Jan. 6, 1931. C. L. JETT 1,788,109

WELL TESTER

Filed Feb. 3, 1928

Fig. 2.

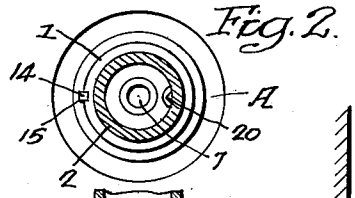



Fig. 1.

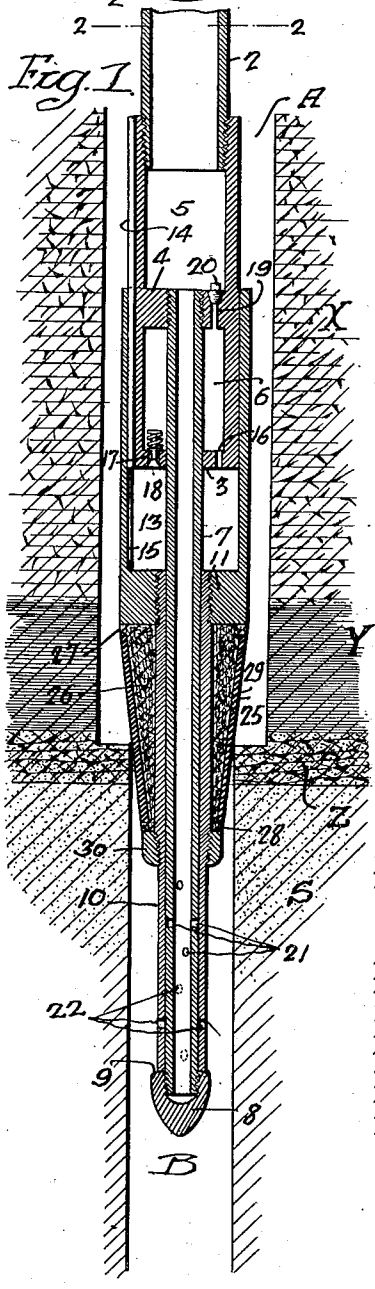



Fig. 5

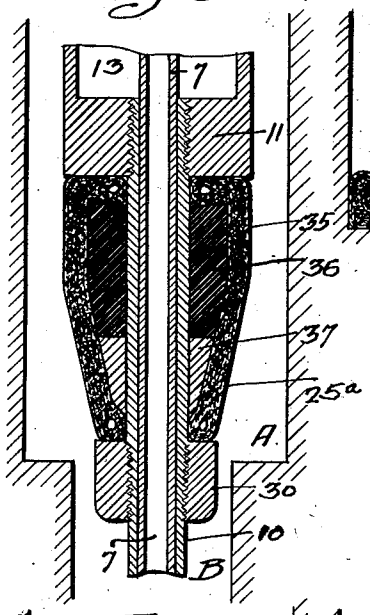



Fig. 6.

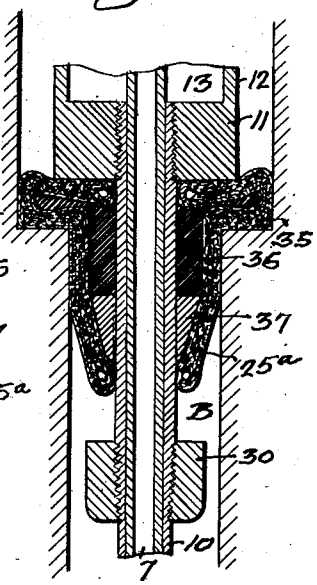



Fig. 3.

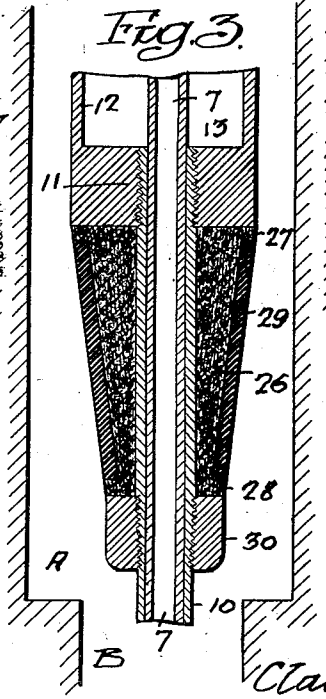
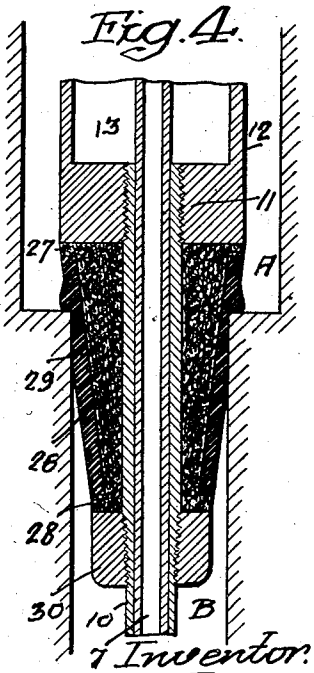



Fig. 4.




