

Nov. 10, 1942.

A. BOYNTON

2,301,190

WELL TESTING TOOL

Filed Oct. 4, 1938

3 Sheets-Sheet 1

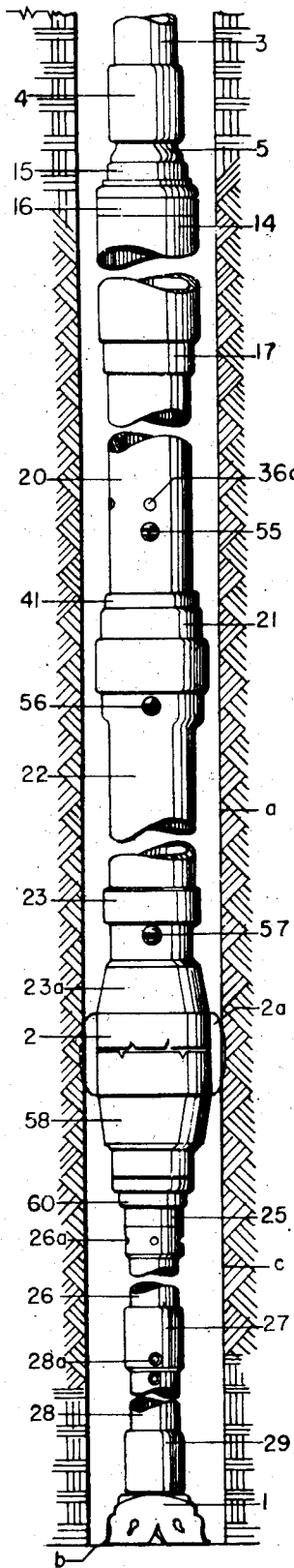


Fig. 1.

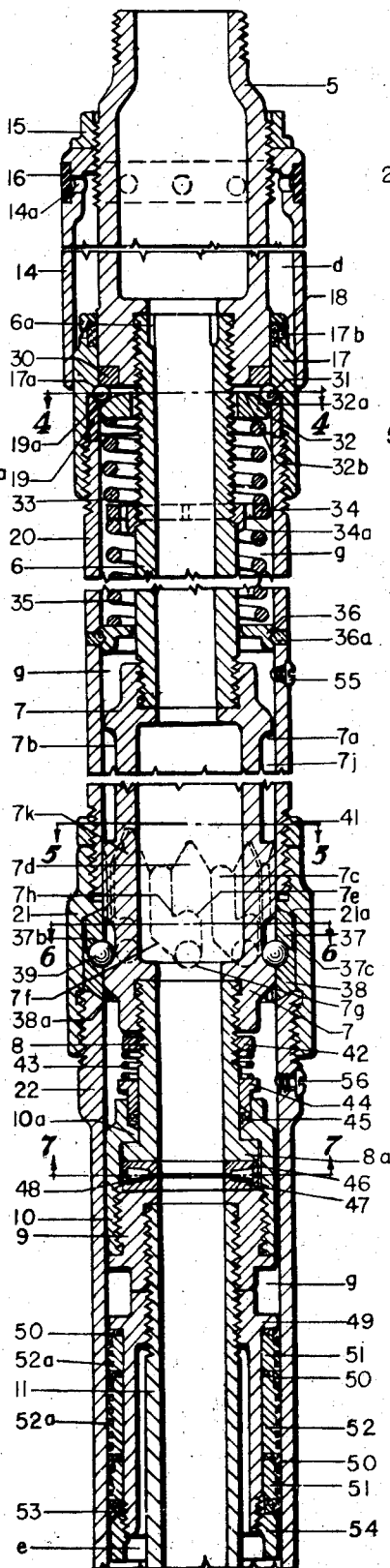


Fig. 2.

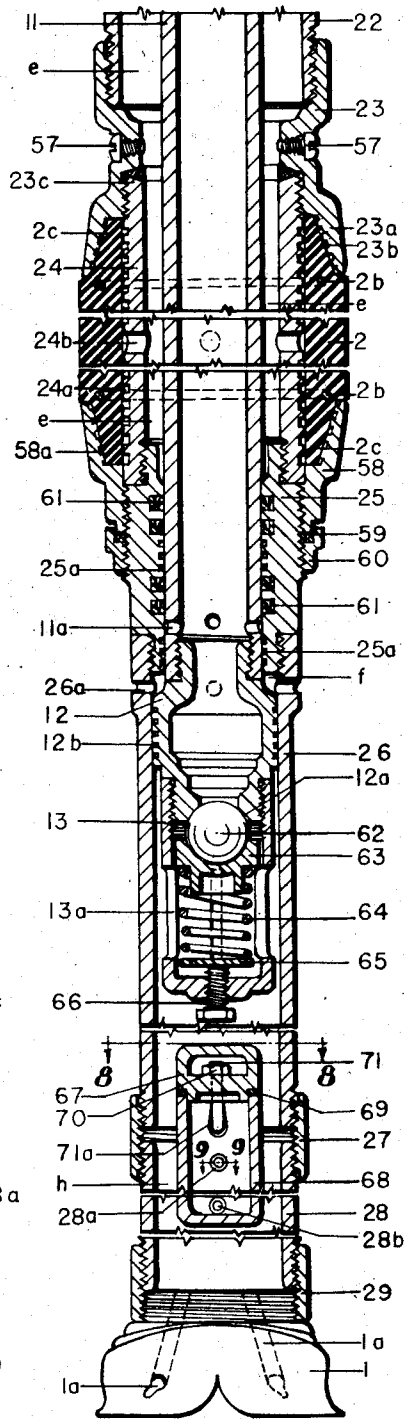


Fig. 3.

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3 Sheets-Sheet 2

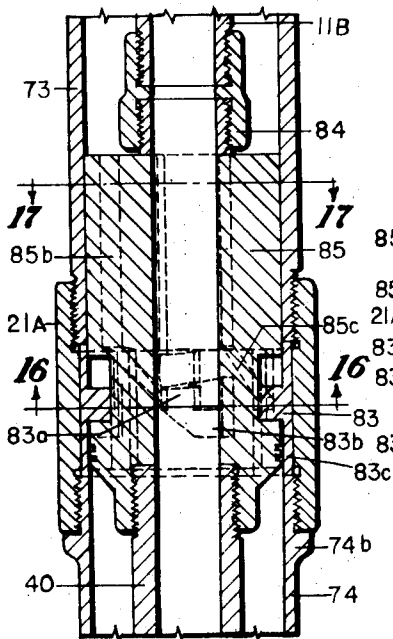


Fig. 15.

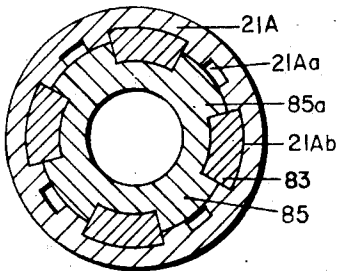


Fig. 16.

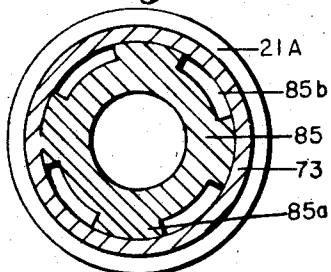


Fig. 17.

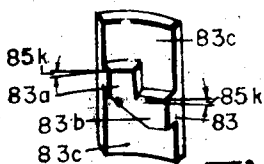


Fig. 18.

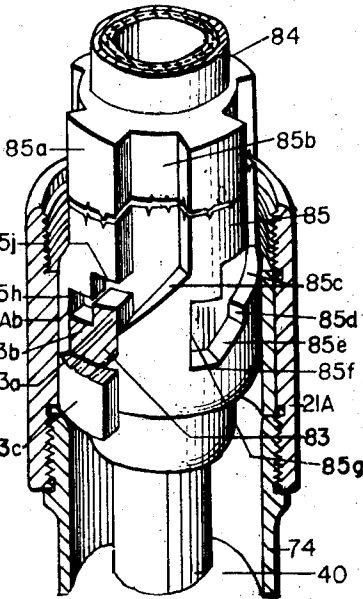


Fig. 19.

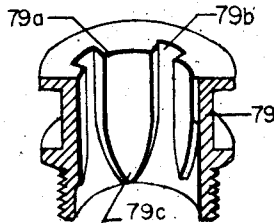


Fig. 20.

