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METHOD OF PACKING WELLS

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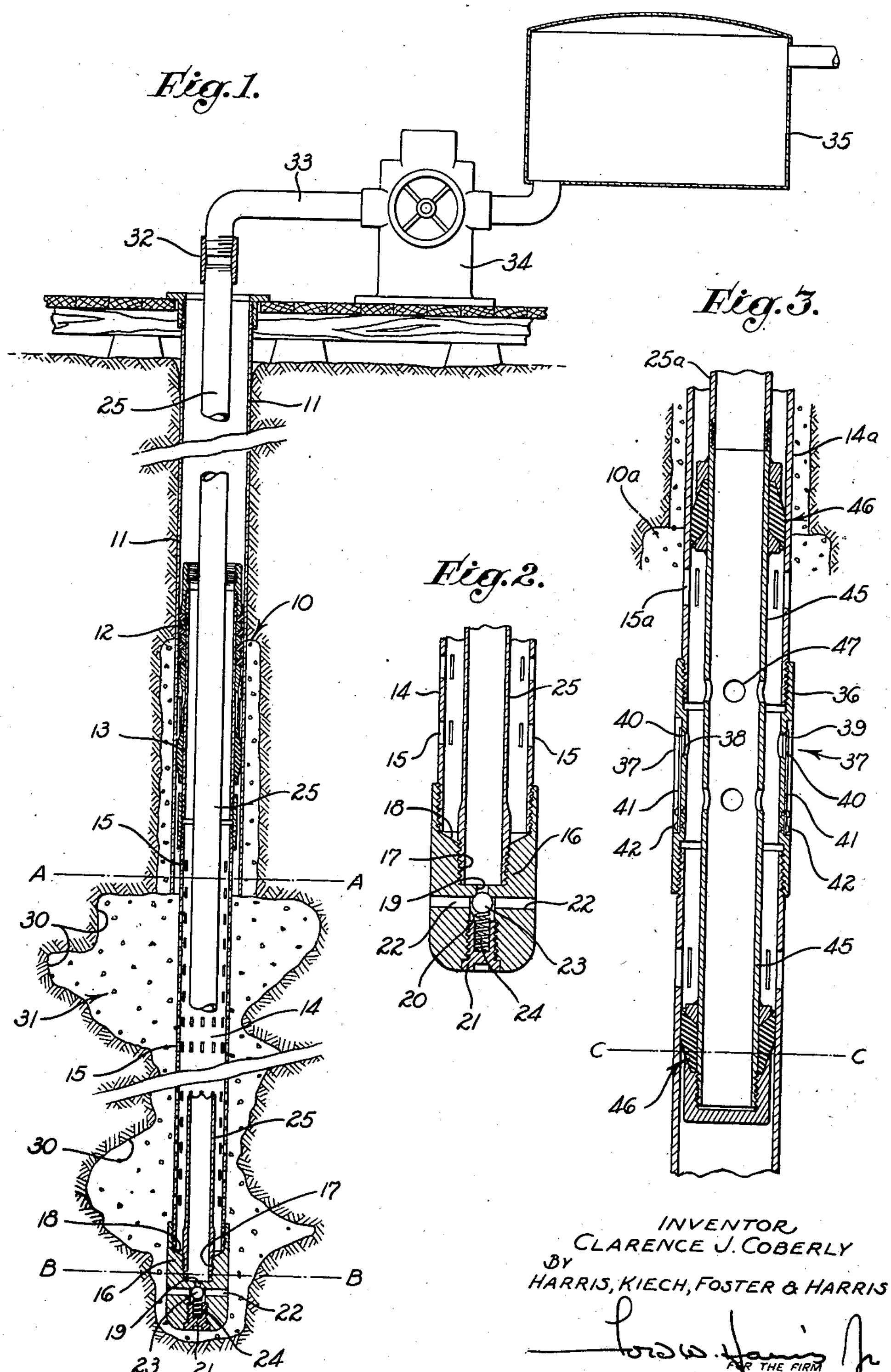
Fig.1.

Fig.3.

Fig.2.



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METHOD OF PACKING WELLS

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7 Claims. (Cl. 166—26)

This application is a division of my application Serial No. 186,597, filed January 24, 1938, for "Gravel packing for wells," now Patent No. 2,217,215, granted Oct. 8, 1940.

