

May 14, 1957

J. F. MEDEARIS
MAGNETIC SEPARATOR

2,792,115

Filed May 24, 1955

2 Sheets-Sheet 1

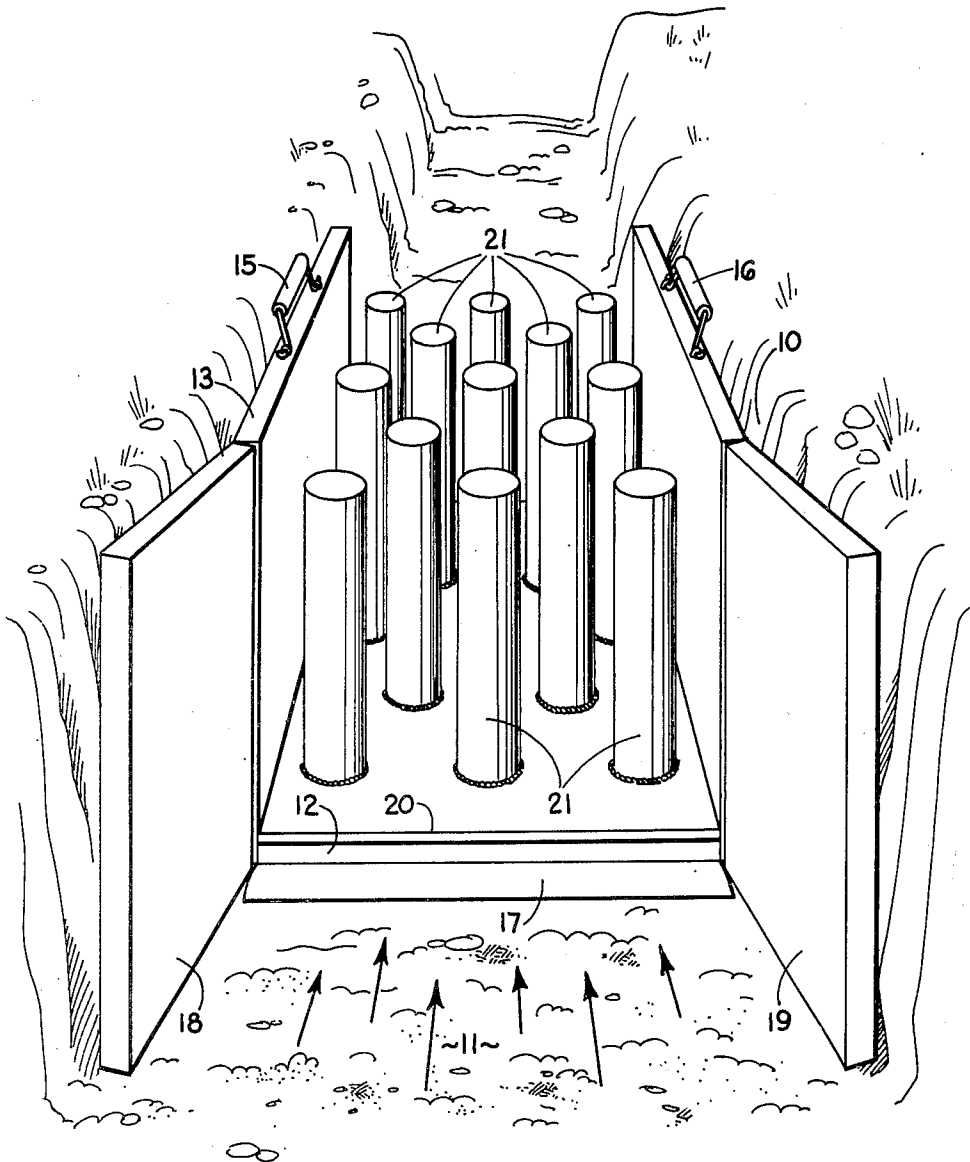


FIG. 1

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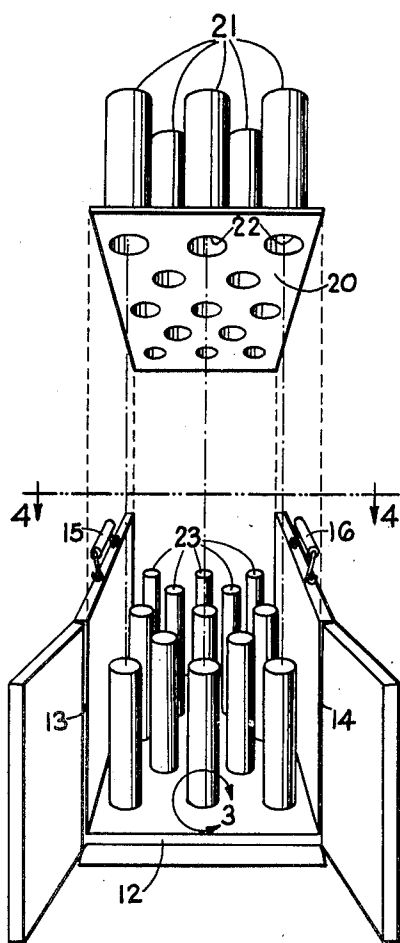


FIG. 2

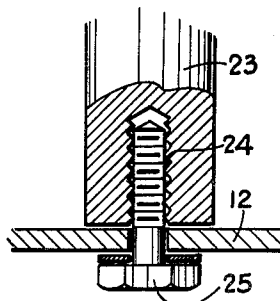


FIG. 3

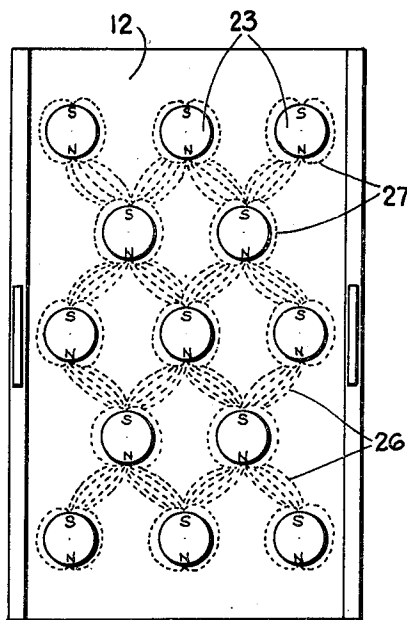


FIG. 4

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MAGNETIC SEPARATOR

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6 Claims. (Cl. 209—223)

This invention relates generally to magnetic separators, and more particularly, to an apparatus for separating magnetic particles from a fluid medium during flowing movement of the fluid.

A preferred application of the invention is in connection with the elimination of small metallic particles which accumulate in the drilling mud during conventional oil well drilling operations. Most of these particles result from the gradual deterioration of various steel drilling tools, bits and the like, and are usually, therefore, subject to magnetization. Such magnetic particles are normally so minute as to prevent their removal to any measurable extent by a mechanical screening or sifting mechanism, but they are still sufficiently large to cause eventual damage through their abrasive action, to pump seals, valves, and other apparatus through which the drilling mud is normally circulated.

An important object of the present invention is to provide a magnetic separator which is extremely rugged in construction and simple to operate.

More particularly, an object is to provide a magnetic separator which may easily and quickly be cleaned of all magnetic particles collected by the apparatus.

Still another object of the invention is to provide a magnetic separating apparatus which does not require electrical power for its operation whereby it is ideally suited for operation in remote locations where such power may not be available.

