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G. A. FREDERICK ET AL

3,546,642

PIGGING DEVICE

Filed May 10, 1968

2 Sheets-Sheet 1

FIG. 1.

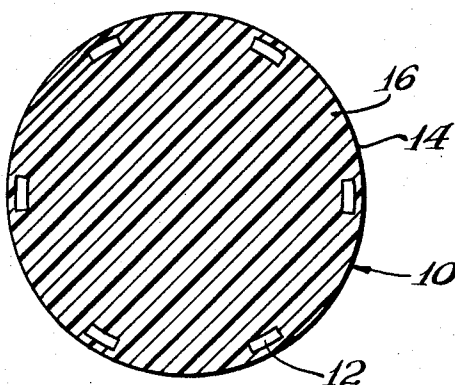


FIG. 2.

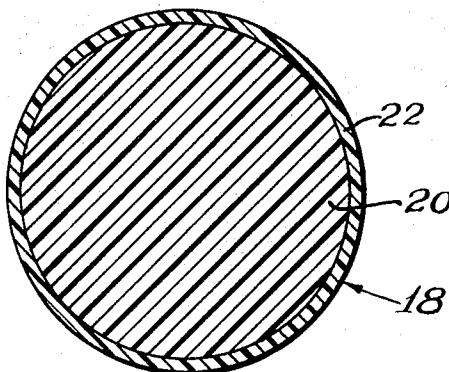
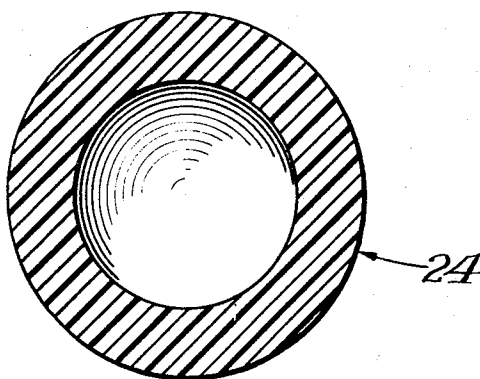


FIG. 3.



Inventors:
George A. Frederick
Leonard E. Burchard
By Bair, Freeman & Malinowski
Attys.

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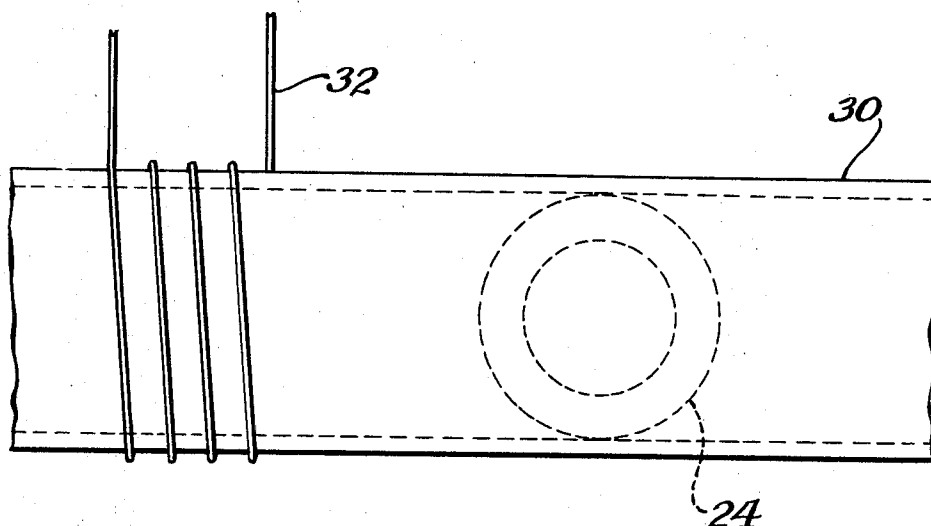
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FIGGING DEVICE

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FIG. 4.



Inventors:
George A. Frederick
Leonard E. Burchard
By *Molinaro, Allegretti,*
Newitt & Wilcoff *Attys.*

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3,546,642

PIGGING DEVICE

George A. Frederick, Wheaton, and Leonard E. Burchard,
Oak Forest, Ill., assignors, by mesne assignments, to
The Peoples Gas Light and Coke Company, Chicago,
Ill., a corporation of Illinois

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Int. Cl. H01f 7/02

U.S. Cl. 335—305

11 Claims

ABSTRACT OF THE DISCLOSURE

A pigging device for use in a pigging device launch and detection system of the type which includes a carrying line and electrical sensing means positioned exterior of the carrying line and responsive to the passage of a pigging device having magnet means contained therein. The pigging device is a spherical or cylindrical flexible member that has an outer peripheral portion which has magnet means uniformly distributed therein so that the magnet means will be as close as possible to the electrical sensing means.

