Sept. 3, 1968 B. Q. BARRINGTON 3,399,740

HYDRAULIC JARRING TOOL FOR USE IN WELLS

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FIG.1

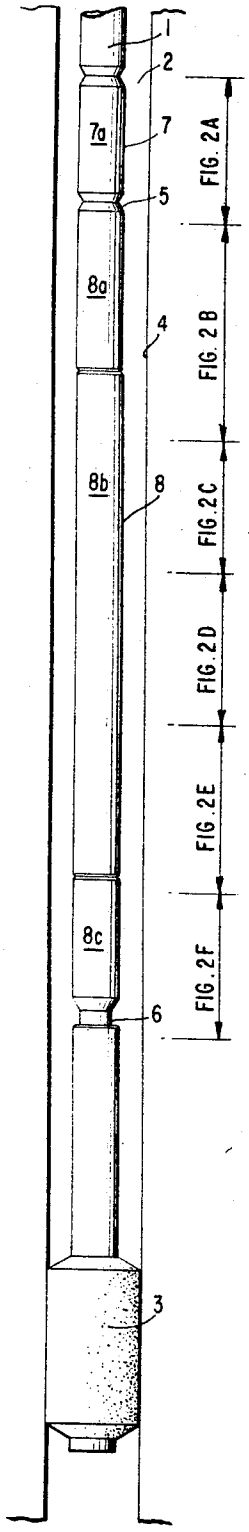


FIG.3

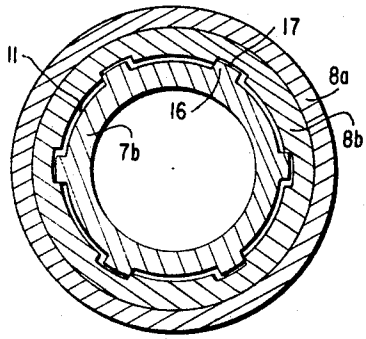


FIG.4

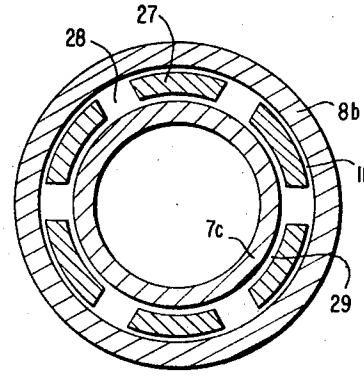


FIG.5

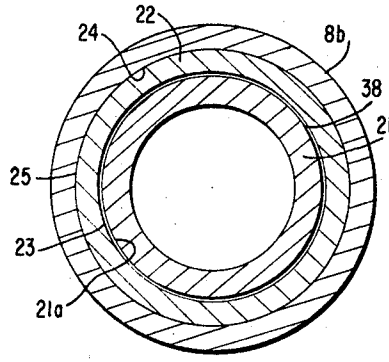


FIG.6

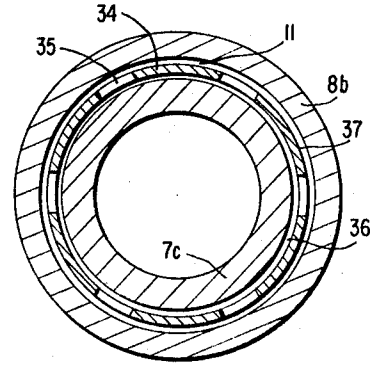


FIG.7

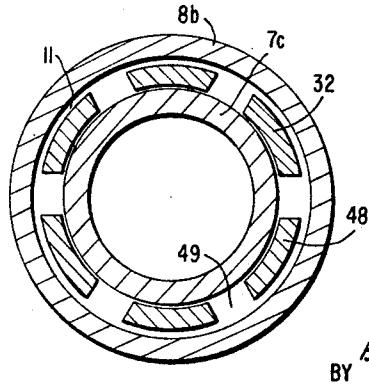
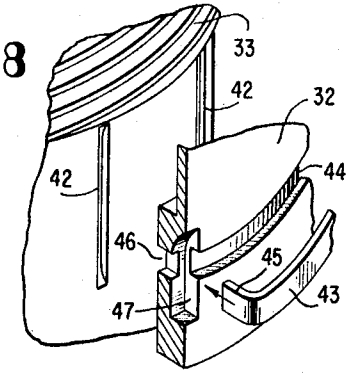


FIG.8



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HYDRAULIC JARRING TOOL FOR USE IN WELLS

