

Oct. 26, 1937.

L. A. LAYNE ET AL

2,096,904

GRAVELING TOOL

Filed Feb. 3, 1936

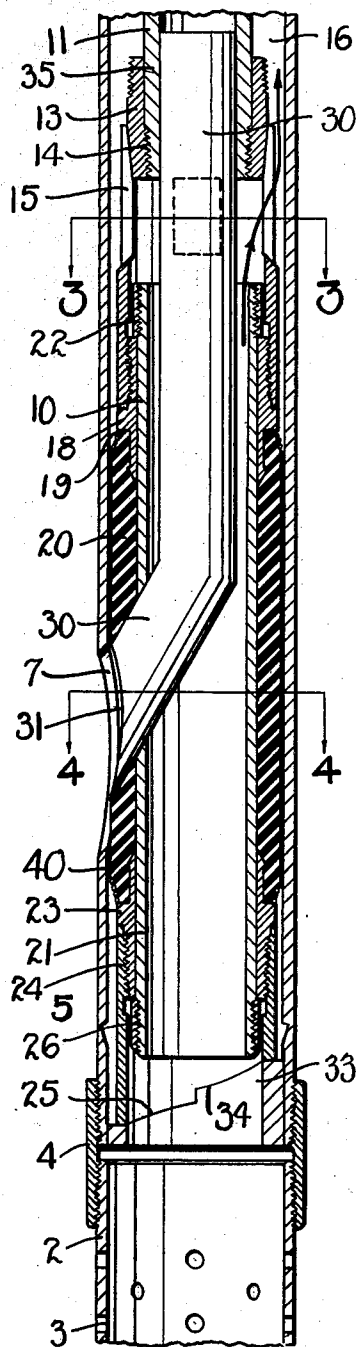


Fig. 1.

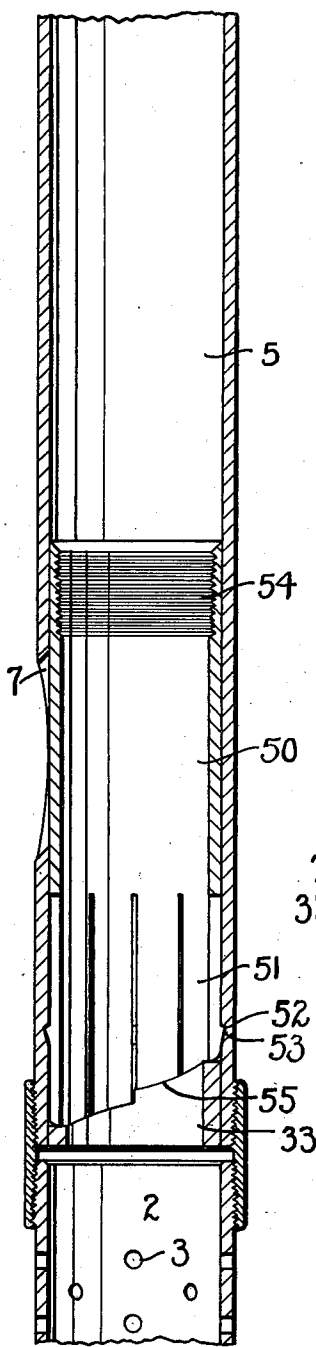


Fig. 2.

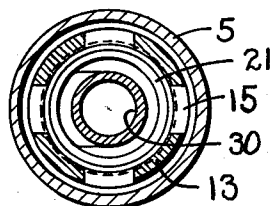


Fig. 3.

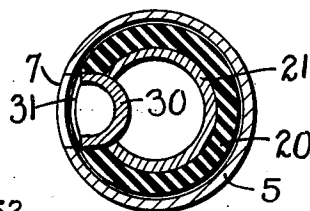


Fig. 4.

L. A. LAYNE
H. C. BLOCK

INVENTORS

BY *Jesse R. Stone*
Lester B. Clark.
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,096,904

GRAVELING TOOL

Leslie A. Layne and Harold C. Block, Houston,
Tex.; said Block assignor to said Layne

Application February 3, 1936, Serial No. 62,028

12 Claims. (Cl. 166—21)

The invention relates to a graveling tool whereby gravel may be deposited at the desired elevation in a well bore.

It is well understood that in the drilling of wells the desired fluid occurs in various porous stratum and that it is of advantage to enlarge the cavity as much as possible in the porous stratum so that the exposed surface thereof for the drainage of desirable fluid will be greater.

It is also desirable to filter out foreign matter from the fluid being recovered and to this end it is the practice to form an enlarged cavity in the porous formation and to then fill this cavity with a filtering material such as gravel. This gravel deposit is usually positioned about the eduction tube or strainer so that a filtering body is formed in this matter.

The present invention directs itself to a tool which may be lowered through the pipe into the well so as to discharge gravel in the cavity about the pipe and to thereafter remove the tool so that it will not interfere with the production of fluid from the well.