This invention generally relates to the well art and more particularly to a method of packing a well so as to prevent sand from the well formation from entering the bore of the well. Although the invention has a wide range of uses, it has particular utility in the oil well pumping art, and, accordingly, the preferred embodiment will be described in connection therewith for the purpose of illustration.

In many oil fields, the oil producing zone is comprised in part at least of relatively fine sand, which, during normal pumping of a well therein, tends to become detached from the formation and to pass through the pump and associated production equipment, causing excessive wear and requiring frequent shut-downs for equipment repairs and replacements. Thus, pumps, tubing, gas traps, and other production equipment which are operated under such conditions have an extremely short life, and the annual cost of replacement and repairs for such equipment due to such production of sand in the oil is a substantial burden on the oil industry. Another major difficulty encountered under such pumping conditions is the tendency for the pumping equipment and tubing to become filled with sand, or "sanded-up," so that the equipment cannot be operated. This always requires a thorough cleaning of the tubing and pumping equipment, which usually necessitates removal of the pump and an extended bailing of the tubing, both of which interrupt the production from the well, causing great economic waste and loss to the operators. Therefore, it is a primary object of this invention to provide a method of treating a well so as to prevent the above-stated difficulties now commonly experienced in the art.

For the purpose of this specification, the term "sand" is defined as meaning any undesirable substance formed of discrete particles normally found in a well and which it may be desired to exclude from entering the production equipment of the well, such as, for example, true sand, shale, mica, or other similar substances.

In the prior art, attempts have been made to overcome the above-stated difficulties by setting a perforated liner at the bottom of the well, having perforations of the proper mesh to prevent the entry of the formation sand therethrough. These attempts have not been successful, however, because in many oil fields, due to the fineness of the sand, producing conditions, low bottom-hole pressures, or other factors, it has not been possible to set a liner which will properly control and prevent the production of sand. The usual difficulty is that where merely a fine perforation liner is used, the formation sand packs therearound to form a bed of sand of low permeability, with an attendant pressure drop therethrough, greatly decreasing the maximum production from the well. In addition, a liner having a fine mesh perforation will readily clog to further reduce the production. It is, therefore, another object of my invention to provide a method for so treating a well that a liner having perforations of relatively large mesh may be employed.

Attempts have been made in the prior art to pack the space between the perforated liner and the well formation with gravel, sometimes referred to as "gravel-packing," for the purpose of forming a bed of gravel therebetween substantially impervious to the flow of sand therethrough but permitting oil to flow into the pump through the liner. Such attempts at gravel-packing have not proved satisfactory because of the lack of knowledge of the factors involved and a proper method of application thereof and apparatus therefor. Accordingly, it is another object of this invention to provide a method for packing a well with a substance comprised of discrete particles, such as, for example, gravel, in which the previously indeterminate factors are given a novel solution.

Although gravel is a cheap and satisfactory substance for use in my invention, it will be understood that any suitable substance comprised of discrete particles may be substituted therefor without departing from the spirit of my invention.

By testing oil wells in the Oklahoma City Field, near Oklahoma City, Oklahoma, in which considerable trouble has been experienced as a result of sand in the pumped oil, I have established a number of relevant facts. For example, in some wells in this field the producing zone is almost continuous sand from top to bottom, the sand occurring in layers of varying hardness, due to different binders, different amounts of binder, different degrees of compaction of the well formation, and other conditions. Furthermore, in most of the older wells of this field, large cavities have formed in the well formation throughout the length of the producing zone as a result of the formation sand becoming detached and being produced with the oil during the flowing and gas left stages of production of the wells. Many of the wells in this field are now being pumped, or are soon to be placed on the pump, but sand difficulties continue during the pumping, the magnitude of which depend on the age of the well, its present production, length of period of natural flow, length of period of gas lift, gas-oil ratio, well location, and any other factors which have affected or may still affect the size of the cavities between the well and the producing zone formation and the ability of the oil to carry sand from the present producing zone to the bore of the well. In some of the newer wells of this field which are being pumped but in which only a small cavity has formed around the well, it has been found that if such a well is shut down for as short a period as a quarter of a minute, the pump becomes sanded-in due to settling of the large percentage of sand carried by the oil in the production tubing. Some or all of these conditions may be found in other oil fields.

