April 9, 1940. C. K. HOLT 2,196,439

WELL CLEANER

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Fig. 1

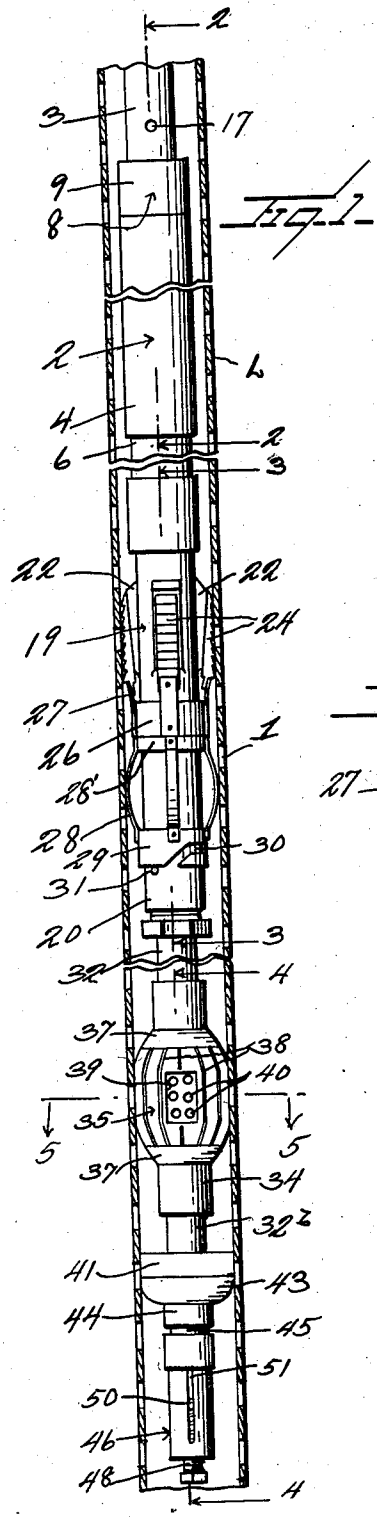


Fig. 2

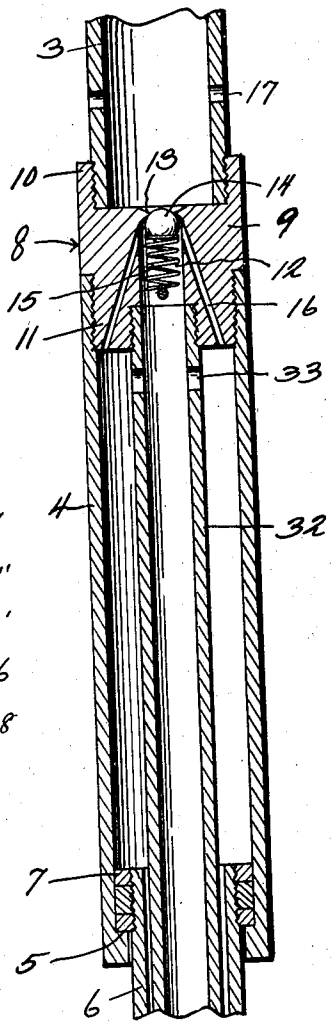
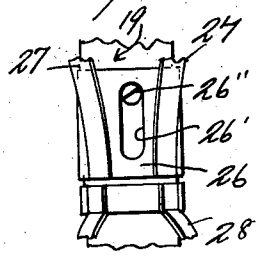


