Nov. 20, 1956 F. F. LEWIS 2,771,141

JET WALL CLEANER

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Fig. 1

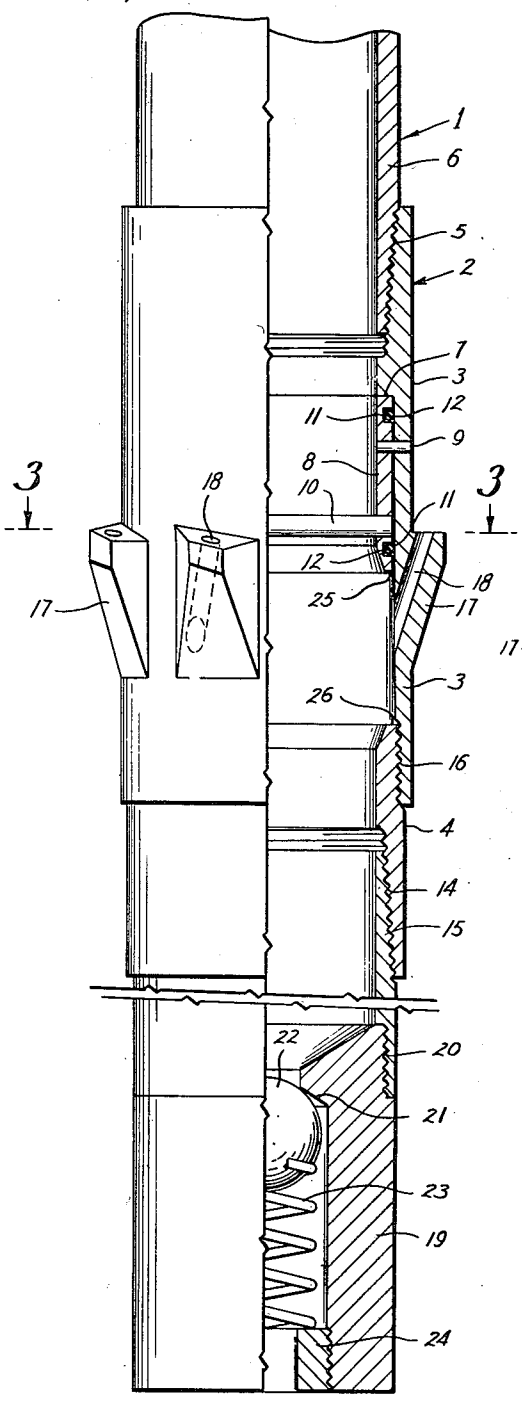
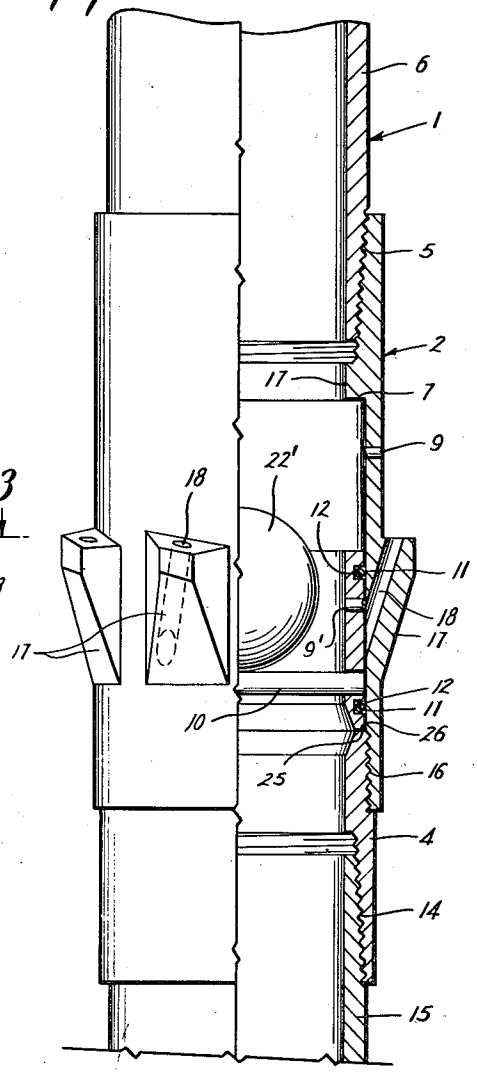


Fig. 2



Farral F. Lewis
INVENTOR.

