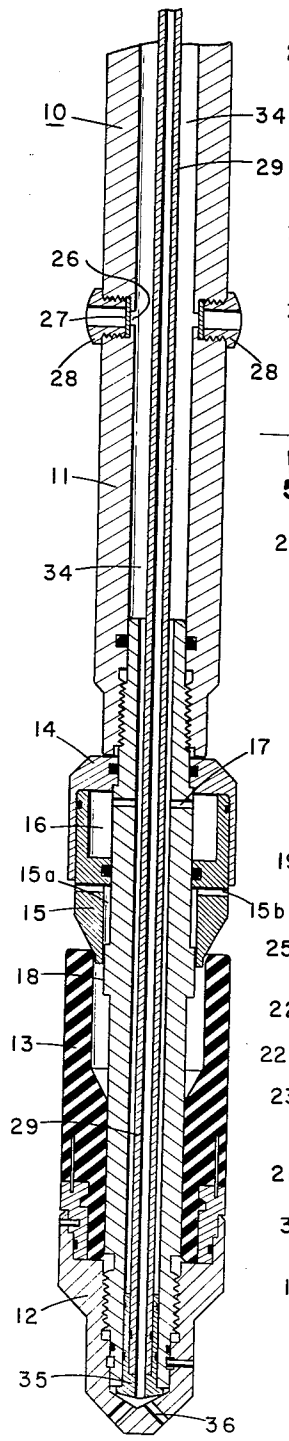
May 21, 1963 G. E. BRIGGS, JR 3,090,436

WIRE LINE HYDRAULIC FRACTURING TOOL

Filed Oct. 6, 1959

2 Sheets-Sheet 1

FIG. 4.



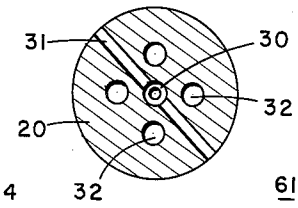


FIG. 5.

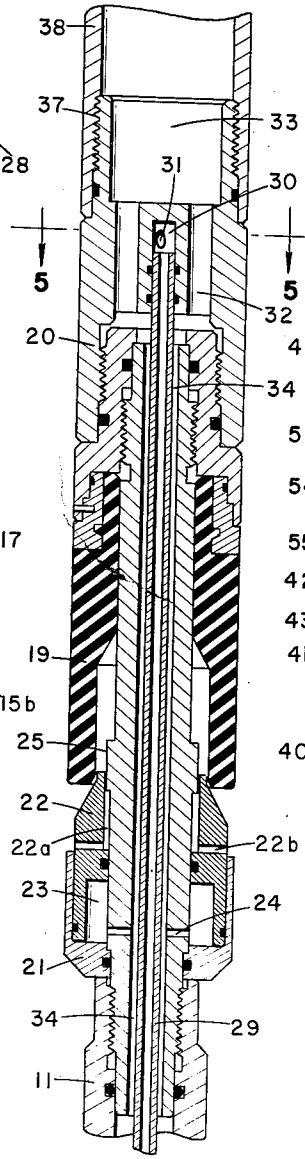
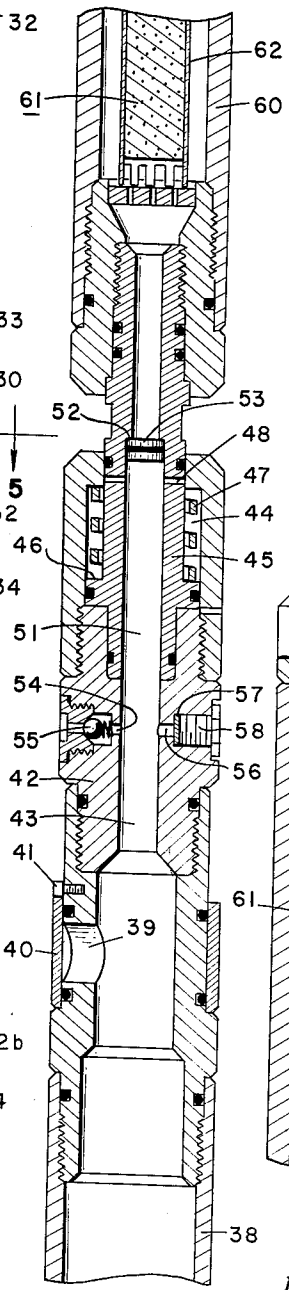


FIG. 3.

