July 14, 1970 H. T. EHRLICH 3,520,359

MAGNETIC JUNK BASKET

Filed June 27, 1968

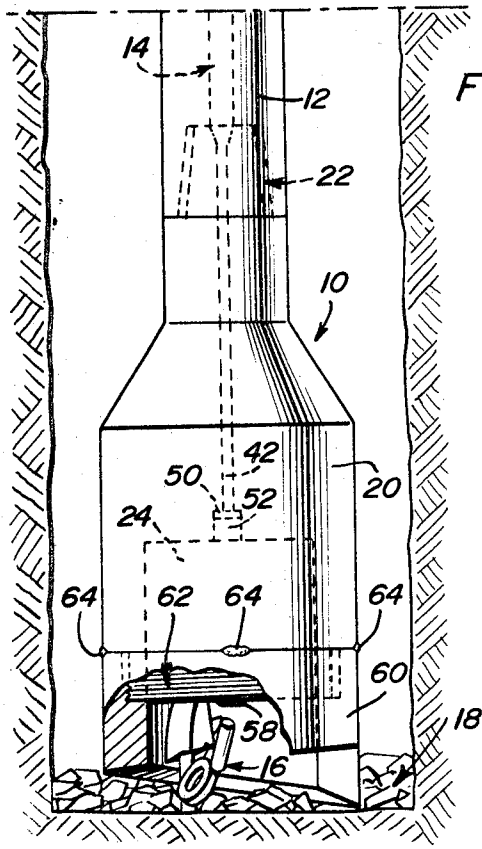


Fig. 1

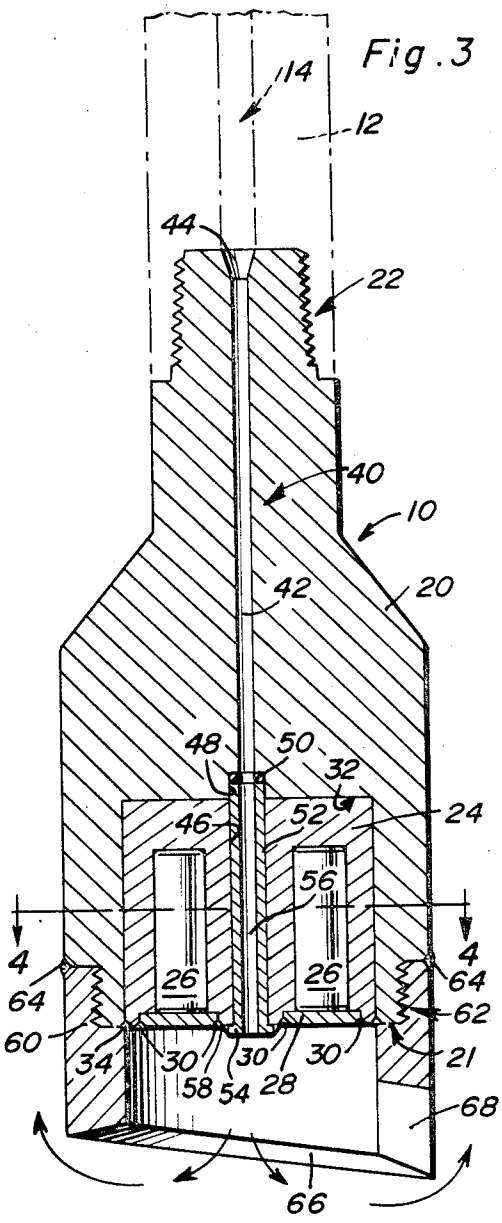


Fig. 3

Fig. 2

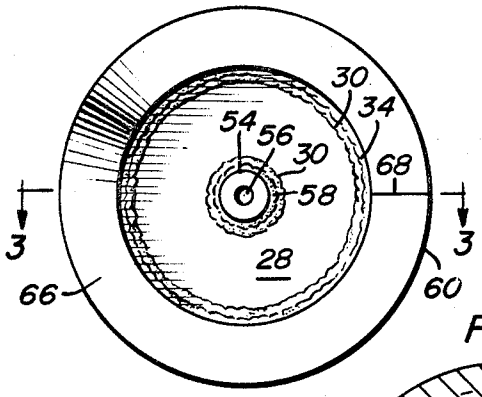
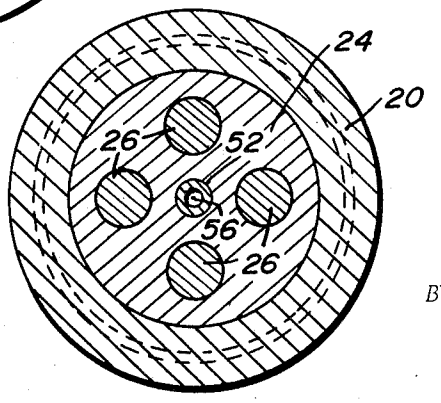


