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PARAFFIN SCRAPER COMBINATION

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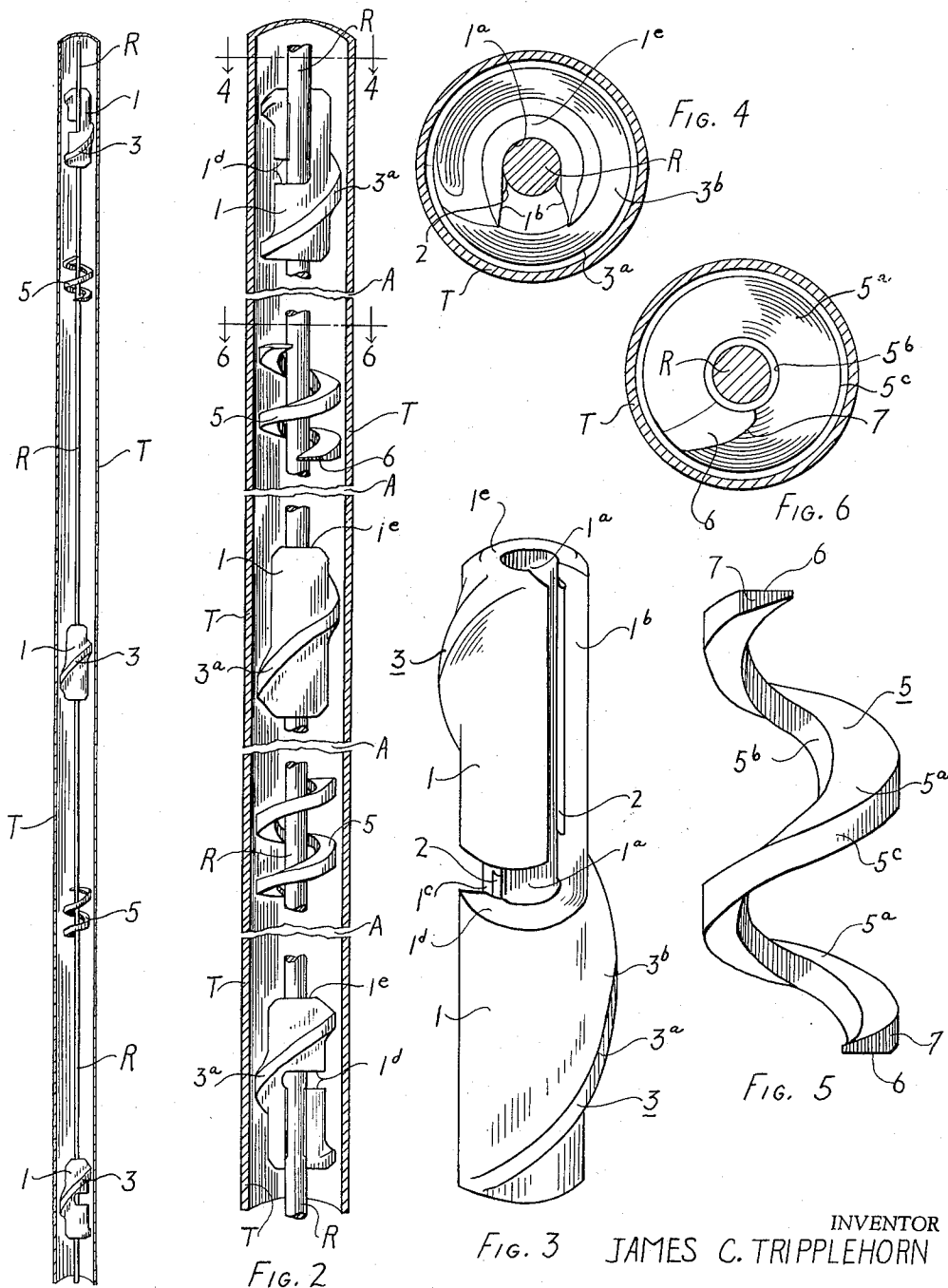


FIG. 1

FIG. 3 JAMES C. TRIPPLEHORN INVENTOR

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PARAFFIN SCRAPER COMBINATION

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This invention relates to novel combinations of paraffin scrapers intended to be used in connection with well pumping sucker rods reciprocating inside a tubing string. More particularly, this invention relates to the novel combination of two different types of paraffin scrapers in such a pumping organization.

