United States Patent

Chapman

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[54] **END-OF-TUBING LOCATOR**

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[22] Filed: **Sept. 11, 1970**

[21] Appl. No.: **71,558**

[52] **U.S. Cl.** **166/64,** 166/113, 166/255

[51] **Int. Cl.** **E21b 47/00**

[58] **Field of Search**.....166/250, 255, 64, 113

[56] **References Cited**

UNITED STATES PATENTS

2,224,412	12/1940	Smith	166/255
2,359,067	9/1944	Warren	166/255
2,746,550	5/1956	Mitchelll, Jr.	166/255
2,960,165	11/1960	Schramm	166/255
2,999,542	9/1961	Myers	166/255
3,061,010	10/1962	Conrad et al.	166/64
3,112,794	12/1963	Chenoweth	166/64
3,143,170	8/1964	Nelson	166/255
3,177,941	4/1965	Conrad	166/113

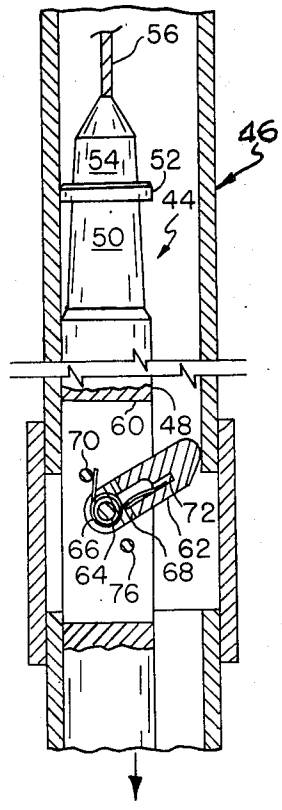
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[57] **ABSTRACT**

An end-of-tubing locator is disclosed for locating the end of a tubing string depending in a well. Although conventional end-of-tubing locators hang up in tubing joint recesses when the locator is withdrawn through the tubing string without performing its normal sequence of operations, the disclosed locator has the ability to disengage from such recesses for further upward movement.

