

June 2, 1959

R. O. PARK
WALL SCRATCHERS

2,888,989

Filed June 11, 1956

2 Sheets-Sheet 1

FIG. 1.

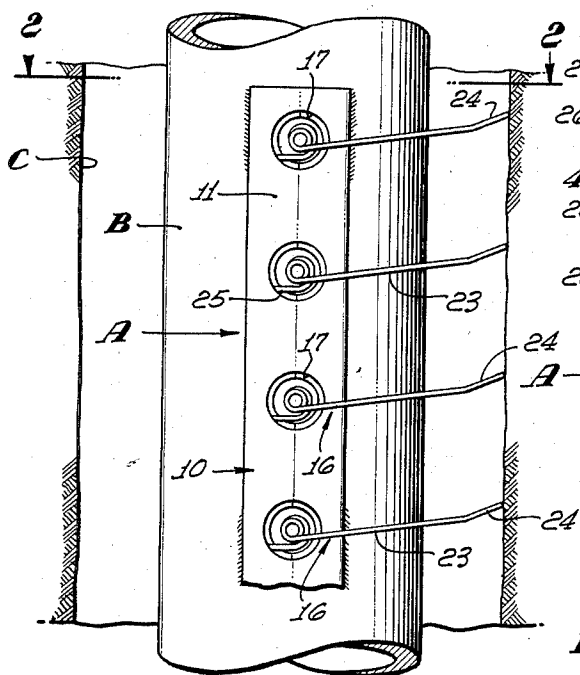


FIG. 3.

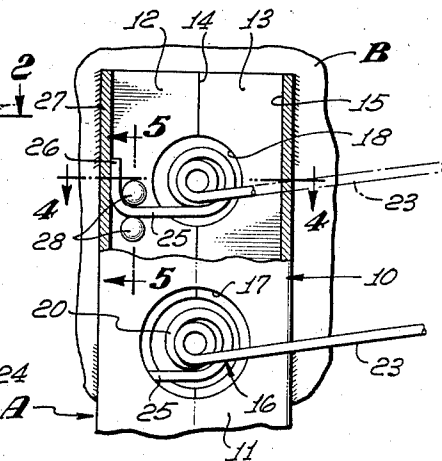


FIG. 4.

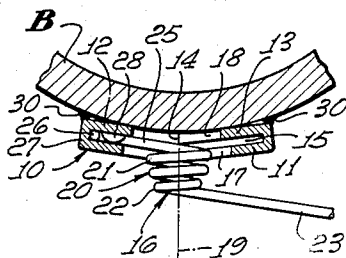


FIG. 2.

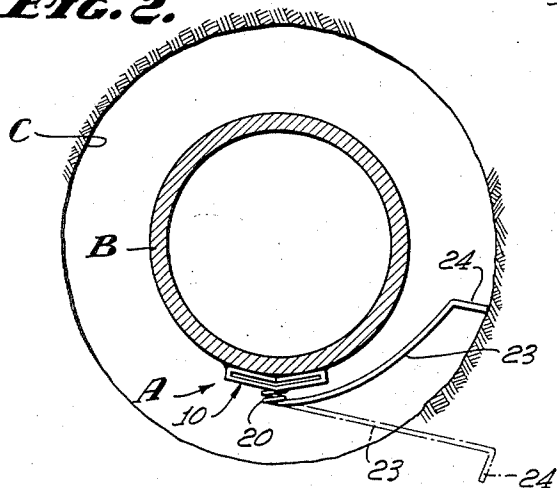
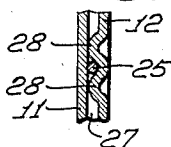


FIG. 5.



INVENTOR.
ROBERT O. PARK
BY
Mellin and Hanson
ATTORNEYS.