FIG. 2.



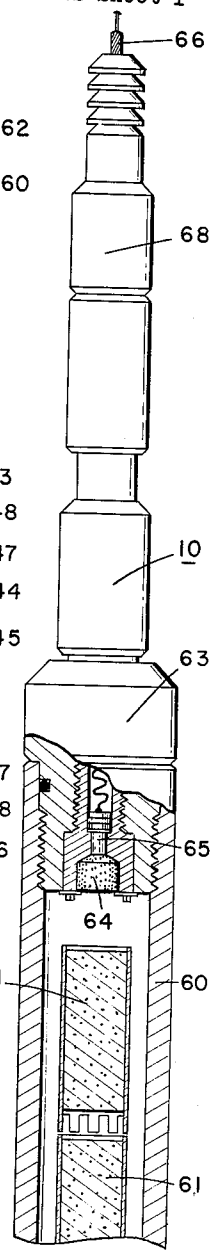


FIG. 1.

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2 Sheets-Sheet 2

FIG. 6.

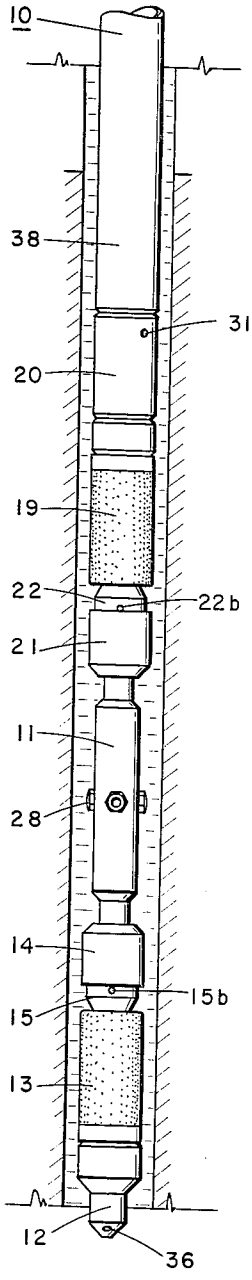


FIG. 7.

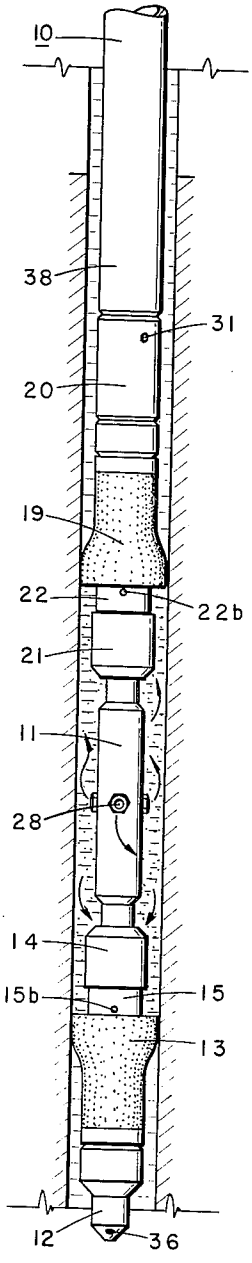
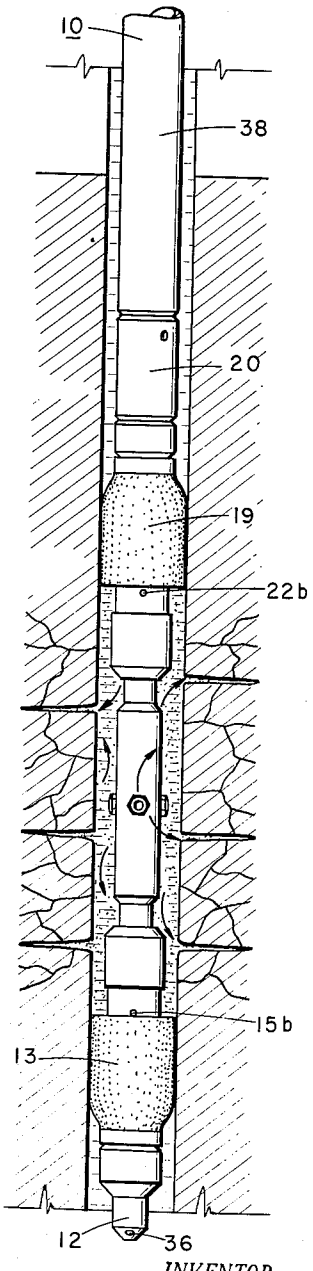


FIG. 8.



