

Nov. 26, 1957

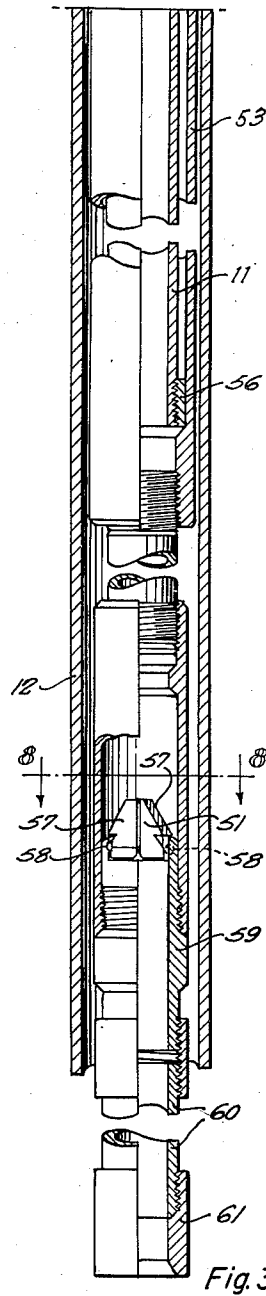
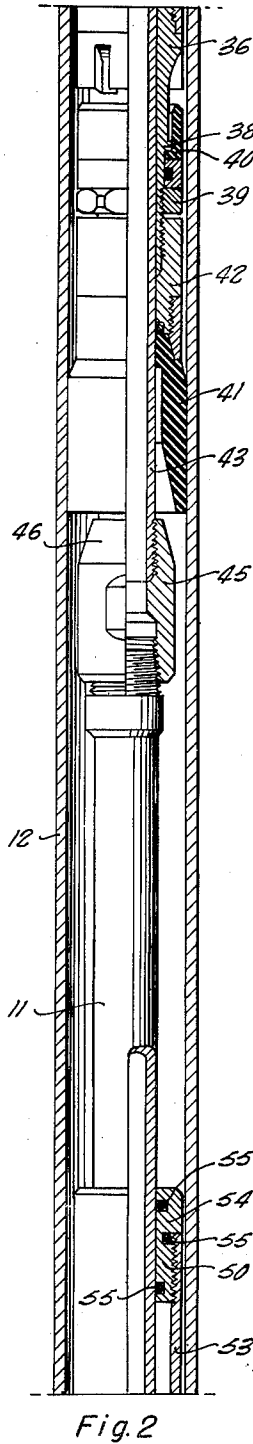
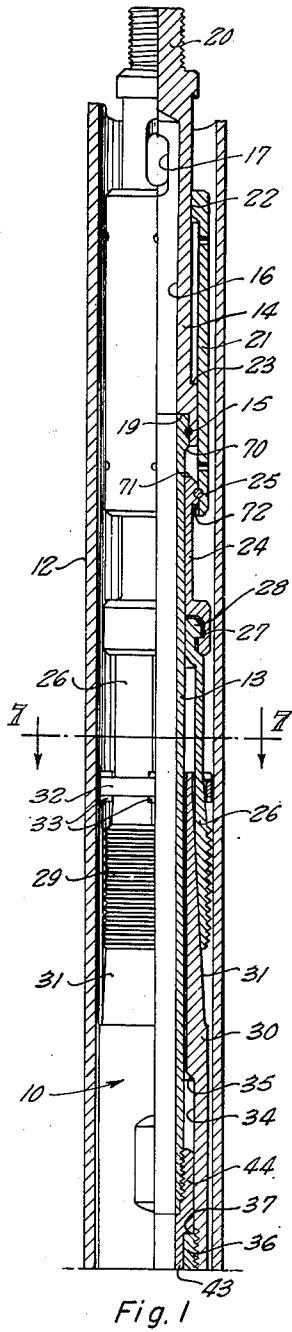
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2,814,348

