July 30, 1968 C. B. PAGE, JR 3,394,763

FREE PISTON TYPE PARAFFIN SCRAPER

Filed Dec. 29, 1965 2 Sheets-Sheet 1

Fig. 1.

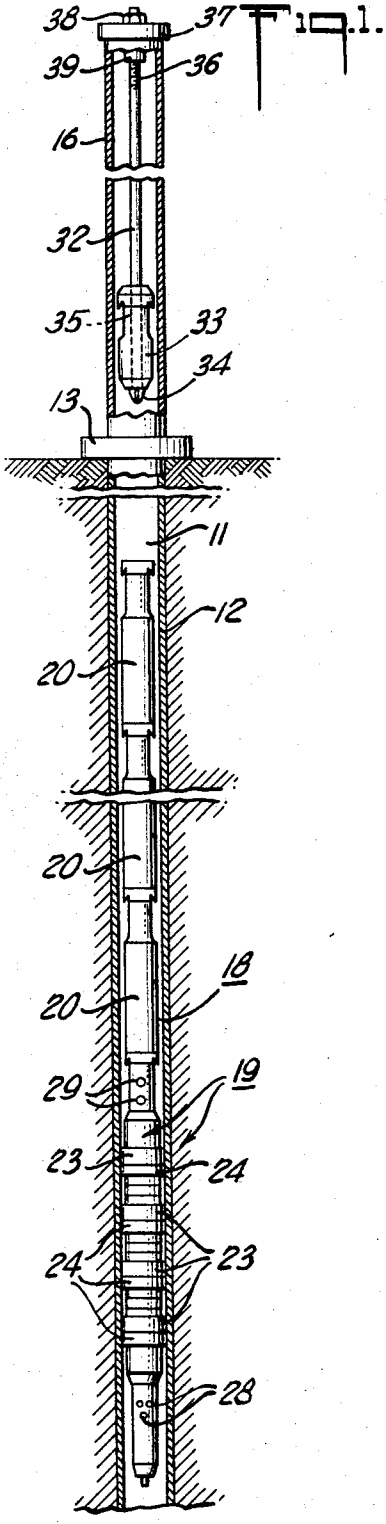
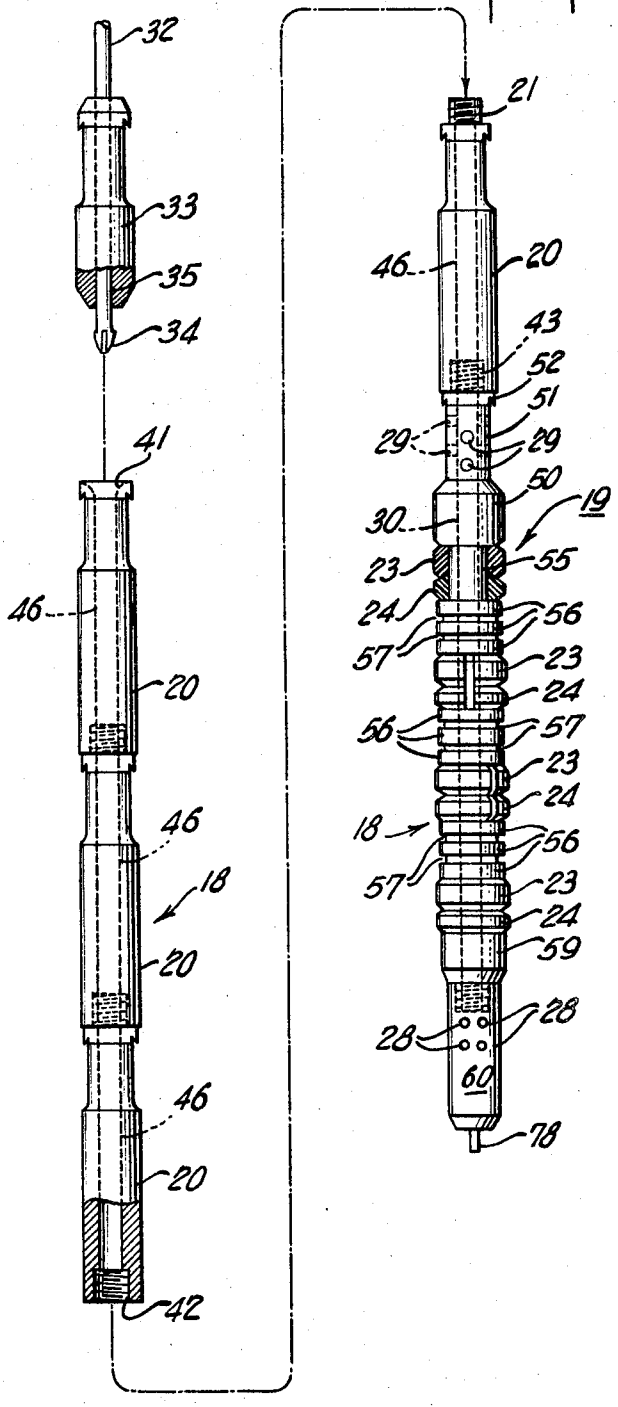