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3,090,436

Patented May 21, 1963

3,090,436

WIRE LINE HYDRAULIC FRACTURING TOOL

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Filed Oct. 6, 1959, Ser. No. 844,670

11 Claims. (Cl. 166—63)

This invention relates to well tools adapted to be lowered into and raised from a well bore by means of a cable connected to suitable hoisting means at the earth's surface.

This invention is specifically concerned with wire line tools adapted to force fluids under pressure into a well formation. More specifically stated, the invention is directed to a wire line tool for initiating fractures in a selected zone.

It is a further object of the present invention to provide a tool which can be lowered by means of a wire line to a specified zone and initiate in the selected zone fractures by means of fluid pressure contained within the tool.

More specifically stated, the object of the present invention is to provide a fracturing tool wherein the tool is actuated by pressure of gases created within the tool to pack off a well zone between packers carried by the tool and to eject a mass of treating or fracturing fluids into the formation isolated by the packers.

The present invention also provides a pressure equalizing passage extending through the tool whereby pressures in the borehole above and below the tool are equalized whereby pressure surges encountered within the borehole cannot move the tool vertically as the tool is being pressurized for operation. This system eliminates the necessity of providing mechanically or hydraulically operated slips to anchor the tool in the borehole.

Briefly described, the tool of the present invention includes an upper housing, an intermediate housing, and a hollow packer mandrel connected into the lower end of the intermediate housing. The mandrel has positioned thereon two opposing cup-shaped packer members for sealing off and isolating a section of formation. A port closed by a frangible plate is provided in the wall of the mandrel between the packers. The upper housing contains propellant charges which can be ignited by igniter means carried in the housing. The intermediate housing contains a fracturing fluid which is displaced down through the packer mandrel by pressure created when the propellant charges are ignited. The fracturing fluid initially operates packer setting means carried by the mandrel and first expands the packers outwardly to engage the borehole wall and then the pressure of the fluids ruptures the frangible plate in the wall of the mandrel. This allows the fracturing fluid to enter the well bore between the packers, compressing the packers more tightly against the borehole wall and subsequently fracturing the formation.

Also provided in the tool is a pressure release assembly which is connected between the upper and intermediate housings whereby upward pull on the line causes the assembly to operate and bleed off pressure from within the tool. The packer mandrel has positioned therein a pressure equalizing tube which extends from below the bottom packer to above the upper packer whereby borehole pressures above and below the mandrel are equalized when the packer members are expanded against the borehole wall.

The present invention, its operation and advantages, will be more clearly understood by the following description taken in conjunction with the drawings in which:

FIGS. 1 through 4, taken together, are sectional views illustrating the structure of the apparatus of the present invention, FIG. 1 being the upper portion of the tool,

FIGS. 2 and 3 the intermediate sections, and FIG. 4 the lower section;

FIG. 5 is a sectional view taken along the line 5—5 of FIG. 3;

FIG. 6 is a fragmentary elevational view illustrating the tool as it is lowered into the well bore;

FIG. 7 illustrates initial expansion of the packer members with fracturing fluid entering the well bore between the packers; and

FIG. 8 shows the packer members fully expanded with the fracturing fluid being forced into the formation.

Referring now to FIGS. 1 through 5 of the drawings, the tool body or housing generally designated as **10** is provided on its lower end with a hollow elongated packer mandrel **11**. A nose plug member **12** is threadedly attached to the lower end of mandrel **11**.

Arranged about the lower end of mandrel **11** and retained against vertical movement thereon by plug member **12** is an upwardly facing cup-shaped packer member **13**. The lower thicker portion of the packer member sealingly engages the outer wall of the mandrel. Positioned just above the packer **13** and fixed to the mandrel **11** is a packer expander housing **14**. Slidably arranged between the inner wall of housing **14** and the outer wall of mandrel **11** is a packer expanding member **15** which, as illustrated in FIG. 4, has its lower tapered end slightly extending into the open end of cup packer **13**. The inner wall of housing **14**, the upwardly extending wall of member **15**, and the outer wall of mandrel **11** form an expansion chamber **16**.