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FIG.2A

FIG.2B

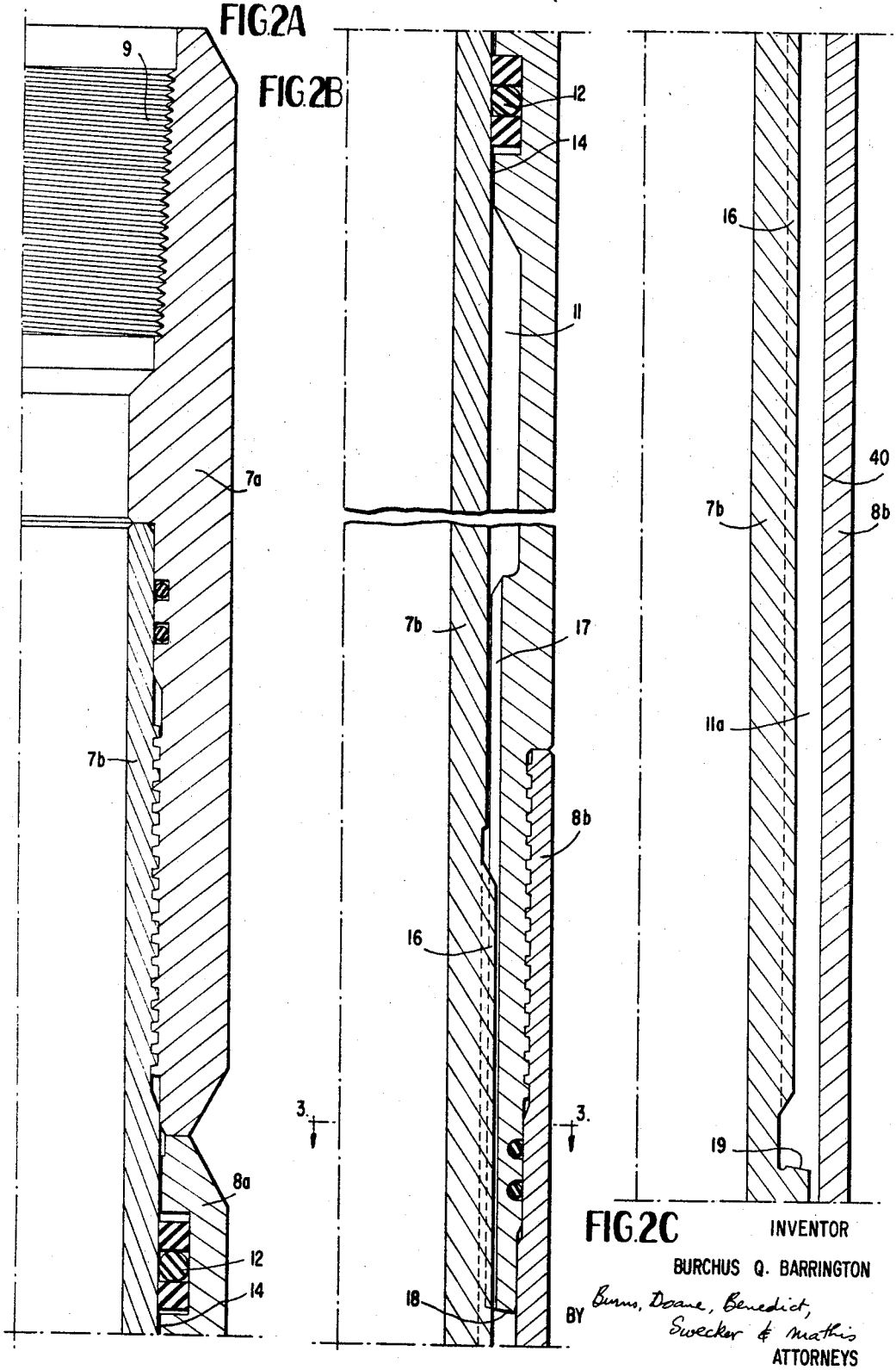


FIG.2C

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HYDRAULIC JARRING TOOL FOR USE IN WELLS