BY Geo. C. Helmig
+ Wm. E. Ford
ATTORNEYS

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Fig. 4

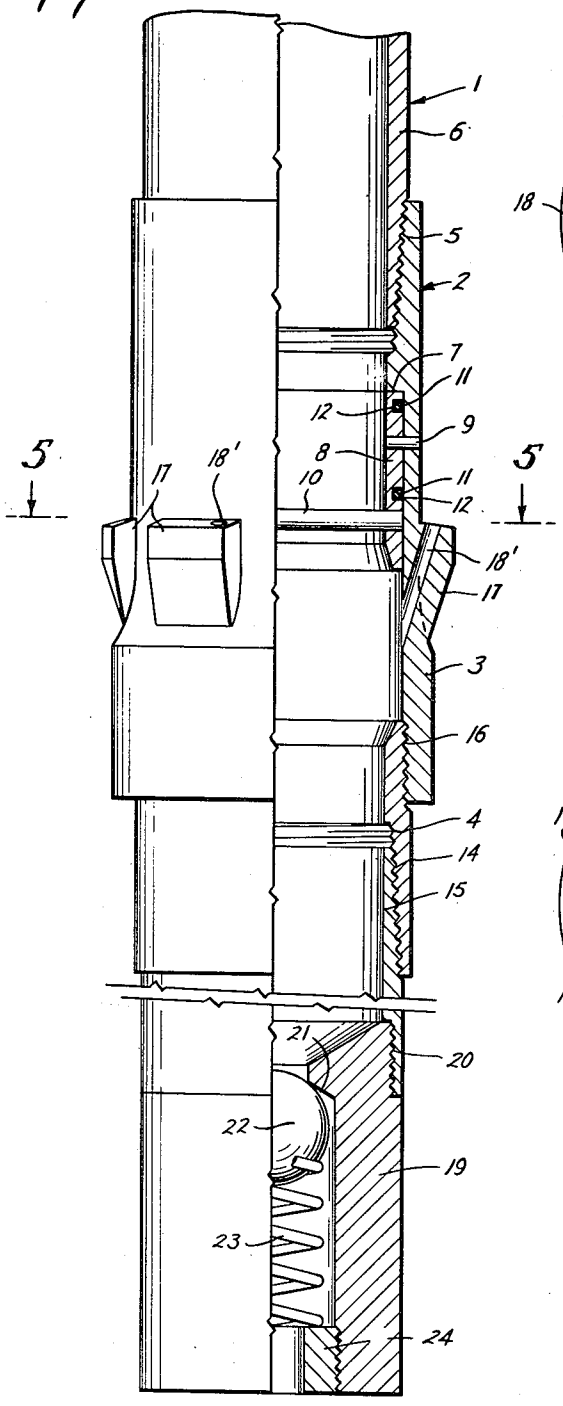


Fig. 3

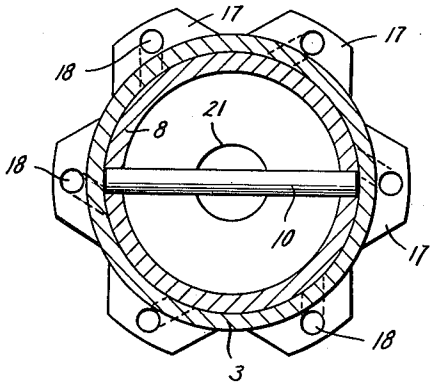
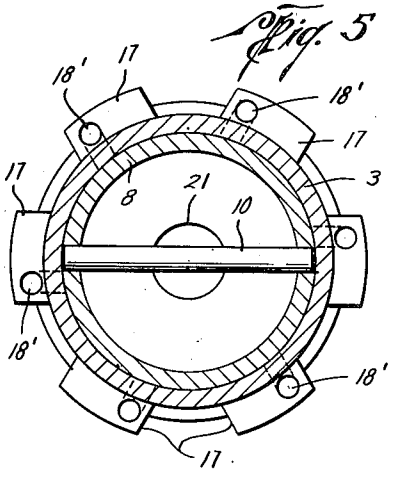


Fig. 5



Farral F. Lewis
INVENTOR.

BY Geo. C. Helmig
+ Wm. E. Ford
ATTORNEYS

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JET WALL CLEANER

Farral Francis Lewis, Shreveport, La., assignor of one-half to Gem Oil Tool Company, Inc., Lafayette, La., a corporation of Louisiana

Application September 3, 1953, Serial No. 378,332

6 Claims. (Cl. 166—222)

This invention relates to a jet wall cleaner for the purpose of cleaning deposits from a well bore, such as deposits which may have been formed on the well bore surface by a drilling mud circulated in the bore during the drilling process.