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Patented Jan. 6, 1931

1,788,109

# UNITED STATES PATENT OFFICE

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## WELL TESTER

Application filed February 3, 1928. Serial No. 251,680.

This invention relates to tools of the type generally known as well testers, which are employed in the oil fields and similar places where wells are to be drilled and operated. The purpose of the tester is to determine whether the ground formation which underlies the upper layers of shale, gumbo and cap rock, carries, contains or is capable of producing profitable liquid or gaseous fluids, before the well casing is "set".

Another purpose of the tester is to determine the natural pressure of the oil, gas and water or other fluids, or of any one thereof, in the "rat hole" or "core hole" before well casing is "set".

Another purpose of the tester is to determine the best part of the ground formation in the well, above the productive formation, in or on which to seat and rest the well casing, before the well casing is "set".

In operation, the prospector drills a hole in the ground at a place which he believes productive formation may be found. This initial hole is of sufficient size to permit the "setting" of a surface casing, to prevent the walls of the well from caving in at the ground surface, and to eliminate the entrance of surface water sands from the well. Drilling is then resumed at the bottom of the initial hole, through the surface casing.

In the drilling of the well, a small hole, known to the trade as a "rat hole", is drilled and cored down through the underlying formations, substantially concentric with the initial hole, to a depth of 50 or 60 feet in search of productive formations.

If no productive formation is encountered in this 50 or 60 feet of "rat hole" a bit just small enough to pass through surface casing is lowered in the hole and the previously formed "rat hole" is then reamed to substantially the full size of the initial hole, to eliminate binding and sticking of a drill pipe subsequently passed down through the initial hole. "Rat holing" and "coring" are then resumed.

When a formation though to be productive is encountered, the tester forming the subject of my invention is then lowered in the "full size hole", being positioned on the lower end of a drill stem or tubing, and having a portion which projects into the "rat hole".

A packer is provided on the tester which is adapted to seal the "rat hole" relative to the "full size hole" to eliminate the passage of mud, water or other undesirable foreign matter from the "rat hole", from which the natural pressure is to be tested and the sample of fluid contained in the formation is to be taken by the tester.

The principal object of the invention is to produce a tester which will be simple of construction, efficient in operation, and inexpensive to manufacture.

Another object of the invention is to provide an improved form of packer which will be more efficient in operation than those employed at the present time.

The details of construction of my invention will be fully disclosed hereinafter, reference being had to the accompanying drawing, of which:

Fig. 1 is a sectional view taken through a "full size hole" and the "rat hole" aligned herewith, showing my improved tester in sectional elevation, with the packer in position to be seated at the mouth of the "rat hole";

Fig. 2 is a sectional plan view taken on the line 2—2 of Fig. 1;

Fig. 3 is an enlarged sectional elevation of the packer in its inactive position;

Fig. 4 is a view similar to Fig. 3 showing the packer in its active position sealing the mouth of the "rat hole";

Figs. 5 and 6 are views similar to Figs. 3 and 4, of a modified form of packer.

In Fig. 1, the "full size hole" A is illustrated as passing into a stratum of cap rock Z. The "rat hole" B is shown as passing through the cap rock Z and the underlying formation S.

The tester comprises a piston 1 adapted to be secured to the lower end of the usual type of tubular drill stem 2. The piston 1 is hollow and is provided with a head 3 and a transverse partition wall 4, which divides the interior of the piston into an upper chamber 5 and a lower chamber 6.

Threaded into the partition 4 and carried thereby is an enlongated tubular piston plunger 7 which passes through an aperture formed in the piston head 3. On the lower end of the plunger 7 is a cap or spud nut 8 which closes the lower end of said tubular plunger and provides a shoulder 9 for supporting a plunger jacket 10 which encircles said tubular plunger 7 and extends upward from the cap nut 8 to a point below the head 3 of the piston 1.

The upper end of the plunger jacket 10 is threaded into an opening formed in the head 11 of a hollow cylinder, the circular wall 12 of which fits snugly around the outside of the piston 1, which is adapted to move longitudinally in the piston cushioning chamber 13 of said cylinder.

