April 14, 1953 K. A. WRIGHT 2,634,813

MULTIPLE WIRE SCRATCHER FOR WELLS

Filed Aug. 14, 1948

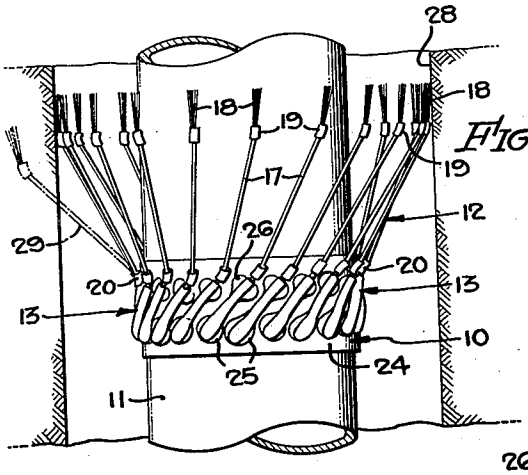


FIG. 1.

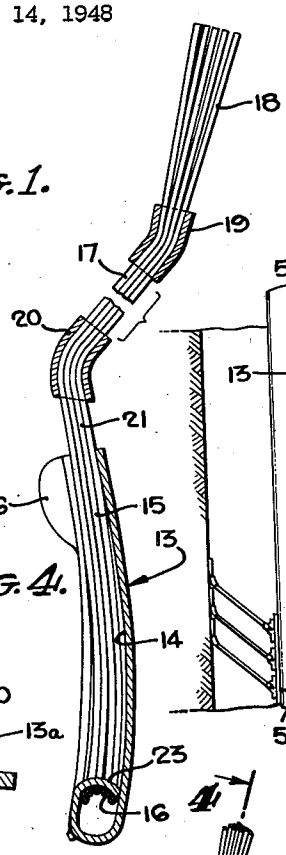


FIG. 4.

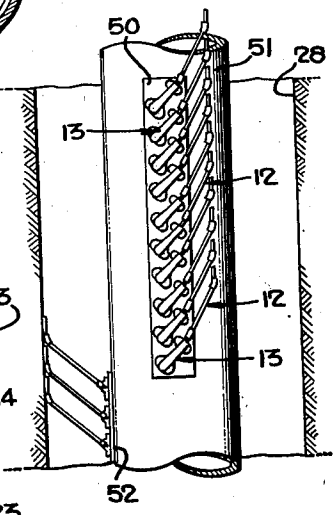


FIG. 6.

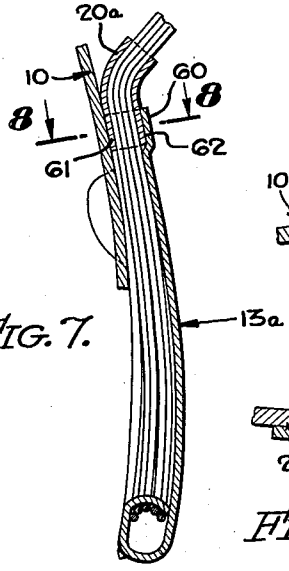


FIG. 7.

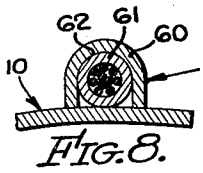


FIG. 8.

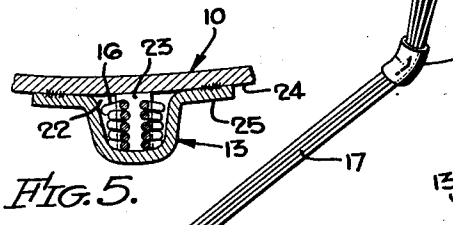


FIG. 5.

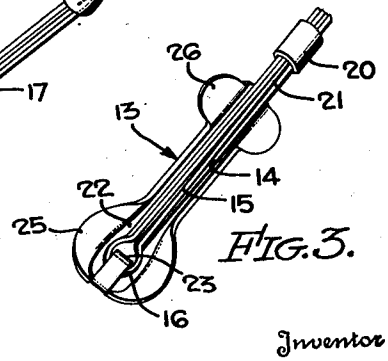


FIG. 3.

