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H. SPODIG

3,277,415

MAGNETIC RETRIEVER

Filed July 2, 1964

FIG. 1

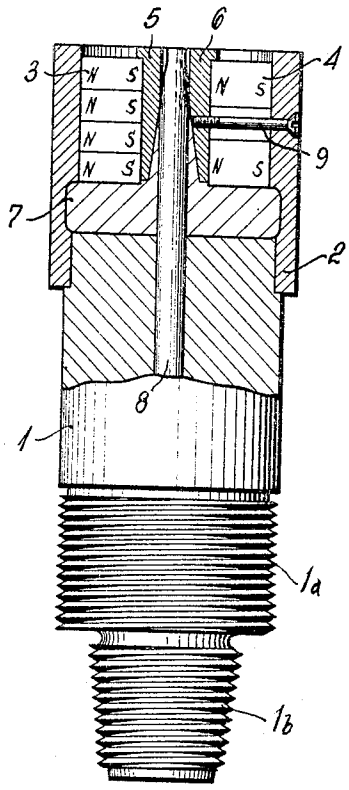
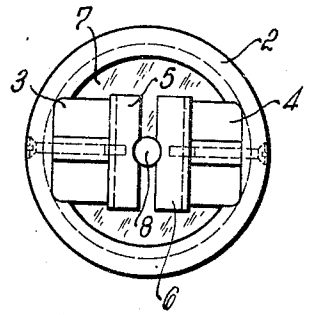


FIG. 2



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MAGNETIC RETRIEVER

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The present invention concerns a magnetic retrieving device. This is a special device for magnetically retrieving magnetic objects from a bore, particularly for retrieving broken drill bits, portions thereof or other iron objects from bore holes, especially from oil wells.

Magnetic retrieving devices of this general kind are known and comprise a metallic head which is attachable to motion producing means e.g. boring rods or drill poles and comprise a magnet system. However, conventionally the magnets of such a magnet system are so connected with the head that the attractive force of the magnet system is concentrated along an annular surface extending along the circumference of the head. Consequently, the magnetic field is comparatively weak in the center area of the system. Therefore, objects attracted by the magnetic field of the magnet system e.g. parts of a broken drill bit are held by magnetic attraction only in the annular area along the outer edge of the head. Of course, in this area the surface where attraction and contact with the object exists is small so that during the movement of the retriever device by pulling it out of the bore the danger and likelihood exists that the objects supported by the magnet system are stripped off or dropped off from the retrieving device. This is very inconvenient and reduces the efficiency of the device almost to uselessness.

Another weakness of known arrangements as mentioned above is due to the fact that the magnetic circuit in the magnet system is not completely or sufficiently closed. As a consequence, the danger exists that the permanent magnets of the system become gradually de-magnetized.

It is therefore an object of this invention to provide for a magnetic retrieving device which is free of the disadvantages of known systems.

It is another object of this invention to provide for a magnetic retrieving device as set forth which is highly efficient and comparatively simple in construction.

With above objects in view the invention includes a device attachable to motion producing means for magnetically retrieving magnetic objects from a bore, particularly from an oil well, comprising, in combination, head body means having a longitudinal axis including attachment means at the rear end thereof for attaching the body means to the motion producing means and including receptacle means at the front end thereof, permanent magnet means mounted in the receptacle means and comprising at least one pair of permanent magnets oriented with their magnetic axes transversely of the longitudinal axis, each of the magnets having an inwardly facing pole face and an outwardly facing pole face, the inwardly facing pole faces of the magnets, respectively, being spaced from the longitudinal axis and also diametrically from each other, and a plurality of pole shoe means mounted in engagement at least with the inwardly facing pole faces of the magnets, respectively, and spaced from each other in direction transverse of the longitudinal axis, the pole shoe means extending in axial direction of the body means up to a transverse plane which defines the forward end of the entire device.

Because in this system magnets or groups of magnets are arranged so as to have diametrically opposed inwardly facing pole faces near the central axis of the device, said pole faces being supplemented by pole shoes extending up to the forward end of the whole device, the strength of the magnetic field is rather concentrated near the center of the front face of the device so that it can be expected that objects to be retrieved will be attracted to the center of the device and held there by magnetic attraction. In this manner, the danger of risking the attracted pieces to be retrieved being stripped off during the removal from the bore is practically eliminated. This is of great importance and decisive for the practical value of a retrieving device of this kind because fragments with sharp edges, unless they are held near the center of the device, have the tendency of being caught by, or interfering with, the walls of the bore.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing, in which:

FIG. 1 is an elevation, partly in axial section, of a retrieving device according to the invention; and

FIG. 2 is a plan view of the device according to FIG. 1 showing the forward face thereof.

