United States Patent

[11] 3,599,719

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[54] **METHOD AND APPARATUS FOR PROVIDING CLEAN PERFORATIONS IN A WELL BORE**
20 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **166/297,** 166/100, 175/4.52
[51] **Int. Cl.** **E21b 43/116**
[50] **Field of Search** 166/297, 55.1, 55, 100; 175/4.52

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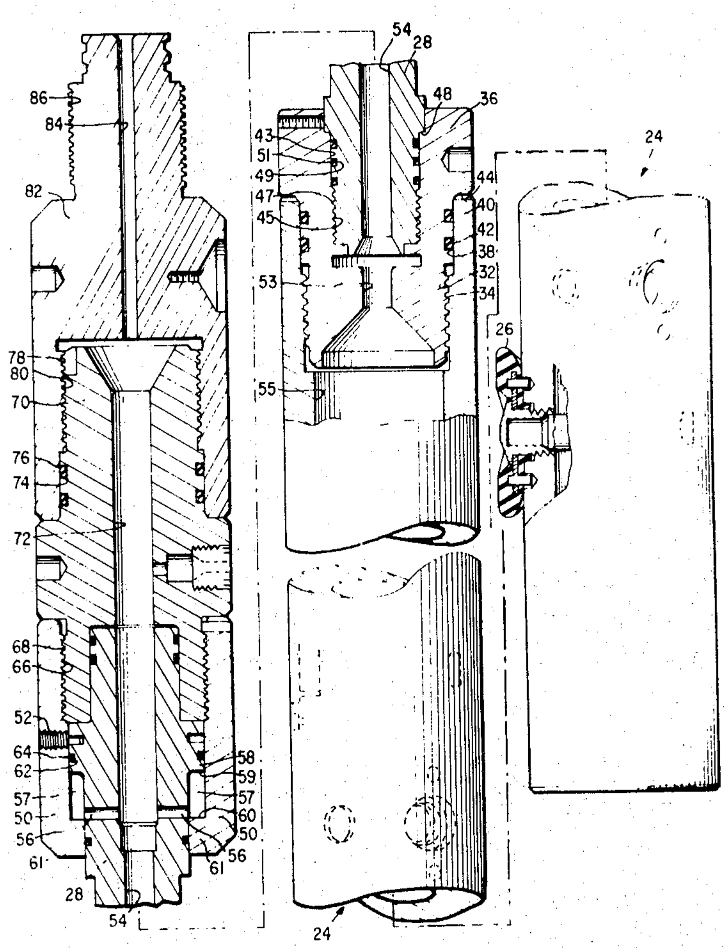
ABSTRACT: A method is provided for perforating the casing of a well and for sealing an isolated flow path from the formation adjacent the casing through the casing wall and into the perforating tool. The tool may be lowered by a cable into a well bore. The tool is permitted relatively free movement in the direction transverse to the axis of the bore. Formation-perforating guns are disposed within the tool and resilient elastomeric sealing pads are mounted on the outside of the tool generally coaxial with the barrel portions of the guns. As each gun is fired and the formation perforated, a pressure differential is applied across the sealing pad due to the pressure of the hydrostatic fluids surrounding the tool being substantially higher than the pressure of the fluids within the formation. The pressure differential immediately flexes the outer lips of the seal toward the casing wall adjacent the perforation site to form a seal therewith. The seal, in turn, pulls the tool transversely across the well bore toward the perforation. The pressure differential created by the perforation thereby secures the tool against the casing wall. To release the tool from the casing, a slide valve may be actuated by a vertically upward pull on the cable which actuation causes annular, high-pressure, hydrostatic fluids to enter the low-pressure space on the formation side of the seal so as to equalize the pressure and release the holding force produced thereby.



