

May 24, 1955

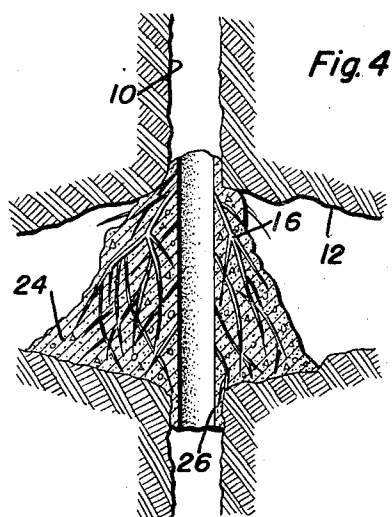
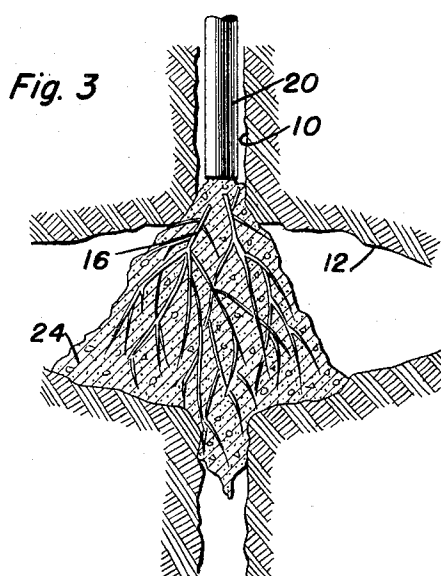
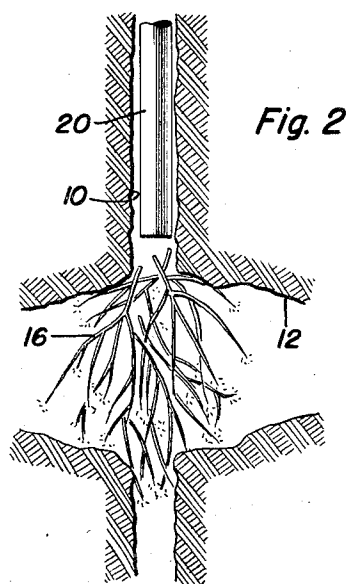
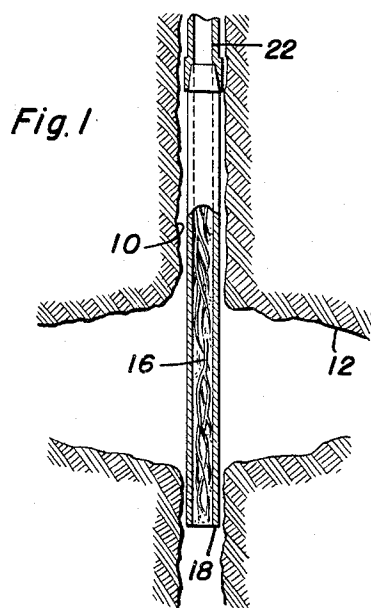
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2,708,973