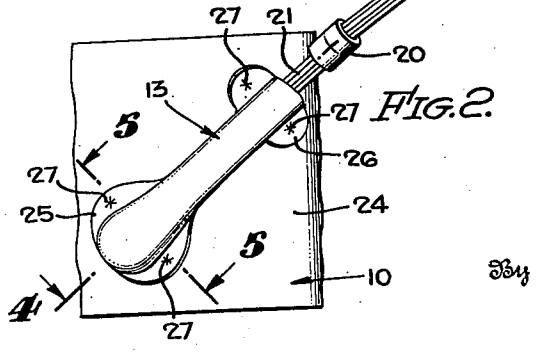


FIG. 2.

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MULTIPLE WIRE SCRATCHER FOR WELLS

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Application August 14, 1948, Serial No. 44,373

20 Claims. (Cl. 166—18)

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This invention relates to the well drilling art and is particularly directed to a cleaner or scratcher adapted to be carried on a pipe insertable into a well bore.

This application constitutes a continuation-in-part of my co-pending applications, "Finger for Well Cleaners or Scratchers," Serial No. 709,489; "Mud Cleaners Applicable to Well Casing or the Like," Serial No. 709,490; and "Well Cleaning and Centering Tool," Serial No. 709,491; all filed, November 13, 1946, and all now abandoned.

The principal object of the present invention is to provide an improved form of scratcher for wells employing multiple wire fingers and adapted to minimize disturbance of the mud cake while going into the well, but to provide effective means for removing the mud cake when raised upwardly within the well bore. An important use of this device is in connection with well cementing operations in which it serves to remove the mud cake and prevent its reforming, so that the cement may directly contact the wall of the hole and prevent channeling in the cement sheath.

Another object is to provide a scratcher device of this type having flexible fingers formed of wire bundles.

Another object is to provide such a device in which the flexibility of the fingers minimizes damage to the device which would otherwise be caused by the usual rough handling of scratcher-equipped well pipe, prior to insertion into a well bore.

A related object is to provide a sleeve adapted to be carried on the external surface of a well pipe such as a casing, and having a plurality of multliple wire scratcher fingers fixed on the outer periphery of the sleeve and extending upwardly and outwardly from the sleeve for contact with the wall of a well bore.

Another object is to provide reenforcement means for such multiple wire scratcher fingers positioned at the inner end of the multiple wire shank adjacent the retainer or body which secures the finger to the sleeve.

A further object is to provide a reenforcement at the inner end of the multiple wire shank and which projects within a recess provided at the forward end of the retainer, whereby the retainer and reenforcement cooperate to provide a bearing surface adjacent the inner end of the shank.

Other objects and advantages will appear hereinafter.

In the drawings:

Figure 1 is an elevation view partly broken away showing a multiple wire scratcher embodying my invention and positioned on a pipe extending into a well bore.

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Figure 2 is a perspective view showing one of the multiple wire scratcher fingers on an enlarged scale.

Figure 3 is a perspective view showing the underside of the retainer.

Figure 4 is a sectional view partly broken away taken substantially on the lines 4—4 as shown in Figure 2.

Figure 5 is a sectional detail taken substantially on the lines 5—5 as shown in Figure 2.

Figure 6 shows a modified form of my invention in which the individual scratcher fingers are mounted on strips carried on the external surface af a well pipe.

Figure 7 is a sectional view illustrating a further modification in which the reenforcement at the inner end of the shank is received in telescopic relation with the forward end of the retainer to provide a bearing surface.

Figure 8 is a sectional detail taken substantially on the lines 8—8 as shown in Figure 7.

Referring to the drawings, the carrier element or sleeve 10 is adapted to encircle a well pipe such as the casing 11. The sleeve may be fixed to the casing 11 by welding or by any other conventional means, or may be loosely mounted on the casing and positioned between the stop lugs (not shown) carried on the external surface of the casing 11. The sleeve 10 may comprise a single integral ring or it may be split for installation on casing having enlarged threaded connections at each end.