It is a principal object of the invention to provide in novel combination fixed and ambulatory paraffin scrapers alternately spaced along the sucker rod, the fixed scrapers tightly engaging the sucker rod and traveling therewith and the ambulatory scrapers each surrounding the rod between adjacent fixed scrapers, the ambulatory scrapers migrating along the rod and serving to scrape both the walls of the tubing and also the outer surfaces of the sucker rod to prevent the building up of paraffin on either, and the fixed scrapers serving to scrape the inner surfaces of the tubing and also serving as abutments for limiting the length of rod over which the ambulatory scrapers may migrate.

Another primary object of the present invention is to provide in combination fixed and ambulatory paraffin scrapers, in which combination the fixed scrapers may be spaced along the rod at intervals much greater than the length of the reciprocatory stroke of the sucker rod and wherein the ambulatory scrapers over a period of time travel a greater distance along the rod than its stroke to clear the rod of serious paraffin deposits.

Such deposits on either the tubing or the sucker rod are highly undesirable since as they build up, they reduce the annular area of the oil passageway between the tubing string and sucker rod and thus reduce the flow of oil to the surface. It is customary to scrape the tubing; but the rod also loads up with deposits which often become so great that the pumping motion is stopped, especially when the rod will no longer drop in the tubing. When an effort is made to pull the rod, the paraffin load therearound drops and dislodges the fixed scrapers, bunching them together in a mass of hard packed paraffin which securely anchors the rod to the tubing walls and makes it necessary to pull both the rod and the tubing together at considerably increased expense. It is therefore an important object of the invention to provide a combination of scrapers which will prevent the building up of paraffin on the sucker rod itself.

It is another object of the invention to provide a combination of paraffin scrapers in which the individual units may be installed anywhere along the length of a sucker rod between the tool joint ends thereof without necessity of altering the standard sucker rod or damaging the same, as for instance by welding.

It is a further very important object of the present invention to provide paraffin scrapers which are made of a plastic which can be economically shaped, and which plastic, at the temperatures encountered in oil wells, is dimensionally stable and resistant to attack by oil and acids. The electrical insulating properties of the plastic are also important since they prevent the attack on other adjacent metal parts in the well by electrolysis. A range of suitable plastic includes the following:

Vinylidene chloride—rigid compound
Polyamides—molding type, nylon 1001, known as Zytel
Polytetra—fluoro ethelene
Polychloro—tri fluoro ethelene
Polymethyl alpha cloro-acrylate

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Polyester diallyl phthalate
Poly acetal resin

The use of plastic in connection with such scrapers is important for several reasons. In the first place, manufacturing of the scrapers can be conveniently and economically carried out either by molding or by an extrusion process or by some other plastic handling process in order to produce the desired form. In addition to the multiple advantages which the plastic has over metal, plastics found in the above range also exhibit springlike qualities generally thought of in connection with metals, which springlike qualities permit the scrapers to flex without damage or breakage. Another advantage in the use of the above plastics results from the fact that the very substance to be scraped by the scraper, namely the paraffin, has very little tendency to stick to the plastics since paraffin does not tend to adhere to a smooth non-porous surface. Therefore, the buildup which occurs on metal paraffin scrapers is substantially absent when the above plastics are substituted for the metals.

It is another primary object of this invention to provide a combination of fixed and ambulatory paraffin scrapers wherein at least the ambulatory scrapers have a specific gravity which is not very different from the specific gravity of the liquids found in oil wells. The plastics of the above range have specific gravities not nearly as different from the average of the well fluids as the specific gravity of most springlike metals would be. In addition there are other low-weight materials which would be suitable. This low-weight feature is of considerable importance because of the fact that the paraffin scraper when made of a material having a specific gravity approximating that of the well liquids will migrate through considerable distances during reciprocation of the sucker rod within the well tubing. For example, in the case where the stroke of the sucker rod in the tubing is 3 feet, a relatively short spiral scraper, perhaps only a foot or so long, will clean a 10 or 15 foot vertical length of sucker rod and tubing despite the relatively short stroke of the pump. This action results from the fact that the specific gravity of the scraper is nearly the same as that of the well liquids, so that the scraper will work its way along the tubing from one abutment to the next adjacent abutment even though this distance may be many times the length of the pump stroke and many times the length of the ambulatory scraper. The latter, of course, does not pass over such a length of sucker rod in one or two strokes, but may require a considerable number of strokes to cover the greater length. Tests have shown, however, that it does cover such a length and that such coverage tends to be repeated at regular enough intervals that the ambulatory scraper will satisfactorily prevent the building up of paraffin deposits on both the rod and the tubing. It is well known that well fluids are not homogeneous but contain oil and water, more or less solid objects, lumps of paraffin, and gas pockets. This non-homogeneous character of the fluid which is being pumped upwardly probably accounts for the fact that the spiral scraper is caused to reciprocate over a greater length of rod and tubing than the length of the stroke.