Fig. 7



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Fig. 4

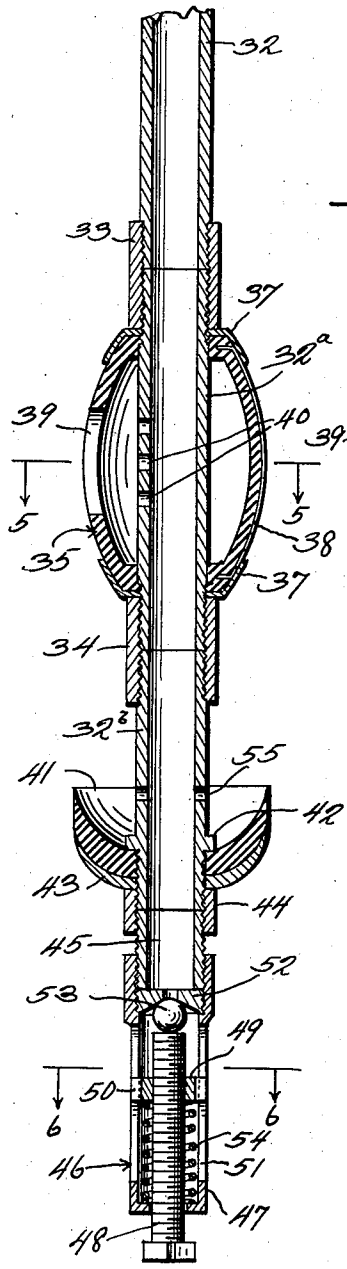


Fig. 5

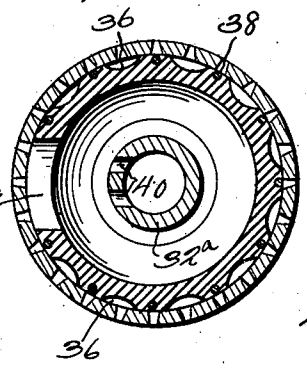


Fig. 6

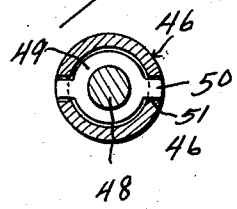
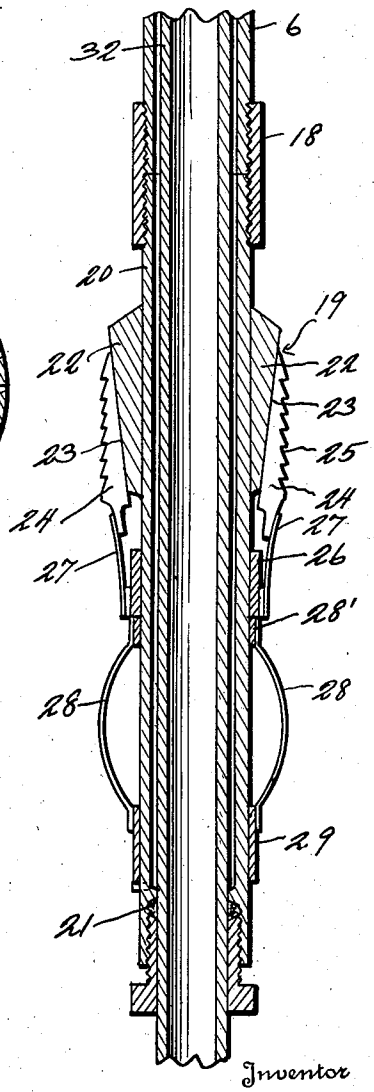


Fig. 3



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WELL CLEANER

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10 Claims. (Cl. 166—20)

This invention relates to improvements in well tools and pertains particularly to a well cleaner which is designed for cleaning the perforations of a well liner.

The present invention has for its primary object to provide an improved type of well liner cleaner or perforation cleaner which is operable to thoroughly clean or open all of the perforations of a liner so as to increase the production of the well, the present invention constituting particularly an improvement upon my co-pending application, Ser. No. 248,915, filed January 3, 1939.

Another object of the present invention is to provide a well cleaner which, in addition to operating to discharge fluid under pressure through the well liner perforations to remove accumulated matter therefrom, employs the pressure of the cleaning fluid to secure in the liner a packer through which the fluid is discharged.

Still another object of the invention is to provide in a perforation cleaner a novel and improved form of packer by means of which a sealing of the liner is effected during the period when the washing or flushing fluid is discharged against the perforations therein.

A still further object of the invention is to provide an improved well cleaner in which a portion is adapted to have limited longitudinal movement within a liner during the performance of the cleaning operation and in which novel and improved means is made use of for ejecting fluid into the liner under high pressure whereby to effect the desired cleaning of the liner perforations.

