

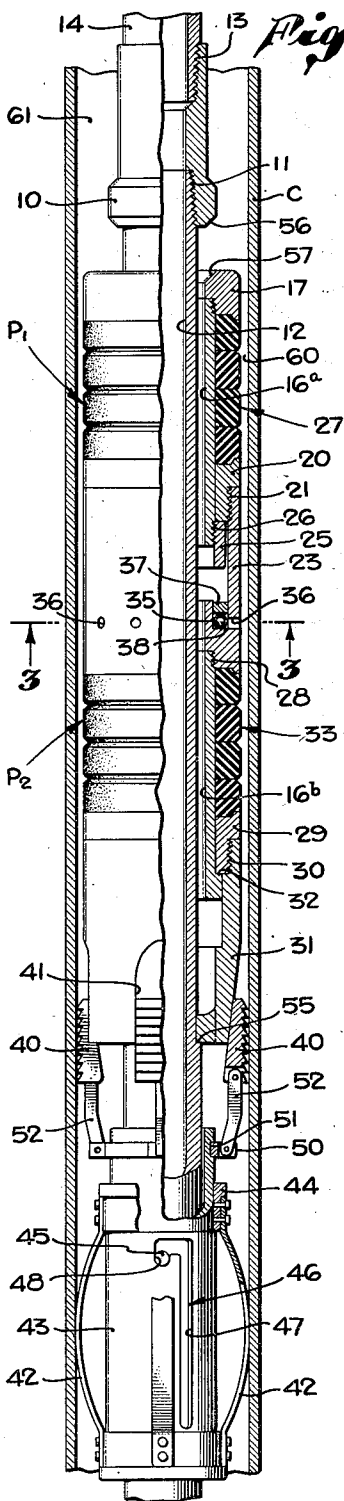
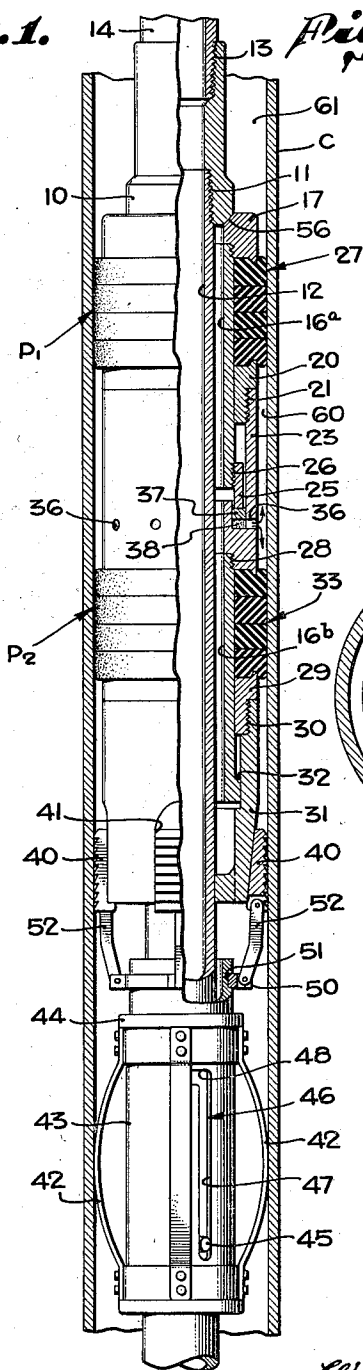
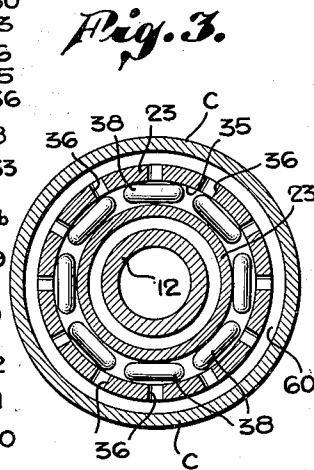
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WELL PACKER

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WELL PACKER

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This invention relates, in general, to well packers and more particularly to well packers, bridging plugs and the like devices having means incorporated therein for indicating leakage.

