Oct. 11, 1966 T. L. ELLISTON 3,278,219

WELL TOOLS

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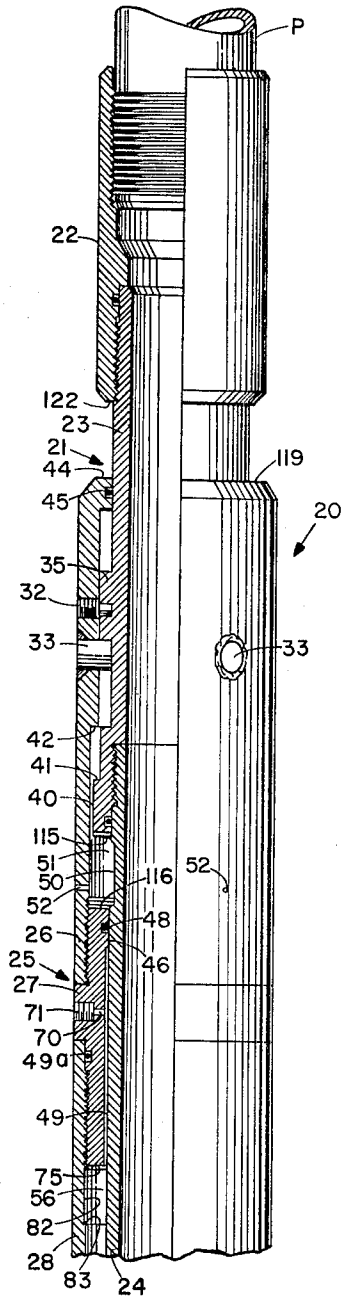


FIG 1

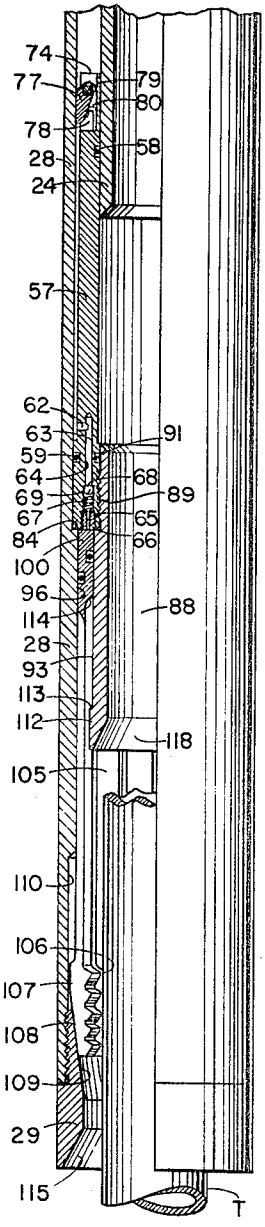


FIG 2

INVENTOR.
Thomas L. Elliston

BY Eastings, Ackley and Walter J. Jagmin

ATTORNEYS

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WELL TOOLS

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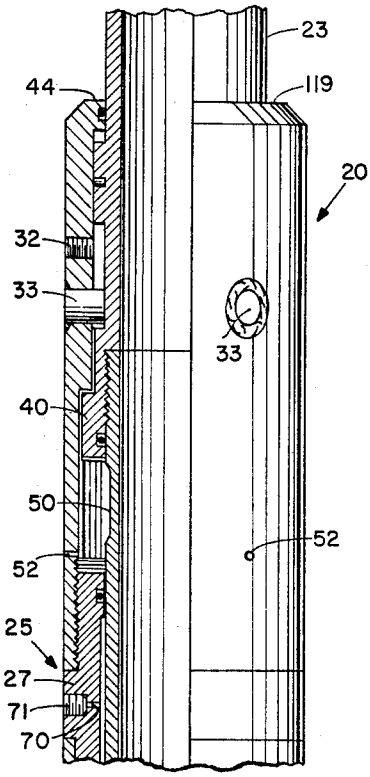


FIG 3

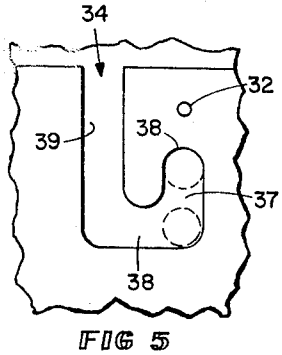


FIG 5

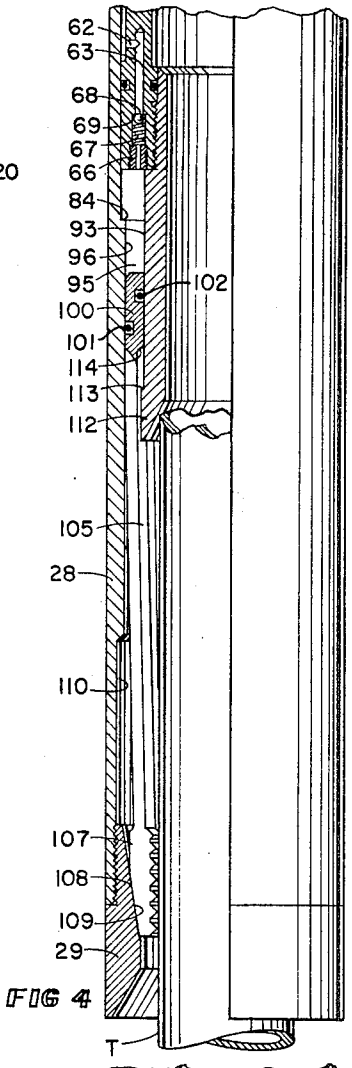


FIG 4

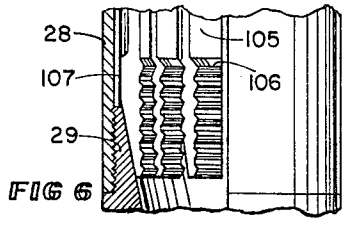


FIG 6

INVENTOR.
Thomas L. Elliston
BY Hastings Ackley and Walter J. Jagger
ATTORNEYS

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WELL TOOLS

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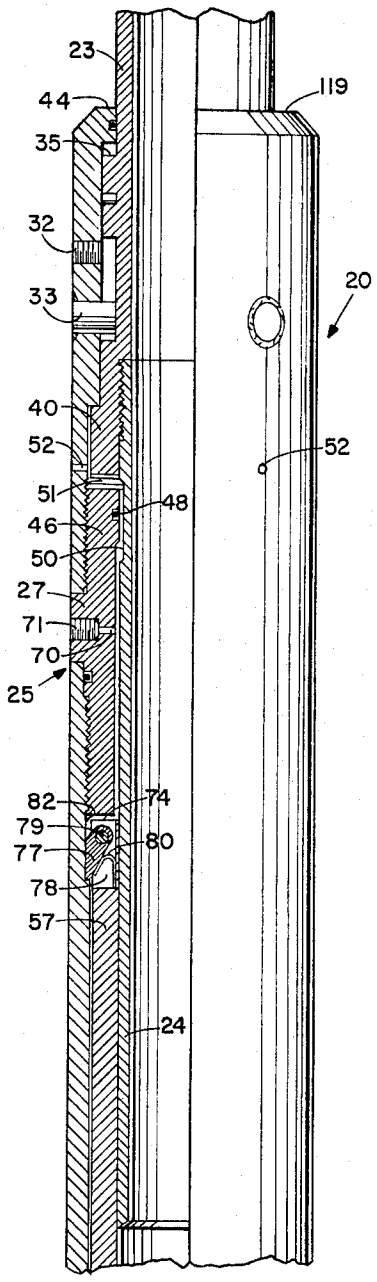