A plurality of multiple wire scratcher fingers generally designated 12 are fixed on the ring 10 and extend upwardy and outwardly therefrom. Each of these fingers 12 includes a retainer 13 having a channel 14 along its underside to receive a plurality of individual spring wires 15. The wires 15 are each doubled at their inner end 16 after the manner of a hairpin, and these wires project outwardly and upwardly in a group or bundle to form the shank 17 and tip 18. A tubular reenforcing collar 19 is positioned on the wire bundle between the tip 18 and shank 17 and is bent after assembly on the wire bundle so that a permanent set is effected whereby the tip 18 extends at an angle to the shank as shown. A similar tubular reenforcing collar 20 is bent after assembly on the wire bundle so that a permanent set is developed and so that the shank 17 extends at an angle to the attachment section 21. This angle is clearly shown in Figure 4.

The loop 16 on each pair of spring wires included in the bundle is positioned within an enlarged recess 22 provided within the retainer 13 at one end of the channel 14. A tongue 23 formed integrally with the body of the retainer 13 extends upwardly into the recess 22 and through the loop 16 of each of the spring wires. The channel 14 is proportioned so that the spring wires substantially fill the channel and rest against the external surface 24 of the sleeve 10. Enlarged looped ends 16 of the wires are wider than the width of the channel 14, and accordingly cannot be pulled out of the channel in an axial direction. The tongue 23 acts further to anchor the wires and prevents the doubled end of each wire from turning relative to the retainer 13.

Opposite ends of the retainer 13 are provided with pairs of tabs 25 and 26 which provide means for securing the retainer to the sleeve 10. Any suitable form of attachment may be used, but I prefer to spot weld the tabs 25 and 26 to the sleeve 10 as indicated at 27. Since the retainers are mounted in an inclined position on a cylindrical sleeve they are shaped after the manner of a helix and the tabs 25 and 26 are not positioned in the same plane.

The retainers 13 are mounted in inclined nested relation on the sleeve 10. Since it is desirable to employ a relatively large number of scratcher fingers on the sleeve and thus insure maximum cleaning ability of the tips 18 against the wall 28 of the well bore, the retainers 13 are mounted as close as possible to each other on the sleeve 10. One of the upper tabs 26 on each retainer projects between the upper and lower tabs on the next adjacent retainer as shown in Figure 1, and by this nesting arrangement a larger number of retainers may be secured on the periphery of the sleeve than could be accommodated if the parts were not nested. The angle of mounting of the retainers on the sleeve 10 and the angle of bend at the collars 19 and 20 is so chosen that when the fingers are deflected inwardly into contact with the well bore 28 from their normal free condition as indicated by the dotted lines 29 in Figure 1, the tip 18 of each of the fingers extends substantially vertically upwardly. In this way minimum resistance is offered to the mud cake which builds up within the bore hole during drilling operations when the sleeve 10 is moved downwardly in the bore hole.

When the sleeve 10 is moved upwardly within the bore hole the fingers 12 flex outwardly and the tips 18 engage the mud cake and remove it from the wall of the well bore. The flexing of the finger 12 occurs primarily along the shank 17 and the extending portion of the attachment section 21 and rotary movement of the bundle occurs within the forward portion of the channel 14 at the opposite end from the tongue 23. The reenforcing collar 20 performs the highly desirable function of maintaining the wires in assembled relation as a group adjacent the point of greatest stress on the wires. This serves to prevent separation of the individual wires adjacent the extending portion of the attachment section 21 and thus contributes toward reliable operation of the finger 12 under repeated flexing.

A single wire having a cross-section equal to the combined cross-sections of the bundle of wires illustrated and possessing the same physical properties would be incapable of flexing to the extent provided by the multiple wire bundle. This is true because the wires making up the shank 17 flex individually and hence the entire bundle may be deformed to the extent permitted by each of the relatively small wires, rather than to the lesser extent which would be permitted by a single wire having a cross-section equivalent to the total of the individual smaller wires. The provision of the reenforcing collar 20 insures that the individual wires shall not spread adjacent the attachment section 21, but on the contrary shall flex from a common location and thus provide flexing movement which is as uniform as would be provided by a single heavy wire.

