United States Patent [19]

Pitts

[11] **3,910,348**

[45] **Oct. 7, 1975**

[54] **DRILLABLE BRIDGE PLUG**

[75] Inventor: **Charles A. Pitts,** Wichita Falls, Tex.

[73] Assignee: **The Dow Chemical Company,** Midland, Mich.

[22] Filed: **July 26, 1974**

[21] Appl. No.: **492,119**

[52] **U.S. Cl.** **166/134;** 166/135

[51] **Int. Cl.²** **E21B 23/06;** E21B 33/129

[58] **Field of Search** 166/135, 134, 123–125, 166/206, 212, 216, 217, 237

[56] **References Cited**

UNITED STATES PATENTS

3,091,293	5/1963	Fry	166/123
3,115,186	12/1963	Kline	166/135
3,250,331	5/1966	Boyle	166/135 X
3,303,885	2/1967	Kisling	166/135 X
3,631,924	1/1972	McGill	166/134
3,631,925	1/1972	Nutter	166/134
3,631,927	1/1972	Young	166/134

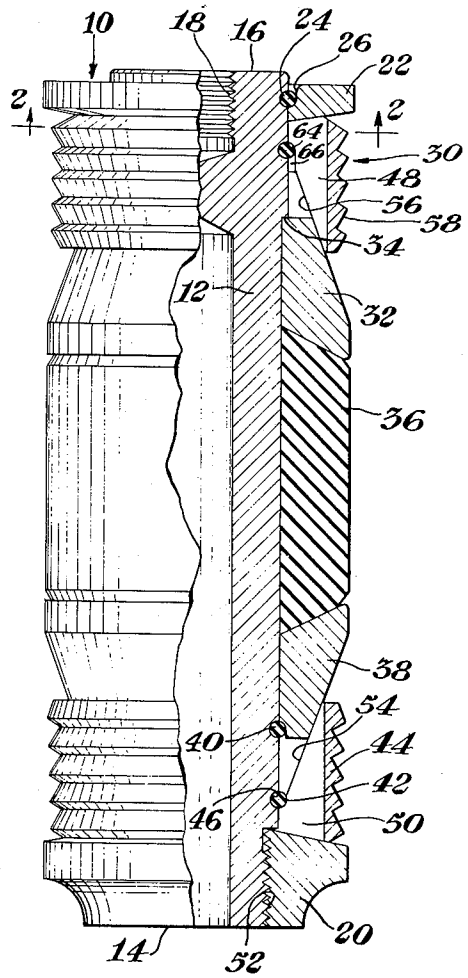
Primary Examiner—David H. Brown

Attorney, Agent, or Firm—Earl D. Ayers

[57] **ABSTRACT**

The invention is an improved bridge plug device which uses shearable "O" rings as appropriate retainers to maintain the assembled component parts in proper relationship before the bridge plug is used in an earth well or the like. The device of this invention is more simply manufactured and assembled than known bridge plugs which utilize shear pins to hold the component parts in position.