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FIG.2D

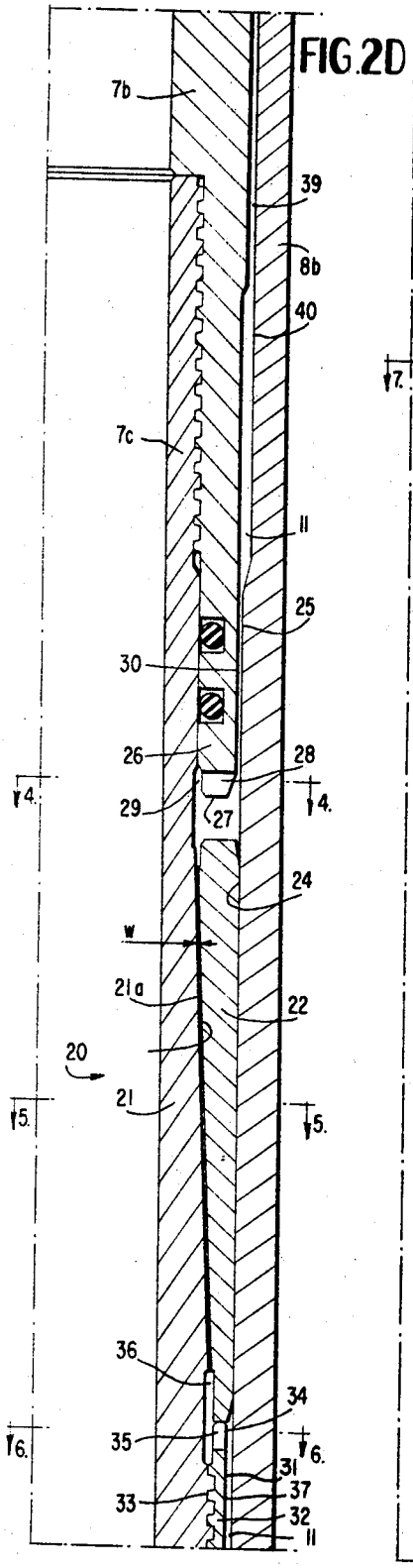
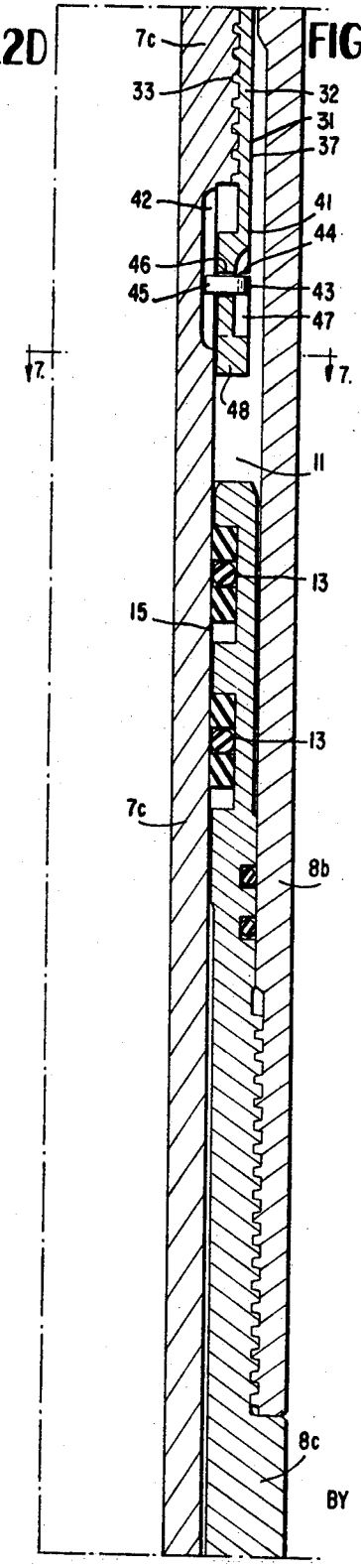


FIG.2E



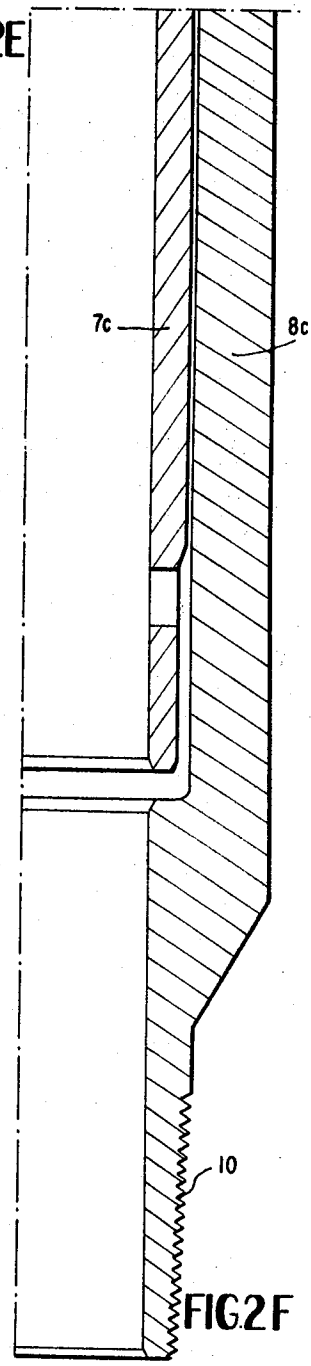


FIG.2F

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United States Patent Office 3,399,740 Patented Sept. 3, 1968

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HYDRAULIC JARRING TOOL FOR USE IN WELLS

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Filed Aug. 18, 1966, Ser. No. 573,312
6 Claims. (Cl. 175—297)

ABSTRACT OF THE DISCLOSURE

A jarring tool including a frustoconical collar supported for axial sliding movement between abutments of a mandrel. The collar, when spaced from the mandrel, defines a flow-restricting passageway operable to impede mandrel movement. Moving the collar axially along the mandrel changes the flow capacity of the passageway.

General background of the invention

This invention relates to an apparatus for use in wells. In particular, it relates to a hydraulic jarring tool which may be effectively employed to facilitate movement of articles which become stuck within well bores.

In perforating drilling and completion operations in oil fields, operators occasionally encounter the necessity of moving articles which have become stuck in a well bore. At times, for example, a packer on a testing tool may stick or fail to release so as to make its removal inordinately difficult.

When this happens a jarring tool may be employed to facilitate the release of the stuck article. Jarring tools may be incorporated in strings supporting articles which are likely to become stuck or they may be subsequently incorporated in conduit strings which are attached to articles stuck in a well bore by following conventional well fishing techniques.

A variety of hydraulic jarring tools have heretofore been provided. In general, these tools have been characterized by flow impeding devices which are carried by movable components of the tools and which are operable for a limited initial portion of the travel or movement of the movable components. This enables an upward strain to be placed on a movable component of a tool, with the movement impeding mechanism initially resisting upward movement of the movable component, while a fixed component of the tool is anchored to the stuck article.