FIG 7

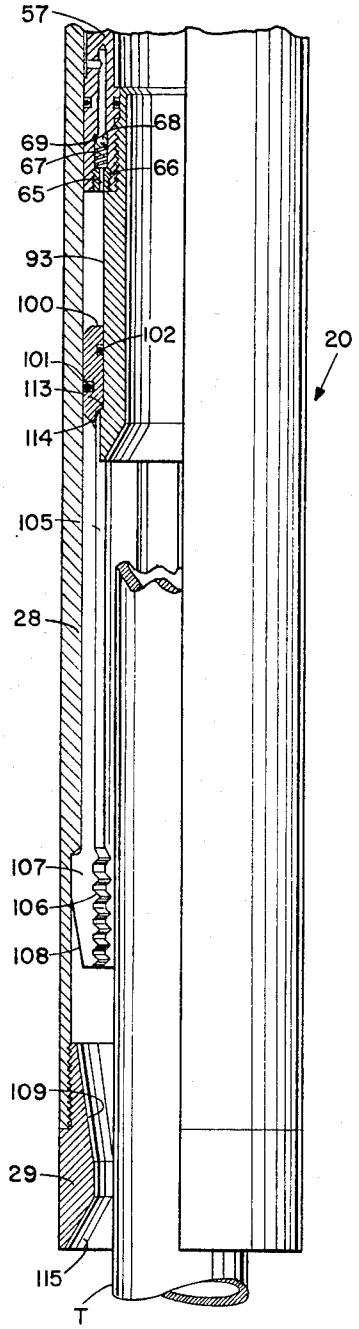


FIG 8

INVENTOR.
Thomas L. Elliston
BY Eastings Ackley and Walter J. Jagger
ATTORNEYS

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WELL TOOLS

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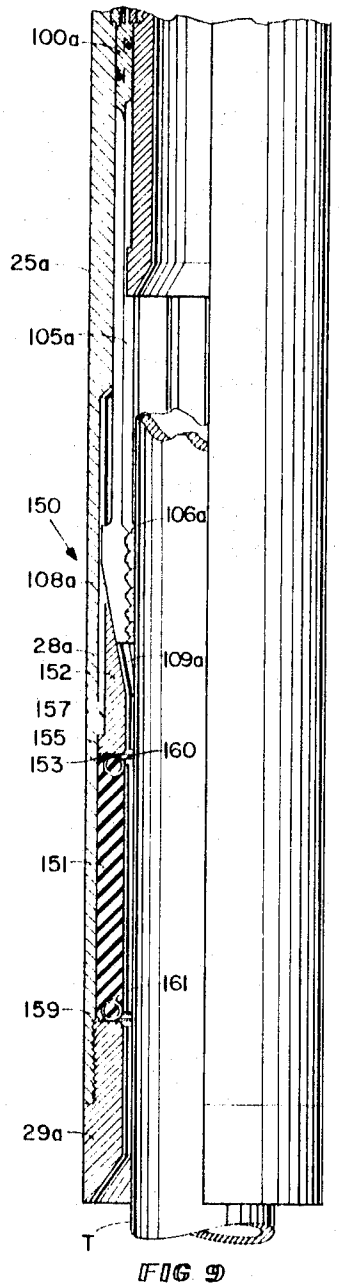


FIG 9

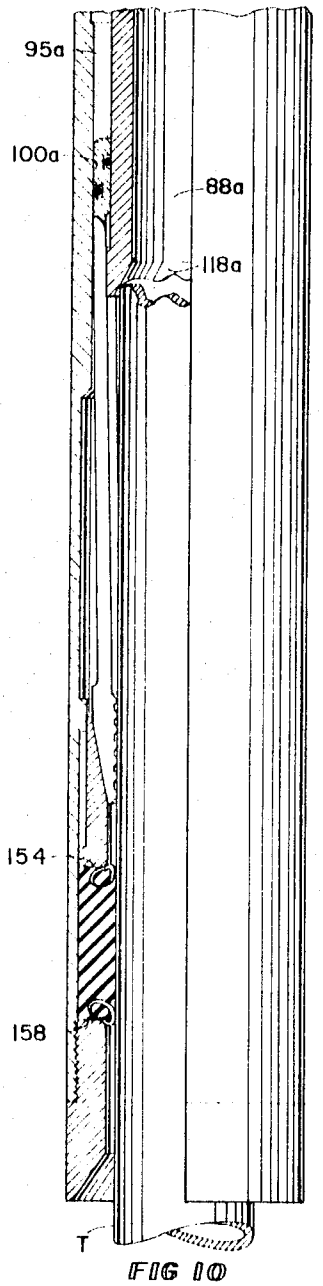


FIG 10

INVENTOR.
Thomas L. Elliston

BY Gustastings Ackley and Walter J. Jagger

ATTORNEYS

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3,278,219

WELL TOOLS

Thomas L. Elliston, Dallas, Tex., assignor to Otis Engineering Corporation, Dallas, Tex., a corporation of Delaware

Filed Dec. 2, 1963, Ser. No. 327,272
13 Claims. (Cl. 294—86.15)

This invention relates to well tools and more particularly to a well tool for retrieving objects, such as tubing and the like, from a well.

An object of this invention is to provide a new and improved well tool which is lowerable in a well to engage and grip objects in the well for removing the objects upwardly from the well.

Another object is to provide a retrieving tool having gripping means for engaging an object, such as the upper end of tubing in a well, which gripping means are forced into gripping engagement with the object upon downward movement of the retrieving tool relative to the tubing after the engagement of the retrieving tool therewith and which are also forced and held in gripping engagement with the tubing upon an upward force thereafter being applied to the retrieving tool.