METHOD AND APPARATUS FOR BRIDGING WELL FISSURES

Filed April 9, 1951

2 Sheets-Sheet 1



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METHOD AND APPARATUS FOR BRIDGING WELL FISSURES

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2 Sheets-Sheet 2

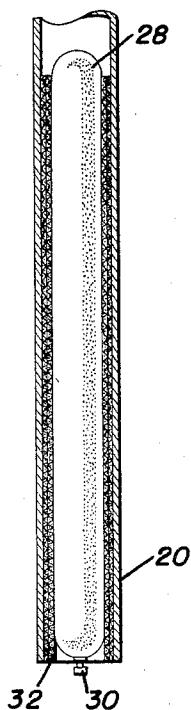


Fig. 5

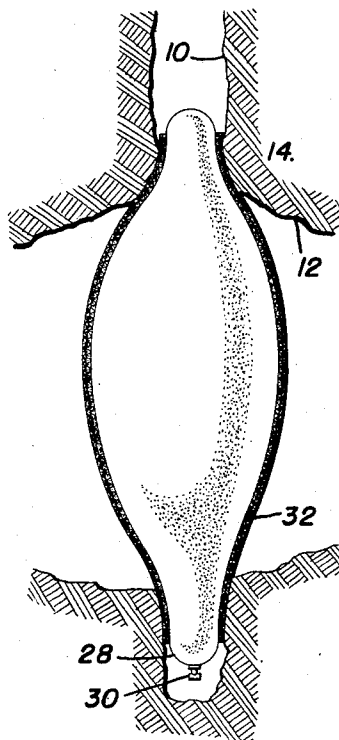


Fig. 6

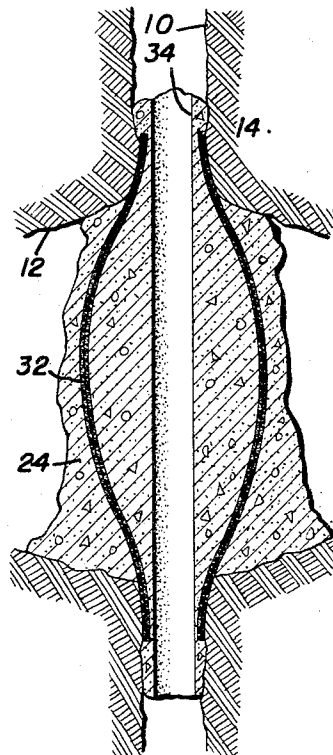


Fig. 7

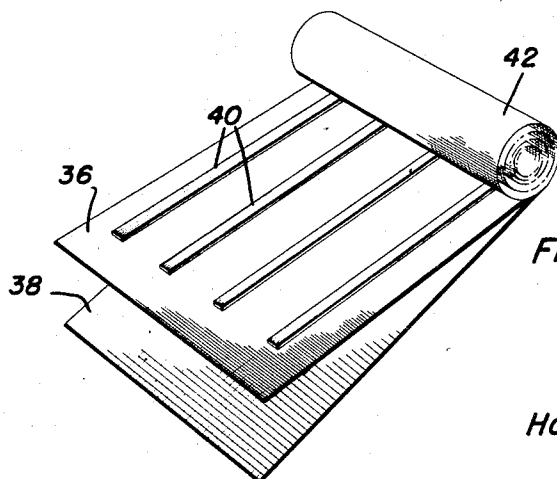


Fig. 8

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METHOD AND APPARATUS FOR BRIDGING WELL FISSURES

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5 Claims. (Cl. 166—22)

The present invention relates to a new and useful method for bridging fissures or cavities encountered during the drilling of wells and to apparatus particularly adapted for practicing the method.

The primary object of this invention is to devise a method and apparatus for sealing or closing off fissures or cavities from a well hole, which will require a minimum of time and materials.

Another important object of this invention is to prevent the loss of drilling mud or the dilution of the same during drilling operations.

Still another important object of this invention is to avoid waste of sealing materials or cementitious materials used in sealing off fissures by preventing the passage of successive quantities of these materials into the fissure or cavity.

A further object of this invention is to devise a method for realizing the above objects, which will be readily utilized by those possessing the customary and expected skill of those normally in charge of or conducting drilling operations.

Yet another object of this invention is to devise an apparatus for practicing the method of this invention which will be simple and inexpensive, and which will, to a large extent, consist of materials customarily at hand during drilling operations.

It is still a further object of this invention to devise a method and apparatus for providing a very strong and reliable seal that will last indefinitely, and which may be readily penetrated by the drill for extending the bore to greater depths.

A meritorious feature of the method of this invention resides in the fact that a wide range of objects may be used for bridging a fissure.

A further feature of the invention resides in the fact that the bridging material is expanded to a position in which the same will constitute a substantial barrier to passage of sealing material therethrough and further into the fissure, and form a skeletal supporting framework for supporting the sealing material.

Another important feature of the present invention resides in the fact that the same may be utilized with equal facility in oil, gas or water wells.

Final important features of the present invention to be specifically enumerated herein reside in the various forms of bridging material illustrated herein, as well as the various forms of construction for urging the bridging material to expanded position.

These, together with various ancillary features and objects of the invention which will later become apparent as the following description proceeds, are attained by the present invention, preferred embodiments of which have been illustrated by way of example only in the accompanying drawings, wherein:

Figures 1-4, inclusive, are views, partially in section, illustrative of sequential stages passed through in practicing the method of the present invention, when plants or vegetable fibers are used in bridging the fissure;

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Figure 5-7, inclusive, are sectional views illustrating a modified form of the invention and showing the apparatus used and the sequential steps in utilizing such apparatus in sealing off a cavity; and,

Figure 8 is a perspective view of a still further modified form of the apparatus suitable for use in practicing the broad method of the present invention.