Repeated reciprocation of the movable component serves to impart repeated jars to the stuck article which ultimately effect the release of the article.

All too often, hydraulic jarring tools previously devised have been characterized by structural complexities which often created as many problems as the tools solved. Many such tools utilized multiple valve arrangements, orifice passages, or ground seat closures for valves, all of which created significant operational problems. Multiple valve arrangements and orifice systems in impedance devices are vulnerable to clogging and failure during operation. The use of ground seat valving devices introduces vulnerability to seat scoring and ultimate tool failure.

Some hydraulic jars have been characterized by the maintenance of the same diameter of internal portions. This restricting structural arrangement introduces structural complexities which are neither necessary nor significant in the effective operation of hydraulic jar tools.

General objects and summary of invention

All of the conventional engineering arrangements above discussed engender fabrication or operational difficulties and limitations which are desirable to avoid. For this reason it is an object of the present invention to provide an improved hydraulic jar tool which is characterized by a radically new and simplified flow impedance mechanism.

It is a particular object of the invention to provide a flow impedance device for use in a well tool which is charatcerized by flow impeding passage means having an axially varying, cross-sectional area.

It is a further object of the invention to provide such an improved flow impedance device which avoids the resort to valve arrangements and which utilizes a single, unvalved flow restricting passage, the flow capacity of which varies depending upon the direction of movement of the flow impeding device.

It is another object of the invention to provide such an improved well tool mechanism including a self-flushing or cleaning flow impeding passage.

It is likewise an object of the invention to provide such an improved device including a unique mechanism for selectively adjusting the minimum flow capacity of the flow restricting passage means and which does not affect the distance of impeded movement between movable components of the tool.

In order to accomplish at least some of the foregoing objectives there is presented through the invention a well tool including a first component and a second component, axially movable relative to the first component. The tool further includes fluid reservoir means and movement impedance means carried by the second component. This movement impedance itself comprises an assembly movable through the reservoir means of the tool. The assembly has wall means extending transversely of the reservoir means and sealingly engaging portions of the first component and further includes passage means extending through the wall means to communicate with opposite axial sides of the wall means. The characterizing feature of the combination resides in the unique structure of the passage means which provides a progressively axially varying cross-sectional area.

A particularly significant facet of the invention resides in a passage means configuration which is generally annular and frustoconical and coaxially aligned with the movement axis of the second component. In the optimum form of the invention, the wall means of the assembly means includes an axially movable portion which is adapted to effect an increase in the width of the annular, frustoconical passage means in response to axial movement of the portion in the direction of the convergence of the frustoconical passage.

Drawings of preferred embodiment

In describing the invention reference will be made to a preferred embodiment illustrated in the appended drawings.

In the drawings:

FIGURE 1 schematically illustrates the hydraulic jarring tool of the present invention positioned in a well bore to facilitate the release of a stuck packer;

FIGURES 2*a* through 2*f* provide fragmentary, vertically sectioned, and enlarged views of the generally cylindrical components of the FIGURE 1 assembly correlating with axial sections of the tool as shown in FIGURE 1;

FIGURE 3 provides a transverse sectional view of a portion of the tool as viewed along the section line 3—3 of FIGURE 2*b* and illustrating structural details of a splined interconnection between relatively movable mandrel and barrel components of the tool;

FIGURE 4 provides a transverse sectional view through a portion of the tool as viewed along the section line 4—4 of FIGURE 2*d* and illustrating radial flow passages formed in upper abutment means carried by the mandrel

which provide fluid communication between reservoir means of the tool and a restricted flow passage of a movement impedance device;

FIGURE 5 provides a transverse sectional view through the FIGURE 1 apparatus as viewed along the section line 5—5 of FIGURE 2*d* and illustrating a generally annular, frustoconical flow passage of the flow impedance device of the FIGURE 1 tool, which flow passage varies in effective cross-sectional area axially of the tool by decreasing in a progressively axial fashion in the direction of the lifting force exerted on the mandrel component of the tool which supports this passage;

FIGURE 6 provides a transverse sectional view of the FIGURE 1 tool as viewed along the section line 6—6 of FIGURE 2*d* and illustrating radial flow passages in lower abutment means carried by the tool mandrel and which provide fluid communication between the tool fluid reservoir and the lower end of the axially varying flow restricting passage of the tool;

FIGURE 7 provides a transverse sectional view of the FIGURE 1 tool as viewed along the section line 7—7 of FIGURE 2*e* and illustrates tool receiving sockets which enable the threadably mounted lower abutment means of the mandrel of FIGURE 1 tool to be adjusted in axial position; and

FIGURE 8 provides an enlarged fragmentary peripheral view of the portion of the FIGURE 1 tool as viewed in the general view direction 8—8 of FIGURE 2*e* and illustrating structural details of a yieldable detent mechanism which serves to secure the lower abutment means of the mandrel in a selected position of axial adjustment.

The overall structure

FIGURE 1 schematically illustrates a conventional installation including a conduit string **1** extending into a well bore **2**. A packer **3** is supported on the lower end of the string **1** and for the purpose of this disclosure is shown as being expanded and in stuck engagement with a wall **4** of the well **2**.