3 Claims, 2 Drawing Figures



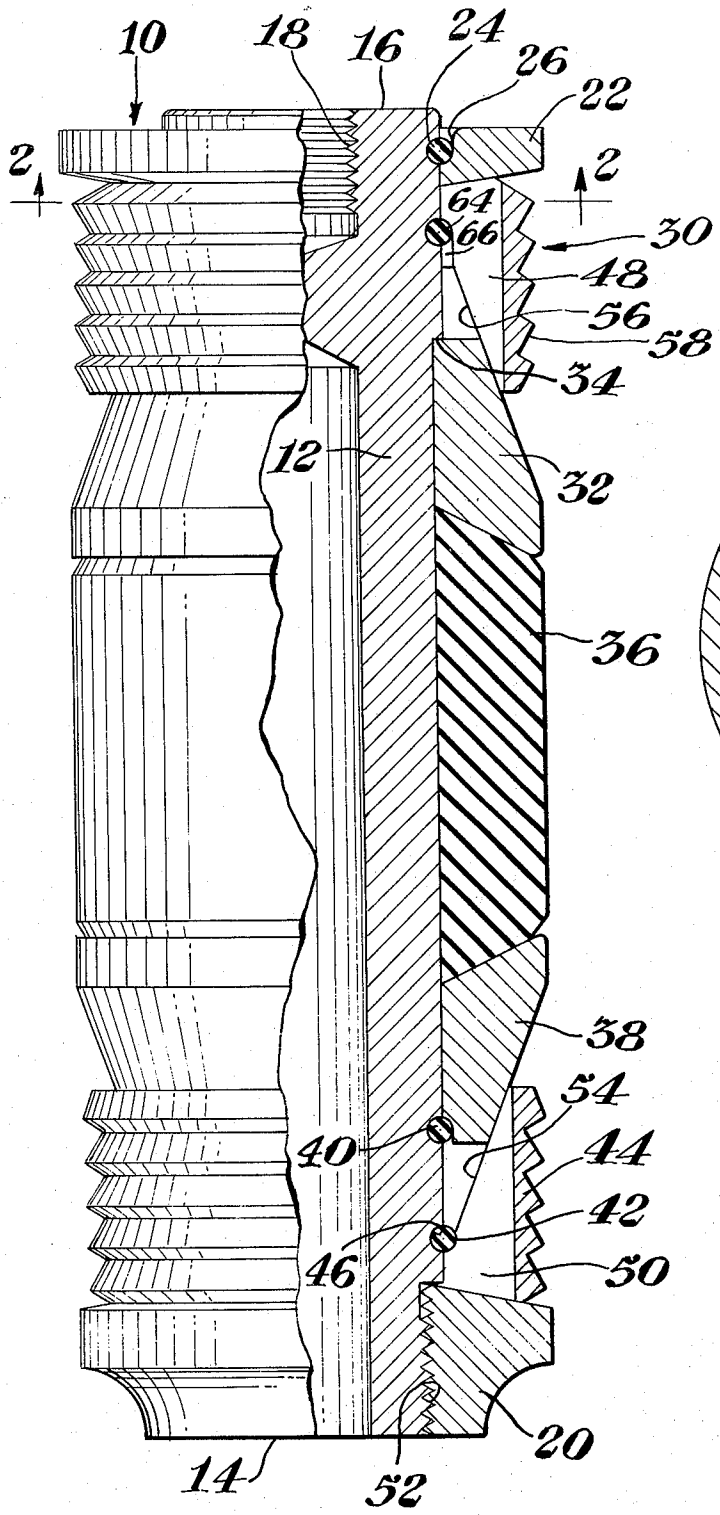

10
18
16
24
26
22
2
2
64
66
30
48
56
58
34
12
32
36
38
54
40
44
42
46
50
20
14
52

Fig. 1

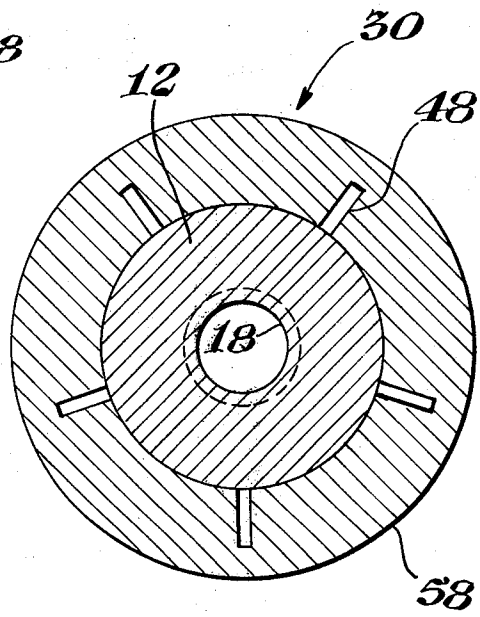

30
12
48
18
58

Fig. 2

DRILLABLE BRIDGE PLUG

BACKGROUND OF THE INVENTION

This invention relates to bridge plugs and particularly to drillable bridge plugs for use in earth wells.

Drillable bridge plugs are well known in the well drilling and servicing arts. However, the usual practice is to employ shear pins to hold the various components of the bridge in predetermined relationship with respect to each other. This use of shear pins requires both precision sizing of the pins and the bores into which they fit, but also requires precise alignment of parts when the pins are inserted.

OBJECTS OF THE INVENTION

A principal object of this invention is to provide an improved drillable bridge plug which is easy to assemble.

