Dec. 19, 1967 W. B. BERRY 3,358,769

TRANSPORTER FOR WELL CASING INTERLINER OR BOOT

Filed May 28, 1965

FIG. 1

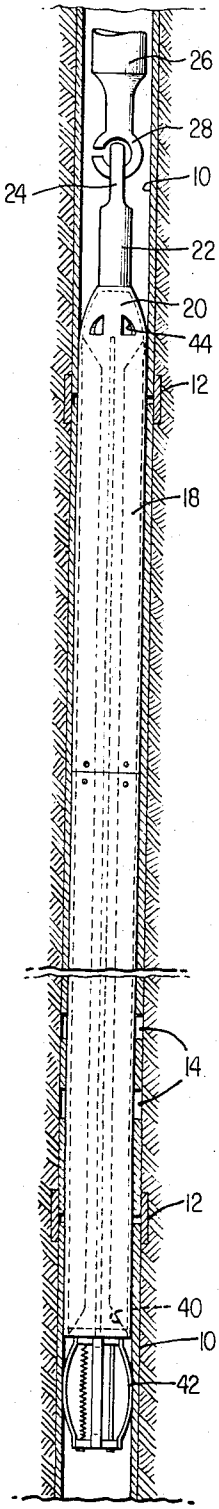


FIG. 4

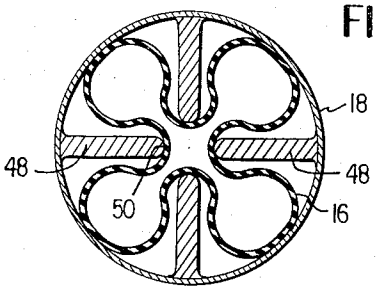


FIG. 2

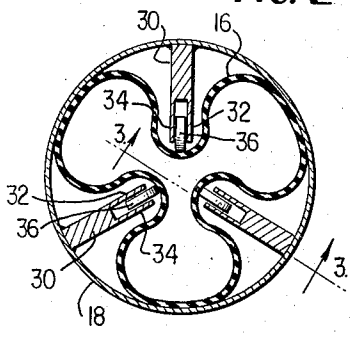


FIG. 3

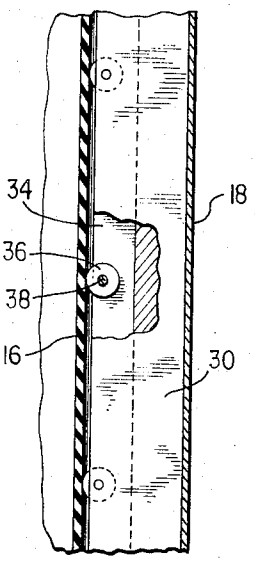
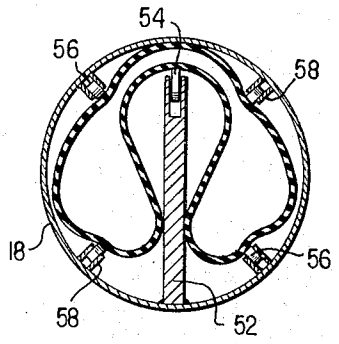


FIG. 5



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TRANSPORTER FOR WELL CASING INTERLINER OR BOOT

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ABSTRACT OF THE DISCLOSURE

An elongated cylindrical member having suitable means affixed to one end thereof whereby a conventional wire line may be connected thereto for lowering said member within a well casing. The cylindrical member is formed with at least one internal radially extending element that engages an elongated resilient sleeve or tubular member for radially compressing said sleeve throughout its length to facilitate the positioning and retention of said sleeve or tubular member within said cylindrical member. 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 constitutes an improvement over certain of the features embodied in applicant's copending application Ser. No. 362,442, filed Apr. 24, 1964.

In accordance with present day oil well operations, a production string of tubing or casing is set in the customary manner in a drilled shaft subsequent to which the casing is perforated in an area that is believed to coincide with an oil or gas bearing zone. The zone is then subjected to a stimulation treatment, such as by hydraulic fracturing, for the purpose of rupturing same to facilitate the formation of passageways therein through which the oil or gas may flow into the casing by way of the perforations. After a zone has been so treated, it is often found desirable to temporarily isolate or seal off same so that another zone at a point either above or below the treated zone may then be subjected to the same type of stimulation treatment.