Fig. 2.



July 30, 1968 C. B. PAGE, JR 3,394,763

FREE PISTON TYPE PARAFFIN SCRAPER

Filed Dec. 29, 1965 2 Sheets-Sheet 2

Fig. 3.

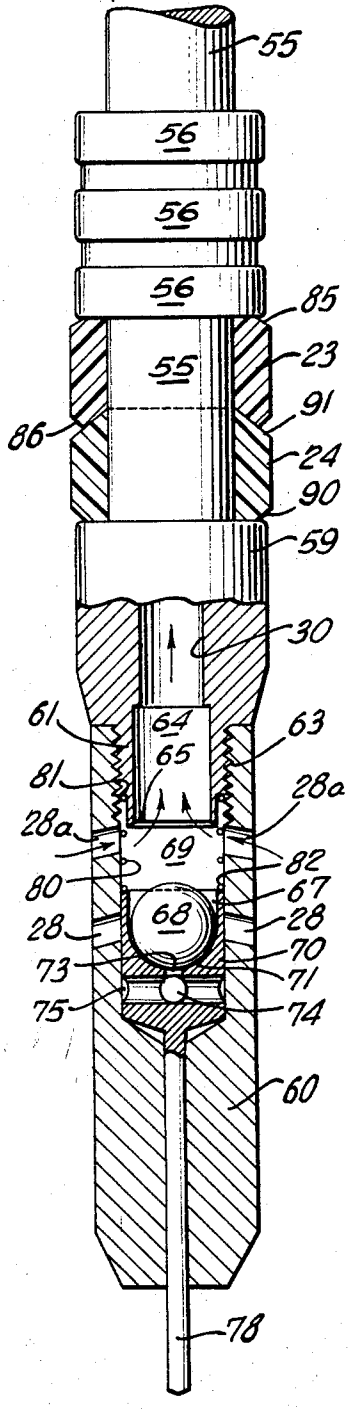


Fig. 5.

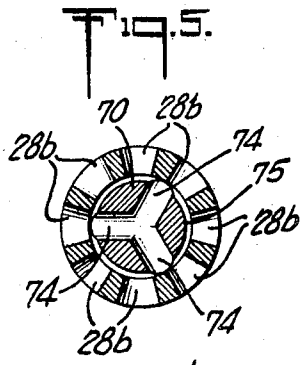


Fig. 4.