EXTENSIBLE MEANS FOR CIRCULATING FLUIDS THROUGH WELLS

Filed Aug. 10, 1953

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

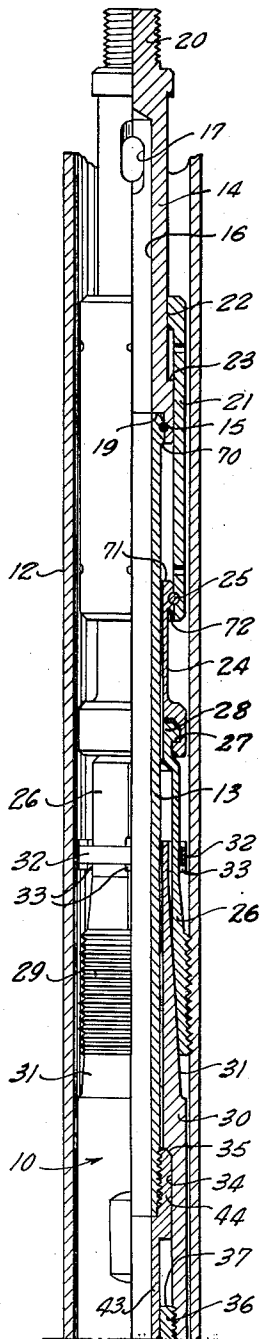


Fig. 4

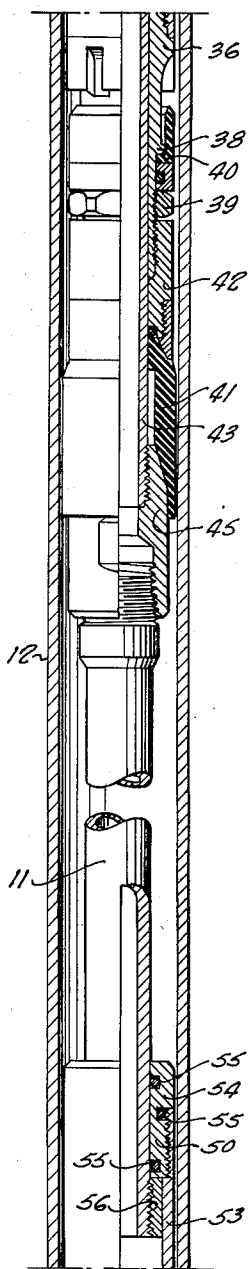


Fig. 5

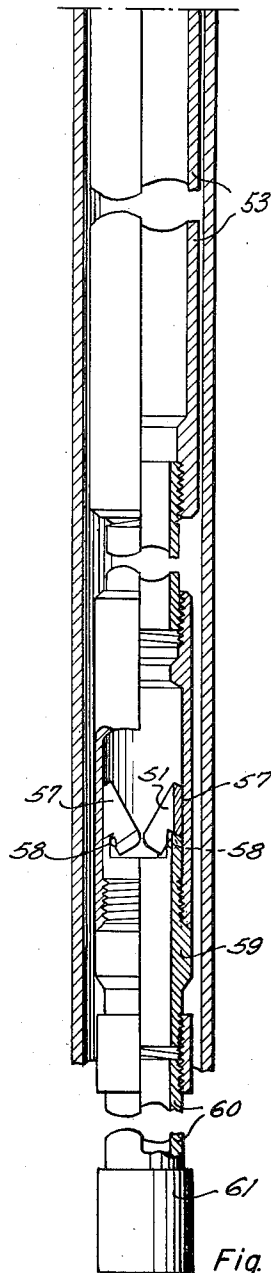


Fig. 6

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3 Sheets-Sheet 3

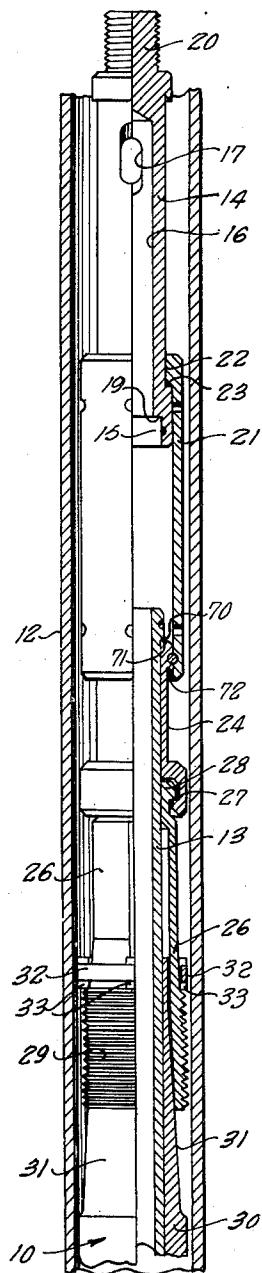


Fig. 9

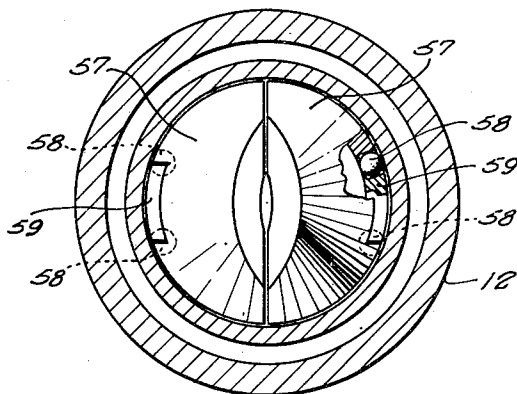


Fig. 8

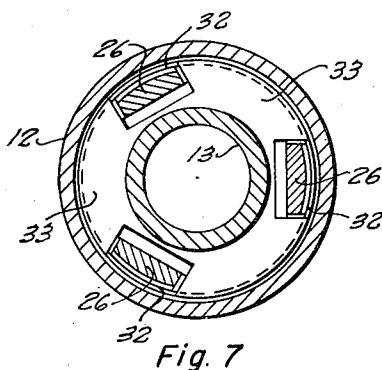


Fig. 7

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EXTENSIBLE MEANS FOR CIRCULATING FLUIDS
THROUGH WELLS

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15 Claims. (Cl. 166—140)

This invention relates to wells and more particularly to means for circulating fluids through wells.

An object of this invention is to provide a new and improved well tool for circulating fluids through a well.

A particular object is to provide a new and improved apparatus for circulating fluids through a well to remove sand from the well.

Still another object of the invention is to provide a well tool of the type described which may be progressively positioned in different predetermined positions in well tubing.

A further object of the invention is to provide a well tool for releasably connecting a tubing extension to well tubing and simultaneously sealing between the well tubing and the well tool whereby fluids pumped into the well may enter the well tubing only through the lower open end of the tubing extension.

A still further object of the invention is to provide a well tool of the type described, which may connect the tubing extension to the well tubing progressively at several different locations.

A yet further object of the invention is to provide a well tool of the type described, which may be held against downward displacement by means of a running tool and a flexible line during the circulation operation.

Another object of the invention is to provide a well tool of the type described, with a running tool which may be easily released from the well tool in the event of an emergency.

Additional objects and advantages of the invention will readily be apparent from the reading of the following description of a device constructed according to the invention, and reference to the accompanying drawings thereof, wherein:

Figures 1, 2 and 3 are views, partly in elevation and partly in section, of the upper, middle and lower portions of the well tool showing it as it appears while being lowered through the tubing of the well;

Figures 4, 5 and 6 are views, partly in elevation and partly in section, of the upper, middle and lower portions of the well tool showing it as it appears while locked in operative position and in use in the tubing of a well;

Figure 7 is an enlarged horizontal cross-sectional view taken on the line 7—7 of Figure 1;

Figure 8 is an enlarged horizontal cross-sectional view taken on the line 8—8 of Figure 3; and

Figure 9 is a view, partly in elevation and partly in section, of the upper portion of the well tool showing it as it appears while being removed from the well tubing.

In the drawings, the numeral 10 designates a well tool for positioning a tubing extension 11 in the well tubing 12. The well tool includes an elongate tubular main mandrel 13 whose upper end is releasably secured to the lower end of a fishing neck 14 by a shear pin 15. The fishing neck has a longitudinal bore 16 and lateral ports 17. It will be noted that the upper end of the main mandrel abuts an internal annular shoulder 19 in the fishing neck so that the shear pin 15 may be sheared

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only by upward jars imparted to the fishing neck, for reasons hereinafter apparent.

The upper end 20 of the fishing neck is threaded so that it may be secured to the lower end of a flexible line by means of a suitable coupling or fitting (not shown).

A shear sleeve 21 is slidably telescoped over the lower end of the fishing neck and is provided with an inwardly extending flange 22 on the upper end thereof which engages an annular exterior shoulder 23 near the lower end of the fishing neck to limit downward movement of the shear sleeve on the fishing neck. In effect, the fishing neck and the shear sleeve constitute a running tool by means of which the tool 10 is lowered and operated.

The shear sleeve supports a tubular slip carrier 24 which is releasably secured to the shear sleeve by a shear pin 25. This shear pin 25 is of greater dimensions than the shear pin 15 so that a greater force is required to shear the pin 25 than the pin 15. The reason for the difference in dimensions of these pins will be hereinafter set forth.