Conduit string **1** includes a hydraulic jar **5** interposed in the string above the stuck packer **3**. Jar **5** may have been initially included in the string or may have been subsequently connected with the packer **3** through conventional well fishing techniques. For example, an operator may have discovered the stuck condition of the packer **3** and separated the upper portion of a conduit string formerly supporting the packer **3** from this packer as, for example, at a conventional safety joint **6**. After the initial string was removed, the jar **5** could have been inserted in the lower end of the removed string and the string then relowered with a conventional coupling at its lower end which was mateable with the safety joint **6** so as to reattach the string to the stuck anchor **3**.

As generally shown in FIGURES 1 and 2*a* through 2*f*, hydraulic jar **5** includes, as its basic components, a mandrel **7** threadably connected with the portion of the conduit string **1** extending upwardly from the jar **5**. Hydraulic jar **5** also includes a barrel component **8** which may be fabricated from a plurality of threadably interconnected cylindrical components **8***a*, **8***b* and **8***c*. Barrel **8** may be threadably connected to safety joint **6** so as to be anchored to the stuck packer **3**.

Mandrel **7** itself may be fabricated from a plurality of threadably interconnected components **7***a*, **7***b* and **7***c*. Component **7***a* at its upper end includes a conventional, female threaded coupling **9** which is connected to a conventional, threaded male fitting in the conduit string **1**. As illustrated, mandrel **7** is generally tubular or cylindrical in character and telescopingly received within the barrel **8**.

Section **8***c* of barrel **8**, as shown in FIGURE 2*f*, may be provided with a conventional threaded male fitting **10** for effecting threaded engagement with the stuck article **3** through the interposed safety joint **6** of FIGURE 1.

A generally annular, hydraulic fluid reservoir **11** is carried within the hydraulic jar **5** between outer and inner walls respectively of mandrel **7** and barrel **8**. The upper and lower limits of this reservoir may be defined by conventional, axially spaced, annular seals **12** and **13** carried by the barrel **8**. Mandrel portion **7***b* includes a cylindrical outer periphery **14** disposed in slidably and sealing engagement with seal **12**. Mandrel section **7***c* includes an outer cylindrical peripheral wall **15** disposed in slidable and sealing engagement with the seals **13**.

In order to enable the hydraulic coupling **5** to transmit rotary force or torque, the mandrel **7** is splined to the barrel **8**. This conventional interconnection, as shown in FIGURES 2*b* and 2*c*, may comprise a plurality of longitudinal ridges or splines **16** carried by and circumferentially spaced about the outer periphery of the mandrel section **7***b*. Each of the splines **16** is slidably received within a radially recessed and longitudinally extending groove **17** formed on the inner periphery of the barrel section **8***b*.

Barrel section **8***a*, at its lower end, provides an annular anvil face **18**. Mandrel section **7***b* carries a radially outwardly extending annular hammer face **19** which is disposed beneath the anvil face **18**. With the mandrel **7** fully converged with the barrel **8**, as shown in FIGURES 2*a* through 2*f*, the hammer **19** is spaced beneath the anvil **18** but is movable upwardly into engagement with the anvil **18** through an annular portion **11***a* of the fluid reservoir **11**.

Movement impedance device

FIGURES 2*d* and 2*e* illustrate structural details of a movement impedance device **20** which is disposed for axial travel within the fluid reservoir **11** and which is carried by the mandrel **7**.

Impedance **20** includes a frustoconical, upwardly converging shoulder **21** carried by the mandrel section **7***c*. Assembly **20** includes a collar **22** having a frustoconical inner face **23** and a generally cylindrical outer face **24**. Outer face **24** is slidably and sealingly receivable within a cylinder wall portion **25** of barrel section **8***b*. Frustoconical wall **23** of collar **22** faces and is mateable with the outer periphery **21***a* of shoulder **21**.

A first, generally annular abutment **26** is carried by the mandrel section **7***b* above shoulder **21** as generally shown in FIGURE 2*d*. The lower end of abutment **26** is defined by a plurality of circumferentially spaced teeth **27** which alternate with a plurality of passages **28**. Each passage extends longitudinally upwardly into the lower end of the abutment **26** and extends radially between an annular passage **29** and the outer periphery **30** of the abutment **26** which is spaced radially inwardly from the cylindrical wall **25**. Recess **29** may comprise an annular groove formed on the outer periphery of the mandrel section **7***c* immediately above the frustoconical wall **21***a* of the shoulder **21**.

Another annular abutment **31** is disposed beneath the shoulder **21** and the collar **22**. Abutment **31** comprises a sleeve **32** connected by a conventional threaded connection **33** to the outer periphery of the mandrel section **7***c*. The upper end of abutment **31** includes a plurality of longitudinally projecting, circumferentially spaced teeth **34**. Alternating with teeth **34** are a plurality of circumferentially spaced passages **35**. Spaced passages **35** extend radially outwardly from an annular passage **36**. As illustrated, passage **36** may comprise an annular recess formed on the outer periphery of the mandrel section **7***c* and which extends longitudinally from the frustoconical face **21***a* downwardly to extend longitudinally past and radially within the radial passages **35**. Thus, passages **35** provide fluid communication between the annular recess **36** and the outer periphery **37** of the sleeve **32**, which periphery is spaced radially inwardly from the cylindrical wall **25**.

