PATENT SPECIFICATION

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Complete Specification Accepted: Feb. 23, 1939.

PROVISIONAL SPECIFICATION

An Improved Plug for use in Forcing Material Through Pipes, especially in Well Sinking

I, NORMAN FRASER BROWN, a British Subject, of 10, Craiglockhart Grove, Edinburgh, N.B., do hereby declare the nature of this invention to be as follows:—

This invention relates to an improved plug for use in forcing material through pipes, especially in well sinking.

When a well, for example an oil well, is sunk it is usually necessary to guard against the risk of water from superposed water carrying strata from flowing down outside the well casing and the separation of two strata is effected by what is known as back cementation. This operation consists in forming a cement joint between the exterior of the casing and an impervious stratum which has been reached by drilling and to which the casing has been lowered, such stratum, of course, being below the water carrying stratum. In carrying out the operation a quantity of cement is inserted at the top of the casing and a plug is inserted in the casing above the charge of cement. Mud is then introduced above the plug and is pumped into the casing in order to force the plug, and with it the cement, down towards the bottom of the casing. At the bottom the cement finds its way, under the force exerted on it by the plug, into the annular space between the casing and the material of the surrounding impervious stratum where it sets and makes a watertight joint between the casing and the material. The plug which has hitherto been used has a cup-shaped portion made of a flexbile material such as leather or rubber which is so dimensioned that the rim of the cup presses slightly against the inner walls of the casing, the base and remainder of the plug passing easily through the casing. The apparent reason for designing the cup in this way was to allow the pressure exerted on the upper face of the plug, i.e. on the inner walls of the cup during its downward movement to cause the sides of the plug to press with increased pressure against the sides of the casing. Owing, however, to the small difference in pressure on the upper and lower faces of the plug the pressure exerted on the sides of the casing cannot be great. Whatever it may be I have discovered that the known type of plug does not prevent a substantial quantity of cement from finding its way past the plug to the casing space above the plug. Actual measurements have shown that, using a well known rubber plug, as much as 2.7 cubic feet of cement per 1" diameter of casing per length of 1000 ft. has formed as a film on the casing and thus been wasted. This waste of cement has been masked by its admixture with the mud which is almost universally used as a displacement fluid in casing cementation and consequently the wastage has gone unperceived.

The present invention has for its object the prevention of the large wastage of jointing material which occurs in known practice and accordingly provides, instead of the known plug, a plug which is arranged to press on the inner walls of the casing and carry down with it all, or the greater part of, any jointing material which tends to adhere to the casing.

The invention further provides a plug which is arranged, independently of any external pressure which may be exerted on the plug during the action of forcing the plug downwards in the casing by the substance which is pumped into the casing, to press on the inner walls of the casing and carry down with it all, or the greater part, of any jointing material which tends to adhere to the casing.

The plug is preferably arranged with scraping edges which press against the casing walls and in one form the plug comprises a substantially cylindrical body portion from which project a series of annular projections arranged one above the other and each having a substantially rectangular cross-section disposed so that, when the plug is in use, one corner of the rectangle presses continually against the casing wall. The projections may be formed on a sleeve which is securely attached to a solid core of suitable material, the sleeve and the projections with their scraping edges being formed of a resilient material such as rubber

[Price 1/-]

while it is contemplated that while the core may be of similar material it may also be formed of a harder, more rigid material, for example wood or cast iron.

The plug may be threaded on to the spindle of a plunger, the head of which is disposed below the plug when the latter is in situ in the casing.

It will be appreciated that the maximum external diameter of the plug when out of the casing is greater than the internal diameter of the casing so that the projecting portions of the plug suffer an appreciable compression force when the plug is inserted in the casing, in contrast with the known plug which is an easy fit in the casing.

The plug provided by the invention is, as will be understood, applicable to purposes other than the back cementation process and is especially advantageous when a mechanical separation is required, between two fluids which are being forced through a pipe. For example, when a pipe line is being cleared of some viscous fluid such as crude oil by pumping water through it prior to carrying out repairs to the line, the use of the plug prevents a film of the viscous fluid being left on the inner walls of the pipe.

Dated this 3rd day of June, 1938.

ABEL & IMRAY,
30, Southampton Buildings, London, W.C.2,
Agents for the Applicant.

COMPLETE SPECIFICATION

An Improved Plug for use in Forcing Material Through Pipes, especially in Well Sinking

I, NORMAN FRASER BROWN, a British Subject, of 10, Craiglockhart Grove, Edinburgh, N.B., do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to a plug for use in forcing material through pipes, for example for forcing cement down in the casing of an oil well, but the plug is not restricted to use in oil wells and is capable of other applications.