10 Claims, 12 Drawing Figures



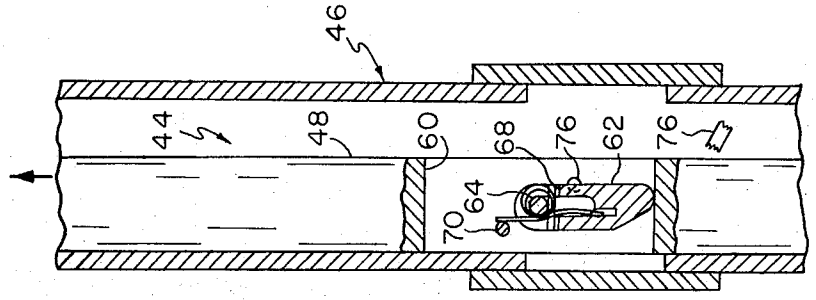


FIGURE 4

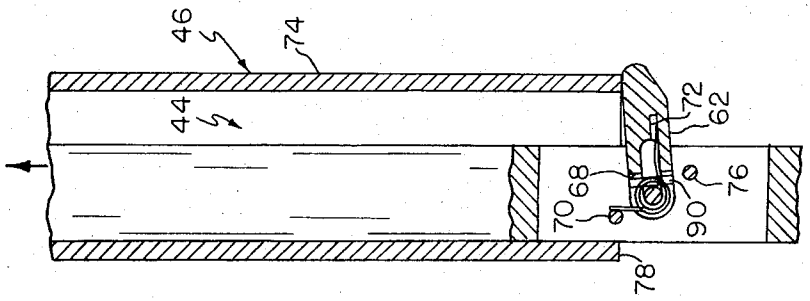


FIGURE 3

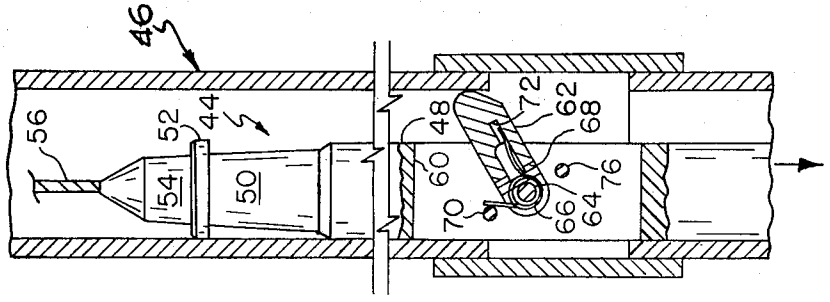


FIGURE 2

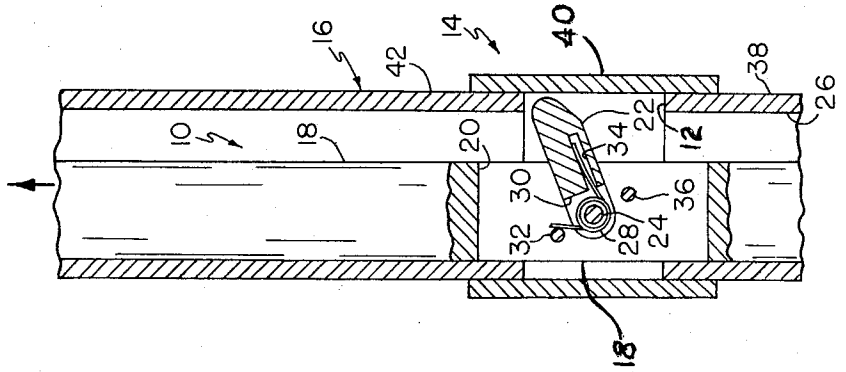


FIGURE 1
(PRIOR ART)

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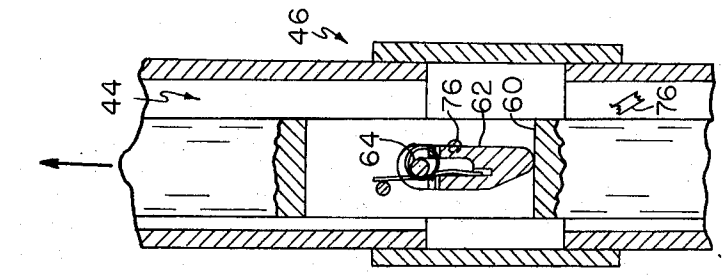