The illustrated embodiment of the invention comprises a head body **1** of substantially cylindrical shape which may be attached to any suitable motion producing means e.g. to bore rods or drill poles by means of either a cylindrical thread **1***a* or a tapered thread **1***b* arranged at the rear end of the head body **1**. The forward end of the illustrated device contains a magnet system which is mounted or held in a receptacle arranged at the forward end of the body **1**. In the particular embodiment the receptacle is formed by a tubular member **2** attached to the body **1** by any suitable means and forming a forward extension thereof. The magnet system consists of at least one pair of permanent magnets, preferably in accordance with FIG. 1 of a pair of groups of permanent magnets **3** and **4** which have their magnetic axes oriented diametrically across the longitudinal axis of the body **1**, in each group a plurality of individual permanent magnets being superimposed over each other in axial direction of the body and in parallel with each other. Each magnet and consequently each group of magnets **3** and **4** has an inwardly facing pole face of one polarity as indicated and an outwardly facing pole face of opposite polarity as indicated. The inwardly facing pole faces of the two groups **3** and **4** face each other and are spaced from each other so that there is room left for pole shoes **5** and **6** engaging, respectively, the inwardly facing pole faces of the magnet groups **3** and **4**. Also the pole shoes **5** and **6** are spaced from each other and from the central axis of the arrangement as can be seen more clearly from FIG. 2 so as to form a magnetic gap between the pole shoes **5** and **6** not bridged by magnetizable material. The outwardly facing pole faces of the magnet groups **3** and **4** are in intimate contact with a corresponding inner surface portion of the tubular member **2**. Screws **9** may be provided for holding the pole shoes and the magnets in correct position relative to the member **2**.

Preferably the thickness of the pole shoes **5** and **6** should increase in direction toward the forward end of the device as is illustrated by FIG. 1.

For obvious reasons, the pole shoes **5** and **6** as well as the tubular member **2** and the body **1** should be of magnetic material so that a most efficient and satisfactory magnetic circuit with respect to the permanent magnet system is established.

As shown by FIG. 1 the pole shoes **5** and **6** as well as the tubular member **2** extend in forward direction up to a transverse plane which constitutes the forward end of the entire device.

It will be understood readily that the illustrated magnet system creates a very strong concentration of a magnetic

field around the center of the forward end face of the device. Consequently, the desired result is achieved that magnetic objects encountered by the retrieving device when the latter is lowered or otherwise entered into a bore will be attracted mostly to the central area of the front face of the device where they will be held most satisfactorily by contact with the substantial area of the forward ends of the pole shoes **5** and **6**. Therefore the danger of portions of the attracted object projecting beyond the outer edge of the tubular member **2** is practically eliminated.

While in the illustrated embodiment only one pair of groups of permanent magnets **3** and **4** is shown, it will be understood that the number of such pairs of groups or of magnets could be increased provided that in each pair the inwardly facing pole faces are arranged so as to be diametrically opposed to each other.

In certain cases it is desirable to fill the inner space of the receptacle, where this space is not occupied by pole shoes and magnets, with some non-magnetic material **7** as shown. Moreover, it is sometimes desirable to provide for at least one channel **8** in axial direction passing through the entire device so that flushing liquid may be introduced into or passed through the device whenever desired.

It will be understood that each of the elements described above, or two or more together may also find a useful application in other types of a device for magnetically retrieving magnetic objects from a bore differing from the types described above.

While the invention has been illustrated and described as embodied in a device for magnetically retrieving magnetic objects from a bore comprising permanent magnet means in a very specific arrangement, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A device attachable to motion producing means for magnetically retrieving magnetic objects from a bore, particularly from an oil well, comprising, in combination, head body means having a longitudinal axis including attachment means at the rear end thereof for attaching said body means to the motion producing means and including receptacle means at the front end thereof; permanent magnet means mounted in said receptacle means and comprising at least one pair of permanent magnets oriented with their magnetic axes transversely of said longitudinal axis, each of said magnets having an inwardly facing pole face and an outwardly facing pole face, said inwardly facing pole faces of said magnets, respectively being spaced from said longitudinal axis and also diametrically from each other, said inwardly facing diametrically opposite pole faces of said pair of permanent magnets having different polarities; and a plurality of pole shoe means mounted in engagement at least with said inwardly facing pole faces of said magnets, respectively, and spaced from each other in direction transverse of said longitudinal axis, said pole shoe means extending in axial direction of said body means to the front face the entire device and forming between themselves a magnetic gap extending to and opening in said front face.