A plurality of slips 26 are supported by the slip carrier, the slips being hung on an annular internal flange 27 in the carrier by means of the hooks 28 on the upper ends of the slips. The lower portions of the slips are provided on their outer face with teeth or serrations 29 which are adapted to dig or bite into the internal walls of the tubing when the slips are moved to expanded positions.

A slip expander mandrel 30 is slidably telescoped on the main mandrel 13 and has an upwardly and inwardly beveled or frusto-conical expander surface 31 on which the slips ride, so that when the slip mandrel is moved upwardly relative to the slips, the slips are moved outwardly to engage the tubing.

The upper end of the slip mandrel is provided with an annular slip retaining band or ring 32 held spaced from the slip mandrel by slip separators 33 integral with the slip mandrel. It will be evident that the band 32 and the separators 33 limit the lateral movement of the slips and hold them in properly spaced position on the slip mandrel.

The slip mandrel 30 is enlarged at its lower portion and has an enlarged bore 34 which provides a downwardly facing annular upper stop shoulder 35 therein. A mandrel sub 36 is threaded in the lower end of the slip mandrel, and the upper end of said sub provides an upwardly facing lower stop shoulder 37 spaced below the downwardly facing stop shoulder in the bore of the slip mandrel.

The lower portion of the mandrel sub is reduced and has an external annular flange 38 near its mid-portion and threads on its lower end on which is threaded a packing retainer ring 39 which holds a cup packing ring 40 against said shoulder. A packing sleeve 41 carried by a bushing 42 is threaded on the lower end of the mandrel sub, with the packing sleeve surrounding the lower portion of the main mandrel 13 and spaced slightly therefrom.

An expander mandrel 43 is threaded on the lower end of the main mandrel and is provided at its upper end with an external stop flange 44 which is disposed between the stop shoulders 35 and 37 which thus limit the longitudinal movement of the main mandrel and the expander mandrel relative to the slip mandrel.

An expander head 45 is threaded on the lower end of the expander mandrel and is disposed below the packing 41 when the stop flange 44 rests upon the lower stop shoulder 37. The expander head has a downwardly and outwardly extending frusto-conical surface 46 which enters into the lower end of the packing sleeve and expands

it into fluid sealing contact with the tubing when the main mandrel, and therefore the expander head, is moved upwardly relative to the slip carrier. The upper stop shoulder 35, of course, limits such upward movement of the main mandrel.

The expander head has an internally threaded lower portion which receives the externally threaded upper end of the tubing extension 11, which may have a slip joint 50 and check valve 51 therein. The slip joint includes an elongate sleeve 53 which telescopes over the tubing extension and has a sealing bushing 54 at its upper end with sealing rings 55 slidably sealing between said bushing and the tubing extension and the sleeve 53. A stop ring 56 on the lower end of the tubing extension engages the lower end of the sealing bushing to limit downward movement of the sleeve relative to the tubing extension. The check valve 51 may be any desired large opening type, but is shown as being of a flapper type formed of two identical frusto-conical sections 57 pivoting on balls 58 from open to closed position and back. The valve sections are mounted on a tubular body 59, to the lower end of which a tubular pipe 60 and foot piece or shoe 61 for entering the sand or detritus being removed are connected.

In use, the fishing neck 14 is secured to the end of a flexible line by means of a coupling or fitting threaded on its upper end 20. The extension tubing 11 is secured to the expander head 45 and the assembly is lowered into the tubing. The tool and tubing extension are lowered through the tubing until the lower open end of the tubing extension passes through the open lower end of the tubing and moves further downwardly until it contacts or penetrates sand in the well bore. The various elements of the tool 10 are then in the positions shown in Figures 1 through 3.

The slips 26 are in a relatively high position on the tapered surface 31 of the slip mandrel so that the teeth or serrations 29 do not tend to dig or bite into the tubing walls, even if they contact them. Moreover, any contact of the teeth with the tubing causes the slips to move upwardly on the slip mandrel where they are free to move inwardly. For this reason, the slips permit free downward movement of the tool when the tool is being lowered through the tubing.