The perforated portion or section of the casing or tubing may be temporarily sealed off in a most effective manner through the use of a sealant member which may readily take the form of an elongated hollow sleeve or boot formed from a suitable resilient material. The sleeve or boot, which becomes in a sense an interliner upon being positioned within the tubing or casing, is usually lowered, by a wire line, into the casing and positioned therein so as to overlie the perforated area and effectively seal same against the passage of oil or gas from the treated zone. The boot or interliner usually has an external diameter such that it will conform mostly to the drift size of the tubing or casing, and being formed from a resilient material, said interliner can very readily be maintained in engagement with the perforated casing with or without any well head pressure.

In order for a boot or interliner to be effective as a sealant, it is essential that it be properly positioned within the casing, so as to overlie the perforated area and said boot or interliner must be susceptible of ready removal from said casing when it is desired to bring into operation the zone that the boot is sealing off. The positioning and retrieving of a boot or interliner is usually undertaken at a point some distance down hole so that it is imperative and highly desirable that the apparatus or structure employed for such an operation be devoid of as many moving parts as possible in order that it may be extremely effective and positive in its operation. Several types of apparatus have been devised for lowering and positioning a boot or interliner within a perforated casing or

tubing and they have been found to be capable of performing such an operation. It is to be noted, however, that these prior art devices have usually embodied structures that are somewhat complex as regards their mode of operation as well as the manner in which the boot or interliner is connected thereto in order that it may be properly positioned within the casing. The present invention is designed to overcome the various shortcoming found to exist in such prior devices as regards the lowering and positioning of a boot or interliner so that it will overlie and effectively seal the perforations in a well casing.

One of the objects of the present invention is to provide a new and novel apparatus for introducing into a perforated well casing a unitary interliner for engaging and effectively sealing the perforations in said casing.

Another object is to provide an elongated tubular hollow member having at least one internal radially extending element engageable with an elongated resilient sleeve having a diameter greater than said member for radially compressing said sleeve throughout its length contemporaneous with positioning and retaining said sleeve within said member.

Another object is to provide a hollow transporter tube having a plurality of spaced internal radial members extending from end to end of said tube to engage a resilient sleeve or boot at spaced annular points for radially crimping said sleeve or boot and reducing its cross sectional area to facilitate its positioning within said tube.

Still another object is to provide a transporter tube having a plurality of spaced internal radial members which engage a resilient sleeve or boot member of elongated tubular configuration that has a normal external diameter greater than the internal diameter of said tube for radially compressing said sleeve at a plurality of spaced annular points to reduce its cross sectional area while producing a plurality of buckled sections to facilitate its positioning within said tube.

A further object is to provide a unitary resilient sealant member of elongated tubular configuration that is capable of being radially crimped or compressed through its length to facilitate its movement into a well tubing or casing and which is readily susceptible of returning to its normal condition for effectively engaging the casing to seal a perforated zone or area.

A still further object is to provide a unitary sealant member with resilient means connected to one end thereof and engageable with a well tubing or casing for effectively placing and maintaining said sealant member within said tubing or casing.

Other objects and advantages, more or less ancillary to the foregoing in the manner in which all of the various objects are realized, will appear in the following description, which, when considered in connection with the accompanying drawing sets forth the preferred embodiment of the present invention.

Referring to the drawing wherein the preferred embodiment of the invention is illustrated.

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

FIGURE 2 is a transverse sectional view of the transporter tube shown in FIGURE 1 and illustrating the manner in which a resilient interliner or boot is positioned within said tube;

FIGURE 3 is a detailed view, partly in section, of one of the crimping guide members provided in said transporter tube, the view being taken on the line 3—3 of FIGURE 2;

FIGURE 4 is a transverse sectional view showing a modified form of transporter tube with the resilient interliner positioned therein; and

FIGURE 5 is a transverse sectional view of a further modified form of transporter tube with a resilient interliner or boot positioned therein.

Referring to FIGURE 1, there is shown a conventional well bore that may extend through various pervious and impervious formations, some of which may have been determined to be producing formations, and said well bore is walled by a production casing string **10**. The casing **10** consists of a series of pipe sections of constant or uniform diameter which are externally threaded at their respective ends whereby adjacent sections may be joined together by threaded couplings **12** to produce a casing of the desired length. The casing **10** after having been set in the customary manner has been subjected to a perforating action in an area that might be considered to be a production zone so that it becomes necessary to close or seal the perforations **14**. Once the perforations **14** have been effectively sealed, the casing **10** may then be perforated in an area opposite another production zone that might be either above or below the zone that communicates with the interior of the casing through the perforations **14**. In order to effectively seal the casing at the perforations **14**, a resilient sealant boot or interliner **16**, FIGURE 2 must be positioned within the casing **10** so as to effectively overlie and seal said perforations.