A key 14 prevents relative circular movement between the piston 1 and cylinder 12. The key 14 is carried by the piston 1, and is adapted to slide in a groove 15 formed in the cylinder wall 12.

In the piston head 3 are formed ports or passages 16 and 17 which provide communication between the lower chamber 6 of the piston 1 and the cushioning chamber 13 of the cylinder 12. The port 16 is unrestricted but passage through the port 17 is adapted to be limited to one direction i. e. from the chamber 6 in the piston to the cushioning chamber 13 of the cylinder 12, by a spring controlled check valve 18, which prevents a return through the port 17 to the chamber 6.

In the partition 4 of the piston 1 is formed an opening 19 which provides communication between the chambers 5 and 6 of the piston 1, said opening 19 being normally closed by a threaded plug 20.

The opening 19 is provided for the purpose of permitting any suitable cushioning fluid to be run into the chamber 6, from which it will flow through the ports 16 and 17 into the cushioning chamber 13 of the cylinder 12.

The piston plunger 7 is provided with series of openings 21 which are adapted to be brought into registry with a series of openings 22 formed in the plunger jacket 10, when the jacket 10 is moved longitudinally on and with respect to the plunger 7, thereby providing direct communication between the "rat hole" B and the interior of the tubular piston plunger 7. The key 14 which prevents relative rotation between the piston 1 and cylinder 12 consequently prevents a similar relative rotary motion between the piston plunger 7 and the plunger jacket 10 which are respectively and rigidly secured to the said piston 1 and cylinder 12, thus alignment of the holes 21 and 22 in the plunger 7 and jacket 10 is at all times assured.

Surrounding the jacket 10 immediately adjacent the under side of the cylinder head 11 is the packer 25, which comprises a tapered plug 26 of hard non-yielding fabric or suitable composition and having an upper flange 27 and a lower flange 28 between which and surrounding the non-yielding tapered plug 26 is a soft extremely pliable gum sleeve 29. A nut 30 is threaded on the jacket 10 below the plug 26, and is adapted to maintain the said plug in contact with the cylinder head 11.

Figs. 5 and 6 illustrate a packer 25*a* which is collapsible and is composed of an outer casing 35 of resilient rubberized fabric. Within the packer casing 35 is located a body of soft pliable gum 36, and a rigid element 37.

In operation, the tester is lowered into the upper or "full size hole" A until the sides of the packer 25 engage the edges of the mouth of the lower or smaller "rat hole" B. As the tubular drill stem 2 is permitted to descend the weight thereof causes the outer soft sleeve 29 of the packer 25 to assume the form illustrated in Fig. 4, completely sealing the mouth of the small hole B against the passage of mud, etc. from the larger hole A into the smaller hole B. Continued lowering of the drill stem 2 causes the piston 1 to move downward in the cushioning chamber 13 of the cylinder 12, causing the cushioning fluid in said cushioning chamber to be forced slowly through the port 16 into the chamber 6 of the piston 1, acting as a dash pot to obviate the shock caused by the descent of the drill stem and permitting the piston head 3 to gradually approach the cylinder head 11. When the said piston head 3 contacts with the said cylinder head 11, the openings 22 in the piston plunger jacket 10 are in alignment with the openings 21 in the plunger 7, which permits the flow of fluid, at natural pressure contained in the small hole B, from the hole B into the interior of the tubular piston plunger 7.

It will here be noted that the chamber 6 of the piston 1 is of such proportions relative to the cushioning chamber 13 in the cylinder 12 as to receive the cushioning fluid from the said cushioning chamber 13 and permit the air trapped in the chamber 6 to be compressed therein to such an extent that the piston head 3 may contact with the cylinder head 11 to bring the openings 21 and 22 formed in the plunger 7 and jacket 10 into alignment with each other. This compression of the trapped air acts as a resilient means for maintaining the walls of the packer 25 in firm contact with the mouth of the smaller hole B, and the softness of the sleeve 29 of said packer permits the said sleeve to adhere to any and all irregularities in the mouth of the hole B, thus forming a perfect seal between the holes A and B.