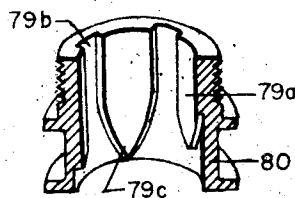


Fig. 21.

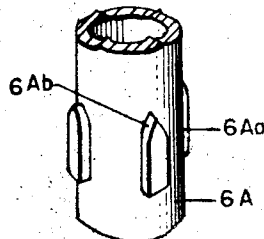


Fig. 22.

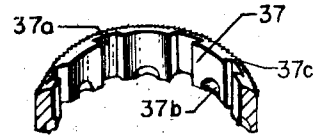


Fig. 23.

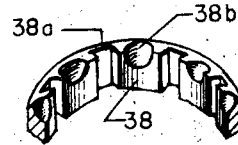


Fig. 24.

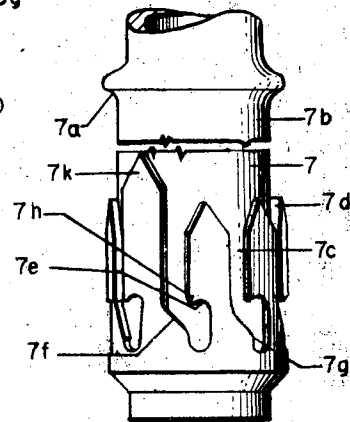


Fig. 25.

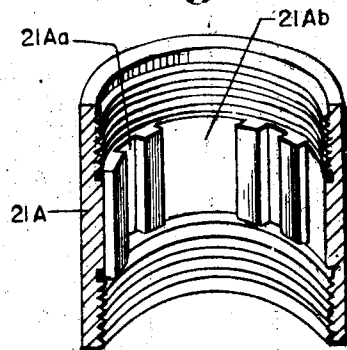


Fig. 26.

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WELL TESTING TOOL

Filed Oct. 4, 1938

3 Sheets-Sheet 3

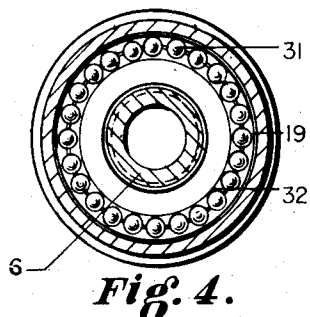


Fig. 4.

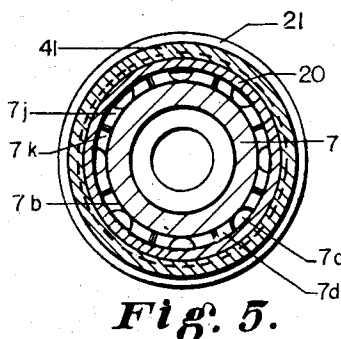


Fig. 5.

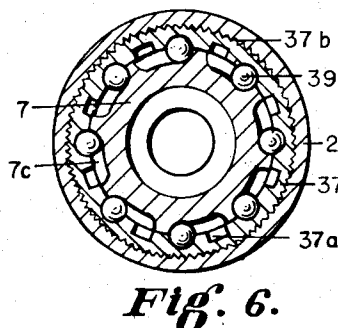


Fig. 6.

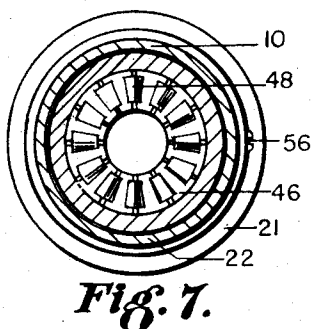


Fig. 7.

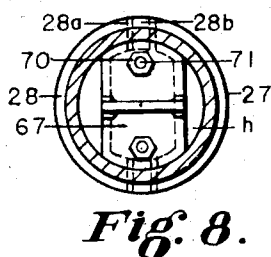


Fig. 8.

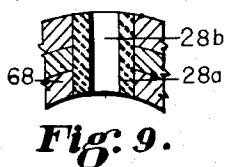


Fig. 9.

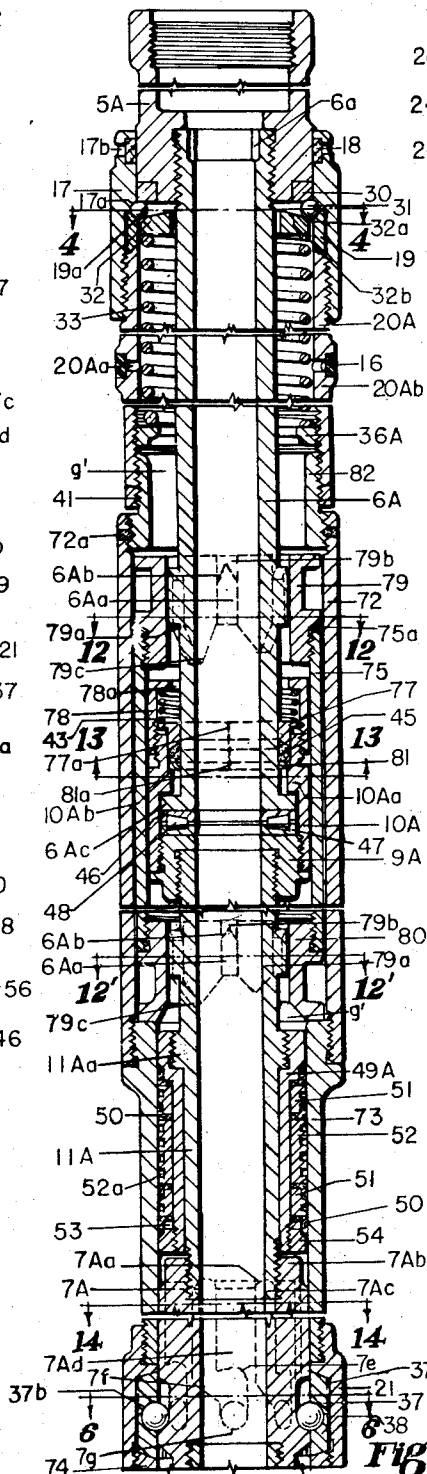


Fig. 10.

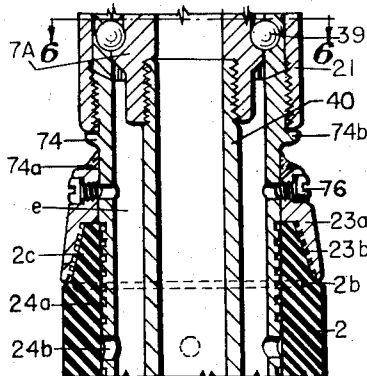


Fig. 11.

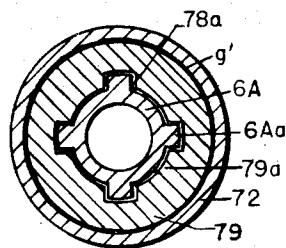


Fig. 12.

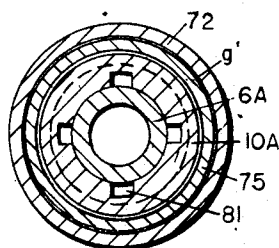


Fig. 13.

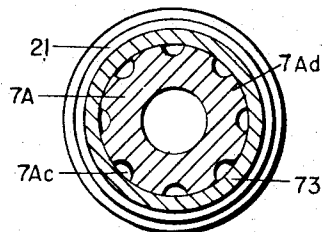


Fig. 14.

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UNITED STATES PATENT OFFICE

2,301,190

WELL TESTING TOOL

Alexander Boynton, San Antonio, Tex.

Application October 4, 1938, Serial No. 233,235

12 Claims. (Cl. 166-1)

My invention relates primarily to well testing means in which a packer mounted upon the drill stem or other pipe is lowered to the top of, or slightly above the formation to be tested; the pipe upon which the packer is mounted extending below the packer and landing upon the bottom of the well. Mechanism is provided to keep the well fluid from entering the pipe until the packer has been expanded against the adjacent formation, so as to prevent downward movement of well fluid from above the packer. The packer is expanded by the pressure of fluid contained within it, the fluid being driven to expand the packer by a piston actuated by the weight of the drill stem above the packer. The same movement that expands the packer opens the drill stem below the packer to allow well fluid to enter. This operation, in effect, pumps the well dry down to the level of the packer. Whatever fluid the well now produces into the drill stem in a given time is a fair test of what it will produce if casing is set and the well completed. Lifting the drill stem off of bottom automatically releases the packer and closes the liquid inlet into the drill stem below the packer. The production of the well enters the drill stem while it sets on bottom and may be recovered, tested, and measured when the drill stem is withdrawn from the well.