In packing gravel around a well base, there are three principal problems presented: (1) selection of the proper mesh gravel to prevent travel of substantial quantities of formation sand therethrough with the oil to be pumped; (2) proper placement of the gravel; and (3) the selection of a liner having perforations of a proper mesh to prevent the gravel from passing therethrough. The latter problem is readily disposed of after selection of gravel of the proper size, as a liner perforation of twice the grain size at the ten percentile may be employed if an assorted size gravel is used, or a perforation twice the width of the grain size of the individual grains may be employed if a closely graded gravel is used.

The selection of the proper size or mesh gravel to screen the formation sand is more difficult. Using sand grains taken from a typical oil well having bad sand conditions and passing them through a bed of gravel, I have discovered that stable bridging of the sand grains over the spaces between the gravel grains occurs when the diameter of an imaginary circle inscribed in the space between the gravel grains is not over two times the diameter of the ten percentile sand grain size. The gravel size may also be stated as: the diameter of the largest gravel grains in a single classified gravel (Tyler scale) suitable for gravel packing is approximately thirteen times the effective sand grain size at the ten percentile. These conclusions are stated for gravel grains of the maximum size that can be used to form a stable sand bridge therebetween, although gravel grains of one or possibly two screen sizes (Tyler scale) smaller would provide an additional factor of safety in insuring the formation of stable sand bridges between the gravel grains. Accordingly, it is a further object of my invention to provide a substance comprised of discrete particles, such as, for example, a gravel, for packing an oil well which bears the above-stated size relation to the size of the formation sand therein.

Regarding the placement of the gravel in an oil well, I have found that the gravel should be transported to the point of placement in such a manner that the possibility of clogging of the gravel during placement is reduced to a minimum. Furthermore, the angle of repose of the gravel must be small so that the gravel may fill all crevices and pockets in the well formation as fully as possible. Also, the method of placing the gravel should be such that if any interruption occurs, placing of the gravel may be resumed without serious difficulty. Further, any material mixed with the gravel to facilitate placement thereof should be readily removable by washing, natural flow of the oil, or otherwise, and preferably should be soluble in or miscible with the produced oil. Also, provision should be made for the placing of additional gravel in the well at some later time in case of settling of the original gravel bed or incomplete filling of the formation cavities. Furthermore, the gravel should preferably be placed from below; that is, the flow of the gravel should be from the bottom of the hole upward, in order to reduce to a minimum the caving of the formation walls during placement of the gravel and to reduce the possibility of a portion of the well hole remaining filled with original formation sand. Therefore, it is another object of this invention to provide a method and composition of matter capable of accomplishing the foregoing desired conditions.

The conditions set forth in the preceding paragraph are best fulfilled by mixing the discrete particles, such as gravel, with a viscous fluid and placing it in a state of pressure-mobile mixture in the well cavity, and, accordingly, this is still another object of the invention. This mixture, being pressure-mobile, will also have the advantage that it may be handled as a fluid, i. e., pumped through tubing in much the same manner that mud is pumped.

Another object of the invention is to provide a novel composition of matter comprised of a substance made up of discrete particles having the size characteristics stated hereinabove, for use in packing a well.

Likewise, it is an object of the invention to provide a pressure-mobile mixture of a substance formed of discrete particles and a viscous fluid.

I provide an apparatus for pumping a well comprising a tubing in the well having a perforated liner at the lower end thereof, and a check valve connected to the bottom of the liner permitting a material to be expelled from the tubing into the well but preventing the material from passing from the well through the valve and into the liner.

I provide an apparatus for use in a well, comprising a tubing in the well, having a plurality of valves spaced along the length of such tubing, and means for selectively passing a substance out of the tubing and into the well through any one of the valves as desired.

Another object of the invention is to provide a method for packing a well in which discrete particles are pumped into the well from the lower end of a tubing, the pumping pressure values being utilized to indicate completion of the packing operation.

Although the principal object of the invention is to prevent the production of sand from a well, with its attendant difficulties given hereinabove, it is also to be noted that the invention may be advantageously applied to wells having little or no sand difficulties. In many wells, although little sand difficulty is experienced, considerable trouble is had with soft portions of the formation, such as clay, for example, caving or "heaving" to shift the bore of the well or to pinch off the liner or other tubing therein. This is due to the fact that there is always a substantial space in a well around the production tubing. By packing this space as described herein, these difficulties may be, in part at least, obviated, and, accordingly, this is another object of the invention.