These and other important objects and advantages of the present invention are attained by providing a plurality of permanent magnets rigidly held by a supporting base plate in a fixed, spaced array. Suitable side walls and deflecting shields are preferably employed for channelling the path of fluid flow through the assembly of magnets to enable separation of the suspended magnetic particles. Each of the magnets is individually enclosed within a non-magnetic means which serves the double function of protecting the magnets themselves from the fluid flow and providing collecting surfaces on which the withdrawn particles may adhere.

The arrangement of magnets on the base plate is such as to result in the fluid passing through the interrelated magnetic fields of several pairs of adjacent magnets, thereby assuring that, regardless of a particular particle's location in the fluid stream, it will eventually pass through a sufficiently intense magnetic field to draw it out of the moving fluid.

The physical arrangement of the non-magnetic means and magnets themselves is such that the non-magnetic means may be readily removed from the magnets. In the absence of the magnetic fields, the particles which have collected on the surfaces of the non-magnetic means will then fall off or may be easily washed away with water or the like. The non-magnetic housing or enclosure may then simply be replaced over the magnets.

The magnets themselves are preferable in the shape of elongated rods magnetized transversely with respect to their longitudinal axes. By this arrangement, one lateral

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side of each rod constitutes a north pole and the opposite lateral side, a south pole. For maximum particle collection efficiency, all of the north pole sides are arranged to face in the same direction in the spaced array.