Still another object of the invention is to provide in a well cleaner of the type described, a reciprocable swab having associated therewith means for relieving a reduced pressure therebeneath as the swab is moved vertically in the liner, in the event that such pressure becomes reduced to the point where it would materially resist the upward movement of the swab in the liner.

The invention will be best understood from a consideration of the following detailed description taken in connection with the accompanying drawings forming part of this specification, with the understanding, however, that the invention is not to be confined to any strict conformity with the showing of the drawings but may be changed or modified so long as such changes or modifications mark no material departure from the salient features of the invention as expressed in the appended claims.

In the drawings:

Fig. 1 is a view in side elevation of the improved perforation cleaner embodying the present invention, the same being shown partially broken away and in a longitudinally sectioned well liner.

Fig. 2 is a sectional view on an enlarged scale taken on the line 2—2 of Fig. 1.

Fig. 3 is a sectional view on an enlarged scale taken on the line 3—3 of Fig. 1.

Fig. 4 is a sectional view on an enlarged scale taken on the line 4—4 of Fig. 1.

Fig. 5 is an enlarged sectional view on the line 5—5 of Fig. 1.

Fig. 6 is a sectional view on the line 6—6 of Fig. 4.

Fig. 7 is a fragmentary view showing in elevation the movement limiting means for the slip collar.

Referring now more particularly to the drawings, the letter L generally designates a well liner of the usual or standard type which has the longitudinally extending slits or openings 1 in the wall thereof, which openings are cleaned by the device embodying the present invention.

In accordance with the present invention there is provided a pumping unit which is generally indicated by the numeral 2 and which is attached, as hereinafter described, to the lower end of a well string 3. The fluid pumping unit comprises an outer barrel 4, the lower end of which is of reduced diameter forming the shoulder 5 and within this barrel there operates the tubular plunger 6, to the upper end of which is secured the packing head 7 which fits snugly within the barrel and in the operation of the cleaner functions to expel fluid from the barrel to the area of the casing which is to be cleaned, in the manner hereinafter stated.

The numeral 8 designates a one-way valve unit which constitutes a bushing or coupling between the well string 3 and the upper end of the barrel 4. This unit comprises the body 9 which at one end is formed for suitable connection with the end of the well string as by the provision of the interiorly threaded collar 10, while its other end is formed for connection with the pump barrel 4 as by the reduced exteriorly threaded portion 11 which threads into the upper end of the barrel. It is understood, of course, that any other suitable means may be employed for connecting this bushing between the well string and the barrel and that the invention is not to be limited to the specific construction shown.

Through the center of the unit 8 is a passage

12, the upper end of which is constricted to form a seat 13 for a ball check valve 14. This ball check is held against its seat by the spring 15 which normally urges the ball upwardly, as shown in Fig. 2, so that when the ball is unseated, it must move down in the body and in this manner open the passage for the flow of fluid downwardly from the well string into the upper part of the outer barrel. The passage of fluid from the well string into the barrel 4 is effected through the medium of the by-pass ports 16 which at their upper ends open into the bore 12 beneath the seat 13 and at their lower ends open through the lower part of the body 8 into the pump barrel, as shown.

Fluid may be passed to the unit 8 either through the well string or by way of the inlet openings 17 which are formed in the wall of the string adjacent the lower end thereof.

The lower end of the plunger 6 is connected by means of a bushing 18 with an anchoring means which is generally indicated by the numeral 19 and by means of which the plunger is fixed against movement in the liner. This anchoring means consists of a central tubular body portion 20, the upper end of which is connected by the bushing 18 with the plunger 6 while the lower end is formed to carry a packing gland unit 21 for the purpose hereinafter stated.

On the outside of the body 20 of the anchoring means there are fixed the downwardly facing camming wedges 22 against the camming face 23 of each of which is slidably positioned a slip 24 which has an inclined inner face for contact with the camming face of the wedge. Each of the slips has a toothed outer face, as indicated at 25, for contact with the inner wall of the liner.