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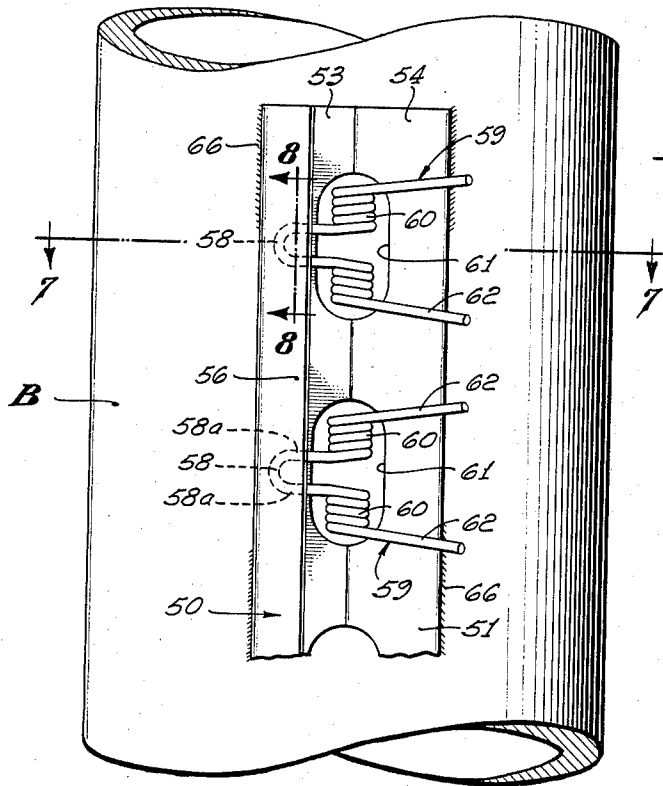


FIG. 6.

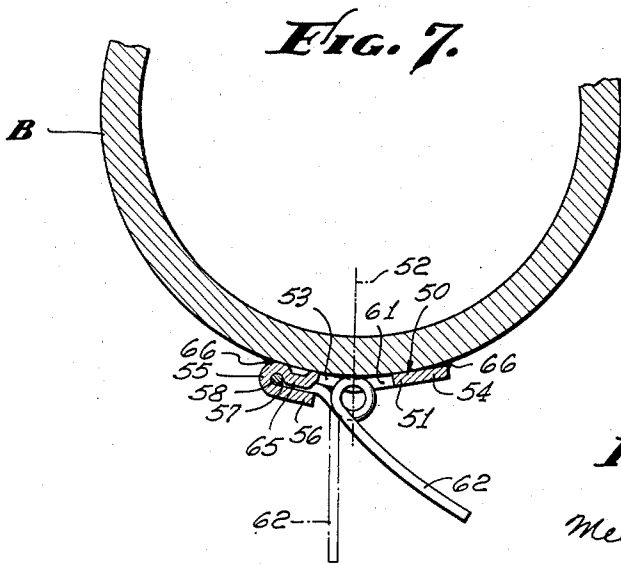


FIG. 7.

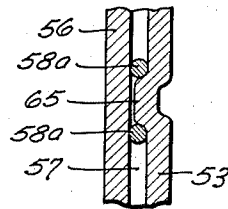


FIG. 8.

INVENTOR.
ROBERT O. PARK
BY
Mellin and Hanson
ATTORNEYS.

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WALL SCRATCHERS

Robert O. Park, Lakewood, Calif., assignor to Baker Oil Tools, Inc., Los Angeles, Calif., a corporation of California

Application June 11, 1956, Serial No. 590,682

16 Claims. (Cl. 166—173)

The present invention relates to subsurface well tools, and more particularly to apparatus for scratching the walls of open well bores, well casing, and similar well bore conduits.

An object of the present invention is to provide a scratcher adapted to be mounted on well casing, and the like, for scratching or removing the mud cake from the wall of the well bore as the casing is rotated, the scratcher device being of strong and sturdy construction, possessing stability when mounted on the well casing, and being economical to manufacture.

Another object of the invention is to provide a rotational type of spring wire wall scratcher device adapted to be mounted on well casing, and the like, in which the scratcher elements tend to fold readily toward the casing during their lowering in the well bore, so as to minimize the scratching action of such elements on the well bore until the region is reached in the well bore at which a scratching operation is to take place.