The method of the present invention encompasses broadly the steps of subjecting bridging material, the desired characteristics of which will be subsequently apparent, to a force tending to expand the same laterally, and while restraining such material against lateral expansion, inserting the same in a well hole and moving the same to a position adjacent a fissure or cavity to be sealed, and then removing the restraining force and allowing the material to expand laterally to a position bridging the fissure or cavity. Usually it is desired to supplement the sealing effect of the bridging material, inasmuch as such bridging material may not be impervious to the passage of fluids therethrough, by the application of a sealing material, preferably of a cementitious character, thereto.

With attention first directed to the form of the invention shown in Figures 1-4, it will be seen that a well hole 10 opens laterally into a cavity 12. It should be stated at this point that the terms "cavity" and "fissure" are used interchangeably throughout the specification and claims, and are meant to define any undesirable opening in the formation 14 that is in communication with the well hole 10. Since objectionable flows of fluid may pass from the well hole 10 into the cavity 12, and vice versa, and for other technical reasons, it frequently becomes necessary to seal off the cavity 12 from the well hole 10, particularly where the volumetric extent of the cavity is very great.

In order to seal off the cavity 12, it is obvious that the latter may be filled with a sealing or cementitious material, however, where the cavity 12 is of very large size, this is a very expensive procedure.

In accordance with the present invention, the cavity 12 is first bridged or sufficient material is lodged therein adjacent the juncture of the same with the well hole 10, that such bridging material will constitute a total or partial dam against the passage of sealing material into the cavity, and serve to hold the latter in the mouth of the cavity, so to speak, to seal the cavity and to allow the material to set if the same is of a cementitious character.

In order to accomplish this purpose a plurality of plants 16 are laterally compressed and inserted root ends first into the lower end 18 of a tube 20, while the latter is disposed above the surface of the ground. Although it is preferred that the plants be inserted in the tube as described, it is obvious that the plants, if desired, may be inserted into the tube through either end thereof root first, or vice versa. While it is thought that most types of plants that can be forced into the tube 20 will suffice for the purposes of the present invention, it is particularly desirable that the plants selected be tough and durable, and that the vegetable fibers of the same possess considerable resiliency so that on removal from the tube 20, the plants will expand laterally. Exemplary of the extremely wide range of plants that serve the purposes of the invention, the yucca plant, the lechuguilla plant, and the white spruce have been found to work extremely well and possess the desired characteristics to a high degree. In general, all plants possess the desired characteristics to some extent, and for particular sizes of tubing 20 and cavity 12 dimensions, some plants may be found to serve more satisfactorily than others.

After the plants 16 are pushed into the tube 20, the tube 20 is lowered in the well hole 10 to the position shown in Figure 1, in which the plants 16 in the tube

20 extend from the top of the cavity 12 to the bottom thereof. It is not essential that the well hole 10 extend below the cavity 12 but it is preferred that the well hole extend a short distance below the bottom of the cavity 12 so that the plants 16 will extend from below the bottom of the cavity 12 to above the top of the same.

Fluid pressure is then applied in the tube 20 to force the mass of plants 16 from the lower end of the tube 20, and while the plants 16 are being forced therefrom, the tube 20 is raised at a rate approximately equal to the rate that the plants are ejected therefrom so that the plants 16 and the tube 20 assume the positions shown in Figure 2, it being noted that upon release of the restraint of the tube 20 upon the plants 16, the latter have spread laterally into the cavity 16.

The aforementioned fluid pressure may be most easily applied within the tube 20 by having lowered the tube 20 in the well hole upon a string of drilling stem 22, the lower end of which is partially shown in Figure 1. Mud, water, or any suitable fluid such as oil may be forced through the drill stem 22 and into the tube 20 to force the plants 16 therefrom.

After the plants 16 are positioned as shown in Figure 2, cement slurry or any suitable cementitious sealing material 24 is passed through the tube 20 into the mass of plants 16, it being noted that the plants 16 form a skeletal framework for supporting the material 24, and prevents substantial quantities of the material 24 from passing therethrough and further into the cavity 12 or the portion of the well hole below the cavity 12, as illustrated in Figure 3. In other words, the mass of plants 16 constitute an effective hindrance against the passage of quantities of sealing material 24 into the cavity 12 substantially in excess of the amount required to seal off the mouth of the cavity 12. After the sealing material 24 has set and has become sufficiently hardened to proceed with drilling operations, the portion of the plants 16 and the matrix of sealing material 24 therefor disposed in alignment with the well hole 10 may be drilled through to form a bore 26 (see Figure 4) that is effectively sealed off from the cavity 12.