When the sucker rod and fixed scrapers are descending, the column of fluid is standing substantially still in the vertical direction although it is caused to rotate by the scraper blades on the fixed scrapers passing downwardly through the fluid column. Since the ambulatory scrapers are spiral-shaped and since the ambulatory scrapers have rotational inertia, the scrapers are forced to travel in one direction by their "screw action" in the column of fluid as the column rotates faster and faster, but as rotation of the column decelerates during the up-

stroke of the rod, the screw-action of the scrapers forces them to travel in the opposite direction in the decelerating fluid. The relative rates of rotation in the two directions between the fluids and the ambulatory scrapers are varied by collisions between the scrapers and the above mentioned solid objects, lumps of paraffin, and gas pockets. Although on the up-stroke of the pump the ambulatory scrapers are carried upwardly by the fluid flow, and perhaps by abutment against the next-lower fixed scraper, the ambulatory scrapers also tend to sink during down-strokes of the rod and may also be forced downwardly by abutment against the next-higher fixed scraper. Also they drop rapidly through gas pockets in the fluid column. It is only when the ambulatory scrapers are relatively lighter than the usual steel scrapers that the above migratory forces all play significant roles in providing the desired ambulatory scraper action.

It is another object of the present invention to provide a flattened "land" surface at each end of each ambulatory scraper and at each end of each fixed scraper, which surfaces lie in planes disposed normal to the axis of the scraper and serve as abutments for contact between ambulatory and fixed scrapers to confine the ambulatory scrapers to assigned lengths of the sucker rod.

Other objects and advantages of the present invention will become apparent in the following discussion of the drawing wherein:

FIGURE 1 is an elevation view showing a sucker rod extending downwardly in the pump tubing, the latter having been broken away to illustrate the sucker rod and also to illustrate the novel combination of paraffin scrapers operatively disposed on the sucker rod with the ambulatory scrapers shown in intermediate positions between the fixed scrapers, as during actual stroking of the sucker rod.

FIG. 2 is a view similar to FIG. 1 but enlarged to provide a better showing of the structure and disposition of the paraffin scrapers.

FIG. 3 is an enlarged perspective view of one of the fixed paraffin scrapers.

FIG. 4 is an enlarged section view taken along line 4-4 of FIG. 2.

FIG. 5 is an enlarged elevation view of one of the ambulatory paraffin scrapers.

FIG. 6 is an enlarged section view taken along line 6-6 of FIG. 2.

Referring to the drawings, FIGS. 1 and 2 illustrate a length of sucker rod R passing through a length of tubing T in which it reciprocates. Around the rod R and within the tubing T are a series of paraffin scrapers which comprise alternately fixed and ambulatory scrapers forming the novel combination of this invention.

As illustrated in FIGS. 1, 2, 3 and 4, each of the fixed paraffin scrapers includes a body 1 having a bore 1a therethrough. In the vicinity of the upper half of the bore 1a is a slot 1b which passes through the wall of the body 1 and opens into said bore. Another similar slot 1c is located in the vicinity of the lower portion of the bore 1a and likewise extends through the wall of the body 1 and enters into the lower portion of the bore 1a. The slots 1b and 1c are opposed to one another both in the sense that they extend away from each other in opposite directions with respect to the longitudinal center of the scraper, and also in the sense that they open in mutually opposite directions radially of the scraper. As can best be seen in FIGS. 1, 2 and 3, the axial slots 1b and 1c are joined together by a transversely disposed slot 1d, this slot serving to join the slots 1b and 1c for the purpose of providing a continuous oil passage through the body 1 of the scraper, and the transverse slot also serving as a mounting slot to permit installation of the scraper on the sucker rod in the manner described in my copending patent application entitled "Opposed Slot Scraper and Guide," Ser. No. 672,267, filed July 16, 1957, now Patent No. 2,928,472.

As can be seen in FIG. 4, the slots 1b and 1c are tapered so as to enlarge outwardly from the bore 1a. The bore 1a is deliberately made slightly smaller in diameter than the diameter of the sucker rod R on which the scraper is intended to be mounted. By thus making the bore slightly smaller, the scraper when installed on the rod R will frictionally grip the rod very tightly and thus prevent slipping of the scraper thereon. The outward tapering of the axial slots 1b and 1c provides outward openings which are somewhat wider than the diameter of the rod R so that the rod may be freely received in the outer portion of the slots 1b and 1c during the initial step of installing the scraper on the sucker rod. Within the tapered slots 1b and 1c are located means designed to increase the grip of the scraper on the sucker rod, this means including a pair of plastic ribs 2, in both the slot 1b and the slot 1c, these ribs being located on both sides of each slot and being integral with the material of which the scraper is formed.