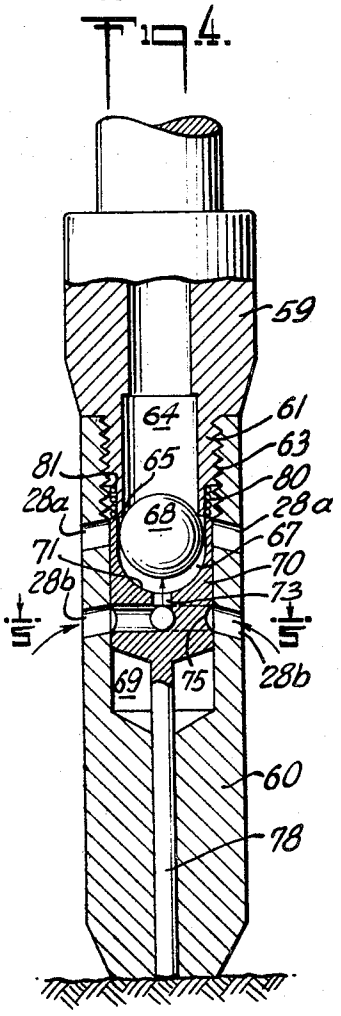


Fig. 6.

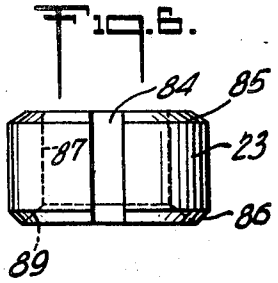


Fig. 7.

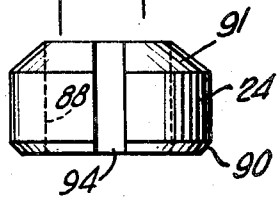


Fig. 8.

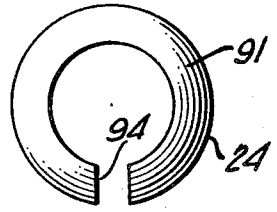


Fig. 9.

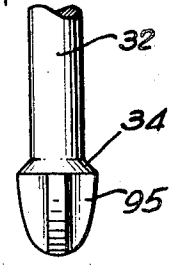
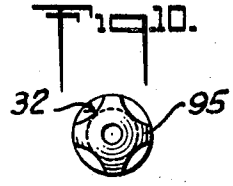


Fig. 10.



United States Patent Office 3,394,763 Patented July 30, 1968

3,394,763

FREE PISTON TYPE PARAFFIN SCRAPER

Charles B. Page, Jr., Marrero, La., assignor to Texaco Inc., New York, N.Y., a corporation of Delaware

Filed Dec. 29, 1965, Ser. No. 517,413
5 Claims. (Cl. 166—170)

ABSTRACT OF THE DISCLOSURE

A free piston paraffin scraper tool having internal by-pass with a check valve therein. In addition, there are self-spreading wipers on the tool and it is adapted to have the check valve reset when the tool reaches the top of the tube. The check valve is a gravity type ball valve with a sleeve valve element that acts in conjunction therewith. The sleeve arrangement acts to hold the ball out of fluid stream when the valve is open.

This invention concerns a so-called free piston type paraffiin scraper. More specifically, it relates to a paraffin scraper (of the free piston type) which has improved structure for more reliable and trouble-free operation.

Heretofore, while there have been several different structures for so-called free piston type paraffin scrapers (or plungers), none of the known structures have been entirely satisfactory in operation. The necessary internal by-pass structural arrangements have included those with structure that move a by-pass valve from open to closed position and which employs tripping pins extending from the ends of the structure. Furthermore, it has been the usual practice to provide a detent arrangement to hold the by-pass valve either open or closed as the case may be whichever position it is in. Such known structures have apparently not been satisfactory in operation. They have tended to stick and to cause the proper functioning of the free piston to cease.

Consequently, it is an object of this invention to provide improved structure for a free piston type paraffin scraper, which is trouble-free and avoids any sticking of the by-pass valve structure. Furthermore, the structure according to this invention eliminates any upper tripping structure in the body of the plunger, and internal connections therefrom to the by-pass valve.

Another object of the invention is to provide improved wiping rings for more effectively cleaning the walls of the tubing.

Briefly, the invention concerns a free piston type paraffin scraper adapted for moving vertically within well tubing. It comprises an elongated body having means for wiping the walls of said tubing, and having an internal passage extending longitudinally through the body from below said wiping means to provide passageway for fluid by-pass when the scraper is descending in said tubing. The scraper also comprises at least one port through the wall of said body connecting with said internal passage and located below said wiping means. It also comprises gravity type ball valve means for closing said internal passage above said port whereby said scraper will be forced upward through said tubing by fluid flowing therein.