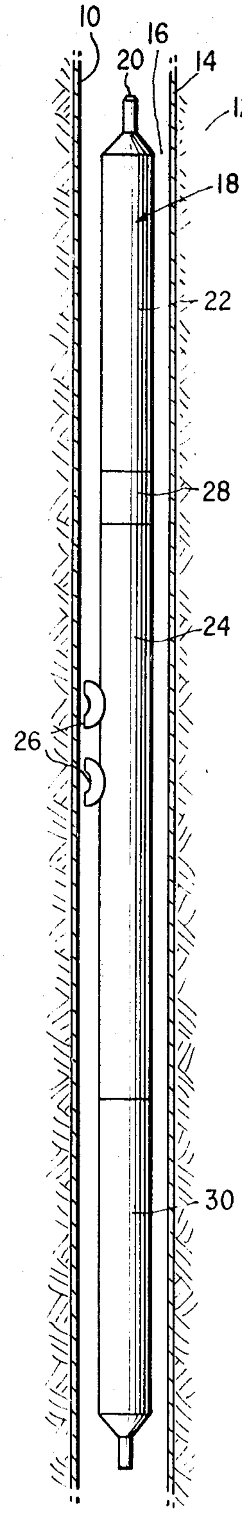


FIG. 1

FIG. 6

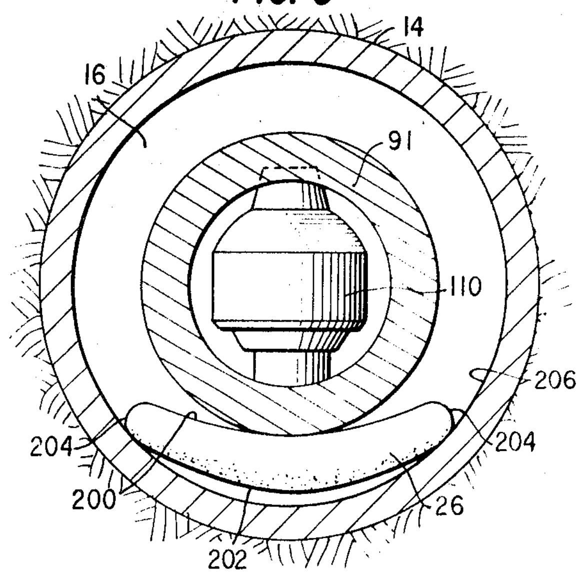


FIG. 7

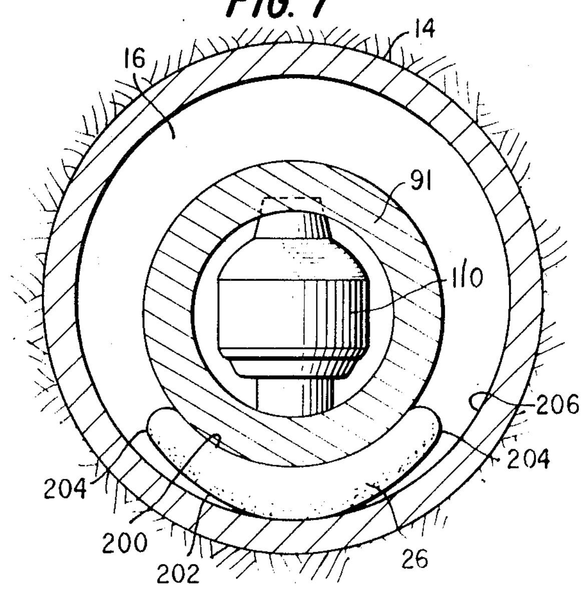


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FIG. 2

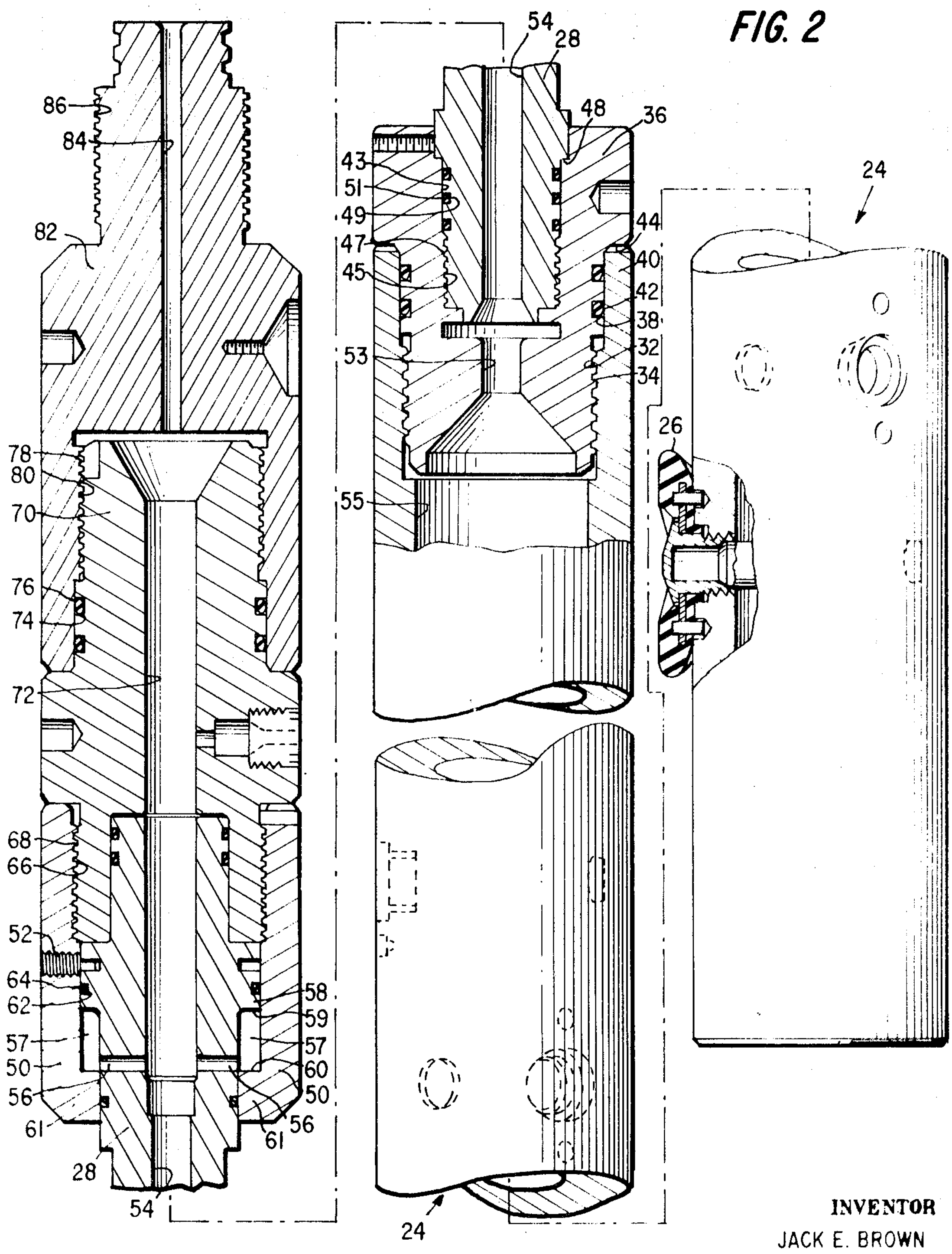

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FIG. 3

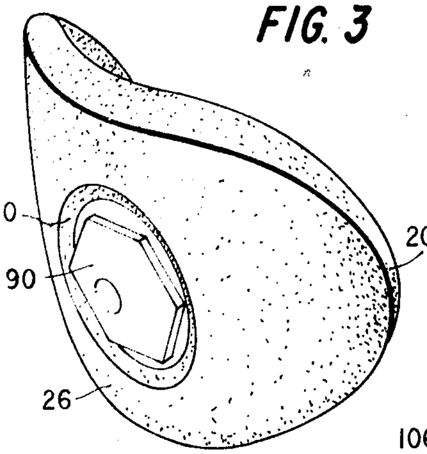


FIG. 4

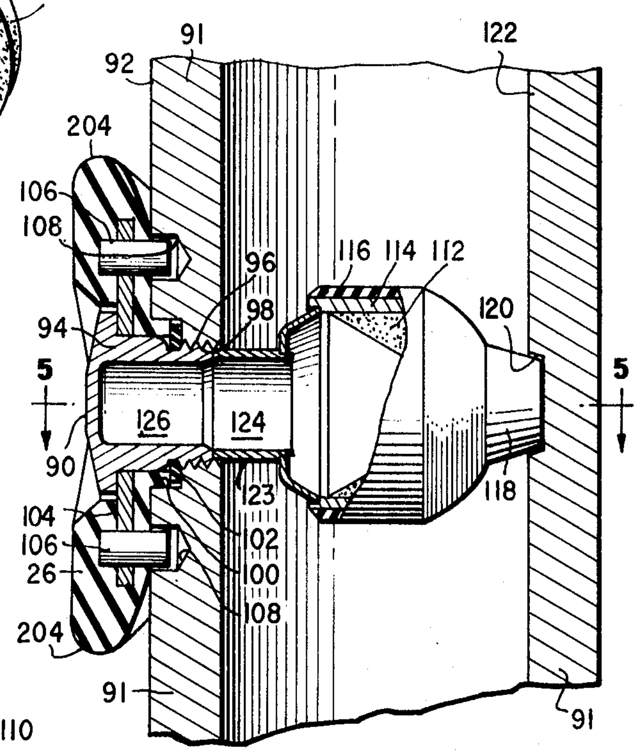
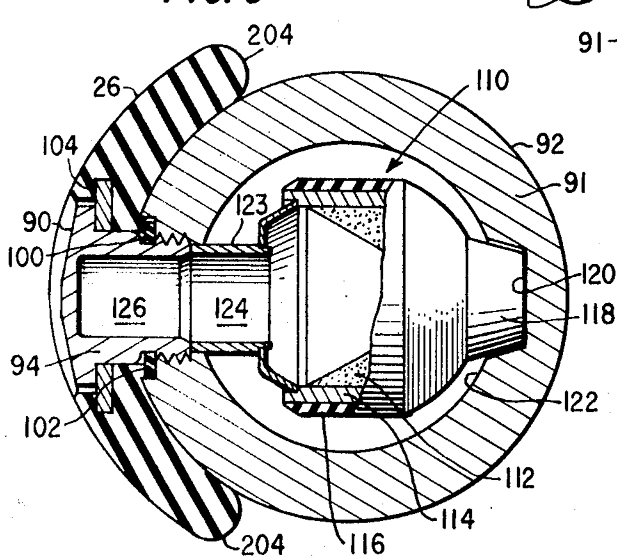


FIG. 5



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METHOD AND APPARATUS FOR PROVIDING CLEAN PERFORATIONS IN A WELL BORE

BACKGROUND OF THE INVENTION

The present invention relates generally to the art of perforating wells and, more particularly, relates to a method and apparatus for perforating a well bore and securing an isolated, cleaned, flow path extending from formation fluids to a perforating tool. The invention further relates to the retrieval of the tool after a satisfactory perforation has been formed and cleaned.

Explosive perforator equipment and methods, wherein a mass, in the form of either a projectile or a jet, is fired into a formation to accomplish a perforation are generally well known. Such equipment and methods are employed to provide communication between the fluids of an earth formation and a well bore with such communication traversing the well bore casing.

