Jan. 4, 1966 G. A. BUMPERS 3,227,216

CIRCULATING JUNK BASKET

Filed July 5, 1963

Fig. 1

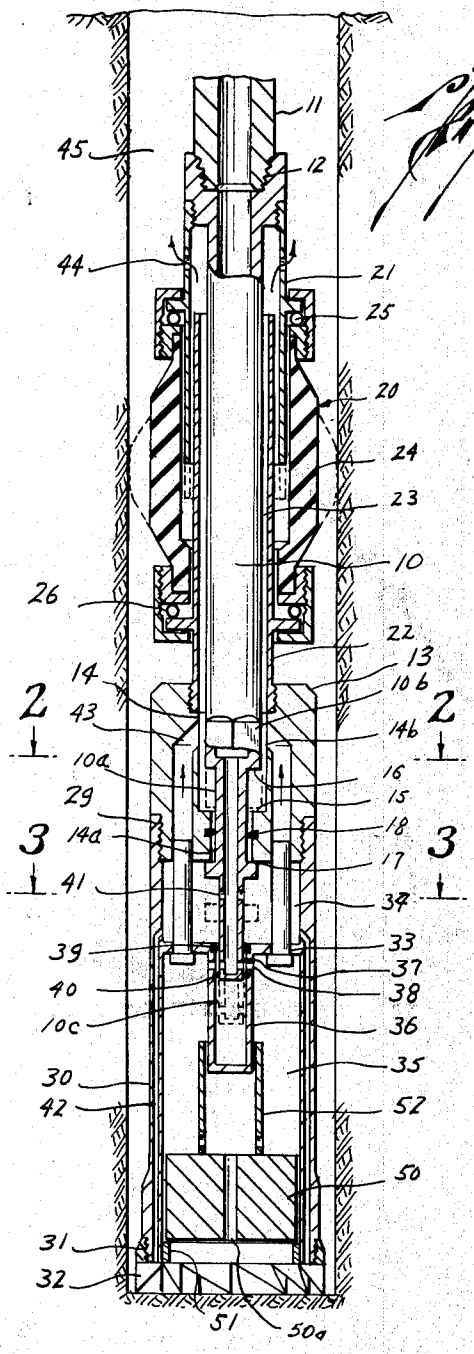


Fig. 2

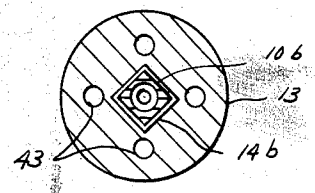
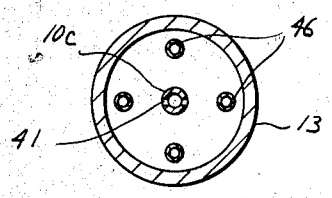


Fig. 3



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CIRCULATING JUNK BASKET

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This invention relates to fishing tools of the type used to remove undesired pieces of material, i.e. "junk" from a well bore.

There is a need, particularly in the oil and gas industry where wells are being drilled deeper and deeper, for a fishing tool of the type commonly known as a circulating junk basket through which the circulation can be changed from normal circulation to reverse circulation and back again simply by manipulating the pipe string to which the tool is attached and it is an object of this invention to provide such a fishing tool.

It is also an object of this invention to provide a fishing tool which employs magnetic means to trap and hold the junk which enters the fishing tool which can adjust itself to the different quantities of junk which may be found on the bottom of a well bore.

It is a further object of this invention to provide a fishing tool which automatically provides for the reverse circulation of well fluid when the tool engages the bottom of the well bore to help wash the particles of material to be recovered into the fishing tool and which automatically returns to conventional circulation when the tool is lifted from the bottom of the well bore. It is a further object of this invention to provide a fishing tool which can be rotated if desired while the fishing tool is in engagement with the bottom of the well bore without affecting the circulation of fluid through the well tool.

It is an additional object of this invention to provide a well tool which requires no waiting time to change circulation from conventional to reverse circulation once the tool is in position in engagement with the bottom of the well bore.

Other objects, features and advantages will be apparent to one skilled in the art from a consideration of the specification, attached drawings and appended claims.

