

Description

This invention relates to a cementing tool for wells.

It is conventional practice in the oil and gas industry to place a casing in a well bore and to cement the casing in position. The cement is placed in the annulus between the casing and the well bore wall, and is intended to secure and support the casing in the well bore and to isolate various formations from one another by preventing migration of formation fluids up and down the well bore. The cement is generally pumped down the casing interior, out into the well bore annulus, and back up toward the surface to the desired level. There are numerous techniques and apparatus employed in such "cementing". One of the most common is to place a cement basket at or near the lower end of the casing, and to introduce cement into the well bore annulus immediately above the basket, the basket keeping the cement from travelling down below the end of the casing to a lower formation, which is a particularly undesirable result if the lower formation is a low pressure or soft formation, being pumped into the annulus.

Prior art cement baskets and devices incorporating such baskets are usually attached to a casing and lowered with the casing into a well bore. The bore will contain well fluid (usually drilling mud), and the known baskets and devices do not permit the casing to fill with well fluid as it is lowered. As a result, it tends to float which causes problems. Furthermore, the prior art cement baskets in general use require that an additional prior art device namely a cementer or cementing collar, be placed above the basket in the casing string in order to place the cement outside the casing. Another prior art device, a separate "float collar" or "float shoe" is required if the operator desires to control the fill rate of the casing as it is floated into the well bore. In addition, the cement baskets of the prior art devices are retained in a collapsed mode as the casing is run into the well by a tie band around the top of the basket, which band is supposed to release and permit the basket to expand when the cementing operation is commenced. However, at cementing rates below six to eight barrels per minute (950 to 1300 dm³/minute), the tie band often fails to completely release, thus preventing the basket from opening freely and so allowing the cement to travel downward to the formation below the basket, damaging that formation as well as rendering the casing cement job incomplete.

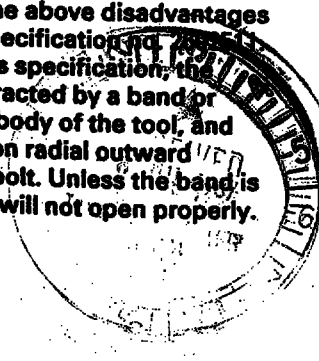
One example of a prior art cement basket tool which suffers certain of the above disadvantages is shown in U.S. patent specification and 1995. In the device shown in this specification, the cement basket is held retracted by a band or strap passing around the body of the tool, and the basket is released upon radial outward movement of a retaining bolt. Unless the band is fully released, the basket will not open properly.

further, the tool contains a ball valve positively preventing fluids in the bore entering the casing as the tool is lowered, so that the tool tends to float which can cause problems.

In contrast to the prior art, we have now devised a cementing tool which provides for automatic fill-up of the casing as it is lowered into the well bore, and also avoids the use of tie bands thus improving the reliability of the complete release of the cement basket for expansion against the well bore wall by contact with the cement stream being pumped into the well bore annulus.

According to the present invention, there is provided a cementing tool comprising: tubular mandrel means, a generally annular recess formed externally of said mandrel, and a plurality of circumferentially spaced slots through the wall of said mandrel; cement basket means having end ring means and a plurality of upwardly extending stave means, said cement basket means surrounding said mandrel means and being secured thereto by shear means associated with said end ring means of said cement basket means, so that the upper ends of said stave means extend into and are temporarily retained by said recess; flapper valve means having an axial bore therethrough and a spring-biased flapper, said flapper valve means being secured to the interior of said mandrel means; ball seat means slidably disposed within said mandrel means below said flapper valve means, said ball seat means having an axial bore therethrough with a ball seat therein, and shear means extending therefrom through said slots into tubular activating sleeve means surrounding said mandrel means under said cement basket means between said recess and said end ring means; and fill-up tube means secured to said ball seat means in said axial bore thereof and extending upward therefrom into said flapper valve means bore.

