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BRIDGE PLUG WITH VALVED HOLLOW MANDREL BYPASS

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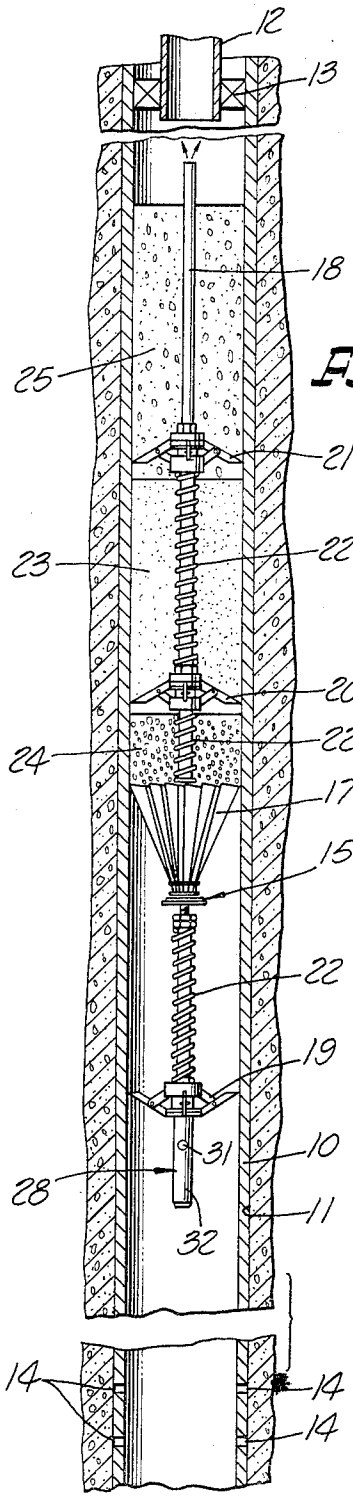


FIG. 1.

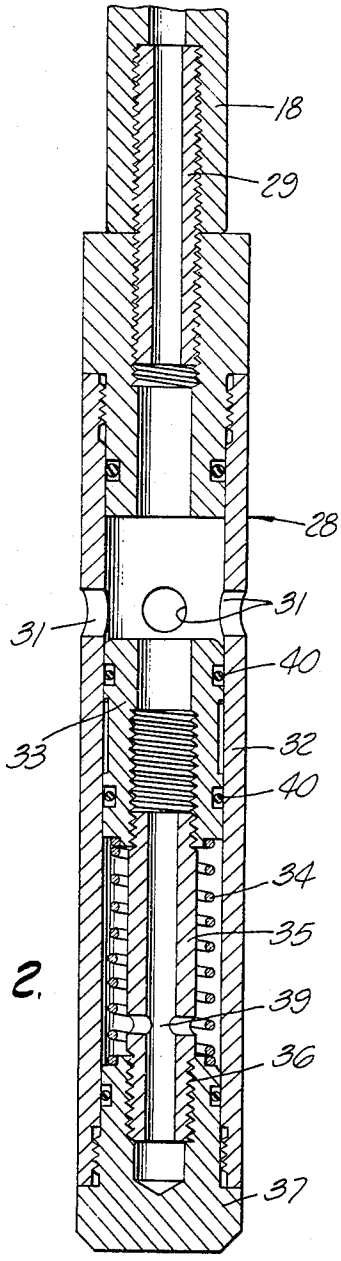


FIG. 2.

GERALD TURNER ARMSTRONG
GEORGE E. BRIGGS
INVENTORS.

BY Lyon & Lyon
ATTORNEYS

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BRIDGE PLUG WITH VALVED HOLLOW MANDREL BYPASS

Gerald Turner Armstrong, Houston, and George E. Briggs, West University Place, Tex., assignors to Halliburton Company, Duncan, Okla., a corporation of Delaware

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ABSTRACT OF THE DISCLOSURE

A bridge plug including a body of cementitious material bonded to the interior of a well casing has a hollow mandrel which extends through the plug and is open at both ends. Fluid accumulating in the well below the plug passes through the hollow mandrel until such time as the cementitious material has "set" and bonded to the well casing. The opening through the mandrel is then closed automatically to prevent flow of fluid therethrough. All of the parts of the bridge plug, including the hollow mandrel, may be lowered into position through a well tubing.

BACKGROUND OF THE INVENTION

This invention relates to apparatus for plugging a well casing, and may be classified as a packer or plug. In a known method of "plugging back," a mechanical basket is placed at the desired level in the casing, and then a body of sealant material is placed on that basket. When the sealant material "sets up" or hardens, and bonds to the interior surface of the casing, a pressure resistant plug is formed. However, if the fluid in the well below the location of the plug is not in a completely static condition, the sealant material may be subjected to pressure from below before it has hardened sufficiently or bonded sufficiently to the casing to withstand the applied load. The sealant material may become channeled or otherwise disturbed before its full strength has been reached during the hardening process. In accordance with the present invention, the hollow mandrel provides a bypass to permit well fluid to pass therethrough during the time needed for the sealant to "set up" or harden and to bond to the interior of the casing. The passage through the mandrel is then closed by a valve, and the bridge plug structure is then complete.