The foregoing and other objects and benefits of the invention will be more fully set forth below in connection with the best mode contemplated by the inventor of carrying out the invention, and in connection with which there are illustrations provided in the drawings, wherein:

FIGURE 1 is a schematic longitudinal elevation partly in cross section and showing a tool according to the invention located within well tubing;

FIGURE 2 is a somewhat enlarged, longitudinal elevation partly broken away in cross section which shows the tool per se in addition to the tripping rod and a centralizer thereon, both located above the tool;

FIGURE 3 is an enlarged longitudinal elevation, partly in cross section, showing the lower end only of the tool;

FIGURE 4 is a view similar to that of FIGURE 3 but showing only the valve structure, and illustrating the valve elements in the opposite position from that illustrated in FIGURE 3;

FIGURE 5 is a transverse cross section taken along the lines 5—5 of FIGURE 4, looking in the direction of the arrows;

FIGURE 6 is a side elevation, showing one of the wiper rings that are located in pairs on the lower portion of the tool;

FIGURE 7 is also a side elevation, showing the other one of each of the pairs of rings;

FIGURE 8 is a top plan view of the ring illustrated in FIGURE 7;

FIGURE 9 is a side elevation of the tip portion of the tripping rod; and

FIGURE 10 is a bottom plan view of the tripping rod illustrated in FIGURE 9.

Referring to FIGURE 1, there is illustrated a well **11** having tubing **12** therein. At the surface, there is a well head **13** with a chamber **16** attached thereto for receiving a free piston type tool **18** when at the top of its travel within the well.

The tool **18** is made up of a body section **19** that has attached at the top thereof a plurality of so-called "sinker" bars **20**. These sinker bars **20** are substantially identical to one another except for the top most one, and they are fastened together, in use, by a male threaded extension **21** on each for attachment of the next succeeding bar thereabove. The purpose of the sinker bars is merely to add weight to the free piston tool, and therefore the number of such bars employed depends upon the conditions of the particular well that is being scraped.

The body **19** of tool **18** carries thereon a plurality of pairs of scrapings rings **23** and **24**. These rings are both constructed of a resilient material and each have an outside diameter sufficient to create pressure against the walls of the tubing that is to be scraped. While any feasible number of these scraping ring pairs may be carried by the body **19** of the tool, it is preferable for a tool according to the invention to embody four pairs of these rings along the length thereof, e.g. see FIGURE 2 where the topmost pair is shown in cross section.

As will appear in greater detail below, the scraper rings are constructed in such a way that, in addition to the fact of their being made of resilient material and of a size for applying some pressure against the walls of the tubing, the rings **23** and **24** act cooperatively with one another and provide for a mutual spreading action as movement of the body **19** takes place within the tubing **12**.

As already indicated, the tool **18** is a free piston type and consequently it has a provision for by-passing fluid around the pairs of scraper rings **23, 24** as it descends downhole within the tubing **12**. This by-pass arrangement includes internal valve structure that will be described in greater detail below. Briefly, the by-pass involves a plurality of ports **28** that are located through the side walls of the tool below the scraper rings and connect to an internal passageway **30** that accommodates flow of the well fluid within the body **19**. This passageway **30** connects with additional ports **29** that are located in the body **19** above all of the scraper rings **23** and **24**.

When the by-pass is closed, well fluid flowing upward within tubing **12** will carry the tool along and cause paraffin scraping action by the scrubbing effect of the pairs of rings **23** and **24**. Of course such action takes place throughout the length of the tubing and until the tool is forced up through the well head **13** and related equipment (not shown) and into the receiving chamber **16**. Then the internal valve which is a gravity type ball valve

(see FIGURES 3 and 4), will be tripped by reason of interaction between the valve structure (within the body **19** of the tool) and a tripping rod **32** that is long enough to extend down through all of the sinker bars **20** and into the body **19** of the tool **18** for causing the valve tripping action desired.