In one preferred embodiment of tool according to the invention, there is a substantially tubular mandrel and a cement basket slidably disposed on the exterior thereof. The lower end of the basket is secured to the mandrel by shear screws, and the upper end of the basket is maintained in a closed mode by an annular overshot on the coupling at the upper end of the mandrel. A flapper valve assembly is located within the mandrel, with a slidable ball seat disposed therebelow, the ball seat having fixed thereto a fill-up tube which extends upward into the flapper valve orifice. The ball seat is secured to a substantially tubular activating sleeve slidably disposed on the exterior of the mandrel, under the cement basket, by a plurality of shear rods extending through cementing ports in the mandrel. The activating sleeve is maintained in its initial position by contact with the bottom of the cement basket. As the casing is lowered into the well bore with the combination cementing shoe and basket of the present invention at its lower end, the casing fills automatically through an



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orifice in the nose at the bottom of the mandrel, due to the fact that the flapper valve is held open by the fill-up tube. The orifice size can be easily changed or selected for varying well conditions and desired rate of fill-up. After the casing reaches the desired depth, a tripping ball is pumped down through the casing to the ball seat, whereupon the fluid pressure acts through the plurality of shear rods, and the activating sleeve on the lower end of the cementing basket to shear the shear screw. The shearing of the latter permits the cement basket to slide downward, the top thereof being thereby freed from the coupling overshot. Continuance of fluid pressure in the casing results in the plurality of shear rods being sheared, and the ball, ball seat and fill-up tube moving to the bottom of the mandrel, releasing the valve flapper and uncovering the cementing ports in the mandrel wall. The subsequent introduction of the cement stream under pressure into the well bore annulus through the cementing ports expands the cement basket by direct contact therewith, preventing damage to the formation below. At the conclusion of the cementing operation, the flapper valve prevents the cement from flowing back into the casing interior. After the cement has set, the interior components of the apparatus of the present invention can be drilled out.

One embodiment of the combination cementing shoe and basket of the present invention will now be described, by way of example only, with reference to the accompanying drawings, wherein:

FIGURE 1 is a vertical full section elevation of the combination cementing shoe and basket as it is run into the well bore at the end of a casing string;

FIGURE 2 is a vertical full section elevation of the combination after the tripping ball has been dropped therein, and the basket released;

FIGURE 3 is a vertical full section elevation of the combination after the ball seat has been pumped to the bottom of the mandrel, the flapper valve released, and cement flow commenced; and

FIGURE 4 is a vertical full section elevation of the combination after cementing is completed and pumping stopped.

Referring to Figure 1, casing string 2 having bore 4 is being lowered into well bore 6 defined by well bore wall 8. Well bore annulus 10 lies between casing string 2 and well bore wall 8.

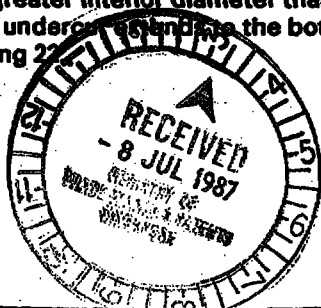
The combination cementing shoe and basket 20 of the present invention is lowered into well bore 6 at the end of casing string 2 being secured thereto by coupling 22 at threads 24. Coupling 22 possesses a substantially cylindrical exterior 26, its interior having upper internal threads 28 separated from lower internal threads 32 by unthreaded cylindrical surface 30. Below lower internal threads 32 lies annular undercut surface 34 of greater interior diameter than threads 32, which undercuts extend to the bottom of coupling 22.