When a well, for example an oil well, is sunk it is usually necessary to guard against the risk of water from superposed water carrying strata from flowing down outside the well casing and the separation of two strata is effected by what is known as back cementation. This operation consists in forming a cement joint between the exterior of the casing and an impervious stratum which has been reached by drilling and to which the casing has been lowered, such stratum, of course, being below the water carrying stratum. In carrying out the operation a quantity of cement is inserted at the top of the casing and a plug is inserted in the casing above the charge of cement. Mud is then introduced above the plug and is pumped into the casing in order to force the plug, and with it the cement, down towards the bottom of the casing. At the bottom the cement finds its way, under the force exerted on it by the plug, into the annular space between the casing and the material of the surrounding impervious stratum where it sets and makes a water-tight joint between the casing and the material. The plug which has hitherto commonly been used has a cup-shaped portion made of a flexible material such as leather or rubber which is so dimensioned that the rim of the cup presses slightly against the inner walls of the casing, the base and the remainder of the plug passing easily through the casing. The apparent reason for designing the cup in this way was to allow the pressure exerted on the upper face of the plug, i.e. on the inner walls of the cup during its downward movement to cause the sides of the plug to press with increased pressure against the sides of the casing. Owing, however, to the small difference in pressure on the upper and lower faces of the plug the pressure exerted on the sides of the casing cannot be great. Whatever it may be I have discovered that the known type of plug does not prevent a substantial quantity of cement from finding its way past the plug to the casing space above the plug. Actual measurements have shown that, using a well-known rubber plug, as much as 2.7 cubic feet of cement per 1″ diameter of casing per length of 1000 ft. has formed as a film on the casing and thus been wasted. This waste of cement has been masked by its admixture with the mud which is almost universally used as a displacement fluid in casing cementation and consequently the wastage has gone unperceived.

An object of the present invention is to provide a plug which, in use, prevents the large wastage of jointing material which occurs in the known practice.

The plug according to the invention

while it is contemplated that while the core may be of similar material it may also be formed of a harder, more rigid material, for example wood or cast iron.

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The plug provided by the invention is, as will be understood, applicable to purposes other than the back cementation process and is especially advantageous when a mechanical separation is required, between two fluids which are being forced through a pipe. For example, when a pipe line is being cleared of some viscous fluid such as crude oil by pumping water through it prior to carrying out repairs to the line, the use of the plug prevents a film of the viscous fluid being left on the inner walls of the pipe.

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This invention relates to a plug for use in forcing material through pipes, for example for forcing cement down in the casing of an oil well, but the plug is not restricted to use in oil wells and is capable of other applications.

When a well, for example an oil well, is sunk it is usually necessary to guard against the risk of water from superposed water carrying strata from flowing down outside the well casing and the separation of two strata is effected by what is known as back cementation. This operation consists in forming a cement joint between the exterior of the casing and an impervious stratum which has been reached by drilling and to which the casing has been lowered, such stratum, of course, being below the water carrying stratum. In carrying out the operation a quantity of cement is inserted at the top of the casing and a plug is inserted in the casing above the charge of cement. Mud is then introduced above the plug and is pumped into the casing in order to force the plug, and with it the cement, down towards the bottom of the casing. At the bottom the cement finds its way, under the force exerted on it by the plug, into the annular space between the casing and the material of the surrounding impervious stratum where it sets and makes a water-tight joint between the casing and the material. The plug which has hitherto commonly been used has a cup-shaped portion made of a flexible material such as leather or rubber which is so dimensioned that the rim of the cup presses slightly against the inner walls of the casing, the base and the remainder of the plug passing easily through the casing. The apparent reason for designing the cup in this way was to allow the pressure exerted on the upper face of the plug, i.e. on the inner walls of the cup during its downward movement to cause the sides of the plug to press with increased pressure against the sides of the casing. Owing, however, to the small difference in pressure on the upper and lower faces of the plug the pressure exerted on the sides of the casing cannot be great. Whatever it may be I have discovered that the known type of plug does not prevent a substantial quantity of cement from finding its way past the plug to the casing space above the plug. Actual measurements have shown that, using a well-known rubber plug, as much as 2.7 cubic feet of cement per 1" diameter of casing per length of 1000 ft. has formed as a film on the casing and thus been wasted. This waste of cement has been masked by its admixture with the mud which is almost universally used as a displacement fluid in casing cementation and consequently the wastage has gone unperceived.