This invention has its most important application to oil wells in which it is desired to carry on so-called dual production, that is, production from two different formations at separate depths in the well. In such dual production practice it is customary to set a packer between the two production zones to isolate them from one another and then produce the lower zone through the packer and the tubing and the upper zone through the annular passage between the tubing and the surrounding casing above the packer.

Under such production conditions it is important for several reasons to determine whether or not there is any leakage of fluid past the packer between the two producing zones separated by the packer either through the casing or by channeling outside of the casing. One important reason for this knowledge is to enable one to determine whether a zone of higher pressure may be losing production by leakage past the packer or by channeling along the outside of the casing to a zone of lower pressure. When this occurs the current well production rate of the higher pressure zone may not only be reduced but ultimate production thereof may be lost, and irreparable damage also may be done to one formation by contamination with the production fluid from another formation. Also the potential production rate and ultimate production of one such formation may be seriously lowered by loss of gas pressure or other fluid pressure to another formation of relatively low pressure.

Another important reason for accurate determination of whether or not a packer, serving to separate the productions in a well from two different producing zones, is free from leakage, is to enable one to obtain accurate and truly representative well potential production rates from which proper prorated production rates for the well can be calculated. If a packer in a dual production well should leak, the separate productions from the separate formations will be influenced by one another. For example, if the packer in a dual production well is leaking and thereby allowing a substantial amount of the fluid from one producing zone to flow past the packer into the fluid produced from the other zone the apparent potential of the first zone will be less and that of the second zone greater than the true potentials.

Hence it is necessary to maintain the two zones and the productions therefrom isolated, particularly at the time tests are made to establish the true well production rate potentials.

Ordinarily the determination of whether or not there is any such leakage past the packer

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or outside the casing as hereinbefore mentioned is a very difficult undertaking and at best uncertain.

It is accordingly a primary object of this invention to overcome the hereinbefore mentioned difficulties.

It is another object of this invention to provide a means and method for indicating leakage of fluid past a well packer set in a well.

It is another object of this invention to provide a means and method for determining the occurrence of leakage along the outside of casing set between two or more formations.

It is still another object of this invention to provide a well packer apparatus incorporating automatic leakage indicating means therein.

In general the foregoing objects of this invention are attained by and the invention is embodied in apparatus comprising a packer means for dividing the well casing or borehole into two longitudinally separated zones, an upper zone and a lower zone, with means incorporated in the packer structure for automatically releasing a tracer fluid upon setting of the packer and occurrence of leakage of the fluid past the packer from one of said zones to the other.

Other objects, advantages and features of novelty will be evident hereinafter.

In the drawings which show by way of illustration preferred embodiments of the invention and in which like reference numerals designate the same or similar parts through the several views:

Figure 1 is a view partially in elevation and partially in longitudinal section showing the apparatus in its initial run-in position within a well casing just prior to setting;

Figure 2 is another view of the apparatus of Figure 1 as it appears after setting in a well casing;

Figure 3 is a cross-sectional view taken on line 3—3 of Figure 1.

Referring now to the drawings, the apparatus there illustrated is as follows:

A well casing is shown at C which may be assumed to have been installed in the usual fashion in a well borehole and into which the packer embodying the invention is run.

The packer structure in general, except as described hereinafter, may be similar to that shown and described in the U. S. Patent 2,005,955 and comprises the following parts:

A packer head or top collar member 10, carries, through a threaded joint 11, a hollow mandrel tube or body 12 which mandrel tube extends downward and concentrically through the packer and slip assemblies. The packer head 10 is adapted to make threaded coupling at 13 with suitable drill pipe or tubing 14 by means of which the whole packer apparatus is suspended while

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being lowered through the well casing and by means of which the packer is manipulated and downward force is applied to set the packer and expand the resilient packing elements into sealing engagement within a surrounding casing after the packer is set. The drill pipe or tubing 14 also serves, after the packer is set, to convey to the well surface any fluid produced from the well below the packer, as hereinafter more fully described.

Concentrically surrounding the mandrel 12 and slidably spaced therefrom are a pair of longitudinally spaced packing assemblies the upper packing assembly being shown at P₁ and the lower packing assembly being shown at P₂.