FIGURE 8

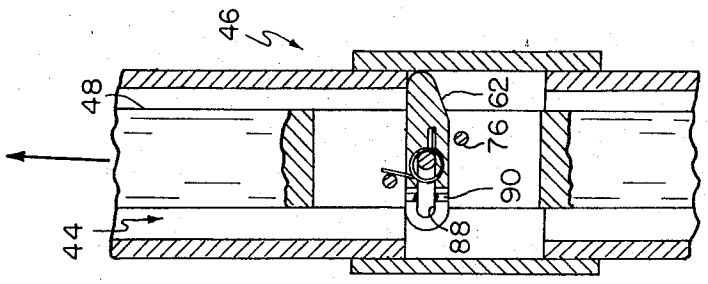


FIGURE 7

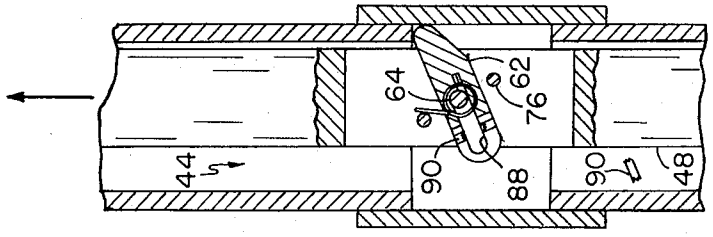


FIGURE 6

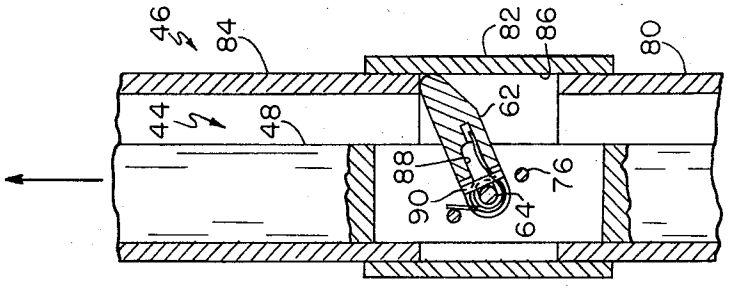


FIGURE 5

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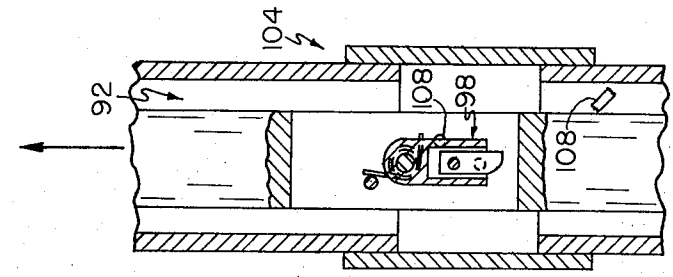


FIGURE 12

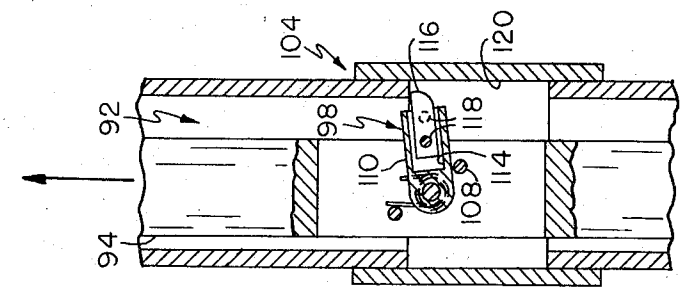


FIGURE 11

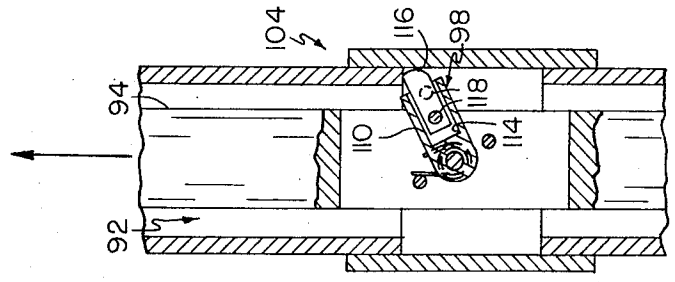


FIGURE 10

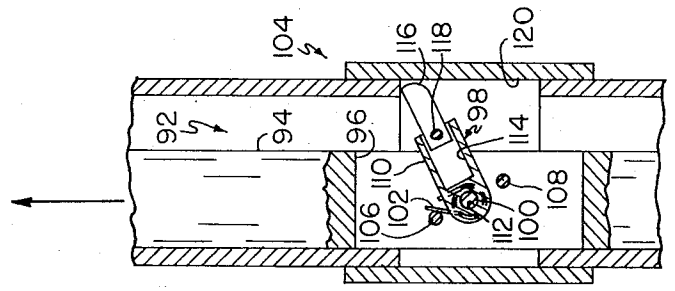


FIGURE 9

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END-OF-TUBING LOCATOR

BACKGROUND OF THE INVENTION

End-of-tubing locators are well known in the prior art for engaging a shoulder adjacent the bottom of the tubing string and are generally designed to engage the underside of the last tubing joint. An end-of-tubing locator widely used in the oil and gas industry is commercially available from Otis Engineering Corporation. The Otis locator comprises an elongate body lowerable by a wireline through a tubing string and includes a latch arm pivoted thereon in an upwardly inclined attitude for downward transport through the tubing string. A spring is provided to bias the latch arm to an extended position generally perpendicular to the elongate body. The latch arm consequently engages the inside wall of the tubing string during downward transport therethrough. As the locator emerges from the bottom of the tubing string, the latch arm is moved to the extended position. An upward pull on the wireline places the latch arm in engagement with the bottom of the tubing string. A shear pin is positioned to retain the latch arm in the extended position until the force on the wireline is sufficient to break the shear pin. Since upward pulling on the wireline slowly increases the tension therein until the shear pin breaks, the lower tubing end can be readily sensed.