Other objects and advantages of my invention will be evident from the following specification, which is for the purpose of illustration only, the claims, and the drawing in which:

Fig. 1 is a diagrammatic sectional view of a well having my preferred form of apparatus therein.

Fig. 2 is an enlarged sectional view of the lower end of the apparatus of my invention.

Fig. 3 is a diagrammatic sectional view of a well having an alternative form of the invention therein.

Referring to the drawing, Fig. 1 shows a well 10 having a water tubing 11 therein which extends from the top of the well to a point just above the oil producing zone of the well, for example, as represented as lying between the lines A—A and B—B, as is well known in the art. Secured in the lower end of the water tubing 11, as by a suitable combination packer and hanger 12, is a permanently set outer tubing 13 at the lower end of which is secured by a suitable coupling a liner 14 having perforations 15 in the walls thereof. It will be recognized, however, that the outer tubing 13 and liner 14 may be formed integrally in one piece, by merely perforating the lower end of the outer tubing. As shown in detail in Fig. 2, a valve shoe 16 is threaded to the lower end of the liner 14 and is provided with an internally threaded central bore 17 and a seat 18 therearound. The central bore 17 communicates with a vertical passage 19 having a counterbore 20 internally threaded to receive a threaded plug 21. Radial passages 22 communicate between the counterbore 20 and the exterior of the valve shoe 16. A ball valve member 23 is held in upwardly seating engagement with the vertical passage 19 by means of a compression spring 24 bearing against the threaded plug 21. The valve shoe 16 and the mechanism therein thus provide a valve means adapted to permit materials to pass outwardly through the vertical passage 19 and the radial passages 22, forcing the ball valve member 23 downwardly against the action of the compression spring 24, but prevent materials from passing inwardly from the well through the radial passages and the vertical passage into the central bore. Threadedly received in the central bore 17 is the lower end of a wash tube 25, which may be extended through the water tubing 11, the outer tubing 13, and the liner 14 into fluid-tight seating relation on the seat 18.

As shown in Fig. 1, the lower end of the wall 10 may have one or more relatively large cavities 30 extending back from the well bore into the producing formation of the well. As pointed out hereinabove, these cavities 30 are normally formed during the natural flow, gas lift, or pumping stages of production from the well, and are caused by relatively soft portions of the well formation, including considerable quantities of fine sand, becoming detached therefrom by the flow of oil inwardly from the formation to the bore of the well. The depth and cross-sectional area of the cavities 30 depend largely upon the history of the well and the flow and pumping conditions therein, and may vary from a foot or two in length to many feet in length. As indicated, it is the primary purpose of the present invention to fill the cavities 30 and the space between the liner 14 and the well formation with a body of discrete particles, such as gravel, so as to form a screen preventing the passage of substantial quantities of formation sand therethrough and through the perforations 15 into the liner and outer tubing 13.

Adapted to be connected to the upper end of the water tube 25 by means of a coupling 32 is a supply pipe 33 having a suitable pumping mechanism 34 in the line thereof, the pipe 33 being connected to a closed supply tank 35 which acts as a reservoir for the material to be used for packing the well.

In operation, and prior to the setting of the outer tubing 13 in the lower end of the water tubing 11, the lower end of the well 10 is cleaned by bailing, or otherwise, so as to remove substantially all of the sand and other foreign materials which may have accumulated in the bottom of the well during prior operations in producing from the well. Such bailing or cleaning is a common expedient in the art and will be familiar to those versed in the industry. When the bottom of the well 10 has been thoroughly cleaned of sand and other foreign materials, the outer tubing 13, with the packer and hanger 12, the liner 14, and the valve shoe 16 attached thereto, is run in the well to substantially the position shown in Fig. 1 by any means well known in the art, such as a string of tubing connected to the upper end of the outer tubing (not shown), and the packer and hanger is then utilized to hold the outer tubing in place at the bottom of the well. As will be noted, the packer 12 forms a seal between the outer tubing 13 and the water tubing 11, which is utilized for a purpose to be described hereinafter. Although I have shown a well 10 in which the water tubing 11 has been inserted in accordance with the usual well practice, it will be recognized that in some wells no water tubing is provided at the bottom of the well and that the packer and hanger 12 may be positioned in direct engagement with the walls of the well without departing from the present invention. When the outer tubing 13 is set in position in the well 10, as described, the wash tube 25 is then run into the well through the water tubing 11 and the outer tubing 13 until the lower end thereof seats on the seat 18 of the valve shoe 16, at which time the wash tube is rotated so as to screw it into the threaded central bore 17 to form a fluid-tight joint with the valve shoe. In some cases, it may be desirable to use the wash tube 25 to run the outer tubing 13 into the position shown in Fig. 1, in which case the wash tube is threaded into the valve shoe prior to insertion in the well and only one operation is required thereby.