In order to keep the tripping rod **32** centralized within the chamber **16** there is a weighted centralizer **33**. This centralizer is constructed of heavy enough material to tend to slide downward along the rod **32** and rest against the shoulders of a star shaped flanged tip **34** that is integrally formed on the lower (free) end of the rod **32**. The centralizer **33** has an internal passage **35** that is of a size to allow free sliding movement along the rod **32**. The outside diameter of the centralizer is only somewhat less than the internal diameter of chamber **16** in order that the rod **32** will always be held in substantially the center of the bore of the chamber.

It will be appreciated that as the scraping tool **18** rises up into chamber **16** above the well head, the uppermost sinker bar **20** will pass over the tip **34** of the rod **32** and will contact the lower surface of the centralizer **33**. Then, as it continues to rise it will carry the centralizer upward in a sliding movement along the rod **32** (within the chamber **16**), until the tripping position for the scraping tool has been reached. At that time the by-pass will be opened and the tool will be free to descend once more down within the tubing **12**.

The tripping rod **32** is supported centrally near the top of the chamber **16**, in any feasible manner, e.g., by having threads **36** at the upper end of the rod **32** as illustrated in FIGURE 1. Thus, the rod is attached to the center of a top plate **37** of the chamber **16**. This may be through a hole in the plate with internal threads (not shown) and a depending sleeve **39** to add lateral stiffness. The rod is clamped firmly by means of a nut **38** screwed onto the free end of the threaded portion **36** of the rod **32**.

It will be appreciated that it might be desirable to spring mount the tripping rod **32** for cushioning the shock when the valve structure is contacted. This could be done in any feasible. manner, not shown.

Referring now to FIGURES 2 through 10 of the drawings, some of the more detailed aspects of the structure will be described. FIGURE 2 shows the complete tool **18** with the body **19** having four sinker bars **20** attached thereabove. The unit is shown in operative relationship with respect to the tripping bar or rod **32**. The latter is illustrated by a fragmentary showing of the bottom of the rod in axial alignment with the tool **18** and with the centralizer **33** located in position on, but displaced upward a short distance above its normal resting place against the tip **34** thereof. It will be observed that the uppermost sinker bar **20** has a smoothly flared mouth portion **41** in order to guide the top sinker bar over the tip **34** of tripping rod **32** when the tool rises and reaches the location of the tripping rod, near the surface.

Each of the intermediate sinker bars **20** has a female threaded socket portion **42** at the lower end thereof when in the position illustrated (see FIGURE 2). Each of these sockets **42** receives and is screwed onto the male threaded extension **21** located at the top of each of the sinker bars **20**, or in the case of the bottom sinker bar to a similar extension **43** located at the top of the body **19** of the scraper portion of tool **18**. Thus, a series of the sinker bars **20** are securely attached to one another and to the top of the body **19** in order to make additional weight for the tool, as required. Of course, each of the sinker bars **20** has an internal passage **46** that is sufficiently large to permit the tip **34** and rod **32** to pass freely down through this passageway as the tool rises into the chamber **16**.

The body **19** of the tool has a central passageway **30** that extends therethrough from the top (as viewed in the drawings) down near the bottom into communication with the ports **28**. The passage **30** has the same size diameter as the passageways **46** through the sinker bars **20**. On the outside of the body **19**, there is a collar **50** located near the top but having a short neck portion **51** extending thereabove. The above mentioned ports **29** extend through the neck **51** in order to connect the internal passageway **30** with the annular space around the tool (when located in the tubing **12**). At the upper edge of the neck **51**, there is a standard type fishing neck structure **52**. This is for use in case the tool should come apart down hole. It will be observed that similar fishing neck structures are included at the top of each of the individual elements going to make up the tool.