Fluid communication between chamber **16** and the bore of mandrel **11** is provided by means of ports **17** which are formed in the wall of mandrel **11**. As can be clearly seen, adequate sealing means are provided to make the chamber **16** fluid-tight. Downward movement of expander member **15** is limited by shoulder **18** provided on mandrel **11**.

Positioned about the upper end of mandrel **11** is a downwardly facing cup-shaped packer member **19** which is similar to packer **13**. Packer member **19** is held against vertical movement on the mandrel by means of sub member **20** which is threadedly attached to mandrel **11**. The upper thick-walled portion of packer **19** sealingly engages the outer wall of mandrel **11**.

An expander housing **21** similar to the housing **14** is fixed to and arranged about the upper end of mandrel **11** below the cup packer **19**. A packer expander member **22** is slidably arranged between the inner wall of housing **21** and the outer wall of mandrel **11**. As in the case of the lower expansion assembly, the upper expansion assembly forms an expansion chamber **23** which is provided with fluid communication with the bore of mandrel **11** by way of ports **24**. As shown in FIG. 3, the free end of the tapered portion of member **22** extends slightly into the cup packer **19**. Upward movement of member **22** is limited by shoulder **25** provided on mandrel **11**.

The wall of the mandrel **11** between the expansion chambers **23** and **16** is provided with a plurality of fluid outlet ports **26** which are closed by frangible rupture plates **27** held in place by threaded sleeves **28**. The frangible plates **27** are designed to rupture or disintegrate at a predetermined pressure exerted within the bore of mandrel **11**.

An open-ended pressure equalizing tube **29** is positioned in and extends through the length of the bore of mandrel **11**. The upper end of tube **29** sealingly engages about its outer periphery with an axial bore **30** of the sub member **20**. A horizontal port **31** extending through the wall of the sub member **20** as shown more clearly

in FIG. 5 fluidly communicates the exterior of sub 20 with the interior of equalizer tube 29.

The sub 20 is also provided with passages 32 which are horizontally spaced apart about the axial bore 30, whereby the upper open end 33 of sub 20 is in fluid communication with the annulus 34 formed between the tube 29 and the interior wall of mandrel 11.

The lower end of annulus 34 is closed by an open ended sealing sleeve 35 inserted in the annulus 34 and held in place by the lower end of the tube 29 and the nose plug 12. Nose plug 12 is provided with ports 36 which allow fluid communication between the exterior of the plug 12 and the interior of pressure equalizing tube 29.

As can be seen in FIGS. 3, 4, and 5, the tube 29, port 31, and ports 36 afford an isolated fluid passage through the lower end of the tool body or housing 10. This allows the pressure in the borehole above the upper packer and below the lower packer to be equalized when the two packers are expanded against the wall of the borehole.

Connected to the upper end of sub 20 by threads 37 is an elongated tubular barrel 38 for the purpose of containing a well treating agent such as fracturing fluid. As shown, a fluid passage is provided between annulus 34 and the barrel 38 by means of passages 32 in sub 20.

Adjacent the upper end of barrel 38 there is provided an opening 39 for facilitating filling of the barrel. The inlet 39 is closed by a removable closure member 40 which is slidably arranged on the barrel 38 and held in a closed position by threaded bolt 41.

Threaded into the upper end of barrel 38 above the inlet 39 is a slide valve sub 42 provided with an axial bore 43.

Slidably arranged in a chamber 44 formed in the upper end of sub 42 is a slide valve 45 which has its upper end extending out the upper end of the sub 42. The valve 45 is provided with an annular shoulder 46. A compression spring 47 biasing between the shoulder 46 and the upper end of sub 42 holds the valve stem in the position shown in FIG. 2. In the position shown, the valve ports 48 are closed.

Slide valve 45 is also provided with a bore 51 which coaxially aligns with the bore 43. The upper portion of bore 51 is of slightly smaller diameter than the remainder of the bore so as to provide an annular shoulder 52.

Slidably arranged within bore 51 and bearing against the shoulder 52 is a seal piston 53. The piston 53 could be replaced by a suitable frangible plate if desired. The purpose of the seal piston 53 is to prevent well fluids from entering into the upper end of bore 51.

Formed in the wall of sub 42 below the chamber 44 is a valved inlet port 54 which is provided with a fluid inlet check valve 55. Directly across from the port 54 is a pressure release port 56 which is closed by a frangible plate 57 held in place by threaded sleeve 58. The release port 56 is provided as a safety precaution and the plate 57 is designed to disintegrate or rupture at a predetermined pressure exerted against it.

