Aug. 1, 1961 C. C. BROWN 2,994,381

LINER SETTING ASSEMBLY

Filed Oct. 24, 1958 3 Sheets-Sheet 1

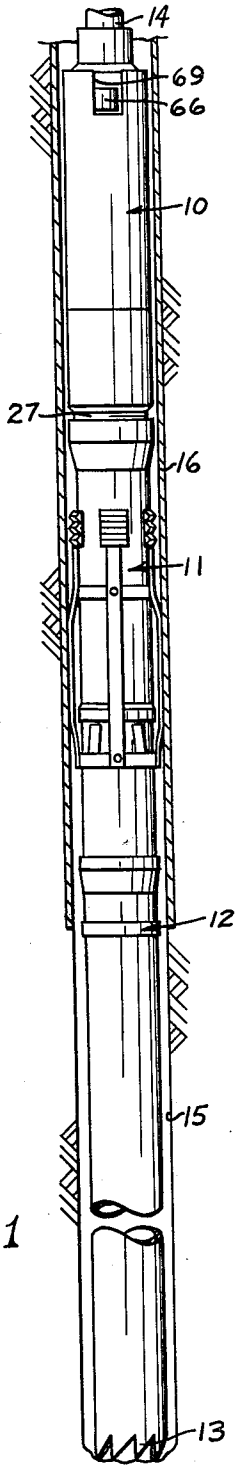

Fig. 1

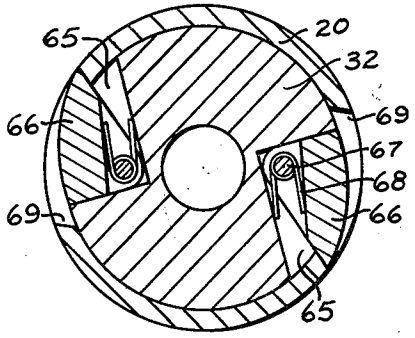

Fig. 7

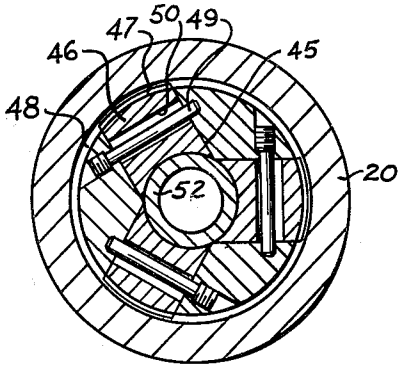

Fig. 8

CICERO C. BROWN
INVENTOR.

BY

ATTORNEY

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LINER SETTING ASSEMBLY

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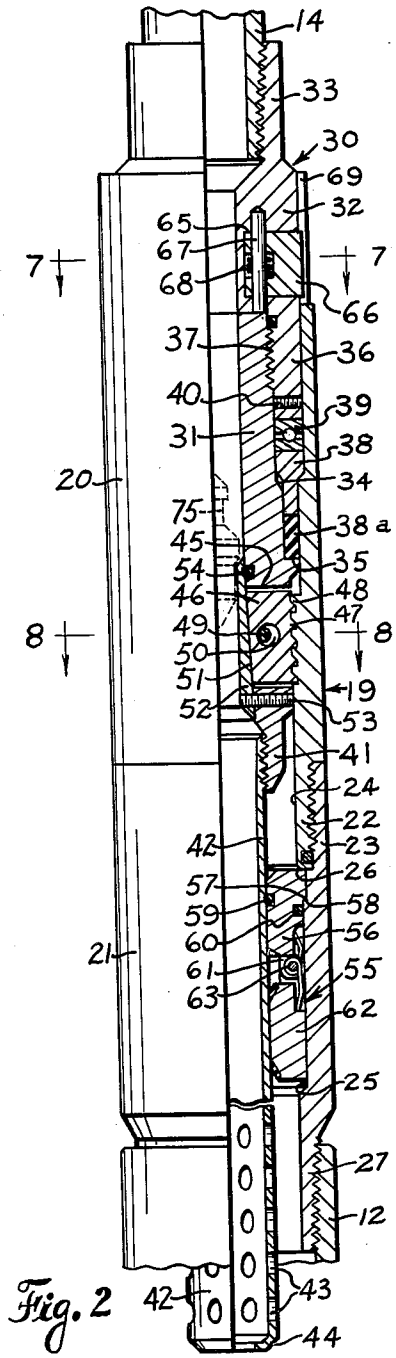