2. A device attachable to motion producing means for magnetically retrieving magnetic objects from a bore, particularly from an oil well, comprising, in combination,

substantially cylindrical head body means made of magnetic material having a longitudinal axis including attachment means at the rear end thereof for attaching said body means to the motion producing means and including receptacle means at the front end thereof; permanent magnet means mounted in said receptacle means and comprising at least one pair of permanent magnets oriented with their magnetic axes transversely of said longitudinal axis, each of said magnets having an inwardly facing pole face and an outwardly facing pole face, said inwardly facing pole faces of said magnets, respectively, being spaced from said longitudinal axis and also diametrically from each other, said inwardly facing diametrically opposite pole faces of said pair of permanent magnets having different polarities; and a plurality of pole shoe means made of magnetic material mounted in engagement at least with said inwardly facing pole faces of said magnets, respectively, and spaced from each other in direction transverse of said longitudinal axis, said pole shoe means extending in axial direction of said body means to the front face of the entire device and forming between themselves a magnetic gap extending to and opening in said front face.

3. A device attachable to motion producing means for magnetically retrieving magnetic objects from a bore, particularly from an oil well, comprising, in combination, substantially cylindrical head body means made of magnetic material having a longitudinal axis including attachment means at the rear end thereof for attaching said body means to the motion producing means and including receptacle means including a tubular member of magnetic material constituting a forward extension of the remainder of said body means at the front end thereof; permanent magnet means mounted in said receptacle means and comprising at least one pair of permanent magnets oriented with their magnetic axes transversely of said longitudinal axis, each of said magnets having an inwardly facing pole face and an outwardly facing pole face, said inwardly facing pole faces of said magnets, respectively, being spaced from said longitudinal axis and also diametrically from each other, said outwardly facing pole faces being in engagement with the inside of said tubular member; and a plurality of pole shoe means made of magnetic material mounted in engagement at least with said inwardly facing pole faces of said magnets, respectively, and spaced from each other in direction transverse of said longidutinal axis, said pole shoe means extending in axial direction of said body means up to a transverse plane which defines the forward end of the entire device.

4. A device attachable to motion producing means for magnetically retrieving magnetic objects from a bore, particularly from an oil well, comprising, in combination, substantially cylindrical head body means made of magnetic material having a longitudinal axis including attachment means at the rear end thereof for attaching said body means to the motion producing means and including receptacle means including a tubular member of magnetic material constituting a forward extension of the remainder of said body means at the front end thereof; permanent magnet means mounted in said receptacle means and comprising at least one pair of groups of permanent magnets, each group comprising a plurality of magnets superimposed in parallel array in the direction of said longitudinal axis and oriented with their magnetic axes transversely of said longitudinal axis, each of said groups of magnets having an inwardly facing pole face and an outwardly facing pole face, said inwardly facing pole faces of said groups of magnets, respectively, being spaced from said longitudinal axis and also diametrically from each other, said outwardly facing pole faces being in engagement with the inside of said tubular member; and a plurality of pole shoe means made of magnetic material mounted in engagement at least with said inwardly facing pole faces of said groups of magnets, respectively, and spaced from each other in direction transverse of said

longitudinal axis, said pole shoe means extending in axial direction of said body means up to a transverse plane which defines the forward end of the entire device.

5. A device attachable to motion producing means for magnetically retrieving magnetic objects from a bore, particularly from an oil well, comprising, in combination, head body means having a longitudinal axis including attachment means at the rear end thereof for attaching said body means to the motion producing means and including receptacle means at the front end thereof; permanent magnet means mounted in said receptacle means and comprising at least one pair of permanent magnets oriented with their magnetic axes transversely of said longitudinal axis, each of said magnets having an inwardly facing pole face and an outwardly facing pole face, said inwardly facing pole faces of said magnets respectively, being spaced from said longitudinal axis and also diametrically from each other; and a plurality of pole shoe means mounted in engagement at least with said inwardly facing pole faces of said magnets, respectively, and spaced from each other in direction transverse of said longitudinal axis, said pole shoe means extending in axial direction of said body means up to a transverse plane which defines the forward end of the entire device and increasing toward said forward end in thickness transverse of said longitudinal axis.