Fig. 4



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MAGNETIC JUNK BASKET

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ABSTRACT OF THE DISCLOSURE

A well tool for retrieving magnetic objects from a well and adapted for connection to a pipe string. The body of the tool is provided with a centrally disposed longitudinally extending circulation fluid bore concentric with the bore of the pipe string. A plurality of permanent magnets, carried in a non-magnetic cage are secured within the body of the tool by a pole plate secured to the body by welding. The cage is also protected from dislodgement from the body by the pressure of the circulation fluid by means of a circulation bore sleeve which prevents the circulation fluid from acting against the top of the cage.

The present invention relates to a magnetic tool for retrieving magnetic objects and fragments from a well bore. More particularly, the present invention relates to a magnetic well tool provided with a plurality of permanent magnets and constructed so as to substantially preclude dislodgement or loss of any of the components of the tool during utilization thereof.

Numerous magnetic well tools have been proposed heretofore. However, such tools are generally characterized by inherent constructional or operational deficiencies which render the tools highly unsuitable for the recovery of magnetic objects, i.e. pipes, bits, bit cones, hammers, etc. which gather at the bottom of a borehole as a result of tool failures or are accidentally dropped down the borehole. The most prevalent deficiencies of magnetic well tools proposed heretofore relate to the tendency for portions of the tool to actually become dislodged during utilization of the tool thereby further adding to the junk that must be retrieved from the borehole. In addition, magnetic retrieving tools provided heretofore do not include satisfactory means for the directing of circulation fluid to effect dislodgement of shale, sand or other caveins of non-magnetic nature so as to permit the magnetic means of the tool to come into magnetic contact with the junk to be retrieved.

It is therefore an object of the present invention to provide a magnetic well tool constructed so as to substantially preclude the dislodgement of components of the tool during utilization thereof.

Another object of the present invention is to provide a magnetic well tool having improved circulation fluid directing means.

A further object of the present invention is to provide an improved construction for a magnetic well tool wherein means are provided for substantially precluding the dislodgement of the magnetic means of the tool by circulation fluid passing downwardly through the tool from the circulation fluid bore of a drill pipe string with which the tool is associated during utilization thereof.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIG. 1 shows a tool embodying the present invention carried on the lower end of a pipe string;

FIG. 2 is an enlarged bottom elevational view of the tool of FIG. 1;

FIG. 3 is a longitudinal cross-sectional view of the tool of FIG. 1 taken substantially along the plane of the line 3—3 of FIG. 2; and

FIG. 4 is a transverse cross-sectional view of the tool of FIG. 1 taken substantially along the plane of the line 4—4 of FIG. 3.

Referring now to the drawings in greater detail and FIG. 1 in particular, the numeral **10** designates an exemplary embodiment of a magnetic well tool, i.e. a magnetic junk basket, constructed in accordance with the principles of the present invention. In FIG. 1 the magnetic tool **10** is shown removably secured to the lowermost section of pipe **12** of a pipe string provided with a circulation fluid bore **14**. The tool **10** is further illustrated recovering magnetic or magnetizible objects indicated by the numeral **16** from a non-consolidated collection of non-magnetic debris, indicated by the numeral **18**, such as comprising shale, etc.

Referring now simultaneously to FIGS. 2–4 it will be seen that the magnetic tool **10** comprises a unitary body member **20** such as machined, or otherwise formed from suitable metallic stock, such as stainless steel, for example, preferably of the type which can be heat treated to effect hardening thereof. As will become more apparent hereinafter the body member **20** need not necessarily be formed of a non-magnetic alloy. The upper portion of the body member **20** is provided with a coupling means designated by the numeral **22** for removably coupling the tool **10** to the lowermost sction of a pipe string **12**. In the exemplary embodiment **10** illustrated the coupling means **22** comprises a threaded pin and box coupling means. However, it can be appreciated that the coupling means may comprise any suitable conventional means.