In the drawings,

FIG. 1 is a vertical sectional view taken through the well tool showing it in engagement with the bottom of the hole preparatory to either removing the tool from the hole or the beginning of the fishing operation;

FIG. 2 is a sectional view taken through the tool along line 2—2 of FIG. 1; and

FIG. 3 is a sectional view taken along line 3—3 of FIG. 1.

In the embodiment illustrated in the drawings the tool is carried into and out of the well bore on an elongated, tubular, mandrel **10** which is connected to pipe string **11** by threads **12**. Slidably attached to the lower end of the mandrel is body **13** which is provided with a centrally located opening **14**, through which the mandrel extends. Opening **14** has a portion **14***a* of smaller diameter adjacent the lower end of the body to provide an internal shoulder **15**. The lower end of the mandrel is also provided with a section **10***a* of reduced diameter designed to pass through opening **14***a* and to also provide opposing shoulders **16** and **17** which engage shoulder **15** and the underside of body **13** and limit the relative movement of the mandrel with respect to the body. Seal ring **18** is provided between the body and the mandrel to prevent the flow of fluid through the central opening of the body. As seen in FIG. 2 the upper portion **14***b* of opening **14** and section **10***b* of mandrel **10** which is located in this portion of opening **14** are rectangular rather than circular in cross section to thereby prevent the mandrel from rotating relative

to the body, thus any rotation imparted to the mandrel through pipe string **11** will also be imparted to the body of the tool.

A telescoping packer assembly generally indicated by the number **20** is located between the upper end of mandrel **10** and the upper end of body **13** and is designed to be forced into sealing engagement with the well bore by relative downward movement of the mandrel in the body. The packing assembly consists of downwardly extending tubular member **21** which is attached to the upper end of mandrel **10** and which slidably receives a similar tubular member **22** attached to the upper end of body **13**. Tubular member **22** is provided with an internal diameter of such that the annular flow space **23** between member **22** and mandrel **10** is sufficient to avoid unnecessarily restricting the flow of fluid therethrough. A packing element **24** is arranged with its upper end rotatably attached to member **21** by means of bearing **25** and its lower end rotatably attached to member **22** by means of bearing **26**. Thus as members **21** and **22** telescope as a result of relative movement between mandrel **10** and body **13**, packing element **24** will be forced outwardly into sealing engagement with the well bore as shown by the dotted lines in FIG. 1.

Attached to the lower end of body **13** by means of threads **29** is tubular member **30**. This is the junk basket within which the junk will be collected. Attached in turn to the lower end of member or junk basket **30** by means of threads **31** is a conventional rotary shoe **32**. Extending laterally across the junk basket and spaced from the end of body **13** is partition **33** which divides the junk basket into an upper chamber **34** and a lower chamber **35**. Depending from partition **33** and extending into chamber **35** is cylindrical member **36**. This member is designed to slidably receive the lower end **10***c* of mandrel **10**. The lower end **10***c* of the mandrel is provided with two vertically spaced fluid ports. The lower port **37** is located within cylindrical member **36** which, in turn, is provided with fluid port **38** adjacent its upper end so that fluid going through mandrel **10** can pass through fluid port **37** through fluid port **38** into chamber **35** when the mandrel is in its uppermost position as shown in FIG. 1. Sealing rings **39** and **40** are located on opposite sides of fluid port **38** in sealing engagement with the lower end of mandrel **10** to control the flow of fluid from the mandrel through port **37** into chamber **35**. When the mandrel slides downwardly with respect to the body when the tool is in engagement with the bottom of the well bore and fishing operations have begun, port **37** is below seal ring **40** and flow through port **37** is stopped.

Spaced vertically above fluid port **37** in mandrel **10** is the upper fluid port **41** which provides fluid communication between mandrel **10** and chamber **34**. Fluid passing into this chamber is directed through passageways **42** provided in the wall of junk basket **30** to a point between the teeth on rotary shoe **32**. To provide a return passageway for this fluid, body **13** is further provided with a plurality of passageways **43** which connect the lower side of the body to annular space **23** between mandrel **10** and telescoping members **21** and **22** of the packing assembly. A plurality of ports **44** are located at the upper end of tube **21** so that fluid passing through annular space **23** can flow outwardly into annulus **45** between the pipe string and the well bore. Connecting the openings **43** with chamber **35** are a plurality of tubes **46** which connect chamber **35** to passageways **43** allowing the fluid to bypass chamber **34**.