No shoulder, or so-called rat hole, is required to set this packer. It may be set anywhere in the well bore. The position of the packer is determined by the length of the anchor string of pipe below it, and all of the well formation below the packer is on test while the packer is allowed to remain expanded.

This new type of packer is pumped loose from the formation by the pressure of the well liquid when the weight of the drill stem is lifted off of it, thus overcoming the great danger and general difficulty of packers sticking fast so that they cannot be removed when tests in straight wall wells have been attempted.

A latch is employed to hold the device in its fully extended position while shipping, handling, and running the assembly into the well in order to prevent accidental compression from end thrusts which would otherwise expel some of the flare chamber fluid that will be later explained. The latch also telegraphs to the operator, so to speak, by producing an audible shock and noticeable vibration when it springs if the drill stem or tool encounters heavy mud, cavings, or other obstruction which might endanger withdrawal of the tool unless the drill

stem be rotated or pumped through as it is lowered.

A bit of the usual fishtail type is ordinarily, but not necessarily, attached to the lower end of the anchor string to facilitate mixing the mud, if necessary to do so, while lowering the device into the well.

The drill stem may be pumped through, as well as rotated, while going into or coming out of the well. If pumped through, the drill stem may, of course, be withdrawn from the well to drain it before a clean production test can be recovered or a quantity of water may be pumped into the stem to clean it and then balled or swabbed out.

The packer is caused to seal off and the device is opened to intake into the drill stem below the packer by a slight clockwise turn of the pipe after the anchor string has landed on bottom, the normal closed position being automatically and instantly resumed when the drill stem is raised off of bottom.

A clutch is provided proximately above the packer. This clutch is latched however so that the entire drill stem will rotate as a unit from the top to the bottom so that obstructions may be removed until the drill stem lands on bottom, the latch then springs loose, and the pipe above the clutch is rotated a part of a turn to the right. This slight rotation frees a piston which may be forced downward by the weight of the drill stem above it and the device is in this manner actuated.

A downward movement of the pipe equal to the piston travel then takes place and fluid under the piston is forced by the weight of the pipe into the packer, causing it to expand and seal off against the wall of the well. This settling frees the clutch. The drill stem from the clutch upward may then be rotated as in drilling, while the packer and all pipe below it remain stationary.

When the packer expands, a flare chamber just above the packer automatically discharges a liquid of such color as to identify it from the well liquid. If the packer effects a complete seal-off against the formation, this liquid flare will remain trapped above the packer and be left in the well. If the packer allows any leakage of liquid downward past it, flare or tell tale liquid will be found in the fluid recovered.

The device also provides for the employment of means for recording pressures, temperatures, etc., obtaining in the well.

As an incidental use, the device may be also employed as a well cementing means.

The main objects of this invention are to provide a formation testing device for wells which may also be used for cutting off leaks in the casing or unwanted production anywhere else in the well, which device has the following advantages:

First—That it may be safely run into, and readily withdrawn from a drilled well for the purpose of recovering a measured sample of the well's production from the horizon below where the packer on the device is set, whether the well be cased or uncased, and which device may be also used to discover and locate leaks through the casing.

Second—That it operates in a straight bore, and does not require that an offset or shoulder be provided by drilling a rat hole of reduced diameter into or through the formation to be tested.

Third—That the pipe upon which the device is run may be rotated from top to bottom, including the device itself, while it is being lowered into, or being withdrawn from the well, and which pipe and device may be pumped through during any or all such time.

Fourth—That the pipe may be rotated above the device when a production test is being made, while the tool and anchor string remain stationary.

Fifth—That it affords means for advising the operator when mud or cavings which should be rotated through or pumped out have been encountered as the device is being lowered into operating position.

Sixth—That, by the action of a piston which compounds the weight of the drill pipe, the packer may be set with more force than the packers which employ the weight of the drill stem directly applied to expand them.

Seventh—That, by wholly withdrawing the internal pressure employed to expand the packer when the pipe is raised, the packer is released and contracted by external pressure of the well fluid.

Eighth—That the pipe may be set down on bottom one or more times with all its weight at will of the operator before the packer is expanded.

Ninth—That it will show whether any of the fluid recovered in the test came from above the packer.

Tenth—That pressure and temperature recording instruments, and other instruments, if desired, may be positioned in the device below the packer for the purpose of ascertaining the pressure and temperature and variations thereof obtaining during the test in the formation being tested.

Eleventh—That casing leaks or other unwanted production anywhere else in a well may be cemented off by employing the same device as the one used to locate and test the leaks or other production.

Twelfth—That, in addition to being efficient, sturdy, and durable; employing neither gears, shear pins, nor other complicated or fragile parts; it requires no left hand threads, no left hand rotation, nor the dropping of weights, bars, go-devils or the like to operate it.

With the foregoing and other related objects in view, reference is now made to the drawings, in which:

Fig. 1 is a side elevation of the preferred form

of the invention in a well bore, with portions of the device broken out, the expanded position of the packer being indicated by dotted lines.

Fig. 2 is a longitudinal section of the upper portion of the device shown in Fig. 1.

Fig. 3 is a longitudinal section of the lower portion of the device shown in Fig. 1.

Fig. 4 is a transverse section on the line 4—4, Figs. 2 and 10.

Fig. 5 is a transverse section on the lines 5—5, Fig. 2.

Fig. 6 is a transverse section on the line 6—6, Figs. 2, 10 and 11.

Fig. 7 is a transverse section on the line 7—7, Fig. 2.

Fig. 8 is a transverse section on the line 8—8, Fig. 3.

Fig. 9 is a transverse section on the line 9—9, Fig. 3.

Fig. 10 is a longitudinal section of the upper portion of the first modified form of the invention shown in Figs. 2 and 3.

Fig. 11 is a partial longitudinal section of the other portion of the device shown in Fig. 10.

Fig. 12 is a transverse section on the line 12—12, Fig. 10.

Fig. 13 is a transverse section on the line 13—13, Fig. 10.

Fig. 14 is a transverse section on the line 14—14, Fig. 10.

Fig. 15 is a longitudinal section of the second modified form of a portion of the invention shown in Figs. 2 and 10.

Fig. 16 is a transverse section on the line 16—16, Fig. 15.

Fig. 17 is a transverse section on the line 17—17, Fig. 16.

Fig. 18 is a perspective view of the lug in Fig. 15.

Fig. 19 is a perspective view partly in section of the parts shown in Figs. 15 and 18 assembled with a portion of the part shown in Fig. 18 broken away.

Fig. 20 is a perspective view in longitudinal section of the part 79 in Fig. 10.

Fig. 21 is a perspective view in longitudinal section of the part 80 in Fig. 10.

Fig. 22 is a perspective view of a portion of the part 6A in Fig. 10.

Fig. 23 is a perspective view in longitudinal section of the base in Fig. 2.

Fig. 24 is a perspective view in longitudinal section of the part 38 in Fig. 2.

Fig. 25 is a perspective view of the clutch shell of Fig. 2.

Fig. 26 is a perspective view in longitudinal section through the lug coupling in Figs. 15 and 19.

The same reference characters are employed to refer to the same or duplicate parts throughout the several views.

In Fig. 1, the preferred form of the invention is shown inserted in a well bore with a fish tail bit 1 resting on bottom of the well at b, the packer 2 being positioned proximately above the formation to be tested c. The dotted lines 2a indicate the packer expanded after the latch has been sprung by the weight of the pipe 3, and the pipe rotated slightly to the right which movements cause the piston 49—54 to act on a liquid confined in the annular space or reservoir e, which in turn expands the packer 2, as will be later explained.

