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MAGNETIC BELL NIPPLE

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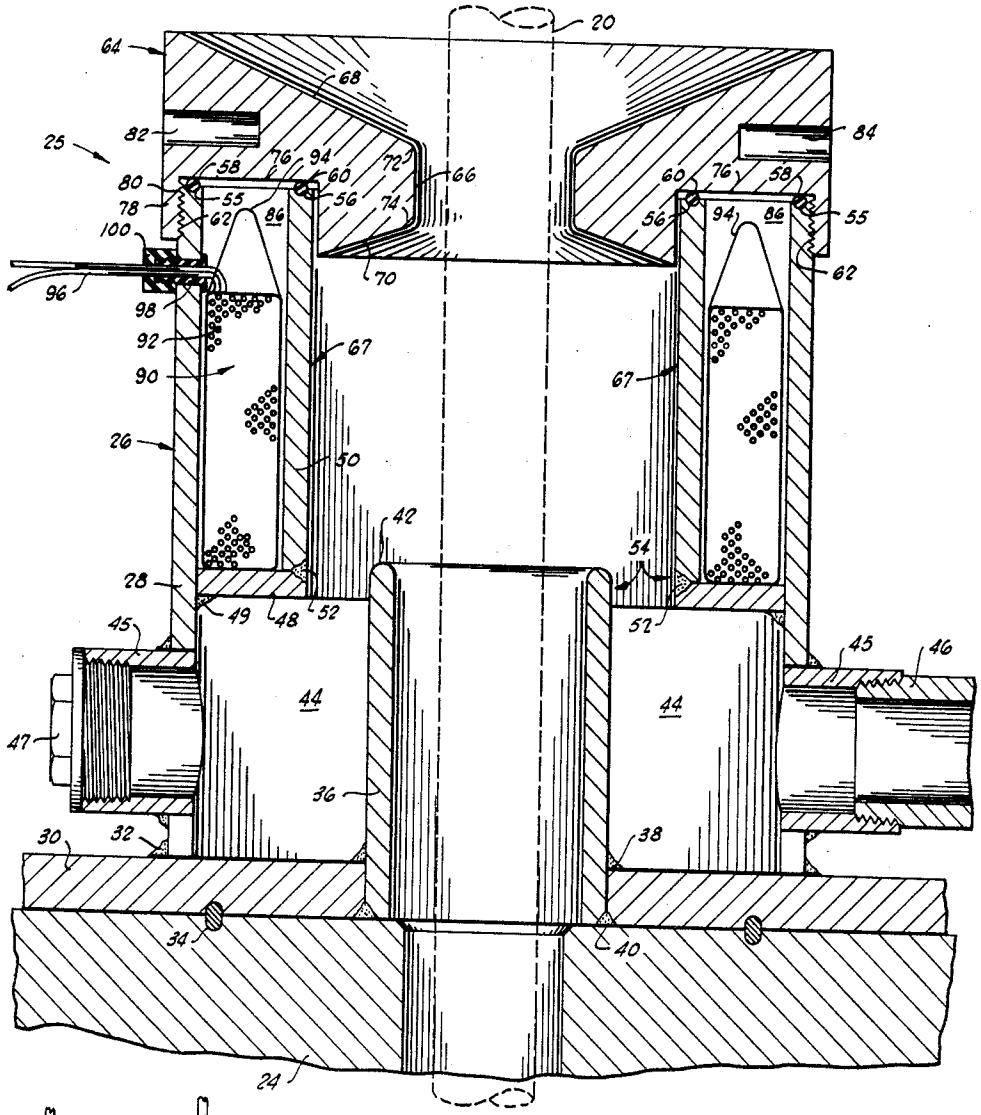



FIG. 1

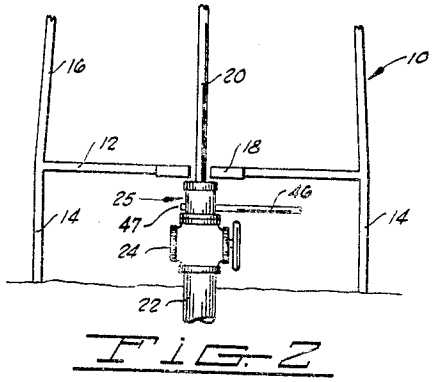



FIG. 2

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# MAGNETIC BELL NIPPLE

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The present invention relates to oil wells, both while the wells are being drilled and after completion, and more particularly, although not by way of limitation, relates to an improved bell nipple for catching pieces of metal which would otherwise fall into the well bore.