These methods and apparatus may be provided for the purpose of either producing formation fluid, testing such fluids, or injecting a desired fluid into the formation. Generally speaking, the perforation-influenced zones or "envelopes" should comprise a relatively large, substantially unrestricted, flow area, adequately cleared of detritus, for fluids entering the formation or for fluids passing from the formation. For formation testing purposes, the fluid path from well casing to testing tool should be properly sealed so that the high-pressure hydrostatic annular fluids surrounding the conduit string do not contaminate or dilute the fluids passing through this path.

Equipment for effecting the formation perforating and for securing a seal for formation fluids is described, for example, in U.S. Pat. No. 3,305,018 issued to White et al. and assigned to the assignee of the present application. While such apparatus is believed to be singularly advantageous, there is a current need for improvement and operational simplification. It is also desirable to facilitate the removal of the perforating tool from the well by easily releasing the seal surrounding the formation perforation.

Heretofore, it had been thought that sophisticated apparatus was necessary to urge a perforating tool into pressure contact with a well casing before detonating a perforating gun. This apparently was because it appeared that the recoil of the gun would drive the tool away from the perforation site. Similarly, it was thought that sophisticated apparatus was necessary to release the tool from the casing after a perforating operation. U.S. Lanmon Pat. No. 3,010,517 is an example of this thinking.