It is one of the objects of the invention to provide a tool which may be lowered into the pipe in the well and so arranged as to form a seal with the discharge port in the pipe so that all of the gravel and its carrier liquid will be discharged from the pipe.

Another object of the invention is to provide a graveling tool which can be moved into alignment with a discharge port and form a seal about such port.

Still another object of the invention is to provide a tool for placing gravel in wells which can be lowered into and removed from the well bore.

Still another object of the invention is to provide a graveling tool which will form a seal with the discharge area in the pipe and at the same time permit a return flow of the carrier liquid therethrough.

Another object of the invention is to provide a protective sleeve which will cover the discharge port in the pipe when the graveling tool is not in use.

It is also an object of the invention to provide the combination of a graveling tool having a packer thereon.

Other and further objects of the invention will be readily apparent when the following description is considered in connection with the accompanying drawing wherein:

Fig. 1 is a vertical, sectional view through a pipe in the well bore in which the graveling tool

has been lowered and is ready to be set in graveling position.

Fig. 2 is a vertical, sectional view of the pipe when the graveling tool is not being used and illustrating the sealing sleeve to cover the discharge port in the pipe.

Figs. 3 and 4 are sections taken on the lines 3—3 and 4—4 respectively of Fig. 1.

The pipe which is positioned in the well bore is indicated generally at 2 and usually includes a section of strainer pipe 3 on the lower end thereof. A coupling 4 serves to connect the strainer 3 with what is generally termed the liner 5. This liner is in the form of a piece of pipe which extends upwardly from the strainer and in event the strainer is of less diameter than the usual casing then the upper end of this liner is sealed with the inside of the lower end of the casing. In some wells, however, the liner and casing are in one piece and in other wells the liner extends to the surface as a separate string of pipe inside of the casing. Regardless of which form is used the liner 5 is believed to be sufficient to illustrate the operation of the present invention.

It will be understood that a cavity has been formed about the strainer 3 and that this cavity is to be filled with gravel by discharging it from the liner 5 through a discharge port 7. This port is formed on the inside of the pipe or liner 5 and is preferably above the coupling 4 and the strainer 3.

The graveling tool is shown generally at 10 and is lowered into the well bore by means of a string of pipe 11. This pipe may be a special graveling string of pipe or it may be any string of ordinary pipe. The lower end of this string of pipe carries a coupling 13 which is threaded to the string at 14. This coupling is of special construction having a plurality of openings spaced circumferentially therein whereby a flow of fluid may move upwardly through the tool 10 and into the area 16 between the setting string and the liner 5.

The coupling 13 is threaded internally at its lower end to receive the packer setting collar 18 which is formed with a shoulder 19 thereon against which the upper end of the resilient packer 20 is arranged to abut. This packer is preferably arranged upon a mandrel 21 which is positioned inside of the packer and extends above the collar 18 and has a ring 22 thereon to suspend the mandrel on the collar 18. The packer is supported at its lower end by a collar 23 which is carried by the upper portion 24 of a clutch mem-

ber 25. A bottom stop collar 26 is arranged to hold the mandrel 21 in position to support the packer 20. A discharge pipe 30 for the gravel is arranged to form a connection between the setting string 11 and the discharge port 7. The end of this pipe 30 forms a discharge opening 31 which is arranged to be moved into alignment with the discharge port 7 in the liner 5. This alignment occurs because of the clutch arrangement 25 which has its lower portion 33 fixed in the lower part of the liner 5.

The clutch 25 has stepped areas 34 which are complementary on the portions 24 and 33 so that when the tool 10 is lowered into position a slight rotation thereof will cause the parts to move into the position shown in Fig. 1 with the ports 7 and 31 in exact alignment. The pipe 30 extends upwardly and has a sliding seat at 35 inside of the lower end of the setting string 11.

When the gravel is to be positioned in the well the tool 10 is lowered with the string 11 until it approaches the elevation shown in Fig. 1. A slight rotation then causes the stepped portions of the clutch 25 to move into engagement as seen in Fig. 1. When the operator is unable to rotate the operating string 11 he is then informed that the clutch is properly set and that the ports 7 and 31 are aligned.

The next step is to lower some of the weight of the graveling string 11 onto the coupling 13 so that the top collar 17 above the packer will move downwardly to cause expansion of the packer. The lower collar 23 is held stationary by the clutch so that the flexible packer 20 will be expanded inside of the liner 5. In this manner a seal will be formed at the position 40 around the circumference of the port 7 so that any material, either fluid or solid, discharged from the pipe 30 will be caused to move out through the liner 5 and cannot move into the cavity inside of the liner.

It will be noted that the mandrel 21 is not compelled to move in either direction by the expansion of the packer, but is floating in between the collars 18 and 23. The slip joint at 35 allows the discharge pipe 30 to remain stationary as the packer is expanded. In this manner the discharge pipe 30 will have little, if any, movement during the packer setting operation and in view of the fact that the port 7 is considerably larger than the discharge opening 31 it seems obvious that the pipe 30 will always be within the periphery of the discharge port 7.