Fig. 2

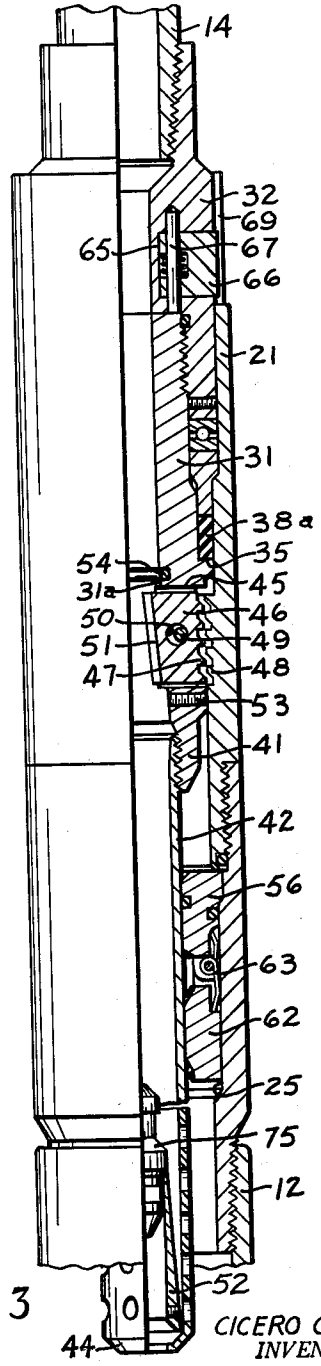

Fig. 3

CICERO C. BROWN
INVENTOR.

BY

ATTORNEY

Aug. 1, 1961 C. C. BROWN 2,994,381

LINER SETTING ASSEMBLY

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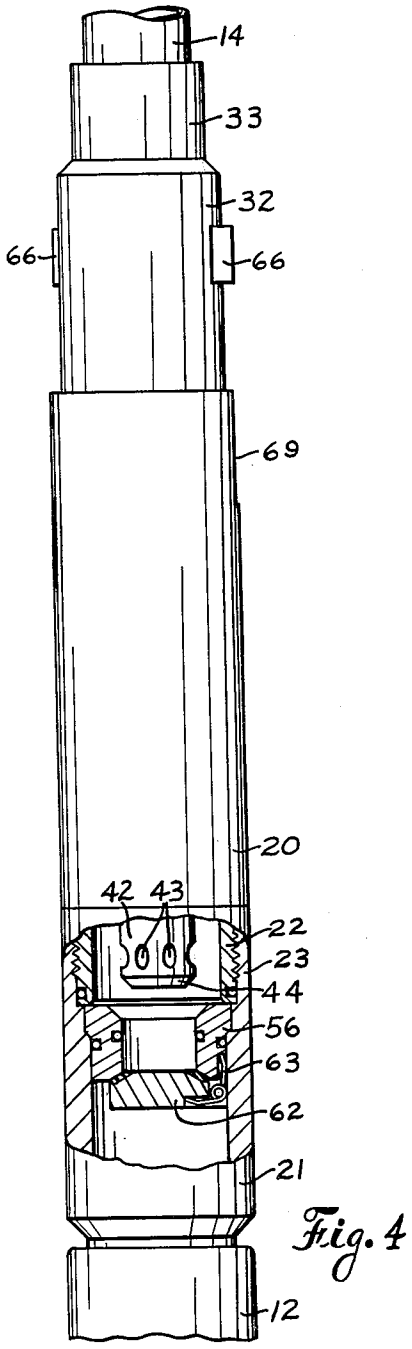

Fig. 4

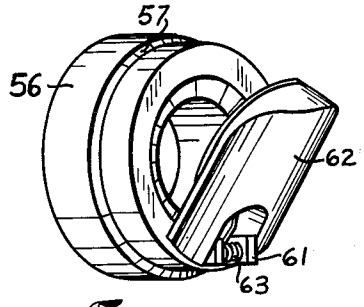

Fig. 5

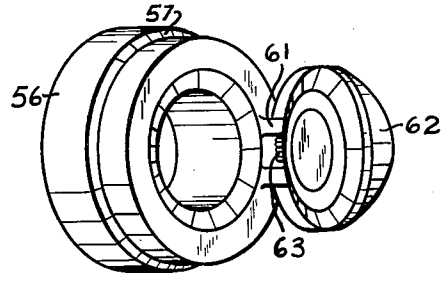

Fig. 6

CICERO C. BROWN
INVENTOR.

