# United States Patent [19]

**Anderson**

[11] **3,880,249**

[45] **Apr. 29, 1975**


[54] **JAR FOR WELL STRINGS**


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[21] Appl. No.: **450,368**

**Related U.S. Application Data**

[63] Continuation-in-part of Ser. No. 320,200, Jan. 2, 1973, abandoned.

[52] **U.S. Cl.** ..... **175/302**; 166/178

[51] **Int. Cl.** ..... **E21b 1/10**

[58] **Field of Search** ..... 175/293, 294, 296, 299, 175/300-304; 166/178



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*Primary Examiner*—David H. Brown
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[57] **ABSTRACT**

A jar for a well string includes an outer housing having means whereby the housing may be connected with one portion of a well string with a mandrel telescopically fitting in the housing and having means for connection with another part of the well string. Means connect the mandrel and housing together for relative longitudinal movement therebetween while inhibiting relative rotation therebetween.

First and second one-way acting coupling means are mounted in spaced relation in the housing and coupling engaging means are mounted on the mandrel so that the coupling enaging means on the mandrel is movable into engagement with either of said one-way acting coupling means upon longitudinal movement of the mandrel relative to the housing.

Shoulder means on the housing and mandrel are provided so that when the mandrel is moved longitudinally relative to said housing in one direction it engages the coupling engaging means thereon with one of the one-way acting coupling means. A predetermined force may then be exerted on the mandrel to move the coupling engaging means through the one-way acting coupling means, and when the coupling engaging means is thus disengaged from the one-way acting coupling means the shoulder means on the housing and mandrel strike to deliver a jar or impact to the well string. When the mandrel is moved in the opposite direction in the housing to engage the coupling engaging means thereon with a second one-way acting coupling means and a force exerted on the mandrel in a predetermined amount to move the coupling engaging means through the one-way coupling means, the shoulder means on the mandrel and housing again strike and deliver a jar or impact to the well string in the opposite direction.

The coupling engaging means, after engagement with either of said one-way acting coupling means, is disengageable from either of said one-way acting coupling means upon longitudinal movement of the mandrel relative to the housing in a direction opposite to that which engages the coupling engaging means with either of said one-way acting coupling means. The foregoing is accomplished without imparting a jar or impact to the well string and enable the mandrel and well string portion connected therewith to be moved freely longitudinally relative to the housing and well string portion connected therewith.