Still another object is to provide a retrieving tool of the character described which is releasable from the object gripped thereby upon limited rotational and then upward movement being imparted to the retrieving tool by means of the pipe by which it is lowered into the well.

A further object is to provide a retrieving tool having hydraulically operated gripping means for engaging and holding an object to be retrieved from a well having release means for releasing the hydraulic pressure holding the gripping means in engagement with the object to be retrieved.

A still further object is to provide a retrieving tool having a pump means including a pump piston and an operator piston movable by fluid pumped by the pump for moving the gripping means into gripping engagement with an object upon downward movement of the retrieving tool relative to the pump piston upon the engagement of the pump piston with an object to be retrieved and having release means for releasing the fluid pressure holding the gripping means in engagement with the object upon a predetermined rotational and longitudinal movement being imparted to the retrieving tool.

Still another object is to provide a retrieving tool of the type described having seal means for sealingly engaging the object being retrieved thereby.

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

FIGURE 1 is a vertical, partly sectional view of the upper portion of a retrieving tool showing it connected to the lower end of a string of pipe by means of which it is lowered into the well;

FIGURE 2 is a view similar to FIGURE 1 being a continuation thereof, and showing the lower portions of the retrieving tool telescoping downwardly over the upper end of a tubing which is to be retrieved from the well;

FIGURE 3 is a vertical, partly section view of the upper portion of the retrieving tool showing the elements of the tool assumed thereby while it is retrieving an object;

FIGURE 4 is a view similar to FIGURE 3, being a continuation thereof, showing the lower portion of the retrieving tool with the gripping means thereof in gripping engagement with the tubing being removed from the well;

FIGURE 5 is a fragmentary view showing the slot and pin means for operating the fluid pressure release means of the retrieving tool;

FIGURE 6 is a fragmentary vertical partly sectional view showing the gripping means of the retrieving tool;

FIGURE 7 is a vertical, partly sectional view of the upper portion of the retrieving tool showing the tool immediately after the actuation of the release means for releasing the fluid pressure holding the operator piston in operative position and the gripping means in engagement with the tubing;

FIGURE 8 is a view similar to FIGURE 7, being a continuation thereof, showing the lower portion of the retrieving tool;

FIGURE 9 is a fragmentary, vertical partly section view of the lower portion of a modified form of the retrieving tool provided with a sealing means for engaging the tubing; and,

FIGURE 10 is a view similar to FIGURE 9 showing the gripping means and the sealing means of the retrieving tool in engagement with the string of tubing.

Referring now particularly to FIGURES 1 through 8 of the drawings, the retrieving tool **20** embodying the invention includes a tubular body or mandrel **21** having a top section **22** threaded on the lower end of a pipe P by means of which the retrieving tool is movable into and from the well, a connector or intermediate section **23** threaded in the lower end of the top section and a bottom section **24** threaded in the bottom end of the intermediate section **23**. A barrel **25** disposed about the mandrel **21** includes a top section **26**, a connector section **27**, a lower section **28** and a cam or bowl section **29**. The top barrel section is releasably secured to the intermediate mandrel section **23** by a shear screw **32** threaded in the top barrel section whose inner end extends into a suitable lateral aperture of the intermediate mandrel section. The top barrel section is also connected to the intermediate mandrel section by means of a plurality of pins **33** rigidly secured, as by welding, to the top barrel section which extend into J-slots **34** of an external annular flange **35** of the intermediate mandrel section. Each pin **33** is positioned in the upper end of the short portion **37** of its J-slot so that it engages the downwardly facing arcuate surface **38** defining the upper end of the short leg **37** when the barrel is in the upper position on the mandrel illustrated in FIGURES 1 and 2 so that a downward force imparted to the mandrel section will not cause shearing of the shear screw **32** and downward movement of the mandrel relative to the barrel assembly.

The mandrel is movable downwardly relative to the barrel, after the shear screw **32** has been sheared by upward movement of the mandrel relative to the barrel which causes the connection portions **38** of the J-slots to be moved into alignment with the pins **33**, upon a rotational movement of the mandrel which moves the long portions **39** of the J-slots into alignment with the pins **33**. The external annular flange **40** at the lower end of the intermediate mandrel section provides an annular upwardly facing shoulder **41** which is engageable with the downwardly facing shoulder **42** provided by the enlargement of the lower portion bore of the barrel section to limit upward movement of the mandrel relative to the barrel. The top end of the top barrel section has an internal annular flange **44** provided with an internal annular recess in which is disposed an O-ring **45** which seals between the flange and the intermediate mandrel section. The O-ring **45** is provided to prevent any foreign

material such as sand from entering between the mandrel and the top barrel section which might render difficult or impossible upward movement of the mandrel relative to the barrel section.

The connector barrel section **27** is threaded in the lower end of the top barrel section and has an internal annular flange **46** provided with an annular recess in which is disposed an O-ring **48** which engages the external seal surface **49** of the lower mandrel section below the upper external annular recess **50** thereof.

The lower end portion of the connector barrel section is threaded in the upper end portion of the lower barrel section **28** and is provided with an external annular recess in which is disposed an O-ring **49***a* which seals between the connector and lower barrel sections.

The mandrel and the top barrel sections are spaced above the connector barrel section to provide an annular passage **51** which is in communication with the exterior through the lateral ports **52** of the top barrel section.

The lower barrel section and the bottom mandrel section are spaced to define an annular pump piston chamber **56** below the connector barrel section in which is slidable a pump **57**. The upper end of the pump piston chamber is opened to the exterior through the annular passage **51** and the ports **52** when the mandrel is moved downwardly relative to the barrel to the position illustrated in FIGURE 7 wherein the O-ring **48** is aligned with the recess **50** of the mandrel and out of engagement with the seal surface **49** thereof.

The pump piston has an annular internal groove or recess adjacent its upper end in which is disposed an O-ring **58** which seals between the bottom mandrel section and the pump piston and with an external annular groove in which is disposed an O-ring **59** which seals between the pump piston and the lower barrel section **28** below a lateral portion **62** of a bypass flow passage **63** of the pump piston. The longitudinal portion **64** of the bypass flow passage **63** opens downwardly through the orifice **65** of a spring retainer **66** threaded in the lower end of the longitudinal portion. A spring **67** disposed in the longitudinal portion of the flow passage biases a ball check valve **68** against an annular seat **69** of the pump piston, its upper end bearing against the ball check valve and its lower end against the retainer.

The ball check valve at all times prevents upward flow of liquid through the bypass flow passage **63** and prevents downward flow therethrough until the pressure in the upper chamber **56** above the piston **57** has increased to a value sufficiently great to overcome the force exerted by the spring **67** on the ball valve. Liquid, such as oil, may be introduced into the pump piston chamber above the pump piston in any desired manner as through an inlet port **70** of the connector barrel section which is closable by a suitable plug **71**.