BY

ATTORNEY

United States Patent Office 2,994,381 Patented Aug. 1, 1961

2,994,381

LINER SETTING ASSEMBLY

Cicero C. Brown, % Brown Oil Tools, Inc.,
P.O. Box 19236, Houston, Tex.

Filed Oct. 24, 1958, Ser. No. 769,401
6 Claims. (Cl. 166—224)

This invention relates to new and useful improvements in a tool assembly for setting liners in a well, and relates particularly to a tool assembly by which a liner may be rotated down through the well bore as it is being set.

In drilling oil and gas wells, the well bore is ordinarily drilled as an open hole to the final depth, only the upper portion of the well being cased with pipe. When the well has penetrated a prospective producing formation, a string of pipe, termed the "liner," is run into the well bore through the anticipated producing section and secured to the lower end of the casing which was previously installed in the upper portion of the well. The liner is then cemented in place preparatory to completing the well by procedures well-known to the art.

As wells have become increasingly deeper, greater difficulty is encountered in inserting the liner because of their correspondingly greater length and the variations in the walls of the bore hole which are commonly encountered by the descending liner. It becomes desirable, therefore, that the liner should be rotatable in order that it may be employed as a drill so that it may be worked down to the proper point in the well bore. With conventional liner setting tools, such rotation, which is conventionally right-hand rotation, is impossible because they generally require right-hand rotation in order to effect release of the setting tool from the liner.

It is a principal object of this invention, therefore to provide a form of liner setting tool assembly which will permit rotation of the liner as it is being run into the well bore, without causing release of the liner setting tool.

Another important object of this invention is to provide a liner setting assembly in which release from the liner is effected without requiring relative rotation between parts of the tool, but by the employment of fluid pressure exerted through the running-in or operating string.

Another object of the invention is to provide a releasable clutch element by which rotational torque is transmitted from the operating string to the liner setting assembly for rotating the liner.

A further object is the provision of a back-pressure valve adapted to be closed upon release of the liner setting tool from the assembly, the back-pressure valve being positioned at a point remote from the lower end of the liner.

A more specific object is to provide a liner setting assembly in which release of the setting tool from the liner is effected by dropping a plug into the bore of the assembly to close the bore of a releasing sleeve and employing fluid pressure on the plug and sleeve to effect release of the setting tool from the liner.

Other and more specific objects and advantages of this invention will become apparent from the following detailed description when read in conjunction with the accompanying drawing which illustrates a useful embodiment in accordance with this invention.

In the drawing:

FIG. 1 is a view showing the liner and liner setting assembly disposed in a well bore;

FIG. 2 is a longitudinal quarter-sectional view of the liner setting assembly showing the parts in the positions occupied when going into the well;

FIG. 3 is a view similar to FIG. 2 showing the position of the parts in the liner setting assembly upon release of the setting tool from the setting sleeve;

FIG. 4 is an elevational, partly sectional, view showing the back-pressure valve in closed position following release of the liner setting tool from the liner.

FIGS. 5 and 6 are perspective views of the back-pressure valve; and

FIGS. 7 and 8 are cross-sections taken, respectively, along lines 7—7 and 8—8 of FIG. 2.

In FIG. 1, the liner setting tool in accordance with this invention, designated generally by the numeral **10**, is shown connected to a liner hanger, designated generally by the numeral **11**, which is connected about the upper end of a liner **12** carrying an annular bit **13** at its lower end. This string of tools is connected to a running-in or operating pipe string **14**, by which the tools are run into a well **15** having its upper portion lined with a casing **16**, the lower portion of the well bore being uncased, as shown.

Liner hanger **11**, by which the liner is secured to the lower end of casing **16**, may be of any conventional and well-known form adapted to anchor the liner to the lower end of the casing. Hanger **11**, illustrated herein, is a type of anchor which is operable by longitudinal movements of the tool string and is constructed and operated substantially like that illustrated and described in Robinson et al. U.S. Patent 764,769, July 12, 1905. The details of the liner hanger or anchor, of themselves, do not, therefore, form a part of this invention.