BACKGROUND OF THE INVENTION

Field of the invention and description of the prior art

This invention relates to a device, commonly called a "pigging" device, for cleaning petroleum lines, gas lines, and the like, and it particularly relates to an improved pigging device for use with a pigging device launch and detection system wherein electrical sensing means are located exterior of the gas line and are responsive to the passage of a pigging device having magnet means associated therewith.

Although the pigging device of the present invention may be used for a variety of purposes, such as for various fluid and vacuum transport systems, wherein such devices are used for cleaning, indicating, counting, separation of two different fluids, or transporting, for purposes of simplicity, the present specification will describe such devices for their primary intended use of cleaning natural gas transmission pipelines.

The operation of a large volume, cross-country, natural gas transmission pipeline involves, at the producing end of the pipeline, the operation of an extensive gathering system. The gathering system conveys natural gas from individual wells or individual production areas to collection points where the gas is then passed to the main, long distance, large volume transmission line. The gathering system pipelines are normally smaller in diameter than the main gas transmission line, which may be in excess of thirty-six inches in diameter.

The operation of a gathering system is quite complex because many different types of natural gases, including natural gas of varying liquid condensate content, natural gas of varying sulfur and corrosive component content, and of varying moisture content, are handled. The gathering systems usually consist of 4-12 inch diameter pipes or larger and have a great number of valves, fittings, pressure regulators, and the like for controlling the flow of gas from the producing wells. Problems in efficient operation and maintenance of these gathering systems are introduced due to liquid condensate accumulation, fouling due to corrosive components in the natural gas, and the formation of hydrocarbon hydrates. These hydrates, mixtures of hydrocarbons and water, freeze at temperatures well above the normal freezing points for either the hydrocarbons or the water separately, and often completely plug the gathering system pipeline.

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It is common in the operation of these gatherings to clean the interior of the pipeline by a process known as "pigging." The pipeline cleaning device or pigging device usually consists of a hard rubber spherical or cylindrical device of substantially the same outside diameter as the interior diameter of the pipe to be cleaned. The "pig" is introduced to the pipeline through separate connections known as pig launchers. The pig or pigging device travels through a section of pipe of equivalent diameter and pushes the deposits described above ahead of it in the direction of and under pressure of the gas flow. The deposits are then transferred to a larger pipe section where, for example, a four inch main joins a six or eight inch section of the gathering system. At this juncture, another pigging device is introduced. This additional pigging device is appropriately sized for the larger pipe and continues with the cleaning of the piping system.

In a gathering system composed of several different sizes of pipelines, the pig launchers and pigging spheres must be sized for each pipeline diameter. The cleaning process involves the launching and detection of the pigging devices as they travel through the pipeline.

The precise time for launching the next pig or pigging device is determined when the smaller pig reaches a junction point or a point where the pipe diameter changes in the gathering system. In practice, it has been quite difficult to identify and locate the pigs of the varying sizes in the system. It had been common practice in locating and timing the pigging devices to use a mechanical contact tripping device to sense or detect the passage of a pig. These devices commonly include an arm or a shaft which extends into the pipeline so that the spherical pig traveling in the pipeline makes physical contact with the arm or shaft causing it to move. The arm movement actuates switching devices to cause the next pigging device to be launched or to otherwise identify and locate a particular pigging device operating in the system.

As pointed out in our U.S. patent application Ser. No. 611,185, now U.S. Pat. No. 3,384,512, these mechanical tripping devices are not satisfactory for a variety of reasons. For example, pieces of condensates and other deposits inside the pipelines often cause the mechanical shafts or arms to move, thereby giving a false indication that a pigging sphere has passed a particular point in the line. Also, the deposits in the pipeline often cause the contact shaft to freeze in one position, and thereby prevent the mechanism from detecting the passage of the pigging devices.

In our above identified earlier application, we have described our invention which overcomes the problems of the mechanical devices with a system wherein the pigging device included a magnet therein. Electrical sensing means are positioned at a predetermined location exterior of the pipeline, and preferably in close proximity thereto. Electrical sensing means, such as a wire coil is wrapped around the pipeline, which electrical sensing means responds to the passage of the permanent magnet in the pigging device moving past a preselected point in the pipeline.