OBJECTS AND SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a relatively simple method and apparatus for perforating a fluid-bearing formation.

It is another object of the present invention to provide a relatively simple method and apparatus for securing an isolated flow path between an elongated tool disposed within a well bore and fluids disposed within a producing formation.

It is still another object of the present invention to provide a method and apparatus for sealing a flow path between fluids contained within a fluid-producing formation and the interior of a tool disposed within a well bore, which seal becomes more effective as the pressure of hydrostatic annular fluids surrounding the tool is increased.

It is yet another object of the present invention to provide a method and apparatus for perforating a fluid-producing formation and for securing an isolated flow path from the formation to the interior of a tool disposed therein which method and apparatus does not require the use of expensive and intricate well bore centralizing or decentralizing tool positioners.

It is a further object of the present invention to provide a method and apparatus for releasing a sealing engagement of a perforating tool with a perforated site which releasing may be accomplished in one simple mechanical step.

It is still a further object of the present invention to provide an apparatus for equalizing the pressures on the casing side of a perforation sealing member which apparatus may be actuated from above the well bore by simply applying an upward force thereto, such as by pulling upward thereon.

The objects of the present and preferred embodiment of the invention may be carried out by providing a method of perforating a well bore and defining an isolated flow path therefrom, including the steps of inserting a laterally unrestrained perforating tool within the well bore and releasing explosive energy from the tool to perforate the casing of the bore. A pressure differential is thereby caused between the formation fluids and the hydrostatic fluids within the bore and surrounding the tool. The pressure differential urges the relatively unrestrained tool toward the perforation site and a web member mounted on the tool flexes away from the tool into sealing engagement with the perforated site on the casing to secure an isolated flow path from the formation to the tool. The seal may be released by equalizing the pressure on the casing side of the web with the pressure on the tool side thereof at which time the tool will fall away from the perforation site and may be retrieved from the well bore.

An independent aspect of this invention entails uniquely combined apparatus means for accomplishing this method.

In another feature of the invention, the equalizing of the pressures acting on the casing side and the tool side of the sealing web may be accomplished by the provision of a slide valve incorporated within the tool which valve may be actuated by an upwardly directed mechanical force.

BRIEF DESCRIPTION OF THE DRAWINGS

While the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification, a preferred embodiment is disclosed in the following detailed description which may be best understood when taken in connection with the accompanying drawings in which:

FIG. 1 is an overall perspective view of a perforating and sealing tool disposed within the bore of a well casing;

FIG. 2 is an enlarged partial sectional view of the overall apparatus shown in **FIG. 1** taken along the longitudinal axis thereof;

FIG. 3 is a pictorial view of a sealing pad which may be used in the present invention to secure an isolated fluid path between the formation and the interior of the tool shown in **FIG. 1**;

FIG. 4 shows a vertical sectional view of the tool shown in **FIG. 1** at the portion thereof in which a formation-perforating gun and the sealing pad of **FIG. 3** are properly mounted;

FIG. 5 is a horizontal sectional view of the portion of the perforating and sealing tool shown in **FIG. 4** taken along line **5–5**;

FIG. 6 is a horizontal sectional view of the tool showing the sealing pad flexing toward a perforation site in the casing under the influence of a pressure differential applied across the pad; and,

FIG. 7 shows the tool and pad of **FIG. 6** wherein the pressure differential has driven the sealing pad and attached tool into a sealing engagement with the perforation site in the well casing.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings in which like numerals are used to indicate like parts throughout the various views thereof, FIG. **1** shows a well bore **10** drilled within formation **12** and a casing **14** (casing may be of cement, mudcake, metal, or even nonexistent) lining the well bore **10** to preserve the integrity thereof. A hydrostatic fluid is disposed within the annular space **16** defined by the casing **14** and a typical perforating and sealing tool indicated generally as **18**, which is lowered into the bore **16**. It should be here noted that the tool **18** is permitted relatively free movement in a direction transverse of the bore which lack of restraint was heretofore believed to result in the unsatisfactory operation of the tool **18**.

The upper end of the tool **18** is fitted with a cable head connection **20** to which is attached a cable (not shown) for lowering or raising the tool within the bore. The next lower portion **22** of the tool may be a collar locator section, an adapter, or may be a formation fluid sampler reservoir. The next lower section of the tool may be a slide valve **28** which may be actuated to equalize a pressure differential applied across sealing pads **26** which pressure differential urges the pads **26** against the casing **14**. The next lower section of the tool **18** is the perforating and sealing tool carrier **24** upon which are secured the perforation sealing pads **26** and within which are mounted formation-perforating guns (not shown). The lowermost portion of the tool **18** may comprise a residual fluid chamber **30** for retaining the initial fluids issuing from a newly formed perforation which fluids carry crushed formation and other fluid-path-blocking detritus. The section **30** may alternatively comprise a formation fluid sampler such as that disclosed in U.S. Pat. No. 2,740,479 issued in 1956 to Schwegman and assigned to the assignee of the present invention.

It should be understood that the sections of the tool **18** may be rearranged in any manner provided the slide valve **28** is disposed above the section **24** which is sealingly anchored to the bore casing **14** which anchor provides a fixed point for developing the necessary tensile force for actuating the valve **28** upon the application of an upward mechanical force to the cable head **20**.