The setting tool assembly, as best illustrated in FIGS. 1 and 2, comprises a generally tubular liner setting sleeve, designated generally by the numeral **19**, composed of an upper section **20** and a lower section **21**. The lower end of upper section **20** is provided with an external threaded pin **22** which is threadedly received in an internally threaded box portion **23** provided in the upper end of lower section **21**. Pin **22** has a bore **24** somewhat smaller in diameter than the bore **25** of lower section **21** to thereby provide a downwardly facing internal shoulder **26** near the upper end of section **21**. The latter has an externally threaded pin **27** at its lower end which is adapted to be threadedly received in the upper end of liner **12**, to thereby connect the setting sleeve to the liner.

A liner setting tool, designated generally by the numeral **30**, is inserted into the bore of liner setting sleeve **19** through the upper end thereof and comprises a tubular body **31** and a head section **32**. The latter has an internally threaded socket **33** at its upper end to receive the lower end of running-in pipe string **14** whereby to connect the tool and liner to the running-in string. The upper portion of body **31** is made substantially smaller in its external diameter than the bore diameter of setting sleeve **19** to thereby provide an annular space **34** therebetween and defining an upwardly facing external shoulder **35** on the lower portion of body **31** which forms a bottom for space **34**. Head portion **32** is provided at its lower end with an annular skirt **36** which extends into annular space **34** between the upper end portion of body **31** and sleeve section **20**. Skirt **36** is internally threaded at **37** to threadedly receive the externally threadedly upper end of body **31**. Mounted in the lower portion of space **34** is a gland ring **38**, the lower end of which rests on a packing **38***a* which is supported on shoulder **35** and forms a seal between body **31** and sleeve section **20**. Mounted between the lower end of skirt **36** and gland ring **38** is a ball bearing **39** forming means permitting rotation between setting tool **30** and setting sleeve **19**. A set screw **40** extends between skirt **36** and body **31** to secure these parts against relative rotation. The lower end of body **31** is provided with an internally threaded socket **41** which receives the upper end of a pipe nipple **42** which extends downwardly through the bore of lower section **21** into the bore of the liner. The

lower end portion of nipple 42 may be perforated, as at 43, and at its lower end nipple 42 is provided with an inturned lip 44, for purposes which will be described more fully hereinafter.

At a point just above socket 41, body 31 is provided with a plurality of angularly spaced radial windows 45 (FIG. 8) in each of which is mounted a nut segment 46 having downwardly facing buttress threads 47 on their outer faces adapted to mesh with complementary threads 48 provided on the interior wall of sleeve section 20 opposite windows 45. Segments 46 are held in windows 45 by means of pins 49 which extend transversely across the windows and pass through transverse openings 50 in the bodies of segments 46. Openings 50 are made larger in diameter than pins 49 to thereby permit a sufficient amount of radial movement of the nut segments in windows 45 to allow the nut segments to retract inwardly far enough to release threads 47 from threads 48. The lower end portion 31*a* of the bore wall of body 31, which portion includes the windows 45, is tapered downwardly and outwardly to a slight degree, and the rear faces 51 of segments 46 are correspondingly tapered. Mounted in the bore of body 31 opposite the inner end of windows 45 is a keeper sleeve 52, the outer surface of which is tapered to conform to the taper of rear faces 51 of nut segments 46 and the adjacent bore wall portion 31*a*. Keeper sleeve 52 is releasably secured to body 31 by means of a shear screw 53 which is adapted to break under pre-determined pressure. An O-ring seal 54 is positioned to seal between the upper end of keeper sleeve 52 and the wall of body 31. When keeper sleeve 52 is in the position illustrated in FIG. 2, in back of nut segments 46, the latter will be held in radially outwardly projected positions at which threads 47 will be in engagement with threads 48, and when keeper sleeve 52 is moved downwardly below windows 45, the nut segments 46 will be free to move radially inwardly, as best seen in FIG. 3, and release body 31 from engagement with setting sleeve 19.