As is well known in the art, any time the top of a well bore is left uncovered there is danger that foreign articles will be accidentally dropped into the well bore. This is particularly the case while a well is being drilled because the well bore must be open in order to admit the drill string or the cable line, as the case may be, and while the tubing string is being inserted or withdrawn by a pulling unit after the well is completed. In either case, since the strings of pipe must be connected and disconnected while disposed in a vertical position within the well bore, it is not uncommon for the roughnecks or roustabouts, who are working over the well bore while connecting or disconnecting the joints of pipe, to kick or drop various tools, nuts, bolts and the like into the well bore. Further, the wrenches used to work the pipe are usually provided with replaceable, toothed dies for gripping the pipe so that the dies can be replaced when they become worn. It is not uncommon for these dies to break loose from a wrench during use and fall downwardly into the well bore. This is particularly the case since the advent of pneumatic and hydraulic power tongs. Whenever this occurs, an expensive fishing job is required in order to remove the steel from the well bore before drilling or normal production can proceed. Otherwise the very hard and strong steel dies will quickly ruin the rotary bits used to drill the hole or will interfere with the operation of the hold-down shoe and similar production equipment as the case may be.

Therefore, the object of the present invention is to provide a device for catching articles which woud otherwise fall into a well bore and require an expensive fishing job. The invention features a magnet disposed adjacent the upper end of the well bore for catching, by magnetic force, any magnetically attractable objects which would otherwise fall into the well bore. The many other aspects of the invention will be more fully described in the following specification and more particularly pointed out in the appended claims.

Another object of the present invention is to provide such a device which will not interfere with the normal operation of a drilling rig or of a pulling unit.

Still another object of the present invention is to provide such a device which will catch articles which would otherwise fall into the well bore and hold them in such a position as not to interfere with continued operation of the drilling rig or pulling unit.

Yet another object of the present invention is to provide a device of the character described having a trap in which most articles caught by the device will be collected.

A further object of the present invention is to provide a device of the type described which will also function as a conventional bell nipple for a drilling rig and guide the bit through the blowout preventer into the surface casing.

Another object of the present invention is to provide a combination junk catcher and bell nipple through which the return flow of drilling mud can be flowed.

Still another object of the present invention is to provide a device of the character described which can be economically manufactured, economically operated, and easily serviced.



Many additional objects and advantages of the present invention will be evident to those skilled in the art from the following detailed description and drawings, wherein:

FIG. 1 is a sectional view taken along the vertical axis of a device constructed in accordance with the present invention; and,

FIG. 2 is a simplified schematic drawing of a conventional drilling rig showing the device of FIG. 1 in operative position.

Referring first to FIG. 2, a conventional drilling rig, indicated generally by the reference numeral **10**, has a floor **12** which is supported above the ground by superstructure **14**. A rotary table **18** is disposed substantially in the center of the floor **12** and a drill string **20** is suspended from the rig and extends downwardly through the rotary table **18** into a well bore having surface casing **22** with a conventional blowout preventer **24**. The improved bell nipple constructed in accordance with the present invention is indicated generally by the reference numeral **25** and will normally be bolted to the upper flange of the blowout preventer **24** such that the drill string **20** will pass downwardly through the bell nipple **25** before passing through the blowout preventer **24** and into the surface casing **22**. However, it is to be understood that in its broader aspects the present invention is not limited to a bell nipple used on drilling rigs, but is intended to encompass the use of such a device for protecting any bore having a vertical component from the magnetically attractable articles.