In the modified form shown in Figure 6 the individual fingers 12 may be of the same form described above, but each of the retainers 13 is mounted on a vertically extending carrier element or strip 50 secured to the external surface of a well pipe 51. The retainers 13 are preferably mounted in nested relation in order to provide as many fingers as possible on the strip 50. Other strips 52 may be mounted on the pipe 51 and located at a different point on the circumference. These strips 50 and 52 are preferably positioned in overlapping relationship so that when the well pipe 51 is rotated no gap is left between the groups of fingers. The well pipe 51 may be raised and lowered in the hole during the cementing operations and simultaneously rotated if desired. In this way the mud cake is removed and prevented from reforming while the cement is sealing the annular space between the well pipe 51 and the bore hole 28.

In the modified form of my invention shown in Figures 7 and 8 the forward end 60 of the retainer 13*a* is extended and is adapted to receive a tubular projection 61 on the collar 20*a* in overlapping relationship. The bearing surface 62 is thereby provided between the retainer 13*a* and the reenforcing collar 20*a*. This inter-engagement and bearing surface contribute to the stability of the lower end of the shank 17 under flexing action and further insures reliable action of the finger under repeated flexing operations. The tubular projection 61 is maintained in contact with the forward end 60, since the projection 61 lies against the outer surface 24 of the sleeve 10.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth, but my invention is of the full scope of the appended claims.

I claim:

1. A multiple wire scratcher finger for wells of the type having a pipe inserted into the well bore, comprising a bundle of wires bent at spaced points to define a tip, a shank, and an attachment section; a bent reenforcing collar encircling the wire bundle at the bend between the attachment section and the shank to maintain the bend and to prevent spreading of the wires near said bend upon flexing of the shank; and means for securing the attachment section in position on the pipe with the wire bundle extending upwardly and outwardly from the pipe to contact the well bore wall.

2. A multiple wire scratcher finger for wells of the type having a pipe inserted into the well bore, comprising a bundle of wires bent at spaced points to define a tip, a shank, and an attachment section; a first bent reenforcing collar encircling the wire bundle at the bend between the attachment section and the shank to maintain the bend and to prevent spreading of the wires near said bend upon flexing of the shank; a second bent reenforcing collar encircling the wire

bundle at the bend between the shank and the tip; and means for securing the attachment section in position on the pipe with the wire bundle extending upwardly and outwardly from the pipe to contact the well bore wall.

3. A multiple wire scratcher finger for wells of the type having a pipe inserted into the well bore, comprising a bundle of wires bent at spaced points to define a tip, a shank, and an attachment section; a bent reenforcing collar encircling the wire bundle at the bend between the attachment section and the shank to maintain the bend and to prevent spreading of the wires near said bend upon flexing of the shank; and means for securing the attachment section in position on the pipe with the wire bundle extending upwardly and outwardly from the pipe to contact the well bore wall, said securing means including a retainer having a channel to receive the attachment section and means at one end of the channel for securing the ends of the wires against rotation.

4. In a well scratcher, the combination of a sleeve adapted to be mounted on a pipe insertable into a well bore; a plurality of multiple wire scratcher fingers carried on the sleeve, said fingers each including a bundle of wires extending upwardly and outwardly from the sleeve to engage the well bore wall and bent at spaced points to define a tip, a shank, and an attachment section; a bent reenforcing collar encircling the wire bundle at the bend between the attachment section and the shank to maintain the bend and to prevent spreading of the wires near said bend upon flexing of the shank; and retainers for securing each of the attachment sections in position on the periphery of the sleeve.

5. In a well scratcher, the combination of a carrier element adapted to be mounted on a pipe insertable into a well bore; a plurality of multiple wire scratcher fingers carried on the carrier element, said fingers each including a bundle of wires extending upwardly and outwardly from the carrier element to engage the well bore wall; means securing the lower end of each bundle in position on the carrier element; and a pair of spaced reenforcing collars fixed to and encircling each wire bundle at intermediate points along its length to define a shank portion therebetween, each pair of collars acting to prevent spreading of the wires under flexing action of the shank.