The Otis locator operates in a satisfactory manner so long as the locator can be passed through the open end of the tubing string and proceed through its normal sequence of operations. It occasionally happens, however, that the locator is unable to pass completely through the tubing string and must be drawn upwardly therethrough while the latch is in the upwardly inclined position. Since the latch is biased into engagement with the inner tubing wall, it will be apparent that any recess in the tubing string tends to cause the tool to lodge therein. Although there are some types of tubing used in the oil and gas industry which are internally flush, most types of conventional tubing include a recess at the joint thereof in which the latch may become wedged.

The process of retrieving a stuck end-of-tubing locator is expensive and time consuming. Conventional wireline tools include a pullout socket which is designed to fail below the tensile strength of the wireline and conventional jars for imparting an impact force on the tool upon pulling on the wireline. After considerable pulling and jarring, the latch pivot pin is broken allowing the latch to retract and freeing the locator.

To overcome this problem of sticking a locator in the joint recess of a tubing string, a number of solutions have been proposed by the prior art to hold the latch elements out of engagement with the tubing string until the locator has emerged from the bottom thereof. Typical disclosures of this type are found in U.S. Pat. Nos. 2,960,165 and 3,143,170. Unfortunately, these proposals require a plurality of small comparatively intricate and relatively fragile parts, some of which are apt to malfunction. Presumably for these reasons, the presently commercially available end-of-tubing locator is not provided with means to prevent lodging thereof in a joint recess.

SUMMARY OF THE INVENTION

It is an object of this invention to provide an end-of-tubing locator which may be withdrawn upwardly through the tubing while the latch means is in engagement therewith without sticking the tool in a joint recess.

Another object of the invention is to provide a relatively simple and expeditious means for releasing an end-of-tubing locator which has become temporarily lodged in a joint recess.

A further object of this invention is to provide an end-of-tubing locator which functions, in its normal mode of operation, in a manner familiar to those skilled in the art but which has another mode of operation when the latch is temporarily lodged in a joint recess.

In summary, this invention comprises an end-of-tubing locator comprising a body having latch means thereon constrained in a path of movement sequentially including an upwardly inclined position for engaging the tubing during transport downwardly therethrough, an extended position for engaging a shoulder adjacent the end of the tubing string and a retracted position for transport upwardly through the tubing; means biasing the latch means from the upwardly inclined position toward the extended position; means for restraining the latch means in the extended position from movement toward the retracted position until the imposition of a predetermined upward force on the locator; and means for releasing the latch means for movement from the upwardly inclined position to a collapsed position for movement upwardly through the tubing upon the imposition of an upward force on the locator.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal cross sectional view of a tubing string illustrating a conventional end-of-tubing locator lodged therein;

FIG. 2 is a longitudinal cross section of a tubing string illustrating an end-of-tubing locator of this invention passing downwardly therethrough;

FIG. 3 is a longitudinal cross sectional view of the tubing end illustrating the locator of this invention in engagement therewith;

FIG. 4 is a longitudinal cross sectional view of a tubing string illustrating the locator of this invention passing upwardly therethrough after performing its normal sequence of operations;

FIG. 5 is a longitudinal cross sectional view of a tubing string illustrating a locator of this invention temporarily lodged in a joint recess during upward movement therethrough;

FIGS. 6–8 illustrate a sequence of operation of the locator of this invention following the lodging thereof in a tubing joint recess; and

FIGS. 9–12 illustrate a sequence of operations of another embodiment of this invention following the lodging thereof in a tubing joint recess.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Attention is directed to FIG. 1 wherein there is shown a tool in the form of an end-of-tubing locator 10 of a type presently commercially available lodged in a

recess 12 in a joint 14 of a tubing string 16. FIG. 1 illustrates the situation when the locator 10 cannot be passed through the bottom of the tubing string 16 and must be withdrawn upwardly therethrough without performing its normal sequence of operations. The end-of-tubing locator 10 comprises an elongate body 18 having a slot 20 therein in which a lug or latch 22 is mounted by a pivot pin 24. The pivot pin 24 mounts the latch 22 for movement in a path including an upwardly inclined position engaging the inner wall 26 of the tubing string 16 as the tool 10 passes downwardly therethrough. A helical spring 28 extends about the pivot pin 24 in a slot 30 in the latch 22. A stop 32 affords an abutment for one end of the spring 28 and a slot 34 in the latch 22 affords an abutment for the other end of the spring 28.