A propellant container housing 60 is screw threadedly connected to the extended portion of a slide valve 45 with its interior fluidly communicating with the upper portion of the bore 51. The lower portion of the bore, as previously described, is closed off by the seal piston 53.

As can be seen in FIGS. 1, and 2, the housing 60 contains a plurality of propellant charges generally designated as 61. The charges 61 consist of a propellant contained in open-ended metal sleeves 62, the length of which determines the burning time of the propellant itself. As shown, the seal piston 53 prevents well fluids from entering into the interior of housing 60.

A propellant igniter section 63 is connected into the upper end of housing 60. An igniter charge 64 carried in the lower end of the section 63 is exposed to the interior of the housing 60. The charge 64 contacts a squib or blasting cap 65 which is, in turn, connected by suitable electrical leads housed in cable 66 which is connected to the upper end of the tool 10 by means of a cablehead or connector 68.

Operation

If it is desired to fracture or treat a certain section of a selected formation the tool is assembled as shown in FIGS. 1 through 5 and is suspended in an upright position just above the well bore by the cable 66 which is connected to a suitable hoisting means (not shown). A treating agent such as fracturing fluid containing a suitable propping agent is placed in the barrel housing 38 through the opening 39. The opening 39 is closed by sleeve 40 and the tube is lowered by means of cable 66 to the desired depth adjacent the selected formation as shown in FIG. 6.

When the tool is properly located, the blasting cap is set off by an electrical current applied through leads carried by cable 66 thereby igniting the charge 64 and, in turn, the propellant charges 61.

As the propellant charges burn, the gas pressure formed builds up within the barrel 60. This pressure forces the seal piston 53 downwardly in the bore 51, 43 and into the barrel 38.

As the pressure increases in the housing 60, the treating fluids contained in barrel 38 are forced downwardly through passages 32 in the sub 20 and into the annulus 34 in mandrel 11 surrounding the tube 29.

The treating fluids are forced through the ports 17 and 24 into the expansion chambers 16 and 23. Expansion of the chambers 16 and 23 causes the expander members 15 and 22 to move outwardly from their respective housings and engage and expand the open ends of the cup-shaped packers 13 and 19 outwardly against the wall of the well bore. This initial expansion of the packers 13 and 19 seals off the well bore between the packers as shown in FIG. 7 so that greater pressure can later be applied between the packers and force the packers into absolute fluid-tight engagement with the wall of the well bore. Such a seal is necessary in order to fracture as desired.

The expander members 15 and 22 continue to move until they engage the shoulders 18 and 25. The pressure within the annulus 34 is then exerted against and ruptures the frangible plates 27 positioned in ports 26 of the mandrel 11.

The treating fluid is then forced out into the well bore through ports 26 and into the annulus surrounding the mandrel 11 between the packer members 13 and 19 whereby the packers are forced into tighter engagement with the wall of the well bore as shown in FIG. 8.

As shown in FIGS. 3 and 4, the inner wall of each of the expander sleeves 15 and 22 and the outer wall of the mandrel 11 form annular passageways 15*a* and 22*a*, respectively. Perforations 15*b* and 22*b* formed in the sleeves 15 and 22 provide fluid communication between the exterior of the expander sleeves and the annular passageways 15*a* and 22*a*, respectively.

The shoulders 18 and 25 which limit the vertical movement of the expander sleeves 15 and 22 are in the form of spaced apart splines which also provide passages for fluid between them. The fluid passageways just described allow pressurized fluid in the well bore between the packers to be exerted through these passages and against the inner wall of the packers 13 and 19 once they are forced out against the wall of the well bore by the expander sleeves.

When the packers 13 and 19 are pushed out into engagement with the wall of the well bore by the expander sleeves 15 and 22 and the frangible plates 27 in the ports 26 are ruptured, the pressurized fluid entering the well bore between the packers can pass through the perforations 15*b* and 22*b*, the annular passages 15*a* and 22*a* and be exerted against the inner wall of the packers.

The pressure of the treating fluids which is still increasing as a result of the burning propellant forces the packers to expand until they form an absolute fluid tight seal with

the wall of the well bore. The sleeves **15** and **22** initially bias the packers against the well bore wall and retain them there until the fluid pressure between the packers can take over for further expansion. The efficiency of cooperation between the expander sleeves and the pressurized fluid can be controlled by proper size selection of the ports **26** of the mandrel **11**.