Tubular mandrel 40 is secured to coupling 22 above it via external threads 42 which mate with lower internal threads 32. As the exterior 44 of mandrel 40 is of somewhat lesser diameter than undercut surface 34 of coupling 22, the overshot bottom 36 of coupling 22 defines annular recess 38 which is open at its bottom. Tubular mandrel 40 has a substantially cylindrical interior 46. Mandrel 40 is pierced by a plurality of circumferentially spaced slots 48 near its upper end. The bottom of mandrel 40 has external threads 50 thereon, which mate with internal threads 54 at the top of nose 52, which has a substantially cylindrical exterior surface 56 leading to substantially hemispherical bottom surface 58, in which an aperture has been cut and the aperture walls threaded at 60. Orifice plate 62 having orifice 64 therein and threads 66 on its perimeter is threaded to nose 52. The upper interior wall of nose 52 below, threads 54 has annular recess 68 cut therein, below which inner surface 70 follows the curvature of hemispherical bottom surface 58.

At the top of combination cementing shoe and basket 20, valve assembly 80 having external threads 82 thereon is threaded to upper internal threads 28 on coupling 22. Valve assembly 80 includes valve body 84, which possesses an axial bore 86 therethrough, bore 88 being defined by upper frustoconical bore wall 88, upper cylindrical bore wall 90, lower frustoconical bore wall 92, and lower cylindrical bore wall 94. The right-hand side (in FIG. 1) of lower cylindrical bore wall 94 has been milled away to provide recess 96. At the top of recess 86 is longitudinal bore 98, into which the end of spring 100 is inserted, spring 100 being wrapped around pin 102 from which flapper 104 is suspended by two arms (unnumbered), the intermediate portion 108 of spring 100 pressing against flapper 104 to rotationally bias it to a closed position seated against lower frustoconical bore wall 92. Flapper 104 is of circular configuration, the circumference of which possesses annular recess 108 which holds elastomeric seal 110.

Ball seat 120 is secured in mandrel 40 below valve body 84. Ball seat 120 has a substantially cylindrical exterior 122, and axial bore 124 through its interior. Bore 124 is defined by upper frustoconical surface 126, upper cylindrical surface 128 having threads thereon, radially flat surface 130 leading inward to frustoconical seat 132, lower cylindrical surface 134, and lower frustoconical surface 136, which exits on radially flat bottom surface 138 of ball seat 120. Fill-up tube 140 has threads 142 at its lower end, which threads mate with those on surface 128 of ball seat 120. The top of fill-up tube 140 extends upwardly into axial bore 86 of valve body 84, to the juncture of bore wall 88 and bore wall 90. Flapper 104 is maintained in an open position by fillup tube 140.

Shear rods 150 extend from ball seat 120 through slots 48 in tubular mandrel 40 into activating sleeve 160, which is also of tubular



configuration. Activating sleeve 160 rests on inner sleeve 172 of cement basket 170. Inner sleeve 172 is secured to mandrel 40 by shear screw 174, which is of lesser shear strength than shear screws 150. End ring 176 is welded to inner sleeve 172, and a plurality of basket staves 178 are in turn welded to end ring 176. Heavy duty canvas 179 (not shown in FIG. 1, see 25 FIG. 2) or other tough, abrasion and rip-resistant fabric is riveted inside staves 178 to fill the gaps between staves as cement basket 170 expands. The upper ends 180 of staves 178 are tucked under overshot 36 of coupling 22 prior to shear screw 174 being inserted. Overshot 36 thus maintains staves 178 and thus basket 170 in a collapsed state until activated.

Referring now to FIGS. 1-4, the operation of the preferred embodiment is described hereafter. As noted previously, combination cementing shoe and basket 20 is run into well bore 6 at the end of casing string 2. The well bore 6 is filled with fluid, such as drilling fluid, and the casing gradually fills as it is "floated" down into the well bore, the rate of fill being generally determined by the size orifice 64 in orifice plate 62. Flapper 104 is held open by fillup tube 140. As the casing string 2 reaches the depth desired, a weighted tripping ball 200 (FIG. 2) is dropped to combination cementing shoe and basket 20, where it enters axial bore 86 of valve assembly 80, and goes down the interior of fillup tube to frustoconical seat 132 in ball seat 120. At this point, fluid pressure is applied in casing bore 4, which acts on ball seat 120 due to the fact that tripping ball 200 is blocking bore 124. The downward force on ball seat 120 is transmitted to inner sleeve 172 through activating sleeve 160 and shear rods 150. Shear screw 174, which secures inner sleeve 172 and cement basket 170 as a whole to mandrel 40 shears, and cement basket 170 drops a longitudinal distance equal to the height of slots 48 in mandrel 40. This drop pulls basket staves 178 out from under overshot 36 whereupon they spring outward to the well bore wall 8, canvas 179 forming a frustoconical cup. The inner sleeve 172 and end ring 176 of cement basket 170 rest against the top of nose 52, which protrudes outwardly beyond mandrel 40.