Heretofore it has been the practice to install on the casing exterior devices termed "scratchers" to scrape or scratch off the filter cake or mud deposit, thereby leaving open and accessible the lines of cleavage and crevices to communicate with the well bore. With such filter cake removed, the cement will flow into the surface pores and formation crevices and lines of cleavage to form a more effective and tenacious bond with the formation of the well bore and thereby firmly and positively stabilize and cement the casing in the bored hole.

Such scratchers constitute appendages or structures added outwardly of the casing proper and serve the sole purpose of eliminating filter cake. After they have carried out their scratching function they are cemented in the annulus between casing and well bore and are lost for any further service.

This invention sets out to avoid the use of scratchers, and has as one of its objects the provision of jet passages in the casing, drill pipe, or tubing assembly itself so that the cleaning of the well bore in a region to be cemented may be accomplished by the jetting of a solvent or cutting acid through such passages, and the directing of such jetted fluid against the well bore to effectively dissolve and scour any filter cake deposit formed thereon as by the drilling mud during drilling. At the same time the structure of this invention serves a function as an integral part of the casing string and does not amount to structure added exteriorly for a particular function which is lost for future service upon being cemented in, as is the case with conventional scratchers.

This invention also sets out to provide a structure for removing filter cake which may have been formed on a well bore which later may be plugged at some predetermined depth, as when it may be desired to deflect the well bore above such depth. In such case it is first desirable to remove the filter cake from the well bore in the plugging area so that the plugging cement will make a firm bond with the well bore. In this case a pipe string having the structure of this invention therein may be manipulated through such area to jet away the filter cake therefrom.

This invention also can be employed to wash out cavities, for instance, as when it may be desirable to enlarge the well bore at the location of a producing area below the casing at the bottom of the well to create a reservoir and to expose an enlarged well bore surface area to fluid flow. In such case this invention serves both as an underreamer to actually remove the formation by jetting to enlarge the bore to uncover a larger surface area through which formation fluids may flow and additionally this invention serves its normal function of jetting away the filter cake tending to form, or forming on the enlarged area surface. As a matter of practice, such enlarged bore areas are gravel packed to prevent sand and loose particles

from being displaced into the enlarged bore area. This invention can also serve to jet away any filter cake which may form on the enlarged area.

This invention particularly sets out to provide a pipe string having jetting means integrally formed therein to afford vertical selection of the area to be cleaned, as of filter cake, by its jetting action. Since the relative position of the jets in the pipe string are known, and since a pipe string can be lowered by measurement to any depth, a vertical control of the area to be cleaned by jetting is afforded. On the other hand the jets are so positioned, and may be so manipulated as to traverse the whole of a well bore.

It is therefore an object of this invention to provide jetting means installable in a pipe string as an integral part thereof and not as an exterior attachment thereto.

It is also an object of this invention to provide a jetting device included in the casing, drill pipe, or tubing, which is so constructed as to throughly take in the whole well bore surface in its jetting action.

It is still a further object of this invention to provide a means to occlude the jet passages from communication with the casing exterior after such passages have served their function, and to do this without producing stoppage or diminution of free fluid flow down the casing interior.

It is still another object of this invention to provide a pipe string in which the jet passage occluding means is of no smaller inner diameter than the casing, thereby providing against obstructing fluid flow down the pipe string or the obstruction of the working diameter of the pipe string.

Other or further objects will be apparent when the specification is considered in connection with the drawings in which:

Fig. 1 is an elevation, part in section, showing a pipe string equipped with the jet wall cleaner of this invention; and in such elevation the jet passages are shown in communication with the space exterior of the pipe string.

Fig. 2 is an elevation, part in section, of the assembly shown in Fig. 1, but with the jet passages being shown occluded.

Fig. 3 is a sectional plan taken along lines 3—3 of Fig. 1.

Fig. 4 is an elevation, part in section, showing a modified embodiment of jet cleaner passage.

Fig. 5 is a sectional plan view taken along line 5—5 of Fig. 4.

In the embodiment shown in the drawings a tubular string, as a casing 1 has installed therein a jet wall cleaner 2, which is shown comprising a tubular body 3 and an adapter 4. Upwardly, such body 3 is internally threaded at 5 to receive therein the pin end 6 of the upper part of the casing 1. Such body 3 is counterbored to provide the shoulder 7 against which the tubular closure or sleeve valve 8 bears upwardly when such closure is fixed in upper position by means of the shear pin 9 which connects the closure device 8 to the body. Transversely, across the tubular valve 8 there extends the cross-pin 10. Also the tubular closure has the peripheral grooves 11, 11 therein to receive the seal rings 12, 12.