It will of course be understood that the material 24 need not necessarily be introduced through the tube 20, and any other conventional means for this purpose may be employed.

In order to expedite the above described procedure, the plants 16 may be ejected from the tube 20 by the material 24 itself, in which instance, the material 24 will follow the plants 16 from the tube 20 to form a matrix thereabout, as will be apparent to those skilled in the art.

It is not absolutely essential to the present invention that the plants 16 be lowered to the position shown in Figure 1 while still in the tube 20, but if desired or deemed expedient for any reason, the tube 20 may be lowered to substantially the position shown thereof in Figure 2 with the plants 16 therein, after which the tube 20 is held stationary and fluid pressure is applied as stated hereinbefore to eject the plants 16 downwardly from the tube 20. Upon being ejected from the tube 20 in this particular manner, the plants 16 will expand laterally while moving downwardly to the fissure bridging position shown of the same in Figure 2.

Inasmuch as the expanded plants 16 are to form at least a partial barrier for the material 24, it is preferred that the plants 16 be packed initially as compactly as possible in the tube 20, and with the leaves, branches, or the like thereof entangled to a considerable extent to strengthen the barrier formed thereby in the cavity 12.

Attention is now directed to the form of the invention shown in Figures 5-7, inclusive. As in Figures 1-4, the well hole is shown at 10, the cavity at 12 and the tube at 20 (partially shown). This form of the invention differs from the form illustrated in Figures 1-4 primarily in the character of the bridging material employed and the means specially provided to cause lateral expansion

of the bridging material upon ejecting the same from the tube.

This form of the invention comprises a resilient inflatable member 28, preferably formed of rubber or similar material, which is provided with a valve inlet 30 through which air or other expansible fluid may be introduced into the member 28 under pressure. Indicated at 32 is a deformable mat or screen that is deformable in character, and which may be formed of woven fibers, metal, or synthetic materials. The member 28 is rolled up within the mat or element 32 while deflated and such elements are inserted in the lower end of the tube 20 with the inlet 28 being accessible. The member 28 is then inflated through the inlet 30 to a high pressure and the inlet 30 is then closed. With the member 28 thus inflated, it will be seen that it bears on the element 32 to urge lateral expansion of the latter. A number of elements 32 may be employed, and if these elements differ in structural strength, the stronger is placed outermost, that is, next to the tube 20.

After the elements 32 and the member 28 are positioned in the tube 20, and after the member 28 is inflated to be in the relative positions thereof shown in Figure 5, the tube 20 is inserted into and lowered in the well hole 10 to a position corresponding to that shown in Figure 1, and is then slowly raised while fluid pressure is applied within the tube 20 to eject the elements 32 and the member 28 therefrom in such a manner that the vertical position of the elements 32 and the member 28 is disturbed as little as possible, whereupon the member 28 expands upon release of a restraint previously imposed thereon by the tube 20 to the position shown in Figure 6, wherein it will be noted that elements 32 bear against the sides of the well hole 10 immediately above and below the cavity 12 with the intermediate portions of the same bulging into the cavity 12.

With the elements 32 in the position shown in Figure 6, a cementitious sealing material 24 is forced into the interior of the elements 32, that is, the space previously occupied by the member 28, it being noted that the member 28 will either rupture upon expansion into the shape shown thereof in Figure 6 by virtue of its own extension, or by the application of pressure thereon by the material 24. Obviously, any other suitable means, not shown, may be provided for rupturing the member 28 if deemed necessary, such as a pointed tool that may be lowered through the tube 20.

It will be seen that the elements 32 will constitute a partial barrier against the passage of material 24 into the cavity or fissure 12, so that the material 24 will assume the position shown in Figure 7, which material 24, upon hardening may be drilled to provide the bore 34 therethrough as will be understood.

In the further modified form of the invention shown in Figure 8, spring means are employed to serve the function of the inflatable member 28 used in conjunction with the form of the invention shown in Figures 5-7. In this form of the invention, a screen 36 is superimposed upon a screen 38 of greater mesh size. A plurality of elongated spring strips 40 are laid on top of the screens 36 and 38 and the screens and the strips 40 are rolled up in a manner that will be clearly apparent from reference to Figure 8 to form a roll 42. Obviously, if the roll 42 is rolled tightly, the same will expand laterally if released from restraint holding the same in a tightly rolled condition. The roll 42 is restrained against lateral expansion and inserted in the tube 20. The roll 42 is then released from the tube 20 in the well hole 10 in a manner similar to that in which the elements 32 were released, as described in connection with Figures 5-7. The roll 42 will be sufficiently compact, of course, while seated in the tube 20 that fluid pressure within the tube 20 will eject the roll 42 therefrom.