In the preferred form of the invention, illustrated in Figs. 2 and 3, the swaged externally

and internally threaded nipple 5 is adapted to have threaded connection to coupling 4 of the drill pipe 3 (Fig. 1). This nipple is threadedly joined at its lower end to a nipple 6 having special wrench slots 6a, and to the lower end of which nipple the clutch shell 7 is similarly joined. The nipple 8 is threaded into the lower end of shell 7. An external flanged portion 8a at lower end of nipple 8 engages under the internally flanged portion 10a of the bearing housing nipple 10. A thrust roller bearing consisting of a top 46, base 47, and rollers 48 is housed within the nipple 10, and held loosely against the flange 8a by a bearing support 9, having external threads engaging the nipple 10 extending above it and internal threads engaging the intake valve nipple 11 extending below it. The piston 12, with peripheral grooves 12b, having threaded engagement with nipple 11, has a valve cage 13 screwed upon its lower end. Within this cage a valve 62, resting upon a valve support 63, is adapted to form sealing engagement upon valve seat 12a, against which it is normally resiliently held by spring 64; the compression force of this spring being accomplished by stud 66 having threaded engagement through the base of nipple 13 by means of which engagement the stud is adapted to raise or lower spring compression washer 65.

Forming the outer shell of the device is the latch housing nipple 20 which is threadedly engaged to the latch chamber cap 17 above it and to the clutch coupling 21 below it. The lower end of nipple 5 has a piston fit within the cap 17. The externally upset nipple 22 screwed into coupling nipple 21 above it is threadedly joined to the connection member 23 below it, the latter being joined to the packer nipple 24 by threads and by a weld 23c while the lower end of the nipple 24 has the sleeve nipple 25 threadedly joined thereon. The inlet nipple 26, secured by threads to nipple 25, is in the same manner connected to the gadget box housing the nipple 28 by coupling 27. The coupling 29, into which the fish tail bit 1 is screwed, completes the outer shell.

The packer should ordinarily be set immediately above the formation to be tested. The length of the anchor string, which string consists of all of the pipe between the packer and the bottom of the well, manifestly determines the elevation at which the packer will be set. The anchor string may be lengthened as may be required by placing additional pipe between nipple 28 and coupling 29, Fig. 3.

The packer 2, which may be of rubber or any other tough, durable, and expansible substance, is loosely fitted over packer nipple 24, having grooves 24a and passages 24b. Two steel rings 2b may be cast into the rubber proximately opposite the inner ends of end shields 23a and 58, as shown. Shield 58, having internal grooves 58a, is threaded upon nipple 25 so as to form a shield for the lower end of the packer, corresponding to the shield 23a, having grooves 23b, which part houses the upper end of the packer. The tapered ends 2c of the packer may each be 6" to 8" long and the straight walled portion of the packer between the tapered ends may be 10" to 18" long. The effective area of the piston employed to expand the packer and the travel thereof should ordinarily be such as will cause the maximum packer expansion to be 3 to 5 inches. The diameter of the piston, its travel, the diameter of the packer, and the

diameter of the well bore in which the device is intended to be used, being all taken into proper account in designing the device, the packer will seal off before the maximum piston travel occurs, unless, of course, the well bore caves or is, for any other reason, unduly enlarged where the packer is set. If the packer should be set in such an enlarged place, it may not seal off and must therefore be reset higher or lower, as the case may require. The amount of fluid that may be employed to expand the packer should, of course, in all forms of the invention, always be less than would rupture the packer if it should be subjected to maximum expansion.

Such packers are extremely strong, but the compounded weight of the drill stem transmitted to the packer expanding fluid is also extremely great. Those skilled in the art will, however, experience no difficulty in constructing and employing the device within such limitations. The lock ring 60 and packing 59 provide a tight seal against possible escape of fluid under high pressure from between the nipple 24 and the packer.

The cup carrier sleeve 49 threaded upon nipple 11 supports the packer pump-out piston made up of the cup spacers 51 and 52 having grooves 52a, cups 50, washer 53, and piston assembly clamp ring 54, the latter being threaded upon the lower end of sleeve 49. The cups and their spacers have a close movable fit within the nipple 22. Clamp 54 may be tightened when necessary to urge the cups into closer engagement with the nipple 22, as is obvious. Manifestly any suitable form of packing may be substituted for cups 50.

The thrust bearing is made leakproof by packing 45, engaged by gland 44, pressed down by spring 43, which is held under adjustable compression by ring 42 threaded upon nipple 8.

The clutch coupling nipple 21 locks the upper ball socket base 37 and lower ball socket base 38 together between the internal shoulder 21a and the upper end of nipple 22. The upper base 37 has longitudinal serrations forming external flutes 37c, which imbed within the inner wall of coupling nipple 21 as base 37 is pressed into the position shown, for the purpose of locking the parts 37 and 21 together so that the part 37 will not rotate within the nipple 21. Since the ball sockets 37b and 38b, Figs. 23 and 24, house one-half of each of the balls 39, and since the part 37 into which one-half of each ball socket is formed is held from rotation within the nipple 21 by flutes 37c, it is apparent that the part 38 is also locked from such rotation by the balls.

The other base 38 has an easy removable fit within the member 21 when nipples 21 and 22 are disconnected. The clutch balls 39 being received externally within sockets 37b-38b and internally within the slots 7c, the slots and sockets each having a depth equal to approximately one-half the diameter of the balls, it is apparent that the balls remain stationary except that each may rotate within its socket, leaving the clutch shell 7 movable. The clutch shell 7, having slots 7c shaped to form lower pockets 7g, sloping surfaces 7f, upper pockets 7e, and downwardly inclined surfaces 7h, to receive balls 39 to one-half of their diameter, has ribs 7d and 7k between and conforming to the slots. The ribs limit the movements of shell 7, while the balls remain engaged within the slots. The upper end of each of these ribs is beveled to a knife edge, and one of them 7k is somewhat longer than the others which are of equal length. Above the slots 7c,

the shell 7 is machined down, as shown at 7b, so that the annular space 7j will receive the balls to one-half of their diameter. The upper end of this portion of reduced diameter is expanded to form the shoulder 7a.

Latch balls 31 received within circular recesses 17a in the cap 17 and 19a in the latch housing nipple 20 are resiliently engaged between the ball rider ring 30 and ball floor ring 32 by the expansive force of latch spring 33 installed under compression by means of latch spring support 34, having threaded engagement upon nipple 6 by means of which threads support 34 controls the compression adjustment of the spring. Spring base 36 secured within nipple 20 by means of welds 36a supports spring 35, which spring installed under compression against support 34 urges the latch to closed position and the entire device to its most elongated position. The recesses 17a and 19a should preferably be formed to fit the contour of the latch balls and should be of a depth slightly less than one-half the diameter of the balls.

If the groove 17a—19a is as deep or deeper than one-half the diameter of the balls, the balls will impinge between the ring 30 and the lower edge of groove 19a, and thereby render the latch inoperative. The latch balls may be $\frac{5}{16}$ " to $\frac{7}{16}$ " in diameter. If the balls are of $\frac{5}{16}$ " diameter, $\frac{5}{16}$ " to $\frac{3}{4}$ " depth of the groove 17a—19a will be found satisfactory. The ring 30, which may be pressed upon the member 5, should be hardened; likewise the balls, ring 32, and sleeve 19 should be hardened. The latch spring 33 may be comparatively short, 3" to 6" being a satisfactory length, because the latch balls cause only a very slight compression of this spring when the balls roll inward upon the upper surface of ring 32 when the latch springs. The return spring 35 may be 9 feet long compressed to 7 feet installed. Both springs may be made of the same or different diameter wire and may be wound to the same or different pitches. The latch is held in the engaged position, as shown in Fig. 2, by the expansive force of spring 33, which urges the steeply inclined surface 32a against the balls, which are thereby impinged upon the surface 17a.

When the latch is sprung, the balls ride downward between the rings 30 and 32 and in doing so, engage inner surfaces of nipples 19 and 20. It will be noted that the upper surface of ring 32 is of two angles. The steeper angle engages the balls while they are imbedded in the groove 17a—19a, as stated, thus imparting great force to the engagement. When the balls are forced out of the groove as the latch springs, they engage upon the more horizontal surface 32b, the angle of which is such as will return the balls into their groove 17a—19a when the latch returns, but at the same time will not urge the balls outward with enough force to score the inner wall of nipple 20.