The upper packing assembly P₁ comprises a packing supporting sleeve 16a threadedly connected at its upper end to an annular valve seat member 17. The lower portion of the packing supporting sleeve 16a extends downward slidably through a packing retaining nut 20 which in turn makes threaded connection at 21 with the upper end of an intermediate cylindrical spacer body 23. The lower end of the packing supporting sleeve 16a carries a downwardly extending cylindrical or ring shaped nut 25 threadedly connected thereto at 26.

A resilient packing element or sleeve, or a plurality of resilient packing rings 27 encircle the supporting sleeve 16a, are retained in position thereon, and are adapted to be axially compressed between the packing setting means which includes the inner confronting annular surfaces of the beforementioned valve seat member 17 and the retaining nut 20.

The lower end portion of the intermediate, cylindrical, spacer body 23 has a form similar to that of the hereinbefore described valve seat member 17 and makes threaded connection as shown at 28 with the upper end of a lower packing supporting sleeve 16b. The lower portion of the lower packing supporting sleeve 16b extends downwardly slidably through a lower packing retaining nut 29 which in turn makes threaded connection 30 with the upper end of a slip cone body 31. The lower end of the packing retaining sleeve 16b instead of carrying a cylindrical nut, as shown at 25, on the upper packing retaining sleeves 16a, is formed with an offset, outwardly extending shoulder as shown at 32 which when the packer is in an unset condition normally acts as a stop to limit the longitudinal sliding motion of the sleeve 16b with respect to the beforementioned packing retainer nut 29.

A resilient packing element or sleeve or a plurality of resilient packing rings as shown at 33 encircle the lower packing supporting sleeve 16b, are retained in position thereon, and are adapted to be axially compressed between the packing setting means which includes the inner confronting annular surfaces of the beforementioned lower end of the intermediate cylindrical spacer body 23 and the lower retaining nut 29.

The beforementioned intermediate cylindrical spacer body 23 is formed with an inner, upwardly facing, annular recess as shown at 35 in coaxial alignment with the beforementioned ring nut 25. A plurality of radially directed ducts or ports 36 interconnect the bottom of the recess 35 and the exterior of the spacer body 23 intermediate the packer assemblies P₁ and P₂. A suitable annular or ring shaped packing member 37 makes a slidable but fluid-tight press fit into the upper portion of the beforementioned annular slot 35.

The annular slot 35 below the annular packing

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member 37 is adapted to retain a suitable capsule or the like container or a number of capsules as shown at 38, containing a tracer material, as hereinafter more fully described.

Means are provided for anchoring the beforementioned slip cone 31 to the casing in a more or less conventional manner. Such means comprise slips 40 which are slidably mounted in dove-tail slip guides 41 formed in the said slip cone 31, the said slips being restrained from movement outwardly from the cone by the overhanging walls of the dove-tail guides but being free to slide longitudinally along the slip surfaces.

The slip control mechanism includes a slip cage of more or less conventional design comprising a plurality of outwardly bowed cage friction springs 42 which are rigidly attached at their lower ends to the lower end portion of a cage sleeve 43 and at their upper ends to a ring or collar 44 which is slidable longitudinally on the upper portion of the said sleeve 43 to permit lateral contraction and expansion of the bow springs 42.

The cage sleeve 43 is free to rotate and slide longitudinally upon the mandrel 12 except as limited by a dowel or latch pin 45 which projects outwardly from the mandrel into slidable engagement within a J-slot 46 formed in the cage sleeve and having a vertical portion 47 and a recessed, lateral portion as shown at 48.

A slip rein ring or collar 50 is retained on the upper end portion of the slip cage sleeve 43 in an annular groove, as shown at 51, providing freedom for rotational movement but preventing lateral movement thereof with respect to the sleeve. A plurality of slip reins 52 interlink the collar 50 and the slips 40; one rein for each slip. In operation the slips 40 are set and released in response to vertical movement of the cage sleeve 43 relative to the slip cone 31 as hereinafter more fully described in connection with the operation of the device.