Another object of this invention is to provide an improved, economical to manufacture, drillable bridge plug.

STATEMENT OF INVENTION

In accordance with this invention there is provided a drillable bridge plug comprising, disposed about a central mandrel, upper and lower slip elements, upper and lower slip cones, a packing element disposed between the cones, a fixed position bottom plate and a movable top plate positioned to bear against the upper slip elements. The top plate, upper slip elements, lower slip cone and lower slip elements are held in position until the bridge plug is to be set by shearable **0** rings disposed in grooves along the outer surface of the mandrel and the inner surface of the parts named.

The bridge plug is "set" in the well bore by using an explosive setting tool whereby the outer part of the setting tool moves downwardly against the top plate of the plug while the mandrel is held in position by a tension stud which is connected to the setting tool. The downward movement of the top plate moves the slips and cones and that movement compresses and expands the packing element to seal it against the well casing or well bore wall.

BRIEF DESCRIPTION OF THE DRAWING

The invention, as well as additional objects and advantages thereof, will best be understood when the following detailed description is read in connection with the accompanying drawing, in which:

FIG. **1** is a side elevational view, partly in section, of a drillable bridge plug in accordance with this invention, and

FIG. **2** is a sectional view taken along the line **2—2** of FIG. **1.**

DETAILED DESCRIPTION OF THE DRAWING

Referring to the drawing, there is shown a drillable bridge plug, indicated generally by the numeral **10,** comprising an elongated inner mandrel **12** having a lower end **14** whose outer peripheral surface is threaded and an upper end **16** having a centrally disposed threaded bore **18** extending into it.

The outer peripheral surface of the mandrel **12** is its largest diameter at its upper end part, then is reduced in diameter somewhat from there until near the lower end of the mandrel **12** where the threaded part is of somewhat reduced diameter.

A top plate **22** having an axial bore **26** sized to fit closely but slidably around the larger diameter part of the mandrel **12.** The top plate is held in position during assembly and until the plug is to be set by **0** ring **24** which fits in opposed grooves in the outer surface of the mandrel and inner wall of the top plate, respectively.

An upper slip member **30** having a horizontally toothed outer configuration and an inner wall part adapted to slide along the outer surface of the mandrel **12** abuts against the lower surface of the top plate **22.**

The inner wall part of the slip member **30** which slides over the mandrel **12** extends along a minor part of the length of the member **30** and then, tapers outwardly at **56,** for example, after a grooved part **66** permits insertion of the **0** ring **28** in a groove in the mandrel **12,** until the slip member is rather thin at the end thereof which is remote from the top plate **22.**

The slip member **30** contains a plurality of symmetrically arrayed longitudinal slits extending along its length and from the inner surface to near the toothed outer part of the member **30.**

An upper cone member **32** having an outer peripheral surface adapted to bear against the tapered undersurface part **56** of the slip member **30,** abuts against the upper end of the longer reduced outer diameter part of the mandrel **12.** The lower end of the upper cone member **32** abuts against the upper end of the packing element **36** which fits slidably about the outer peripheral surface of the mandrel **12.**

The packing element **36** is illustrated as having tapered ends, but ends which are perpendicular to the longitudinal axis of the plug are also practical.

A lower cone member **38** fits around the mandrel **12** with its upper end abutting against the lower end of the packing element **36.** The cone member **38,** like the cone member **32,** has a tapered outer surface along which the tapered undersurface **54** of the lower slip member **44** is adapted to move.

The cone member **38** is held in position abutting against the packing element **36** by an **0** ring **40** which rides in a groove in the mandrel and abuts against a recessed part of the lower end of the cone member **38.**

The lower slip member **44,** of the same form as the upper slip member **30,** fits around the mandrel **12** with its tapered surface **54** overlapping the tapered outer surface of the cone member **38.** The slip member **30** has longitudinal slits **50** which are arrayed as the slits **48** are in slip member **30.**

Upward movement of the slip member **44** is prevented by the **0** ring member **46** which fits into a groove in the outer surface of the mandrel and abuts against a recessed part of the member **30.**

A retaining base member **20** is screwed over the threads **52** of the further reduced diameter lower end of the mandrel **12.**