The well tool is thus provided with three passageways through which fluid can flow. The first passageway consists of mandrel **10** (which actually provides a continuation of the flow passageway through pipe string **11**), upper fluid port **41**, chamber **34**, and passageway **42** in

the wall of junk basket **30**. This first passageway then directs fluid from the mandrel to the bottom of the tool and discharges it at a point adjacent the teeth on rotary shoe **32**. The second passageway consists of chamber **35**, tubes **46** which connect chamber **35** to passageway **43** in the body, passageways **43**, annular space **23** from which fluid flows into annulus **45** and then to the surface. This second passageway then provides a return route for the fluid discharged from the first passageway. A third passageway comprises mandrel **10**, fluid port **37** in the lower end of the mandrel, fluid port **38** in cylindrical member **36** through which fluid can enter chamber **35** which is also connected to the second passageway described previously.

With this arrangement of fluid passages, circulation down the pipe string into the mandrel can be switched from conventional to reverse circulation by providing means for controlling the flow through the third passageway. In the embodiment illustrated these means are the seal rings **39** and **40**.

It is the purpose of this well tool to gather undesirable particles of material or junk into the open end of junk basket **30** and remove this junk from the well bore. Some means must be provided to hold this junk once it enters the bottom of the tool and in the embodiment illustrated in the drawings this is accomplished by bi-polar bar magnet **50**. The magnet has opposite poles at its upper and lower ends and is preferably made of one of the modern ferromagnetic alloys having a high retentivity and field strength. To allow the tool to accommodate varying amounts of junk, the magnet **50** is slidably mounted within junk basket **30** to allow the magnet to move upward away from the lower end of the tool as the junk on the bottom of the well bore is washed into the open end of the junk basket. Stop ring **51** is located adjacent the open end of the junk basket to hold the magnet in the tool and a cylindrical guide member **52** is attached to the upper end of the magnet to slidably engage member **36** and guide the magnet as it moves upward. By allowing the magnet to move upward in the junk basket, the magnet can be located adjacent the lower end of the tool in position to attract the junk which initially enters the junk basket and to then move up as more junk is forced into the junk basket by the circulating fluid and the rotating rotary shoe. By allowing the junk to enter the basket in this fluid to thereby remove any coating of mud, etc. on the way, it is exposed to the cleaning action of the circulating junk which would reduce the magnetic attraction between the various pieces of junk themselves and between the junk and the magnet.

In operation, the tool is attached to a pipe string and lowered into the well bore. As the tool travels downwardly within the well bore the fluid that it displaces can flow either around the tool in the conventional manner or upwardly through the open end of the tool through tubes **46**, passageways **43**, annular space **23** and back to the annulus **45** or through passageways **42** and fluid port **38** into mandrel **10** and into the pipe string.

When the tool reaches the bottom of the well bore the downward travel of body **13** will stop. By continuing to lower pipestring **11**, mandrel **10** will move downwardly relative to body **13**, which will cause tubular members **21** and **22** of the packer assembly to telescope causing packing element **24** to be compressed and forced outwardly into sealing engagement with the well bore. This position of the packing element is indicated by the dotted lines in FIG. 1. At the same time that the packer element is being set to seal off the annulus between the tool and the well bore, the lower end **10***c* of the mandrel has moved downwardly with respect to cylindrical member **36** until fluid port **37** is located below seal ring **40**. This seals off fluid port **37**, preventing the flow of fluid from the mandrel into chamber **35**, forcing all fluid circulated down the pipe string to flow through fluid ports **41** into chamber **34** from where it flows through passageways **42** to

a point adjacent the teeth on rotary shoe **32**. Fluid discharged at this point would, of course, flow not to the inside of the tool but rather outwardly toward the well bore and up the outside of the tool unless it was prevented. This is the purpose of packing element **24** which seals off the annulus above the bottom of the well bore and forces all of the fluid pumped down pipe string **11** to flow from the outer peripheral edge of the rotary shoe into the open end of the tool. This produces the desired washing action which tends to carry the junk which has accumulated on the bottom of the hole into the junk basket where it can be held by magnet **50**. Magnet **50**, of course, can hold only junk which is magnetizable and should the tool be used to recover junk which is not magnetizable, then other means such as conventional junk catchers of the type well known in the art can be employed.