As seen best in FIG. 3 the body portion **20** beneath the coupling **22** is radially enlarged so as to provide for the reception of a cage means **24** within which are housed a plurality of permanent magnets **26** retained therein by a disk-like pole plate **28** secured to the cage **24**, which will be understood is formed of a non-magnetic alloy, such as brass, for example, by means of weld bead **30**. The brass cage **24** is received within a downwardly opening cylindrical recess as indicated at **32**, which communicates with the lower end portion **21** of the body member **20**. The cage **24** is pressed into the body **20** and fixedly secured therein by a weld bead **34** which is preferably continuous about the juncture of the cage **24** and lower portion **21** of the body member **20**.

As seen best in FIG. 4 the magnetic means provided in the tool **10** comprises a plurality of permanent magnets **26** equidistantly spaced about a radius within complementary cylindrical recesses provided in the cage **24**. The complementary recesses and the permanent magnets **26** are preferably sized so as to frictionally retain the magnets **26** therein. By way of example, the permanent magnets **26** each comprise a permanent magnet capable of exerting a lifting force of approximately 3,200 to 4,000 lbs., which it will be appreciated is generally sufficient to retrieve relatively large, heavy magnetic or magnetizible objects from a borehole or cased well.

Inasmuch as, and as illustrated in FIG. 1, lost objects, especially objects **16** within a well bore are very frequently partially or completely embedded within consolidated material, such as the material **18**, the tool **10** is further provided with a circulation fluid passage means **40** comprising a centrally disposed and vertically extending bore **42** in the body member **20**, generally of a lesser diameter than the bore **14** of the pipe **12**. The bore **42** adjacent the upper end thereof is provided with a frusto-conically relieved portion **44** for effectively reducing the diameter of the bore **14** to that of the bore **42**. It will be appreciated

that the aforementioned relationship of the relative diameter of the bore **14** and bore **42** is done so as to increase the velocity of circulation fluid passing downwardly through the bore **42**.

A salient feature of the present invention resides in the constructional details of the manner in which the circulation fluid passage means **40** "passes" through the cage **24** to preclude fluid pressure, generated by circulation fluid passing downwardly through the bore **42**, from acting upon the upper surface of the cage **24** whereby in the absence of a construction as dictated by the present invention, the cage **24** might be blown out of the body member **20** by the pressures generated by circulation fluid. It will thus be seen that the cage **24** is provided with a through-passage indicated by the numeral **46** concentric with the bore **42** but of a greater diameter than the bore **42**. In addition, and as best seen in FIG. 3, the body member **20** includes a counterbore **48** concentric with the bore **46** and of the same diameter. The counterbore **48** is of sufficient depth, i.e. extends upwardly into the body **20** above the upper wall of the recess **32**, a distance sufficient to accept a resilient seal member **50**, such as an O-ring for example and the upper end of a circulation fluid sleeve or magnetic cage blow-out prevention sleeve **52** having an enlarged peripheral lower flange **54**. The sleeve **52** is press fit upwardly through the cage **24** into sealing engagement with the seal member **50** thereby placing the bore **56** of the sleeve **52** in sealing communication with the bore **42**. The sleeve **52** is secured in the assembled relationship best seen in FIG. 3, by a weld bead **58** about the juncture of the flange **54** and the cage **24**.

From the foregoing it will be seen that the cage **24** is prevented from being blown-out, or washed out by circulation fluid passing downwardly through the passage defined by the connecting bores **14**, **42** and **56** whereby, as shown by the flow arrows in FIG. 3, the circulation is available for displacing unconsolidated material, such as the material **18**, to permit the magnets **26**, acting through the magnetic pole plate **28** to attract junk, such as the junk **16**, whereby the junk **16** can be retrieved from the borehole by the withdrawal of the pipe string **12** from the borehole.

In addition, an exemplary embodiment of a magnetic tool constructed in accordance with the principles of the present invention, as exemplified by the tool **10**, preferably includes a rotary guide shoe **60** coupled to the lower portion of the body member such as by the complementary threaded coupling means indicated by numeral **62** and fixedly secured to the body **20** by welds **64**, which as seen in FIG. 1, need not necessarily extend completely about the junction of the shoe **60** and the body **20**. As seen best from a simultaneous consideration of FIGS. 1 and 3, the shoe **60** comprises a longitudinally extending annular ring including a downwardly spiralling lower edge portion **66** which defines a tooth member **68** for assisting circulation fluid in the unearthing of junk, such as junk **16** from unconsolidated material, such as the material **18**. It will thus be appreciated that in the embodiment illustrated the shoe **60** is primarily adapted for maximum efficiency when the pipe string, and thus the tool **10**, is rotated in a clockwise direction as seen in FIGS. 1, 3 and 4, which corresponds to a counter-clockwise rotation of the tool **10** as seen in FIG. 2. As will the body **20**, the shoe **60** can, for example, be formed of heat hardened stainless steel.