**33 Claims, 10 Drawing Figures**

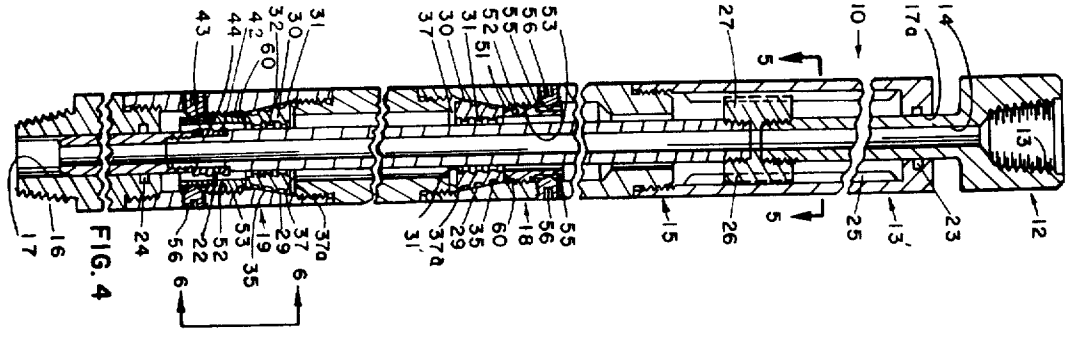



FIG. 4

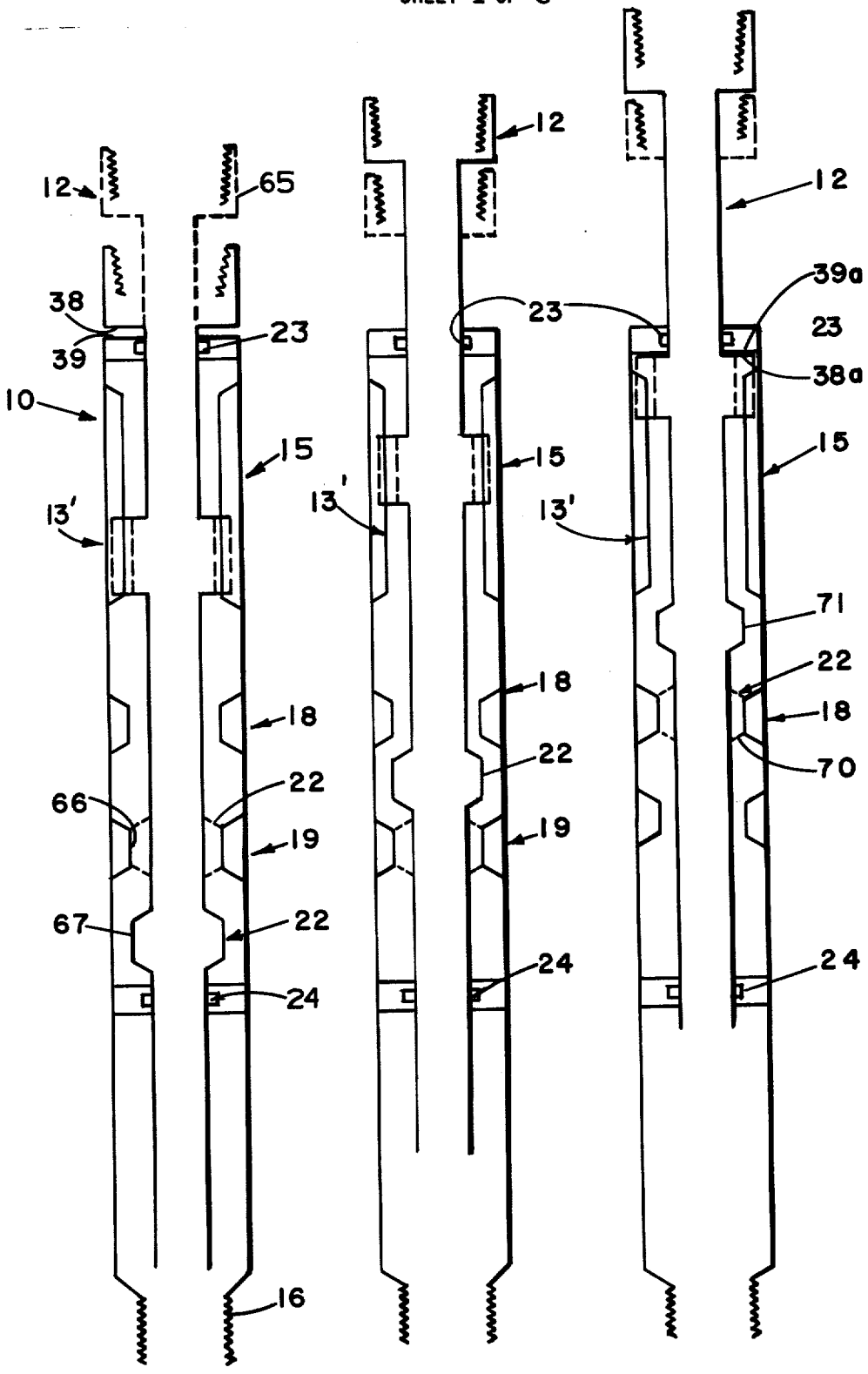



FIG. 1 FIG. 2 FIG. 3

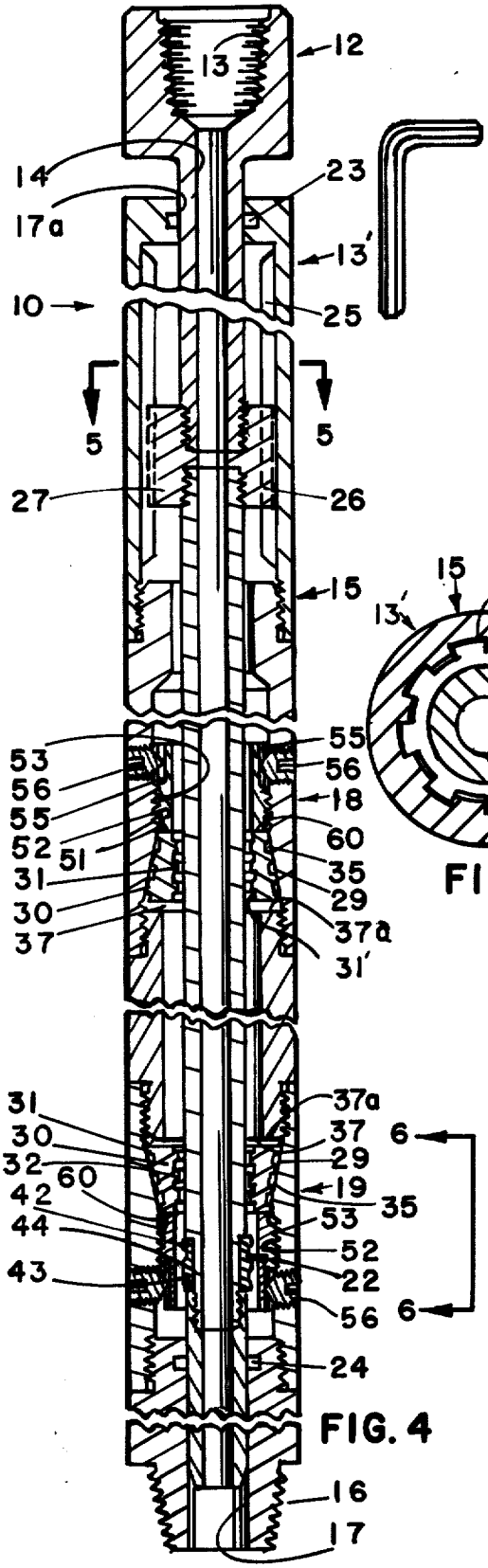



FIG. 4

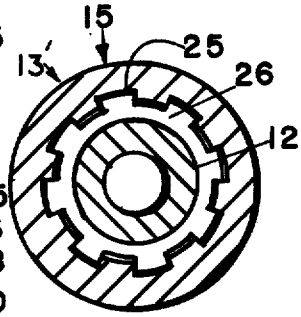



FIG. 5

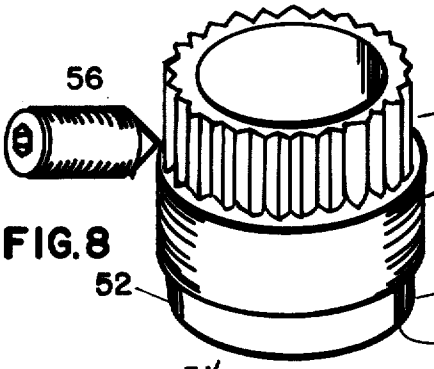



FIG. 8

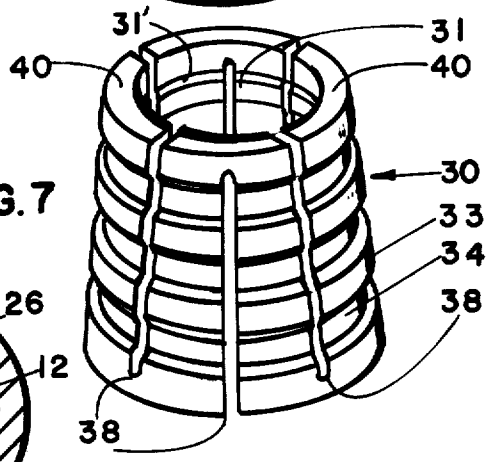



FIG. 7

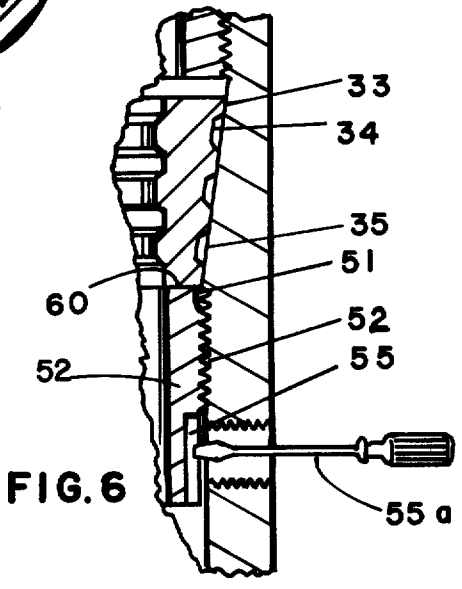



FIG. 6

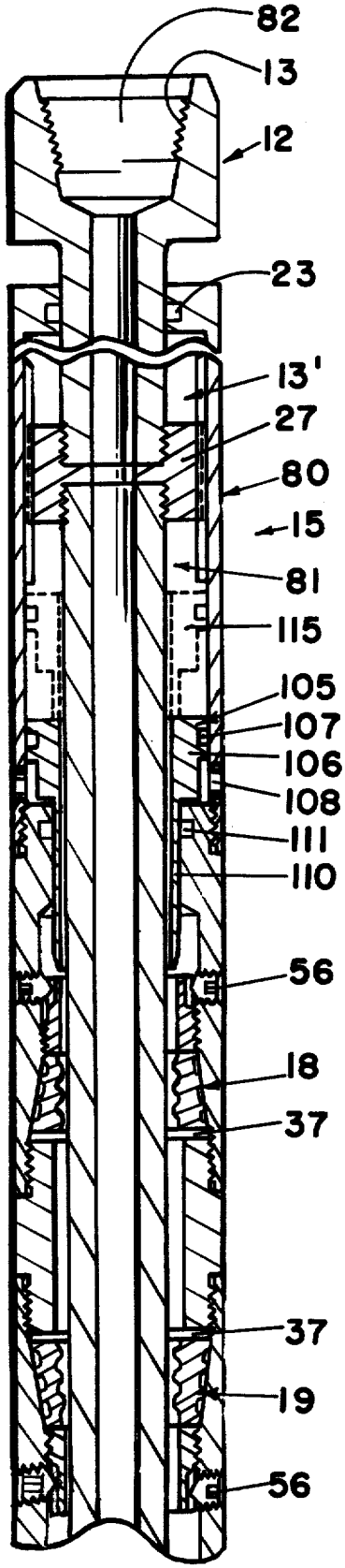

82
13
12
23
13'
27
80
15
81
115
105
107
106
108
111
110
56
18
37
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19
56

FIG. 9

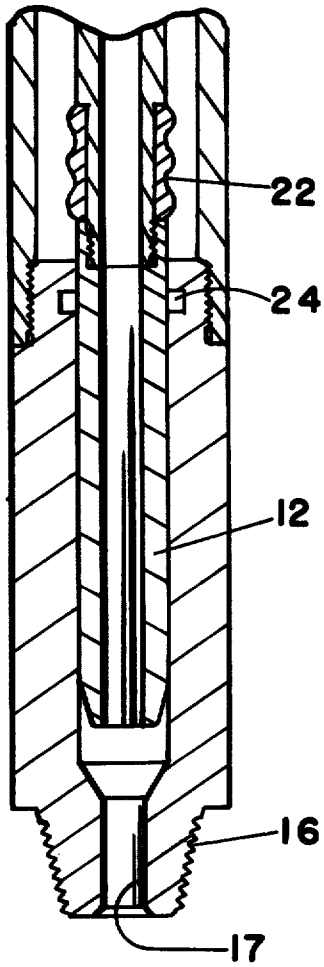

22
24
12
16
17

FIG. 10

# JAR FOR WELL STRINGS

## CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of my prior copending application Ser. No. 320,200 filed on Jan. 2, 1973, now abandoned, for "Jar For Well Strings."

## DISCUSSION OF THE PRIOR ART

The prior art with which applicant is familiar is as follows: U.S. pat. Nos. 2,013,127; 2,059,540; 2,891,772; 3,050,131; 3,208,541; 3,233,690; 3,685,598; and 3,685,599.

So far as known to applicant, there is no jar in the prior art which is adapted to be carried in the well string during drilling operations and which is constructed and arranged so that a jar or impact may be delivered to the well string in either an up or down direction as desired and which is also constructed and arranged so that part of the jar and well string may be freely movable longitudinally relative to another part of the jar and well string without delivering a jar or impact to the well string.

Also, so far as known to applicant, there is no jar in the prior art that is adapted to be carried in the well string during drilling operations and which includes a mandrel for connections to one part of the well string and a housing for connection to the other part of the well string with engageable means on the mandrel and housing whereby a jar or impact may be delivered in either an up or down direction to the well string, and which engageable means on the housing and mandrel, after engagement, may be disengaged without delivering a jar or impact to the well string.