Along the body **19** below the collar **50** (as viewed in FIGURE 2) there are a plurality of grooves **55**, four in number, that have a reduced outside diameter compared to the collar **50**. These grooves, or reduced diameter sections along body **19**, are dimensioned to accommodate the pairs of split rings **23** and **24** thereon. Between each of the grooves **55**, there is a group of three spacer seal rings **56** that are an integral part of the body **19** and have the same outside diameter as the collar **50**. They are formed as rings separated by two seal grooves **57** to discourage straight flow between pairs of split rings and to provide some space for accumulation of paraffin particles. Below the lowermost set of scraper rings **23** and **24** there is another collar **59** that has the same outside diameter as the body spacer rings **56** and the upper collar **50**.

Below the lower collar **59**, there are the lower ports **28**. They are formed in two sets, longitudinally spaced apart for cooperation with internal structure of the by-pass valve, as will be described in greater detail with respect to FIGURES 3, 4 and 5 of the drawings.

The details of the by-pass valve structure that are illustrated particularly in FIGURES 3, 4 and 5, comprise an important feature of the invention. It will be noted that there is attached at the bottom of the body **19** of the tool, i.e., below the collar **59** (when viewed as illustrated in the drawings) a tip or nose section **60**. This nose section **60** is fastened securely onto a lower threaded extension **61** that depends from the collar **59**. This is accomplished by having a tapped socket **63** for receiving the threaded extension **61**. There is a slightly enlarged chamber **64** located mostly within the extension **61** and at the lower end of the passageway **30**. This chamber **64** is coaxial with the passageway **30**. The chamber has a beveled lower edge **65** which forms a valve seat in conjunction with a ball **68** that is located within the bore of a coaxial chamber **69** located in the nose section **60** below the tapped socket **63**. The ball **68** is supported by a cage **67**. This takes the form of a cup like hollow forming a sleeve on the upper edges of a piston **70** that is machined for a fluid tight sliding fit within the bore **69**. The length of the piston **70** is such as to provide limited vertical movement within the chamber **69**.

As indicated above, the piston **70** has a smooth cyclindrical upper portion on the exterior thereof formed over the hollow of the cage **67**. This acts by reason of the slide fit to provide fluid valving action in relation to both the upper and lower sets of ports **28** in the nose section **60** of the tool. The cage portion of the piston **70** is hollowed out and has a spherically rounded bottom **71** to form a cup that supports the ball **68** under certain conditions.

At the center of the bottom **71** of the cage **67** (within piston **70**) there is a short axial passage **73** that connects with a plurality of radial passages **74**. All of the radial passages **74** extend out of the surface of the piston **70** and are interconnected peripherally by a groove **75** that extends all the way around the external surface thereof. Extending from the bottom of the piston or sleeve **70** there is an integrally connected pin **78** that extends beneath the lower surface of the nose **60** or not depending upon the position of the piston **70**, with which it moves at all times.

Located within the bore of chamber **69** and above the

sleeve or piston **70** (when viewed as illustrated in FIGURES 3 and 4), there is a relatively light coil spring **80** that is inserted with one end resting against a shoulder **81** and with the other end in contact with a slightly beveled edge **82** of the piston **70**. The spring **80** acts to apply a bias force on the piston or sleeve **70** tending to move it downward into its lowermost position, i.e. the position illustrated in FIGURE 3.

The upper set of ports **28***a* are located just beneath and tangent to the beveled edge **65** of chamber **64**. These provide passage for fluid flow from the exterior of the tool to the inner passage **30**, therethrough. Of course, such fluid flow path will be cut off whenever the ball **68** is up into valve closing position in relation to the valve seat surface formed by beveled edge **65**, e.g. the position illustrated in FIGURE 4. The other set of ports **28***b* are spaced axially somewhat below ports **28***a* and are arranged for interconnecting with the groove **75** of piston **70** when the piston is in its uppermost position, e.g. the position illustrated in FIGURE 4.

FIGURE 6 illustrates the upper one (when the tool is in its working position) of a pair of the scraper rings, i.e., ring **23**. It will be observed that this ring is formed with a split ring structure, having an opening **84** therein to permit a squeezing down in the outside diameter and to facilitate removal of the ring from the body **19** of the tool. Externally the ring **23** has beveled edges **85** and **86**, of about the same width and bevel angle, while internally there is a straight cylindrical opening **87** from the top down to a point near the bottom where it meets an internally tapered or conical surface **89**. Surface **89** widens and intercepts the beveled edge **86** of the ring **23**.