6. In a well scratcher, the combination of a relatively large diameter short length cylindrical sleeve adapted to be mounted on a pipe insertable into a well bore; a plurality of multiple wire scratcher fingers carried on the sleeve, said fingers each including a retainer having spaced tabs adapted to be joined to the outer surface of the sleeve, the retainers being positioned on the periphery of the sleeve in inclined position with their tabs in nested relationship, the fingers each including a bundle of wires extending from the upper end of each retainer and projecting upwardly and outwardly from the sleeve and beyond the upper end of the sleeve to engage the well bore wall.

7. A multiple wire scratcher finger for wells of the type having a pipe inserted into the well bore, comprising a bundle of wires bent to define an attachment section and a shank; a bent reenforcing collar encircling the wire bundle at the bend to maintain the bend and to prevent spreading of the wires near the bend upon flexing of the shank; a retainer provided with a channel to receive the attachment section, said retainer providing means for securing the bundle

of wires in position on the pipe with the wire bundle extending upwardly and outwardly from the pipe to contact the well bore wall; and means on the retainer at one end of the channel for receiving a portion of the collar in overlapping relation.

8. A multiple wire scratcher finger for wells of the type having a pipe inserted into the well bore, comprising a bundle of wires bent to define an attachment section and a shank; a bent reenforcing collar encircling the wire bundle at the bend to maintain the bend and to prevent spreading of the wires near the bend upon flexing of the shank; a retainer provided with a channel to receive the attachment section, said retainer providing means for securing the bundle of wires in position on the pipe with the wire bundle extending upwardly and outwardly from the pipe to contact the well bore wall; means at one end of the channel for securing the ends of the wires against rotation; and means on the retainer at the other end of the channel for receiving a portion of the collar in overlapping relation.

9. A flexible cleaner finger for engaging the wall of a bore hole, comprising in combination: a bundle of pairs of spring wires forming an elongate resilient element, each pair of wires being integrally joined at one end to form a loop, means spaced along the length of said wires confining the wires against spreading, said means including a reenforcing collar fixed to and encircling the resilient element at a location remote from the wire loops, said means also including a retainer having an elongate body provided with a channel to receive a portion of the length of the bundle of wires adjacent the wire loops, and securing means on the retainer body at one end of the channel engaging the loop on each of the pairs of wires.

10. A flexible cleaner finger for engaging the wall of a bore hole, comprising in combination: a bundle of pairs of spring wires, each pair of wires being integrally joined at one end to form a loop, a clamping collar fixed to and encircling the bundle of wires at a location remote from the wire loops, a retainer having an elongate body provided with a channel to receive a portion of the bundle of wires, the channel being enlarged at one end to form a pocket to receive the wire loops; and a tongue fixed on the retainer and individually engaging the loop on each of the pairs of wires to anchor each pair with respect to the retainer.

11. A flexible cleaner finger for engaging the wall of a bore hole, comprising in combination: a bundle of pairs of spring wires forming an elongate resilient element, each pair of wires being integrally joined at one end to form a loop, the pairs of wires extending for the full length of the elongate resilient element and being bent at spaced locations to define a base end portion at one end, an intermediate shank, and a tip, a reenforcing collar fixed to and encircling the resilient element at the location of the bend between the shank and the tip, a retainer having an elongate body provided with a channel to receive the base end portion of the resilient element, and a tongue fixed on the retainer extending into the channel and extending through the loop on each of the pairs of wires to anchor each pair with respect to the retainer.

12. A cleaner finger adapted to be mounted upon a cylindrical portion of a carrier for engaging the wall of a bore hole, comprising in combination: a bundle of spring wires having a base

end portion at one end, an intermediate shank, and a tip at the other end, the bundle of spring wires having a first bend joining the shank to the base end portion, and having a second bend joining the shank to the tip, a clamping collar encircling the bundle of wires at the second said bend, a retainer having a curved body shaped as a portion of a helix for surface contact with the cylindrical surface of the carrier, the retainer body being provided with a channel to receive the base end portion of the bundle of wires.