## SUMMARY OF THE INVENTION

An object of the present invention is to provide a double acting jar for a well string during drilling operations wherein a jar or impact may be applied in either an up or down direction to the well string, and wherein the jar is constructed and arranged so that the arrangement which effects the jar may be engaged and then disengaged without necessarily effecting a jar to the well string to enable a part of the well string to be moved freely longitudinally relative to another part of the well string.

Yet a further object of the present invention is to provide a double acting jar to be carried in a well string during drilling operations for delivering either an upward or downward jar or impact to the well string, which jar is constructed and arranged to enable the drill string to be freely moved up or down a desired amount independent of the outer conditions which may exist in the well string.

Yet a further object of the present invention is to provide a jar to be carried in a well string during drilling operations for delivering either an upward or downward impact or jar to the well string and which is constructed and arranged so as to provide for free travel to enable the well string in which the tool is mounted to be moved up or down without a jarring action.

Still a further object of the present invention is to provide a jar to be carried in a well string during drilling operations for delivering either an upward or downward impact or jar to the well string and which jar is constructed and arranged to accommodate relative longitudinal movement between the portions of the drill string in which it is connected without necessarily



delivering a jar or impact to the well string and which jar has a large internal diameter to permit the passage of survey instruments and other wire line tools therethrough.

Still a further object of the present invention is to provide a jar to be carried in a well string during drilling operations for delivering either an upward or downward impact or jar to the well string and which jar is constructed and arranged to accommodate relative longitudinal movement between the portions of the drill string in which it is connected without necessarily delivering a jar or impact to the well string and which may be employed in deviated holes without affecting the direction of the hole.

Yet another object of the present invention is to provide a jar to be carried in a well string during drilling operations for delivering either an upward or downward impact or jar to the well string and which jar is constructed and arranged to accommodate relative longitudinal movement between the portions of the drill string in which it is connected without necessarily delivering a jar or impact to the well string and which may be employed in well strings in connection with directional drilling where downhole motors are employed without necessarily changing the course of the motor drill and the well bore being drilled.

Still another object of the present invention is to provide a jar to be carried in a well string during drilling operations for delivering either an upward or downward impact or jar to the well string and which jar is constructed and arranged to accommodate relative longitudinal movement between the portions of the drill string in which it is connected without necessarily delivering a jar or impact to the well string and which may be employed in well strings wherein the well bore is at least partially drilled by a jet deflection method of hole deviation.

Yet a further object of the invention is to provide a well string jar for delivering either an upward or downward impact to the well string and which can be adjusted to deliver a selective amount of impact in either an upward or downward direction to the well string.

Still another object of the invention is to provide a well string jar for delivering either an upward or downward impact to the well string and which can be adjusted to deliver a selective amount of impact in either an upward or downward direction to the well string and which impact amount in either direction is selectively independent of the impact amount in either an upward or downward direction.

Still a further object of the present invention is to provide a jar to be carried in a well string during drilling operations for delivering either an upward or downward impact or jar to the well string and which jar is constructed and arranged to accommodate relative longitudinal movement between the portions of the drill string in which it is connected without necessarily delivering a jar or impact to the well string and which jar is adjustable to deliver a different amount of impact in either an upward or downward direction and independently of the impact amount in either an upward or downward direction.

Yet another object of the present invention is to provide a jar to be carried in a well string during drilling operations for delivering either an upward or downward impact or jar to the well string and which jar is constructed and arranged to accommodate relative

longitudinal movement between the portions of the drill string in which it is connected without necessarily delivering a jar or impact to the well string and including a mandrel movable longitudinally relative to a housing with spaced seal means therebetween of substantially the same diameter to provide a substantially constant volume between the mandrel and housing upon movement of the mandrel relative to the housing.

Still a further object of the present invention is to provide a jar to be carried in a well string during drilling operations for delivering either an upward or downward impact or jar to the well string and which jar is constructed and arranged to accommodate relative longitudinal movement between the portions of the drill string in which it is connected without necessarily delivering a jar or impact to the well string and which enables the present invention to be employed in floating vessels or other structures subject to movement without necessarily actuating the tool of the present invention.

Another object of the present invention is to provide an arrangement in a jar of the class described herein including means to equalize the pressure existing externally and internally of the jar.

Another object of the present invention is to provide an arrangement in a jar of the class described herein including means to equalize the pressure existing externally and internally of the jar and wherein such means include a piston means sealably fitting within the jar and port means in the jar for conducting fluid from externally of the jar to act on the piston whereby the pressure internally and externally of the jar is equalized when the external pressure is larger than the internal pressure.

Other objects and advantages of the present invention will become apparent from a consideration of the following description and drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic illustration of a form of the present invention showing the mandrel in partial dotted line position at the upper end of the figure and the coupling engaging means on the mandrel, to illustrate the position of the mandrel when the coupling engaging means therein is engaged with one of the one-way acting coupling means on the housing and ready for delivering a downward impact to the well string when a predetermined force is exerted on the mandrel. The full line position of the figure diagrammatically illustrates the relative position of the mandrel and housing immediately prior to impact of the shoulder means on the housing and mandrel after the coupling engaging means has been moved downwardly through one of the one-way acting coupling means;

FIG. **2** schematically illustrates the relationship of the mandrel and housing when the mandrel is freely movable relative to the housing between the spaced one-way coupling means on the housing;

FIG. **3** is a schematic illustration showing in dotted line the position of the mandrel when it is engaged with another of the one-way acting coupling means, and shows in full line view the position of the mandrel relative to the housing after the coupling engaging means has been upwardly moved through the other one-way acting coupling means to enable the shoulders on the housing and mandrel to strike and deliver a jar or impact to the well string in an upward direction;

FIG. **4** is a longitudinal sectional view of a preferred embodiment of the present invention;

FIG. **5** is a vertical sectional view on the line **5—5** of FIG. **4**;