Assuming that the latch balls are in the groove 17a—19a to a maximum depth of slightly less than one-half the diameter of the balls, the latch may be adjusted to be sprung by the application of less force by lessening the depth that they are allowed to enter this groove. The less they enter it, the easier they can be forced out of it. Such adjustment may be made by screwing the nipple 6 upward in coupling 21, lock ring 41 being used to secure the adjustment. In making such adjustment, it can be observed that the ring 30 is not also forced upward as the

nipple 20 is forced upward, because the balls 39 engaging the lowermost extremity 7g of slots 7c do not permit such movement. It is apparent that the purpose of spring 35 is to automatically return the latch to engaging position and after being so returned, spring 34 and the above described adjustment determine the force with which the latch engages.

Flare chamber sleeve 14, which is secured in place by lock ring 15 has a close sliding fit over latch chamber cap 17. Ports 14a are closed by rubber band 16. The chamber d may be filled with a flare fluid, as will be explained in discussion of operation.

The instrument case or gadget box 68 is secured within nipple 28 by welds 28a, as clearly appears in Figs. 8 and 9. The removable lid 67 is secured by nuts 70 and stud 71, the latter being secured to the inner wall of the gadget box by welds 71a. The passages 28b are drilled through the weld to place the interior of the gadget box in direct communication with the contents of the well bore. In drilling passages 28b, it will be noticed that part of the weld 28a is left surrounding the passage for the dual purpose of securing the box to nipple 28 and of preventing leakage if pump pressure should be applied interior of nipple 28, thereby forcing fluid under such pressure through the fish tail bit, as will be explained. Gasket 69 is provided between lid 67 and the box for a similar purpose. Open spaces h are provided for fluid passages.

The annular spaces g within nipples 20 and 22 may be filled with a lubricant through holes shown closed by plugs 55 and 56 for the latch and clutch assemblies and also to provide a lubricated surface for piston 49—54 in its return after the test. Slots 31a, Fig. 6, and 38a, Fig. 2, in registration, openings 34a, the annular space between spring base 36 and nipple 6, and slots 7c, provide for free circulation of the lubricant. The annular space e within nipples 22 and 24 contains a liquid supplied through holes closed by plugs 57. This liquid is forced downward by piston 49—54 to expand the packer 2, as will be later explained.

In operation, the latch is sprung when the bit lands on bottom or the device encounters mud, cavings, or other obstruction with sufficient force to cause the weight of the drill pipe to impart sufficient force to ring 30. Regardless of the nomenclature used in describing and referring to the several nipples and their connected parts forming the inner string of the device, the drill pipe or other pipe upon which the device will ordinarily be run into the well will be considered as extending to and including the intake nipple 11 in Figs. 2 and 3, and as extending to and including the intake nipple 40 in the modified forms illustrated in Figs. 10, 11, 15 and 19.

When the latch springs, the clutch shell 7 is thrust downwardly so that the balls 39 are quickly disengaged from their seats in pockets 7g and land after a short travel ($1\frac{1}{2}$ to 2 inches) with forceful impact in the pockets 7e. If the drill pipe be now picked up, the latch will again engage, and pockets 7g will again receive balls 39, the weight of the independently movable shell of the device aiding spring 35 to accomplish the re-engagement. After the latch is sprung, the clutch balls 39 support the weight of the drill pipe, the load being transmitted to the balls by roof of pockets 7e. If the drill pipe be now rotated clockwise, imparting the same rotation to shell 7, the balls 39 will be caused to roll upon

the downwardly inclined surface 7h, until slots 7c arrive at the balls.

The clutch shell 7 then again moves downward, transmitting this downward movement to the piston composed of cup carrier sleeve 49, 5 threadedly engaged upon nipple 11, cup spacers 51, 52, washer 53, and piston assembly clamp 54. The annular space e below the piston 49-54 and above the sleeve nipple 25 is filled with a liquid such as white lead, glycerine, or heavy oil. 10 This piston then forces this liquid through passages 24b, which passages communicate with the interior of the packer 2. The piston being forced downwardly by the weight of the drill stem, it is apparent that the packer will be expanded against the well formation with great force, this expanded position being indicated at 2a, Fig. 1. The steel rings 2b moulded into the packer causes the expansion of the packer to take place between them, and thus prevents the tapered ends 2c from being forced out of their retaining shields or cups 23a-58. The internal grooves 23b-58a aid in preventing the packer from being forced out of the retaining shields because the greater the expanding force applied internally of the packer, the greater will be the force impinging the tapered ends of the packer upon the grooved inner surface of the retaining shields. The grooves 24a provide that the interior wall of the packer will be deformed into them by the pressure of well fluid exterior of the packer as it is lowered into the well. This pressure may be several thousand pounds to the square inch in wells of considerable depth. Such a force will prevent the packer from being distorted by mud or cavings as it is being lowered into operating position.

The cups 61 fitted within recesses provided for them in the sleeve 25 through which sleeve nipple 11 has a close sliding fit, serve to securely 40 confine the packer expansion liquid within the chamber e. The small grooves 25a will become filled with foreign matter which will tend to serve as piston rings if the cups 61 become worn. Upon inspection, whenever these grooves contain foreign matter, the cups should be replaced.

When the fish tail has landed on bottom, the latch sprung, and the pipe has been rotated clockwise to cause downward movement of the piston 49-54, which expands the packer, as described, the intake ports 11a will move downward and become uncovered below the sleeve 25. Well fluid from below the packer then enters the drill stem via inlet ports 26a, annular space f, and intake ports 11a. The test is then on. 55 The recording instruments in instrument box 68, having communication with the well fluid below the packer through openings 28b, record the pressure and temperature both before and during the test; many types and makes of such instruments being now available. The operator sees that his watch and the timing mechanism placed in the gadget box agree, and notes the time when the test begins and ends. Tests are usually made during a period of 15 to 45 minutes. The usual travel of piston 49-54 may be 16 to 24 inches, depending upon the effective area of the piston and the clearance between the packer 2 in its unexpanded position and the formation to be engaged by it when expanded. This travel is always enough to allow clutch shell 7 to settle far enough that ribs 7d will settle below the balls 39. The shell is therefore then free of all engagement with the balls which are then projected into the annular space 7j. If the drill 75

stem forces the piston 49-54 down the maximum travel thereof, the balls 39 will be engaged by the shoulder 7a while the drill stem is rotated. If the drill stem should not settle so far, the piston 49-54 then supports the weight of the drill stem upon the liquid in chamber e. The drill stem may, and generally should be, rotated during the test.

Such rotation is provided for as follows: After the latch has been sprung and the drill stem has been rotated clockwise to roll the balls out of pockets 7e into slots 7c, the shell 7 settles and the portion of reduced diameter forming the annular space 7j is then opposite the balls. This movement frees shell 7 from engagement with the balls and disengages the clutch coupling. The drill stem above the bearing 46-47-48 may then be rotated while that part of the drill stem below the bearing will remain stationary.

It is apparent that the displacement of piston 49-54 may be varied by increasing or decreasing the diameter of the piston and correspondingly increasing or decreasing the inside diameter of the nipple 22, or by increasing or decreasing the outside diameter of the nipple 11, so that greater or less force may be imparted to the liquid in chamber e, which expands the packer as the piston is forced downwardly. In order to maintain a constant volume of displacement, it is also apparent that the travel of the piston should be increased if the displacement of the piston is decreased, and vice versa. The weight of the drill stem may thus be compounded as may be desired to impart more or less force to the liquid employed to expand the packer as varying sizes, depths, and conditions of wells may require, and, at all times provide the proper amount of liquid displacement to sufficiently expand the packer.

When the drill stem is lifted at conclusion of the test, spring 35, aided by the weight of the independently movable shell of the device, instantly elongates the assembly to the position shown in Figs. 2 and 3. In this movement the clutch engages. There is no danger that, due to some slight error in construction, the upper ends of ribs 7d will impinge upon the balls 39 by two ribs straddling the center of two balls, because one of the ribs 7k is longer than the others. This longest rib acts as a pilot to positively guide the others into proper place so that no impingement of ribs upon balls is possible. The sloping surface 7f guides the balls 39 back into their normal position within pockets 7g of slots 7c.

The annular space d is a flare chamber which may be filled with a tell tale fluid of a different color from the drilling fluid in the well above the packer, red lead or yellow paint being satisfactory. This chamber is filled through ports 14a and then closed by rubber band 16. Well pressure transmits through this rubber band to ports 17b, which communicate with packing 18. In this manner mud in the well is excluded from the latch and clutch chamber g. When the piston 49-54 is forced downward and causes expansion of the packer, the contents of the flare chamber d are forced out into the well bore through ports 14a and past rubber ring 16. If the packer holds tight and allows no well fluid from above it to contaminate the test, there will be no flare chamber fluid in the drill stem when it is withdrawn after the test, but if the packer did leak, flare fluid will be found in the

drill steam. The device can thus be depended upon to tell the truth about the test.