A typical one of the rings **24** is illustrated in FIGURE 7. In this case the internal opening **88** is a straight cylindrical shape from top to bottom. The exterior surface has a beveled edge **90** at the lower edge thereof which is similar in width and angle to edges **85** and **86** of rings **23**. However, at the upper edge of each of the rings **24** there is a much wider beveled edge **91** that has a slope substantially the same as (for cooperating with) the internal conical surface **89** of each of the other rings **23**. Here again, rings **24** are made with split ring structures so that there is an opening **94** to provide for snapping the ring into place on the body of the tool **19** and to permit squeezing thereof.

It will be observed that when both rings **23** and **24** are in place on the tool and the tool is moved upward within the tubing, there will be a tendency for the cooperating tapered surfaces **91** and **89** to act upon one another so as to cause the upper ring **23** to be spread outward by the camming action of the tapered surface **91** acting axially against the corresponding internal taper of surface **89**.

FIGURES 9 and 10 illustrate in more detail the structure of tip **34** of the rod **32**. It will be observed that the tip is formed with four round-tapered flanges **95** that are spaced equally around the end of the rod **32** to form a star-shaped pointed end. The effect is to provide an enlargement that will support the centralizer **33** and keep it from falling off the bottom of the rod **32**, while providing space for fluid flow past the tip **34** when it enters passages **46** and **30** of the tool **18**.

Operation

The operation in general is standard for free piston type paraffin scrapers. However, with respect to this invention it may be best understood with reference to FIGURE 1 and to FIGURES 3 and 4 which latter show the workings of the internal valve structure. Thus, while free piston type scraper tools are old and well known in the art, they have been relatively unsatisfactory in their operation and it is an attribute of this invention that the internal valve structure operates so as to avoid such difficulties.

Commencing with the operation of the tool as it is allowed to fall freely down the tubing, it is to be noted that during such action, the scraper ring pairs are acting to scrub the tubing walls by reason of their dimensions as indicated above. It may also be noted once more that the size of the openings **84** and **94** in the rings **23** and **24** are such as to allow room to squeeze down and accomodate drift in the inside diameter of the tubing. The scrubbing action is enhanced by the improved dual ring structure according to this invention, which is described in considerable detail above.

During downward descent of the tool within the tubing, the well fluid is able to flow through the interior of the tool. In this manner the fluid flow bypasses the scraper rings by entering the upper set of ports **28***a* and flowing through the central passage **30** of the body **19** of the tool as well as on upward through passage **46** within the sinker bars as well as out through the upper ports **29** to join the well fluid above the scraper rings (plus the spacer-seal rings **56**) on the body **19**.

When the tool reaches the bottom of the tubing, or a preset stop element therein, it will be set for upward movement thereafter. The setting action is created when pin **78** strikes the stop, or the bottom of the tubing, and thus lifts the piston **70** and cage **67** upward within the chamber **69**. This action is illustrated in FIGURES 3 and 4 where the elements are shown in FIGURE 3 in the positions for descending. On the other hand, they have been shifted, or set to the other state, in FIGURE 4.

Cage **67** carries ball **68** therewith and closes the upper set of ports **28***a* by reason of the upper (sleeve) edge of the piston **70** sliding across the inner openings of these ports. In addition to closing the upper sets of ports **28***a*, the lower set of ports **28***b* will be in alignment with the circumferential groove **75** in the piston **70**. Therefore fluid from the well is able to flow inward through the radial passages **74** and up through the short axial passage **73** to lift the ball **68** within the cage **67** and force it into valve closing contact with the beveled valve seat surface **65**.

When the ball valve is thus closed, the fluid is no longer able to flow through the by-pass around the scraper rings (on the body **19** of the tool) and consequently the fluid flow pressure will cause the tool to be lifted and carried upward therewith. This then reverses the movement of the tool within the tubing and causes scraping action once more during its upward movement.