A shear pin 36 is positioned adjacent the latch 22 in the path of movement thereof to restrain the latch 22 in an extended position. When the locator 10 passes through the bottom of the tubing string 16, the spring 28 biases the lug 22 against the shear pin 36. An upward pull on the body 18 causes the latch 22 to abut the end of the tubing string 16. As the upward force applied to the body 18 is increased to a predetermined amount, the shear pin 36 fails thereby allowing the latch 22 to rotate in the clockwise direction to assume a depending position in the slot 20 for upward transport through the tubing string 16. The failure of the shear pin 36 is detectable at the surface by viewing the wireline force indicator. The location of the end of the tubing string 16 is thereby determined.

The tubing string 16 is illustrated as non-upset tubing comprising a lower joint 38 having a conventional collar 40 threadably attached thereto in which the male end of an upper joint 42 is threadably secured. The recess 12 formed by conventional non-upset tubing is sufficient to lodge the latch 22 therein. Other types of conventional tubing, particularly externally upset tubing known in the industry as E.U.E. 8RD, also include recesses sufficient to lodge a conventional locator therein.

The conventional locator 10 operates satisfactorily so long as it proceeds through its normal mode of operation. The difficulty arises when the locator 10 cannot pass through the end of the tubing string 16 to allow the latch 22 to rotate from the upwardly inclined position shown in FIG. 1 to the extended position abutting the shear pin 36. This situation occurs when the tubing string 16 is partially or wholly obstructed as by the accumulation of debris therein. When the locator 10 cannot be passed through the end of the tubing string 16, it must be withdrawn upwardly therethrough while the latch 22 is in the upwardly inclined position. In this circumstance, the latch 22 is apt to become lodged in the recess 12 of the tubing joint 14.

It will be apparent from FIG. 1 that a mere upward pull on the body 18 does not free the locator 10 from movement since the overall width of the locator from the free end of the latch 22 to the opposite side of the body 18 is greater than the internal dimension of the tubing string 16 from one side of the recess 12 to the opposite side of the inner wall 26. When a conventional tubing locator becomes stuck in the tubing string 16, one of two procedures are typically followed. If wireline jars have been run in the tubing string 16 with the locator 10, the jars are used to provide impact forces to the elongate body 18 in an effort to break the pivot pin 24. If wireline jars have not been run or if the wireline pulls loose from the socket thereof (not shown) an overshot is run into the tubing string 16 with suitable jars and a small tubing string to grasp the top of the body 18 and provide impact forces thereto.

The time and expense necessary to break the pivot pin 24 varies, but it is not uncommon to spend several days jarring on the body 18 in order to finally break the pivot pin 24. It is accordingly apparent that improved means are desirable to expeditiously remove the locator 10 from the tubing string 16 when the latch 22 does not undergo its normal sequence of operations. Although there have been proposals to captivate the latch during transport through the tubing string, as shown in U.S. Pat. Nos. 2,960,165 and 3,143,170, these solutions have not come into widespread use.

Referring now to FIGS. 2–4, an end-of-tubing locator 44 of this invention is illustrated undergoing its normal sequence of operations in a tubing string 46 which is illustrated as conventional non-upset tubing but which may comprise any convenient type. The locator 44 is illustrated as comprising an elongate body 48 which may conveniently be substantially identical to the corresponding part of presently commercially available locators. The body 48 includes a necked down upper segment 50, a flange 52 to be received in conventional overshots, and a wireline socket 54 in which is secured a conventional wireline 56. The body 48 preferable comprises a rounded lower end and a slot 60 for receiving a latch or lug 62.

The latch 62 is mounted by a pivot pin 64 for movement in a path sequentially including an upwardly inclined position (FIG. 2) for engaging the tubing string 46 during downward transport therethrough, an extended position (FIG. 3) for engaging a shoulder adjacent the end of the tubing string 46 and a retracted position (FIG. 4) for upward transport through the tubing string 46. A spring 66 of any convenient type is provided in a slot 68 in the latch 62 to bias the same from the upwardly inclined position of FIG. 2 toward the extended position of FIG. 3. A spring stop 70 affords an abutment for one end of the spring 66 while a slot 72 affords a similar abutment for the other end thereof.