The hollow elongated resilient sealant boot or interliner **16** is intended to be lowered into the casing **10** by means of a cylindrical transporter tube or carrying member **18**. The transporter tube is of elongated configuration and formed with a tapered upper end portion **20**, that has secured thereto or formed integrally therewith, a cylindrical stem member **22** which terminates in a hook or eye portion **24**. The eye portion **24** of the cylindrical member **22** is connected to a conventional sinker bar **26** by means of a hook **28**. The sinker bar **26** as well as the cylindrical stem member **22** are preferably formed from solid metal to provide the necessary weight to effect the lowering of the transporter tube **18** and sealant member within the casing string **10**, and the sinker bar may be connected to a conventional wire line, not shown, to facilitate and control the lowering of the transporter tube through the casing string.

As shown in FIGURES 2 and 3 the transporter tube **18** is provided on its inner surface with a plurality of inwardly projecting radial members or guides **30**. The members or guides **30** are arranged to project inwardly towards the center of the transporter tube **18** and are of a length commensurate with that of the transporter tube so that said guide members extend from the lower open end of the transported tube to the tapered upper end **20** of said tube. The radial members or guides **30** are spaced approximately 120° from one another around the interior of said transporter tube and said members or guides may be formed integrally with the transporter tube **18** or they may be secured, by any suitable means, to the inner surface of said tube. The innermost edges of the longitudinally extending radial members or guides **30** are bifurcated to provide a pair of spaced parallel arms **32** and **34** for the reception of rollers **36**. The rollers **36** are freely mounted upon pins **38** which in turn are supported, in any suitable manner, adjacent the outer edges of the arms **32** and **34** so that the rollers will project a slight distance beyond the outer or innermost edges of the guides **30**. It is to be understood that the radial members or guides **30** may be formed with the bifurcated portion extending from one end to the other or the innermost edges of the radial members or guides **30** may be formed with spaced bifurcated portions which would constitute pockets or recesses having arms **32** and **34** for receiving the rollers **36**. The rollers would still be spaced from one another and arranged to project beyond the inner edges of the radial members or guides. It is contended that such a change or variation would still fall within the scope of the present invention. The ends of the radial members

or guides **30** adjacent the lower or open end of the transporter tube **18** terminate in inclined portions or segments **40**, FIGURE 1, which facilitate the guiding of the sealant boot or interliner **16** as it is being introduced into the transporter tube **18**.

The elongated sealant boot or interliner **16** is of tubular configuration and preferably formed of high-strength rubber or some suitable resilient composition which would be sufficiently flexible so that said boot or interliner could easily expand against the wall of the casing string **10** or even against the wall of a bore hole if same is used without a casing string and can, therefore, be retained in said expanded position by the pressure within said casing or bore hole for effectively overlying and sealing the perforated or productive zone. The sealant boot or interliner has an external diameter such that it will conform closely to the drift size of the casing **10** so that the external diameter of the sealant boot or interliner **16** is greater than the internal diameter of the transporter tube or carrying member **18**. Thus, in order to position the sealant boot or interliner **16** within the transporter tube **18**, it must be crimped or compressed along its entire length so as to reduce its external diameter or cross sectional area to a point that the boot or interliner can be readily positioned within the transporter tube. As shown in FIGURE 2, the sealant boot or interliner **16** has been radially compressed or crimped at three equally spaced points and said compressing or crimping extends throughout the length of the interliner. The compressing or crimping is accomplished by manually compressing the upper end of the boot or interliner while forcibly guiding same over the inclined ends **40** of the radial members or guides **30**. As the sealant boot or interliner is continued to be forced into the transporter tube **18**, the rollers **36** on the inner edges of the radial members or guides **30** will engage the interliner to effect the radial crimping or compressing thereof at spaced annular points while at the same time facilitating the movement of the entire boot or interliner into the transporter tube **18**. As shown in FIGURE 1, the lower end of the sealant boot or interliner **16** has secured thereto a depending spring tension cage member **42** which is maintained outside and beneath the transporter tube **18** at all times.