When the shoe 61 on the lower end of the slip joint and tubing extension reaches the sand, upward jars are imparted to the fishing neck and thus to the main mandrel 13 and the expander head. The jars are not, however of sufficient force to shear the pins 15 and 25. The jars cause the slip mandrel to move upwardly relative to the slips 26, which are thus moved outwardly into engagement with tubing so that the teeth or serrations bite or dig into the walls of the tubing to prevent upward movement of the tool 10 and the tubing extension in the tubing.

Simultaneously, the expander head 45 moves upwardly into the lower end of the packing sleeve 41 and causes it to expand into contact with the tubing and thus prevent passage of fluids between the tool and the tubing. The upward movement of the expander head is limited, of course, by the engagement of the stop flange 44 with the upper stop shoulder 35 of the slip mandrel so that the expander head can expand only a predetermined portion of the sleeve packing, whereby undue wear of the sleeve packing is prevented.

Tension is now maintained on the flexible line to maintain the slips and packing in their set positions. In addition, water or other fluid is pumped into the well in the annulus between the well casing (not shown) and the tubing, and thus fluids containing sand are caused to flow up the open lower end of the tubing extension, through the tubing extension, the expander head 45, the expander mandrel 43, the main mandrel 13, and the fishing neck 14 and out through the lateral ports 17 of the fishing neck into the tubing 12 above the tool, and thence to the surface. The pumping of this water into the annulus creates

a pressure which tends to maintain the tool in the set position. Back flow of fluid from above and exteriorly of the tool is prevented by the packing cup 38.

It will be evident that this forced circulation of water will remove the sand from the well bore, and the upper level of the sand will fall as the pumping is continued, until the level of the sand recedes from the open lower end of the tubing section. This position of the tool is illustrated in Figures 4 through 6. The slip joint 50 permits some longitudinal adjustment in the length of the tubing extension, and the check valve 51 prevents back flow of fluids or sand downwardly out of the tubing extension. The tubing extension must then be lowered until the shoe at its lower open end again contacts or penetrates the sand in the bottom of the well bore and the slip joint is telescoped, so that efficient removal of the sand can be continued. Obviously, if desired, a plurality of slip joints may be employed to increase the amount of sand removable at any one setting of the tool.

The tool and the tubing extension are again lowered after downward jars are imparted to the fishing neck, through a flexible line, to move the expander head out of expanding position in the packing sleeve. It will be noted that the expander mandrel must be moved downwardly to cause its stop flange 44 to abut the lower stop shoulder 37 in the slip mandrel 30 before downward jars are imparted to the slip mandrel. This insures that the packing sleeve is not in expanded position when the slip mandrel is jarred downwardly to free the slips for movement into non-expanded positions, and prevents damage to the packing sleeve which might occur if the tool were moved while the packing sleeve was in expanded position.

Once the tool is freed by these downward jars, it is lowered to a new position wherein the open lower end of the tubing extension contacts or penetrates the sand and the slip joint 50 is telescoped, whereupon the pumping operation is repeated. This sequence of operations is repeated until the desired amount of sand has been removed from the well bore.

Upon completion of the sand removal operation, upward jars are delivered to the fishing neck by the flexible line, which are of sufficient force to shear the pin 15. The fishing neck is thus disconnected from the main mandrel. Downward jars are then delivered to the fishing neck and main mandrel to move the expander head 45 downwardly out of engagement with the packing sleeve and, when the stop flange 44 contacts the lower stop shoulder 37, subsequently to move the slip mandrel 30 downwardly so that the slips 26 are released from engagement with the tubing.

When this occurs, the various elements are in the positions shown in Figure 9, wherein the flange 22 of the shear sleeve 19 rests on the shoulder 23 of the fishing neck and the external annular stop shoulder 70 on the upper end of the main mandrel rests on the top annular shoulder 71 of the slip carrier. It will be evident that in this position the slips 26 are in a raised position on the frusto-conical surface 31 of the slip mandrel, so that they are in a retracted position and cannot engage the tubing.

The well tool 10 can thus be raised out of the tubing, the tubing extension being raised along with the tool out of the tubing.

In the event of an emergency necessitating the abandonment of the tool and tubing extension in the well, upward jars are imparted to the fishing neck by means of the flexible line, such blows being of sufficient force to shear the pin 25, thus freeing the shear sleeve and fishing neck from the tool 10. The fishing neck and shear sleeve, which constitute a running tool, are freed for removal from the well.

After the emergency has passed, the tool and tubing extension may be removed from the well by means of any suitable fishing tool which may be lowered on a flexible line to engage the undercut shoulder 72 of the

slip carrier, and thus lift the tool and tubing extension from the well.