The upward movement of the pump piston in the chamber **56** is limited by the engagement of its upper annular end surface or shoulder **74** with the annular bottom end shoulder **75** of the connector barrel section.

A latch or pawl **77** disposed in a suitable external recess **78** of the top pump piston section **57** is pivotally secured to the pump piston, as at **79**, and is biased outwardly by a leaf spring **80**. The lower end of the latch or pawl **77** enters into the internal annular latch recess **82** of the lower barrel section when the pump piston is moved to its uppermost position relative to the barrel and engages the lower upwardly facing annular shoulder **83** of the lower barrel section **28** to latch the pump piston against subsequent downward movement relative to the barrel. Downward movement of the pump piston relative to the barrel is limited by the engagement of its lower end with the upwardly facing annular shoulder **84** of the lower barrel section **28**.

A dependent sleeve **88** has a reduced upper end portion **89** threaded into the lower end of the pump piston. An O-ring **91** disposed in a suitable annular external recess of the pump piston seals between the piston and the sleeve.

The external surface **93** of the sleeve is of greater radius than the external surface **49** of the bottom mandrel section **24** and, therefore, the volume of the upper portion of the pump piston chamber above the O-ring **59** decreases more rapidly than the volume of the lower portion of the pump piston chamber below the O-ring **59** which increases as the barrel and mandrel is moved downwardly relative to the pump piston when the pump piston is held against downward movement. Liquid then pumped from the pump piston chamber is forced into the upper end of the annular operator piston chamber **95** defined by the internal surface **96** of the lower barrel section below its shoulder **84** and the external surface **93** of the sleeve.

An operator piston **100** is slidably disposed in the operator piston chamber and has O-rings **101** and **102** disposed in suitable external and internal recesses thereof which engage the internal and external surfaces **96** and **93**, respectively. The operator piston has a plurality of dependent resilient collet fingers **105** whose lower ends are provided with inner serrations or teeth **106** and with external bosses **107**. The bosses have outer cam surfaces **108** inclined downwardly and inwardly and are engageable with the internal downwardly and inwardly extending or beveled cam surface **109** of the bottom or bowl barrel section **29**. The external bosses of the fingers are receivable in the lower enlarged portion **110** of the bore or passage of the lower barrel section **29** which permits the collet fingers to assume their inoperative outer positions, illustrated in FIGURE 2, when the operator piston is in its upper position relative to the barrel illustrated in FIGURE 2.

The pump piston sleeve **88** has an external outer flange **112** providing an upwardly facing external annular shoulder **113** which is engageable with the downwardly facing internal shoulder **114** of the operator piston to limit downward movement of the operator piston relative thereto. The bottom or bowl barrel section **29** has an upwardly and inwardly inclined cam or beveled surface **115** for camming or guiding the barrel over the upper end of an object such as the tubing T which is to be removed from the well while the sleeve **88** has a similar upwardly and inwardly inclined or beveled shoulder **118** which is engageable with the upper end of such object as the tubing.

In use, when an object is to be retrieved or removed from a well, for example, the tubing T whose upper end portion may have broken off in the well, the retrieving tool **20**, with its operative elements in the positions shown in FIGURES 1 and 2, is secured to the lower end of a string of pipe P. The operator piston **100** is now in its upper position wherein its annular top end surface engages the annular bottom end surface of the pump piston **57** so that the external bosses **107** of the collet fingers are in the enlarged portion **110** of the bore of the lower barrel section and the collet fingers are in their outer inoperative positions in the barrel illustrated in FIGURE 2. An incompressible fluid, such as oil, is introduced into the top portion of the upper pump piston chamber **56** above the pump piston through the filler port **70** to fill the pump piston chamber above the pump piston which is then in its lowermost position in the barrel. The plug **71** is then threaded in the filler port to close it. The ball check valve **68** now prevents flow of the oil from the top portion of the chamber **56** above the pump piston to the lower end of the chamber through the bypass flow passage **63** due to the force exerted thereon by the spring **67** and the operator piston is held against downward movement in the barrel since any downward movement thereof in the barrel tends to create a vacuum in the chamber **56** below the pump piston. In addition, the collet fingers **105** tend to hold the operator piston in its upper position illustrated in FIGURE 2 due to the engagement of the cam surfaces **108** thereof with the cam surface **109** of the

barrel and the resilient force with which the collet fingers resist inward flexing or movement. The operator piston is thus held in its uppermost position against any accidental downward movement in the barrel and the collet fingers remain in their outer inoperative positions during lowering of the retrieving tool in the well. The barrel is now held in its upper position on the mandrel **21** by the shear screw **32**. The pins **34** are in the upper ends of the short portions **37** of the J-slots and engage the downwardly facing surfaces **38** defining the upper ends of the short portions.

The retrieving tool is then lowered into the well on the string of pipe P until the lower end of the barrel telescopes the upper end of the object which is to be retrieved, such as the upper end of the tubing T. The cam surface or shoulder **115** of the bottom barrel section **29** guides downward movement of the mandrel over the upper end of the tubing. As the retrieving tool telescopes over the upper end portion of the tubing and the collet fingers move downward thereabout, their teeth or serrations **106** do not grippingly engage the outer surface of the tubing since the lower ends of the collet fingers are now in their outer inoperative position. The retrieving tool is moved downwardly over the upper end portion of the tubing until the top end of the tubing engages the bottom surface **118** of the pump piston sleeve **88** which is beveled inwardly and upwardly to help center the retrieving tool on the tubing as it is lowered thereon. When the sleeve **88** engages the upper end of the tubing, further downward movement of the pump piston is arrested.

A further downward force imparted to the pipe P at the surface now causes the mandrel **21** and barrel **25** to move downwardly relative to the pump piston **57** and the incompressible liquid in the pump piston chamber **56** above the pump piston is forced downwardly through the bypass flow passage **63** into the lower portion of the pump piston chamber below the pump piston and into the upper end of the operator piston chamber **95** above the operator piston **100**. The cross-sectional area of the operator piston chamber **95** is substantially smaller than that of the lower portion of the pump piston chamber so that the liquid pumped through the bypass flow passage **63** past the check valve **68** into the upper end of the operator piston chamber causes the operator piston to move downwardly relative to the barrel. Downward movement of the operator piston relative to the barrel causes the lower ends of the collet fingers to be moved inwardly due to the camming engagement of the cam surfaces **108** with the cam surface **109** of the bottom or bowl barrel section **29** and their teeth or serrations **106** engage the external surface of the tubing T and dig thereinto. The pawl or pawls **77** do not prevent such downward movement of the barrel relative to the pump piston since the barrel slides downwardly past the surfaces of the pawl or pawls which are biased against the internal surfaces of the lower barrel section **28** by the spring **80**.