Referring now to FIG. 1, the bell nipple **25** is comprised generally of an elongated housing, indicated generally by the reference numeral **26**, having a cylindrical outer wall **28** which is welded to a flange **30** by a peripheral weld bead **32**. The flange **30** is adapted to mate with the upper flange of the blowout preventer **24** and a standard metal API ring gasket **34** may be provided to establish a fluid-tight seal. The flange **30** may be connected to the flange of the blowout preventer **24** by bolts (not shown), or any suitable fastening means. Further, as will hereafter be described in greater detail, there will be cases in which the bell nipple **25**, or a device constructed in accordance with the basic concept of the present invention may merely be situated above and axially aligned with the well bore, as when tubing is being run by a pulling unit.

The flange **30** has an axial bore in which a central nipple **36** is secured by any suitable means such as the peripheral weld beads **38** and **40**. The central nipple **36** extends upwardly within the housing **26** to some suitable height, as will be presently described, and the upper end **42** is preferably rounded to reduce damage which might be caused to tools lowered through the bell nipple **25**, as hereafter described. Thus it will be noted that the central nipple **36**, in combination with the cylindrical outer wall **28**, forms an annular cavity or trap chamber **44** for collecting foreign articles, as will hereafter be described. Two or more half collars **45** may be provided in the cylindrical outer wall **28** of the housing **26** to provide access to the trap chamber **44**. One of these half collars may be provided with a suitable conduit **46** for returning drilling mud from the well bore to the pit, as will hereafter be described in greater detail. The other half collar **45** may be temporarily closed by some suitable means such as the plug **47** to provide access to the trap chamber **44** for cleaning.

An annular washer **48** is welded to the outer cylindrical wall **28** by a peripheral weld bead **49** at a level slightly below the upper end **42** of the central nipple **36**. An

inner cylindrical wall 50 is welded to the innermost edge of the washer 48 by a peripheral weld bead 52. It will be noted that the innermost diameter of the inner wall 50 is somewhat larger than the outer diameter of the nipple 36 so as to provided an annular passageway 54 therebetween. The cylindrical inner wall 50 preferably extends upwardly to precisely the same height as the upper end of the cylindrical outer wall 28 and the upper ends of the cylindrical outer wall 28 and the cylindrical inner wall 50 are provided with annular, upwardly facing grooves 55 and 56, respectively, for receiving O-ring seals 58 and 60, respectively. The upper end of the cylindrical outer wall 28 is provided with exterior threads 62 for connecting the outer wall of a cap, indicated generally by the reference numeral 64.

The cap 64 is generally disc shaped and has a central bore 66. The diameter of the central bore 66 is preferably slightly less than the inner diameter of the central nipple 36 so as to perform a guide function as hereafter described and is considerably smaller than the diameter of the inner wall 50 in order to form what may be termed an annular recess 67 and to insure that articles attracted to the inner wall 50, as hereafter described, will not be knocked loose by the drill bit or drill stem being lowered through the bell nipple 25. The upper face 68 of the cap 64 is generally frusto-conical or bell shaped, from which the bell nipple 25 gets its name, and slopes inwardly toward the central bore 66. Similarly, the lower face 70 of the cap 64 is generally frusto-conical and slopes upwardly toward the central bore 66. Further, the annular edges 72 and 74 formed between the cylindrical wall of the central bore 66 and the upper and lower faces 68 and 70, respectively, are preferably rounded substantially as illustrated. Therefore, it will be noted that the sloping upper and lower faces of the cap tend to guide any tool striking these faces toward the central bore 66, as well as to prevent any tool passing through the bell nipple 25 from hanging-up, and the rounded edges 72 and 74 tend to reduce damage which might otherwise occur to the tools.