The operation of the apparatus of the invention is as follows:

The packer apparatus is lowered through the well casing in the condition shown in Figure 1 to the level in the well or opposite the formation at which it is desired to be set. When the packer apparatus has been thus lowered to the setting position the latch pin 45 is released from the lateral recess 48 of the J-slot 46 in the slip cage sleeve 43 by imparting slight left-hand rotational movement to the mandrel 12 through the supporting tubing 14. Relative rotation is thus imparted between the latch-pin 45 and the cage sleeve 43 by reason of the fact that the cage sleeve 43 is restrained against rotation by the frictional engagement of the cage springs 52 with the inside surface of the casing C, whereas the mandrel 12 is free to rotate with the string of tubing 14 to which it is attached.

After the latchpin 45 has been thus released from the J-slot recess 48 the tubing is again lowered a short distance resulting in downward movement of the mandrel 12 with respect to the cage sleeve 43. Due to the frictional engagement of the cage springs 42 with the inside surface of the casing C the sleeve 43 remains substantially stationary. The whole packer mechanism including packing assemblies P₁ and P₂ will then be free to move downward with the mandrel 12, the whole assembly thereof initially riding upon and being supported by the shoulder 55 provided in the lower portion of the mandrel. The sleeve 43, slip collar 50, slip reins 52,

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and slips 40 will thus be caused, in effect, to move upward relative to the downwardly moving packer assembly including the slip cone 31, and the slips 40 will thus be caused to move upward along the slip cone guides and outward into gripping engagement with the inside surface of the casing thereby locking the cone 31 to the casing and preventing any further downward movement thereof relative to the casing. Thereafter, further downward movement of the mandrel 12 is continued while the packing assemblies P₁ and P₂ remain stationary, supported upon the slip cone 31, until the valve face 56 of the head 10 comes to rest upon the valve seat 57 in the upper end of the valve seat member 17 which seals the circulation passage through the packer between the mandrel 12 and the packing supporting sleeves 16a and 16b. Further downward movement of the tubing string thereafter forces the upper valve seat 17 and packing retainer sleeve 16a downward with respect to the packing retaining nut 20 thereby applying longitudinal compressive force and motion to the resilient packing sleeve or rings 27. This longitudinal or axial force is in turn transmitted through the packing retainer nut 20 and the intermediate cylindrical spacer body 23 to the lower packing sleeve or rings 33 resulting in downward motion of the said intermediate cylindrical spacer body 23 and the lower packing retainer sleeve 16b relative to the before-mentioned packing retainer nut 20 and slip cones 31 and thereby applying longitudinal compressive force to the resilient packing sleeve or rings 33.

Downward motion and pressure is continued to be applied through tubing 14 until the packer is firmly seated and set with the packings 27 and 33 expanded into sealing engagement with the inside surface of the casing C as illustrated in Figure 2.

As the upper packing retainer sleeve 16a moves downward, with respect to the upper packing retainer nut 20 during the setting operation, and as the packing rings 27 are compressed longitudinally the depending portion of the cylindrical nut member 25 carried on the lower end of the sleeve 16a moves downward into the upper open end portion of the annular groove 35 and into contact with the upper surface of the annular packing member 37. The packing elements 27 in the upper packing assembly P₁ and the relative length of the sleeve 16a and intermediate cylindrical spacer body 23 are so proportioned that when the packer is fully set in a given casing or borehole, as illustrated in Figure 2, the cylindrical nut member 25 is moved downward a sufficient distance to be brought into contact with the annular packing member 37 and to move the packing member 37 downward against the frangible capsule 38 and apply sufficient pressure to said capsule 38 to crush or rupture it and release the tracer material contained within it. Upon thus breaking the frangible capsule 38 and releasing the tracer material into the lower end portion of the recess 35 the tracer material is then free to flow or move or be expelled outward through the ducts 36 into the annular space or cavity 60 formed between the concentrically positioned outside surface of the intermediate cylindrical spacer body 23 and the inside surface of the casing C and between the sealed off upper and lower inner ends by the packing assemblies P₁ and P₂.