In the use of the transporter tube of the present invention, the sealant boot or interliner **16** is first positioned within the tube to a point wherein the spring tension cage member **42** is positioned at or near the lower end of the transporter tube. The tube is then secured to the sinker bar **26** by means of the hook **28** and eye **24** of the cylindrical member **22** so that the transporter may then be lowered in the casing string **10** by a conventional wire line with the spring tension cage member **42** preceding the tube and interliner. The tapered end **20** of the transporter tube **18** is provided with a plurality of spaced openings **44** to permit the passage of fluid into and out of the tube as it is being lowered into the casing string **10**. The transporter tube will be readily lowered in the casing string **10** as the retarding or drag action imposed by the resilient elements of the spring tension cage member **42** engaging the inner face of the casing will be overcome by the weight of the transporter tube, cylindrical member **22** and sinker bar **26**. The transporter tube will be lowered to a point below the perforated area **14** of the casing **10** so as to be certain that the cage member **42** is positioned within the casing a desired distance below the lowermost perforation in the casing. With the cage member **42** so positioned, the direction of movement of the transporter tube **18** will be reversed through the wire line so that the cylindrical portion **22** and the transporter will then be raised or elevated within the casing string. This movement of the transporter tube will result in the sealant boot or interliner **16** being withdrawn from the transporter inasmuch as the spring tension cage member **42** will, through its engagement with the inner surface of the casing, act as an anchor to effect the ready with-

drawal of the sealant boot or interliner from the transporter tube as said tube is being elevated or raised within the casing string. Thus, as the sealant boot or interliner moves along the rollers **36** and out of the lower end of the transporter tube **18**, it will expand into engagement with the inner face of the casing string **10**, due to its resilient characteristics and thus, as the boot becomes free of the transporter, it will overlie the perforations **14** for effectively sealing the perforated area or zone.

The modified transporter tube shown in FIGURE 4 is identical in all respects to the transporter tube shown in FIGURE 2 with the exception that the inner surface of the tube is provided with four equally spaced inwardly projecting radial members or guides **48** so that the sealant boot or interliner **16** is crimped or compressed at four equally spaced points. The radial members or guides **48** are formed with rounded inner ends or edges **50** which constitute bearing surfaces that extend the full length of said members in lieu of using rollers as shown in FIGURE 2. In the event that the boot or interliner is sufficiently flexible so as to have a low tension drag, it is readily capable of sliding or moving along the bearing surfaces **50** of the radial guides **48** while being compressed and inserted into the transporter tube. Thus, the thickness as well as the size and the length of the sealant boot or interliner may readily determine whether it is more feasible to use a transporter tube of the type as shown in FIGURE 4 rather than the type as shown in FIGURE 2. However, in either instance, the mode of crimping or compressing the sealant boot or interliner along its entire length is identical and the manner in which the boot is inserted into the transporter tube is the same for the tube as shown in FIGURE 4 as it is for the tube shown in FIGURE 2.

The modified transporter tube shown in FIGURE 5 is provided with a single inwardly projecting radial member or guide **52** which is of a width slightly less than the internal diameter of the transporter tube **18**. The radial member or guide **48** is provided with rollers **54** along the innermost edge in the same manner as the radial members or guides **30** shown in FIGURE 2. The inner surface of the transporter tube **18** as shown in FIGURE 5 is provided at spaced points throughout its length and on its inner surface with a plurality of small rollers **56** that are freely mounted within suitable brackets **58** that are secured to the inner surface of the transporter tube **18**. The rollers **56** tend to facilitate and aid the positioning of the sealant boot or interliner **16** within the transporter tube **18** in order to reduce friction drag, and in FIGURE 5, the boot or interliner is provided with only a single crimping or compressing along the entire length of the boot. It is to be noted that the rollers **54** along the inner edge of the radial member **52** as well as the brackets **58** and rollers **56** may be dispensed within the modified form of FIGURE 5 if the boot or interliner **16** is sufficiently flexible and has a low tension drag. The use of rollers along the inner edge of the radial member as well as the bracket rollers **56** is to aid in positioning the boot or interliner within the transporter tube under the conditions wherein friction or drag would tend to hinder or restrict the ready positioning of the boot within said transporter tube.