The lower face 70 of the cap 64 is provided with a downwardly facing annular groove 76, preferably having a flat bottom, which is only slightly wider than the radial distance between the inner surface of the inner wall 50 and the outer surface of the outer wall 28. The groove 76 forms an annular depending skirt portion 78 which is provided with interior threads 80 for connecting the cap 64 to the cylindrical outer wall 28 and thereby completing the housing 26. Two or more radially extending bores 82 and 84 may extend inwardly from the peripheral edge of the cap 64 such that rods may be inserted in the bores to assist in threading the large sized cap 64 onto the threads 62 of the outer wall 28. When the cap 64 is screwed down tightly, the flat bottom of the groove 76 will engage the O-ring seals 58 and 60 to form an elongated, annular, water-tight magnet chamber 86 as defined by the outer wall 28, the inner wall 50, the annular washer 48 and the cap 64.

A suitable magnet means, indicated generally by the reference numeral 90, is disposed in the annular chamber 86. The magnet means 90 is preferably a cylindrical electromagnetic coil 92 having a single conductor circumferentially wound around the coil, substantially as illustrated. Of course the conductor should be electrically insulated in the conventional manner as is the case in electric motors and the like, and the entire electromagnetic coil is preferably sized so as to fit freely in the annular magnet chamber 86. The electromagnetic coil 92 is preferably permanently encased in a waterproof epoxy resin or other suitable waterproof material which does not interfere with the magnetic lines of force. A series of wire handles 94 may be connected to the coil 92 and extend upwardly to assist in removing the coil from the magnet chamber 86. The electrical leads 96 to the electromagnetic coil 92 are passed through the outer wall 28 of the housing 26 by a suitable watertight connection such as might be provided by an insert sleeve 98 and a cap 100. The electrical leads 96 then extend to a suitable source of electric power, either A.C. or D.C., which may conveniently be the electric power generator which is standard equipment on nearly all drilling rigs and which is used for lighting and the like. The current from the source of power to the electromagnetic coil 92 is preferably controlled by a suitable switch located on the driller's instrument and control panel so that he may turn the current to the electromagnetic coil "on" and "off" at will.



*Operation*

From the above description, it is believed that the fundamental operation of the improved bell nipple 25 will be obvious to those skilled in the art. When the current to the electromagnetic coil 92 is turned "on," a strong magnetic field will be established within the inner wall 50 and any magnetically attractable articles falling into the bell nipple 25 will be attracted by the electromagnet and held securely against one side of the inner wall 50.

It will also be evident to those skilled in the art that the various components of the housing 26 can be easily fabricated and assembled. For example, the flange 30 may be a standard, commercially available flange. Standard pipe may be used for fabricating the nipple 36, the cylindrical inner wall 50 and the cylindrical outer wall 28. Of course the collars 45 may be standard pipe collars cut in half. The annular washer 48 may be cut from plate stock. The threads 62 and annular grooves 55 and 56 may be cut by turning the assembled housing on a lathe. Similarly, the cap 64 may be formed by turning on a lathe. The electromagnetic coil 92 may easily be formed in a conventional manner by winding on a suitable cylindrical matrix and the desired water-tight sealers applied. The coil 92 can then be easily inserted in the annular magnet chamber 86, the leads 96 extended through the insert sleeve 98 and the cap 100 added. The O-ring seals 58 and 60 may be placed in the respective annular grooves and the cap 64 threaded onto the threads 62 by rods placed in the radially extending bores 82 and 84. After the bell nipple 25 is assembled, it may be easily bolted to the upper flange of the blowout preventer 24.

During normal operation, the downwardly and inwardly tapered upper bell face 68 of the cap 64 will assist in guiding the drill bit (not illustrated) into the bell nipple 25. Since the diameter of the central bore 66 is somewhat less than the diameter of the central nipple 36, the drill bit on the lower end of the drill string 20 will normally not contact the upper end or the central nipple 36. However, since the upper end 42 is rounded, if the bit does strike the central nipple 36, the damage to the bit and the nipple will be reduced to a minimum. As the drill string 20 is lowered, the smaller diameter of the bore 66 will continue to perform a guiding function and tend to maintain the pin and box couplings between the various joints of drill pipe centered within the bell nipple 25 and thereby reduce bumping against the central nipple 36 to a minimum. In any event, it will be evident that a substantial clearance will always be provided between the inner wall 50 and the drill string 20 such that smaller articles held against the inner wall 50 by the magnetic force will be wholly within the annular recess 67 and will not be knocked from the wall by the drill bit or string being lowered into the well bore.