When the outer tubing 13 and the wash tube 25 are in position, as shown in Fig. 1, the supply pipe 33 is connected to the wash tube by means of a coupling such as 32, so as to connect the wash tube with the supply tank 35 through the pumping mechanism 34. The supply tank 35 is then filled with the substance with which it is desired to pack the well 10, and, as described hereinabove, for this purpose I prefer to use a pressure-mobile mixture of discrete particles, such as gravel, and a viscous fluid, such as a hydrocarbon derivative obtained from the same type of oil as is to be produced from the well. This mixture is mixed in the supply tank 35 and is then pumped therefrom by the pumping mechanism 34 through the supply pipe 33 and downwardly through the wash tube 25, through the central bore 17 of the valve shoe 16, the vertical passage 19, depressing the ball valve member 23, and outwardly through the radial passages 22 into the well around the lower end of the valve shoe. Actuation of the pumping mechanism 34 is continued, and the pressure-mobile mixture flows upwardly in the well 10, filling the cavities 30 and the space between the formation and the liner 14 until it reaches the packer and hanger 12, at which time the pumping pressure on the pumping mechanism 34 rises to indicate that the bed 31 has been completely formed. When this material rise in pressure occurs, the operation of the pumping mechanism 34 is stopped, the supply pipe 33 and coupling 32 are disconnected from the wash tube 25, and the wash tube is then unscrewed from the valve shoe 16 and removed from the well. The interior of the liner 14 and outer tubing 13 is then bailed to remove any gravel from the wash tube therein, any suitable type of pumping mechanism may then be lowered through the well 10 into pumping position with relation to the liner 14, and pumping of the well may then be commenced. During pumping, oil or other well fluid flows from the formation through the bed 31 comprised of discrete particles, such as gravel, flows through the perforations 15 of the liner 14 and may then be pumped to the surface of the ground. Due to proper selection of the size of the discrete particles with reference to the size of the formation sand, and the proper selection of the size of perforations 15, the discrete particles are substantially prevented from entering the liner 14 through the perforations 15 thereof, and the formation sand is prevented from passing through the bed 31 of discrete particles. By the selection of discrete particles of the proper size relative to the size of the formation sand, as pointed out herein, a substantial quantity of the sand is effectively screened from entry into the liner 14 without decreasing the normal flow of oil or other well fluid through the bed 31. By using a viscous fluid for the pressure-mobile mixture, the mixture may be pumped as a fluid through the tubing and valve shoe 16 and will readily flow into the desired position in the well. By using a viscous fluid which is miscible or soluble in the oil or other fluid to be produced from the well, the viscous fluid will be quickly washed out of the bed 31 by the well fluid passing therethrough upon commencement of the normal pumping operation.

Although the invention has been primarily described in connection with a well in which a pump is to be installed, it will be appreciated that I do not intend to have the invention limited to packing a well to be pumped, since the invention is equally applicable to a well that is in the natural flow or gas lift stages.

It will also be understood that when the packing operation is commenced, there is ordinarily a considerable head of oil accumulated in the bottom of the well 10, and particularly below the packer and hanger 12, and that as the pressure-mobile mixture is passed upwardly in the well around the liner 14 this head of oil must be displaced. To prevent the oil from being forced back into the well formation, the perforations 15 are preferably continued up the liner 14 to a point adjacent the packer and hanger 12, so that as the pressure-mobile mixture is introduced into the bottom of the well 10 and upwardly therein, the oil thereabove may flow into the liner through the perforations 15, thus preventing a high back-pressure from being built up on the producing zone formation.