The elements of the device are permitted to remain in this position while the natural pressure test is being made with pressure

gauge installed on drill stem at the surface of the ground, and for a sufficient length of time to permit a goodly quantity of the fluid and natural pressure contained in the hole B to flow through the openings 21 and 22 into the interior of the plunger 7 and into the dry drill stem 2, and as the drill stem is raised the air compressed in the piston chamber 6 expands and holds the packer in its sealing position while the plunger 7 is moved relative to the jacket 10, breaking the alignment between the openings 21 and 22 formed in these respective elements, thus trapping the fluid received from the hole B in the said plunger 7 and drill stem 2. Thus it will be seen that the plunger 7 and its jacket 10 act as a sleeve valve to permit the fluid to flow through the openings 21 and 22 into the plunger 7 and drill stem 2, and to cut off this communication and trap the said fluid in the plunger 7 and drill stem 2.

During the upward movement of the piston 1 relative to the cylinder 12 the check valve 18 opens to permit a quick flow of the cushioning fluid from the chamber 6 to the cushioning chamber 13 so that the packer 25 will not be raised from its seat in the mouth of the hole B, by a vacuum created in the chamber 13 by the upward movement of the piston 1 therein.

The upward movement of the tester is then continued to the surface of the ground where the sample of fluid contained in the drill stem 2 and plunger 7 is removed and its nature determined.

The packer 25*a* illustrated in Figs. 5 and 6 is of a more pliable nature than the packer 25 and, in addition to sealing the mouth of the small hole B, is expanded to such an extent that it rests on the bottom of, and engages the circular wall of the "full size hole" A thereby maintaining a seal between the holes A and B in event of the breaking down of the wall of the small hole B at the mouth thereof, and by means of hydrostatic pressure bearing down on said packer 25*a*.

I claim:

1. The combination in a well tester adapted to be lowered into a well of a packing element adapted to engage the wall of a well and thereby isolate one section of the well from the other portion thereof, a hollow element extending into said isolated section and adapted to receive a sample of fluid at natural pressure therefrom, a sleeve valve for controlling the flow of fluid to the interior of said hollow element, connected to said packing element and adapted to be operated by a continued lowering of the tester occuring after said packing element has engaged the wall of said well, means for moving said packing element into sealing engagement with said well wall, means for cushioning the operation of said moving means relative to the said packing element comprising a cylinder carried by said packing element and a hollow piston carried by said moving means operable in said cylinder, a cushioning fluid in said cylinder between the head thereof and the head of said piston, said piston head being provided with a restricted opening permitting the gradual passage of said cushioning fluid into the interior of said hollow piston.

2. The combination in a well tester adapted to be lowered into a well of a packing element adapted to engage the wall of a well and thereby isolate one section of the well from the other portion thereof, a hollow element extending into said isolated section and adapted to receive a sample of fluid at natural pressure therefrom, a sleeve valve for controlling the flow of fluid at said natural pressure to the interior of said hollow element, connected to said packing element, and adapted to be operated by a continued lowering of the tester after said packing element has engaged the wall of said well, means for moving said packing element into sealing engagement with said well wall, means for cushioning the operation of said moving means relative to the said packing element comprising a cylinder carried by said packing element and a hollow piston carried by said moving means operable in said cylinder, a cushioning fluid in said cylinder between the head thereof and the head of said piston, said piston head being provided with a restricted opening permitting the gradual passage of said cushioning fluid into the interior of said hollow piston, and a check valve in said piston head adapted to permit the said fluid to be exhausted quickly from the interior of said piston into said cylinder.

3. The combination in a well tester of a piston adapted to be secured to a drill stem of ordinary construction and adapted to be lowered into a well by said drill stem, a cylinder surrounding said piston and adapted for longitudinal movement relative thereto, a packing element carried by said cylinder and adapted to engage a shoulder formed in the wall of the well to be tested whereby said packing element functions to isolate the portion of the well below the shoulder from the portion thereof above said shoulder, a tubular plunger connected to said piston extending through said cylinder and said packing element into the isolated section of the well and provided with an opening adapted to afford communication between the interior of said plunger and the said isolated section of the well, a jacket surrounding said tubular plunger secured to said packing element and said cylinder and provided with an opening adapted to register with that of the tubular plunger when said packing element engages said shoulder and thereby causes a relative movement of said cylinder and said jacket longitudinally with respect to said piston

and said plunger respectively, as the drill stem is lowered into the well.

4. The combination in a well tester of a piston adapted to be secured to a drill stem of ordinary construction and adapted to be lowered into a well by said drill stem, a cylinder surrounding said piston and adapted for longitudinal movement relative thereto, a packing element carried by said cylinder and adapted to engage a shoulder formed in the wall of the well to be tested whereby said packing element functions to isolate the portion of the well below the shoulder from the portion thereof above said shoulder, a tubular plunger connected to said piston extending through said cylinder and said packing element into the isolated section of the well and provided with an opening adapted to afford communication between the interior of said plunger and the said isolated section of the well, a jacket surrounding said tubular plunger secured to said packing element and said cylinder and provided with an opening adapted to register with that of the tubular plunger when said packing element engages said shoulder and thereby causes a relative movement of said cylinder and said jacket longitudinally with respect to said piston and said plunger respectively, as the drill stem is lowered into the well, and a fluid in said cylinder between the head thereof and the head of said piston for cushioning the action of the piston within the cylinder.