5 A better understanding of the invention will be had by referring to a preferred embodiment as shown and described with respect to the accompanying drawings, in which:

10 Fig. 1 is a perspective view of a mud ditch with the magnetic separator of the present invention disposed therein;

Fig. 2 is another perspective view of the magnetic separator illustrating how the non-magnetic housing means is adapted to be removed for cleaning purposes;

15 Fig. 3 is an enlarged cut-away view of the portion of the magnetic separator enclosed in the circular arrow 3 of Fig. 2; and,

20 Fig. 4 is a plan view of the magnetic portion of the apparatus taken in the direction of the arrows 4—4 of Fig. 2.

Referring to Fig. 1, there is shown a typical drilling mud ditch or channel 10 for guiding the flow of drilling mud 11 to or from the mud pit during a drilling operation. The magnetic separator of the present invention is shown disposed in the ditch 10 and includes a rectangular base plate 12, preferably of brass. Two side walls 13 and 14 are brazed, welded, or otherwise permanently secured to the longitudinal sides of the base plate and extend upwardly as shown, to define a box-like channel open at its top and ends. These side walls may be provided with handles 15, and 16, respectively, to facilitate lifting the apparatus from the mud ditch.

25 The lower front edge of the base plate 12 is preferably provided with an inclined lip 17 for providing a sloping surface from the mud ditch to the base plate, whereby the flowing mud 11 will be carried up over the front edge of the base plate and through the apparatus. Similar deflecting type structures 18 and 19 are hinged to the front vertical edges of the side walls 13 and 14 and are adapted to be swung outwardly against the ditch walls 13 and 14 to guide the mud flow through the separator.

30 As seen in the view of Fig. 2, a mounting plate 20 is adapted to rest on the upper surface of the base plate 12 and fit closely between side walls 13 and 14. Mounting plate 20 is also preferably made of brass and serves to support a plurality of hollow tubular members 21 closed at their upper ends. It will be observed that the lower ends of the tubular members 21 terminate in corresponding openings or bores 22 in the base 20. Each of the tubes 21 is preferably made of copper and is permanently welded or otherwise secured to the mounting plate 20 in position so that its lower open end is in register with the corresponding bore 22 in the plate.

35 As will be evident from Fig. 2, the mounting plate 20 and tubes 21 constitute an integral structure which may be separated from the base plate 12. As shown, the tubes 21 serve as non-magnetic housing means for a plurality of permanent magnets 23 extending upwardly from the base plate 12. Each of the magnets 23 is in the shape of an elongated rod which is vertically positioned and rigidly secured in parallel spaced relationship with respect to the other rods, by the base plate 12. The corresponding ends of the magnets 23 tie in common planes.

40 Referring particularly to Fig. 3, this stable configuration may be effected by providing a threaded bore 24 in the end of the magnet 23 and threading a bolt 25 up through the bottom of the base plate 12 into the bore. By this arrangement, should one of the magnets become damaged, it may be easily replaced.

45 The spacing of the tubular members 21 is the same as the magnets 23, and the inner diameter of the tubes is made slightly larger than the outer diameter of the

magnets so that the tubes may be telescoped over the magnets when the mounting plate 20 is disposed between the side walls to rest on the base plate 12 as shown in Fig. 1.

Referring now to Fig. 4, it will be seen that each of the permanent magnets is magnetized transversely to its longitudinal axis. By this arrangement, one lateral side of the magnet will be a north pole and the other lateral side a south pole. The several magnets 23 are arranged in parallel rows and staggered as shown so that fluid passing between the sidewalls will come in contact with at least one of the covering tubes 21 during its flow through the apparatus. Preferably, the lateral north pole side of each magnet 23 faces in the same direction as each of the other lateral north pole sides of the other magnets. In the illustration of Fig. 4, all magnetic north poles are shown facing the entrance end of the channel box, but other directions are possible.

With the magnets arranged as described, the magnetic lines of force will travel along paths indicated by the dotted lines 26 in Fig. 4. Also, some lines of force will follow around the periphery of its own generating magnet such as shown at 27 so that a magnetic force will be established throughout the entire area of any given cross-section through which the fluid may be passing.