When further downward movement of the mandrel and barrel is arrested as the lower ends of the collet fingers reach the limit of their inward movement after their teeth have dug into the tubing, an upward force is imparted to the string of pipe P at the surface and the upward force applied thereby to the mandrel may now cause the shear pin **32** to shear since such force tends to move the barrel upwardly but such upward movement of the barrel is now resisted by the weight of the tubing or any force resisting its upward movement. It will be apparent that such upward movement of the mandrel is limited by the engagement of the shoulder **41** of the mandrel with the shoulder **42** of the barrel. Further upward movement then imparted to the pipe P causes an upward force to be exerted on the tubing T which is then moved upwardly to the surface by means of the retrieving tool.

It will be apparent that the greater force necessary to move the tubing upwardly, the greater will be the force with which the serrations or teeth **106** of the collet fingers are held in gripping engagement with the tubing due to the camming engagement between the cam surface **109** of the barrel and the cam surface **108** of the collet fingers. The tubing is thus held against downward movement relative to the barrel and will be raised by the retrieving tool as the string of pipe is raised upwardly to the surface.

Should it be desired to disengage the retrieving tool from the tubing before it has been pulled upwardly to the surface after the teeth or serrations **106** of the collet fingers have been moved into gripping engagement with the tubing, the pipe P is first pulled up to position the connecting portions **38** of the J-slots in alignment with the pins **33**, then rotated to the right, as seen in FIGURE 5, to move the lower ends of the long portions or legs **39** of the J-slots into alignment with their pins **33**, and then downwardly to cause the mandrel to move downwardly relative to the barrel until such downward movement of the mandrel moves the sealing surface **49** downwardly below the O-ring **48** and out of sealing engagement therewith so that the fluid trapped in the upper portion of the pump piston chamber **56** above the pump piston is free to flow outwardly of the barrel through the annular passage **51** and the ports **52**. Such downward movement of the mandrel relative to the barrel and to the pump piston is continued until the lower end shoulder **115** of the mandrel engages the annular end shoulder **116** of the connector barrel section **27** or until the downwardly facing bottom end shoulder **122** of the top mandrel section engages the annular top shoulder **119** of the top barrel section, whichever occurs sooner. Further downward movement of the pipe P now causes the barrel to move downwardly with the mandrel relative to the pump and operator pistons, the oil in the pump piston chamber above the pump piston flowing to the exterior as the volume of the pump piston chamber above the pump piston is decreased. The barrel and mandrel are now moved downwardly relative to the pump piston until the upper end shoulder **74** of the pump piston is engaged by the shoulder **75** of the barrel connector section **27**. During such downward movement of the barrel, its cam surface **109** is moved downwardly relative to the collet fingers and their cam surfaces **108** so that the collet fingers are freed to move outwardly to their outer positions due to their resilient force of the collet fingers. When the barrel is moved to its lowermost position relative to the pump piston, illustrated in FIGURE 7, the pawl or pawls **77** are in alignment with the internal annular recess **82** and move outwardly thereinto. An upward pull may now be imparted to the mandrel through the pipe and causes its shoulder **41** to engage the shoulder **42** of the barrel to cause the barrel to move upwardly with the mandrel. Upward movement of the barrel now causes the pump piston to move upwardly therewith due to the engagement of the pawl or pawls **77** with the shoulder **83**. Upward movement of the pump piston and barrel now causes upward movement of the operator piston due to the engagement of the shoulder **113** of the sleeve with the shoulder **114** of the operator piston which takes place before the barrel cam surface **109** can again engage the cam surfaces **108** of the collet fingers. The retrieving tool is thus released from engagement with the tubing T and may be removed from the well leaving the tubing in the well.

It will now be seen that a new and improved retrieving tool **20** has been illustrated and described which has gripping means which inherently resiliently tend to remain in their outer inoperative positions and which are movable into gripping engagement with an object to be removed from a well by hydraulic means which includes the pump and operator pistons **57** and **100**.

It will further be seen a retrieving tool includes a mandrel having a barrel disposed thereabout providing an annular pump piston chamber **56** closed at its upper end in which an annular pump piston is slidable and that the pump piston and the barrel have means providing another

annular piston chamber **95** which communicates with the lower end of the pump piston chamber and in which an operator piston is slidably disposed.

It will further be seen that the retrieving tool is provided with a bypass flow passage **63** communicating the upper end portion of the pump piston chamber above the pump piston with the lower end portion thereof below the pump piston and that a check valve **68** prevents flow of fluid through the bypass passage from the lower end portion of the pump piston chamber to the upper end portion thereof.

It will further be seen that downward movement of the mandrel and the barrel relative to the pump piston causes liquid to be forced or pumped from the upper end of the pump piston chamber to the lower end thereof and into the upper end of the operator piston chamber due to the difference in the cross-sectional areas of the pump piston chamber above and below the pump piston, the cross-sectional area of the pump piston chamber below the pump piston being smaller than the cross-sectional area of the pump piston chamber above the pump piston.

It will further be seen that the operator piston is moved downwardly relative to the barrel by liquid pumped into the upper end of its chamber and that the operator piston has gripping means which are movable into gripping engagement with an object positioned therebetween by co-engageable means of the barrel and the gripping means upon downward movement of the operator piston relative to the mandrel.

It will further be seen that the mandrel and the barrel have valve or seal means, the seal surface **49** and the O-ring **48**, which close the upper end of the pump piston chamber and which open the top end of the pump piston chamber to the exterior of the barrel upon downward movement of the mandrel relative to the barrel, and that the barrel and the mandrel have co-engageable means which permits such downward movement of the mandrel relative to the barrel only upon a predetermined longitudinal upward movement and a predetermined rotational movement of the mandrel relative to the barrel.

It will further be apparent that the barrel and the mandrel may be moved downwardly relative to the pump piston after such predetermined downward movement of the mandrel relative to the barrel to move the co-engageable means of the gripping means and of the barrel out of engagement with one another to permit the gripping means to move out of gripping engagement with the object held therebetween.