OPERATION

The bridge plug of this invention is assembled by slipping the top plate **22** along the mandrel **12** with the **0** ring **24** in place so that the groove **26** extending downwardly from its top surface passes over the ring **24.** The plate **22** is then retained by the ring **24** bearing against the wall of the groove **26.**

The upper slip member **30** slides over the mandrel **12** and bears against the top plate **22.** The slip member **30** is then held in place by inserting the **0** ring element **28**

into the groove **64** in the mandrel through the open ended groove **66** in the inner part of slip member **30.**

The upper cone member **32** then slips over the mandrel **12,** coming to rest against the shoulder **34** between the larger and smaller diameter wall parts of the mandrel **12.**

The packing element **36** is then slid over the mandrel **12** to bear against the end of the upper cone member **32.**

The lower cone member **38** is then slid over the mandrel **12** to abut against the lower end of the packing element **36** and is held in place by an **0** ring **40** in a groove in the mandrel **12** at the lower end of member **38.**

The lower slip member **44** slips over the mandrel **12** with its tapered surface **54** bearing against the inclined surface of the conical member **38.** Further advancement of the slip member **44** is prevented by the **0** ring **46** in a groove in the outer surface of the mandrel **12.**

The base element **20** is then screwed onto the threaded lower end of the mandrel **12,** bearing against the lower end of the lower slip member **44.**

The bridge plug of this invention may be assembled in about ten minutes as compared with about an hour for a bridge plug using shear pins to hold its assembled parts in position. In addition, the cost of manufacture of this bridge plug is reduced over a similar bridge plug utilizing shear pins because no precision drilling or fitting for using shear pins is required.

Also, the shearing pressure of **0** rings is more uniform than is the case with shear pins, so the operation of the bridge plug of this invention is more predictable.

The bridge plug **10** is lowered down the bore hole, usually within a string of casing, on a cable to which is coupled an explosively actuated setting tool, as is well known in the art.

The setting tool (not shown) has a stud at its lower end which is coupled to the threaded bore **18** at the upper end of the mandrel **12.** The setting tool also has an outer rim part which is adapted to be driven downwardly with respect to the above mentioned stud on firing of the explosive material in the setting tool.

Once the explosive material in the setting tool is fired, the rim part of the setting tool forces the top plate downwardly, shearing the **0** rings **28** and **40** as the upper slip member **30,** upper cone **32,** packing element **36** and lower cone **38** are driven downwardly with the top plate **22** by the rims of the setting tool.

As relative movement occurs between the slip members and cones, the pressure causes the slip members to break along the slots **48, 50,** segmenting the advancing slip elements. The setting tool, once the packing element **35** and slip members **30, 44** have advanced to set the bridge plug **10** is separated from the bridge plug by breaking the tension stud which has been attached to the mandrel **12** during the setting operation.

Because precision fits are not required with most parts of the bridge plug **10,** most parts may be cast rather than forged or machined, further reducing the manufacturing costs of the unit.

What is claimed is:

1. A bridge plug for use in well bores and the like comprising an elongated mandrel having an upper end including setting tool attachment means, and a lower end having threads on its outer peripheral part, a base element, said base element being threadedly engaged with said threads on said mandrel, and a lower slip member, lower cone member, packing element, upper cone member, upper slip member and top plate being disposed around said mandrel in the named order, said packing element having ends each of which abut against one of said cone members, each cone member having a tapered surface which tapers towards said mandrel from that part of its outer surface which is adjacent to said packing element, each of said slip members having a tapered under surface adapted to bear against the tapered surface of its adjacent cone member, said lower slip member abutting against said base element and said upper slip member abutting against said top plate, an array of **0** rings, each of said **0** rings lying in a groove in the outer periphery of said mandrel and abutting against an upper or lower inner edge of a retained part of said plug, said grooves being so disposed along said mandrel that, until the **0** rings contacting said upper slip member and said lower cone member are sheared, downward movement of said upper slip member, upper cone member, packing element and lower cone member is prevented.

2. A bridge plug in accordance with claim **1** wherein said **0** rings each contact an edge surface of the adjacent part which surrounds said mandrel.

3. A bridge plug in accordance with claim **1** wherein said upper cone member abuts against a shoulder on the outer peripheral surface of said mandrel.

* * * * *