Referring now to FIG. 2, the overall apparatus of FIG. 1 is shown in enlarged partial cross-sectional detail. As indicated by the broken centerline of FIG. 2 the tool is developed from top to bottom in the direction of the drawing from left to right. Since the upper and lower chambers **22** and **30**, respectively, may comprise any conventional members to carry out one of the desired functions of the overall tool **18**, only the sealing and perforating section **24** and the slide valve **28** are detailed and will be described in this specification. It is to the sections **24** and **28** that the present invention is primarily directed.

The perforation and sealing section **24** of the tool **18** is formed as a tubular housing having a formation-perforating gun and sealing pad arrangement (described later in connection with FIGS. 3, 4 and 5) mounted therein. The uppermost portion of the perforation and sealing section **24** is formed with internal threads **32** which engage within external threads **34** formed on the lower portion of a lower adapted member **36**. Annular grooves **38** are formed about the lower adapted member **36** adjacent an upper portion **40** of the perforation and sealing tool **24**. O-ring seal members **42** may be disposed within the annular grooves to prevent the axial flow of fluid along the surfaces adjacent thereto. An annular shoulder **44** is formed on the lower adapted member **36** to limit the longitudinal travel of the perforation and sealing member **24** on the lower adapted **36** when the threads **34** and **32** are properly engaged.

The lower adapted member **36**, itself, is provided with an axial bore **43** having internal threads **45** formed therein. A slide valve member indicated generally in FIG. 1 as numeral **28** is inserted within the bore **43** of the lower adapted member **36** and is provided with external threads **47** formed on the lower end thereof for engagement within internal threads **45** of the lower adapted member **36**. Annular grooves **49** may be formed on the lower portion of the slide valve **28** for retaining O-ring seals **51** which, once again, perform the function of preventing the longitudinal leakage of fluids between the slide valve **28** and the lower adapted member **36** in the area adjacent to said seals. A shoulder **48** may be formed on the lower portion of the slide valve **28** to properly position the slide valve longitudinally within the lower adapted member **36** upon the threaded engagement of the two.

The upper portion of the slide valve **28** is attached to a collar member **50** by means of a shearpin **52**. An axial bore **54** is formed through the slide valve member and communicates with an internal bore **55** of the tubular housing of the penetration and sealing section **24** of the tool through a similar axial bore **53** formed through the lower adapted member **36**. Radially extending passages **56** communicate between the axial bore **54** of the slide valve **28** and the exterior cylindrical surfaces thereof. Radially extending shoulders **58** are formed on the slide valve and, when the slide valve is properly connected to the collar **50** by means of the shearpin **52** an annular space **57** is defined between a lower radially extending end of the collar **50** and the lower horizontal surface of the slide valve shoulder **58**. The functional relationship of the configuration of the collar **50** with respect to the slide valve **28** and the available slide valve travel through the space **57** will be described later in the specification.

The slide valve may be provided with annular grooves **62** disposed about the upper end thereof for the disposition of O-ring seals **64** therein. The upper portion of the collar **50** is formed with internal threads **66** which threadedly engage within threads **68** formed on a lower portion of a connecting mandrel **70**.

The mandrel **70** is formed with an axial bore **72** which is in fluid communication relationship with the axial bore **54** of the slide valve **28**. The upper portion of the mandrel **70** is formed with annular grooves **74** for retaining O-ring seals **76**. External threading **78** is formed at the upper terminal end of the mandrel **70** for threaded engagement with internal threads **80** formed on the lower end of an upper adapted member **82**. The upper adapter member **82** is formed with an axial bore **84** which is somewhat smaller in diameter than the bore **72** of the mandrel **70** and is in fluid communication relationship therewith. The upper end of the upper adapted member **82** is formed with external threads **86** to which may be attached a formation fluid sampler reservoir or an evacuated residual chamber (not shown). Of course, a sampler reservoir would be provided with passageways disposed in fluid communication relationship with the axial bore **84** of the upper adapter member **82** and with means to trap the formation fluid within the reservoir before retrieving the tool **18** from the bore **10**.

In operation, the slide valve **28** is actuated by a vertically upwardly directed force on the tool which shears the shearpin **52** so as to permit the collar **50** to slide upwardly along the slide valve **28** until the lower radially extending surface **59** of the shoulder **58** formed on the valve **28** abuts against a lower radially extending surface **60** defining a lower portion **61** of the collar member **50**. When the surface **59** of the valve **28** engages surface **60** of the collar member **50**, the radial ports **56** of the valve **28** are exposed to the high pressure of the annular hydrostatic fluids surrounding the overall tool **18** and retained within the well bore defined by the casing **14**. The hydrostatic fluid then rushes through the radial ports **56** and down through the axial bores **54** and **53** of the sleeve valve **28** and the lower adapted **36**, respectively, into the tubular housing of the perforation and sealing section **24** of the tool **18**. The high-pressure hydrostatic annular fluid is then directed to the low-pressure casing side of the sealing pad **26** to release the sealing engagement thereof in a manner which will be explained later with reference to FIGS. 6 and 7 of the drawings.

If a formation fluid sampler chamber comprises a part of the overall tool **18**, prior to the actuation of the slide valve **50**, the formation fluid sampler chamber may be closed off from the hydrostatic-fluid-carrying bore **84** of the upper adapter member **82**. Any conventional method of closing off such a chamber, as by explosive valving, may be utilized for this application.

FIG. 3 shows the sealing pad **26** used in the method of the present invention which pad **26** consists of a resilient, elastomeric material such as synthetic or natural rubber. The pad **26**, when pressed flat, is of an almost circular configuration and when in an operational shape is bent to conform to the outer surface of a cylinder such as a drill pipe tool. The pad **26** is secured to the perforation and sealing portion **24** of the overall tool **18** by means of a mounting stud **94**. A boltlike configuration is attributed to the stud **94** by the provision of a hex-nut-shaped head **90** which compresses the sealing pad **26** between the stud **90** and the casing **91** of the perforation and sealing section **24** of the tool **18**.