While the well bore is being cut by rotation of the drill string 20, the return flow of drilling mud will normally be directed upwardly through the annulus between the drill string 20 and the surface casing 22 and the nipple 36. The drilling mud will then pass downwardly through the annular space 54 into the annular trap chamber 44 and then outwardly through the collar 45 and con-

duit 46 to the drilling mud pit. Of course in some instances the drilling mud may entirely fill the bell nipple 25 and will then flow out through the central bore 66. However, in such an event the annular O-ring seal 60 will continually prevent the wet drilling mud from entering the annular magnet chamber 86 and interfering with the operation and long life of the electromagnetic coil 92.

Assume now that the drill string 20 is either being run into or withdrawn from the well bore and accordingly occupies substantially the position shown in dotted outline of FIG. 1. When the drill string is in this position, the roughnecks will be working above the rotary table 18 with various pipe tongs to connect or disconnect the successive joints of drill pipe so that they may be either withdrawn or inserted in the well bore. During this operation, it is not uncommon for one of the dies of the tongs to break loose and fall downwardly between the rotary table 18 and the drill string 20 onto the sloping upper bell face 68, downwardly through the central bore 66, and heretofore downwardly to the bottom of the well bore. However, as the metallic die falls downwardly between the inner wall 50 and the drill string 20, the magnetic field created by the electromagnetic coil 92 will instantly arrest the fall of the die and bias the die firmly against the most adjacent portion of the interior wall 50. The die will be held against the inner wall 50 so long as the current through the electromagnetic coil 92 persists. Due to the annular space or recess 67 between the inner wall 50 and the drill string 20, the normal operation of inserting or withdrawing the drill string can continue without being concerned about the die which has fallen into the bell nipple 25. If the current to the electromagnetic coil 92 should be temporarily broken for any reason, such as might occur in the event no one saw the die fall, the die will then drop downwardly through the annular space 54 into the annular trap chamber 44. The die may then be taken from the trap chamber 44 by removing the plug 47 at a later time. Of course, should any other metallic object be inadvertently kicked between the rotary table 18 and the drill string 20 and into the bell nipple 25, it will also be caught by the magnetic attraction of the electromagnetic coil 92 in the same manner.

When the drill string 20 is removed completely from the bell nipple 25 and from the opening in the rotary table 18, it will be evident that considerably larger articles can then be inadvertently kicked or dropped through the opening in the rotary table 18 and into the bell nipple 25. However, it will be appreciated by those skilled in the art that a magnetic force of considerable magnitude can be created merely by increasing the ampere-turns of the electro-magnetic coil 92. It will also be noted that in the event a large article, such as a sledge hammer or medium sized pipe wrench, is dropped through the rotary table 18 into the bell nipple 25, the mangetic force will at least draw the lower end of the article against the inner wall 50 where if it continues to fall it will contact the upper end 42 of the nipple 36. The article will then normally fall crossways of the longitudinal passageway extending through the bell nipple 25 and lodge, even though the magnetic force might not otherwise be sufficient to support the entire weight of the article. However, as mentioned, in almost all cases the magnetic force of the electromagnetic coil 92 can be made sufficiently great as to arrest the downward travel and catch virtually any piece of metal small enough to pass through the central bore 66.