A further object of the invention is to provide a rotational type of wall scratcher having scratcher elements mounted on an elongate body member adapted to be secured to the well casing, in which the radial thickness of the body member is comparatively small, which permits passage of the casing through relatively close clearance surface casing and in closely fitting well bores.

An additional object of the invention is to provide a wall scratcher to be mounted on well casing, and the like, in which the scratcher elements are secured in place in a simple and inexpensive manner.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of several forms in which it may be embodied. Such forms are shown in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a side elevational view of the invention as applied to a well casing disposed in a well bore;

Fig. 2 is a cross-section taken along the line 2—2 on Fig. 1;

Fig. 3 is an enlarged side elevation and longitudinal section through part of the apparatus disclosed in Fig. 1;

Fig. 4 is a cross-section taken along the line 4—4 on Fig. 3;

Fig. 5 is a section taken along the line 5—5 on Fig. 3;

Fig. 6 is a view of a modified form of wall scratcher mounted on a casing section;

Fig. 7 is a fragmentary cross-section taken along the line 7—7 on Fig. 6;

Fig. 8 is an enlarged section taken along the line 8—8 on Fig. 6.

In the form of invention shown in Figs. 1 to 5, inclusive,

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a single wall scratcher device A is disclosed, which is adapted to be secured to well casing B that is to be run in a well bore C to the desired depth. Wall scratchers are usually provided to remove, through a scratching action, the mud cake from the wall of the well bore along the length of the latter at which cement is to be deposited, to secure a good cement bond between the casing B and the well bore wall. The scratcher A disclosed is of the rotational type, in that the scratching action on the wall of the well bore C occurs as a result of rotating the well casing.

Although only part of a single full scratcher device is shown in the drawing, in actual practice the scratcher device A is much longer than illustrated, a plurality of scratcher devices being mounted along the entire length of the casing portion disposed in the portion of the well bore from which the mud cake is to be removed. The scratcher devices are ordinarily arcuately spaced from each other around the well casing, and will cover the desired length of the casing. As an example, assuming each scratcher device to be about five feet in length, and that a one-hundred foot length of well bore wall is to have the mud cake removed therefrom, about twenty of the scratcher devices will be mounted on the casing lengthwise therealong, each scratcher being arcuately displaced from the next adjacent scratcher by about 120 degrees, the ends of the scratcher devices themselves preferably overlapping each other to a small extent, to insure complete mud cake removal along the desired length of the well bore.

As disclosed in the drawings the scratcher A includes an elongate body member or strip 10, which is preferably formed of sheet metal, and which is of a relatively shallow box-like cross-section. Thus, each body member 10 can be made from a single sheet of sheet metal having an outer web portion 11 and inner flanges 12, 13 that are bent toward each other, and whose edges 14 abut or substantially abut, the flanges being in spaced relation to the web to provide a space 15 therebetween for the reception of a part of each wire spring scratcher element 16. The web portion 11 is provided with a row of holes or openings 17, preferably equidistant from one another, these outer holes or openings 17 being in substantial alignment with inner holes or openings 18 formed collectively in the opposed inner flanges 12, 13, the opening in each flange being generally semi-circular, so that the two flanges together provide a complete hole or opening 18.

The body member 10 is adapted to be placed snugly against the exterior of the well casing B. To insure such a snug and stable bearing against the well casing, the body member 10 is bent at a relatively shallow angle, as disclosed most clearly in Figs. 2 and 4, about a generally central radial plane 19, flanges 12, 13 making a shallow angle with respect to each other, which is also true of the portions of the web 11 on opposite sides of the central plane 19. Not only will the body member 10 engage the periphery of the well casing snugly, but the same body member can be used effectively for attachment to well casings of widely different outside diameters.