When the device is withdrawn from the well, in addition to learning the amount and physical properties of the production, it is also desirable to know the temperature at different levels as well as the temperature variations which obtained in the tested formation during the test and also the pressures and variations in pressures which obtained there then. If the operator checked his time with the timing mechanism of the recording instruments, and kept a record of the time when the device was at different levels going in and coming out of the well, the above information should be found in the instrument case or gadget box, from which the instruments may be removed by unscrewing nipple 28 from coupling 27 and unscrewing nuts 70 to remove cover 67.

Heavy mud, settlings, and cavings may sometimes be unexpectedly encountered while lowering the device into the well. Such obstructions can sometimes be overcome by rotating the drill stem and bit. The pockets 7g engaging over the balls 39 hold the clutch engaged so that the entire drill stem may be rotated as a unit before the latch is sprung. If while rotating the operator should inadvertently allow the drill pipe to engage the mud with too much weight and thereby spring the latch and disengage the clutch, a slight raising of the drill pipe will re-engage both latch and clutch as has been explained. Rotation of the drill stem and bit may then be continued as before. Sometimes, however, bottom cannot be reached by merely rotating the drill pipe; and in still other cases, casings will occasionally stick the drill pipe while coming out of the well. If this happens going in, the drill pipe may be pumped through and the pipe withdrawn and drained before a test can be made or the drill pipe may be cleaned with a liquid such as clear water, which should then be bailed or swabbed out.

The device may be pumped through at any time by simply connecting the hose to the drill pipe and starting the pump. The path of the pump fluid is down through the drill pipe to valve 62, which will be unseated by the pump pressure; thence through slots 13a, past the gadget box through spaces h and out through openings 1a in the fish tail. Attention is directed to valve support 63, which has a free sliding fit within cage 13. It will be noted that no pump fluid can pass the valve seat 12a or valve 62 until valve support 63 has been pushed downward by the pump pressure until a portion of slots 13a have been uncovered. In this manner seat 12a and valve 62 are far apart before fluid passes between them. Thus the valve seat and valve will be subjected to minimum abrasion by the fluid pumped through, which generally carries considerable abrasive matter, such as sand and stone cuttings. Piston 12, having a close sliding fit within the nipple 26, prevents the pump fluid from discharging through ports 26a and forces it to take path through the fish tail. Grooves 12b in piston 12 afford lodgement spaces for solids which when lodged there impede leakage and thereby prolong the life of the piston.

While the latch assembly, consisting of parts 33, 34, 31, 30, 32, and 41; the return mechanism, consisting of parts 35 and 36; the clutch parts 7, 37, 38, 39, 42, 43, 44, 45, 46, and 47; the pump through parts 13, 62, 63, 64, 65, 66, and 12 (a plug closing the lower end of nipple 11 being 75

substituted for part 12); the instrument box parts 28, 67, 68, 69, 70, and 71; and the flare chamber parts 14, 15, and 16, all add desirable features, any or all of them may be omitted from the construction and the device will still function as a well testing and cementing means. It will therefore be noted that the packer 2, piston 49-54, and intake valve nipple having ports 11a, which are uncovered by the same drill stem movement that expands the packer, constitute the basic elements of the device, shown in Figs. 2 and 3.

Illustrating the first modified form of the invention shown in Figs. 10 and 11, piston coupling 5A may be threadedly joined to drill stem 3 and installed to replace the preferred type shown in Fig. 1, it being understood that both devices are of the same construction from the lower end up to and including the packer, below which the construction shown in Fig. 3 will be considered as forming the continuation of Fig. 11. The nipple 26A, having passages 20Aa closed by rubber band 16 let into the thickened wall portion 20Ab, is threadedly joined to latch chamber cap 17 above it and to nipple 82 below it. The cap 17, having passages 17b, communicating with the recess which contains packing 18, has a close movable fit over the lower portion of the piston coupling 5A. The nipple 82 is threadedly joined between nipples 20A and 72, the lower threads being secured by welds 72a. Cylinder nipple 73 is threadedly joined between nipples 72 and clutch coupling nipple 21, the latter having threaded connection to packer nipple 74. The packer shield 23a is secured upon the nipple 74 by the weld 74a. The opening normally closed by plug 76 may be used to fill or drain the annular space e which contains the liquid employed to expand the packer.

The upper clutch key nipple 6A, having special wrench slots 6a, clutch keys 6Aa with wedge like upper ends 6Ab, and lower end flange 6Ac, is threadedly joined to the piston coupling 5A. The bearing housing nipple 10A having an internal circular shoulder 10Aa engaging over the externally flanged portion 6Ac of the nipple 6A is threadedly joined to the thrust roller bearing support 9A. The lower clutch key nipple 11A having keys 6Aa with wedge like upper ends 6Ab, similar to the keys upon the nipple 6A, has threaded connection between the bearing support 9A and the clutch shell 7A. The intake valve nipple 40 threadedly joined to the clutch shell 7A has intake ports 11a, see Fig. 3, at its lower end, and has the same parts in continuation as were shown for the intake valve nipple 11 in Figs. 2 and 3.

The latch shown in Fig. 10 is, in purpose and operation, the same as the latch shown in Fig. 2. The spring 33 in Fig. 10 normally holds the device extended to its greatest length and also operates the latch, thus performing the functions of both springs 33 and 35 in Fig. 2. The return spring base 36A having threaded connection within the nipple 20A affords means for adjusting the compression of the latch spring. The force with which the latch engages depends upon the depth that the latch balls engage within the circular recess 17a-19a and the compression force imparted to the balls 31 by the ring 32 which transmits the force of spring 33. Nipple 20A may be screwed upwardly or downwardly upon nipple 82 to adjust the latch and may be secured in proper position by lock ring 41, as was explained for the latch shown in Fig. 2. The irregular annular space g' extending from

the lower end of member 5A to the piston 49A—54 is a combination lubrication and flare chamber which may be filled with a colored lubricant such as red or white lead, which may be placed in the chamber through the openings 20Aa. The rubber band 16 serves to confine this liquid until the latch springs and the piston 49A—54 is thrust downwardly to expand the packer, as was explained for the device shown in Figs. 2 and 3. When this downward movement takes place, some of the fluid in chamber g' will be forced out through passages 20Aa, the rubber band 16 yielding to permit such escape of the flare fluid. If the lower end of the member 5A, which is a piston within its mating cylinder 17, were of the same diameter as the piston 49A—54, no fluid would be forced out of the chamber g' when these pistons move downward, but the lower piston is of smaller diameter than the upper one. The greater displacement of the piston member 5A on its downward stroke, therefore, forces some of the flare fluid out of the chamber g' through openings 20Aa.

On the return trip of the pistons, it is evident that well fluid will intrude through or past the rubber band 16 to compensate for the aforementioned displacement. For that reason, a flare fluid heavier than the well liquid should be placed in the chamber g' in order that the lighter well liquid coming into this chamber will remain on top where it can be readily removed when the device is withdrawn from the well, thus avoiding the necessity of draining the entire chamber g'. It will be noted that this flare chamber discharges only a short distance above the packer, and that it is discharged by the same movement and for the same purpose as was stated under the discussion of Figs. 2 and 3.

The split ring 81 engaging upon internal circular shoulder 10Ab supports the packing 45 compressed by split gland 77, which is held yieldably against the packing by the force of spring 43 installed under compression by cap 78 threadedly engaged upon housing nipple 10A. The internal slots 78a provide that the cap, before being engaged upon the member 10A, will clear the keys 6Aa. The gland 77 and ring 81 are each cut transversely into halves, indicated by dotted lines 77a and 81a, respectively, keys 6Aa and flanges 6Ac making it necessary to so split these members in order to assemble them as shown. It will be noted that spring 43 has such internal diameter that enables it to be assembled over the keys.

The cup carrier sleeve 49A has threaded engagement over the enlarged portion 11Aa of the lower clutch key nipple 11A. This sleeve has the same cups 50 and spacer rings 51 mounted upon it and held in place by the clamp 54 as was explained for the very similar piston shown in Fig. 2, both pistons serving the same purpose.