FIG. **6** is a partial horizontal view illustrating a form of the one-way acting coupling means carried by the housing and a means of adjustment thereof;

FIG. **7** is an elevational view of a form of a slip means which may be employed in the one-way acting coupling means;

FIG. **8** is an elevational view of a form of the adjustment means for the slip means and shows in exploded view the means of locking such adjustment means after the slip means have been adjusted;

FIG. **9** is a partial longitudinal sectional view of a modified form of the invention; and

FIG. **10** is a continuation of FIG. **9.**

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Attention is first directed to FIG. **4** of the drawings wherein the invention is referred to generally by the numeral **10.** The well tool of the present invention is adapted to be connected into a well string and carried therein during drilling operations and includes a mandrel referred to generally at **12** which is provided with means **13** for connection with the portion of the well string extending upwardly therefrom and to the earth's surface. The mandrel extends longitudinally within a housing referred to generally at **15,** and the housing **15** includes suitable threaded means **16** so that it may be connected into the portion of the well string extending downwardly therefrom in the well bore.

Means referred to generally at **13'** are provided for connecting the mandrel **12** and housing **15** together to accommodate relative longitudinal movement therebetween while inhibiting relative rotation therebetween.

First and second one-way acting coupling means are carried by the housing **15** and are referred to generally at **18** and **19.** It will be noted that the one-way acting coupling means **18** and **19** are mounted in longitudinal spaced relationship in the housing **15** as diagrammatically illustrated in FIGS. **1** through **3** and shown in greater detail in FIG. **4.**

Coupling engaging means referred to generally at **22** in FIGS. **1** through **4** are carried on the mandrel **12** for engagement and disengagement with the spaced one-way acting coupling means **18** and **19** as will be described in greater detail.

The mandrel **12** is provided with a bore **14** extending longitudinally therethrough for circulation of drilling fluids during drilling operations in a manner well known in the art. The lower end of the mandrel **12** is slidably received within the bore **17** at the lower end of the housing **15** and is sealed off by the seal means **24** to inhibit communication between the interior of the housing and the exterior thereof as the mandrel is moved longitudinally relative to the housing.

Similarly, the upper portion of the mandrel **12** extends through the bore designated **17*a*** at the upper end of the housing and the seal means **23** slidably engages the mandrel and inhibits communication between the interior of the housing and the exterior thereof as the mandrel is moved longitudinally relative to the housing **15.** Seal means **23** slidably engages the mandrel **12** in housing bore **17*a*** and is substantially the same diameter at seal means **24** and housing bore **17** which will pro-

vide a substantially constant interior volume as the mandrel **12** is moved longitudinally relative to the housing **15.**

If desired, a suitable liquid may be placed within the housing to lubricate the components of the tool and to further inhibit entry of contaminants from the exterior of the housing during drilling operation and during operation of the jar.

The connecting means designated generally at **13'** between the mandrel **12** and the housing **15** to accommodate relative longitudinal movement therebetween while inhibiting relative rotational movement therebetween includes a plurality of circumferentially spaced recesses **25**, better shown in FIG. **5**, extending longitudinally of the housing **15** on the interior surface thereof as shown in FIGS. **4** and **5**. A plurality of projections **26** formed on the enlargement **27** on the mandrel **12** are circumferentially spaced on such enlargement to fit within the recesses **25** as shown in FIGS. **4** and **5** of the drawings whereby the mandrel **12** may be moved longitudinally relative to the housing **15** while inhibiting relative rotational movement therebetween. It will be noted that the longitduinally extending recesses **25** in the housing **15** are of suitable extent to accommodate the desired longitudinal movement of the mandrel **12** relative to the housing **15** during operation of the tool as will be described.

The first and second one-way acting coupling means **18** and **19** may be of any suitable form to accomplish the desired functions of the tool, and as illustrated in FIG. **4** each includes an annular bowl **29**, one of which faces upwardly, and the uppermost of which is shown as facing downwardly. Slip means referred to generally at **30** are carried on the bowls **29** as illustrated in FIG. **4** of the drawings.

As shown more clearly in FIG. **7**, each annular slip means **30** includes a plurality of longitudinally spaced, radially extending ridges **31** and recesses **31'** which face inwardly for engagement with the coupling engaging means **22** on the mandrel **12.** Also, surface means are provided on the slip means **30** to provide predetermined yieldable passage of coupling engaging means **22.** Such surface means includes a plurality of circumferentially extending projections **33** with recesses **34** therebetween on the outer surface of each slip means **30** to provide an irregular surface which will tend to allow coupling engaging means **22** to be forcibly operated through slip means **30** to provide an adjustable detent with the longitudinal travel of mandrel **12.**

Additionally, each slip means **30** includes longitudinally extending, circumferentially spaced grooves **38** which define segments **40** on each slip means so that the slip means **30** may expand and contract radially during functioning of the jarring tool.

The coupling engaging means **22** may be of any suitable form and is shown as including an enlargement **42** carried by the mandrel **12** having a plurality of circumferentially extending recesses **43** and annular projections or ridges therebetween, which recesses and projections interfit and engage the circumferentially extending projections **31** and recesses **31'** on each slip means **30** when such coupling engaging means **22** is engaged with either of the one-way acting coupling means **18** or **19.**

For reference purposes, the one-way acting coupling means **18** may be designated the first one-way acting coupling means, and the one-way acting coupling means **19** may be designated as the second one-way acting coupling means.

The housing **15** is formed of a plurality of sections that are adapted to be connected together in any suitable manner with seal means therebetween (not shown) to inhibit communication between the interior and exterior of the housing.