Although a discussion of the utilization of the tool **10** has been inter-dispersed with the description of the structure thereof, the utilization of the tool **10** will be briefly summarized. Thus, and once again referring to FIG. 1, the tool **10** is coupled to the lowermost section of pipe **12** comprising a pipe string, when making up the string at the well head, and the string run in until the tool **10** bottoms, or should the junk to be retrieved be bridging the bore, until the tool comes to rest thereagainst. During the running in of the pipe it is to be understood it is generally preferable to maintain circulation of a conventional circulation fluid downwardly through the pipe **12** and a tool **10** to preclude seizing of the string. In addition, and as discussed previously, such circulation of the fluid discharging from the lower end of the bore **56** displaces unconsolidated material, shale, sand, cuttings, etc., within which the magnet or magnetizible junk may be partially or wholly embedded, whereby such junk comes under the magnetic influence of the permanent magnets **26** acting through the pole plate **28** so as to effect removal, and recovery of such junk, from the borehole by withdrawal of the pipe string from the borehole.

It will thus be seen that a magnetic tool construction in accordance with the present invention and provided with the magnetic pole at one end thereof as defined by the pole plate **28**, magnetically and fixedly retains the magnets in the body of the tool **10** wherein washout prevent means insure that pressure generated by circulation fluid, generally necessary for the efficient utilization of a magnetic retrieving tool, does not effect dislodgement of the aforementioned magnetic means.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. A magnetic well tool to be carried by a pipe string comprising an elongated body member provided with a downwardly opening recess, a first centrally disposed axially extending fluid passage means communicating said recess with a circulation fluid bore in a pipe string with which said magnetic tool is to be associated, a magnetic means fixedly secured in said recess and having a magnetic pole at the lower end portion thereof to attract and hold magnetic and magnetizible objects to be retrieved from a well, said magnetic means including a second fluid passage means in registry with said first fluid passage means for placing said first fluid passage means in communication with the lower end portion of said magnetic means, and said second fluid passage means including sleeve means for precluding wash-out of said magnetic means from said body member by circulation fluid under pressure passing downwardly through said first and second fluid passage means.

2. The combination of claim **1** wherein said magnetic means includes a non-magnetic cage substantially filling said downwardly opening recess and having fixed therein a plurality of permanent magnet members generally equidistantly spaced about a radius, the ends of said permanent magnet members being contiguous with a magnet pole plate exposed at the lower end of said magnetic means.

3. The combination of claim **1** including a rotary shoe means fixedly secured to and downwardly depending from the lower end portion of said body member.

4. The combination of claim **1** wherein said first and second fluid passage means are in sealing communication at a point axially offset from the junction of the upper portion of said magnetic means with the contiguous axial surface of said body member defining the upper limit of said recess.

5. The combination of claim **2** wherein said sleeve means of the second fluid passage means has an upper end received in said body member in sealing engagement with said first fluid passage means, said sleeve means being fixedly secured in said magnetic means.

6. The combination of claim **5** wherein said means sealing juncture of said first and second fluid passage means comprises a resilient seal member.

7. A retrieving tool for well bores comprising an axially elongated body having a tubular lower end portion and a fluid conducting passage terminating at said tubu-

lar magnetic means secured to the body completely within the tubular end portion, conduit member extending through the magnetic means for conducting fluid from the passage externally of the magnetic means and the body, said conduit member having opposite ends projecting axially from the magnetic means, retaining means securing one of the ends of the conduit means to the magnetic member, and means sealing the other of the ends of the conduit member to the body in axially spaced relation to the tubular end portion.

8. The combination of claim 7 wherein the magnetic means includes a non-magnetic cage completely filling the tubular end portion of the body, a plurality of permanent magnets carried within the cage in surrounding relation to the conduit means, and a pole plate secured to

the cage adjacent said one of the ends of the conduit means retaining the magnets within the cage.

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U.S. Cl. X.R.

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