A floating clutch is shown in Fig. 10. This clutch consists of upper end member 79, having internal longitudinal projections 79a forming slots 79b; shell 75, threaded upon the member 79 and welded at 75a; lower end member 80 having internal longitudinal projections 79a forming slots 79b; the upper clutch key nipple 6A having keys 6Aa with wedge shaped upper ends 6Ab; the lower clutch key nipple 11A having keys 6Aa with wedge shaped upper ends 6Ab; and the thrust bearing 43—47—48.

The clutch shell is housed within the nipple 72 and confined therein against longitudinal movement by the lower end of nipple 82 and the

upper end of cylinder nipple 73. The shell has slight end clearance between the nipples 73 and 82 and also slight side clearance within the nipple 72. The upper clutch keys 6Aa have an easy sliding fit within the slots 79b and the lower clutch keys 6Aa have an easy sliding fit within the slots 79b. These keys and slots are normally engaged as shown in Fig. 10, this being the engaged position of the clutch which prevents the drill pipe above the thrust bearing from rotating independently of the nipple 11A and its connected parts below the bearing. In operation, upper and lower sets of keys 6Aa are thrust downward for their full travel with their respective units 6A and 11A after the latch springs and the drill pipe is rotated clockwise and settles, as was explained in connection with Figs. 2 and 3. This movement results in expanding the packer sufficiently to place the keys entirely below the slots. The clutch is then disengaged, and the drill pipe above the thrust bearing may be rotated upon the bearing independent of all other parts. The packer and entire outer shell of the device from its lower extremity to and including the chamber cap 17 remain stationary while the drill pipe is rotated and the clutch is disengaged.

The clutch being disengaged, if the drill pipe be then raised, the clutch and latch will automatically become reengaged by the expansive force of spring 33, aided by the weight of the movable shell of the device, the latter being all parts not attached to the drill stem. The tapered lower ends of projections 79a guide the keys back into the engaged position. Two of these projections, 79c, one within the upper end member 79 and the other within the lower end member 80, extend downward below their companion projections and thus serve as guides to pilot the keys into their respective slots 79b, similar to the manner by which the ribs 7d are guided between the clutch balls 39 in Fig. 2. The clutch may be said to float because all female elements thereof form a unit that is unconnected and free at both ends and all around when the keys and slots are not engaged. While the drill stem is rotated when the clutch is disengaged, the outer shell of the clutch does not rotate. When the keys and slots are engaged, this shell rotates with the drill stem which it locks together above and below the thrust bearing.

The shell 7A in Fig. 10 is not directly part of the clutch, as was the similar part 7 in Fig. 2, but the movements and positions of the shell 7A does have to do with the operation of the clutch and also controls the action of the piston part 49A and the other piston parts assembled upon it. The balls 39 are immovably imbedded, except that they may rotate in the pockets 37b and 38b within the members 37 and 38, in the same manner as was described for Fig. 2. The other half of these balls project within the irregular slots 7Ac formed by the ribs 7Ad. The shell 7A, limited in its movement by the balls and walls of the slots, functions and is actuated as follows: The lower pockets 7g normally engage the balls, as shown in Figs. 2 and 10, at which time the clutch is engaged as appears in Fig. 10.

Now assume the lower connection of the device (the fish tail) to be landing on bottom of the well. The latch then springs. The shell 7A settles and engages the balls 39 within pockets 7e. The drill stem is then rotated clockwise part of a turn. The shell moves with inclined surface 7h engaging the balls to place within the straight

upper portion of slots 7Ac. The weight of the drill stem now drives downward the piston coupling 5A, latch assembly, internal clutch members, piston 49A—54, and shell 7A. This movement causes expansion of the packer 2 and opens the intake ports as was explained for Figs. 2 and 3. The length of the slots 7Ac are such that the packer will be pumped out to its maximum expanded diameter before the unslotted portion 7Ab will engage the balls at the upper ends of the slots 7Aa. The packer will seldom allow such maximum travel because it will generally engage the wall of the well and thereby arrest the piston travel before its maximum expansion has occurred.

While the foregoing discussed mechanical differences between the device illustrated in Fig. 10 and the one illustrated in Figs. 2 and 3 differentiate the two constructions, the operation and results thereby obtained will be the same for both devices which are interchangeable.

The second modified form of this invention relates to the piston travel and clutch governing means shown in Figs. 15 and 19. This mechanism may be substituted for the parts 7A, 21, 37, 38, and 39, in Fig. 10. In making such substitution, the lug coupling 21A in Figs. 15 and 19 replaces and corresponds to the coupling 21 in Fig. 10. The lugs 83 replace the balls 39 and ball socket bases 37 and 38. The landing shell 85 corresponds to the shell 7A in Fig. 10. Such substitution being made, the second modification is in all other respects the same as the first modification discussed with reference to Figs. 10 and 11.

The lug coupling 21A, threadedly connected to cylinder nipple 73 above it and to packer nipple 74 below it, has internal longitudinal slots 21Aa, Figs. 16 and 25, for circulation of a lubricating fluid, and also has internal longitudinal slots 21Ab to receive the lugs 83, Figs. 19 and 25. These lugs are cast or machined integral with the shell 83c. The shells have a close fit within the slots 21Ab and are secured therein against longitudinal movement by being locked between the ends of nipples 73 and 74. The shoulder 74b provides that the same number of threads will always be engaged at each end of the lug coupling 21A when the lug shells are locked in place between the opposing ends of nipples 73 and 74.

The landing shell 85 is threadedly joined to the nipple 11B by means of coupling 84 and similarly joined to the intake nipple 40 below it. The intake nipple 40 in Figs. 11, 15, and 19, corresponds in purpose to the nipple 11 in Figs. 2 and 3, except that the packer piston is mounted upon it in Figs. 2 and 3. The landing shell 85 has longitudinal ribs 85a forming between them slots 85b. The lower ends of these slots are of irregular shape formed within the inclined surfaces 85c, the perpendicular walls 85d, the sloping walls 85e, the horizontal floors 85f, the perpendicular walls 85g, the lower lug landing roof 85h, and the upper landing roof 85j. It will be noted that the upper ends of lugs 83a and 83b are sloped (8 deg. to 20 deg. being usually satisfactory), as shown by the included angle indicated at 85k, Fig. 18. In Fig. 19 one of the lugs shown in Fig. 18 appears, partly broken away, and in its lower position within one of the slots 85b.

The landing roofs 85h and 85j are formed at an angle to conform to the angle 85k of the lugs 83b and 83a, respectively, so that when the lugs engage upon these opposing surfaces of the shell, they will be enmeshed therewith to the extent of

the angle 85k, in such manner as to cause the shell 85 to resist clockwise rotation with a force sufficient to overcome friction of these engaged surfaces, plus the force required to raise the shell 85 and its superimposed drill stem far enough to disengage these surfaces. Normally, that is when the latch is engaged, the lugs engage upon the surfaces 85e and 85j.

When the latch springs after the device is landed, as was explained for the two preceding forms of the invention, the lugs engage upon the surfaces 85h and 85j, the travel ordinarily provided being 2" to 3". If the drill stem be now rotated clockwise slightly, the lower lugs 83b will move and engage the upper landing roofs 85j while the upper lugs 83a will move into the lower end of the vertical portion of the slots 85b. If the drill stem be again rotated clockwise slightly more, each of the lower lugs will disengage the upper landing roofs and both lugs of each lug unit will then be free within the vertical portion of slots 85b. The weight of the drill stem then forces downward the piston, which acts to expand the packer, as heretofore explained. The slots 85b are of such length as will allow the full stroke of the piston before the coupling 84 will engage the lugs.

When the drill stem is raised to withdraw the device, the spring 33, aided by the weight of the movable shell of the device, causes the lugs to move back to their normal position as illustrated in Figs. 15 and 19. In accomplishing this return, the sloping wall surfaces 85c guide the lugs out of the upper straight portion of the slots into engagement with the surfaces 85e and 85j.

If it be desired to rotate the device at any time either going in or coming out of the well, the vertical walls 85d will engage the lugs to keep the clutch engaged in the same manner as the balls 39 are confined within the pockets 7g in Fig. 10.

If the mechanism illustrated in Figs. 15 and 19 be substituted for the corresponding parts in Fig. 10, the device will be operable in the same manner as the two preceding forms of the invention.