Surrounding the body 20 below the wedges 22 is a collar 26 to which is attached a series of spring arms 27, each of which carries a slip 24 as shown in Fig. 3, and constantly urges the slip into contact with its wedge block 22.

The collar 26 is held against turning movement on the tubular body 20 by means of a vertical slot 26' which is formed therein and in which engages a stop pin 26'' which is fixed in the body 20.

Abutting the lower edge of the collar 26 and adapted for free turning movement about the body 20 is a ring 28' to which are attached the upper ends of a series of outwardly bowed springs 28. The lower ends of the springs are connected with a shifting collar 29 which freely encircles the body 20 and this collar has formed therein a camming groove 30 which opens through its lower edge, as shown in Fig. 1. This groove 30 is adapted to receive the cam pin 31 which is secured in the body 20. The camming groove 30 and pin 31 provide a releasable latch means for holding the slips in retracted position so that the tool may be conveniently moved through the liner when it is being inserted to working position or removed therefrom. When the tool is being inserted, the shifting collar will be disposed with the pin 31 in the groove 30. This will hold the slips 24 in their lowest positions with respect to the wedges 22. In this position, the parts are retained when the tool is lowered into the liner and the securing of the tool in the liner at the desired depth is effected by a partial turning of the body 20 whereby the collar, being held through the engagement of the springs 28 with the inner wall of the liner, will be rotated with respect to the body 20, the tool meanwhile being given a slight downward movement so that the camming pin 30 as it rides along the lower edge of the collar, will force the slips upwardly into locking engagement with the wall of the liner. A reversal of this movement will effect the disconnection of the toothed slips from the wall of the liner so that the tool may be shifted or removed as desired.

Extending through the releasable latching means 19 and through the tubular plunger 6 is a relatively long inner barrel 32, the upper end of which is connected with the body 9 of the downwardly opening check valve unit 8. This inner barrel is provided at its upper end, and consequently in the upper end of the outer barrel 4, with the fluid inlet openings 33 and it passes through the packing gland unit 21 in the lower end of the body 20 of the latching means, the packing gland being held in sufficiently firm contact with the outer side of the inner barrel to prevent the passage of fluid through the body 20 and the tubular plunger 6.

Below the latching means the inner barrel is divided into the sections 32^a and 32^b, these sections being connected in alinement by the bushings 33 and 34, as shown in Fig. 4. The section 32^a passes through a packer body which is generally indicated by the numeral 35 and which is in the form of an oblate spheroid on the long axis thereof, this packer body being formed of rubber and having its outer face provided with the longitudinally extending grooves 36. At the upper and lower ends of the packer body are caps 37 which are held between the ends of the packer and the adjacent bushings 33 and 34, as shown.

The packer body 35 is reinforced by a plurality of wires 38 or other suitable reinforcing strands running through the material of the body as shown in Fig. 5, and in the transverse center of the body the wall is provided with a fluid discharge window or orifice 39. As shown, this orifice 39 faces laterally or horizontally and is preferably, though not necessarily, square or rectangular in outline. This orifice is proportioned to oppose a limited number of the spaced perforations 1 of the liner.

The tubular portion 32^a of the inner barrel constitutes a support for the packer and is provided in its wall with a series of discharge apertures 40 which are directed toward the orifice 39.

The lower or terminal portion 32^b of the inner barrel passes through an upwardly directed or opening cup 41 of flexible material which constitutes a swab and which is of a diameter to fit snugly within the liner, as shown in Fig. 1. This swab is held between an annular rib formed upon the portion 32 and the rigid cup 43 by a nut 44 which is threaded on the lower end of the inner barrel, as shown.

The lower end of the inner barrel or the portion 32^b thereof, has coupled therewith through the medium of the nipple 45, a foot valve 46. This valve consists of an elongated tubular casing 47 which has extended through the lower end thereof and longitudinally therethrough, the screw 48. This screw passes through and has threaded thereon the traveler nut 49 which has laterally extending ears 50 which slidably engage in the longitudinal guide slots 51 which are formed in the wall of the casing 47. At its upper end the casing 47 has a ball valve seat 52 against the under side of which positions the ball check 53. This ball check is engaged by the inner end of the screw or adjusting stem 48 and is maintained on its seat by the spring 54 which is dis-

posed beneath the nut and which normally urges the latter upwardly together with the screw 48. It will be readily apparent that the pressure with which the ball 53 is maintained on its seat may be adjusted or regulated by turning the screw so as to compress or relieve the spring 54.