After the packer has been set as hereinbefore described and is in the position illustrated in

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Figure 2, and the tracer fluid has been released, to the annular space 60, any leakage of fluid in either direction past the packing assemblies P₁ and P₂ between the upper and lower portions of the well casing above and below the packer mechanism will result in carrying a portion of the tracer material from the annular space 60 along with the leakage fluid. The tracer material will thus eventually appear in the well fluid produced from the well either through the well tubing 14 or through the annular space 61 intermediate the well casing C and the tubing 14.

For example, if the pressure in the casing C is greater above the packer than it is below the packer there is a downward differential pressure across the packing elements P₁ and P₂ and if under these conditions there is any substantial leakage past the packing elements P₁ and P₂ the tracer fluid which has been released into the annular space 60 will be carried downward into the annular space below the packer and between the mandrel 12 and the casing C. The tracer fluid will then be carried downward through the lower annulus and if the well is being produced through the tubing will eventually enter the tubing at its lower end and flow together with the production through the tubing to the well surface where it may be detected by suitable means.

If, on the other hand, the differential pressure past the packing elements P₁ and P₂ is upward and leakage occurs, the tracer fluid contained in the annular cavity 60 will be carried upward past the packer into the annular space 61 between the tubing 14 and the casing C and production of fluid from the well through the annulus will thereby carry the tracer material along with it to the well surface where the presence of the tracer material may, as before-mentioned, be detected there by suitable means.

The frangible container for the tracer material may be in the form of a hollow or tubular annular ring made of glass and adapted to fit into the recess 35, or the tracer material may be contained in a plurality of hollow, spherical or slightly elongated glass capsules. The annular hollow ring or the plurality of hollow capsules may also be made of a suitable plastic material, in either case the material being such that it will be fractured or ruptured upon application of crushing force beneath the annular packing ring 37 to liberate the tracer material into ducts 36.

A typical example of the testing procedure employed in connection with the use of the apparatus of the invention hereinbefore described is as follows:

In a cased well 9000 feet deep with a producing sand of gas distillate at 7,500 feet the bottom hole pressure is approximately 3,800 pounds. Also at 8,950 feet a sand exists, producing oil with a fluid pressure at that point of 3,000 pounds per square inch. It is desired to produce the top sands through the casing and the lower sands through the tubing. The casing is perforated at approximately 7,500 feet and at approximately 8,950 feet respectively, opposite the upper and lower producing formations. 1400 feet of tubing is first run into the hole and the packer device hereinbefore described, containing the tracer fluid is installed at its top end. The packer carrying the 1,400 foot length of tubing depending therefrom is then run into the well on a suitable tubing string and set about 10 feet below the top perforations. Connections are then installed at the casing head with provisions for separately con-

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trolling and separately collecting the flow from the tubing and the casing. The lower zone is then flowed through the tubing and the upper zone through the annulus between the casing and tubing. Under such conditions if a leak occurs it is usually past the packer between packing and casing or through the leaks in the tubing walls or joints or through channeling in the cement along the outside of the casing.

After the well flow is thus established one or other of the formations may be first shut in; for example the upper producing zone is first shut in and the production from the bottom producing zone allowed to flow through the tubing at as high a rate as possible. Since flowing of the production through the tubing at a high rate will materially decrease the well pressure at the bottom of the well below the packer the differential pressure downward across the packings will then be a maximum. If the packing leaks under this condition the tracer fluid will be carried into the lower portion of the casing below the packer and be produced through the tubing along with the lower zone production. If no tracer fluid is produced through the tubing the packer is obviously holding under this condition without leakage. Next the tubing should be shut in and the production from the upper producing zone allowed to flow through the casing annulus at as high a rate as possible. Under this condition the differential pressure upward across the packings will be a maximum. If the packer leaks under this condition the tracer fluid will be carried into the upper portion of the casing above the packer and be produced through the casing annulus along with the upper zone production. If no tracer fluid appears in the production through the casing annulus the packer is obviously holding without leakage.

Now if in the first test hereinbefore mentioned, tracer fluid is produced but in the second test no tracer fluid is produced this would be an indication of failure of the lower packing element of the packer, allowing some of the tracer fluid to leak down and be produced through the tubing. However, the fact that no tracer fluid is produced through the casing annulus production, means that the upper packing element is still intact and functioning properly. The inverse of this would be true if the casing production contained tracer fluid but the tubing production contained none, that is, it would indicate that the lower packing element is intact but that the upper packing element of that packer had failed and was leaking. In a perfect packoff, no tracer fluid would be produced at any time either through the tubing or the casing.