Continued pressure in casing bore 4 will cause shear rods 150 to shear against the bottom of slots 48, causing ball seat 120 with ball 200 in fill-up tube 140 to fall into nose 52. The removal of fill-up tube 140 from axial bore 86 of valve body 84 releases flapper 104 to hold back pressure after the cementing job is finished.

Cement is pumped down casing bore 4 after ball seat 120 moves down to nose 52, the cement entering well bore annulus 10 through slots 48 (FIG. 3), after which it travels upward in the annulus to the desired level, downward movement of cement being prohibited by the cement basket 170 which is expanded against well bore wall 8. The lateral contact of the cement stream through slots 48 against cement basket 170 as well as the relatively greater weight

of the cement with respect to the well bore fluid, and the fluid pressure differential above and below the cement basket 170 will ensure its complete expansion (FIGS. 3 and 4). For purposes of clarity, cement has not been shown inside the tool 20 in any view even though it would obviously be full of cement in FIGS. 3 and 4.

After cementing is finished and the pumping is stopped, reentry of cement into casing bore 4 is prevented by flapper 104 sealing against surface 92 with the assistance of elastomeric seal 110 at its periphery. After the cement in annulus 10 hardens, all interior components of combination cementing shoe and basket 20 can be drilled out, leaving an open bore of substantially the same inner diameter as casing string 2.

Thus it will be apparent that a novel and unobvious combination cementing shoe and basket has been invented, having the capability to replace three existing prior art devices and to overcome the disadvantages thereof. In particular, the advantages of the present invention include the removal of the need for a tie band gives a significant advantage over prior art cement baskets, and the avoidance of the need for a prior art cementing collar as well as a shut-off plug such as is needed in those prior art cementing collars, and the avoidance of the need for a float valve. It will further be understood that the present invention may be used in more than one location in a casing string, as long as the ball and ball seat size of each lower tool is smaller than that of the one immediately above it.

Certain additions, deletions and modifications to the present invention as disclosed herein in its preferred embodiment will also be apparent to one of ordinary skill in the art, for example, a cement basket employing overlapping staves or leaves might be employed in the present invention; the present invention might be configured as a collar instead of a shoe and placed further up in the casing string if desired. A rod secured to the ball seat and extending upward into the valve assembly bore may be employed in lieu of the fill up tube to initially maintain the flapper in an open position.

Claims

1. A cementing tool comprising: tubular mandrel means (40), a generally annular recess (38) formed externally of said mandrel, and a plurality of circumferentially spaced slots (48) through the wall of said mandrel; cement basket means (170) having end ring means (176) and a plurality of upwardly extending stave means (178), said cement basket means surrounding said mandrel means and being secured thereto by shear means (174) associated with said end ring means of said cement basket means, so that the upper ends (180) of said stave means extend into and are temporarily retained by said recess; flapper valve means (80) having an axial bore (86)

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configuration. Activating sleeve 160 rests on inner sleeve 172 of cement basket 170. Inner sleeve 172 is secured to mandrel 40 by shear screw 174, which is of lesser shear strength than shear screws 150. End ring 176 is welded to inner sleeve 172, and a plurality of basket staves 178 are in turn welded to end ring 176. Heavy duty canvas 179 (not shown in FIG. 1, see 25 FIG. 2) or other tough, abrasion and rip-resistant fabric is riveted inside staves 178 to fill the gaps between staves as cement basket 170 expands. The upper ends 180 of staves 178 are tucked under overshoot 36 of coupling 22 prior to shear screw 174 being inserted. Overshoot 36 thus maintains staves 178 and thus basket 170 in a collapsed state until activated.