A plurality of spring wire scratcher elements 16 is mounted on the body member 10, there being one scratcher element for each pair of aligned holes 17, 18 in the web 11 and the inner flanges 12, 13. Each scratcher element includes a conically wound coil portion 20, with the larger turn or turns 21 disposed inwardly of the body member, and the smaller turn or turns 22 merging into an outwardly directed spring-like arm 23, that terminates in a scratcher finger 24 bent with respect to the arm, so as to make a substantial angle therewith. The innermost turn 21 of the spring merges into a leg portion 25,

which extends transversely within the space 15 between the web portion 11 and one of the flanges 12, the leg 25 merging into a foot portion 26 disposed substantially at right angles to the leg portion, and engaging the side wall 27 of the body member. Each spring element 16 is retained in appropriate assembled position on the body member 10 by pressing a projection 28 inwardly from one of the flanges 12 on opposite sides of the leg portion 25 at the region of merger of the leg 25 into the foot portion 26. The projections or nipples 28 thus formed prevent the outer portion of the leg 25 from shifting to a substantial extent, and hold the foot portion 26 in its location adjacent the side 27 of the shallow box-like body member 10.

The leg portion 25 and the arm portion 23 extend in substantially opposite directions from the spring coil portion 20, the arm preferably projecting outwardly, when unrestrained, and slightly in an upward direction. The arm 23 is inclined to the body member 10 to a small extent with its outer end or finger 24 terminating in a circle (when the scratcher device is mounted on the well casing) which is much greater than the outside diameter of the casing B, and also much greater than the inside diameter of the wall of the well bore C against which the scratcher element is to operate. The finger 24 itself is bent with respect to the arm in a forward direction as regards the direction of rotation of the well casing B, which will be a right-hand direction of rotation since the threaded connections between adjacent casing sections are usually the right-hand.

The scratcher device A is mounted lengthwise on the well casing with its flanges 12, 13 bearing against the latter. The side marginal portions 27 of the body member are secured to the casing, as by use of welding material 30, which may be deposited at suitable intervals along the length of the body member 10 on both of its sides. The scratcher device A will be secured to the well casing so that the arms 23 and fingers 24 extend in a trailing direction as regards the rotational direction of the well casing during the scratching operation.

After the desired number of scratcher devices A have been welded to the casing along the required length and arcuately spaced from one another, as described above, the well casing B is run in the well bore. The coil portions 20 have their axes generally radial of the well casing, the coils being permitted to flex in universal fashion, which will permit the arms 23 to deflect upwardly as the casing is being run in the well bore, such upward deflecting also being permitted and facilitated by the fact that the coil itself can wind and unwind under load, and by the ability of the spring arm 23 itself to deflect. During such running within the well bore, each coil portion 20 may also be forced inwardly of the body member 10 within the openings 17, 18 to the extent limited by engagement of the base 21 of the coil with the periphery of the well casing B itself.

The fact that the coil 20 can move inwardly to the extent indicated means that the scratcher apparatus A permits the casing B to be run through surface casing (not shown) and well bores having substantially close clearance with the well casing B itself, since the over-all radial increased thickness of the well casing is not very great, consisting merely of the thickness of the relatively shallow box section of the body member 10 and the extent to which the coil spring portion 20 will project outwardly beyond the outer surface of the web 11.

Since the spring arms 23 deflect upwardly in the well bore, and since the fingers 24 themselves are also directed in an outward and upward direction with respect to the arms, very little scratching action will be performed on the wall of the well bore while the casing is being lowered therewithin. However, once the casing B has been lowered to the proper depth and it is desired to scratch the mud cake from the wall of the well bore C, the well casing is rotated, the arms 23 being deflected in a backward

or trailing direction from the normal position that the arms tend to occupy (such as shown in broken lines in Fig. 2), the outer ends of the fingers 24 being urged against the wall of the well bore C and any mud cake present on its surface. The rearward deflection of each arm 23 is also facilitated by the coil spring portion 20, which can coil or uncoil to a great extent to insure the maintenance of the scratching fingers 24 with substantial force against the wall of the well bore C. The well casing B is rotated while fluid is being circulated through its interior, the circulating fluid carrying the mud cake removed from the wall of the well bore upwardly to the top of the hole.