When the packers **13** and **19** are fully expanded the pressure of the fluids being still increased by the burning propellant charges **61** is then exerted against the formation structure exposed between the packer members. The treating fluids are thereby forced into the formation as shown in FIG. 8.

During the operation described, the pressure equalizing system afforded by tube **29** and ports **31** and **36** allows well pressures above and below the tool to be equalized. This pressure equalizing prevents the tool from being moved up or down due to pressure surges encountered in the well and eliminates the necessity of mechanical anchoring means being attached to the tool.

When it is desired to release the pressure within the tool so as to remove it from the well bore, an upward pull is exerted on cable **66**, thereby compressing spring **47** and exposing the ports **48** above the valve housing **42**. This allows the pressure within the tool **10** to bleed off until it is equalized with the borehole pressure outside the tool.

With pressure within and without the tool equalized, the resilience of the cup packers **13** and **19** is such that they will automatically contract and force the expander members **15** and **22** to their original position. The tool is now in position to be removed from the well bore.

The pressure release port **56** closed by frangible plate **57** is provided to afford a safety factor to the tool. For example, the tool may be placed in a cased hole which has been perforated adjacent a certain formation and it is desirable to treat this formation through a selected span of the perforations. It is possible that an error in measurement may cause the tool to be located in a portion of the casing which is not perforated. If this were to happen, the pressure built up by the tool **10** would all be exerted directly against the blank casing wall causing possible damage to the casing. The plate **57** is designed to rupture within a safe pressure range which would allow the pressure in the tool to bleed off above the packers and thereby prevent damage to the casing and to the tool itself. It is evident that the rupture plate **57** could, if desired, be replaced by a spring loaded check valve which could be set to open at the same pressure required to rupture the plate **57**. Although the tool is illustrated as being positioned in an open borehole, as previously pointed out it can just as easily be run in casing and located opposite a selected range of perforations.

The present invention provides a tool for fracturing subsurface formations without the use of heavy surface equipment usually involved in such operations. As described, the power to operate the tool and initiate formation fractures is entirely contained within the tool. The tool can be easily and accurately located in a well bore adjacent a selected formation which is to be treated.

Although the present tool was designed and has been described as a fracturing tool, it is evident that it can be used for other formation treating operations such as acidizing.

Having fully described and illustrated the structure and operation of the present invention, what I claim is:

1. A well tool comprising an elongated housing providing a pressure chamber and a fluid chamber and a fluid passageway communicating said chambers, a displaceable closure means arranged in said passageway, a mandrel connected into the lower end of said housing and provided with a bore communicating with said fluid chamber, upper and lower packer members arranged on the outer wall of said mandrel, expansive housings arranged on the outer wall of said mandrel between said packers for expanding said packers into engagement with the wall of the well bore responsive to fluid pressure, said wall of said mandrel provided with ports communicating said mandrel with the interior of said expansible housings, blowout means arranged in the wall of said mandrel between said expansible housings, said blowout means adapted to rupture at a predetermined pressure in said mandrel, means arranged in said pressure chamber for generating pressure within said chamber, pressure releasing means arranged in said housing and operable from the earth's surface, pressure equalizing means provided in said tool for equalizing the well bore pressure below the lower packer member with that above the upper packer member when said packer members are expanded against the wall of said well bore and means connected to said housing for raising and lowering said housing.

2. A well tool comprising an elongated housing provided with a pressure chamber and a fluid chamber, means in said housing for producing fluid in said pressure chamber, said housing providing a passageway between said chambers, displaceable sealing means arranged in said passageway, a packer mandrel connected into the lower end of said housing with the bore thereof communicating with said fluid chamber, upper and lower opposing cup packers arranged on said mandrel, expansive housings provided on said mandrel between said packers for expanding said packers into contact with the wall of said well bore in response to fluid pressure, said mandrel providing ports for communicating said bore with the interior of said expansible housings, said expansible housings provided with passages which allow fluid from the well bore between said cup packers to be exerted against the inner wall of said packers when said packers are expanded, a conduit extending from the lower end to the upper end of said mandrel for equalizing well pressures above and below said tool, blowout means in said housing above said packers for releasing excessive pressure from within said housing and valve means operable from the surface of the well for venting pressure from said housing, and frangible means in said mandrel wall between said packers for releasing pressurized fluid from said mandrel, said frangible means being rupturable in response to a predetermined pressure.