With the packer set and the pipe 30 in position the gravel will be discharged downwardly usually in combination with a carrier liquid which is delivered at a relatively high velocity to carry the gravel into the well cavity. The carrier liquid when discharged into the cavity will drain back through the strainer 3 and will be forced upwardly through the mandrel 21 and the ports 15 into the area 16 between the setting string and collar. This is the return flow of carrier liquid and it will discharge from the top of the well bore.

After the gravel has been deposited the washing liquid may be circulated in this same manner in order to wash the gravel free of any foreign matter and when the operator observes the returns clearing up he is then advised that the gravel has been deposited and washed clean. It is then only necessary to raise the weight of the setting string 11 and the entire graveling tool can in this manner be withdrawn from the well.

If it is desired to close the port 7 a sleeve such as 50 may be dropped or lowered into the hole in any desired manner so that it will move into the

liner 5 in the position shown in Fig. 2. The lower end of this sleeve 50 is formed with a plurality of spring fingers 51 which carry outstanding lugs 52 which are arranged to engage in the undercut sockets 53 formed in the liner. In this manner the sleeve 50 is latched in position and cannot be removed except when a suitable tool is engaged in the threads 54 to exert a considerable pull and release the lugs 52 from the sockets 53. The lower end 55 of this sleeve is formed the same as the bottom of the top clutch body 24 to engage with the bottom clutch body 33. In this manner it is insured that the discharge port 7 will be completely closed and there can be no inflow of either liquid or solid material into the well except through the strainer 3.

Broadly the invention contemplates a graveling tool which may be readily lowered into and removed from a well bore when a graveling operation is to be performed.

What is claimed is:

1. A graveling tool for discharging gravel in wells comprising an outer pipe having an opening therein, a stop member in said pipe, a discharge tool adapted to be moved into said pipe and to abut said stop member, a packer on said last tool to engage the inside of said pipe to seal about said opening, a discharge port through said packer, and means to deliver gravel to said port through said packer.

2. A graveling tool for discharging gravel in wells comprising an outer pipe having an opening therein, a stop member in said pipe, a discharge tool adapted to be moved into said pipe and to abut said stop member, a packer on said last tool to engage the inside of said pipe to seal about said opening, a discharge port through said packer, means to deliver gravel to said port through said packer, and interengaging means on said discharge tool and said stop member to align said opening and port.

3. The combination with a pipe in a well wherein gravel is to be deposited of a gravel discharging tool, ports in said pipe and tool, means to align said ports, and a packer to seal the connection between said ports.

4. The combination with a pipe in a well wherein gravel is to be deposited of a gravel discharging tool, ports in said pipe and tool, means to align said ports, a packer to seal the connection between said ports, and a return passage through said tool for the gravel carrying liquid.

5. A gravel discharge tool for use inside of a pipe within a well bore comprising a body, a gravel discharge line projecting laterally there-through, and a packer on said body adapted for expansion to seal about said line where it projects from said body.

6. A graveling tool for wells comprising a body, a packer thereon, a gravel line projecting laterally from said body and packer, a liquid return passage through said body around said line, and means to expand said packer to seal about said line.

7. A graveling tool including a gravel discharge line, an expansible packer means to seal about said discharge line, and means to cooperate with the pipe through which the gravel is being discharged to orient said tool.

8. A well screen and liner therefor, a port through said liner above the screen, a graveling tool to be lowered into said liner, dental clutch members on said tool and liner to orient said tool with said port, a gravel line carried by said tool, packer means on said tool which is expansible to

seal the inside of said liner about said port whereby the gravel from said line will discharge from said pipe, and a liquid return passage through said tool for the carrier liquid rising through said screen.

5 9. A well graving tool including a body to seat in the pipe about which the gravel is to be deposited, said body including a mandrel, a gravel discharge pipe supported by said mandrel, a packer on said mandrel, and a slip joint connection between the body and said mandrel whereby said packer may be expanded.

10 10. A well screen and liner therefor, a port through said liner above the screen, a graving tool to be lowered into said liner, dental clutch members on said tool and liner to orient said tool with said port, a gravel line carried by said tool, 15 means on said tool to seal the inside of said liner about said port whereby the gravel from said line

will discharge from said pipe, a liquid return passage through said tool for the carrier liquid rising through said screen, and a sleeve to be deposited in said liner to cover said port after the graving operation is completed.

11. In a well to be graveled, a liner, a gravel discharge port therethrough, a stop in the liner below said port, a closure sleeve to be deposited in said liner to engage said stop and to cover said port, and means to latch said sleeve in said liner.

12. A graving tool for wells having a pipe therein including a body, expansible means thereon to seal between said body and the well pipe, a return passage through said body and expansible means, and a graving pipe extending into said body.

LESLIE A. LAYNE.
HAROLD C. BLOCK.