In the form of invention disclosed in Figs. 6, 7 and 8, the elongate body member 50 is formed of a single piece of material, such as sheet metal, having a base portion 51 bent around a central radial plane 52 to form the wings 53, 54 that make a wide angle with each other, and which extend in opposite directions from the central plane. The base portion 51 merges at one side into a side portion 55 which merges into a flange 56 overlying the base portion 51 and which is in spaced relation thereto to provide room 57 for the reception of the heel portion 58 of a spring wire scratcher element 59. The spring wire scratcher element includes a pair of helical coil portions 60 that are substantially coaxial, each coil portion merging into the generally U shaped heel portion 58. To enable the coil portions 60 to be disposed against the periphery of the casing B, the base portion 51 is provided with an opening 61 of generally ovate or oval shape, in which the inner parts of the spring coils are located.

The outer ends of the coils 60 merge into arm portions 62, which may be parallel to each other, or which may diverge slightly with respect to each other, these arm portions merging into scratcher finger portions (not shown) in the same general manner as illustrated in the other form of the invention.

The body member 50 is of the requisite length and will have the desired number of spring wire scratcher elements 59 mounted thereon, each element having its coil spring portions 60 disposed in one of the openings 61 of the body base, and with its heel portion 58 extending into the space 57 between the base 51 and the flange 56, with the central part of the heel engaging the side 55 of the body member. Withdrawal of the spring scratcher element 59 from its assembled relation on the body member is prevented by pressing a dimple or projection 65 inwardly from one portion of the heel. Such inward projection will prevent the heel 58 from moving out of the space 57 and will hold the spring element 59 in appropriate assembled relation with respect to the body member 51.

A plurality of scratcher devices disclosed in Figs. 6 to 8, inclusive, are mounted along the desired length of the string of well casing B, and are secured thereto as by use of welding material 66. The well casing is lowered in the well bore, the spring arms 62 deflecting upwardly in a direction toward the well casing, so as to avoid the performance of any undue scratching action on the wall of the well bore, until the casing has been run to the desired depth. When such depth has been reached, the casing B is rotated, the scratcher arms 62 bending in a rearward direction, with the fingers at their outer ends engaging the wall of the well bore to remove the mud cake therefrom, such mud cake being circulated from the well bore by the circulating fluid pumped down the well casing and passing upwardly through the annulus therearound. The arms 62 can deflect and provide a spring force urging the fingers against the wall of the well bore, such spring force also being furnished by the winding or unwinding action of the coil spring portions 60 of the scratcher element.

It is, accordingly, apparent that scratcher devices have been provided that do not substantially increase the ef-

fective diameter of the well casing on which they are mounted. The scratcher devices themselves are comparatively simple in structure and in manner of assembly, possessing substantial strength and stability. The spring elements 16 or 59 are held in position on the body members 10 or 50 without the use of any external fastening devices, the required securing of the spring elements to the body member being obtained by use of the material of the body member itself.

The inventor claims:

1. In a wall scratcher to be mounted on a tubular string to be disposed in a well bore: an elongate body member adapted to be secured to the tubular string lengthwise along the latter and including a base portion adapted to bear against the tubular string and an outer portion overlying and integral with said base portion and co-extensive with said base portion and spaced therefrom to form a groove therewith; metallic spring scratcher elements longitudinally spaced from each other, each of said scratcher elements having a leg disposed in said groove and an arm extending outwardly from said body member and adapted to engage the wall of the well bore; said groove having a width substantially the same as the thickness of a scratcher leg; and means for securing said legs to said body member.

2. In a wall scratcher to be mounted on a tubular string to be disposed in a well bore: a body member adapted to be secured to the tubular string and including a base portion adapted to bear against the tubular string and an outer portion overlying and attached to said base portion and spaced therefrom to form a groove therewith; a metallic spring scratcher element having a leg disposed in said groove and an arm extending outwardly from said body member and adapted to engage the wall of the well bore; said groove having substantially the same width as the thickness of said leg; one of said portions having means thereon extending into said groove toward the other of said portions to contact said leg and secure said leg to said body member.