As illustrated, collar **22** is axially slidable between the abutment extremities as defined by the lower ends of the

teeth **27** and the upper ends of the teeth **34**. The lower abutment **31** is engageable with the lower end of the collar **22** which has the largest diametered portion of the inner frustoconical wall **23**.

When the collar **22** is disposed in its lowermost position, i.e., in abutting engagement with the teeth **34**, the frustoconical collar wall **23** is slightly radially spaced from the mating frustoconical shoulder wall **21***a* so as to define a flow restricting passage **38**. Flow restricting passage **38** is generally annular and frustoconical is configuration and decreases in cross-sectional area in a generally upward direction, i.e., the direction in which movement of the mandrel **7** is to be initially impeded.

When collar **22** is disposed in its uppermost position, i.e., in engagement with the lower extremities of the teeth **27**, the width of the passage **38** will be substantially increased. Thus between the lower and upper positions of the collar **22**, the flow capacity or effective width *w* of the passage **38** will progressively increase such that the flow capacity of the passage will progressively increase.

Immediately above cylinder wall **25** is an enlarged barrel chamber **39** defined by a generally cylindrical wall **40** having a diameter exceeding that of the wall **25**. The axial extent of the wall **40** substantially exceeds the axial distance required to move the mandrel **7** from its illustrated position of convergence with the barrel **8** to a position sufficient to bring the collar **22** fully into radial juxtaposition with the chamber **39**. When the collar **22** is positioned in the chamber **39**, the cylindrical wall **24** is spaced radially inwardly from the wall **40**.

The initial or lower position of the collar **22** relative to the shoulder **20** is determined by the axial position of the threaded sleeve **32** in relation to the mandrel section **7***c*. By turning the sleeve **32** so as to advance it upwardly on the threaded coupling **33** the collar **22** will be raised so as to increase the width *w* of the flow restricting passage **38**. Conversely, of course, threaded downward movement of the sleeve **32** will serve to lower the collar **22** relative to the shoulder **21** and thus decrease the width and cross-sectional area of the passage **38**.

The sleeve **32** may be secured in selected positions of threaded adjustment by a yieldably releasable, detent mechanism **41**. Mechanism **41** comprises a series of circumferentially spaced, longitudinally extending recesses **42** formed on the outer periphery **15** of the mandrel section **7***c* immediately beneath the coupling zone **33**. Mechanism **41** additionally includes a resilient, split ring **43** self grippingly secured in an annular groove **44** formed on the lower end of the sleeve **32**, and having one of its two free ends yieldably engageable with the recess **42**. Thus, as shown in FIGURE 2*e*, this one free end **45** may extend generally radially from the ring groove **44** through a radial opening **46** in the sleeve **32** so as to extend from the groove **44** fully through the sleeve and into detenting engagement with a groove **42** of the sleeve section **7***c*. Thus, by rotating the sleeve **32** the yieldable detent finger **45** will be deflected from one groove **42** to another. With this arrangement the sleeve **32** may be secured at any of a series of incremental rotary positions determined by the sequential detenting engagement of the finger **44** with the recesses **42**. Sleeve **32** may include a radially extending screw driver recess **47** and socket wrench engaging teeth **48** and recesses **49** to facilitate engagement of the sleeve with tools for effecting its rotation.

Operation of movement impedance device

With the tool components disposed as shown in FIGURES 2*d* and 2*e*, an upward lifting force is exerted on the string **1**. Resistance to upward movement of the mandrel **7** is provided by the movement impedance device **20** which is fully immersed and axially movable through the fluid body which fills the fluid reservoir **11**. This movement impedance results from the relatively small flow capacity of the frustoconical passage **38** when the collar **22** is supported in its lower position on the abutment **31**.

The movement impedance effect of the small flow passage **38** continues until the collar **22** and shoulder **21** are moved fully into the enlarged chamber **39**. At this point, movement of fluid within the reservoir **11** downwardly past the movement impedance device **20**, so as to permit upward movement of the mandrel **7**, is greatly facilitated. This facilitation results from an annular bypass passage which then exists between the wall **40** and the collar wall **24** and which enables fluid to move downwardly around the outside of the collar **22** and effectively bypass the flow restricting passage **38**. Thus, when the collar **22** is moved into the chamber **39**, the flow impedance effect of the mechanism **20** is interrupted and the mandrel **7** may then undergo abrupt upward movement. This abrupt upward movement results from the interruption of the impedance effect of the mechanism **20**, in conjunction with the prior stretching or tensioning of the mandrel **7** which occurred while trying to lift the mandrel **7** against the full impeding resistance afforded by the mechanism **20**. As a result of this rapid upward movement of the mandrel **7**, the hammer face **19** is brought into abrupt engagement with the anvil face **18** and an upward jar or force is imparted to the stuck article **3**.