It is sometimes desirable, however, to provide a special solvent for removing the viscous fluid from the bed 31 prior to commencement of the pumping operation. In such cases, I prefer to empty the closed tank 35 of its pressure-mobile mixture, replacing it with a viscous fluid solvent or other substance which will effectively cut the viscosity of the viscous fluid, such as distillate in the case where a viscous hydrocarbon is employed as the carrying agent for the discrete particles, which is then pumped through the supply pipe 33 and the wash tube 25 and into the well as described, from which it flows through the bed 31 so as to decrease the viscosity of the viscous fluid therein. This may be regarded as a modified form of my process, and can also be performed by means of a standard perforation washer, as is well known in the art.

Also, in some installations, I have found it desirable to precede the packing operation by pumping a quantity of the viscous fluid to be used into the bottom of the well without any discrete particles therein, so as to form a layer of heavy fluid at the bottom of the well, the purpose of which is to protect the viscous fluid in the pressure-mobile mixture from contamination by mixture with the oil or other well fluid from the formation. This operation will normally be carried out prior to pumping of the pressure-mobile mixture into the well as described.

In Fig. 3 I show a modified form of apparatus which may be used in connection with the apparatus shown in Fig. 1 to carry out a modified method of packing a well. Similar parts are given similar indicating numerals with the suffix *a* added thereto. The device shown in Fig. 3, and the method employed therewith, are frequently preferable where the producing zone of the well is extremely long and where a long liner 14*a* is required, or where there are alternate blank and perforated zones in the liner. In such cases, the liner 14*a* is divided into a plurality of sections joined together by couplings 36, each of the couplings having inwardly closing valves 37 therein comprised of openings 38 in the wall of the coupling provided with seats 39 adapted to receive an inwardly faced valve member 40 resiliently held in engagement with the seat 39 by a spring arm 41 suitably secured to the coupling as by rivets 42. Although only one coupling 36 is shown in Fig. 3, it will be understood that as many of such couplings as desired may be utilized. The valves 37 thus permit the pressure-mobile mixture to be forced out of the liner into the well 10*a* at various points along the length of the liner. In this form of the invention the wash tube 25*a* is provided with a fitting 45 adapted to be secured to the lower end thereof having basket packers 46 at opposite ends thereof and radial openings 47 therein. In operation of the device shown in Fig. 3, the liner 14*a* is first set in the well as described with relation to Fig. 1, and the wash tube 25*a* is run into the tubing as described with relation to Fig. 1, and the pressure-mobile mixture is pumped therethrough and into the well as heretofore described. Due to the long length of the liner 14*a*, the pressure-mobile mixture cannot satisfactorily be pumped from the bottom of the inlet shoe 16 above a certain distance above the inlet shoe due to the weight of the pressure-mobile mixture and packing thereof in the cavities 30. When the bed of discrete particles 31 is thus formed to a certain height, such as represented by the line C—C, pumping of the pressure-mobile mixture is discontinued, the wash tube 25*a* is removed from the well, and the fitting 45 is attached to the bottom thereof as shown in Fig. 3. The wash tube 25a is then run into the well to a position in which the basket packers 46 straddle any one of the couplings 36, preferably the lowest coupling through which it is possible to place the mixture, and the pressure-mobile mixture is then pumped downwardly through the wash tube 25a and outwardly through the opening 47, forcing the valve member 40 outwardly against the resilient action of the spring arm 41 to permit the pressure-mobile mixture to be pumped outwardly through the liner 14a into the well above the bed 31 previously formed. Pumping is then continued as desired or until the pressure required therefor rises substantially, and the pumping is then discontinued, the wash tube 25a is then moved until the basket packers 46 straddle another coupling 36, preferably the next higher in the liner 14a through which the mixture can be placed, and pumping may then be resumed to force the pressure-mobile mixture outwardly into the well through the inwardly closing valve 37 above that first used. This may be continued as desired until the entire well is suitably packed with a bed or beds 31 of discrete particles formed by the pressure-mobile mixture. The wash tube 25a may then be withdrawn from the well, the well bailed, a well pump inserted, or production otherwise commenced as described in connection with Fig. 1. In the apparatus shown in Fig. 3, the perforations 15a should be selected of a mesh such that no discrete particles will be able to enter the perforations from the inside of the liner 14; otherwise, when the basket packers 46 with the pressure-mobile mixture therebetween are being moved through the liner, the perforations will become plugged. Liners with fine-meshed slots may be set without affecting the well production, due to the high permeability of the bed 31, and thus it will be possible in most cases to select a liner having perforations which will not plug with discrete particles when the pressure-mobile mixture is in engagement with the inside of the liner 14a.