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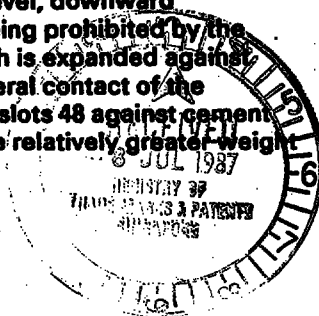
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(12)

therethrough and a spring-biased flapper (104), said flapper valve means being secured to the interior of said mandrel means; ball seat means (120) slidably disposed within said mandrel means below said flapper valve means, said ball seat means having an axial bore (124) therethrough with a ball seat (120) therein, and shear means (150) extending therefrom through said slots into tubular activating sleeve means (160) surrounding said mandrel means under said cement basket means between said recess and said end ring means; and fill-up tube means (140) secured to said ball seat means in said axial bore thereof and extending upward therefrom into said flapper valve means bore.

2. A tool according to claim 1, wherein said tubular mandrel means has a coupling (22) secured to the top thereof, said coupling having a downward extending annular overshoot (36) at the lower end thereof protruding over the exterior of said mandrel to form said recess.

3. A tool according to claim 1 or 2, wherein said mandrel means has a nose means (58) at the bottom thereof, said nose means having an orifice (64) therethrough, said orifice preferably being formed in a removable orifice plate (62) in said nose, whereby the size of said nose orifice may be varied by replacement of said orifice plate.

4. A tool according to claim 1, 2 or 3, wherein said flapper valve means is secured to said coupling at the top of said mandrel, and further includes frustoconical flapper seat means (92) in said axial bore, said flapper of said flapper valve means being rotationally upwardly biased toward contact with said flapper seat means.

5. A tool according to claim 1, 2, 3 or 4, wherein said ball seat is a frustoconical surface located below the end of said fill-up tube means.

6. A tool according to any of claims 1 to 5, wherein said cement basket means further includes fabric means (179) secured to and extending between said stave means, whereby a generally frustoconical cup is formed when the upper ends of said stave means are released from said recess to expand radially outwardly of said mandrel.

7. A tool according to any of claims 1 to 6, wherein said stave means are welded to the inside of an end ring of said end ring means, and said end ring is welded at its lower extent to an inner sleeve (172) closely surrounding said mandrel means.

8. A tool according to claim 7, wherein said activating sleeve means rests upon said inner sleeve.

9. A tool according to any of claims 1 to 8, wherein said fill-up tube means comprises a fill-up tube threaded to the interior of said ball seat means bore above said ball seat.

Patentansprüche

1. Zementierungswerkzeug, enthaltend: Halterohrmittel (40), eine allgemein ringförmige Ausnehmung (38) an der Außenseite des Halterohrs, eine Vielzahl von umfangsmäßig im Abstand voneinander angeordneten Schlitzen (48), die sich durch die Wandung des Halterohrs erstrecken; Zementkorbmittel (170) mit Endringmitteln (176) und einer Vielzahl von aufwärts verlaufenden Stabmitteln (178) und welche Zementkorbmittel die Halterohrmittel umgeben und daran durch den Endringmitteln der Zementkorbmittel zugeordnete Schermittel (174) befestigt sind, so daß die oberen Enden (180) der Stabmittel in die Ausnehmung verlaufen und dadurch vorübergehend gehalten werden; Klappenventilmittel (80) mit einer Axialbohrung (86), die sich durch die Klappenventilmittel hindurch erstreckt, und mit einer durch eine Feder vorgespannte Klappe (104), welche Klappenventilmittel am Inneren der Halterohrmittel befestigt sind; Kugelsitzmittel (120), die unterhalb der Klappenventilmittel gleitbeweglich in den Halterohrmitteln angeordnet sind und eine durch die Kugelsitzmittel hindurch verlaufende Axialbohrung (124) mit einem darin befindlichen Kugelsitz (120) und Schermittel (150) aufweisen, die sich von den Kugelsitzmitteln durch die Schlitze in rohrförmige Betätigungshülsenmittel (160) erstrecken, die die Halterohrmittel unter den Zementkorbmitteln zwischen der Ausnehmung und den Endringmitteln umgeben; und Auffüllrohrmittel (140), die an den Kugelsitzmitteln in deren Axialbohrung befestigt sind und sich von dort aufwärts in die Bohrung der Klappenventilmittel erstrecken.