Referring now particularly to FIGURES 9 and 10 of the drawings, the retrieving tool **150** is similar to the retrieving tool **20** and, accordingly, the elements of the retrieving tool **150** have been provided with the same reference numerals, to which the subscript "*a*" has been added, as the corresponding elements of the well tool **20**. The well tool **150** differs from the retrieving tool **20** by having a resilient tubular seal member **151** disposed in the lower barrel section **28***a* above the bottom barrel section **29***a*. An annular cam of bowl member **152** having an inwardly and downwardly beveled shoulder or surface **109***a* engageable by the downwardly and inwardly beveled surfaces **108***a* of the collet fingers **105***a* is disposed above the resilient sealing element **151** and its annular end surface or shoulder **153** engages the annular top end surface **154** of the resilient seal element. Upward movement of the annular bowl member **152** is limited by the engagement of the top annular shoulder of its external annular flange **155** with the bottom shoulder of the internal flange **157** of the lower barrel section **28***a*. Downward movement of the resilient tubular seal member **151** is limited by the engagement of its annular bottom end surface or shoulder **158** with the top end annular shoulder or surface **159** of the bottom barrel section **29***a*. The resilient member is provided at its top and bottom with annular garter spring type members **160** and **161** which are molded to the body of the seal member **151** and which deform to bridge the gaps between the external surface of the object to be retrieved, such as the tubing T, and the internal surfaces of the bottom barrel section **29***a* and the bowl member **152** when the resilient member is compressed to limit extrusion of the resilient substance of the seal member into the gaps.

It will be apparent that when the downward movement of the sleeve **88***a*, and therefore of the pump piston of the retrieving tool is stopped by the engagement of the shoulder **118***a* of the sleeve **88***a* with the top end surface of the tubing T, further downward movement of the barrel **25***a* causes liquid under pressure to be pumped into the operator piston chamber **95***a* above the operator piston **100***a* and the operator piston is moved downwardly relative to the barrel. As the operator piston is moved downwardly relative to the barrel, the collet fingers first exert a downward force on the bowl member **152** and tend to move it downwardly in the lower barrel section against the resilinet force of the seal member **151** which is thus compressed and expanded into sealing engagement with the tubing. When downward movement of the bowl member is stopped, when the resilient member is fully compressed and in sealing engagement with the tubing, further downward movement of the piston **100***a* and the collet fingers causes the lower ends of the collet fingers to be cammed inwardly due to the camming engagement of their surfaces **108***a* with the cam surfaces **109***a* of the now stationary bowl member **152** so that their serrations or teeth **106***a* grippingly engage the external surfaces of the tubing.

It will be apparent that when an upward force is then exerted on the bowl **29***a* the seal member is held compressed and the lower ends of the collet fingers are biased inwardly into gripping engagement with the tubing T so that the greater force with which the tubing T resists upward movement, the greater the force with which the seal member **151** and the gripping means or collet fingers of the retrieving tool are held in sealing and gripping engagement with the tubing T.

It will now be apparent that the retrieving tool **150** functions in the same manner as the retrieving tool **20** but in addition has a sealing means providing a fluid type seal between the object to be retrieved and if desired, fluids may be pumped into or from the tubing T being retrieved through the retrieving tool and through the string of pipe by means of which a retrieving tool is lowered into and raised from the well.

The foregoing description of the invention is explanatory only, and changes in the details of the construction illustrated 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 is claimed and desired to be secured by Letters Patent is:

1. A well tool including: a tubular mandrel; a barrel disposed about said tubular mandrel and providing with said tubular mandrel an annular upper piston chamber; an annular pump piston longitudinally movable in said chamber and having means providing with said barrel a lower annular chamber whose upper end is in communication with the lower end of said upper chamber by a bypass flow passage; an annular operator piston longitudinally movable in said lower chamber, said operator piston being movable downwardly in said lower chamber relative to said barrel upon downward movement of said mandrel and said barrel relative to said pump piston by liquid displaced from the upper end portion of said upper chamber by such downward movement of said mandrel and said barrel relative to said pump piston, said piston having means engageable with an object extending upwardly in said barrel for preventing downward movement of said pump piston relative to the said object; gripping means disposed in said barrel and operable by said operator piston for engaging an object extending upwardly into said mandrel, said gripping

means and said barrel having co-engageable means for moving said gripping means inwardly to engage an object in said barrel upon downward movement of said operator piston relative to said barrel, said barrel and said mandrel having co-engageable means for controlling movement of said mandrel relative to said barrel, said barrel and said mandrel having means closing the upper end of said upper chamber, said last mentioned means opening the upper end of said upper chamber to the exterior of the well tool upon predetermined rotational movement of said mandrel relative to said barrel to permit downward movement of said mandrel relative to said barrel and said pump piston to free said gripping means for movement out of engagement with an object held thereby whereby said retrieving tool is releasable from an object previously engaged thereby.

2. A well tool including: a tubular mandrel; a barrel disposed about said tubular mandrel and providing with said tubular mandrel an annular upper piston chamber; an annular pump piston longitudinally movable in said chamber and having means providing with said barrel a lower annular chamber whose upper end is in communication with the lower end of said upper chamber by a bypass flow passage; an annular operator piston longitudinally movable in said lower chamber, the cross-sectional area of the upper end of said upper chamber being greater than the cross-sectional area of the lower end of said upper chamber whereby downward movement of said barrel and mandrel causes liquid to be pumped from the upper end of said upper chamber into the upper end of said lower piston chamber, said lower chamber having a smaller cross-sectional area than the lower end portion of said upper chamber whereby said operator piston is moved downwardly relative to said barrel by liquid pumped into said lower chamber upon downward movement of said mandrel and barrel relative to said pump piston; gripping means disposed in said barrel and operable by said operator piston for engaging an object extending upwardly into said mandrel, said gripping means and said barrel having co-engageable means for moving said gripping means inwardly to engage an object in said barrel upon downward movement of said operator piston relative to said barrel, said barrel and said mandrel having co-engagcable means for controlling movement of said mandrel relative to said barrel, said barrel and said mandrel having means closing the upper end of said upper chamber, said last mentioned means opening the upper end of said upper chamber to the exterior of the well tool upon predetermined rotational and longitudinal movement of said mandrel relative to said barrel to permit downward movement of said barrel relative to said pump piston to free said gripping means for movement out of engagement with an object held whereby said retrieving tool is releasable from an object previously engaged thereby.