After a well has been pumped or otherwise produced for some time with a packing bed 31 therein, the bed may settle, making it desirable to add an additional layer of discrete particles on the top thereof. The inwardly closing valves 37 of the liner 14a may be utilized in such cases to increase the depth of the bed 31 without disturbing the bottom portion of the bed, and this is another modified use of the invention.

Although the invention has been described in connection with a well in which cavities 30 have already been formed during the past history of the well by prior flow conditions, it will be evident that extensive cavities around the perforated liner will increase the natural production of the well by increasing the formation area draining into the well, provided the formation sand can be held in place. It will therefore be evident that in new wells where no such cavities 30 have been formed during the history of the well, it may be advantageous to create such cavities by any means well known in the art, such as underreaming the well hole prior to the packing operation. Although it is old in the art to underream a well to increase the production thereof, and although this does not play any part in the present invention, it will be recognized that underreaming in conjunction with the present invention may be distinctly advantageous in new wells so as to obtain maximum production therefrom.

It will be understood that modifications of the apparatus and method disclosed herein may be used without departing from the spirit of the invention, and, accordingly, I do not desire to be limited by the foregoing specification but intend to be granted the full scope of the following claims.

I claim as my invention:

1. A method of removing sand grains from the production flow of a well, including the steps of: forming a single classified body of discrete particles in which the diameters of the largest particles are approximately thirteen times the size of the sand grains in the well at the ten percentile; disposing said body of discrete particles in the well in the path of the production flow therefrom; and passing said production flow through said body of discrete particles.

2. A method of removing sand grains from the production flow of a well, including the steps of: forming a single classified body of discrete particles in which the diameter of a circle inscribed in the spaces between the largest particles is approximately two times the size of the sand grains in the well at the ten percentile; disposing said body of discrete particles in the well in the path of the production flow therefrom; and passing said production flow through said body of discrete particles.

3. A method for packing a well having substantial quantities of sand in the well formation of the producing zones thereof, including the steps of: permanently setting a liner in a well opposite to a production zone of the well; forming a bed of discrete particles around a portion of said liner, said bed being substantially impervious to sand in the well; extending a tubing downwardly into said liner to a first position adjacent the top of said bed; and passing additional discrete particles downwardly through said tubing and out through said liner at a point above said bed so as to form an additional layer of said particles around said liner on the top of said bed.

4. A method for packing a well having substantial quantities of sand in the well formation of the producing zones thereof, including the steps of: permanently setting a liner in a well opposite to a production zone of the well; forming a bed of discrete particles around a portion of said liner, said bed being substantially impervious to sand in the well; extending a tubing downwardly into said liner to a first position adjacent the top of said bed; passing additional discrete particles downwardly through said tubing and out through said liner at a point above said bed so as to form an additional layer of said particles around said liner on the top of said bed; raising said tubing upwardly to a second position in said well adjacent the top of said additional layer without moving said liner; and passing additional discrete particles downwardly through said tubing and out through said liner at a point above said additional layer so as to form a further layer of said particles around said liner on top of said additional layer.

5. A method for packing a well having a perforated liner permanently set therein, including the steps of: forming a first bed of discrete particles around a portion of said liner, said bed being substantially impervious to sand in the well; extending a tubing downwardly into said liner to a position above the top of said first bed; and passing additional discrete particles downwardly through said tubing and out through the walls of said liner to form a second bed of said particles around said liner above said first bed.

6. A method for packing a well having a perforated liner permanently set therein, including the steps of: passing a stream of discrete particles downwardly through said liner, out the lower end thereof, and up around the outside thereof to form a first bed of said particles around a portion of the length of said liner, said first bed being substantially impervious to sand in the well; and passing additional discrete particles downwardly through said liner and out through the walls thereof at a point above the top of said first bed to form a second bed of said particles around said liner above said first bed.

7. A method for packing a well having a perforated liner permanently set therein, including the steps of: setting a tubing in a first position in the liner; passing a stream of discrete particles downwardly through said tubing and outwardly through the walls of said liner to form a first bed of discrete particles around said liner, said first bed being substantially impervious to sand in the well; raising said tubing to a second position in said liner without moving said liner; and passing additional discrete particles downwardly through said tubing and outwardly through the walls of said liner to form a second bed of discrete particles around said liner above said first bed, said second bed being substantially impervious to sand in the well.

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