2. Werkzeug nach Anspruch 1, dadurch gekennzeichnet, daß die Halterohrmittel eine an deren oberem Ende befestigte Kupplung enthalten, die an ihrem unteren Ende ein abwärts verlaufendes, überschließendes ringförmiges Teil besitzt, das unter Ausbildung der Ausnehmung außen über die Halterohrmittel vorspringt.

3. Werkzeug nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Halterohrmittel an ihrem unteren Ende Nasenmittel (58) mit einer durch diese hindurch verlaufenden Öffnung (64) aufweisen, welche Öffnung vorzugsweise in einer ausbaubaren Öffnungsplatte (62) in der Nase ausgebildet ist, wodurch die Größe der Nasenöffnung durch Austausch der Öffnungsplatte verändert werden kann.

4. Werkzeug nach Anspruch 1, 2 oder 3, dadurch gekennzeichnet, daß die Klappenventilmittel an der Kupplung am oberen Ende der Halterohrmittel befestigt sind und ferner in der Axialbohrung kegeltumpfförmige Klappensitzmittel (92) enthalten, gegen die und zur Berührung mit denen die Klappe der Klappenventilmittel drehbar nach oben vorgespannt ist.

5. Werkzeug nach Anspruch 1, 2, 3 oder 4, dadurch gekennzeichnet, daß der Kugelsitz eine



kegelstumpfförmige Fläche ist, die sich unter dem Ende der Auffüllrohrmittel befindet.

6. Werkzeug nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß die Zementkorbmittel ferner Gewebemittel (179) enthalten, die an den Stabmitteln befestigt sind und zwischen diesen verlaufen, wodurch ein allgemein kegelstumpfförmiger Becher gebildet wird, wenn die oberen Enden der Stabmittel aus der Ausnehmung gelöst werden und sich von den Halterohrmitteln radial nach außen ausdehnen.

7. Werkzeug nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß die Stabmittel innenseitig an einen Endring der Endringmittel angeschweißt sind und der Endring in seinem unteren Bereich an eine Innenhülse (172) angeschweißt ist, die die Halterohrmittel eng umgibt.

8. Werkzeug nach Anspruch 7, dadurch gekennzeichnet, daß die Betätigungshülsenmittel auf der Innenhülse aufsitzen.

9. Werkzeug nach einem der Ansprüche 1 bis 8, dadurch gekennzeichnet, daß die Auffüllrohrmittel ein Auffüllrohr enthalten, das oberhalb des Kugelsitzes mit dem Inneren der Kugelsitzmittel verschraubt ist.