3. In a wall scratcher to be mounted on a tubular string to be disposed in a well bore: an elongate body member adapted to be secured to the tubular string lengthwise along the latter and including a base portion adapted to bear against the tubular string and an outer portion overlying and attached to said base portion and spaced therefrom to form a groove therewith; a metallic spring scratcher element having a leg disposed in said groove and an arm extending outwardly from said body member and adapted to engage the wall of the well bore; said groove having substantially the same width as the thickness of said leg; one of said portions having means thereon extending into said groove toward the other of said portions to contact said leg and secure said leg to said body member.

4. In a wall scratcher to be mounted on a tubular string to be disposed in a well bore: a body member adapted to be secured to the tubular string and including a base portion adapted to bear against the tubular string and an outer portion overlying and attached to said base portion and spaced therefrom to form a groove therewith; a metallic spring scratcher element having a leg disposed in said groove and an arm extending outwardly from said body member and adapted to engage the wall of the well bore; said groove having substantially the same width as the thickness of said leg; one of said portions having means thereon extending into said groove toward the other of said portions on opposite sides of said leg to contact said leg and secure said leg to said body member.

5. In a wall scratcher to be mounted on a tubular string to be disposed in a well bore: an elongate body member adapted to be secured to the tubular string lengthwise along the latter and including a base portion adapted to bear against the tubular string and an outer portion overlying and attached to said base portion and spaced

therefrom to form a groove therewith; a metallic spring scratcher element having a leg disposed in said groove and an arm extending outwardly from said body member and adapted to engage the wall of the well bore; said groove having substantially the same width as the thickness of said leg; one of said portions having means thereon extending into said groove toward the other of said portions on opposite sides of said leg to contact said leg and secure said leg to said body member.

6. In a wall scratcher to be mounted on a tubular string to be disposed in a well bore: a one-piece elongate body member adapted to be secured to the tubular string lengthwise therealong and having openings therethrough; spring scratcher elements each including an outwardly extending arm adapted to engage the wall of the well bore and a coil adapted to be disposed in said openings; said body member having opposed elongate portions common to and engaging said elements to secure said elements to said body member.

7. In a wall scratcher to be mounted on a tubular string to be disposed in a well bore: a one-piece elongate body member adapted to be secured to the tubular string lengthwise therealong and having openings therethrough; spring scratcher elements each having a leg and an outwardly extending arm adapted to engage the wall of the well bore, each of said elements further including a coil between said arm and leg adapted to be disposed in said openings; said body member having opposed elongate portions common to and engaging said legs to secure said elements to said body member.

8. In a wall scratcher to be mounted on a tubular string to be disposed in a well bore: an elongate body member adapted to be secured to the tubular string lengthwise along the latter and including a base portion adapted to bear against the tubular string and an outer portion overlying and integral with said base portion and coextensive with said base portion and spaced therefrom to form a groove therewith; said base portion having openings therethrough; spring scratcher elements longitudinally spaced from each other, each of said scratcher elements having a leg disposed in said groove and an arm extending outwardly from said body member and adapted to engage the wall of the well bore, each of said scratcher element further including a coil between said arm said groove having a width substantially the same as the thickness of a scratcher leg; and leg adapted to be disposed in said opening; and means for securing said legs to said body member.

9. In a wall scratcher to be mounted on a tubular string to be disposed in a well bore: an elongated body member adapted to be secured to the tubular string lengthwise along the latter and including a base portion adapted to bear against the tubular string and an outer portion overlying and integral with said base portion and spaced therefrom to form a groove therewith; spring scratcher elements each having a leg disposed in said groove and an arm extending outwardly from said body member and adapted to engage the wall of the well bore; said groove having substantially the same width as the thickness of each of said legs; parts of one of said portions extending into said groove toward the other of said portions on opposite sides of said legs to secure said legs to said body member; each of said scratcher elements including a foot secured to its leg and making a substantial angle therewith.