It will be seen that an improved method of circulating fluids through a well to remove sand or detritus therefrom, has been disclosed, and that a well tool for supporting a tubing extension in well tubing for carrying out the method has been illustrated and described. The tool includes a central tubular member formed of the main mandrel 13, an expander mandrel 43 and an expander head 45, as well as an outer tubular member, mounted on the central tubular member, which includes the slip mandrel 30, the mandrel sub 36 and the packing sleeve 41; and that a plurality of slips 26 are movably mounted on the tapered portion 31 of the slip mandrel whereby upon downward movement of the slips upon the tapered position, the slips are moved outwardly into engagement with the tubing 11. It will be apparent that a stop flange 44 of the central tubular member cooperates with the spaced opposed upper and lower stop shoulders 35 and 37 of the outer tubular member to limit its longitudinal movement on the central tubular member. It will also be seen that a running tool has been provided for the tool 10 which includes a fishing neck 14 detachably secured to the main mandrel by a shear pin 15 and a shear sleeve detachably secured to the slip carrier 24 by a shear pin 24.

It will be apparent that by use of the tool 10, the tubing extension may be anchored to the tubing of a well at any point in the tubing, and that a fluid tight seal is formed between the tool and the tubing by the packing sleeve 41 so that fluids may flow into the tubing above the tool only through the lower open end of the tubing extension.

It will also be evident that the tool and tubing may be progressively anchored to the tubing at different locations in the tubing to progressively remove sand or detritus from the tubing. And, moreover, it will be seen that all operations with the tool are effected by the flexible line by which it is lowered and raised.

As used herein, the term "detritus" is intended to include sand, cuttings, scrap or junk tools, drilling mud, jells or any other loose matter present in the bore of the well.

The foregoing description of the invention is explanatory only, and changes in the details of the construction illustrated and described may be made by those skilled in the art, within the scope of the appended claims, without departing from the spirit of the invention.

What I claim and desire to secure by Letters Patent is:

1. A well tool comprising: a central member having a longitudinal flow course and provided with an expander means on its lower end; an outer tubular member mounted on said central member, spaced cooperating stop shoulders on said central member and said outer tubular member engageable with each other and positioned to permit said outer tubular member to undergo limited movement longitudinally on said central member, said outer member including an expansible packing means on the lower end thereof, said expander means being adapted to expand said expansible packing means to seal between said central member and well tubing; gripping means movably mounted on said outer member; means on said inner member engageable with said gripping means to hold said gripping means in engagement with said tubing to prevent upward movement of the well tool with respect to said tubing; means on the lower end of said central member for holding a tubing extension dependent therefrom; and a running tool including an elongate member detachably connected to the upper end of said central member and having a flow course communicating with the flow course of said central member and with the exterior of said running tool thereabove; and a member mounted on said elongate member for limited downward movement on said elongate member and having its lower end detachably connected to the gripping means.

2. The device of claim 1 wherein a tubing extension is connected to the lower end of the central member, said tubing extension including a pair of telescoping sections connected by a slip joint, whereby the length of said tubing extension may increase as the level of the sand in the well is lowered by removal of the same.

3. A well tool comprising: a central tubular member having a longitudinal axis and provided with an expander on its lower end; an outer tubular member mounted on said central tubular member for limited movement thereon parallel to said longitudinal axis, said outer tubular member including an upwardly and inwardly tapered portion and an expansible packing sleeve on the lower end thereof, said expander being adapted to expand said expansible packing sleeve to seal between said central tubular member and well tubing; a slip carrier slidably mounted on said central tubular member above said outer tubular member; a plurality of slips carried by said slip carrier and slidable over said tapered portion into tubing engaging position by said tapered portion upon downward movement of said slips relative to said outer tubular member; said central tubular member being provided with an external flange intermediate its ends and said outer tubular member being provided with a pair of internally faced opposed stop shoulders engageable by said external flange for limiting longitudinal movement of said outer tubular member on said central tubular member; and an extensible conductor member connected to the lower end of said central tubular member below said expander.