FIG. 4 shows a partial vertical sectional view of the perforation and sealing portion 24 of the tool 18 in which the sealing pad 26 is secured to the exterior surface 92 of the casing 91 of the perforation and sealing portion 24 by means of the mounting stud 94. The stud 94 is formed with external threads 96 at the inner end thereof which threadedly engage within internal threads 98 defining an aperture within the casing 91 of the tool. The portion of the aperture of the tool adjacent the outer surface 92 thereof may be enlarged in diameter with respect to the threaded portion 98 so as to form an annular groove 100 for retaining an annular sealing member 102.

A relatively rigid annular disc 104 may be embedded within the resilient, elastomeric sealing pad 26 for providing a rigid base upon which the hex nut head 90 of the stud 94 may impinge to securely attach the sealing pad 26 to the outer surface 92 of the tool section 24. Positioning lugs 106 may also be embedded within the sealing pad 26 and annular member 104 for the purpose of locating the sealing pad 26 generally coaxially about the aperture formed by the threads 98. The lugs 106 fit within cylindrical recesses 108 formed within the surface 92 to effect the proper alignment.

A formation-perforating gun shown generally as 110 is disposed within the perforating and sealing portion 24 of the tool 18 transversely to the axis thereof. The gun 100 comprises a shaped charge 112 disposed within a generally cylindrical casing 114 which may comprise any suitable material. An outer nonmetallic covering 116 may cover the cylindrical casing 114 and may protect the metal against corrosion. A rear portion of the gun 118 is formed as a frustoconical projection 118 which may be inserted within a correspondingly shaped recess 120 formed within the internal surface 122 of the perforating and sealing portion 24 of the overall tool 18. The other end of the gun 110 is provided with a cylindrical barrel 123 having an annular bore 124 which is aligned with an axial bore 126 formed within the stud 94 used to secure the sealing pad 26 to the surface 92 of the tool. Alignment of the gun 110 is accomplished by properly inserting the projection 118 within the recess 120 formed within the wall 122 of the tool and then properly lining the barrel bore 124 with the bore 126 formed within the stud 94.

In operation, the gun may be fired by an electrical firing cord (not shown) which may fire a series of such perforating guns simultaneously. The gun 110 may effect a perforation by firing a projectile into the fluid-producing formation or merely by directing the expanding gases of a shaped charge thereinto. In either alternative, the projectile or gases rupture the hex-nut-shaped head 90 of the stud 94 and penetrate deeply into the formation to form a perforation envelope therein. At this time, a pressure differential develops across the tool between the high-pressure hydrostatic annular fluids about the tool and the lower-pressure formation fluids within the perforation envelope.

Referring now to FIGS. 6 and 7, FIG. 6 shows a horizontal view of the perforating and sealing tool immediately after a perforation is blasted within the formation wall of a production area. The pressure differential between the hydrostatic fluids on the tool side 200 of the seal 26 and on the bore casing side 202 thereof forces the outer lip 204 of the seal 26 to flex out into engagement with the inner surface 206 of the bore casing 14 adjacent the perforation site.

Since the tool 18 is permitted relatively free motion in the direction transverse to the axis of the bore, the force on the sealing pad 26 caused by the pressure differential moves the tool and seal into pressure engagement with the inner surface 206 of the casing. It is important that the sealing pad be resilient because it would take too long for the tool itself to be moved to engagement with the perforation site and a resulting seal is far more effective when the outer lips of the pad 26 can be deflected to secure a seal around the perforation envelope developed by the gun 110 immediately upon the detonation thereof. FIG. 7 shows the sealing pad 26 in the engaged position wherein an isolated fluid flow path has been secured from the formation fluids into the tool so as to preclude leakage and contamination by the annular hydrostatic fluids surrounding the tool.

As discussed earlier, this seal may then be released by an upward pull on the cable head 20 which pull acting against the holding force of the differential pressure against the seal actuates the slide valve 28 by shearing the pin 52 and sliding the collar 50 upward to expose the radial ports 56 of the valve 28 to the high-pressure of the hydrostatic fluid within the well bore 16. This pressure is then communicated through the axial passageways defined through the tool 18, through the ruptured gun casing 114 (the integrity of which has been destroyed by the blast during the perforating operation) through the barrel 123 and the stud bore 126 to the casing side 202 of the seal 26 so as to equalize the pressure on both sides 200 and 202 of the seal 26 and thereby release the holding force which urges the seal 26 against a perforation site. The released tool 18 may now be retrieved from the well bore 16.

This pressure-equalizing process may be accomplished by the mechanical pull described above or may be done electrically with a time-delay mechanism which is currently in use in other well applications. Surprisingly, the differential pressure across the seal has proven to apply sufficient holding force to permit an upward force on the supporting cable to shear the pin 52 and to actuate the pressure-equalizing valve. In actual operation in the field, differential pressures acting across sealing pads 26 have held up to over 40,000 pound pulls with tools having from six to eight pads. This is due to the fact that the differential pressure between the tool side and casing side of the sealing pad 26 may exceed 300 pounds per square inch.