Either form of the invention may be employed to force cement slurry through cracks or perforations in the casing of a well or into the uncased formation of a well. To do this, the packer is positioned and expanded immediately above the opening in the casing through which cement is to be forced, or immediately above the formation to be cemented, in the same manner as for testing formations. Before pumping in the cement, fluid from below the packer may be bailed or swabbed out of the pipe upon which the device is run, or this fluid may be forced back into the formation by the cement. Liquid cement then is pumped in through the drill stem. The cement passes out of the drill stem through ports 11a, Fig. 3. The packer then forms a barrier against upward migration of the cement in the same manner as it prevents downward migration of well fluid from above the packer when the device is used for testing production. The path of the cement is obviously the same as that previously stated for the well liquid, only the direction of travel is reversed.

The device may thus be used to locate leaks in casing or unwanted production anywhere else in a cased or uncased well bore, and at the same time be employed to cut off such leaks or unwanted production. Obviously both purposes may be accomplished in the same or succeeding runs of the device, no change whatsoever in construc-

tion or adjustment being necessary for the accomplishment of both purposes.

In all modified forms of the invention, whether the same be used as a well testing or cementing device, the latch, clutch, check valve, flare chamber, and instrument box parts may be omitted, as was stated for the preferred form of the invention. While the foregoing parts generally add to the operating efficiency, the packer assembly with its fluid chamber, piston, and intake valve on bottom end of the drill stem or actuating pipe constitute the fundamental mechanical elements of the device.

The invention as herein illustrated and described sets out a very limited number of the many constructions which have been developed for the same purpose. It will, therefore, be understood that many changes in construction and arrangement of parts may be made within the scope and purpose of this invention as embraced by the stated objects and appended claims.

What is claimed is:

1. A well testing device of the pump packer type including a shell, an operating string of pipe, a releasable latch means connecting said shell and pipe and operable by application of weight of said string of pipe to release the pipe for movement relative to said shell, a packer on said shell, means also operable by said string of pipe to force liquid into said packer, and intake ports on said shell and string to be moved into alignment after setting of said packer to admit a sample of liquid from the well.

2. A well testing device of the pump packer type including a shell, an operating string of pipe, a releasable latch means connecting said shell and pipe and operable by application of weight of said string of pipe to release the pipe for movement relative to said shell, a packer on said shell, means also operable by said string of pipe to force liquid into said packer, and intake ports on said shell and string to be moved into alignment after setting of said packer to admit a sample of liquid from the well, and means on said shell and pipe to discharge telltale material above the packer.

3. A formation testing tool of the character described including an elongated housing, an expansible packer thereon to seal with the well bore, a string of drill pipe extending into and longitudinally movable in said housing, latch means releasable by lowering some of the weight of said pipe to release the pipe from said housing, and means to open said pipe to the formation below said packer upon movement thereof after release of said latch.

4. A formation testing tool of the character described including an elongated housing, an expansible packer thereon, a reservoir in said housing, a string of drill pipe extending into and longitudinally movable in said housing, latch means releasable by lowering some of the weight of said pipe to release the pipe from said housing, means to open said pipe to the formation below said packer upon movement thereof after release of said latch, and additional means to force liquid to and from said reservoir into said packer as said pipe moves.

5. A formation testing tool of the character described including an elongated housing, an expansible packer thereon to seal with the well bore, a string of drill pipe extending into and longitudinally movable in said housing, latch means releasable by lowering some of the weight of said pipe to release the pipe from said housing, means

to open said pipe to the formation below said packer upon movement thereof after release of said latch, and clutch means releasable and engageable by movement of said pipe so that the drill pipe may rotate either with or independently of said housing.

6. A combination formation tester and cementing tool for wells including a housing, an operative pipe, a latch to releasably connect said pipe and housing, a hydraulic packer to be set by liquid forced from said housing by longitudinal movement of said pipe after release of said latch, and ports in said housing and pipe to be aligned to admit sample liquid from the well or to discharge cement from the tool.

7. A combination formation tester and cementing pool for wells including a housing, an operative pipe, a latch to releasably connect said pipe and housing, a hydraulic packer to be set by liquid forced from said housing by longitudinal movement of said pipe after release of said latch, and ports in said housing and pipe to be aligned to admit sample liquid from the well or to discharge cement from the tool, and additional means to connect the pipe to rotate said housing but releasable to allow the pipe to rotate independently thereof.

8. A combination formation tester and cementing tool for wells including a housing, an operative pipe, a latch to releasably connect said pipe and housing, a hydraulic packer to be set by liquid forced from said housing by longitudinal movement of said pipe after release of said latch, and ports in said housing and pipe to be aligned to admit sample liquid from the well or to discharge cement from the tool, and additional means to discharge telltale fluid from said housing above said packer to indicate that the packer has sealed with the wall of the well bore.

9. A combination formation tester and cementing tool for wells including a housing, an operative pipe, a latch to releasably connect said pipe and housing, a hydraulic packer to be set by liquid forced from said housing by longitudinal movement of said pipe after release of said latch, and ports in said housing and pipe to be aligned to admit sample liquid from the well or to discharge cement from the tool, and additional means to connect said latch to allow the pipe to rotate said housing or to rotate independently of said housing, said additional means including a releasable ball clutch.

10. A combination formation tester and cementing tool for wells including a housing, an operative pipe, a latch to releasably connect said pipe and housing, a hydraulic packer to be set by liquid forced from said housing by longitudinal movement of said pipe after release of said latch, and ports in said housing and pipe to be aligned to admit sample liquid from the well or to discharge cement from the tool, and additional means to connect said latch to allow the pipe to rotate said housing or to rotate independently of said housing, said additional means including interfitting lugs and grooves.

11. A combination well testing and cementing device including an operating string of pipe, a shell surrounding said pipe adapted to have limited telescopic movement over a portion of the pipe, an adjustable and releasable latching means connecting said shell and pipe operable by weight of said pipe to release the pipe for limited telescopic movement relative to said shell, the latch having two springs, one adapted to

control the force of the latch and the other adapted to co-act with the pipe in reengaging the latch, said latch being adapted to produce an audible shock and sudden movement of the pipe when it disengages, a cylindrical packer having tapered ends received within retainer shields on said shell, said packer having reinforcing wires or rods on either side of its expansible portion, a piston in said shell, a compartment filled with liquid under said piston, the piston being operable by said pipe to force said liquid into said packer and expand it against the well bore or well casing, intake ports in said pipe and shell normally out of communication with each other and adapted to be placed in communication to admit into the pipe a sample of well fluid after the packer has been expanded, a flare-fluid chamber within a sleeve upon said string of pipe and slidable over said shell, said sleeve containing a telltale substance adapted to be discharged into the well bore above the packer as the packer is expanded by lowering the pipe relative to the shell after the latch has been released, an instruments case or gadget box in the pipe below the packer, a releasable clutch between the upper and lower portions of said pipe, said clutch being positioned above the piston and packer, a check valve within the pipe below the packer, said valve being adapted to be opened by fluid pumped into the pipe for circulation if the tool should become stuck in the well, a thrust bearing between the independently rotatable upper and lower portions of the pipe, and an inlet or spacer pipe below the thrust

bearing the same being a continuation of said shell to position the packer relative to the bottom of the well and the formation to be tested.

12. A combination well testing and cementing device including an operating string of pipe, a shell surrounding said pipe adapted to have limited telescopic movement over a portion of the pipe, a latching means connecting said shell and pipe operable by weight of said pipe to release the pipe for limited telescopic movement relative to said shell, a cylindrical packer adapted to be expanded by fluid pressure transmitted from a piston in said shell, intake ports in said pipe and shell normally out of communication with each other and adapted to be placed in communication by telescopic movement of said pipe relative to said shell, a flare-fluid chamber within a sleeve slidable over said shell, said sleeve containing a telltale substance adapted to be discharged into the well bore above the packer, an instruments case or gadget box in the shell, a releasable clutch between the upper and lower portions of said pipe, a check valve within the pipe below the packer, said valve being adapted to be opened by fluid pumped into the pipe in case the tool should become stuck in the well, a thrust bearing between the independently rotatable portions of the pipe, and an inlet or spacer pipe being a continuation of said shell below the thrust bearing to position the packer relative to the bottom of the well and the formation to be tested.

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