Means are spaced from the sensing means and are responsive to it for recording and determining that the pigging device has passed the preselected position in the carrying line. Although the described system has proven to be very satisfactory for most applications, one problem has arisen, however, when a pipeline having a relatively large diameter, such as an excess of twelve inches, for example, thirty-six inches in diameter, is to be cleaned. In both our previously discussed invention and in the Nehse et al. Pat. No. 3,011,197, the pigging devices or pipeline cleaning devices contemplate the use of a single permanent magnet inside of the pigging device. In the larger pipe-

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line, when the pigging device has a magnet at its center portion, the field strength of the magnet, being spaced at a substantial distance from the electrical sensing means, has, at times, been inadequate to create a response in the magnetic responsive electrical sensing means. When this occurs, the gathering system fails, so the desired cleaning of the next larger section of pipeline by the next pigging sphere does not occur.

In our earlier identified application, we did suggest that the permanent magnet could be located towards the surface of the pigging device. However, we did not contemplate the use of more than one magnet in the pigging sphere. Thus, when the electrical sensing means is located at one point in the pipeline, and is not wrapped around the pipe, a particularly bad situation occurs because if the pigging device has its one magnet near its outer surface at a point diametrically opposite the location of the electrical sensing means, the electrical sensing means is likely to be too far from the permanent magnet to be actuated by the magnet's field strength.

SUMMARY OF THE INVENTION

It is therefore an important object of this invention to provide an improved pipeline cleaning device or pigging device which is constructed so as to substantially avoid many of the problems of the prior art.

It is also an important object of this invention to provide an improved pigging device useful in connection with a pigging device launch and detection system which electrically senses the passage of a magnet or magnet means in a pigging device, wherein regardless of the pipeline diameter, the actuation of the sensing mechanism by the magnet is substantially assured.

A further object of this invention is to provide an improved pipeline pigging device having magnet means uniformly distributed in its outer peripheral portion so that, at all times, the magnet means are in close proximity to the inside surface of the pipeline and assure sensing thereof by magnetic responsive sensing means exterior of the pipeline.

It is yet another object of this invention to provide an improved pipeline cleaning device or pigging device which is particularly characterized by its simplicity and economy of construction and manufacture and by its efficiency in operation.

Further purposes and objects of this invention will appear as the specification proceeds.

The foregoing objects are accomplished by providing a pigging device for use in a pigging device launch and detection system of the type having a carrying line with an inner surface and electrical sensing means exterior of the carrying line being responsive to the passage of a pigging device containing magnet means moving past a predetermined point in the line, wherein the pigging device generally comprises a flexible member having an outer peripheral portion with an outer surface, said outer surface having at least a portion substantially coextensive with the said inner surface of the carrying line, and magnet means are uniformly distributed in the said outer peripheral portion whereby magnet means are as close as possible at all times to the said electrical sensing means to thereby assure the sensing of the magnet means contained in the device so that the operation of the system is substantially assured.

BRIEF DESCRIPTION OF THE DRAWINGS

Particular embodiments of the present invention are illustrated in the accompanying drawings wherein:

FIG. 1 is a cross-sectional view of one form of our invention wherein permanent magnets are uniformly distributed in the outer peripheral portion of a pigging device;

FIG. 2 is another embodiment of the present invention wherein the outer skin portion of the pigging device comprises a flexible permanent magnet portion;

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FIG. 3 is still another alternate embodiment of our invention wherein the entire pigging device is constructed of a flexible permanent magnet material; and

FIG. 4 is a schematic view of the embodiment of FIG. 3 within a carrying line having an electrical sensing means adjacent thereto.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In its principal aspect, our invention comprises a cylindrical or spherical flexible device having substantially the same outside diameter as the inside diameter of a carrying line 30, as seen in FIG. 4, such as a natural gas pipeline, so that the outer periphery of the device will movably contact the inside of the pipeline in order to effect the cleaning thereof; it is important in our invention to provide magnetic means, uniformly distributed in the outer peripheral portion of the pigging device. By providing the magnetic means in the outer peripheral portion, there is assurance that the magnetic means will always be in close proximity to the inside of the pipeline and thereby to the electrical sensing means 32, which is preferably located at a point outside of the pipeline but in close proximity thereto. Thus, the field strength of the permanent magnet is close to the electrical sensing means 32 so as to be detected thereby.

Referring to the accompanying drawings, various embodiments of the invention are shown. In FIG. 1, a spherical device 10 is shown and is constructed of a relatively hard, flexible material, such as rubber, neoprene, polyurethane, and the like. Preferably, the flexible pigging device, which may pass through noncircular sections of pipe or through valve sections, is sufficiently rigid to clean deposits from the pipeline, but also sufficiently flexible to pass through irregular pipe sections, valves, etc. The pigging device 10 in FIG. 1 has a plurality of small permanent magnets, such as Alnico magnets, which may be cylindrical in shape and of varying heights and diameters. The magnets 12 are embedded interior of the outer periphery 14 of the pigging device 10 but in close relationship thereto. The magnets 12 are uniformly spaced from each other around the entire peripheral portion, generally 16, of the device 10. By providing uniform distribution to the individual permanent magnets 12, there is assurance that at least one of the plurality of permanent magnets 12, regardless of the particular rotated position of the device 10 in the pipeline, will always be in close proximity to the electrical sensing means (not shown) positioned exterior of but proximate to the pipeline.