It should be noted that the equalizing valve may be placed anywhere in the tool 18 with the same efficient operation as that discussed in the preferred embodiment provided that it is disposed somewhere above the perforating and sealing section 24. The resilient nature of this sealing pad 26 is essential to its operation to ensure that the perforated site is sealed immediately upon gun 110 detonation without having to wait for the slowly moving tool to move into engagement therewith. The sealing pad 26 may be formed with a 45° chamfer 210 surrounding the mounting stud 24, as shown in FIG. 3, to prevent cutting or shredding of the pad by the action of the charge blast. Also, such a chamfer permits some vertical misalignment between the perforation envelope and stud bore 126 after the charge has been detonated without diminishing the area of the passageway through which the formation fluids must flow.

The lugs 106 embedded within the sealing pad 26 and the plate 104 provide alignment so as to assist as an additional aid in ensuring that the passageway cross-sectional area is not diminished by an improper alignment between the stud bore 126 and the perforation envelope blasted within the formation.

It should also be noted that a sampler chamber may be disposed at the upper or lower end of the tool. Similarly, such a perforation and sealing device may be used without a sampler chamber but for the purpose of withdrawing the initial detritus-filled formation fluids from the production site into a low-pressure bore within the overall tool whereby a newly formed perforation envelope may be cleaned out.

Of special importance is the fact that the simple and inexpensive apparatus described in the preferred embodiment of the present invention does not require the use of centralizing or decentralizing apparatus to position the tool with respect to a desired perforation site before blasting. It has been found that the pressure differential across the sealing pad caused by the high-pressure hydrostatic annular fluid and low-pressure formation fluids is sufficient to quickly move the tool into a proper sealing position and to effect a leakproof seal with the perforation envelope. Therefore, the tool may be freely lowered into the bore without all the attending centralizing and decentralizing paraphernalia which is being used with currently operated equipment.

Of course, particular significance should be attached to the discovery that when the perforating gun is fired, the tool and the sealing pad mounted thereon are not recoiled away from the perforation site but, instead, are immediately urged thereagainst by the differential pressures developed across the sealing pad. It is existing policy that relatively small perforating charges must be used in order to prevent misalignment or fouling of tool-positioning apparatus and to prevent the tool from recoiling away from a site against the bias of a tool decentralizing and positioning means. However, due to this discovery, far larger blasting charges may be used than have heretofore been thought to be practical.

It can thus be seen that a simple and inexpensive method and apparatus have been provided for forming a perforation envelope within a formation and for providing a sealed, isolated, fluid flow path from the formation to a drill pipe tool supported within a well bore.

U.S. unobvious nature of the unrestrained tool body and web flexing before sealing aspects of the invention are demonstrated, in part, by patents such as U.S. Bretzke, Jr. Pat. No. 3,173,485. While flexing of a perforation sealing web is disclosed in the patent, the concept of flexing before tool body movement, to accomplish rapid initial sealing between the tool and well bore wall, is not recognized.

While what has been described is a preferred embodiment of the present invention, it is of course, understood that various modifications and changes may be made therein without departing from the true spirit of the invention and it is therefore intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the present invention.

I claim:

1. A method of perforating a well bore and defining an isolated flow path, said method comprising:

supporting a perforating tool within a well bore, with said tool being substantially unrestrained with respect to transverse movement within said well bore and operable to move generally transversely of said well bore away from a site to be perforated;

releasing explosive energy from said tool directed toward said site to perforate said well bore, with said tool remaining unrestrained with respect to movement transversely of said well bore;

creating a differential pressure within said well bore urging said tool toward said site in response to the perforation of said site;

sealing a portion of said well tool against said perforated site in response to said differential pressure, with said tool being unrestrained against said transverse movement; and

defining an isolated flow path leading from said perforated site to the interior of said tool, with said tool remaining unrestrained with respect to said transverse movement except for said differential pressure.

2. A method according to claim 1:

wherein the step of releasing explosive energy from said tool directed toward said site comprises the step of detonating a shaped charge mounted within said tool; and

wherein the step of supporting a perforating tool within a well bore comprises the step of lowering and positioning the perforating tool by a cable attached to the upper end of said tool.

3. A method according to claim 1 further comprising:

supporting elastomeric web means on the exterior of said tool, with said web means being operable in response to differential pressure acting thereacross to flex away from said tool and generally toward said perforation site;

in response to said differential pressure, flexing said web means toward said perforation site and positioning said web means in sealing engagement with said well bore adjacent said perforation site; and

thereafter, in response to said differential pressure, moving said well tool toward said site to cause said web means to restore to an unflexed position and complete said sealing.

4. A method of perforating a well bore and defining an isolated flow path, said method comprising:

supporting a perforating tool within a well bore adjacent a site to be perforated;

supporting elastomeric web means on the exterior of said well tool, with said web means being operable in response to differential pressure acting thereacross to flex away from said tool and generally toward said perforation site;

releasing explosive energy from said tool directed toward said site to perforate said well bore;

creating a differential pressure within said well bore urging said tool toward said site in response to the perforation site;

in response to said differential pressure, flexing said web means toward said perforation site and positioning said web means in sealing engagement with said well bore adjacent said perforation site;

thereafter, in response to said differential pressure, moving said well tool toward said site to cause said web means to restore to an unflexed position.

5. A method according to claim 4 with the additional step of removing said perforation tool from said well bore, said removing step including the step of;

releasing the engagement of said web means with said perforation site by equalizing the pressure acting on the tool side and the perforation site side of said web so as to eliminate the pressure differential applied thereacross.

6. A method according to claim 5 wherein said equalizing step comprises the step of communicating the pressure within the well bore with the pressure at the perforation site through a formation fluid passageway formed through said web by the releasing of the explosive energy.

