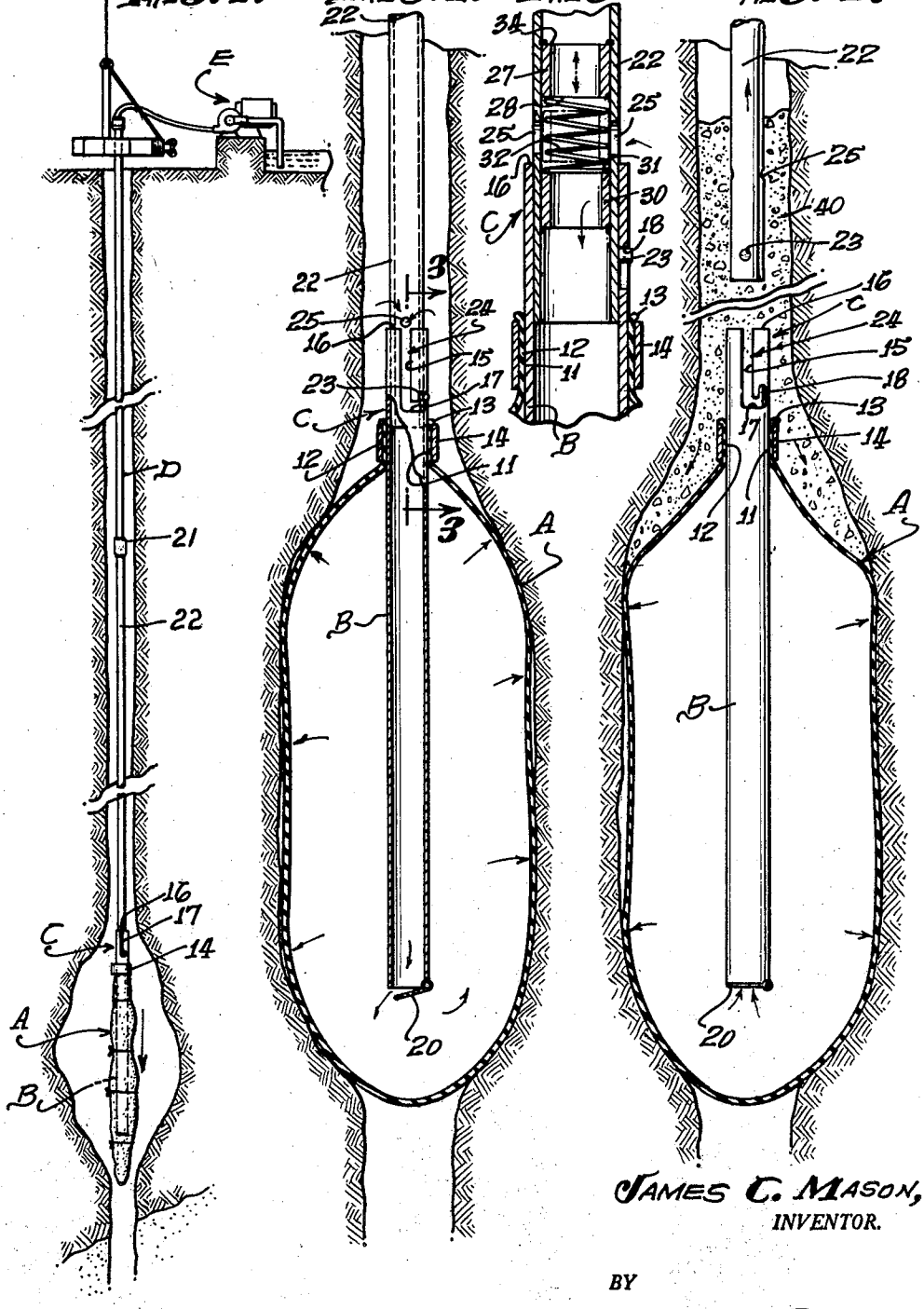
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WELL BRIDGING TOOL

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FIG. 1. FIG. 2. FIG. 3. FIG. 4.



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WELL BRIDGING TOOL

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This invention relates to packers for use in oil and gas wells or the like to effect a seal with the wall surface therein, and more particularly to an improved packing or bridging tool for forming a seal with the interior wall of the well bore for separating one portion of the well from another portion thereof, such that, for example, cement can be poured into the well bore above the tool when the well is abandoned.

In many well drilling operations it is sometimes necessary to bridge or plug a pipe, tubular conduit or an uncased well bore at some predetermined point. It is common practice to establish such a bridge or plug by placing a body of cement or the like at the desired point in the conduit or hole and allowing the same to harden in place. When it is necessary to remove such a plug, however, a time-consuming and expensive drilling operation is required, which is particularly objectionable where it is necessary to bridge the conduit or well casing at successive points from time to time as in testing operations of the type well known to the art.