6. A device attachable to motion producing means for magnetically retrieving magnetic objects from a bore, particularly from an oil well, comprising, in combination, substantially cylindrical head body means made of magnetic material having a longitudinal axis including attachment means at the rear end thereof for attaching said body means to the motion producing means and including receptacle means at the front end thereof; permanent magnet means mounted in said receptacle means and comprising at least one pair of permanent magnets oriented with their magnetic axes transversely of said longitudinal axis, each of said magnets having an inwardly facing pole face and an outwardly facing pole face, said inwardly facing pole faces of said magnets, respectively, being spaced from said longitudinal axis and also diametrically from each other; and a plurality of pole shoe means made of magnetic material mounted in engagement at least with said inwardly facing pole faces of said magnets, respectively, and spaced from each other in direction transverse of said longitudinal axis, said pole shoe means extending in axial direction of said body means up to a transverse plane which defines the forward end of the entire device and increasing toward said forward end in thickness transverse of said longitudinal axis.

7. A device attachable to motion producing means for magnetically retrieving magnetic objects from a bore, particularly from an oil well, comprising, in combination, substantially cylindrical head body means made of magnetic material having a longitudinal axis including attachment means at the rear end thereof for attaching said body means to the motion producing means and including receptacle means including a tubular member of magnetic material constituting a forward extension of the remainder of said body means at the front end thereof; permanent magnet means mounted in said receptacle means and comprising at least one pair of permanent magnets oriented with their magnetic axes transversely of said longitudinal axis, each of said magnets having an inwardly facing pole face and an outwardly facing pole face, said inwardly facing pole faces of said magnets, respectively, being spaced from said longitudinal axis and also diametrically from each other, said outwardly facing pole faces being in engagement with the inside of said tubular member; and a plurality of pole shoe means made of magnetic material mounted in engagement at least with said inwardly facing pole faces of said magnets, respectively, and spaced from each other in direction transverse of said longitudinal axis, said pole shoe means extending in axial direction of said body means up to a transverse plane which defines the forward end of the entire device and increasing toward said forward end in thickness transverse of said longitudinal axis.

8. A device attachable to motion producing means for magnetically retrieving magnetic objects from a bore, particularly from an oil well, comprising, in combination, substantially cylindrical head body means made of magnetic material having a longitudinal axis including attachment means at the rear end thereof for attaching said body means to the motion producing means and including receptacle means including a tubular member of magnetic material constituting a forward extension of the remainder of said body means at the front end thereof; permanent magnet means mounted in said receptacle means and comprising at least one pair of groups of permanent magnets, each group comprising a plurality of magnets superimposed in parallel array in the direction of said longitudinal axis and oriented with their magnetic axes transversely of said longitudinal axis, each of said groups of magnets having an inwardly facing pole face and an outwardly facing pole face, said inwardly facing pole faces of said groups of magnets, respectively, being spaced from said longitudinal axis and also diametrically from each other, said outwardly facing pole faces being in engagement with the inside of said tubular member; and a plurality of pole shoe means made of magnetic material mounted in engagement at least with said inwardly facing pole faces of said groups of magnets, respectively, and spaced from each other in direction transverse of said longitudinal axis, said pole shoe means extending in axial direction of said body means up to a transverse plane which defines the forward end of the entire device and increasing toward said forward end in thickness transverse of said longitudinal axis.

9. A device as claimed in claim 1, wherein said head body means includes portions of non-magnetic material substantially filling the space left within said receptacle means between and around said permanent magnet and pole shoe means.

10. A device as claimed in claim 2, wherein said head body means includes portions of non-magnetic material substantially filling the space left within said receptacle means between and around said permanent magnet and pole shoe means.

11. A device as claimed in claim 3, wherein said head body means includes portions of non-magnetic material substantially filling the space left within said receptacle means between and around said permanent magnet and pole shoe means.

12. A device as claimed in claim 4, wherein said head body means includes portions of non-magnetic material substantially filling the space left within said receptacle means between and around said permanent magnet and pole shoe means.

13. A device as claimed in claim 5, wherein said head body means includes portions of non-magnetic material substantially filling the space left within said receptacle means between and around said permanent magnet and pole shoe means.

14. A device as claimed in claim 7, wherein said head body means includes portions of non-magnetic material substantially filling the space left within said receptacle means between and around said permanent magnet and pole shoe means.

15. A device as claimed in claim 9, wherein said head body means are provided with an axial channel for introducing flushing liquid.

16. A device as claimed in claim 10, wherein said head body means are provided with an axial channel for introducing flushing liquid.

17. A device as claimed in claim 11, wherein said head body means are provided with an axial channel for introducing flushing liquid.

18. A device as claimed in claim **12**, wherein said head body means are provided with an axial channel for introducing flushing liquid.

19. A device as claimed in claim **13**, wherein said head body means are provided with an axial channel for introducing flushing liquid.

20. A device as claimed in claim **14**, wherein said head body means are provided with an axial channel for introducing flushing liquid.

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