Mounted in lower sleeve section 21 is a back-pressure valve, designated generally by the numeral 55, which comprises an annular body 56 seated in the annular space between the wall of bore 25 and the exterior of nipple 42. Body 56 has an external shoulder 57 engageable on an internal shoulder 58 formed on the bore wall of section 21 and is held against upward movement by shoulder 26. O-ring seals 59 and 60 form fluid-tight seals, respectively, between body 56 and nipple 42 and between body 56 and sleeve section 21. Swingably secured to the lower end of body 56 at one side thereof, by means of a hinge pin 61, is a flapper valve 62 which is adapted to close the bore of body 56 when released to do so by retraction of nipple 42, as will be subsequently described. In the position illustrated in FIG. 2, flapper valve 62 is held in the open position by nipple 42 and is positioned between nipple 42 and the wall of sleeve section 21. A coil spring 63, suitably arranged about hinge pin 61 between body 56 and the valve, biases flapper valve 62 toward the closed position.

Head section 32 of the setting tool carries means cooperable with the setting sleeve to form a clutch through which right-hand or clockwise rotation of the running-in string is transmitted to the setting sleeve and liner, but which permits rotation of the setting tool relative to the setting sleeve and liner in response to left-hand or counter-clockwise rotation of the running-in string. While various forms of clutch means may be employed to function as here described, the drawing illustrates an embodiment which is particularly useful in the tool assembly herein described.

Head section 32 is provided with a pair of oppositely disposed recesses 65 in which are pivotally mounted pawls or clutch dogs 66 on pivot pins 67 extending vertically across recesses 65. Dogs 66 are resiliently biased by means of springs 68 to project outwardly from the recesses 65. The upper end portion of upper sleeve section 20 is provided with slots 69 on opposite sides thereof into which, when they are in registration with recesses 65, the pawls 66 will project. With this arrangement, as best seen in FIG. 7, pawls 66 will project into and abut against a wall of the slots 69 when head section 32 is rotated in the right-hand or clockwise direction relative to sleeve section 20, to thereby transmit rotation from operating string 14 to the setting sleeve and the liner. When head section 32 is rotated in the reverse or counter-clockwise direction, it will be seen that pawls 66 will be moved inwardly of recesses 65 so that head section 32 and the setting tool may be rotated relative to sleeve section 20 and its connected elements, including liner 12.

In operation, the tool assembly is connected to liner 12, with its associated liner hanger 11, and to running-in string 14, the parts of the tool assembly being in the relative positions illustrated in FIG. 2.

The tool string and liner will then be run into the well and the running-in string 14 may be rotated in order to rotate the liner and cause bit 13 to cut its way past any obstructions which might be encountered as the string moves downwardly in the well bore. The rotation of the entire string being in the normal or right-hand direction, pawls 66 will be in engagement with the walls of slots 69 in order to transmit the rotary movement from the running-in string to the tool string and the liner in order to drive bit 13, as noted.

When the liner is positioned at the point in the well at which it is to be cemented, the tool string will be manipulated to actuate hanger 11 in order to anchor the liner to casing 16. Cementing operations will now be conducted in the usual manner through the bore of the tool string and out the bottom of the liner into the annular space between the liner and the wall of the well bore. When the cement is in place, a plug 75 will be dropped through the bore of the tool string and pumped down into engagement with the upper end of keeper sleeve 52 to close the bore thereof. Thereupon fluid pressure will be applied through the bore of the string until sufficient pressure has been built up to break shear pins 53, thereupon releasing sleeve 52. The latter will be pumped downwardly past segments 46 and will be caught by lip 44 in the lower end of nipple 42, as seen in FIG. 3. The downwardly tapered shape of sleeve 52 will enable easy release of sleeve 52 from the lower end portion of body 31 and segments 46.

When keeper sleeve 52 has been thus removed from engagement with segments 46, the latter are free to move radially inwardly and upon an upward pull applied on the running-in string, the camming action of threads 47 on threads 48 will urge the nut segments 46 inwardly, as shown in FIG. 3, until they are clear of threads 48. Thereupon the running-in string, together with the setting tool 30, may be withdrawn from inside setting sleeve 19 and when the lower end of nipple 42 has moved above flapper valve 62, the latter will automatically swing to the closed position, illustrated in FIG. 4, under the urging of spring 63 and thus prevent return flow of cement-displacing fluid, or the cement, through the liner.