It is a principal object of the present invention to provide a simple and efficient retrievable bridge plug formed from an expandable sheath of rubber or the like which is provided with a fluid-pressure connection for the introduction of fluid under pressure to the interior of the sheath to distend or expand the same and wedge it in place within the well bore.

It is another object of the present invention to provide a bridging plug of the above type which may be removed from its installed position.

Another object of the present invention is to provide an improved means for expanding the flexible sheath utilized as a bridging element in the tool.

It is a further object of the present invention to provide a bridging tool of the type described, the operation of which is not dependent upon the existence of a particular pressure within the well bore being plugged.

Yet another object of the present invention is to provide a plug of the type described which may be utilized as a retrievable plug but may also be easily filled with cement or like material to form a permanent plug in the well bore.

A still further object of the present invention is to provide an improved construction for a well bore bridging plug which is simple and economical to manufacture and use.

The novel features which are believed to be characteristic of the present invention both as to its organization and method of operation, together with further objects and advantages thereof, will be better understood from the following description considered in connection with the accompanying drawing in which a presently preferred embodiment of the invention is illustrated by way of example. It is to be expressly understood, however, that the drawing is for the purpose of illustration and description only and is not intended as a definition of the limits of the invention.

In the drawing:

FIGURE 1 is a partially diagrammatic view in elevation of a bridging plug in accordance with the present invention as utilized in a well bore;

FIGURE 2 is a view in elevation of the apparatus of the present invention with the expandable bag partially expanded by pressure of fluid within the well;

FIGURE 3 is a partial view in elevation of the valving arrangement of the present invention taken along line 3—3 of FIGURE 2; and

FIGURE 4 is a view corresponding to FIGURE 2 but with the bridging plug fully expanded in place within the well bore and with the setting drill string removed therefrom.

Referring now to the drawing, the present invention includes in general an inflatable bag A of rubber or similar elastomeric material which is generally cylindrical in configuration with a closed lower end and an opening defined at the upper end thereof. A tubular member B extends longitudinally throughout a substantial portion of the length of the bag and is connected by a connecting and valve assembly C to a drill string D. In the utilization of the tool, the tool is extended within the well bore from a drilling rig E suitable for the purposes for which the bridging plug is to be applied as shown in FIGURE 1.

Referring now particularly to FIGURES 2 and 3, the inflatable bag A has a relatively small opening **11** at the upper end thereof and a neck **12** with a bead **13** is formed in order that the bag can be sealingly engaged upon the tubular member B. The bag at the neck **12** thereof is sealingly engaged with the tubular member by means of a collar **14** which is formed of drillable material such as aluminum. The tubular member B extends throughout a substantial portion of the length of the inflatable bag and through the opening **11** at the upper and thereof to a position above the bead **13** when the bag is relatively oriented as shown in the drawings. The tubular member B has an inside diameter adapted to be mated by means of the connecting and valve member C to a drill string D of the type well known to the art. Exteriorly of the bag, that is, above the bead **13**, a longitudinally extending slot **15** is provided from the upper end **16** of the tubular member downward to a position which is still above and exteriorly of the bag. A transverse slot **17** is then formed at the lower end of the longitudinal slot **15** and is turned upward at **18** to form a J-slot **24** of the well-known type. A one-way check valve **20** is pivotally mounted at the open lower end of the tubular member B and is so constructed and arranged with respect to the end of the member that fluid may pass downward through the tubular member but is blocked from passing from the interior of the bag upward through the tubular member as shown in FIGURE 4.

The connecting and valving assembly C includes a connecting tubular member **22** which is adapted to be connected at the upper end thereof to the lower end of the string D by a collar **21** as shown in FIGURE 1. The outside diameter of the connecting tube **22** is approximately equal to the inside diameter of the tubular member B and is slidably mateable therewith. A pin **23** is affixed to the exterior wall of the connecting tube **22** and is mateable with the J-slot **24** formed by the slots **15** and **17** as previously described. Thus, the connecting tubular member **22** can be longitudinally affixed to the tubular member B by slidably engaging the connecting tube **22** with the tubular member B such that the pin **23** passes downward in the portion **15** of the J-slot after which it can be rotated along the transverse slot **17** and raised and locked into the upwardly extending portion **18** of the J-slot. Fluid ports **25** are provided through the wall of the tubular connector **22** at a longitudinal position which is above the upper end **16** of the tubular member B.