Above the swab 41, the inner barrel section 32a is provided with apertures 55 for the purpose of relieving an excessive reduced pressure beneath the swab during the operation of the tool.

In the use of the present tool, the same is lowered into the well liner and when the packer has reached the desired depth, the anchoring means is manipulated in the manner previously described so as to secure against movement that portion of the tool with which the tubular plunger 6 is connected. By then longitudinally reciprocating the well string, the outer barrel will be raised and lowered with respect to the packing head 7 of the plunger and this will also move the inner barrel together with the packer and swab which are carried thereby. On the upward movement of the well string and the parts connected therewith, the packing 7 or the piston of the plunger 6 will move down in the outer barrel and this will effect the drawing of fluid past the check valve unit 8 and through the passages 16 into the outer barrel. Upon reverse movement of the well string and attached parts, the piston packer 7 will move upwardly in the outer barrel and force the fluid through the openings 33 into the inner barrel and through the latter to the discharge apertures 40. The fluid will be projected through the apertures 40 and through the window or orifice 39 toward the perforations in the liner and being so projected under force, will remove any obstructing material which may be in the perforations over which the orifice passes as the packer moves downwardly in the liner. Upon again moving the packer upwardly, the swab 41 will create a sucking action in the lower part of the liner or will tend to reduce the pressure in the lower part of the liner if the apertures below the swab are closed or stopped up, and this reduced pressure will have the effect of loosening the obstructing material. If, however, the reduced pressure exerts such a restraining effect upon the upward movement of the packer and swab as to seriously interfere with the operation of the tool, the downwardly opening ball check 53 will yield against the tension of the spring 54 and allow fluid to pass through the openings 55 and through the foot valve into the area beneath the swab and thus break the vacuum produced.

By the provison of a hollow packer 35 which may be filled with the fluid as it is discharged from the inner barrel, means is provided for setting up a sealing contact with the inner wall of the liner as the packer will tend to expand under the effect of the fluid pressure therein and thus maintain a tight contact with the liner wall so that the ejected fluid cannot leak between the packer and wall but must pass out through the liner openings which are covered by the orifice 39 as illustrated in Fig. 5.

It will be understood that after the perforations lying within the range of longitudinal movement of the packer have been cleaned, the packer will be turned in the liner to cover another group of perforations and the reciprocating movement of the packer will be repeated until these perforations are cleaned, whereupon it will be turned further to take in another group, and this procedure will be repeated until all of the perforations in the liner throughout the length of the same through which the packer may be moved, are cleaned, after which the tool may be raised to clean a new section.

While the tool herein described has been designed primarily for the cleaning of perforations in well pipe or pipe liners, it is also adaptable for use in the application or spotting of cement in certain restricted areas in wells.

It will also be understood that the present tool may be used in the well while stationary as well as during its movement therein.

What is claimed is:

1. In a tool for cleaning the perforations of a well pipe or liner, a packer for insertion in the liner having a fluid discharge orifice for discharging fluid outwardly through the perforations, said packer being of hollow form and flexible material and expanded by the fluid to effect its sealing engagement with the liners.

2. In a tool for cleaning the perforations of a well pipe or liner, a packer of hollow form and of flexible material adapted for insertion into the liner, the packer having a wall opening for the discharge of fluid outwardly toward and through the perforations, and means for introducing fluid under pressure into the packer, the packer being filled and expanded by the introduced fluid into sealing contact with the liner.

3. In a tool for cleaning the perforations of a well pipe or liner, a packer of hollow form and of flexible material adapted for insertion into the liner, the packer having a wall opening for the discharge of fluid outwardly toward and through the perforations, and means for introducing fluid under pressure into the packer, the packer being filled and expanded by the introduced fluid into sealing contact with the liner, the fluid being introduced into the packer in a radial direction and toward the said wall opening.