10. In a wall scratcher to be mounted on a tubular string to be disposed in a well bore: a one-piece body member adapted to be secured to the tubular string and having an opening therethrough; spring scratcher elements each including an outwardly extending arm adapted to engage the wall of the well bore and a coil adapted to be disposed in said opening; said body member having opposed portions engaging said elements to secure said elements to said body member; the axis of each of said coils extending transversely of said body member.

11. In a wall scratcher to be mounted on a tubular string to be disposed in a well bore: a one-piece body member adapted to be secured to the tubular string and having an opening therethrough; spring scratcher elements each including an outwardly extending arm adapted to engage the wall of the well bore and a coil adapted to be disposed in said opening; said body member having opposed portions engaging said elements to secure said elements to said body member; the axis of each of said coils extending lengthwise of said body member.

12. In a wall scratcher to be mounted on a tubular string to be disposed in a well bore: an elongate body member adapted to be secured to the tubular string lengthwise along the latter and including a base portion adapted to bear against the tubular string and an outer portion overlying and attached to said base portion and spaced therefrom to form a groove therewith extending lengthwise of the tubular string; said base portion and outer portion having aligned openings therethrough; spring scratcher elements each having a leg disposed in said groove and an arm extending outwardly from said body member and adapted to engage the wall of the well bore; means for securing said legs to said body member; each of said scratcher elements further including a coil connecting its arm and leg, said coil being adapted to be disposed in said openings.

13. In a wall scratcher to be mounted on a tubular string to be disposed in a well bore: an elongate body member adapted to be secured to the tubular string and including an outer web portion and a pair of opposed flanges substantially abutting each other and spaced inwardly from said web portion to provide a groove therewith; said web portion and flanges having aligned openings therethrough; a spring scratcher element having a leg disposed in said groove and an arm extending outwardly from said body member and adapted to engage the wall of the well bore; means for securing said leg to said body member; said scratcher element further including a coil connecting said arm and leg, said coil being adapted to be disposed in said openings.

14. In a wall scratcher to be mounted on a tubular string to be disposed in a well bore: an elongate body member adapted to be secured to the tubular string and including an outer web portion and a pair of opposed flanges substantially abutting each other and spaced inwardly from said web portion to provide a groove therewith; said web portion and flanges having aligned openings therethrough; a spring scratcher element having a leg disposed in said groove and an arm extending outwardly from said body member and adapted to engage the wall of the well bore; means for securing said leg to said body

member; said scratcher element further including a coil connecting said arm and leg, said coil being adapted to be disposed in said openings, the axis of said coil extending transversely of said body member and intersecting said openings.

15. In a wall scratcher to be mounted on a tubular string to be disposed in a well bore: an elongate body member adapted to be secured to the tubular string and including an outer web portion and a pair of opposed flanges substantially abutting each other and spaced inwardly from said web portion to provide a groove therewith; said web portion and flanges having aligned openings therethrough; a spring scratcher element having a leg disposed in said groove and an arm extending outwardly from said body member and adapted to engage the wall of the well bore; means for securing said leg to said body member; said scratcher element further including a coil between said arm and leg adapted to be disposed in said openings, the axis of said coil extending transversely of said body member and intersecting said opening; parts of one of said flanges extending into said groove towards said web on opposite sides of said leg to secure said leg to said body member.

16. In a wall scratcher adapted to be mounted on a tubular string to be disposed in a well bore: an elongate body member adapted to be secured to the tubular string lengthwise along the latter and including an elongate base portion adapted to bear against the tubular string and an elongate outer portion overlying and attached to said base portion and spaced therefrom to form a groove therewith; said base portion having an opening therethrough; spring scratcher elements each having a pair of coil portions adapted to be disposed in said opening and arms extending outwardly from said coil portions and said body member and adapted to engage the wall of the well bore; each of said scratcher elements further including legs attached to each other and to said coil portions and disposed in said groove; at least parts of one of said portions extending into said groove toward the other of said portions to secure said legs of all of said elements to said body member.

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