While the tool is on the bottom of the well bore it is desirable to rotate the rotary shoe, since it is preferably provided with tapered teeth which will tend to force the junk on the bottom of the well bore toward the center of the rotary shoe. This rotation is possible even though packing element **29** is in sealing engagement with the well bore since it is rotatably attached to the tool by means of bearings **25** and **26**. Thus the entire tool can rotate with respect to the packing element which remains stationary in sealing engagement with the well bore. Rotation, of course, is imparted to the rotary shoe by means of the square section **10***b* on the mandrel which is located within the square opening **14***b* in body **13**.

While the tool is on bottom then fluid is circulated from the outer periphery of the tool into its open lower end as described above. This fluid passes upward through magnet **50** which is provided with a central opening **50***a* through which the fluid can readily flow. From chamber **35** the fluid passes upward through tubes **46**, passageways **43** in body **13**, through annular space **23** between the outside of the mandrel and the inside of tubular members **21** and **22**, and out ports **44** into annulus **45** from which it returns to the surface of the ground.

After fishing operations are completed and the tool is picked up from the bottom of the well bore, mandrel **10** moves upward relative to body **13** to the position indicated in FIG. 1. This movement simultaneously causes packing element **24** to return to its original position and fluid port **37** in the lower end of mandrel **10** to move back into fluid communication with chamber **35** through fluid port **38** in cylindrical member **36**. Whatever junk may have been washed into the lower end of the tool is held within the tool by means of magnet **50** and the tool is ready for the trip out of the well bore. As the tool travels out of the well bore fluid can flow past the tool between it and the well bore and down through mandrel **10** out through both ports **37** and **41** and out of the bottom of the tool either through chamber **35** or passageways **42**.

From the foregoing, it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the apparatus.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

The invention having been described, what is claimed is:

1. A fishing tool for recovering junk from the bottom of a well bore, comprising in combination, a body, a junk basket attached to the body and extending downwardly therefrom; an elongated tubular mandrel adapted

to be connected to a pipe string for lowering the tool into a well bore; means for slidably connecting the body to the mandrel for limited longitudinal movement of the body relative to the mandrel; packing means, means connected to the mandrel and the body for compressing the packing means to seal the annular space between the tool and the well bore when the mandrel moves downwardly relative to the body; means for providing a flow space between the packing means and the mandrel that is connected with the annular space between the pipe string and the well bore above the packing means; the mandrel having two vertically spaced, fluid ports adjacent its lower end through which fluid can flow into and out of the mandrel; said tool having a plurality of fluid passages including a first fluid passage connecting the upper fluid port on the mandrel to the annular space between the junk basket and the well bore, a second fluid passageway connecting the interior of the junk basket and the flow space between the packing means and the mandrel, and a third fluid passageway connecting the lower fluid port in the mandrel to the interior of the junk basket; and valve means for stopping the flow of fluid between the lower fluid port in the mandrel and the interior of the junk basket when the junk basket engages the bottom of the well bore and the mandrel slides vertically downward relative to the body to set the packer to force all of the fluid pumped down the pipe string into the mandrel to flow out of the mandrel through the upper fluid port, through the first passageway, and into the interior of the junk basket at its lower end, to tend to wash any junk adjacent the bottom of the well bore into the junk basket.

2. The fishing tool of claim 1 further provided with means for rotatably connecting the packing compressing means to the mandrel and the body to allow the mandrel and the body to be rotated relative to the packing means.

3. A fishing tool for recovering junk on the bottom of a well bore, comprising, in combination, a tubular body having a central opening therethrough, an elongated tubular mandrel extending through the central opening in the body to slidably mount the body on its lower end, stop means on the body and the mandrel to interengage and limit the distance the mandrel can slide upwardly relative to the mandrel, a packer attached at one end to the mandrel and at the other end to the body to be forced into sealing engagement with the well bore when the mandrel slides downwardly relative to the body, a flow passage between the packer assembly and the mandrel connecting the exterior of the packing assembly above where it sealingly engages a well bore with the central opening in the body, an open ended tubular junk basket attached to and depending from the body to engage the bottom of the well bore and hold the body against further downward movement to allow the mandrel to move downwardly with respect to the body and force the packing assembly into sealing engagement with such well bore; the mandrel having two vertically spaced fluid ports means including a passageway providing fluid communication between the upper port and the exterior of the junk basket, means for connecting the lower port to the interior of the junk basket when the stop means are in engagement to allow fluid flow therebetween, means for stopping the flow of fluids through the lower port when the junk basket engages the bottom of the well bore and moves upward relative to the mandrel to move the packer assembly into sealing engagement with a well bore to cause fluid to flow from the lower periphery of the junk basket into the junk basket by pumping fluid into the mandrel, and a fluid passageway in the body connecting the interior of the junk basket to the annular space between the mandrel and the packer assembly to allow the fluid entering the junk basket to flow to the exterior of the packer assembly above where it sealingly engages the well bore.

