of a length commensurate with the spacing between the seat portion 27 and the yoke portion 28 so that the housing may be positioned between these two elements. The upper end portion of the housing or body portion 31 terminates in reduced end portions or lips 32 that are designed to extend into the yoke 28 to aid in the retention of the knife and latch assembly on the segment 25 within the transporter. The lower or bottom ends of the housing 31 are provided with spring loaded ball or pin members 33 which are of a size slightly smaller than the apertures 30 in the arms 29 of the seat portion 27 so that when the housing 31 is positioned upon the seat portion 27, the spring loaded ball or pin members 33 will be forced into the apertures 30 to insure the retention or locking of the housing 31 upon the seat portion 27. A suitable tool, not shown, having a yoked end portion may be employed for forcing the balls or pins 33 against the action of the springs and thus move the pins out of the apertures 30 so that the housing 31 may then be removed from the seat portion 27 and the yoke 28. The forward face of the housing 31 has a depending leg or segment 34 which has the flange portion 35 of a triangular shaped knife blade 36, secured thereto by suitable set screws 37. The longest side of the knife blade 36 is provided with a sharp cutting edge which is designed to engage and sever the tie tapes or strings that are employed to hold the sealant member in its crimped condition within the transporter.

The housing or body portion 31 has pivotally mounted therein by means of a pin or rod 40 a depending latch bar 41 that extends along the rear face of the depending leg or segment 34 of said housing. The lower end of the leg 34 of the housing 31 has secured thereto a coil spring 42 which engages the forward face of the latch bar 41 for forcing the latch bar away from the leg 34. The rear face of the latch bar 41 terminates in a keeper or protruding segment 43 which is designed to engage the anchor member 20 for holding same in locked position within the transporter tube 17. The housing 31 also has mounted therein a pawl bar 44 which is arranged to overlie the latch bar 41 but is retained within the housing 31 so as to be capable of having a pivotal movement about pin 45 within said housing and along the surface of the latch bar 41. The housing 31 has mounted therein a suitable actuator, shown in broken lines at 46, one type of which is manufactured and sold by Hercules, Inc. and designated BA31K7. Upon the energizing of the actuator it is caused to engage and move the pawl bar 44 about the pin 45 which movement of the pawl bar 44 causes the latch bar 41 to move about its pivot point 40 against the action of the spring 42 resulting in the releasing of the anchor member 20 from the transporter 17.

The eyelets 24, FIGURES 3 and 4, in the lower end of the sealant boot or interliner 19, each have one end of a flexible connector 47 affixed thereto with the other ends of said connectors being secured to suitable pins or bolts 48 provided on the inner surface of the anchor member 20. The elongated tubular anchor member 20 is formed with a reduced upper end portion 49 that defines with the body portion of the anchor member, an external annular shoulder or ledge 50. The reduced end portion 49 of the anchor member is designed to have a telescopic fit within the lower end of the transporter tube 17 so that the bottom-edge of the transporter tube 17 will seat on the shoulder or ledge 50, FIGURE 3. The anchor member 20 is formed with a plurality of circumferentially spaced slots 51 which extend throughout the length of the anchor member 20, terminating adjacent both the top and bottom edges thereof. The portion of the anchor member 20 below the shoulder or ledge 50 that defines the slots 51 are provided with vertically spaced notches or indentations 52, FIGURE 6. The slots 51 in the anchor member 20 each have slidably mounted therein a slip or grab member 55 which is provided on opposite sides thereof with outwardly extending flanges or lips 56 that are positioned within the spaced notches or indentations 52. It is to be noted that the notches 52 as well as the flanges 56 are both inclined or sloped upwardly so that the slip or grab members 55 will have a movement upwardly and outwardly with respect to the anchor member 20. The outer face or surface of each of the slip or grab members 55 may be serrated or formed with a plurality of transverse notches or grooves 57 that define suitable teeth for engagement with the inner surface of the casing string 15, FIGURES 2 and 4. The lower or bottom end of each of the slip or grab members 55 is formed with a recess 58 which is designed to receive one end of a relatively stiff compression spring 59. The spring 59 is bent back upon itself so as to have the shape or configuration of a horseshoe with the other end of the spring terminating in an outwardly extending projection 60. The projection 60 of the spring 59 is anchored in a recess 61 that is formed in an internal annular flange 62 provided at the lower end of the anchor member 20. The springs 59 are also secured to the inner-

surface of the anchor member **20** by suitable brackets **63**.