After this jarring force has been imparted, the upper portion of the string **1** is then relowered so as to move the mandrel **7** downwardly back into converged relation with the barrel **8**. During this downward movement, while the collar **22** is within the chamber **39**, fluid within the reservoir **11** may flow upward around the collar **22** both between the walls **39** and **24** and through the passage **38**. On this downward stroke of the mandrel **7** the collar **22** will be held upwardly against the abutment **26** because of fluid resistance to its downward movement so as to cause the effective enlargement of the passage **38**. As a consequence of the increase in size of the passage **38**, and the bypass channel around the outer periphery of the sleeve **22**, downward movement of the assembly **20** through the chamber **29** is vastly facilitated.

When the collar **22** has moved into slidable engagement with the cylinder **25** so as to substantially prevent bypassing flow around the outside of the collar **22**, fluid flow upwardly to assembly **20** still occurs at a relatively high flow rate. This high flow rate results from the enlarged size of the passage **38** which is a consequence of the collar **22** being in its uppermost position, i.e., engaged with the abutment **26**. With the elements returned to their initial position as illustrated in FIGURES 2*b* through 2*f*, the cycle may then be sequentially repeated so as to impart further jarring forces to the stuck article **3**.

Significantly, during the upward movement of the mandrel **7**, the flow passage **38** progressively enlarges in the direction of fluid flow as a consequence of the frustoconical and downwardly diverging character of this passage. With this constantly or progressively enlarging flow impeding passage, the likelihood of passage clogging is substantially diminished. The flow of fluid downwardly through the passage becomes progressively easier as the area available for flow progressively increases.

The enlargement in size of the passage **38**, resulting from axial movement of the sleeve **22** facilitates, effective, complete, and overall flushing of the passage **38** on downstrokes of the mandrel **7**.

Advantages and scope of the invention

A prime advantage of the invention resides in the consistently effective and virtually non-cloggable character of the flow impedance device. The progressively enlarging character of the flow impeding passage in the direction of fluid flow, when the impedance device is resisting mandrel movement, effectively minimizes the likelihood of clogging.

The manner in which the flow impeding passage changes considerably in size between up and down strokes of the mandrel causes the passage to be effectively flushed between each impedance stroke.

The adjusting device enables the time of the impedance stroke to be selectively adjusted without changing the length of the mandrel stroke. In other words, as the size of the passage **38** is decreased by adjusting the position of the collar **32** the time duration of the impedance up stroke is increased. This enables a tool to be adjusted to change the duration of an impedance stroke without creating the complication of adjusting the length of the mandrel stroke.

The tool is able to operate effectively with every major internal segment of the barrel having a different diameter. Thus, the diameter of the cylinder **25** is substantially smaller than the diameter of the enlarged chamber **39** and the diameter of the barrel **8** in the vicinity of the spline grooves **17** differs substantially from the diameter of either the passage **39** or the cylinder wall **25**.

It is especially noteworthy that the flow impedance mechanism **20** operates without the impediment of valve orifices, valve seats, plural valve arrangements, etc. Flow is controlled through the simple utilization of the frustoconical passage **38** which is continuously open and automatically changes in size, depending upon the direction of mandrel stroke. Valving at either lower or upper ends of the collar **22** is effectively avoided by reliance on the non-impeding flow passages **28** and **35**. As will be appreciated, passages **28** and **35** in no way regulate flow through the impedance device, since this flow regulation is achieved entirely through the variable, frustoconical flow passage **38**.

In maintaining the mandrel splines fully axially displaced from the mandrel hammer, there are no problems engendered with respect to transmitting hammer force to the mandrel splines which would result by attempting to integrate these components.

In describing the invention reference has been made to a preferred embodiment. However, those skilled in the well tool art and familiar with the disclosure of this invention may envision additions, deletions, substitutions, or other modifications which would fall within the purview of the invention as defined in the appended claims.

I claim:

1. In a well tool, a combination comprising:
a first component;
a second component having a longitudinal axis, said second component being movable relative to said first component along said longitudinal axis;
fluid reservoir means;
movement impedance means carried by said second component and movable through said reservoir means along said longitudinal axis of said second component;
first wall means carried by said movement impedance means;
second wall means carried by said movement impedance means and disposed adjacent said first wall means;
at least one of said wall means having at least a portion generally inclined relative to the longitudinal axis of said second component and operable, in combination with the other of said wall means, to define a generally converging restricted passage means adjacent said inclined portion and including
a first portion having a first cross-sectional area; and
a second portion displaced from said first portion along the path of flow of fluid through said restricted passage means and having a second cross-sectional area smaller than said first cross-sectional area; and
seal means carried by said second component and operable, in combination with said restricted passage means, to cause said restricted passage means to impede movement of said second component within said reservoir means along said longitudinal axis.