Upon release of the roll 42 in the well hole, the roll 42

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will unwind to such an extent as to seat against the well hole 10 above and below the cavity 12.

As in the previously described forms of the invention, a cementitious sealing material is formed into the center of the expanded roll 42 to form a seal for the cavity 12 as will be evident to those skilled in the art. In the event that the springs 40 are not of sufficient strength to bulge the screens 36 and 38 into the cavity 12, it will be apparent that the pressure of the cementitious material applied to the interior of the roll 42 will serve this purpose.

It will be evident that the use of the springs 40 may be dispensed with entirely when the screens are formed of a material of sufficient resiliency to be self unrolling after being released from the tube.

Since the mat 32 in the form of the invention shown in Figures 5-7, as well as the screens 36 and 38 of the form of the invention shown in Figure 8 obviously do not have to be in roll form, but may be placed in the tube in any suitable arrangement so as to expand laterally under the urging of the elements 28 and 40, respectively, upon release from tube, the scope of the invention is not to be considered limited solely to the use of mats and screens of roll form. For example, the mats and screens may be of zigzag or accordion shape.

It is also contemplated that in filling the tube with any of the forms of the invention shown in the drawings, chopped, cut, or ground rags formed of cotton, silk, wool, rubber, or synthetic fibers may also be inserted in the tube either packed in therewith or placed loosely in the tube above the same, so that upon expelling the mass from the tube by fluid, the rags will be forced against the plants, mats or screens (as the case may be) to further perfect the seal of the fissure bridged thereby. In fact, it is thought that such rags may be inserted and tightly packed in the tube in lieu of the bridging constructions shown in the drawings.

From the foregoing, the method of the invention and the nature of apparatus suitable for use in practicing the method of the invention will be readily understood and further explanation is believed to be unnecessary. However, since numerous modifications and changes will readily occur to those skilled in the art after a consideration of the foregoing specification and accompanying drawings, it is not desired to limit the invention to the exact apparatus shown and method described, but all suitable modifications and equivalents may be resorted to, falling within the scope of the appended claims.

Having described the invention, what is claimed as new is:

1. For use in bridging a fissure in a well hole, a tube and deformable fissure bridging material slidably disposed therein, and spring means disposed within the deformable material and also within the tube for urging lateral expansion of the deformable material, whereby the spring means will expand the deformable material laterally to a

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size exceeding the outside diameter of the tube upon the material when said means is ejected from the tube.

2. For use in bridging a fissure in a well hole, a tube and deformable fissure bridging material slidably disposed therein, and a resilient inflatable member disposed within the deformable material and also within the tube, whereby the member may be inflated with an expansible fluid to urge lateral expansion of the bridging material when ejected from the tube.

3. A method for bridging a fissure in a well bore comprising applying a confining compressive force against an inherently resilient elongated body of material normally tending to expand laterally to thereby restrain the body against lateral expansion and hold it in a relatively narrow mass, introducing the body while in the confined state into a well bore to a position opposite the fissure and thereafter releasing the restraining and confining force to allow the body to expand laterally to its normally unconfined state whereby to expand and bridge the fissure.

4. A method for bridging a fissure in a well bore comprising applying a confining compressive force against an inherently resilient cluster of elongated discrete bridging elements normally tending to expand laterally to thereby restrain the cluster against lateral expansion and hold it in a relatively narrow mass, introducing the mass while in the confined state into a well bore to a position opposite the fissure, releasing the restraining and confining force to allow the cluster to expand laterally to its normally unconfined state to provide a skeletal bridge across the fissure and then introducing a cementitious material into said well bore and into and upon said skeletal bridge to establish a seal across said fissure.

5. A method for bridging a fissure in a well bore comprising providing an inherently resilient generally tubular body provided with a filler of loose cement and normally tending to expand laterally, applying a confining compression force against said resilient tubular body and its filler to thereby restrain the body and its filler against lateral expansion and hold it in a relatively narrow mass, introducing the body while in a confined state into a well bore opposite the fissure and thereafter releasing the restraining and confining force to allow the tubular body and the cement filler to expand laterally to its normally unconfined state whereby to expand and bridge the fissure.

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