As the locator 44 passes under a terminal joint 74 of the tubing string 46, the spring biases the latch 62 toward a shear pin 76. An upward pull on the wireline 56 elevates the locator 44 and places the latch 62 in abutting relation with a shoulder 78 adjacent the end of the terminal joint 74 and preferable constitutes the underside thereof. Imparting an upward predetermined force to the wireline 56 causes the latch 62 to engage and shear the pin 76 and allow the latch 62 to assume the depending position of FIG. 4 for upward transport through the tubing string 46. The end of the tubing string 46 is readily sensed at the surface by viewing a tension indicator (not shown) operatively connected to the wireline 56. The normal sequence of operation of the locator 44 of this invention is substantially identical to the normal operation of locators presently commercially available.

Referring now to FIGS. 5–8, the locator is illustrated in its other mode of operation when the locator 44 has not emerged from the bottom of the tubing string and

proceeded through its normal mode of operation. This normally occurs when the tubing string is obstructed, as by the accumulation of debris. It will be apparent that the latch **62** is apt to become lodged in the tubing joint recess when the locator **44** is withdrawn upwardly through the tubing string.

In FIGS. **5–8**, the tubing string **46** is illustrated as comprising a lower joint **80** to which is attached a collar **82** threadably receiving an upper joint **84** and providing a recess **86** in the tubing joint. A comparison of FIGS. **1** and **5** reveals that the mounting means for the latch **62** has been modified to position the pivot pin **64** in an elongate slot **88** extending along the axis of the latch **62** with a low order shear pin **90** constraining the pivot pin **64** in the slot **88** adjacent one end thereof.

As the free end of the latch **62** engages the recess **86**, the shear pin **90** initially constrains the pivot pin **64** in one end of the slot **88**. As the upward force imparted by the wireline **56** to the body **48** increases to a predetermined value, the shear pin **90** fails allowing the latch **62** to move relative to the pivot pin **64** into an intermediate position shown in FIG. **6**. During this relative movement, the body **48** is moved slightly upwardly and continues movement until the latch **62** is rotated into engagement with the main shear pin **76** as suggested by FIG. **7**. Further upward pull on the wireline **56** causes the lug **62** to break the shear pin **76** thereby allowing the latch **62** to assume a depending position in the slot **60** for upward transport through the tubing string **46** as shown in FIG. **8**.

A comparison of the operation of the conventional locator **10** and the locator **44** during recovery from a tubing joint recess reveals that the recovery operation is basically the same in the sense that the pivotal connection between the latch and the body is broken allowing movement of the latch toward the body. The basic difference lies in the amount of force that must be imparted to the locator body to break the pivotal connection. In the conventional locator **10**, the pivot pin **24** is substantially stronger than the shear pin **36** since, in the normal mode of operation, it is the shear pin **36** that must be broken. In the locator **44** with the latch **62** in the upwardly inclined position, the pivotal connection between the latch **62** and the body **48** is broken at a substantially lesser force than is required to break the pivotal connection with the latch **62** in the extended position of FIG. **3**.

This occurs since the shear pin **90** is resisting forces applied to the body **48** with the latch **62** upwardly inclined while, with the latch **62** in the extended position of FIG. **3**, the shear pin **90** does not resist the upward force applied to the body **48**. It will accordingly be seen that the shear pin **90** and slot **88** releases the latch **62** in the upwardly inclined position during upward movement through the tubing string **46** for movement of the latch **62** toward the body **48** upon imposition of an upward force on the body **48** that is substantially lower than the force necessary to break the pivot pin **64**.

Referring now to FIGS. **9–12**, there is shown another end-of-tubing locator **92** comprising another embodiment of this invention. The locator **92** comprises an elongate body **94** having a slot **96** therein in which a latch **98** is pivotally mounted by a pin **100**. A suitable spring **102** biases the latch **98** from an upwardly inclined position for engaging the tubing string **104** during downward transport therethrough to an extended position for engaging a shoulder adjacent the lower end of the tubing string **104**. The locator **92** also comprises a spring stop **106** affording an abutment for one end of the spring **102** while the other end of the spring **102** is disposed over the top of the latch **98**. A main shear pin **108** is positioned in the slot **96** to restrain the latch **98** in the extended position from movement toward a depending position until a predetermined upward force is imparted to the body **94**. It will be apparent that the normal sequence of operations of the locator **92** is substantially the same as that of the locators **10, 44**.