3. A well tool comprising an elongated housing providing a pressure chamber and a fluid chamber, means in said housing for producing fluid and pressurizing said pressure chamber, said housing providing a passageway between said chambers, a displaceable closure member in said passageway, inlet valve means in said housing for admitting fluid into said housing below said displaceable means, blowout means in said housing for releasing excessive pressures in said housing, vertically spaced apart opposing cup packers arranged on the outer wall of said housing, expansive means arranged on said housing between said packers for expanding said packers into contact with the wall of the well bore in response to fluid pressure in said housing, said housing provided with fluid ports communicating said fluid chamber with the interior of said expansible means, a frangible section in the wall forming said fluid chamber between said cup packers and adapted to rupture in response to a predetermined pressure in said fluid chamber, valve means in said housing operable from the earth's surface for venting pressure from said housing, a conduit communicating the exterior of said housing below said lower packer with the exterior of said housing above said upper packer.

4. A well tool comprising an elongated housing provided with a pressure chamber and a fluid chamber, said pressure chamber containing a propellant charge for generating fluid and producing pressure therein, said housing provided with an igniter mechanism for igniting said

propellant charge, said housing providing a passageway between said chambers, displaceable sealing means arranged in said passageway, a blowout section in said housing for releasing excessive pressures from said housing, opposing cup packers vertically spaced apart on said housing for sealing off said well bore around said housing between said packers, expansive housings positioned on and fixed to said housing between said opposing cup packers for expanding said packers into contact with the wall of said well bore in response to fluid pressure in said housing, said housing providing a fluid passageway between said fluid chamber and the interior of said expansible housings, said housing providing fluid outlet ports between said packers, said outlet ports communicating with said fluid chamber and closed by rupturable disks, valve means in said housing operable from the surface of said well for venting pressures from said housing, a conduit in said housing providing fluid communication betwen the well bore below the lower packer and the well bore above the upper packer.

5. A well tool adapted to be suspended in a well bore by a cable comprising a housing providing a pressure chamber and a fluid chamber, means in said housing for producing fluid and pressurizing said pressure chamber, said housing providing a passageway between said chambers, displaceable sealing means in said passageway for isolating said pressure chamber from said fluid chamber, blowout means in said housing for releasing excessive pressure from said housing, means for admitting well fluid into said fluid chamber when the pressure in said fluid chamber is less than the pressure in the borehole, opposing cup-shaped packers vertically spaced apart on the exterior of said housing, expansive housings arranged on the exterior of said housing between said packers for expanding the packers into engagement with the wall of said well bore responsive to fluid pressure in said housing, said housing provided with ports communicating the interior of said expansible housings with said fluid chamber, fluid outlet ports provided in the wall of said housing forming said fluid chamber between said packers, rupturable disks closing said ports, a pressure release valve arranged in said housing operable from the surface of said well for releasing pressure from said housing, and conduit means extending through said housing for equalizing the well bore pressure below said lower packer with the well bore pressure above said upper packer.

6. A well tool comprising in combination an elongated housing comprised of a pressure chamber and a fluid chamber, means in said housing for increasing the pressure in said pressure chamber, said housing provided with a passageway between said chambers, a closure means in said passageway displaceable in response to pressure in said fluid chamber, said housing provided with a valved inlet port communicating said fluid chamber to the exterior of said housing, a blowout section in said housing for releasing excessive pressures in said housing to the well bore, valve means in said housing and operable in response to signal to release pressure from said housing, vertically spaced apart opposing cup-shaped packers arranged on the exterior of said housing, said packers expansive to engage the wall of said well bore, expansive housings arranged on the exterior of said housing between said packers, each of said expansible housings having a fixed end attached to said housing and a free end adapted in response to expansion of said expansible housings which in turn actuate in response to fluid pressure in said fluid chamber to cause said free ends to move between the inner wall of said cup packers and said housing whereby the packers are expanded into contact with the wall of said well, said housing provided with fluid ports communicating the interior of said expansible housings with said fluid chamber, a frangible section in the wall forming said fluid chamber between expansible housings adapted to rupture at a predetermined fluid pressure in said fluid chamber and an equalizing conduit arranged in said housing for communicating the well bore pressure below the lower packer and above the upper packer.