In FIG. 2, another embodiment of our improved pigging device is shown. The pigging device, generally 18, shown in FIG. 2, comprises a central core 20 which may be of hardened rubber, polyurethane, or the like, the same material as the spherical device 10 shown in FIG. 1. The outer peripheral portion 22 of the device 18, however, comprises flexible permanent magnet material. This material, well known in the art, consists of finely divided magnetic particles united together by a flexible binder. The outer peripheral skin 22 is bonded to the outer surface of the central core 20 by any suitable bonding agent, or, alternatively, the outer skin 22 may be formed by the molding thereof over the outer surface of the central core 20. The finely divided particles are generally a ferrite material, such as barium ferrite. The particles are generally dispersed in an elastomeric material such as rubber, synthetic rubber, polyethylene, polyurethane, polyvinyl chloride, etc. In the embodiment of FIG. 2, the magnetic material is thereby evenly or uniformly distributed in the outer peripheral portion 22 of the device 18.

Referring to FIG. 3, there is shown still another embodiment of our improved pigging device. The pigging device 24 is constructed entirely of the same flexible magnetic materials from which the outer peripheral portion 22 of the embodiment of FIG. 2 is constructed. The finely divided magnetic particles united by the flexible binder

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in the spherical device 24 may be formed into the desired integral or unitary shape by various molding techniques.

The magnetic field strength of pigging devices made in accordance with our invention have been found to require a minimum strength of about eighty gauss. Although the minimum strength is about eighty gauss, preferably, to assure actuation of the electrical sensing means, the strength of the magnetic means should be higher, preferably about five hundred gauss. The greater the strength of the magnetic material, the greater is the assurance that the electrical sensing means will detect the passage of the pigging device containing the magnetic material.

In the embodiment of FIGS. 1 and 2, the devices are shown as being solid. In the embodiment of FIG. 3, the device is shown as having a hollow inside, which may be filled with gas or liquid under pressure. It is to be understood that all embodiments may be constructed either hollow or solid, as desired.

While in the foregoing, there has been provided a detailed description of one particular embodiment of the present invention, it is to be understood that all equivalents obvious to those having skill in the art are to be included within the scope of the invention as claimed.

What we claim and desire to secure by Letters Patent is:

1. A movable device for use in a launch and detection system of the type having a carrying line with an inner surface, electrical sensing means exterior of said carrying line and being responsive to the passage of said movable device having magnet means therein moving past a predetermined point in said line, said movable device comprising a flexible member having an outer peripheral portion and an outer surface with at least a portion thereof substantially coextensive with the said inner surface of said carrying line to provide for movement thereof through said line in substantial contact with the said inner surface, and magnet means substantially uniformly distributed in the said peripheral portion whereby said magnet means are as close as possible to said inner surface of said carrying line and thereby to said sensing means, so as to substantially assure the sensing of said movable device, containing said magnet means, by said electrical sensing means.

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2. The device of claim 1 wherein said flexible member has a spherical outer surface which is coextensive with said inner surface.

3. The device of claim 1 wherein said flexible member is cylindrical in shape and the cylindrical portion thereof is coextensive with the said inner surface.

4. The device of claim 1 wherein said magnet means comprises a plurality of permanent magnets embedded in the outer peripheral portion of said flexible member.

5. The device of claim 4 wherein said plurality of permanent magnets are spaced substantially equidistant from each other in said outer peripheral portion.

6. The device of claim 1 wherein said magnet means comprises finely divided magnetic particles united by a flexible binder.

7. The device of claim 6 wherein said device comprises an inner core having an outer surface, and said united finely divided magnetic particles and flexible binder are joined to said outer surface in a contiguous sheet.

8. The device of claim 6 wherein said flexible member is constructed entirely of said finely divided magnetic particles and said flexible binder.

9. The device of claim 1 wherein said magnet means has a minimum field strength of about eighty gauss.

10. The device of claim 1 wherein said magnet means has a field strength of about five hundred gauss.

11. The device of claim 1 wherein said magnet means is below the surface of said flexible member.

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GEORGE HARRIS, Primary Examiner

U.S. Cl. X.R.

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