The springs **59** are designed to move the slip or grab members **55** upwardly in the slots **51** to a point where the upper end of each grab member will extend beyond the shoulder or ledge **50** and said upward movement is translated into an outward movement due to the inclination of the notches **52** and the cooperating flange segments **56**. This upward and outward movement of the slip or grab members **55** will move the serrated or notched surfaces **57** of the slip or grab members into engagement with the inner surface of the casing string **15** as shown in FIGURE 4. The upward or raised position of the slip or grab members **55**, as occasioned by the expansion action of the springs **59**, is the normal operating position of said slip or grab members within the anchor member **20**. When the slip or grab members **55** are in their lower or retracted position, FIGURE 3, the outer serrated faces of said grab members will lie substantially within the outer surface of the anchor member **20**. The notches or grooves **57** are formed in the outer face of said grab members so as to project downwardly and in this manner will firmly grip the inner surface of the casing string **15** and prevent a downward movement of the anchor member. The serrated outer faces of the grab members will not hinder or impede the upward movement of the anchor member within the casing string **15** as said serrated faces will simply slide along the inner surface of the casing string when the anchor member as well as the sealant boot or interliner **19** are being removed from the perforated area **16** of the casing string.

In the use and operation of the transporter and anchor member for the purpose of lowering and positioning the resilient sealant boot or interliner within a well casing, the boot or interliner is initially placed within a vise, not shown, where it is crimped or collapsed in a direction parallel to its longitudinal axis so as to reduce its overall diameter. As the boot or interliner is progressively crimped or collapsed from one end to the other, it is retained in said condition by binding the boot or interliner at spaced intervals with suitable tie tapes or strings **66**, FIGURE 8, which may be of a fiberglass tape or any suitable twine or cord. After the boot or interliner has been crimped throughout its length, it is slidably inserted into the transporter tube or carrying member **17** with the hook-like grab members **23** being first inserted into the transporter tube so as to be nearest the well head when the boot is positioned in the casing **15**. When the boot or interliner has been inserted into the transporter tube the flexible connectors **47** are connected to the eyelets **24** in the boot and to the bolts or pins **48** in the anchor member **20**. Prior to inserting the boot or interliner into the transporter tube **17**, the segment or section **25** is removed from the tube and the knife and latch assembly is mounted upon the seat **27** and the yoke **28** of the bracket structure. A pair of electrical connectors are carried in a conduit **67** that is mounted on the inner surface of the transporter tube, FIGURES 3 and 8. The bellows actuator is provided with a firing chamber, not shown, that is energized by the closing of a suitable switch, not shown, for delivering current through the electrical connectors in the conduit **67** to said firing chamber. With the crimped boot or interliner positioned in the transporter tube the segment or section **25**, with the knife and latch assembly mounted thereon, is then positioned within the tube **17**. At the time of placing the crimped boot or interliner in the tube **17** it is essential that it be so positioned that when the segment or section **25** is placed in the tube **17** the knife blade **36** will be inserted into the crimp of the boot or interliner **19**.

The reduced end portion **49** of the anchor member is then telescopically inserted into the lower end of the transporter tube **17** and in so doing it is essential that one of the slots **51** in the anchor member **20** be brought into and maintained in alignment with the latch bar **41**. As the reduced end portion **49** continues its movement into the transporter tube **17**, the lower end of the transporter tube will engage the upper ends of the slip or grab members **55** and gradually force these members downwardly in the slots **51** at the same time compressing the springs **59** in the lower end of the anchor member **20**. The lower end of the transporter tube **17** will ultimately engage or seat upon the shoulder or ledge **50** at substantially the same time that the keeper portion **43** of the latch bar **41** is being forced through one of the slots **51** by the spring **42** so that, at this time, the anchor member becomes secured within or attached to the lower end of the transporter tube **17**. The downward movement of the slip or grab members **55** causes these members to be withdrawn into the anchor member **20** so that the external diameter of the anchor member throughout its length will be substantially the same as the external diameter of the transporter tube **17** thereby permitting the transporter tube and anchor member to be readily raised or lowered within the casing string **15**.

When the transporter tube **17** has been so lowered in the casing string as to be positioned within the perforated zone A with the anchor member **20** below said zone, a switch at the well head end of the casing string **15** is closed so as to deliver a suitable current through the electrical connectors in the conduit **67**. The actuator **46** will be energized causing a movement of the pawl bar **44** which will result in a movement of the latch bar **41** against the action of the spring **42** and the withdrawing of the keeper or protruding segment **43** of the latch bar from the slot **51**. The withdrawal of the keeper **43** of the latch bar **41** from the slot **51** will separate the anchor member **20** from the transporter **17** and thus permit the upward and outward movement of the slip or grab members **55** under the action of the springs **59** resulting in the anchor member **20** being securely positioned within the casing **15** as the serrated surfaces of the grab members engage the inner surface of the casing string. With the anchor member **20** secured within the casing string **15**, the transporter tube **17** may then be raised or elevated which movement will result in the knife blade **36** being drawn up through the longitudinal crimped portion of the sealant boot or interliner **19** and at the same time severing the tie strings or tapes **66**. Thus, as the boot emerges from the lower end of the transporter tube, it will expand to its initial tubular shape or form due to the inherent resiliency of the sealant boot or interliner and thus become placed over the perforations **16** in the casing string **15** in the manner as illustrated in FIGURE 2. With the sealant boot or interliner and anchor member so positioned within the casing string **15**, the perforations **16** in the zone A will be effectively sealed and the casing string may then be subjected to a perforating action either above or below the zone or formation A or the well may be serviced in any other type of operation that might be required. Upon the completion of any further operations within the well, the sealant boot **19** and anchor member **20** may then be removed by lowering a retrieving shoe, not shown, on the armored cable or wire line **18** for engaging the grab hooks **23** after which the sealant boot and anchor member may be gradually withdrawn from the casing string **15**.