The slip means **30** is of somewhat smaller longitudinal extent than the annular tapered surface **35** of each bowl means **29** to provide a void or space **37** for longitudinal movement of the slip means **30** relative to their respective bowl means **29** before engaging the shoulder or end **60** of the adjustment means **50** or the shoulder **37*a*** of the housing **15.**

The amount of force necessary to be exerted on the mandrel **12** and the amount of impact or jar thus delivered by the tool of the present invention is determined before it is lowered in the well bore. To accomplish this, the adjustment means referred to at **50** are provided for each of the slip means **30.** The adjustment means **50** determines the amount of grip exerted by each of the slip means **30** when engaged with the coupling engaging means **22,** and this determines the amount of force necessary to be exerted on the mandrel **12** to move the coupling engaging means **22** through either the first or second one-way acting coupling means to deliver either an upward or downward jar or impact to the well string.

The adjustment means **50** each include an annular member **51** having threads **52** thereon for engaging with the threads **53** in the housing. A plurality of longitudinally extending serrations **55** are provided adjacent one end of the annular member **51** and such serrations may be engaged by suitable means such as a screwdriver **55*a*** or the like extending through the housing for rotation of the annular member **51** either toward or away from its respective slip means **30.** After the desired amount of adjustment has been accomplished, suitable means such as the Allen screw **56** with the pointed end thereon may be engaged in the threaded opening in the housing and in turn engaged in the serrated portion **55** to lock the annular member **51** at the desired adjusted position.

The construction and arrangement of the adjusting means is well known in the prior art as is its function, and it is believed that a detailed description thereof is unnecessary.

The adjustment means **50** enables the annular slip means **30** to be positioned relative to the annular tapered surface **35** of its respective bowl means **29** and relative to the coupling engaging means on the mandrel **12** so that when the coupling engaging means **22** is engaged with either the first or second one-way acting coupling means **18** or **19,** the amount of force necessary to be applied to the mandrel **12** to move the coupling engaging means **22** through either the first one-way acting coupling means **18** or the second one-way acting coupling means **19** is predetermined.

By way of illustration, when it is desired to deliver a downward impact by the tool of the present invention to the well string in which it is connected, the tool components will be in the relative positions schematically shown in FIG. **1** of the drawing. In such position the mandrel **12** is illustrated in dotted line position at its upper end when the coupling engaging means **22** thereon is engaged with the second one-way acting coupling means **19.** The engagement of the coupling

engaging means **22** with the second one-way acting coupling means **19** is illustrated in dotted line at **66**.

The housing **15** is provided with shoulder means **39** and mandrel **12** is provided with shoulder means **38** that are adapted to strike when a downward force is exerted on the mandrel **12** to move the coupling engaging means **22** of the mandrel through the second one-way acting coupling means **19**.

When this occurs, the mandrel **12** moves to the full line position shown in FIG. **1** and the coupling engaging means **22** thereon moves through the second one-way acting coupling means **19** as illustrated at **67**. It can be appreciated that disengagement of the coupling means **22** with the second one-way acting coupling means **19** occurs quickly to enable the shoulders **38** and **39** to strike to deliver the downward impact to the portion of the well string connected to the housing **15**.

The construction and arrangement of the slip means **30** and bowl means **29** is such that when the mandrel **12** is moved from the position shown in FIG. **1** to the position illustrated in full line view in FIG. **2**, the coupling engaging means **22** on the mandrel **12** moves easily through the second one-way acting coupling means **19** without engaging or locking therewith. Since the first one-way acting coupling means **18** and second one-way acting coupling means **19** are spaced longitudinally relative to each other, it can be appreciated that the mandrel **12** may be moved freely relative to the housing **15** which enables the well string portion connected with the mandrel **12** to be moved relative to the well string portion connected with the housing **15**.

Also, the construction and arrangement of the slip means **30** and bowl means **29** as well as the relationship of the components of the present invention enable the mandrel **12** to be moved into engagement with either the first one-way acting coupling means **18** or the second one-way acting coupling means **19** and to then be disengaged therefrom by moving the mandrel in a direction opposite to that which engaged the coupling engaging means **22** in either the first or second one-way acting coupling means **18** or **19**. For example, the coupling engaging means **22** on the mandrel **12** will engage with the second one-way acting coupling means **19** when the mandrel **12** is moved downwardly; however, by reversing the direction of the mandrel and moving it upwardly, the coupling engaging means **22** disengages from the slip means **30** in the second one-way acting coupling means **19** without imparting a jar or impact to the well string.

Similarly, the coupling engaging means **22** may be moved upwardly to engage in the first one-way acting coupling means **18** and if it is desired to then disengage the coupling engaging means **22** from the first one-way acting coupling means **18** without imparting a blow to the well string, the mandrel may be moved in an opposite direction, that is downwardly, whereupon the coupling engaging means **22** disengages from the first one-way acting coupling means **18** without imparting a blow to the well string in which the tool is connected. Thus, the tool of the present invention enables the mandrel and well string connected therewith to be moved freely a predetermined amount relative to the housing and well string connected therewith without imparting a jar or blow up or down and/or the mandrel and well string connected therewith may be moved freely longitudinally a predetermined amount to deliver a predetermined jar or blow, selectively up or down without regard to other conditions existing in the well bore, as illustrated in FIG. **2**.

If the well string in which the present invention is stuck in a manner in which it is desired to impart an upward blow, to the well string, this may be accomplished as illustrated in FIG. **3** by engaging the coupling engaging means **22** on the mandrel **12** with the first one-way acting coupling means **18** and by then moving such coupling engaging means **22** through the one-way coupling means **18** to disengage therefrom, whereupon the shoulder means designated **38***a* on the mandrel **12** engages the shoulder means designated **39***a* on the housing **15** and imparts an upward jar or impact to the well string.