The sealant boot or interliner as shown in FIGURE 5 is positioned within the casing string in the same manner as the sealant boot or interliner shown in FIGURE 2 and here again the thickness and size of the sealant boot or interliner could very readily dictate as to whether a transporter tube of the type as shown in FIGURE 5 should be used in lieu of the type as shown in either FIGURE 2 or FIGURE 4. It should be borne in mind that the depth within the casing string that the boot or sealant liner is to be positioned could readily determine what thickness of sealant boot would have to be employed in order to withstand the pressure for effectively sealing a perforated area. Thus, the thickness of the sealant boot or interliner

could very readily determine the type of transporter tube that should be employed as the thicker the sealant boot or interliner, the more difficult it becomes to compress or crimp same so as to force it into the transporter tube. Therefore, it might very well be that the thickness of the sealant boot or interliner would under certain conditions dictate that a transporter tube of the type as shown in FIGURE 5 should be employed rather than the type shown in FIGURE 2 or FIGURE 4. In this connection, it should be noted that the transporter tube may readily be assembled in multiple sections such as shown in FIGURE 2 or in lieu of multiple sections a single section can be employed and here again, the length of the sealant boot or interliner would dictate as to whether a transporter tube of a single section or one of multiple sections would be required. It is to be noted, however, that the same general concept for crimping and compressing the boot or interliner **16** is embodied in the several different forms of the transporter tube. In addition, the various radial members or guides of the transporter tubes are provided with means that not only facilitate the positioning of the boot or interliner within the tube but also aid and abet its ready removal therefrom.

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 rearrangements 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 a cylindrical transporter member, an inwardly extending radial guide member provided on the inner surface of said transporter member, a sealant member formed of a resilient material and having a normal external diameter greater than the internal diameter of said transporter member, resilient means connected to one end of said sealant member, said guide member engaging said sealant member to radially compress same in a direction throughout its length and reduce its cross sectional area upon its insertion into said transporter member, means connected to an end of said transporter member for lowering and raising same in said casing and positioning said resilient means in engagement with said casing at a point below said apertures for withdrawing said sealant member from said transporter member and allowing said sealant member to expand into engagement with the casing in the area of the apertures.

2. A transporter for an elongated tubular shaped interliner adapted to be radially compressed throughout its length to reduce its cross sectional area comprising a tubular carrying member, a plurality of inwardly extending radial members provided on the inner surface of said carrying member, and being of a length commensurate with that of said carrying member, said radial members being equally spaced from one another about the inner surface of said carrying member and arranged in diametrically disposed pairs, the inner edge of each pair of said radial members being spaced from one another, a plurality of rollers mounted in the inner edges of said radial members, said rollers engaging said interliner at spaced points to radially compress same and reduce its cross sectional area throughout its length contemporaneous with the insertion of said interliner into said carrying member.

3. A transporter for an elongated tubular shaped interliner adapted to be radially compressed throughout its length to reduce its cross sectional area comprising a tubular carrying member, a plurality of inwardly extending radial members provided on the inner surface of said carrying member, and being of a length commensurate with that of said carrying member, said radial members being equally spaced from one another about the inner surface of said carrying member with the inner edges of said radial members being spaced from one another, a

plurality of rollers mounted in the inner edges of said radial members, said rollers engaging said interliner at spaced points to radially compress same and reduce its cross sectional area throughout its length contemporaneous with the insertion of said interliner into said carrying member.

4. A transporter for an elongated tubular shaped interliner adapted to be radially compressed to reduce its diameter throughout its length comprising a tubular carrying member, an inwardly extending radial member provided on the inner surface of said carrying member and being of a length commensurate with that of said carrying member, a plurality of spaced rollers mounted in the inner edge of said radial member, a plurality of spaced brackets mounted on the inner surface of said carrying member, rollers mounted in said brackets, said spaced rollers in said radial member engaging said interliner to radially compress same and reduce its diameter throughout its length contemporaneous with said bracket rollers engaging said interliner upon its insertion into said carrying member.

5. Apparatus for applying a sealant member to the inner surface of a well casing for sealing apertures formed

therein comprising an elongated cylindrical transporter member, an inwardly extending radial guide member provided on the inner surface of said cylindrical member, said radial member being of a length commensurate with that of said cylindrical member, a sealant member formed of a resilient material and having a normal external diameter greater than the internal diameter of said cylindrical member, said radial member engaging the outer surface of said sealant member to compress same throughout its length to reduce its diameter contemporaneous with said sealant member being inserted into said cylindrical member, and means connected to an end of said cylindrical member for lowering said sealant member in said well casing.

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JAMES LEPPINK, *Primary Examiner.*