Although the foregoing description is necessarily of a detailed character, in order that the invention may be completely set forth, it is to be understood that the specific terminology is not intended to be restrictive or confining, and that various re-arrangements of parts and modifications of detail may be resorted to without departing from the scope or spirit of the invention as herein claimed.

I claim:

1. Apparatus for temporarily sealing apertures formed in the casing of a well comprising an elongated transporter tube, an elongated tubular sealant member slidably positioned within said tube, an anchor member telescopically positioned within said transporter tube for repeated movement therewith, means connecting said sealant member to said anchor member within said tube, means connected to said tube for lowering same in said

casing and positioning said anchor member below said apertures and means slidably mounted in said anchor member for engaging said casing to facilitate the withdrawal of said sealant member from said tube.

2. Apparatus as set forth in claim 1 wherein said first named means includes a plurality of flexible connectors detachably connected to the lower end of said sealant member and the upper end of said anchor member.

3. Apparatus as set forth in claim 1 wherein said transporter tube is formed with a removable segment and said sealant member is crimped throughout its length to reduce its overall diameter, securing means affixed to said sealant member to retain it in its crimped condition and permit its insertion into said tube, a knife and latch assembly mounted on said segment with said knife being arranged to project into the crimp of said sealant member upon said segment being positioned in said tube, said knife severing said securing means upon the removal of said sealant member from said tube.

4. Apparatus as set forth in claim 1 wherein said anchor member is formed with a plurality of circumferentially spaced vertically extending slots for the reception of slidable grab members.

5. Apparatus as set forth in claim 4 wherein said slots have spaced inclined indentations associated therewith and said grab members are formed with spaced inclined flanges for slidably moving in said indentations, said grab members having serrations formed on the outer surfaces thereof and means carried by said anchor member and engageable with said grab members for moving said grab members in said slots and indentations to force said serrated surfaces into engagement with said casing.

6. Apparatus as set forth in claim 4 wherein springs are secured to said anchor member and engage said grab members for moving said grab members in said slots.

7. Apparatus as set forth in claim 6 wherein said anchor member has a reduced end portion defining an external annular shoulder, said reduced end portion telescopically positioned within said transporter tube with said tube engaging said grab members and moving same to compress said springs as said transport tube abuts said shoulder and a latch member carried by said tube and arranged to project into one of slots for retaining said reduced end portion of said anchor member in telescopic engagement with said tube.

8. Apparatus as set forth in claim 4 wherein said transporter tube is formed with a removable segment, a knife and latch assembly supported on said segment and arranged to project into said tube upon the positioning of said segment in said tube, the latch of said assembly being arranged to project into one of said slots for retaining said anchor member in telescopic engagement with said tube.

9. Apparatus as set forth in claim 8 wherein said knife and latch assembly includes a housing that is detachably mounted upon supports secured to the inner surface of said removal segment with a latch bar pivotally mounted in the housing, spring means connected to said housing and engaging said latch bar for urging same into one of the slots in said anchor member.

10. Apparatus as set forth in claim 9 wherein said housing has actuating means connected thereof or moving said latch member out of said slot against the action of said spring to permit the separation of said anchor member and tube.

11. Apparatus for temporarily sealing apertures formed in the casing of a well comprising a transporter tube, an elongated tubular sealant member slidably positioned within said tube, an anchor member connected to said sealant member, said anchor member having a portion thereof telescopically positioned within said tube subjacent said sealant member, latch means carried by said tube for engaging the portion of said anchor member to retain same within said tube, a plurality of reciprocating members carried by said anchor member, means connected to said transporter tube for lowering said tube and anchor member in said casing and positioning said anchor member below the area of the apertures, means in said tube for actuating said latch means to release said anchor member from said tube, and means engaging said reciprocating members for moving them into engagement with said casing for securing said anchor member in said casing and effecting the withdrawal of said sealant member from within the tube as the tube is being raised in the casing.

12. Apparatus as set forth in claim 11 wherein said actuating means includes a bar positioned adjacent said latch means and means for slidably moving said bar to cause said latch means to release said anchor member.

13. Apparatus as set forth in claim 11 wherein said means engaging said reciprocating members includes a relatively flat spring member having one end engaging said reciprocating members and the other end secured to said anchor member.

14. Apparatus as set forth in claim 11 wherein said reciprocating members have serrations formed on the outer surface thereof for engaging said casing.

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DAVID H. BROWN, Primary Examiner

U.S. Cl. X.R.

166—162, 215