7. A method according to claim 6 wherein the step of communicating the pressure within the well bore with the pressure at the perforation site comprises the step of actuating a slide valve connected within the overall perforating tool.

8. A method according to claim 7 wherein the actuating of the slide valve connected within the overall perforating tool comprises the step of applying a force to a collar member surrounding the slide valve so as to move the collar axially along the slide valve to expose to a surrounding high-pressure fluid a series of fluid passageways formed in the tool and communicating with the low-pressure perforation site through the fluid passageway formed through the web by the releasing of explosive energy.

9. A method according to claim 8 wherein the step of applying a force to the collar member comprises the step of pulling up on the upper portion of the tool against the sealing engagement of the web with said well bore adjacent said perforation site;

the tool being unrestrained in the transverse direction except for the sealing engagement of the web with the well bore.

10. A method according to claim 9 wherein the step of supporting a perforating tool within a well bore adjacent a site to be perforated comprises the step of lowering and positioning said perforating tool by means of a cable.

11. A method according to claim 10 wherein the step of releasing explosive energy from said tool directed toward said site comprises the step of detonating at least one shaped charge.

12. A well bore casing perforation and sealing tool comprising:

supporting means;

a formation-perforating gun means having barrel means;

a resilient sealing web means mounted on the outer surface of said tool and disposed generally coaxial with said barrel means of said gun means;

a pressure-equalizing means for equalizing the pressures on the well bore casing side and the tool side of said web means when it is desired to release a seal formed by a differential pressure acting on said web means to hold said web means in sealing engagement about a perforation site within a well bore casing;

said tool being unrestrainable in the transverse direction within a surrounding well bore except for the pressure differential acting on said web means.

13. An apparatus according to claim 12 wherein said pressure-equalizing means comprises a slide valve operable to complete a flow path from a high-pressure fluid acting upon the tool side of said web means to a low-pressure area on the casing side of said web means;

said slide valve being operable in response to an upward pull on said supporting means.

14. An apparatus according to claim 13 wherein said slide valve comprises a tubular member having an axial bore and radial passageways leading from said axial bore to the outer surface of said valve; and

wherein a slidable collar member covers said radial passageways and whereby an upper force on said collar member shears said attachment means and causes said collar member to slide upward along said tubular member to expose said radial passageways to the pressure existing within said well bore outside said tool.

15. An apparatus according to claim 14 wherein said formation-perforating gun means comprises a shaped charge.

16. An apparatus according to claim 15 wherein said supporting means comprises a cable attached to an upper end of said tool.

17. Apparatus for perforating a well bore and defining an isolated flow path, said apparatus comprising:

means for disposing a perforating tool within a well bore, with said tool being substantially unrestrained with respect to transverse movement within said well bore and operable to move generally transversely of said well bore away from a site to be perforated;

means for releasing explosive energy from said tool directed toward said site to perforate said well bore, with said tool remaining unrestrained with respect to movement transversely of said well bore;

means creating a differential pressure within said well bore urging said tool toward said site in response to the perforation of said site;

means for sealing a portion of said well tool against said perforated site in response to said differential pressure, with said tool being unrestrained against said transverse movement; and

means for defining an isolated flow path leading from said perforated site to the interior of said tool, with said tool remaining unrestrained with respect to said transverse movement except for said differential pressure.

18. Apparatus for perforating a well bore and defining an isolated flow path, said apparatus comprising:

means for disposing a perforating tool within a well bore adjacent a site to be perforated;

means providing elastomeric web means on the exterior of said well tool, with said web means being operable in response to differential pressure acting thereacross to flex away from said tool and generally toward said perforation site;

means for releasing explosive energy from said tool directed toward said site to perforate said well bore;

means for creating a differential pressure within said well bore urging said tool toward said site in response to the perforation site;

means operable, in response to said differential pressure, to permit flexing of said web means toward said perforation site and position said web means in sealing engagement with said well bore adjacent said perforation site;

means operable, in response to said differential pressure, to move said well tool, subsequent to said flexing of said web means, toward said site to cause said web means to restore to an unflexed position.

19. Apparatus for perforating a well bore and defining an isolated flow path, said apparatus comprising:

means for disposing a perforating tool within a well bore, with said tool being substantially unrestrained with respect to transverse movement within said well bore and operable to move generally transversely of said well bore away from a site to be perforated;

means for releasing explosive energy from said tool directed toward said site to perforate said well bore, with said tool remaining unrestrained with respect to movement transversely of said well bore;

means creating a differential pressure within said well bore urging said tool toward said site in response to the perforation of said site;

means for sealing a portion of said well tool against said perforated site in response to said differential pressure, with said tool being unrestrained against said transverse movement;

means for defining an isolated flow path leading from said perforated site to the interior of said tool, with said tool remaining unrestrained with respect to said transverse movement except for said differential pressure;

means providing elastomeric web means on the exterior of said well tool, with said web means being operable in response to differential pressure acting thereacross to flex away from said tool and generally toward said perforation site;

means operable in response to said differential pressure, to permit flexing of said web means toward said perforation site and position said web means in sealing engagement with said well bore adjacent said perforation site; and

means operable, in response to said differential pressure, to move said well tool subsequent to said flexing of said web means, toward said site to cause said web means to restore to an unflexed position.

20. An apparatus according to claim 19 including:

pressure-equalizing means comprising a slide valve operable to complete a flow path from a high-pressure fluid acting upon a tool facing side of said web means to a low-pressure area on a well bore wall facing side of said web means;

said slide valve being operable in response to an upward pull of an upper portion of said tool.