The adapter 4 is threaded internally at its lower end 14 to receive therein the pin end 15 at the top of the lower portion of the casing 1. The upper end of such adapter 4 is threaded externally at 16 to receive thereon the lower end of the body 3. Preferably the inner diameter of the body 3, the inner diameter of the closure 8, and the inner diameter of the adapter 4, are substantially the inner diameter of the casing 1 so as to provide an uninterrupted flow passage down the casing.

The body 3 has the external projections or bosses 17 spaced apart circumferentially at intervals about its outer diameter.

Such bosses 17 have passages 18 extending therethrough for controlled pressure stream ejection from the casing interior and against the bore wall of a cleaning and flushing fluid introduced into the top of the casing and controlled from the ground surface. As seen in the sectional half of Fig. 1 of the drawing, each velocity jet nozzle passage 18 is laterally inclined upwardly and outwardly from the casing interior on an axis oblique or divergently related to the longitudinal extent of the casing wall and, as shown by dotted lines in the elevational half of Fig. 1, is also vertically inclined to a longitudinal plane containing the casing axis and intersecting the axis of the passage and the discharge mouth of the velocity jet passage is outside the exterior wall surface of the body 3 above the boss and faces upwardly in the external shoulder afforded by the top face of the boss 17. In Fig. 3, the nozzle passages are shown as lying in vertical planes parallel to the casing axis in each instance and equidistant from the axis, so that the nozzle passages lie in planes which are substantially tangential to the inner wall of the casing. Accordingly, the pressure jetting streams are all directed outwardly of the casing to wipe against the wall of the well bore in swirling helical paths within the annular space surrounding the casing for an effective scouring action on the well bore surface.

The bottom of the casing is normally and originally closed by the check valve 19 which is connected at 20 to the casing and which provides the valve seat 21 for the ball seal 22. The ball 22 is pressed upwardly by the spring 23, which bears downwardly against the hollow stop plug 24, which is threadable into the valve to adjust the compression of such spring.

Thus the interior of the casing is provided with a pair of selectively effective valved outlets constructed by the relatively large passage controlled by the pressure responsive valve 22 and the relatively small jet passage 18 controlled by the closure sleeve 8. In normal operation under the pressure of the fluid in the pipe string or casing, the valve 22 is closed while the jet passages 18 are opened. Also, the structure of this invention is employable where the bottom of the casing, tubing, or pipe string may be completely plugged. However, under certain conditions the open jets are initially in by-passing relation to the larger outlet and tend to relieve any pressure buildup which would otherwise be sufficient to open the pressure responsive valve 22.

In the embodiment of the invention shown in Figs. 4 and 5 the passages 18' provided in the body 3 are directed upwardly and outwardly in vertical planes parallel to the body axis but relatively nearer the casing axis and only slightly offset from the radial as compared to the Figs. 1–3 embodiment, and the passages 18' terminate in discharge mouths in the outwardly and downwardly inclined upper faces of the external bosses 17. The jet passages are thus arranged for ejecting fluid to strike the well bore surface at acute scraping angles thereto.

In operation a solvent, as a cutting acid, is pumped down the casing at a pressure controlled by the relief valve 19, and under sufficient pressure to flow with force out of the passages 18 or 18', when the pin 9 holds the closure 8 in upper position. There are enough of such passages circumferentially spaced about the body 3, and the passages are of sufficiently large diameter, to insure that the ejected fluid substantially contacts all of the surface of the well bore surrounding the casing. To further insure that such coverage is obtained, a number of jet wall cleaners 2 may be installed in the casing 1 at axially spaced apart intervals as required.

After the well bore wall has been effectively cleaned by the jetted fluid, and is conditioned for cementing the casing into place, it is desirable to close the jet passages 18 for preventing fluid loss from the casing during subsequent oil production. Accordingly, a weight 22' may be dropped or lowered into the casing to provide sufficient impact on the cross pin 10 to shear the pin 9. The closure 8 may now slide downwardly, and the weight on the cross-pin 10 further insures such sliding, until the lower end 25 of the closure 8 lodges upon and is stopped as seen in Fig. 2, by the upper end face 26 of the adapter 4. The passages 18 or 18' are now occluded by the closure 8, while the seals 12, 12 seal above and below such passages. A cement slurry under pressure is now introduced through the casing for flow past the valve 21 and upwardly about the lower end of the casing for firm adherence to the cleaned bore surface and the exterior of the casing for sealing off the well bore.

In case more than one jet wall cleaner is provided in axially spaced apart position, it may be necessary to employ a heavier weight to shear cross-pin 10 of an upper window prior to employing the weight method to move a lower closure into passage occluding position.