As previously mentioned, the switch for controlling the current to the electromagnetic coil 92 is preferably located within easy reach of the driller so that the current to the electromagnetic coil can be turned off when there is no danger of a foreign article inadvertently finding its way into the well bore. In fact, in many cases the current to the electromagnetic coil 92 can be turned off during most operations and the driller will be able to foresee the possibility of some article being dropped into the well bore. The current to the electromagnetic coil 92 can then be turned on for so long as the situation continues to exist.

Although the electromagnetic coil 92 has been described in detail and has many advantages, it is to be understood that substantially any magnet means capable of providing a magnetic field of the desired strength is within the broader aspects of the present invention. In particular, permanent magnets may be used in cases where a source of electric power is not available.

Having thus described a preferred embodiment of the present invention, it is to be understood that various changes, substitutions and alterations can be made therein without departing from the spirit and scope of the present invention as defined by the appended claims.

What is claimed is:

1. A device for catching magnetically attractable articles which may fall into a vertically disposed well bore, the device comprising:
   - a base flange member having a central aperture;
   - an inner nipple connected to the base flange, the inner nipple being disposed around the central aperture and extending upwardly therefrom;
   - a cylindrical outer wall disposed around the inner nipple and connected to the base flange, the outer wall having a substantially greater diameter than the inner nipple for forming an annular trap chamber;
   - a cylindrical inner wall disposed within the cylindrical outer wall and connected to the outer wall at a midpoint thereof to form an annular magnet cavity therebetween, the diameter of the inner wall being greater than the diameter of the inner nipple to form an annular passageway therebetween communicating with the trap chamber;
   - magnet means disposed in the annular magnet cavity; and,
   - a cap member connected to at least one of the upper ends of the outer and inner walls and forming a water-tight seal with both, the cap member having a central bore extending therethrough of substantially smaller diameter than the inside diameter of the inner wall.

2. A device for catching magnetically attractable articles which may fall into a vertically disposed well bore as defined in claim 1 wherein:
   - the magnet means disposed in the annular magnet cavity comprises a cylindrically wound electromagnetic coil; and,
   - the upper face of the cap member is contoured to slope downwardly and inwardly toward the central bore.

3. A device for catching magnetically attractable articles which may fall into a vertically disposed well bore as defined in claim 2 wherein:
   - the upper end of the outer cylindrical wall is provided with exterior threads;
   - the cap member is provided with a depending peripheral skirt having interior threads for mating with the threads on the outer cylindrical wall to provide a connection therebetween; and,
   - annular sealing means are provided between the upper ends of the outer and inner walls and the cap member such that the magnet cavity will be made watertight.

4. A device for catching magnetically attractable articles which may fall into a vertically disposed well bore, the device comprising:
   - an elongated cylindrical housing having a cylindrical inner wall and a longitudinal passageway extending therethrough;
   - magnet means disposed around the outer periphery of the cylindrical inner wall;
   - guide means connected to the housing for maintaining an elongated tool passing through the longitudinal

passageway generally centered and spaced from the inner wall; and,

annular trap means disposed within the housing and below the inner wall for catching articles which drop from the inner wall,

whereby free-falling, magnetically attractable articles passing through the inner wall will be caught and held against the inner wall by the magnetic force of attraction of the magnet means and the elongated tool will be maintained in spaced relation to the inner wall so as not to loosen articles held against the inner wall.

5. A device for catching magnetically attractable articles which may fall into a vertically disposed well bore, the device comprising:

an elongated cylindrical housing having a cylindrical inner wall and a longitudinal passageway extending therethrough;

magnet means disposed around the outer periphery of the cylindrical inner wall; and,

guide means connected to the housing for maintaining an elongated tool passing through the longitudinal passageway generally centered and spaced from the inner wall comprising a cap member connected to



the top of the housing having a central bore therethrough aligned with the longitudinal passageway, the central bore having an inside diameter smaller than the inside diameter of the inner wall,

whereby free-falling, magnetically attractable articles passing through the inner wall will be caught and held against the inner wall by the magnetic force of attraction of the magnet means and the elongated tool will be maintained in spaced relation to the inner wall so as not to loosen articles held against the inner wall.

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