3. A well tool including: a tubular mandrel; a barrel disposed about said tubular mandrel and providing with said tubular mandrel an annular upper piston chamber; an annular pump piston longitudinally movable in said chamber and having means providing with said barrel a lower annular chamber whose upper end is in communication with the lower end of said upper chamber by a bypass flow passage; an annular operator piston being movable downwardly in said lower chamber relative to said barrel upon downward movement of said mandrel and said barrel relative to said pump piston by liquid disposed from the upper end of said upper chamber by such downward movement of said mandrel and said barrel relative to said pump piston, said pump piston having means engageable with an object extending upwardly in said barrel for preventing downward movement of said pump piston relative to the said object; gripping means disposed in said barrel and operable by said operator piston for engaging an object extending upwardly into said mandrel, said gripping means and said barrel having co-engageable means for moving said gripping means inwardly to engage an object in said barrel upon downward movement of said operator piston relative to said barrel, said barrel and said mandrel having co-engageable means for controlling movement of said mandrel relative to said barrel, said barrel and said mandrel having means closing the upper end of said upper chamber, said last mentioned means opening the upper end of said upper chamber to the exterior of the well tool upon predetermined movement of said mandrel relative to said barrel to permit downward movement of said barrel relative to said pump piston to free said gripping means for movement out of engagement with an object held thereby whereby said retrieving tool is releasable from an object previously engaged thereby upon a predetermined movement of said mandrel relative to said barrel, said pump piston and said barrel having means co-engageable when said barrel is in a lowermost position relative to said pump piston wherein said gripping means are free to move out of engagement with an object disposed therebetween and upward movement of said barrel relative to said pump piston is limited.

4. A well tool including: a tubular mandrel; a barrel disposed about said tubular mandrel and providing with said tubular mandrel an annular upper piston chamber; an annular pump piston longitudinally movable in said chamber and having means providing with said barrel a lower annular chamber whose upper end is in communication with the lower end of said upper chamber by a by-pass flow passage; an annular operator piston being movable downwardly in said lower chamber relative to said barrel upon downward movement of said mandrel and said barrel relative to said pump piston by liquid disposed from the upper end of said upper chamber by such downward movement of said mandrel and said barrel relative to said pump piston, said pump piston having means engageable with an object extending upwardly in said barrel for preventing downward movement of said pump piston relative to the object; gripping means disposed in said barrel and operable by said operator piston for engaging an object extending upwardly into said mandrel, said gripping means and said barrel having co-engageable means for moving said gripping means inwardly to engage an object in said barrel upon downward movement of said operator piston relative to said barrel, said barrel and said mandrel having co-engagebale means for controlling movement of said mandrel relative to said barrel, said barrel and said mandrel having means closing the upper end of said upper chamber, said last mentioned means opening the upper end of said upper chamber to the exterior of the well tool upon predetermined rotational and longitudinal movement of said mandrel relative to said barrel to permit downward movement of said barrel relative to said pump piston to free said gripping means for movement out of engagement with an object held thereby whereby said retrieving tool is releasable from an object previously engaged thereby upon a predetermined movement of said mandrel relative to said barrel, said pump piston and said barrel having means co-engageable when said barrel is in a lowermost position relative to said pump piston wherein said gripping means are free to move out of engagement with an object disposed therebetween and upward movement of said barrel relative to said pump piston is limited, said pump piston and said operator piston having co-engageable means limiting upward movement of said pump piston relative to said operator piston.

5. A well tool including: a tubular mandrel; a barrel disposed about said tubular mandrel and providing with said tubular mandrel an annular upper piston chamber; an annular pump piston longitudinally movable in said chamber and having means providing with said barrel a lower annular chamber whose upper end is in communication with the lower end of said upper chamber by a by-pass flow passage; an annular operator piston longitu-

dinally movable in said lower chamber, the cross-sectional area of the upper end of said upper chamber being greater than the cross-sectional area of the lower end of said upper chamber whereby downward movement of said barrel and mandrel causes liquid to be pumped into the upper end of said lower piston chamber, said lower chamber having a smaller cross-sectional area than the lower end of said upper chamber whereby said operator piston is moved downwardly relative to said barrel by liquid pumped into said lower chamber by the downward movement of said mandrel and barrel relative to said pump piston; gripping means disposed in said barrel and operable by said operator piston for engaging an object extending upwardly into said mandrel, said gripping means and said barrel having co-engageable means for moving said gripping means inwardly to engage an object in said barrel upon downward movement of said operator piston relative to said barrel, said barrel and said mandrel having co-engageable means for controlling movement of said mandrel relative to said barrel, said barrel and said mandrel having means closing the upper end of said upper chamber, said last mentioned means opening the upper end of said upper chamber to the exterior of the well tool upon predetermined rotational and longitudinal movement of said mandrel relative to said barrel to permit downward movement of said barrel relative to said pump piston to free said gripping means for movement out of engagement with an object held thereby whereby said retrieving tool is releasable from an object previously engaged thereby upon a predetermined movement of said mandrel relative to said barrel, said pump piston and said barrel having means co-engageable when said barrel is in a lowermost position relative to said pump piston and said gripping means are free to move out of engagament with an object disposed therebetween and upward movement of said barrel relative to said pump piston is limited.

6. A well tool including: a tubular mandrel; a barrel disposed about said tubular mandrel and providing with said tubular mandrel an annular upper piston chamber; an annular pump piston longitudinally movable in said chamber and having means providing with said barrel a lower annular chamber whose upper end is in communication with the lower end of said upper chamber by a bypass flow passage; an annular operator piston longitudinally movable in said lower chamber, the cross-sectional area of the upper end of said upper chamber being greater than the cross-sectional area of the lower end of said upper chamber whereby downward movement of said barrel and mandrel causes liquid to be pumped into the upper end of said lower piston chamber, said lower chamber having a smaller cross-sectional area than the lower end of said upper chamber whereby said operator piston is moved downwardly relative to said barrel by liquid pumped into said lower chamber by the downward movement of said mandrel and barrel relative to said pump piston; gripping means disposed in said barrel and operble by said operator piston for engaging an object extending upwardly into said mandrel, said gripping means and said barrel having co-engageable means for moving said gripping means inwardly to engage an object in said barrel upon downward movement of said operator piston relative to said barrel, said barrel and said mandrel having co-engageable means for controlling movement of said mandrel relative to said barrel, said barrel and said mandrel having means closing the upper end of said upper chamber, said last mentioned means opening the upper end of said upper chamber to the exterior of the well tool upon predetermined movement of said mandrel relative to said barrel to permit downward movement of said barrel relative to said pump piston to free said gripping means for movement out of engagement with an object held thereby whereby said retrieving tool is releasable from an object previously engaged thereby upon a predetermined movement of said mandrel relative to said barrel, said pump piston and said barrel having means co-engageable when said barrel is in a lowermost position relative to said pump piston wherein said gripping means are free to move out of engagement with an object disposed therebetween and upward movement of said barrel relative to said pump piston is limited, said pump piston and said operator piston having co-engageable means limiting upward movement of said pump piston relative to said operator piston.