The operation of the apparatus will be evident from the above description. The non-magnetic covering means comprising the mounting plate 20 and tubes 21 is first placed over the magnets 23. The tubes are made longer than the magnets so that mounting the plate 20 may securely rest on the upper surface of the base plate 12. The magnets 23 projecting within the tubes 21 serve, together with the side walls 13 and 14, to securely hold the mounting plate and tubes from lateral movement, while the weight of the plate and tubes is sufficient to prevent the structure from vertically separating.

Operators at the drilling rig may then lift the apparatus by means of the handles 15 and 16 and place it in the mud ditch as shown in Fig. 1. The side deflectors 18 and 19 are then swung outwardly to engage the side walls of the ditch and these deflectors together with the guiding lip 17 will channel the flowing mud 11 between the side walls and past the tubular members 21, the mud eventually passing out the open rear end of the apparatus. The mud level is normally no higher than about the mid point of the tubes 21 so that no top is needed for the structure.

The permanent magnets 23 within the tubular elements are preferably formed from an aluminum, nickel, cobalt alloy which provides an intense permanent magnetic field. Magnetic particles in the mud will be attracted by this field to the exterior copper walls of the tubes 21 and held there by the magnetic lines of force. When the surface of the tubes appears to be building up relatively thick layers of particles, the apparatus is first removed by means of the handles 15 and 16, and the mounting plate and tubes 21 may then be lifted off the permanent magnets 23. The removal of this non-magnetic covering means may be easily accomplished by simply using one or more of the tubes 21 as a gripping means.

After the tubes and plate 20 are removed, there will, of course, no longer be a magnetic field present to hold the particles to the surface of the tubes and they will therefore fall to the bottom plate 20. The plate and tubes may then be carried to one side and washed down with a hose. With the tubes properly cleaned, they are then replaced over the magnets 23 and the entire structure is again lowered into the ditch 10.

Normally, the apparatus may stay in the trough several hours before the layer of collected particles becomes sufficiently thick to impair the efficiency of the apparatus. Therefore, the relatively short time taken to clean the structure will not result in a serious loss of collecting time.

If desired, another structure may be placed in the ditch while the first is being cleaned, and the two structures alternately used.

It will be apparent from the above description, that the present invention provides an extremely rugged apparatus. There are only two main separable parts and all joints, with the exception of the bolt retaining means for the permanent magnets and the deflectors, are permanently welded or otherwise firmly secured together.

The use of elongated permanent magnets with transverse poles magnetized along a diameter arranged in a staggered parallel array, as shown, provides an effective magnetic field for removing particles from fluid flowing therethrough.

While the invention has been described with respect to the elimination of magnetic, metallic particles from drilling muds, it is to be understood that the principles disclosed herein are applicable to any operation in which it is desired to separate magnetic particles from a flowing fluid. The apparatus is therefore not to be thought of as limited to the exact structure shown in the accompanying drawings for illustrative purposes.

What is claimed is:

1. A magnetic separator comprising: a plurality of magnets; a base plate supporting said magnets in a spaced array; and a non-magnetic covering means including a composite connected structure of receiving pockets in a spaced array corresponding to the array of said magnets adapted to individually enclose said magnets.

2. A magnetic separator according to claim 1, in which each of said magnets is in the shape of an elongated rod and is permanently magnetized in a direction transverse to its longitudinal axis whereby one lateral side is a north pole and the opposite lateral side is a south pole.

3. A magnetic separator according to claim 2, in which said magnets are arranged with their longitudinal axis parallel to each other and with their corresponding ends in common planes the north pole lateral sides facing in substantially the same direction.

4. A magnetic separator comprising: a plurality of magnets; a base plate of non-magnetic material supporting said magnets in a spaced array; and non-magnetic means for individually enclosing said magnets including a mounting plate; hollow tubular members of non-magnetic material secured to said mounting plate in a spaced array corresponding to said spaced array for said magnets, said tubular members being closed at their upper ends and open at their lower ends to register with bores in said mounting plate, said magnets being receivable within said tubular members through said bores, when said mounting plate is placed over said base plate.

5. A magnetic separator according to claim 4, in which said base plate includes upwardly extending side walls defining a box-like channel open at the top and ends; a lip member secured to the front edge of said base plate and slanting downwardly therefrom; and side deflecting members hinged to the front vertical edges of said side walls, whereby said magnetic separator may be placed in a fluid ditch and fluid guided between said side walls to pass about said tubular members individually enclosing said magnets.

6. A magnetic separator according to claim 5, in which each of said magnets is detachably secured to said base plate.

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