13. A cleaner finger adapted to be mounted upon a cylindrical portion of a carrier for engaging the wall of a bore hole, comprising in combination: a bundle of spring wires, a retainer having a curved body shaped as a portion of a helix for surface contact with the cylindrical surface of the carrier, the retainer body being provided with a channel to receive an end portion of the bundle of wires, and securing means fixed on the retainer body to secure one end of the bundle to the retainer body.

14. A scratcher unit applicable to a well casing including an elongate carrier shaped to extend longitudinally of the well casing in contact with the exterior surface thereof, a series of spring fingers mounted on the outer surface of the carrier, the series extending longitudinally of the carrier, each finger including a retainer having spaced mounting flanges fixed to the carrier, the retainers being positioned on the carrier in parallel inclined position with adjacent flanges in nested relationship, each finger also including a bundle of spring wires in contiguous relationship, each bundle being secured within each retainer and extending from one end of the retainer in a direction inclined upwardly and laterally outwardly from the carrier to engage and scratch the wall of a well bore.

15. A mud cleaner device, comprising in combination: a well casing, an elongate carrier fixed to the well casing and extending longitudinally thereon, a series of spring fingers mounted on the outer surface of the carrier, the series extending longitudinally of the carrier, each finger including a retainer having spaced mounting flanges fixed to the carrier, the retainers being positioned on the carrier in parallel inclined position with adjacent flanges in nested relationship, each finger also including a bundle of spring wires in contiguous relationship, each bundle being secured within each retainer and extending from one end of the retainer in a direction inclined upwardly and laterally outwardly from the carrier to engage and scratch the wall of a well bore.

16. In a well scratcher for removing mud sheath from the wall of a well bore, a scratcher finger comprising a bundle of wires having a permanent angular bend, and a bent reenforcing collar fixed to and encircling the bundle at the bend to maintain the permanent angular bend in the bundle and to prevent separation of the wires.

17. In a well scratcher for removing mud sheath from the wall of a well bore, a scratcher finger comprising a bundle of wires, the bundle having two permanent angular bends spaced along the length of the wires, a bent reenforcing collar fixed to and encircling the bundle at each of said bends to maintain the permanent angular bends in the bundle and to prevent separation of the wires.

18. In a well scratcher for removing mud sheath from the wall of a well bore, the combination of: a carrier strip adapted for mounting upon a well pipe, a plurality of scratcher fingers mounted on the carrier strip and extending outwardly to engage the wall of the well bore, each scratcher finger comprising a bundle of wires having a permanent angular bend, and a bent reenforcing collar fixed to and encircling the bundle at the bend to maintain the permanent angular bend in the bundle and to prevent separation of the wires.

19. In a well scratcher for removing mud sheath from the wall of a well bore, the combination of: a carrier strip adapted for mounting upon a well pipe, a plurality of scratcher fingers mounted on the carrier strip and extending outwardly to engage the wall of the well bore, each scratcher finger comprising a bundle of wires, the bundle having two permanent angular bends spaced along the length of the wires, a bent reenforcing collar fixed to and encircling the bundle at each of said bends to maintain the permanent angular bends in the bundle and to prevent separation of the wires.

20. In a well scratcher device for removing mud sheath from the wall of a well bore, the combination of: a carrier strip adapted for mounting upon a well pipe, a plurality of scratcher fingers each comprising a bundle of wires, each bundle having two permanent angular bends spaced along the length of the bundle, defining a substantially straight shank between the bends and a mounting portion at one end and a scratcher tip at the other, means securing each mounting portion to the carrier strip in an inclined position, a bent reenforcing collar fixed to and encircling the bundle at each of said bends to maintain the permanent angular bends in the bundle, each shank in its initial free position extending upward and outward and with sidewise direction from the carrier strip, and each scratcher tip in its initial free position extending upward from the shank, whereby the scratcher tips extend substantially parallel with the wall of the bore hole for minimum scratching action when the well scratcher device is moved downward in the well, and whereby the scratcher tips engage the wall of the well bore for maximum scratching action when the well scratcher device is moved upward in the well to cause flexing of the shanks.

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