In the event difficulty occurs in pumping out keeper sleeve 52, the setting tool may be released from the setting sleeve by rotating the running-in string in the left-hand or counter-clockwise direction. Such counter-clockwise rotation will be transmitted to nut segments 46 which will thus be unscrewed out of threads 48 and thereby release the setting tool for withdrawal, threads 47 and 48 being right-hand threads. In this operation, bearing 39 will be of assistance in enabling the relative rotation of the parts to be conducted easily.

By locating the back-pressure valve in the setting tool assembly, thereby placing it adjacent the upper end of the liner, the valve is protected against damage which often otherwise occurs in more conventional arrangements where

such valves are usually located in the cementing shoe at the lower end of the liner. The described arrangement, therefore, in accordance with this invention will assure a better seal against back flow. Valve **63** and body **56** are preferably made of a readily drillable material, such as plastic, so that it may be drilled out easily when the cement has set and the bore is to be cleared in the usual manner.

It will be understood that various alterations and modifications may be made in the details of the illustrative embodiments within the scope of the appended claims but without departing from the spirit of this invention.

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

1. A tool assembly for setting a liner in a well bore, comprising, a tubular setting sleeve connectible to a liner, a setting tool including a generally tubular body insertible in the bore of the setting sleeve and connectible to an operating pipe string, means releasably connecting said body to the setting sleeve, means on the body initially holding said first-mentioned means in position connecting said body to said setting sleeve, said last-mentioned means being actuatable by fluid pressure to release said body from the setting sleeve, and clutch means carried by the body operable in response to rotation of the body in one direction to drivingly engage said sleeve for rotating the sleeve in said direction, and to be releasable from the sleeve for rotation relative to the sleeve by rotation of the body in the opposite direction, said clutch means comprising pawls resiliently biased to project from said body, and openings in said setting sleeve having walls abuttable by the pawls in response to said rotation in said one direction and operable to move said pawls out of said openings by said rotation of the body in said opposite direction.

2. A tool assembly for setting a liner in a well bore, comprising, a tubular setting sleeve connectible to a liner, a setting tool including a generally tubular body insertible in the bore of the setting sleeve and connectible to an operating pipe string, co-operable thread means carried by the body and the setting sleeve releasably connecting said body to the setting sleeve, means on the body initially holding the thread means in connecting engagement, said last-mentioned means being actuatable by fluid pressure to release the thread means on the body from the thread means on the setting sleeve whereby to release said body from the setting sleeve, and clutch means carried by the body and operable in response to rotation of the body in one direction to drivingly engage said sleeve for rotating

the sleeve in said direction, and to be releasable from the sleeve for rotation relative to the sleeve by rotation of the body in the opposite direction.

3. A tool assembly according to claim 2 wherein said clutch means comprises pawls resiliently biased to project from the body, and openings in the setting sleeve having walls abuttable by the pawls in response to said rotation in said one direction and operable to move said pawls out of said openings by said rotation of the body in said opposite direction.

4. A tool assembly according to claim 2 having normally open valve means mounted in the setting sleeve operable in response to withdrawal of said body from the setting sleeve to close the bore of said sleeve against backflow of fluid therethrough.

5. A tool assembly for setting a liner in a well bore comprising, a tubular setting sleeve connectible to a liner, a setting tool including a generally tubular body insertible in the bore of the setting sleeve and connectible to an operating pipe string, cooperable thread means releasably connecting said body to the setting sleeve, the thread means carried by the body comprising a plurality of angularly spaced thread segments radially movable through the wall of the body into and out of engagement with the thread means on the sleeve, releasable keeper means positioned in the bore of said body to normally hold said thread segments in engagement with the threads on the sleeve, said keeper means being actuatable by fluid pressure to release said thread segments whereby to release said body from the setting sleeve, and clutch means carried by the body and operable in response to rotation of the body in one direction to drivingly engage said sleeve for rotating the sleeve in said direction, and to be releasable from the sleeve for rotation relative to the sleeve by rotation of the body in the opposite direction.

6. A tool assembly according to claim 5 wherein said releasable keeper means comprises a tubular sleeve element slidable in the bore of the body and breakable shear pin means securing the sleeve element to the body.

References Cited in the file of this patent

UNITED STATES PATENTS

1,870,779	Layne et al.	Aug. 9, 1932
2,189,703	Burt et al.	Feb. 6, 1940
2,230,447	Bassinger	Feb. 4, 1941
2,315,921	Baker	Apr. 6, 1943
2,409,811	Taylor et al.	Oct. 22, 1946