7. A well tool including: a tubular mandrel; a barrel disposed about said tubular mandrel and providing with said tubular mandrel an annular upper piston chamber; an annular pump piston longitudinally movable in said chamber and having means providing with said barrel a lower annular chamber whose upper end is in communication with the lower end of said upper chamber by a bypass flow passage; check valve means preventing fluid flow through said bypass flow passage from the lower end of the upper chamber to the upper end thereof; an annular operator piston longitudinally movable in said lower chamber, said operator piston being movable downwardly in said lower chamber relative to said barrel upon downward movement of said mandrel and said barrel relative to said pump piston by liquid displaced from the upper end of said upper chamber by such downward movement of said mandrel and said barrel relative to said pump piston, said piston having means engageable with an object extending upward in said barrel for preventing downward movement of said pump piston relative to the said object; gripping means disposed in said barrel and operable by said operator piston for engaging an object extending upwardly into said mandrel, said gripping means and said barrel having co-engageable means for moving said gripping means inwardly to engage an object in said barrel upon downward movement of said operator piston relative to said barrel, said barrel and said mandrel having co-engageable means for controlling movement of said mandrel relative to said barrel, said barrel and said mandrel having means closing the upper end of said upper chamber, said last mentioned means opening the upper end of said upper chamber to the exterior of the well tool upon predetermined rotational movement of said mandrel relative to said barrel to permit downward movement of said mandrel relative to said barrel and said pump piston to free said gripping means for movement out of engagement with an object held thereby whereby said retrieving tool is releasable from an object previously engaged thereby.

8. A well tool including: a tubular mandrel; a barrel disposed about said tubular member and providing with said tubular mandrel an annular upper piston chamber; an annular pump piston longitudinally movable in said chamber and having means providing with said barrel a lower annular chamber whose upper end is in communication with the lower end of said upper chamber by a bypass flow passage; an annular operator piston longitudinally movable in said lower chamber, said piston being movable downwardly in said lower chamber relative to said barrel upon downward movement of said mandrel and said barrel relative to said pump piston by liquid displaced from the upper end of said upper chamber, said pump piston having means engageable with an object extending upwardly in said barrel for preventing downward movement of said pump piston relative to the object; and gripping and sealing means disposed in said barrel and operable by said operator piston for engaging an object extending upwardly into said mandrel and sealing between said barrel and the object upon downward movement of said operator piston relative to said barrel.

9. A well tool including: a tubular mandrel; a barrel disposed about said tubular member and providing with said tubular mandrel an annular upper piston chamber; an annular pump piston longitudinally movable in said chamber and having means providing with said barrel a lower annular chamber whose upper end is in

communication with the lower end of said upper chamber by a bypass flow passage; an annular operator piston longitudinally movable in said lower chamber, said operator piston being movable downwardly in said lower chamber relative to said barrel upon downward movement of said mandrel and said barrel relative to said pump piston by liquid displaced from the upper end of said upper chamber, said pump piston having means engageable with an object extending upwardly in said barrel for preventing downward movement of said pump piston relative to the object; and gripping and sealing means disposed in said barrel and operable by said operator piston for engaging an object extending upwardly into said mandrel and sealing between said barrel and the object upon downward movement of said operator piston relative to said barrel; said barrel and said mandrel having co-engageable means for controlling movement of said mandrel relative to said barrel, said barrel and said mandrel having means closing the upper end of said upper chamber, said last means opening the upper end of the upper chamber to the exterior of the well tool upon predetermined rotational movement of said mandrel relative to said barrel to permit downward movement of said mandrel relative to said barrel and said pump piston to free said gripping means for movement out of engagement with an object held thereby whereby said retrieving tool is releasable from an object previously engaged thereby.

10. The well tool of claim **9**, wherein said seal and gripping means includes a tubular seal element disposed in said barrel against downward movement therein; annular means disposed in said barrel and engageable with the upper end of said seal element and movable downwardly in said barrel, said annular means including a cam surface; and resilient gripping means carried by said operator piston having cam surfaces engageable with said cam surface whereby downward movement of said operator piston causes downward movement of said annular means to cause said seal element to be expanded into sealing engagement with an object disposed inwardly therein and causes said gripping means to be moved inwardly into gripping engagement with the object.

11. The well tool of claim **8**, wherein said seal and gripping means includes a tubular seal element disposed in said barrel against downward movement therein; annular means disposed in said barrel and engageable with the upper end of said seal element and movable downwardly in said barrel, said annular means including a cam surface; and resilient gripping means carried by said operator piston having cam surfaces engageable with said cam surface whereby downward movement of said operator piston causes downward movement of said annular means to cause said seal element to be expanded into sealing engagement with an object disposed inwardly therein and causes said gripping means to be moved inwardly into gripping engagement with the object.

12. A well tool including: a tubular member providing an annular piston chamber closed at its upper end; an annular pump piston disposed in the lower portion of said pump piston chamber and having bypass flow means communicating the upper end of said chamber to the lower end thereof, said pump piston having engaging means extending downwardly in said tubular member and engageable with an object extending upwardly thereinto whereby downward movement of said tubular member causes liquid to be forced out of said upper chamber through said bypass flow passage upon downward movement of the tubular member relative to the pump piston when downward movement of the pump piston is arrested by the engagement of its engaging means with an object extending into the said tubular member, said tubular member and said pump piston providing a second annular piston chamber, and operator piston slidably mounted in said chamber and positioned in the upper position therein, said tubular member and said operator piston having co-engageable means for grippingly engaging an object extending into the barrel when said operator piston is moved downwardly in said tubular member by fluid forced from said upper chamber into said lower chamber, said tubular member including a barrel section and a mandrel section movable longitudinally with respect to each other and having means for opening the upper end of said closed chamber upon predetermined longitudinal movement of said mandrel section relative to said barrel section of said tubular member.

13. A well tool including: a tubular member providing an annular piston chamber closed at its upper end; an annular pump piston disposed in the lower portion of said pump piston chamber and having bypass flow means communicating the upper end of said chamber to the lower end thereof, said pump piston having engaging means extending downwardly in said tubular member and engageable with an object extending upwardly thereinto whereby downward movement of said tubular member causes liquid to be forced out of said upper chamber through said bypass flow passage upon downward movement of the tubular member relative to the pump piston when downward movement of the pump piston is arrested by the engagement of its engaging means with an object extending into said tubular member, said tubular member and said pump piston providing a second annular piston chamber, an operator piston slidably mounted in said chamber and positioned in the upper position therein, said tubular member and said operator piston having co-engageable means for grippingly engaging an object extending into the barrel when said operator piston is moved downwardly in said tubular member by fluid forced from said upper chamber into said lower chamber, said tubular member having means for opening the upper end of said closed chamber, said tubular member including a barrel section and a mandrel section; and co-engageable means on said sections for controlling longitudinal movement of said sections relative to one another, said opening means being opened upon predetermined downward movement of said mandrel section relative to said barrel section.

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GERALD M. FORLENZA, *Primary Examiner.*

G. F. ABRAHAM, *Assistant Examiner.*