A slidable valving sleeve **27** is positioned within the connecting tube **22** for longitudinal sliding movement with respect thereto. The valving sleeve **27** is positioned within the tubular connector **22** at a longitudinal position above the ports **25**. That is, the lower end **28** of the sleeve in its upper position as shown in FIGURE 3 is

above the ports 25. A cylindrical collar 30 is affixed within the tubular connector 22 at a position beneath the fluid ports 25 to provide a shoulder 31 beneath the ports. A compression spring 32 is positioned upon the shoulder 31 between the stationary shoulder and the slidable sleeve 27. The sleeve 27 is thus normally urged upward to the position shown in FIGURE 3 at which the bottom surface 28 of the sleeve is above the ports. The relative location of the collar 30 and the height of the spring 32 is such that the sliding sleeve valve 27 is movable downwardly to a closed position as shown in phantom in FIGURE 3 at which the lower end 28 is beneath the ports 25 while the upper end 34 is above the ports 25 to effectively close the ports against the passage of fluid therethrough. A shoulder is provided at the upper end 34 of the sleeve 27 of such area that when contacted by fluid flowing downwardly thereby a sufficient downward force is exerted on the shoulder to move the sleeve 27 downwardly against the force of the spring 32. This action is subsequently explained in greater detail in conjunction with a description of the operation of the invention.

The tubular member B as well as the collar 14 are formed of drillable material such that they can be easily washed over or drilled away when it is necessary to remove the bridging plug from the well bore.

Thus, in operation the apparatus of the present invention is utilized by affixing the connecting valve assembly C to a drill string D by means well known to the art. As shown in FIGURE 1, the connecting tubular member 22 with the valve assembly included therein is assembled or connected to the tubular member B by inserting the pin 23 into the J-slot as shown in FIGURE 2. The inflatable bag A is deflated and is preferably wrapped tightly about the tubular member B as shown in FIGURE 1 for descent into the hole. The bridging plug is lowered into the well bore as shown in FIGURE 1 to the position at which the bridge is to be formed. When the apparatus has reached the proper depth within the well bore, if well fluid exists within the bore, it will pass inwardly through the ports 25 and downwardly through the collar 30, the tubular connecting member 22, the tubular member B and outward through the valve 20 to the interior of the inflatable bag A to cause the bag to be partially inflated. The extent of inflation will depend upon well pressure existing within the bore. When the well pressure has been equalized such that the pressure at the exterior of the drill string is substantially equal to the pressure of the interior of the inflatable bag, additional fluid can be pumped downwardly from the drilling apparatus E through the drill string, through the sliding sleeve member 27, collar 30 and downward through the tubular member B. As fluid under pressure is admitted down the drill string the force of the pressure upon the upper shoulder 34 of the sliding sleeve 27 will force the sleeve downward from the position shown in FIGURE 3 to the closed position shown in phantom line at which it blocks the fluid ports 25 so that fluid progressing down the drill string cannot pass outwardly through the ports and must pass downward through the tubular member B to the interior of the inflatable bag A. The elastomeric bag A is inflated to a desired pressure by the fluid after ports 25 close, and expands to wedge in the bore hole or frictionally grip the sides thereof to remain in a fixed position in the bore hole.

It can be seen that the spring 32 can be determined to allow closure of the fluid ports at any desired fluid pressure within the drill string. Thus the fluid under pressure progresses outwardly from the tubular member B through the valve 20 and into the inflatable bag until the bag is inflated to the required pressure. When the fluid pressure is removed from the interior of the drill string, the valve 20 will close to entrap the fluid within the bag due to the tendency of the fluid in the bag to flow to the lower pressure zone in the tubing. As such flow of fluid tends to take place from the bag A to tubular member B, valve 20 which acts as a check valve, closes. The drill string together with the tubular connecting members and valve assembly can then be removed from the inflatable bag A and tubular member B by rotating the drill string a partial turn to remove the pin 23 from the J-slot 24. Cement 40 can then, for example, be poured into the well bore where it will set and harden upon the inflatable bag to form an effective bridge in the well bore. When it is necessary to remove the bridge, a drilling or wash-over operation can be easily performed since all portions of the tool remaining within the well bore are of drillable material or are portions of the elastomeric inflatable bag.

What is claimed is:

A well bridging tool capable of being lowered into a well bore to a desired depth by a tubing string and a portion of said tool thereafter inflated by fluid under pressure to grip said well bore to the extent that said portion of said tool will support fluid cement thereabove until said cement sets, which tool includes:

(*a*) an inflatable resilient bag having a closed lower end and an upper end in which an opening is defined;

(*b*) a tubular member that extends into the confines of said bag through said opening;

(*c*) means for holding the upper extremity of said bag in sealing contact with said tubular member;

(*d*) means for releasably connecting the upper portion of said tubular member to the lower end of said tubing string; and

(*e*) a check valve on said tubular member that permits fluid to be discharged downwardly into said bag until said fluid is at a desired pressure therein and said bag has expanded to grip said well bore, said check valve closing upon upward flow of fluid from said bag to said tubular member due to the pressure on fluid in said tubular member being lowered below the pressure on fluid in said bag, with said fluid in said bag being trapped therein as a result of the closing of said check valve both before and after said tubular member has been released from said tubing string.

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