If, however, no tracer fluid is produced either through the tubing or casing but the tubing and casing pressure substantially equalize when both casing and tubing are shut-in it is obvious that a leak exists somewhere else. In this latter case the leak may be either through defects in the tubing or possibly the leakage is occurring by channeling through or around the cement outside of the casing between the upper and the lower producing zones, and measures may then be taken to check the condition of the tubing and if necessary also to perform squeeze cementing in the manner well known in the art to eliminate any channeling leakage.

While a circulation type of casing packer mechanism is shown and described herein as a preferred apparatus to which the present invention is applicable, it is not so limited since the

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present invention is applicable to advantage to any type of packer which operates in a manner similar to that herein illustrated to place, expand or deform a resilient packing element or body radially into sealing engagement with a surrounding casing or formation wall.

The process and apparatus of this invention is, furthermore, not limited in its application to production type packers as herein illustrated but is also applicable to various other types of packers such as packers similarly constructed and adapted to be set in direct engagement with well bore-hole formations or in connection with bridging plugs adapted to be set either in casing or in uncased bores.

The tracer material may be any one or a mixture of two or more of the well known dyes which have been similarly employed to trace the flow or course of fluids such as, for example, fluorescein, uranine, eosin, gentisin and the like.

When fluorescein is employed as the tracer material its presence in the production from the well may be detected by drawing samples of the produced liquid and allowing it to stand quiescent in an open container for a relative short period of time. If the produced liquid is mainly oil the fluorescein, being relatively insoluble in oil and lighter than oil will float to the top surface and appear there upon inspection as a thin surface film or blotch, or as thin thread like or straited discolorations on the surface when the sample is stirred gently. If the produced liquid is water, or is oil containing sufficient water to separate therefrom by gravity, the presence of fluorescein therein can be detected by the characteristic greenish-yellow color which it imparts to the settled-out water phase.

If uranine dye is employed as the tracer material either in a liquid solution or in dry powdered form, its presence will be indicated by the yellowish color it imparts to the water phase.

While the term "tracer material" has been used frequently herein it is to be understood that this is intended to include not only solid materials but also suitable liquid and gaseous tracers. In the case where fluorescein, uranine or eosin and the like dyes are employed as the tracer materials they may be utilized either in concentrated solutions in suitable liquids in which they are soluble, or in suspension in suitable liquid dispersing agents or in dry crystalline powder form.

In the latter event where powdered tracer material is employed it reaches the annular space 60 from the recess 35 by diffusion through the leakage fluid, if any, which enters these spaces by leakage past the packing elements.

It is to be understood that the foregoing is illustrative of but one method and apparatus and that the invention is not limited thereby but may include various modifications and changes made by those skilled in the art without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. In a dual production method wherein a packer is set on a string of tubing in a well intermediate upper and lower producing zones to isolate said zones from one another and one of said zones is produced through the tubing and the other is produced through the annular space in the well outside of the said tubing the method of detecting leakage past said packer between said zones comprising the steps of releasing a tracer material into contact with the said well wall at a point longitudinally intermediate the

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upper and lower ends of said packer; shutting in one of said zones and while so shut in producing the other zone and testing the production so produced to determine the presence of any tracer material therein.

2. In a dual production method wherein a packer is set on a string of tubing in a well intermediate upper and lower producing zones to isolate said zones from one another and one of said zones is produced through the tubing and the other is produced through the annular space in the well outside of the said tubing the method of detecting leakage past said packer between said zones comprising the steps of releasing a tracer material into contact with the said well wall at a point longitudinally intermediate the upper and lower ends of said packer; shutting in one of said zones and while so shut-in producing the other zone and testing the production so produced to determine the presence of any tracer material therein; then shutting in the said other zone so produced and producing the said one of said zones previously shut-in and testing the production so produced to determine the presence of any tracer material therein.