5. The combination in a well tester of a piston adapted to be secured to a drill stem of ordinary construction and adapted to be lowered into a well by said drill stem, a cylinder surrounding said piston and adapted for longitudinal movement relative thereto, a packing element carried by said cylinder and adapted to engage a shoulder formed in the wall of the well to be tested whereby said packing element functions to isolate the portion of the well below the shoulder from the portion thereof above said shoulder, a tubular plunger connected to said piston extending through said cylinder and said packing element into the isolated section of the well and provided with an opening adapted to afford communication between the interior of said plunger and the said isolated section of the well, a jacket surrounding said tubular plunger secured to said packing element and said cylinder and provided with an opening adapted to register with that of the tubular plunger when said packing element engages said shoulder and thereby causes a relative movement of said cylinder and said jacket longitudinally with respect to said piston and said plunger respectively, as the drill stem is lowered into the well, and a fluid in said cylinder between the head thereof and the head of said piston for cushioning the action of the piston within the cylinder, said piston head being provided with a restricted passage to permit said cushioning fluid to gradually escape into a cavity formed in said piston.

6. The combination in a well tester of a piston adapted to be secured to a drill stem of ordinary construction and adapted to be lowered into a well by said drill stem, a cylinder surrounding said piston and adapted for longitudinal movement relative thereto, a packing element carried by said cylinder and adapted to engage a shoulder formed in the wall of the well to be tested whereby said packing element functions to isolate the portion of the well below the shoulder from the portion thereof above said shoulder, a tubular plunger connected to said piston extending through said cylinder and said packing element into the isolated section of the well and provided with an opening adapted to afford communication between the interior of said plunger and the said isolated section of the well, a jacket surrounding said tubular plunger secured to said packing element and said cylinder and provided with an opening adapted to register with that of the tubular plunger when said packing element engages said shoulder and thereby causes a relative movement of said cylinder and said jacket longitudinally with respect to said piston and said plunger respectively, as the drill stem is lowered into the well, a fluid in said cylinder between the head thereof and the head of said piston for cushioning the action of the piston within the cylinder, said piston head being provided with a restricted passage to permit said cushioning fluid to gradually escape into a cavity formed in said piston whereby the air trapped in said piston cavity is compressed therein, and a check valve in said piston head adapted to permit the said cushioning fluid to be exhausted quickly from said piston cavity into said cylinder, under the influence of the compressed air in said cavity whereby the said packing element is held in its sealing engagement with said well shoulder until after the fluid openings in said tubular plunger are closed by said jacket.

7. The combination in a well tester of a piston adapted to be secured to a drill stem of ordinary construction and adapted to be lowered into a well by said drill stem, a cylinder surrounding said piston and adapted for longitudinal movement relative thereto, a packing element carried by said cylinder and adapted to engage a shoulder formed in the wall of the well to be tested whereby said packing element functions to isolate the portion of the well below the shoulder from the portion thereof above said shoulder, a tubular plunger connected to said piston extending through said cylinder and said packing element into the isolated section of the well and provided with an opening adapted to afford communication between the interior

of said plunger and the said isolated section of the well, a jacket surrounding said tubular plunger secured to said packing element and said cylinder and provided with an opening adapted to register with that of the tubular plunger when said packing element engages said shoulder and thereby causes a relative movement of said cylinder and said jacket longitudinally with respect to said piston and said plunger respectively, as the drill stem is lowered into the well, a fluid in said cylinder between the head thereof and the head of said piston for cushioning the action of the piston within the cylinder, said piston head being provided with a restricted passage to permit said cushioning fluid to gradually escape into a cavity formed in said piston whereby the air trapped in said piston cavity is compressed therein, a check valve in said piston head adapted to permit the said cushioning fluid to be exhausted quickly from said piston cavity into said cylinder, under the influence of the compressed air in said cavity whereby the said packing element is held in its sealing engagement with said well shoulder until after the fluid openings in said tubular plunger are closed by said jacket, and means for limiting the movement of said tubular plunger relative to said jacket, whereby the said packing element is released from its well sealing position when the drill stem is raised.

CLAUDE L. JETT.