An object of the present invention is to provide a plug which, in use, prevents the large wastage of jointing material which occurs in the known practice.

The plug according to the invention

comprises a body portion and at least one annular ring portion of resilient material projecting outwardly from said body portion and terminating in a circular edge defining the greatest diameter of the plug, said edge being defined by two converging surfaces, both angularly disposed to the axis of the plug, which extend inwardly towards the body portion, the arrangement being such that the said edge is adapted to press against the walls of a pipe and exert a scraping action thereon independently of the influence of fluid pressure exerted on the plug.

Examples of plugs constructed according to the present invention are shown in the accompanying drawings in which—

Fig. 1 is a part sectional elevation of a plug disposed inside a pipe.

Fig. 2 is a fragmentary sectional elevation showing the form assumed by the rings of the plug on application of a force tending to reverse its direction of travel.

Fig. 3 is a part sectional elevation of a plug particularly adapted for the smaller diameter pipes employed in deep oil well sinking.

Referring to the drawings, the plug 1 comprises a body portion 2 of a resilient material such, for example, as rubber. From the body portion 2 project annular ring-shaped portions 3 which, as shown, are integral with the body portion. The preferred form of cross-section of the portions 3 is shown in Figs. 1 and 3, and this cross-section is generally rectangular in form with the sides 4, 5 converging slightly and terminating in a side 6 which is obliquely disposed with respect to the axis of the plug. As is shown in Fig. 1, the portions 3 form a circular edge 7 which presses against the inner walls of the pipe 8. It will be appreciated that the maximum external diameter of the plug, i.e. the diameter of the circular edge 7, when out of the pipe 8 is greater than the internal diameter of this pipe so that the portions 3 suffer an appreciable compression force when the plug is inserted in the casing and this is in direct contrast to the known plugs used in oil well sinking which latter plugs move easily in the well casing.

The body portion 2 fits tightly over a solid comparatively rigid core 9 or is otherwise fixedly secured to this core. The core may be of any desired material but when the plug is for use in oil well sinking it is made of a material substantially unaffected by water or cement which can readily be broken up in the known manner. Such materials are known and used in the art and per se do not constitute the present invention. It will be understood that the plug may be used as the "bottom plug" in the "two plug" method of back cementation in which case it precedes the ordinary plug and the cement to prevent contamination with fluid or mud in the well. When formed for use as a "bottom plug" the plug has a central bore which is normally closed in known manner by a friable disc, this disc being arranged to burst and open the passage whenever a predetermined pressure differential is exceeded.

The plug shown in Fig. 3 has a solid body portion and the projecting annular ring portions are integral with this portion, the whole plug being made of a resilient material, for example rubber.

In Fig. 2 the projecting annular ring portions of the plug 2 are shown in a highly compressed form such as they would adopt if the pressure of the displacement fluid above the plug were to fall for any reason, such as an accidentally burst pipe. It will be seen that the resistance to backward movement is raised to a high value with the object of providing a certain degree of safety in case of breakdown for the work already accomplished.

In Fig. 1 a guide portion 10 is shown integral with the core 9, but the portion 10 may alternatively be secured, as by screws, to the core.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A plug for use in forcing materials through pipes which comprises a body portion and at least one annular ring portion of resilient material projecting outwardly from said body portion and terminating in a circular edge defining the greatest diameter of the plug, said edge being defined by two converging surfaces, both angularly disposed to the axis of the plug, which extend inwardly towards the body portion, the arrangement being such that the said edge is adapted to press against the walls of a pipe and exert a scraping action thereon independently of the influence of fluid pressure exerted on the plug.

2. A plug as claimed in Claim 1, in which the cross-section of the ring portion is a figure bounded on one side by the body of the plug and having two sides adjacent thereto and a fourth side which is oblique to the axis of the plug.

3. A plug as claimed in Claim 2 in

which the said two sides adjacent to the body converge towards the said fourth side.

4. A plug as claimed in any of Claims 1—3, in which the body portion of the plug is of resilient material which fits over a relatively rigid core.

5. A plug as claimed in Claim 4 in which the core is of friable material and is connected with a cylindrical guide member of relatively rigid friable material concentric with the plug.

6. A plug for use in forcing material through pipes, substantially as described with reference to Figs. 1 and 2 or Fig. 3 of the accompanying drawings.

Dated this 19th day of August, 1938.

ABEL & IMRAY,
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