3. In a dual production method wherein a packer is set on a string of tubing in a well intermediate upper and lower producing zones to isolate said zones from one another and one of said zones is produced through the tubing and the other is produced through the annular space in the well outside of the said tubing the method of detecting leakage past said packer between said zones comprising the steps of releasing a tracer material into contact with the said well wall at a point longitudinally intermediate the upper and lower ends of said packer; shutting in one of said zones and while so shut-in producing the other zone and testing the production so produced to determine the presence of any tracer material therein; then shutting in the said other zone so produced and producing the said one of said zones previously shut-in and testing the production so produced to determine the presence of any tracer material therein and then simultaneously shutting in both of said zones to compare the shut-in pressures of said zones.

4. In a dual production method wherein a packer is set on a string of tubing in a well intermediate upper and lower producing zones to isolate said zones from one another and one of said zones is produced through the tubing and the other is produced through the annular space in the well outside of the said tubing the method of detecting leakage past said packer between said zones comprising the steps of releasing a tracer material into contact with the said well wall at a point longitudinally intermediate the upper and lower ends of said packer; then simultaneously shutting in both of said zones to compare the shut-in pressures of said zones; then producing one of said zones while the other of said zones is shut-in and testing the production so produced to determine the presence of any tracer material therein; then shutting in the said one of said zones so produced and producing the other of said zones previously shut-in and testing the production so produced to determine the presence of any tracer material therein.

5. In a dual production method wherein a packer is set on a string of tubing in a well intermediate upper and lower producing zones to isolate said zones from one another and one of said zones is produced through the tubing and the other is produced through the annular space in

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the well outside of the said tubing the method of detecting leakage past said packer between said zones comprising the steps of releasing a tracer material into contact with the said well wall at a point longitudinally intermediate the upper and lower ends of said packer; shutting in one of said zones and while so shut-in producing the other zone and testing the production so produced to determine the presence of any tracer material therein; then simultaneously shutting in both of said zones to compare the shut-in pressures of said zones; then producing said one of said zones previously shut-in while said other zone is shut in and testing the production so produced to determine the presence of any tracer material therein.

6. Packer apparatus comprising: a pair of interconnected packing assemblies having a pair of spaced packing elements; setting means in said assemblies movable longitudinally relative to one another to expand said packing elements laterally into sealing engagement with a surrounding borehole wall; a member of said assemblies having formed in it a chamber adapted to contain tracer material; a duct leading through a wall of said member from said chamber to a point on the exterior of the packer apparatus intermediate said packing elements; and means coupled to at least one of said setting means and movable thereby relative to said chamber to expel tracer material from said chamber through said duct to the space intermediate said packing elements.

7. Packer apparatus comprising: a packer body; a pair of longitudinally spaced packing elements surrounding said packer body; a pair of setting means on said packer body and movable with respect to one another to expand said packing elements into sealing engagement between said packer body and a surrounding borehole wall to form thereby a sealed-off cavity between said packing elements and between said packer body and said wall; a frangible container positioned intermediate relatively movable portions of said pair of setting means and in communication with said sealed-off cavity; and means coupled to said pair of setting means and movable thereby into contact with said frangible container upon imparting relative motion between said pair of setting means, to rupture said container and release a tracer material from said container into said sealed-off cavity.

8. Packer apparatus comprising: a packer body; a pair of longitudinally spaced packing elements surrounding said packer body; a member carried by said packer body having walls defining a chamber therein and adapted to contain a quantity of a tracer material; a pair of setting means on said packer body and movable with respect to one another to place said packing elements into sealing engagement between said packer body and a surrounding borehole wall to form thereby a sealed-off cavity between said packing elements and between said packer body and said wall; a flow passageway providing communication between said chamber and said cavity and means coupled to said pair of setting means and actuatable by movement thereof relative to one another to apply pressure to such tracer material in said chamber and thereby effect expulsion of said tracer material from said chamber through said flow passageway into said sealed-off cavity.