The free movement of the mandrel **12** relative to the housing **15** without imparting a jarring or blow to the well string may be quite useful in drilling operations where drill collars above or below the tool of the present invention are stuck, or are differentially stuck, or are trying to stick. Should the drill collars become stuck, either an upward or downward impact to the well string may be imparted after a predetermined force has been applied to the well string as previously described.

In those situations where the tool is employed in wells where the pressure in the well bore annulus may exceed the pressure internally of the jar by a substantial amount, it may be desirable to employ that form of the present invention illustrated in FIGS. **9** and **10**. The mandrel is again illustrated generally at **12** with thread means **13**, and the housing is referred to generally by the numeral **15**. Means referred to generally at **13'** connect the mandrel **12** and housing **15** together to accommodate relative longitudinal movement therebetween while inhibiting relative rotation therebetween. The components of the FIG. **9** and **10** modification are similar to the previously described with regard to FIGS. **1–8** and are given the same reference numerals in FIGS. **9** and **10** except as noted hereinafter.

As previously noted, the present invention may be employed in situations when the well bore pressure externally of the housing **15** such as represented by the numeral **80** is substantially greater than the pressure existing internally of the tool between the mandrel **12** and housing **15**, such pressure being represented generally by the numeral **81**. The pressure internally of the mandrel is represented by the numeral **82**.

In some situations the exterior annulus hydraulic pressure such as represented at **80** may be substantially greater, or exceed the pressure **81** between the mandrel **12** and housing **15** so that such pressure differential may alter the ability of the tool to perform other hydraulic or mechanical functions as desired.

In order to substantially equalize the pressure **80** externally of the jar with the pressure **81** internally of the jar between the mandrel **12** and housing **15**, an arrangement as illustrated generally by the numeral **105** is provided. Such arrangement includes the piston means **106** with annular seal means **107** thereon for sealably engaging within the outer housing **15**, such piston means **106** surrounding the mandrel **12** as shown.

Port means **108** are provided in the outer housing for conducting the pressure **80** externally of the housing to act on the piston means **106**.

The arrangement **105** includes the first portion represented by the piston **106** and an annular skirt means **110** extending from the first portion and surrounding

the mandrel, such skirt portion **110** being integrally formed with the piston **106.** Seal means as represented at **111** are provided between the skirt portion **110** and the outer housing **15,** and it will be noted that the port means **108** is positioned in the outer housing between the seal means **107** on the piston means **106** and the seal means **111** on the skirt portion **110.**

Thus, pressure externally of the tool represented by the numeral **80** is sealed off from communicating with the pressure internally of the tool, such pressure being represented by the numeral **81,** but such external pressure represented by the numeral **80** may be communicated through the port **108** to act on the piston means **106,** when such external pressure exceeds the internal pressure **81** to move the piston means and skirt to dotted line position represented at **115,** and thus equalize the pressure externally and internally of the tool.

The skirt portion **110** is of suitable extent so that even though it may move longitudinally between the mandrel **12** and body **15,** it will maintain sealing engagement with the outer housing.

From the foregoing, it can be seen that this arrangement enables the external pressure **80** to equalize with the internal pressure **81** between the mandrel **12** and housing **15** when such external pressure **80** exceeds the internal pressure **81.**

The present invention is very useful to be run in conjunction with any type of downhole motor used in directional drilling. Ordinarily, a motor should be oriented in a particular direction according to a drilling plan. The operation of the jar of the present invention does not cause it to torque or twist, which would change the desired course of the motor. Also, the position of the scribe line indicating the face of the tool (the direction that the downhole motor is facing) is always ascertainable when the present invention is employed.

Additionally, where a well bore is being drilled by jet reflection, that is, where the well is being jetted with a "big eye" bit for deflection run, the tool of the present invention may be slacked off so as to effect a positive downward spudding operation necessary in such method.

Also, the jar of the present invention will allow rotation of the drill pipe out of the hole which eliminates the possibility of causing the jar to trip prematurely to effect a jar in either an upward or downward direction, which occurs in some other types of jars, such as a torque jar.

Since the first and second one-way acting coupling means **18** and **19** each include adjustment means **50,** it can be appreciated that gripping action of each first and second one-way acting coupling means **18** and **19** may be independent of each other. By way of illustration, it may be more desirable to adjust first one-way acting coupling means **18** so that a tighter gripping action is effected with coupling engaging means **22** on mandrel **12** in an amount greater than the gripping action set in second one-way acting coupling means **19.** Thus, when the tool of the present invention is actuated to deliver an upward impact, the amount of such impact will be greater than that which is set in the second one-way acting coupling means **19.** In other words, the amount of upward impact, or the amount of downward impact to be delivered by the tool of the present invention may be selected independently of each other without affecting the operation of the tool.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape, and materials as well as in the details of the illustrated construction may be made without departing from the spirit of the invention.

What is claimed is:

**1.** A jar for a well string including:

a. an outer housing;

b. a mandrel extending longitudinally within said housing;

c. means connecting said mandrel and housing for relative longitudinal movement therebetween while inhibiting relative rotation therebetween;

d. first and second one-way acting coupling means mounted in spaced relation in said housing;

e. coupling engaging means on said mandrel, said coupling engaging means movable into engagement with either of said one-way acting coupling means upon longitudinal movement of said mandrel relative to said housing and disengageable from either of said one-way acting coupling means upon longitudinal movement of said mandrel relative to said housing in a direction opposite to that which engaged said coupling engaging means with either of said one-way acting coupling means on said housing;

f. shoulder means on said housing and mandrel;

g. said coupling engaging means and said first one-way acting coupling means cooperating when said mandrel is moved longitudinally relative to said housing in one direction to engage and thereafter releasable when a predetermined force is exerted on said mandrel in said one direction to effect disconnection of said coupling engaging means and first one-way acting coupling means to cause said shoulder means on said housing and mandrel to strike and deliver a jar to the well string in said one direction; and

h. said coupling engaging means and said second one-way acting coupling means cooperating when said mandrel is moved longitudinally relative to said housing in another direction to engage and thereafter releasable when a predetermined force is exerted on said mandrel in said other direction to effect disconnection of said coupling engaging means and second one-way acting coupling means to cause said shoulder means on said housing and mandrel to strike and deliver a jar to the well string in said other direction.