SUMMARY

Briefly stated, this invention concerns apparatus for placing a bridge plug in a well, the bridge plug containing cementitious material which requires time to "set up" or harden and to bond with the interior of the well casing. A valved bypass passage through the structure of the plug prevents pressure buildup below the plug until the cementitious material has hardened. The valve is then closed automatically.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a longitudinal sectional view in idealized form, showing a well casing containing a bridge plug embodying this invention.

FIGURE 2 is a longitudinal sectional view of a preferred form of shutoff valve device employed in connection with the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, the casing **10** extends into the well bore **11** and a tubing **12** extends into the casing **10**. A packer assembly between the tubing **12** and the casing **10** is shown diagrammatically at **13**. When it is desired to plug the casing **10** at a location above the position of the perforations **14**, a device generally designated **15** is lowered through the tubing **12** and into the casing **10** on a wire line, not shown. The wire line is of conventional type and serves to ignite an explosive squib when an electric current is furnished from the surface.

The device **15** includes a conventional expansible basket **17** mounted on a hollow axially extending mandrel **18**. A lower slip assembly **19** and two upper slip assemblies **20** and **21**, all of conventional design, are mounted on the mandrel and spaced by coil springs **22**. The device **15** is initially contained within the metal cylinder, not shown, to the top of which is attached the electric wire line. The two upper slip assemblies **20** and **21** and the basket **17** are confined about the mandrel by the metal cylinder. The lower slip assembly **19** located just below the lower open end of the cylinder, is restrained by a seizing wire, not shown. The explosive squib is attached to the seizing wire in a manner to break the wire when an electric current is furnished from the surface. When the seizing wire is broken, the lower slip assembly **19** extends laterally to engage the interior wall of the casing **10**. An upward pull on the line lifts the metal cylinder upward over the basket and upper slip assemblies **20** and **21**. These upper slip assemblies then prevent downward movement of the device **15**. The electric line and the metal cylinder are then removed from the well upward through the tubing **12**.

Sand **23**, gravel **24** and sealant **25** dumps are deposited on the extended basket **17** by means of conventional equipment operating through the tubing **12**. The sealant usually comprises cementitious cement of the type used in oil wells.

The shutoff valve assembly generally designated **28** is connected to the lower end of the mandrel **18** by means of the threaded connector **29**. The mandrel **18** is open from end to end and its upper end extends above the body of cementitious material **25**. The lower end communicates with the interior of the casing **10** through ports **31** in the wall of the valve housing **32**. The movable closure **33** is slidably mounted within the housing **32** and is urged toward closed position by means of the coil spring **34**. A hollow rod **35** formed of magnesium is connected to the housing **32** by means of the threads **36** and the end plug **37**. So long as the hollow rod **35** remains intact, the parts remain in the position shown in FIGURE 2, with the ports **31** open.

Fluid from the well passing into the casing **10** through the perforations **14** passes through the ports **31** and contacts the interior of the hollow magnesium rod **35**. Chemical action between the well fluids and the magnesium rod **35** eventually dissolves enough of the rod **35** so that the force of the spring **34** breaks the rod **35** in tension at the location of a weakened zone **39**. The spring then moves the closure member **33** upward, causing the axially spaced O-rings **40** to straddle the ports **31**, thereby closing off the ports **31**. This serves to close the bypass through the interior of the hollow mandrel **18**. The size of the weakened zone **39** and the wall thickness of the rod **35** are chosen so that the time interval required before tension failure of the rod **35** occurs is sufficient to enable the cementitious plug **25** to "set" and to bond to the interior of the casing **10**.

If desired, the interior of the housing **32** may initially be filled with salt water at the surface just before lowering the basket **17**, mandrel **18**, valve assembly **28**, etc., into position in the well. This procedure is advantageous if the well is not known to contain liquids which will chemically attack the magnesium rod **35**.

Having fully described our invention, it is to be understood that we are not to be limited to the details herein set

forth, but that our invention is of the full scope of the appended claim.

We claim:

1. In a bridge plug for use in a well casing having a tubing extending therein, the combination of: a hollow mandrel having a passage therethrough and open at the top, an expansible basket secured to the mandrel and adapted to engage the inside of the casing, a valve assembly fixed to the hollow mandrel below said basket, expansible means on the mandrel above the basket engageable with the inside of the casing to prevent downward movement of the expansible basket in the casing, the mandrel, basket, valve assembly, and expansible means being adapted to be lowered as a unit into the casing through the interior of the tubing, whereby upon subsequent lowering of a body of material including cementitious material through the tubing to rest on the expansible basket and in direct contact with the inside of the casing and covering the expansible means, the valve assembly permits flow of well fluid from below the body to above the body through the hollow mandrel, the valve assembly having means for closing the passage after the cementitious material has hardened to form a bond with the inside of the casing.

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CHARLES E. O'CONNELL, Primary Examiner

IAN A. CALVERT, Assistant Examiner

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