4. The fishing tool of claim 3 in which the packer assembly is rotatably attached to the mandrel and the body to allow the tool to rotate relative to the packer assembly, the tool being further provided with means for preventing relative rotation between the mandrel and the body to allow the rotation of the pipe string to be transmitted through the mandrel to the body and to the junk basket.

5. A magnetic fishing tool, comprising, in combination, a body having a central opening therein, an elongated tubular mandrel with its lower end extending through the central opening in the body and its upper end adapted to be connected to a pipe string for lowering the tool into a well bore, the mandrel having a shoulder thereon located below the body to support the body on the mandrel, and means to prevent the mandrel from rotating relative to the body; first and second telescoping tubular members surrounding the mandrel, the first tubular member being attached to the upper end of the mandrel with the second member attached to the body, the mandrel being spaced from the tubular members sufficiently to provide an annular flow passage therebetween, a packing element with one end rotatably attached to the first member and its other end rotatable attached to the second member to allow the members to rotate relative to the packing element; the first tubular member having an opening to allow fluid to flow between the annular flow passage between the mandrel and the tubular members and the outside of the first tubular member; a tubular housing attached to and extending below the body to engage the bottom of the well bore and hold the body and second tubular member against further downward movement to allow the mandrel to move downward relative to the body and force the packing element into sealing engagement with the well bore, a partition extending laterally across the housing to divide the housing into an upper and a lower chamber; said partition having a central opening and a depending member extending into the lower chamber having a first opening to reciprocably receive the lower end of the mandrel, said member having a second opening connecting the interior thereof to the lower chamber; said mandrel having two vertically spaced openings, the upper opening being located in the upper chamber and the lower in the depending member, seal means carried by one of the mandrel and the member and located to allow fluid to flow from the mandrel through the lower opening therein into the member and from the member through the second opening therein into the lower chamber when the mandrel is in its uppermost position supporting the body but which prevents the flow of fluid from the member through the second opening into the lower chamber when the mandrel has moved downwardly relative to the body sufficiently to force the packing element into sealing engagement with the well bore; a first passageway in the housing member connecting the interior of the upper chamber to the exterior of the housing, connecting means including a second passageway in the body connecting the annular space between the mandrel and the telescoping tubular members to the interior of the lower chamber whereby fluid flowing to the exterior of the housing through the first passageway can flow into the lower chamber of the housing to help move any junk on the bottom of the well bore into the housing and from the lower chamber to the annular space between the mandrel and the telescoping members through the connecting means, and a magnet reciprocally mounted in the housing to attract and hold any magnetizable junk which enters the housing.

6. A fishing tool for recovering junk from a well bore, comprising, a body, a junk basket attached to and depending from the body, a mandrel, means for slidably connecting the body to the mandrel for limited longitudinal movement of the body relative to the mandrel between a lower and an upper position, the body being supported by the mandrel when it is in its lower position, a packing element, means for moving the packing element into sealing engagement with the well bore when the downward travel of the junk basket and body is stopped and

the mandrel moves downwardly relative thereto, said tool having a first fluid pasageway connecting the interior of the junk basket and the exterior of the tool above the packing element, a second fluid passageway connecting the interior of the mandrel to the exterior of the tool below the packing element, and a third passageway connecting the interior of the mandrel to the interior of the junk basket, and valve means, including seal means carried by one of the body and the mandrel to sealingly engage the other for stopping the flow of fluid through the third passageway only when the downward travel of the junk basket and body has been stopped and the mandrel has moved downwardly relative thereto to cause fluid pumped into the mandrel to flow therefrom through the

second passageway to the exterior of the tool below the packing element and thence into the junk basket.

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