The latch means **98** comprises a first latch element **110** having an aperture **112** therein receiving the pivot pin **110** in a conventional pivot arrangement. The latch element **110** further comprises a blind opening **114** extending along the long axis thereof telescopingly receiving a second latch element **116**. A low order shear pin **118** connects the latch elements **110, 116** during normal operation. As the latch **98** is temporarily lodged in a recess **120** in the tubing string **104** and a predetermined upward force is applied to the body **94**, the shear pin **118** fails thereby allowing relative movement of the latch element **116** into the blind opening **114** as shown in FIG. **10**. Further upward movement of the body **94** rotates the latch **98** to position the latch element **110** against the main shear pin **108** as shown in FIG. **11**.

Applying a predetermined upward force on the body **94** shears the pin **108** and allows the latch **98** to assume the downwardly inclined position of FIG. **12** for upward transport of the locator **92** through the tubing string **104**. As shown, the locator **92** functions similarly to the locator **44**. Depending, however, on the overall length of the latch **98** when the elements **110, 116** are telescoped, the overall dimension of the body **94** and latch **98** may be sufficiently small to allow upward transport through the tubing string **104** without shearing the main shear pin **108**. It will be seen that the shear pin **118** releases the latch element **116** in the upwardly inclined position during upward movement through the tubing string for movement toward the body **94** upon the imposition of a predetermined upward force on the body **94** which is substantially less than that required to break the pivot pin **100** when the latch **98** is in the extended position.

It will be seen that there is provided an improved end-of-tubing locator which may be expeditiously withdrawn upwardly through the tubing without having to undergo its normal sequence of operation and accordingly is readily removable from a tubing string under many conditions experienced in practice.

I claim as my invention:

1. In a tool lowerable through a tubing string for locating the end thereof of the type comprising a body having latch means thereon; means mounting the latch means in a path of movement including an upwardly inclined position for engaging the tubing string during downward transport therethrough, an extended position for engaging a shoulder adjacent the end of the tubing string and a retracted position for upward transport through the tubing string, the mounting means including means for restraining the latch means in the ex-

tended position to the body until imposition of a first upward predetermined force thereon; and means biasing the latch means from the upwardly inclined position toward the extended position; the improvement wherein the mounting means comprises

means holding the latch means in the upwardly inclined position during upward movement through the tubing string and releasing it for movement toward the body upon imposition of a second lesser upward predetermined force thereon.

2. The tool of claim 1 wherein the third predetermined force is less than the second force.

3. The tool of claim 1 wherein the latch means comprises a latch and the constraining means comprises means pivotally mounting the latch on the body from the upwardly inclined position through a generally horizontal attitude in the extended position to a depending attitude in the retracted position.

4. The tool of claim 3 wherein the releasing means comprises means for breaking the pivotal mounting means and enabling movement of the latch means through the pivot axis to a position abutting the restraining means.

5. The tool of claim 4 wherein the restraining means comprises a shear pin positioned in the path of movement of the latch adjacent the extended position.

6. The tool of claim 4 wherein the latch comprises a slot therein, the pivotal mounting means comprises a pin in the slot and the releasing means comprises shear means constraining the pivot pin in the slot.

7. The tool of claim 3 wherein

the latch comprises telescoping parts; and

the releasing means comprises shear means connecting the telescoping parts together.

8. An end-of-tubing locator comprising an elongate body; a latch having an enlarged opening therein; a pin in the opening mounting the latch to the body for movement about an axis transverse thereto for movement between an upwardly inclined position and a depending position; means releasably holding the pin in a predetermined position in the opening until application of a predetermined force on the latch when in the upwardly inclined position and ineffective to release the pin when the latch is disposed in an extended position transverse to the body; means biasing the latch toward the extended position; and means engaging and restraining the latch at the extended position from movement toward the depending position until the imposition of a predetermined upward force on the body.

9. The locator of claim 8 wherein the enlarged opening is an axial slot and the predetermined position is the lower slot and when the latch is upwardly inclined.

10. The locator of claim 8 wherein the released pin is arranged to mount the latch for movement in a path including a position abutting the restraining means and the depending position.

* * * * *