Revendications

1. Outil de cimentation comprenant: des moyens formant mandrin tubulaire (40), un évidement de forme générale annulaire (38), formé à l'extérieur dudit mandrin, une pluralité de fentes (48) espacées circonférentiellement formées à travers la paroi dudit mandrin; des moyens formant panier à ciment (170) possédant des moyens formant un anneau d'extrémité et une pluralité de moyens formant douves (178) qui s'étendent vers le haut, lesdits moyens formant le panier à ciment entourant lesdits moyens formant mandrin et étant fixés à celui-ci par des moyens de cisaillement (174) associés auxdits moyens formant anneau d'extrémité desdits moyens formant panier à ciment, de sorte que les extrémités supérieures (180) desdits moyens formant douves sont engagés dans ledit évidement et sont retenus temporairement dans ledit évidement; des moyens formant clapet à volet (80) comprenant un perçage axial traversant (86) et un volet (104) sollicité élastiquement, lesdits moyens formant clapet à volet étant fixés à l'intérieur desdits moyens formant mandrin; des moyens formant siège de bille (120) disposés coulissants dans lesdits moyens formant mandrin, au-dessous desdits moyens formant clapet à volet, lesdits moyens formant siège de bille étant traversés d'un perçage axial (124) muni intérieurement d'un siège de bille (120), et des moyens de cisaillement (150) qui partent desdits moyens formant siège en traversant lesdites fentes pour pénétrer dans des moyens formant manchon tubulaire d'activation (160) qui entourent lesdits moyens formant mandrin au-dessous desdits moyens formant panier à ciment.

entre ledit évidement et lesdits moyens formant anneau d'extrémité; et des moyens formant tube de remplissage (140), fixés auxdits moyens formant siège de bille dans ledit perçage axial de ces moyens et qui s'étendent vers le haut à partir de ces moyens formant siège pour pénétrer dans ledit perçage des moyens formant clapet à volet.

2. Outil selon la revendication 1, dans lequel lesdits moyens formant mandrin tubulaire portent un raccord (22) fixé à leur extrémité supérieure, ledit raccord possédant à son extrémité inférieure un prolongement annulaire (36) qui se prolonge vers le bas et fait saillie au-dessus de la surface extérieure dudit mandrin pour former ledit évidement.

3. Outil selon la revendication 1 ou la revendication 2, dans lequel lesdits moyens formant mandrin comprenant des moyens (58) formant nez à leur base, lesdits moyens formant nez étant percés d'un orifice (64), ledit orifice étant de préférence formé dans une plaque à orifice amovible (62) logée dans ledit nez, de sorte que la dimension de l'orifice dudit nez peut ainsi être modifiée par remplacement de ladite plaque à orifice.

4. Outil selon l'une des revendications 1, 2 et 3, dans lequel lesdits moyens formant clapet à volet sont fixés audit raccord en haut dudit mandrin, et qui comprend en outre des moyens tronconiques (92) formant siège de clapet dans ledit perçage axial, ledit volet desdits moyens formant clapet à volet étant sollicité vers le haut par un mouvement rotatif pour entrer en contact avec lesdits moyens formant siège de clapet.

5. Outil selon l'une des revendications 1, 2, 3 et 4, dans lequel ledit siège de bille est une surface tronconique située au-dessous de l'extrémité desdits moyens formant tube de remplissage.

6. Outil selon l'une quelconque des revendications 1 à 5, dans lequel lesdits moyens formant panier à ciment comprennent en outre des moyens en tissu (179) fixés auxdits moyens formant douves et s'étendant entre ces moyens, de sorte qu'il se forme une cuvette de forme générale tronconique lorsque les extrémités supérieures desdits moyens formant douves sont libérées dudit évidement pour se déployer radialement vers l'extérieur dudit mandrin.

7. Outil selon l'une quelconque des revendications 1 à 6, dans lequel lesdits moyens formant douves sont soudés à la face interne d'un anneau d'extrémité desdits moyens formant anneau d'extrémité et ledit anneau d'extrémité est soudé, dans sa région inférieure, à un manchon intérieur (172) qui entoure étroitement lesdits moyens formant mandrin.

8. Outil selon la revendication 7, caractérisé en ce que lesdits moyens formant manchon d'activation reposent sur ledit manchon intérieur.

9. Outil selon l'une quelconque des revendications 1 à 8, dans lequel lesdits moyens formant tube de remplissage comprennent un tube de remplissage vissé sur l'intérieur dudit perçage des moyens formant siège de bille, au-dessus dudit siège de bille.