4. A well tool comprising: a central tubular member having a longitudinal axis and provided with an expander on its lower end; an outer tubular member mounted on said central tubular member for limited longitudinal movement thereon, said outer tubular member including an upwardly and inwardly tapered portion and an expansible sleeve on the lower end thereof, said expander being adapted to expand said expansible sleeve to seal between said central tubular member and well tubing; a slip carrier slidably mounted on said central tubular member above said outer tubular member; a plurality of slips carried by said slip carrier and slidable over said tapered portion into tubing engaging position by said tapered portion upon downward movement of said slips relative to said outer tubular member; and a running tool including a fishing neck detachably secured to the upper end of said central tubular member, said fishing neck having a bore communicating with the interior of said central tubular member and lateral ports communicating with said bore; and a shear sleeve mounted on said fishing neck for limited downward movement on said fishing neck and having its lower end detachably secured to said slip carrier.

5. A well tool comprising: a central tubular member having a longitudinal axis and provided with an expander on its lower end; an outer tubular member mounted on said central tubular member for limited movement longitudinally thereon, said outer tubular member including an upwardly and inwardly tapered portion and an expansible sleeve on the lower end thereof, said expander being adapted to expand said expansible sleeve to seal between said central tubular member and well tubing; a slip carrier slidably mounted on said central tubular member above said outer tubular member; a plurality of slips carried by said slip carrier and slidable over said tapered portion into tubing engaging position by said tapered portion upon downward movement of said slips relative to said outer tubular member; means on the lower end of said central tubular member for holding a tubing extension dependent therefrom; and a running tool including a fishing neck detachably secured to the upper end of said central tubular member, said fishing neck having a bore communicating with the interior of said central tubular member and lateral ports communicating with said bore; and a shear sleeve mounted on said fishing neck for limited downward movement on

member is in a second position and shortened when said tubular extension member is in a first position, said tubular extension member being adapted to move freely from said first to said second position and vice versa, said means on the upper end of said tubular member for lowering and retrieving said tubular member in and from said tubing including anchoring and sealing means alternately engageable with and releasable from the tubing to anchor the upper end of said tubular member in sealing engagement with the tubing against upward movement therein at successively lower positions in said well tubing without removing the tubular member from the tubing.

13. Apparatus for conducting operations in a cased and tubed well without manipulating said tubing which comprises: a tubular member having a continuous open passage and sized for movement through the tubing and provided with external sealing means on its upper end portion, said tubular member being lowerable through and releasably and sealingly securable in said tubing to form a continuous open passageway with said tubing, means on the upper end of said tubular member for lowering and retrieving said tubular member in and from said tubing, gripping means on the upper end of said tubular member and operable by said lowering and retrieving means to releasably secure the upper end of said tubular member to said tubing at successively lower positions therein against upward movement without removing the tubular member from the tubing, and a telescoping tubular extension member slidably engaged with said tubular member and with its lower end projectable a substantial distance below the lower end of the tubular member such that the effective length of said passageway is lengthened when said tubular extension member is in a second position and shortened when said tubular extension member is in a first position, said tubular extension member being adapted to move freely from said first to said second position and vice versa.

14. Apparatus for conducting operations in a cased and tubed well which comprises: a tubular member having a continuous open passage and sized for movement through the tubing and provided with external sealing means on its upper end portion, said tubular member being lowerable through and releasably and sealingly securable in the lower portion of said tubing to form a continuous open passageway with said tubing; anchoring means on the upper end of said tubular member alternately engageable with and releasable from the tubing to anchor said tubu-

lar member at successively lower positions in said tubing against upward movement therein without removing said tubular member from within said tubing; and a tubular extension member with its upper end telescopically engageable with the lower end of said tubular member and with its lower end projectable a substantial distance below the lower end of the tubular member whereby the lower end of the tubular extension member is engageable with detritus in the well.

15. Apparatus for conducting operations in a cased and tubed well without manipulating said tubing which comprises: a tubular member having a continuous open passage and sized for movement through the tubing, said tubular member being lowerable through and releasably and sealingly securable in the lower portion of said tubing to form a continuous open passageway with said tubing; anchoring means on the upper end of said tubular member alternately engageable with and releasable from the tubing to anchor said tubular member at successively lower positions in said tubing against upward movement therein without removing said tubular member from within said tubing; a telescopic tubular extension member slidably engaging with its upper end the lower end of said tubular member, the lower end of said tubular extension member projectable a substantial distance below the lower end of the tubular member, the slidable engagement of the tubular extension member with the tubular member providing for shortening and extending said passageway; means holding said tubular extension member in slidable engagement with said tubular member; means for sealing between said tubular extension member and the tubular member; and packing means for sealing between the tubular member and the tubing.

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