The body 1 of the scraper is provided with a helical scraping blade 3 which starts at one end of the body and extends therearound to the other end. In the form shown in the present drawings, the helix passes around the body only once, but it is to be understood that it is entirely possible for it to pass around the body more than one revolution, even though it may be necessary to break the helix where it crosses the slots. The helical blade 3 has an outer bearing surface 3a intended to rub on the inside surface of the tubing, the bearing surface 3a actually coinciding with the surface of an imaginary cylinder which is concentric with the axis of the scraper. The sides 3b of blade 3 are tapered or filed into the cylindrical body portion 1 so as to provide a smooth surface having no sharp corners in which the paraffin might tend to collect. It will also be noted that the ends of the blade 3 are tapered inwardly and blend smoothly into the rounded ends of the scraper where the outer body surfaces join the flat end surface 1e. The inward tapering of the outer surface of the body 1 and of the bearing surface 3a as they approach the ends 1e serve to prevent snagging of the paraffin scraper on the tubing joints, etc. If desired, further grip-increasing means may be provided in the bore 1a, such as steel clips (not shown), although the features and advantages of the present novel combination of fixed and ambulatory paraffin scrapers should make the addition of auxiliary grip-increasing means unnecessary.

Referring now to the ambulatory paraffin scrapers shown in FIGS. 1, 2, 5 and 6, these scrapers surround the sucker rod R within the tubing T and comprise a plurality of open helical convolutions, the total number of which may be varied for the purpose of providing a length of scraper which will provide adequate scraping coverage in a particular well. The ambulatory scraper 5, as illustrated in the present drawing, has a rectangular cross section and includes radially disposed side surfaces 5a and longitudinally disposed surfaces 5b and 5c. The inner longitudinal surface 5b is intended to contact the sucker rod R and the outer longitudinal surface 5c is intended to contact the inner surface of the tubing T. It will be noted that clearances are provided between the sucker rod and the inner periphery of the scraper (surface 5b), and between the outer periphery of the scraper (the surface 5c) and the inner surface of the tubing T so that the scraper 5 will be free to reciprocate with respect to the tubing and the rod, and also free to migrate along the axial lengths of both in either direction until an abutment is struck, the abutment comprising either the land 1e on one end of a fixed scraper 1, or else an enlarged tool joint at one end of the sucker rod. The fact that the ambulatory scrapers are of smaller outside diameter than the inside diameter of the tubing and of larger inside diameter than the diameter of the rod permits the ambulatory scrapers lateral motions by which they can scrape alternatively against either the inner surfaces of the tubing, or against the outer surface of the sucker rod. With

respect to the cross-sectional shape by which the sides 5a, 5b and 5c of the scraper are related, it is to be noted that other non-rectangular forms would serve satisfactorily. For example, the scraper may be provided with sides 5a which approach each other so as to provide a truncated pyramid shape, or alternatively, the sides 5a could be made concave, or any other satisfactory shape which would serve to leave relatively sharp scraping edges at the intersections of the respective scraper surfaces.

The ends of the scraper are preferably cut off in the direction of a plane lying normal to the axis of the scraper so as to provide flat "lands" 6 at each end of the scraper, on which surfaces the scraper will contact the abutments which confine its longitudinal travel. In order to prevent snagging, the ends of the scraper, FIG. 6, should be somewhat rounded as at 7. It is clearly understood that the total number of helical convolutions of the scraper 5 is not to be limited to any particular number so long as there are a sufficient number of convolutions to prevent excessive cocking of the spiral scraper on the sucker rod which might cause wedging of the spiral scraper between the rod and the tubing.

As illustrated in FIGS. 1 and 2, the fixed and ambulatory scrapers are alternately spaced along the length of the sucker rod R, the ambulatory scrapers being free to migrate along the length of the rod R which is located between two fixed scrapers 1. As the rod R is reciprocated within the tubing T, the fixed scrapers 1 travel with the rod, their positions being fixed with respect thereto and the fixed scrapers 1 being retained on the rods at the selected positions by a tight frictional grip. The ambulatory scrapers 5 comprising a plurality of open convolutions are free to travel on the rod between the fixed scrapers, and since their specific gravity is very similar to that of the well fluids being pumped upwardly between the sucker rod and the tubing T, these ambulatory scrapers 5 are caused to migrate axially during the pumping operation. These scrapers, according to actual tests in oil wells, work their way along the sucker rod sometimes upwardly and sometimes downwardly, but over an interval of time cover a length of rod which is actually greater than the stroke of the pump. If, however, in the case of a particularly difficult well it appeared that the scrapers were not migrating the full distance between the fixed scrapers, then the fixed scrapers may be placed closer together and/or the ambulatory scrapers made longer so that the distances over which they must travel to cover the entire sucker rod are equivalent to the length of the stroke of the pump, or less.