**2.** The invention of claim **1** wherein said connecting means between said mandrel and housing includes a plurality of longitudinally extending recesses on said housing and projections on said mandrel fitting in said recesses.

**3.** The invention of claim **1** including spaced seal means between said mandrel and housing to seal off the interior of said housing from the exterior without changing the volume between said seal means as said mandrel is moved longitudinally relative to said housing.

**4.** The invention of claim **3** wherein said connecting means between said mandrel and housing includes a plurality of longitudinally extending recesses on said housing and projections on said mandrel fitting in said recesses.

5. The invention of claim 1 including means on said mandrel and housing for connecting the jar in a well string.

6. The invention of claim 5 including spaced seal means between said mandrel and housing to seal off the interior of said housing from the exterior without changing the volume between said seal means as said mandrel is moved longitudinally relative to said housing.

7. The invention of claim 5 wherein said connecting means between said mandrel and housing includes a plurality of longitudinally extending recesses on said housing and projections on said mandrel fitting in said recesses.

8. The invention of claim 1 including means to equalize the pressure existing on the outside of said outer housing with the pressure in the jar between said outer housing and mandrel.

9. The invention of claim 8 wherein said means to equalize includes piston means sealably engaging said outer housing and surrounding said mandrel, said outer housing having port means therein for communicating pressure exteriorly of said housing to act on said piston means.

10. The invention of claim 9 wherein said piston means includes one portion surrounding said mandrel, said one portion having seal means thereon to sealably engage within said outer housing, and skirt means extending from said first portion and surrounding said mandrel, said skirt portion and outer housing having seal means therebetween and wherein the port means in said outer housing is between said seal means on said one portion and the seal means between said skirt portion and outer housing.

11. The invention of claim 1 wherein said first and second coupling means each include:

a. bowl means;

b. slip means carried by said bowl means; and

c. said slip means having surfaces thereon for engaging said coupling engaging means.

12. The invention of claim 11 including means on said mandrel and housing for connecting the jar in a well string.

13. The invention of claim 11 including spaced seal means between said mandrel and housing to seal off the interior of said housing from the exterior without changing the volume between said seal means as said mandrel is moved longitudinally relative to said housing.

14. The invention of claim 11 wherein said connecting means between said mandrel and housing includes a plurality of longitudinally extending recesses on said housing and projections on said mandrel fitting in said recesses.

15. The invention of claim 11 including adjustable means carried by said housing to set the force necessary to be exerted on said mandrel to effect a jar in either of said directions.

16. The invention for claim 15 including means on said mandrel and housing for connecting the jar in a well string.

17. The invention of claim 15 including spaced seal means between said mandrel and housing to seal off the interior of said housing from the exterior without changing the volume between said seal means as said mandrel is moved longitudinally relative to said housing.

18. The invention of claim 15 wherein said connecting means between said mandrel and housing includes a plurality of longitudinally extending recesses on said housing and projections on said mandrel fitting in said recesses.

19. The invention of claim 11 including adjustment means engaging said slip means whereby the grip of said slip means on said coupling engaging means may be varied.

20. The invention of claim 19 including means on said mandrel and housing for connecting the jar in a well string.

21. The invention of claim 19 including spaced seal means between said mandrel and housing to seal off the interior of said housing from the exterior without changing the volume between said seal means as said mandrel is moved longitudinally relative to said housing.

22. The invention of claim 19 wherein said connecting means between said mandrel and housing includes a plurality of longitudinally extending recesses on said housing and projections on said mandrel fitting in said recesses.

23. The invention of claim 11 including surface means on said slip means to enable said slip means to yield when said coupling engaging means moves therethrough.

24. The invention of claim 23 wherein said surface means includes a plurality of recesses on the surface of said slip means adjacent said bowl means.

25. The invention of claim 23 including adjustable means carried by said housing to set the force necessary to be exerted on said mandrel to effect a jar in either of said directions.

26. The invention of claim 23 including adjustment means engaging said slip means whereby the grip of said slip means on said coupling engaging means may be varied.

27. The invention of claim 23 including means on said mandrel and housing for connecting the jar in a well string.

28. The invention of claim 23 including spaced seal means between said mandrel and housing to seal off the interior of said housing from the exterior without changing the volume between said seal means as said mandrel is moved longitudinally relative to said housing.

29. The invention of claim 23 wherein said connecting means between said mandrel and housing includes a plurality of longitudinally extending recesses on said housing and projections on said mandrel fitting in said recesses.

30. A jar for a well string including:

a. a housing;

b. a mandrel movable longitudinally in said housing; and

c. means on said mandrel and spaced cooperating means on said housing engageable upon nonrotational movement of said mandrel relative to said housing for selectively moving said mandrel relative to said housing and for selectively delivering an upward or a downward impact to the well string.

31. The invention of claim 30 including adjustable means adjacent each of said spaced cooperating means to preset the amount of upward and downward impact independently of each other.

32. The invention of claim 30 wherein said spaced cooperating means on said housing is constructed and arranged to be selectively disengaged without delivering an upward or downward impact to the well string.

33. The invention of claim 30 wherein said spaced cooperating means on said housing is constructed and arranged to accommodate relative longitudinal movement between said mandrel and housing without imparting either an upward or downward impact to the well string.

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