9. Packer apparatus comprising: a packer body; a pair of longitudinally spaced packing elements surrounding said packer body; a mem-

ber in said packer body having walls defining a chamber therein and adapted to contain a tracer material-containing capsule; a pair of setting means on said packer body and movable relative to one another to place said packing elements into sealing engagement between said packer body and a surrounding borehole wall to form thereby a sealed-off cavity between said packing elements and between said packer body and said wall; a duct in said member interconnecting said chamber and said cavity; and means coupled to and actuatable by the movement of said setting means relative to one another to apply a rupturing pressure to such capsule in said chamber and thereby effect the release of tracer material from such capsule into said chamber from which it may flow through said duct to said sealed-off cavity.

10. Packer apparatus comprising: a packer body; a pair of longitudinally spaced packing elements surrounding said packer body; a pair of setting means on said packer body and movable relative to one another to place said packing elements into sealing engagement between said packer body and a surrounding borehole wall to form thereby a sealed-off cavity between said packing elements and between said packer body and said wall; a frangible tracer container carried by said packer body, the exterior of said container being positioned in communication with said sealed-off cavity; and means coupled to and actuatable by movement of said setting means relative to one another, to apply a rupturing force to said frangible container and thereby release tracer material therefrom into said sealed-off cavity.

11. Packer apparatus comprising: a packer body; a pair of longitudinally spaced packing elements surrounding said packer body; a member carried by said packer body having walls defining a chamber; a pair of setting means on said body movable relative to one another to place said packing elements into sealing engagement between said packer body and a surrounding borehole wall to form thereby a sealed-off cavity between said packing elements and between said packer body and said wall; a frangible tracer material-containing means in said chamber; a flow passageway extending from said chamber to the exterior of said packer body through which said chamber and said sealed-off cavity are interconnected; and means coupled to and actuatable by movement of said pair of said setting means relative to one another to apply a rupturing force to said frangible containing means and thereby release tracer material therefrom into said chamber for passage through said flow passageway into said sealed-off cavity when said packer is set.

12. Packer apparatus comprising: a packer body adapted to be secured to the lower end of a tubing string; a pair of longitudinally spaced packing elements surrounding said packer body; a pair of setting elements on said packer body movable relative to one another to expand said packing elements into sealing engagement with the inside surface of a surrounding casing and thereby form a sealed-off, annular space intermediate said packing elements and between said packer body and said casing; a normally fluid-tight initially closed container in said apparatus

to contain a quantity of a tracer material, the exterior of said container being positioned in communication with said annular space; and means coupled to and movable by said pair of setting elements to apply compressive force to said closed container sufficient to open said container into said sealed-off, annular space.

13. Packer apparatus comprising: a packer assembly including packing means adapted to be moved into sealing engagement with a surrounding wall; actuating means in said apparatus movable relative to said packing means for moving said packing means into sealing engagement with said wall; a container for a tracer material in said packer assembly; and means coupled with said actuating means, for releasing tracer material from said container to a point exterior to said packing means adjacent said wall and longitudinally intermediate the ends of said packing means when said packing means is moved into sealing engagement with said wall.

14. Packer apparatus comprising: a mandrel adapted to be secured to the lower end of a tubing string; a pair of longitudinally spaced, coaxial sleeve elements slidably supported with respect to one another on said mandrel; a packing element on each of said sleeve elements; means carried by said sleeve elements to compress said packing elements axially and thereby expand said packing elements radially into sealing engagement with a surrounding casing when said sleeve elements are moved axially toward one another on said mandrel; a chamber carried by one of said sleeve elements; a projection carried by the other of said sleeve elements positioned to enter said chamber when said sleeve elements are moved axially toward one another sufficiently to expand said packing elements into sealing engagement with said casing; and a flow passageway extending from the interior of said chamber through the said one sleeve element to a point on the exterior of the sleeve element adjacent the inner adjacent ends of said spaced packing elements.

15. Packer apparatus according to claim 14 with a fluid-tight container in said chamber in position to be ruptured by the entrance of said projection into said chamber to release and to expel material from said container through said flow passageway when said projection enters said chamber.

16. Packer apparatus according to claim 14 with a frangible fluid-tight container in said chamber in position to be ruptured by said projection to release and to expel material from said container and from said chamber through said flow passageway when said projection enters said chamber.

WILLIAM E. LYND.

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