What is claimed is:

1. In a well tubing tool for jetting a high velocity fluid stream from within the well tubing and in a swirling path over the side wall of a well bore in which the tubing may be fitted, a tube section having a series of circumferentially spaced external bosses which terminate at their upper ends in upwardly facing shoulders projecting outwardly of the tube section wall and a pressure fluid jetting passage extending upwardly through each boss from the tube section interior and terminating in an upwardly directed discharge mouth in the upwardly facing shoulder of the boss and said passage extending on an axis which lies in a plane parallel to a longitudinal plane containing the axis of the tube section and is outwardly divergently related to the longitudinal extent of the tube section wall.

2. In a well tool of the character described, a casing section insertable in a well casing string for co-operation with a pressure responsive cement ejecting valve constituting a part of an assembled casing string, a series of initially open velocity jet passages extending outwardly through the wall of the casing section and each having its discharge mouth directed for jet discharge on an axis in spaced parallelism with a longitudinal plane containing the axis of the casing section and diverging outwardly from the longitudinal extent of said casing section wall for a swirling action of the pressure fluid jetted therefrom in generally helical flow relation with the casing section, a jet closure sleeve valve slidably mounted inside said casing section, a stop abutment in the casing section engageable by said slidable sleeve valve in its jet passage closing position, a releasable connection between the slidable sleeve valve and the casing section initially holding the sleeve valve in position to uncover said jet passages and force applying means controlled from the ground surface and operable to release said connection and permit downward sliding of the closure sleeve valve into abutment engaging position.

3. Equipment for cleaning a well bore wall and then cementing a casing to the cleaned bore wall, including a tubular casing member having a cement ejecting passage at the lower terminal thereof, a spring seated valve closing said cement ejecting passage and outwardly yielding to fluid pressure thereon from within the casing to open said cement ejecting passage, a casing section having a series of circumferentially spaced cleaning fluid jets leading outwardly from the wall of the casing section above and in initially open by-pass relation with said cement ejecting passage and being directed to jet pressure cleaning fluid from within the casing section and against the bore wall opposite thereto, a closure ring for said circumferentially spaced cleaning jets slidably mounted within said casing section, a shear pin connection between said ring and the casing section holding the ring initially above and clear of said jets, a jar weight receiving seat on said ring projected inwardly of the casing diameter and into the descending path of a weight dropped into the casing and for the transmission into the closure ring of a ham-

mer jar to shear the pin connection and slide the ring downwardly into jet overlapping closure relation and an internal shoulder on the casing below said jets as a limit stop for downward ring travel and against which said ring seats in closing the by-pass relation of the jets to said cement ejecting passage.

4. Well bore cleaning and casing cementing equipment, including a casing section for assembly as a part of the lower terminal of a well casing string, a cement ejecting passage leading from said casing section, a normally closed valve for said passage responsive to fluid pressure internally of the casing section to open said passage, an initially open cleaning jet leading outwardly from the casing section in flow by-pass relation with said cement ejecting passage for directing a casing contained cleaning pressure fluid against the bore wall, a cleaning jet closure movably mounted by said casing section for movement between an inoperative position and a jet closing position and a releasable connection initially securing said closure in its inoperative position and means operable from the top of the well bore to release said connection and effect closure movement to its jet closing position.

5. Equipment for first cleaning a well bore wall and then cementing a casing to the wall, including a casing closure valve arranged to open in response to internal casing fluid pressure for the ejection of cement from the casing and into the well bore, a casing section having an initially open pressure fluid jetting passage in by-pass relation with said valve and directed outwardly of the casing wall to impinge a pressure jetted wall cleaning fluid stream from the casing and against the well bore wall for cleaning the same, a closure for said initially open jetting passage and a releasable connection initially fixing said closure to the casing section in open position and releasable at will from the ground surface for closure movement to a position occluding said jetting passage.

6. Equipment for cleaning a well bore wall and then cementing a portion of a tubing within the well bore, including a tubing portion to be cemented having a pair of passages leading outwardly therefrom, a pressure responsive valve normally closing one of said passages under a yieldable biasing force which is yieldable to open the valve in response to internal fluid pressure within the tubing portion and through which passage a cement slurry is to be ultimately ejected, the other of said passages being initially open and serving to relieve fluid pressure on said pressure responsive valve and to jet cleaning pressure fluid supplied to the tubing portion against the wall of the well bore for scouring the same in preparation for and the bonding thereto of cement subsequently ejected through said valve closed passage and an obturator for said initially open passage prefixedly connected in said tubing portion in operative position and releasable to an active position occluding said passage in readiness for the ejection past said pressure responsive valve of a charge of cement slurry introduced into said tubing portion.

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