It should also be pointed out that other types of fixed scrapers may be employed so long as they are capable of maintaining their selected position on the rod R and so long as they permit comparatively free passage of oil therepast. Both types of scrapers in the present organization also perform the function of guiding the rod within the tubing T.

The present invention is not to be limited to the exact form shown in the drawings, for obviously changes may be made therein within the scope of the claims.

I claim:

1. For use on a sucker rod within a string of tubing, the combination of different types of paraffin scrapers alternately disposed on the sucker rod, said scrapers comprising fixed scrapers attached to the rod and spaced by predetermined lengths thereof; and ambulatory scrapers having inner diameters greater than the diameter of the rod and having outer diameters less than the inside diameter of the tubing, the ambulatory scrapers surrounding the rod and being freely movable thereon in axial directions, said ambulatory scrapers being placed on each of said lengths to migrate therealong during reciprocation of the rod in the tubing and clean both the rod and the tubing, said ambulatory scrapers each being an open helix having sharp inner and outer edges for scraping the rod and the tubing surfaces respectively, and the material of

said helix being deformable to permit the helix to flex enough to be entwined onto the rod.

2. In a combination as set forth in claim 1, the outside diameter of said ambulatory scraper being less than the inside diameter of said tubing and the inside diameter of the scraper being greater than the diameter of said sucker rod, and the ends of both the ambulatory scrapers and of the fixed scrapers being cut off in a plane normal to the axis of the sucker rod to provide abutment surfaces where the scrapers contact each other.

3. In a combination as set forth in claim 2, said abutment surfaces being sufficiently large in area to prevent entwining of adjacent scrapers.

4. For use on a sucker rod being reciprocated in a string of tubing while pumping well fluids, the combination of different types of paraffin scrapers alternately disposed on the sucker rod, said scrapers comprising fixed scrapers attached to the rod and spaced by predetermined lengths thereof; and ambulatory scrapers having inner diameters greater than the diameter of the rod and having outer diameters less than the inside diameter of the tubing, the ambulatory scrapers surrounding the rod and being freely movable thereon in axial directions, said ambulatory scrapers being placed on each of said lengths and having specific gravities approximating the average specific gravity of the well fluids whereby the ambulatory scrapers may be caused to migrate along said lengths by the reciprocatory action of the sucker rod and by the flow of said fluids.

5. In a combination as set forth in claim 4, the lengths of rod by which the fixed scrapers are spaced being greater than the length of stroke of the rod.

6. In a combination as set forth in claim 4, said fixed scrapers each having frictional rod-gripping means for holding their positions on the rod, said means permitting attachment of the scrapers to the rod at arbitrary selected locations therealong.

7. In a combination as set forth in claim 4, said ambulatory scrapers each being an open helix having sharp inner and outer edges for scraping the rod and the tubing surfaces respectively, and the material of said helix being deformable to permit the helix to flex enough to be entwined onto the rod.

8. For use on a sucker rod being reciprocated in a string of tubing while pumping well fluids, the combination of different types of paraffin scrapers alternately disposed on the sucker rod, said scrapers comprising fixed scrapers attached to the rod and spaced by predetermined lengths thereof; and ambulatory scrapers surrounding the rod and movable thereon in axial directions, said ambulatory scrapers being placed on each of said lengths and being made of a plastic material having such a specific gravity that the forces acting on the ambulatory scraper due to buoyancy effects are small as compared with the forces acting thereon due to relative motion between the rod and the tubing and due to the flow of said fluids.

9. In a combination as set forth in claim 8, the lengths of rod by which the fixed scrapers are spaced being greater than the length of stroke of the rods.

10. In a combination as set forth in claim 8, said plastic material being nylon.

11. In a combination as set forth in claim 8, said ambulatory scrapers each being an open helix having sharp inner and outer edges for scraping the rod and the tubing surfaces respectively, and the material of said helix being deformable to permit the helix to flex enough to be entwined onto the rod.

12. In a combination as set forth in claim 11, the outside diameter of said ambulatory scraper being less than the inside diameter of said tubing and the inside diameter of the scraper being greater than the diameter of said sucker rod, and the ends of both the ambulatory scrapers and of the fixed scrapers being cut off in a plane normal

to the axis of the sucker rod to provide abutment surfaces where the scrapers contact each other.

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