4. In a tool for cleaning perforations of a well pipe or liner, a packer comprising a hollow body formed of flexible material and adapted for insertion into the liner, the packer having a fluid discharge orifice, a pumping unit consisting of a plunger and a barrel, said packer being coupled with the barrel and adapted to be moved longitudinally in the liner therewith, means for securing the plunger in the liner against movement, and means for conducting fluid ejected from the pumping means into the packer and discharging the same radially therein toward said wall opening.

5. In a tool for cleaning perforations of a well pipe or liner, a packer comprising a hollow body formed of flexible material and adapted for insertion into the liner, the packer having a fluid discharge orifice, a pumping unit consisting of a plunger and a barrel, said packer being coupled with the barrel and adapted to be moved longitudinally in the liner therewith, means for securing the plunger in the liner against movement, and means for conducting fluid ejected from the pumping means into the packer and discharging the same radially therein toward said wall opening, the said packer being adapted to be filled with the discharge fluid to be expanded thereby into sealing contact with the wall of the liner.

6. In a tool for cleaning the perforations of a well pipe or liner, a pump unit consisting of a barrel and a tubular piston working therein, the barrel being designed for connection with a well string, means for securing the piston in the well

liner against movement relative to the barrel, an inner barrel connected at one end with the upper end of the pump barrel, a downwardly opening valve controlling the admission of fluid into the upper end of the pump barrel, and a packer carried by said inner barrel for sealing contact with the inner wall of the liner, the packer having a laterally directed discharge orifice and said inner barrel having laterally opening outlet apertures directed toward said orifice, and an inlet aperture communicating with the upper end of the pump barrel.

7. In a tool for cleaning the perforations of a well pipe or liner, including a fluid pumping means adapted to be inserted into the liner, a longitudinally reciprocable barrel connected with the pumping means to receive fluid therefrom, a packer of hollow form and of flexible material adapted for insertion into the liner and having said inner barrel extending therethrough, the packer having a fluid discharge orifice in the wall and the inner barrel having fluid discharge openings directed toward said orifice, the entire interior of the packer being adapted to receive the fluid from said apertures, and a swab connected with the inner barrel below said packer.

8. In a tool for cleaning the perforations of a well pipe or liner, a packer operable in the liner for sealing contact with its interior, the packer having an orifice for directing fluid outwardly through the perforations of the liner, means for effecting the discharge of fluid under pressure through said orifice, a swab coupled with the packer beneath the same and operable in the liner to produce a swabbing action, said packer and swab moving together longitudinally in the liner, and means for relieving an excessive reduced pressure in the liner beneath the swab.

9. In a tool for cleaning the perforations of a well pipe or liner, a packer operable in the liner for sealing contact with its interior, the packer having an orifice for directing fluid outwardly through the perforations of the liner, means for effecting the discharge of fluid under pressure through said orifice, a swab coupled with the packer beneath the same and operable in the liner to produce a swabbing action, said packer and swab moving together longitudinally in the liner, a downwardly opening foot valve connected with the swab beneath the same, and means for bypassing fluid from above the swab to beneath the same through said foot valve.

10. In a tool for cleaning the perforations of a well pipe or liner, a pumping unit adapted to be inserted into the liner and comprising an outer barrel, an inwardly opening check valve in the upper end of said barrel for connection with a well string, a tubular plunger extending into the lower end of the barrel, means carried by the tubular plunger for securing the same against movement within the liner, an elongated inner barrel extending through said tubular plunger and connected at its upper end with the upper end of the outer barrel and having communication therewith, a packer carried by the outer barrel and consisting of a hollow flexible body adapted for sealing contact with the inner wall of the liner and having a discharge orifice, said inner barrel having discharge openings within the packer and directed toward said orifice, a swab carried by the inner barrel below the packer and adapted for contact with the inner wall of the liner, the inner barrel having a fluid inlet aperture therethrough between the swab and packer, and a foot valve connected to the inner barrel below the swab and including a spring pressed downwardly opening valve element adapted to shift to permit fluid to pass through the inner barrel from above the swab into the liner below the swab.

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