2. In a well tool, a combination comprising:
a first component;
a second component axially movable relative to said first component;
fluid reservoir means;
movement impedance means carried by said second component and movable through said reservoir means;
said movement impedance means having wall means defining restricted passage means and operable to cause fluid to flow therethrough from a portion of said reservoir means in advance of said second component, when said second component is in motion, to a portion trailing said moving second portion and thereby impede movement of said second component through said fluid reservoir means;
said wall means of said movement impedance means including a wall portion reciprocable along an axis in response to the pressure of fluid within said reservoir means, said movable wall portion extending generally transversely of said axis, and said transverse and movable wall portion being operable to effect a decrease in width of said restricted passage means in response to movement of said wall portion in one direction along said axis; and
spaced abutment means carried by said movement impedance means, said spaced abutment means being displaced along said axis of reciprocation of said transverse and movable wall portion and operable to define the extremities of reciprocating movement of said wall portion; and
one of said abutment means being disposed ahead of said transverse and movable wall portion in said one direction and adjustable in position along said axis of reciprocation of said transverse and movable wall portion.

3. In a well tool, a combination comprising:
a first component;
a second component axially movable relative to said first component;
fluid reservoir means; and
movement impedance means carried by said second component and comprising an assembly movable through said reservoir means;
said assembly having wall means defining a generally annular and frustoconical passage means operable to cause fluid to flow therethrough from a portion of said reservoir means in advance of said second component, when said second component is in motion, to a portion trailing said moving second portion and thereby impede movement of said second component through said fluid reservoir means;
said passage means progressively varying in cross-sectional area along the general direction of fluid flow therethrough.

4. In a well tool, a combination comprising:
a first component;
a second component axially movable relative to said first component;
fluid reservoir means; and
movement impedance means carried by said second component and comprising an assembly movable through said reservoir means;
said assembly having wall means defining a generally annular and frustoconical passage means converging in one direction and operable to cause fluid to flow therethrough from a portion of said reservoir means in advance of said second component, when said second component is in motion, to a portion trailing said moving second portion and thereby impede movement of said second component through said fluid reservoir means;
said passage means progressively varying in cross-sectional area along the general direction of fluid flow therethrough;

said wall means of said assembly means including an axially movable portion operable to effect an increase in width of said generally annular and frustoconical passage means in response to axial movement of said portion in the direction of convergence of said passage means.

5. A hydraulic jarring tool for use in a well, said tool comprising:

mandrel means;

barrel means telescopingly receiving said mandrel means;

frustoconical shoulder means carried on said mandrel means;

a collar having a frustoconical inner wall and a cylindrical outer wall, with the inner wall facing said frustoconical shoulder means, said inner wall of said collar having a configuration conforming with the outer periphery of said frustoconical shoulder means;

axially spaced, first and second abutment means carried by said mandrel means and disposed on opposite axial sides of said frustoconical shoulder means and supporting said collar for limited axial movement relative to said frustoconical shoulder means, with the inner wall of said collar being radially spaced from said shoulder means while in engagement with one of said abutment means;

cylinder means carried by said barrel means adapted to telescopingly and slidably receive the outer wall of said collar;

wall means defining a chamber axially adjacent said cylinder means, said wall means having at least a portion spaced from the outer wall of said collar when said collar is radially adjacent thereto and defining with said outer wall a flow passage extending fully axially of said collar;

fluid reservoir means including said cylinder means and said chamber with said shoulder means and collar being axially movable therewithin;

said inner wall of said axially movable collar cooperating with said frustoconical shoulder means to define a variable capacity flow passage of axially progressive, varying capacity; and

means providing fluid communication between each of the opposite axial ends of said variable capacity passage and said fluid reservoir means.

6. A hydraulic jarring tool for use in a well, said tool comprising:

mandrel means;

barrel means telescopingly receiving said mandrel means;

frustoconical shoulder means carried on said mandrel means;

a collar having a frustoconical inner wall and a cylindrical outer wall, with the inner wall facing said frustoconical shoulder means, said inner wall of said collar having a configuration conforming with the outer periphery of said frustoconical shoulder means;

axially spaced, first and second abutment means carried by said mandrel means and disposed on opposite axial sides of said frustoconical shoulder means and supporting said collar for limited axial movement relative to said frustoconical shoulder means, with the inner wall of said collar being radially spaced from said shoulder means while in engagement with one of said abutment means;

cylinder means carried by said barrel means adapted to telescopingly and slidably receive the outer wall of said collar;

wall means defining a chamber axially adjacent said cylinder means, said wall means having at least a portion spaced from the outer wall of said collar when said collar is radially adjacent thereto and defining with said outer wall a flow passage extending fully axially of said collar;

fluid reservoir means including said cylinder means and said chamber with said shoulder means and collar being axially movable therewithin;

said inner wall of said axially movable collar cooperating with said frustoconical shoulder means to define a variable capacity flow passage of axially progressive varying capacity; and

means providing fluid communication between each of the opposite axial ends of said variable capacity passage and said fluid reservoir means, and comprising, on each abutment means,

a plurality of radial passages extending axially inward from the end of each abutment facing said collar, and

an annular recess formed on said mandrel means between said shoulder means and said abutment means,

said radial passages providing fluid communication between said reservoir means and said annular recess,

said one abutment means being engageable with the end of said collar having the larger diametered portion of the inner wall thereof; and

said one abutment means comprising:

a sleeve threadably mounted on said mandrel means,

the outer periphery of said sleeve being receivable within said cylinder means but radially spaced therefrom when so received,

a plurality of recesses carried by and spaced circumferentially about said mandrel means, and

yieldable detent means carried by said sleeve and releasably engageable with said recesses.

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