7. A well tool adapted to be suspended in a well bore by a wire line comprising: a housing provided with a chamber for containing a well treating fluid, a frangible section in the wall of said housing forming said chamber and adapted to rupture in response to a predetermined fluid pressure in said chamber, upper and lower expansible packer members arranged on the outer wall of said housing and respectively located above and below said frangible section for packing the annulus between said housing and the wall of said well bore, means for producing a second fluid in said housing to pressurize said well treating fluid in order to force said well treating fluid through said section when said section is ruptured, means carried by said housing for expanding said packers responsive to fluid pressure in said housing and means in said housing for equalizing the well bore pressures respectively above and below said upper and lower packer members.

8. A well tool adapted to be suspended in a well bore by a wire line comprising a housing provided with a chamber for containing a well treating fluid, a frangible section in the wall of said housing forming said chamber and adapted to rupture in response to a predetermined fluid pressure in said chamber, upper and lower expansible packer members arranged on the outer wall of said housing and respectively located above and below said frangible section for packing off the annulus between said housing and the wall of said well bore, means for producing a second fluid in said housing to pressurize said well treating fluid in order to force said well treating fluid through said section when said section is ruptured, means carried by said housing for expanding said packers responsive to fluid pressure in said housing, means in said housing for equalizing the well bore pressures respectively above and below said upper and lower packer members, and pressure bleed-off means carried by said housing for venting said housing and adapted to operate in response to signal.

9. A well tool adapted to be suspended in a well bore by a wire line comprising: a housing provided with a chamber for containing a well treating fluid, a frangible section in the wall of said housing forming said chamber and adapted to rupture in response to a predetermined fluid pressure in said chamber, upper and lower expansible packer members arranged on the outer wall of said housing and respectively located above and below said frangible section for packing off the annulus between said housing and the wall of said well bore, means for producing a second fluid in said housing to pressurize said well treating fluid in order to force said well treating fluid through said section when said section is ruptured, means carried by said housing for expanding said packers responsive to fluid pressure in said housing, means in said housing for equalizing the well bore pressures respectively above and below said upper and lower packer members, pressure bleed-off means carried by said housing for venting said housing and adapted to operate in response to signal, and blow out means in said housing for releasing excessive pressure from within said tool at a second predetermined value of pressure therein.

10. A well tool adapted to be suspended in a well bore by a wire line comprising: a housing provided with a chamber for containing a well treating fluid, a frangible section in the wall of said housing forming said chamber and adapted to rupture in response to a predetermined pressure in said chamber, upper and lower expansible packer members arranged on the outer wall of said housing and respectively located above and below said frangible section for packing off the annulus between said housing and the wall of said well bore, means for producing a second fluid in said housing to pressurize said well treating fluid in order to force said well treating

fluid through said section when said section is ruptured, means carried by said housing for expanding said packers responsive to fluid pressure in said housing, means in said housing for equalizing the well bore pressures respectively above and below said upper and lower packer members, pressure bleed-off means carried by said housing for venting said housing and adapted to operate in response to signal, blow out means in said housing above said packers for releasing excessive pressures from within said housing and responsive to a second predetermined value of pressure therein, and means in said housing above said packers for admitting bore hole fluids to said housing whenever the pressure in said bore hole exceeds the pressure in said housing.

11. In apparatus for treating well formations while suspended from a wire line, the combination comprised of means for controlling said apparatus, fluid producing means responsive to and associated with said control means for pressurizing said apparatus, retractable fluid motor means connected in fluid communication with said producing means for actuating in response to pressurization of said apparatus by said producing means, opposing retractable packer means spaced along said apparatus and in operative connection with said motor means for expanding into sealing contact with said well bore to isolate a section of said well bore responsive to

actuation of said motor means, walled container means connected in fluid communication with said producing means for storing material for treating said well bore, means communicating fluid pressure across said isolated section of the well bore to equalize bore hole pressure in the bore hole across said section, and pressure responsive closure means in a wall portion of said container means between said packer means and adapted to release the contents of said container means responsive to a predetermined pressure applied from said producing means, said control means being adapted to vent any pressure in said apparatus in response to a predetermined tension exerted between said wire line and said apparatus to thereby permit retraction of said motor means and packer means prior to withdrawal of said apparatus from said well bore.

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2,776,014	Lee et al.	Jan. 1, 1957
2,927,638	Hall	Mar. 8, 1960