The upward movement of the scraper will continue until the tool reaches the surface. As the tool **18** reaches the top of the tubing, the tip **34** of the tripping rod **32** will enter the internal passage **46**. It is guided into the passage centrally thereof by being maintained in a coaxial position (centralizer **33**) and by the widened mouth **41** at the top of uppermost sinker bar **20**.

As the tool **18** continues to rise, the tripping rod **32** will extend on into passage **30** of the body section **19** until the tip **34** of the tripping rod **32** strikes the ball **68**. In this manner the ball **68** is moved downward off its valve seat **65** which opens the by-pass passageway around the tool once more.

When the by-pass valve has thus been tripped, it will assume its other position, i.e. that illustrated in FIGURE 3, by having the ball **68** fall by gravity into the cage so as to rest against the rounded bottom **71**. Then the tool is enabled to descend once more, with the well fluid flowing through the tool in by-pass of the scraper rings, as before.

It will be noted that this operation continues automatically so long as there is sufficient well fluid flowing to carry the tool upward therewith. Consequently an automatic tube scraping action is continuously carried out without any attention except for any periodic checks that may be desired.

It will be noted that the construction of the by-pass valve in this tool is relatively simple in structure and sure in action. Thus a common defect in prior by-pass structures, namely premature closing of the by-pass due to shock or fluid, is avoided.

While a particular embodiment of the invention has been described above in considerable detail, in accordance with the applicable statutes, this is not to be taken as in any way limiting the invention but merely as being descriptive thereof.

I claim:

1. A free piston type paraffin scraper adapted for moving vertically within well tubing comprising

an elongated body having means for wiping the walls of said tubing,

said wiping means comprising at least one pair of split rings having cooperatively tapering end walls for causing one of said rings to tend to open the other,

an internal passage extending longitudinally through said body from a point below said wiping means to provide passageway for fluid by-pass when the scraper is descending in said tubing,

at least one port through the wall of said body connecting with said internal passage and located below said wiping means, and

gravity type ball valve means for closing said internal passage above said port whereby said scraper will be forced upward through said tubing by fluid flowing upward therein.

2. A free piston type paraffin scraper adapted for moving vertically within well tubing comprising

an elongated body having means for wiping the walls of said tubing,

an internal passage extending longitudinally through said body from a point below said wiping means to provide passageway for fluid by-pass when the scraper is descending in said tubing,

a plurality of longitudinally spaced ports through the walls of said body and located below said wiping means,

gravity type ball valve means for closing said internal passage above said ports whereby said scraper will be forced upward through said tubing by fluid flowing upward therein,

a sleeve valve element including an internal cage structure for said ball,

said sleeve structure cooperating with said plurality of ports and having two positions whereby in one position said ball is contained in said cage with the upper ports open for providing fluid by-pass through said internal passage, and in the other position said sleeve closing said upper ports and opening the lower ports into a fluid connection below said ball for lifting same and closing said ball valve to seal off the by-pass passageway.

3. A free piston type paraffin scraper according to claim 2 additionally including means attached near the top of the tubing including a centrally located reset rod for contacting said ball and opening the ball valve in addition to moving said sleeve and ball-cage to its lower position whereby the by-pass passage for fluid flow is reopened and the scraper may fall downward within the tubing.

4. A free piston type paraffin scraper according to claim 2 wherein said wiping means comprises at least one pair of split rings having complementary tapering end walls for causing one of said rings to tend to open the other.

5. A free piston type paraffin scraper according to claim 3 wherein said wiping means comprises at least one pair of split rings having complementary tapering end walls for causing one of said rings to tend to open the other.

References Cited

UNITED STATES PATENTS

2,257,080	9/1941	Turner	166—170
2,661,024	12/1953	Knox	166—170
2,785,757	3/1957	Middleton	166—170
3,329,211	7/1967	Roach	166—170

JAMES A. LEPPINK, *Primary Examiner.*