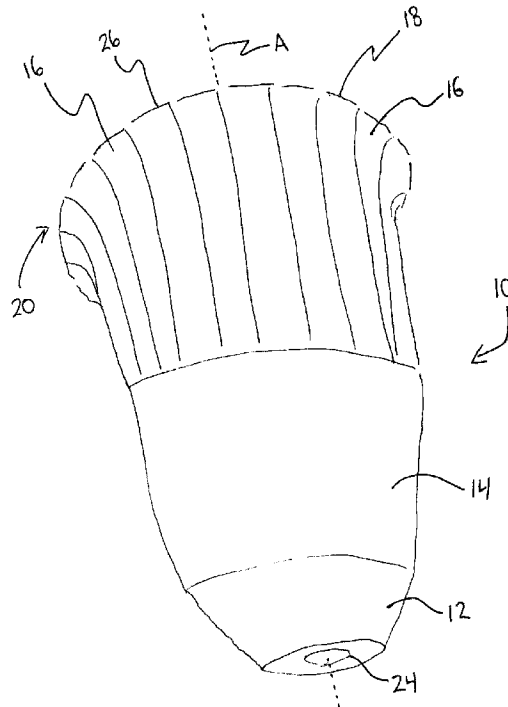




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(57) Abrégé/Abstract:

A pipeline pig has a nose, a central section having a central axis, a plurality of fins extending rearwardly from the central section, each of the plurality of fins having a pressure responsive scraping end; the scraping ends of the plurality of fins collectively define a circular scraping surface extending radially outwardly from the central axis of the central section; each of the fins having inward facing pressure bearing surfaces; and at least a flow-through passage extending between the fins.

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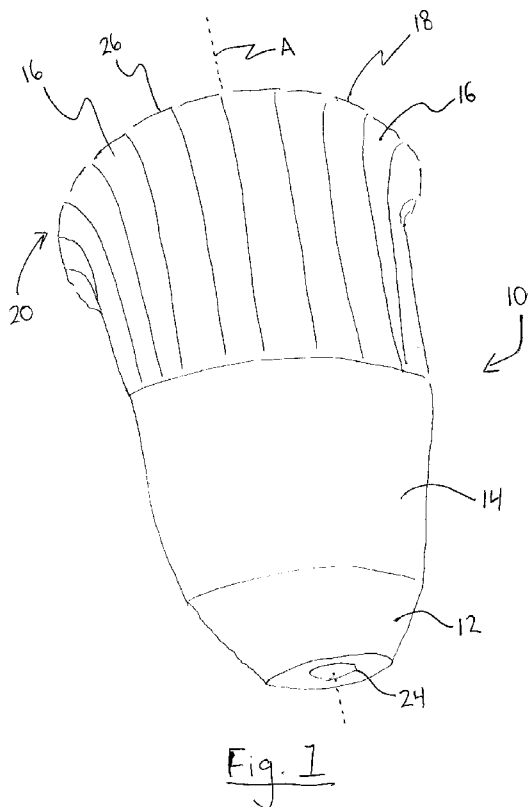
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(57) Abstract: A pipeline pig has a nose, a central section having a central axis, a plurality of fins extending rearwardly from the central section, each of the plurality of fins having a pressure responsive scraping end; the scraping ends of the plurality of fins collectively define a circular scraping surface extending radially outwardly from the central axis of the central section; each of the fins having inward facing pressure bearing surfaces; and at least a flow-through passage extending between the fins.

PIPELINE PIG WITH FINS

TECHNICAL FIELD

[001] This relates to a pig for cleaning a pipe or a pipeline, and method of making a pig.

BACKGROUND

[002] The interior of a pipeline may become covered with various substances that may be difficult to remove. A pipeline pig may be useful in cleaning the pipe or pipeline. A variety of pigs are known such as those disclosed in US patents 1683429, 3460180, 6170493, 6391121 and 6569255.

SUMMARY

[003] In one embodiment there is a pipeline pig, comprising a nose, a central section having a central axis, a plurality of fins extending rearwardly from the central section, each of the plurality of fins having a pressure responsive scraping end; the scraping ends of the plurality of fins collectively define a circular scraping surface extending radially outwardly from the central axis of the central section; each of the fins having inward facing pressure bearing surfaces; and at least a flow-through passage extending between the fins.

[004] In one embodiment there is a method of constructing a pipeline pig, comprising: making a plurality of slots in a sheet of metal; rolling the slotted sheet of metal to form a plurality of fins; and connecting the plurality of fins to a nose and central section of a pipeline pig.

[005] These and other aspects of the device and method are set out in the claims, which are incorporated here by reference.

BRIEF DESCRIPTION OF THE FIGURES

[006] Embodiments will now be described with reference to the figures, in which like reference characters denote like elements, by way of example, and in which:

[007] Fig. 1 is a perspective view of an embodiment of a pipeline pig with fins;

[008] Fig. 2 is a side view of an embodiment of a pipeline pig with fins;

[0009] Fig. 3 is a perspective view of a plurality of fins of the pipeline pig of Fig. 1;

[0010] Fig. 4 is an end view of a pipeline pig of Fig. 1;

[0011] Fig. 5 is a perspective view of a fin for a pipeline pig; and

[0012] Fig. 6 is an embodiment of a pipeline pig with fins.

DETAILED DESCRIPTION

[0013] Figs. 1, 3 and 4 show a pipeline pig 10 having a nose 12, a central section 14 having a central axis A. A plurality of fins 16 extend rearwardly from the central section 14. Each of the plurality of fins 16 has a pressure responsive scraping end 18. The nose may protrude forwardly in the direction of the pipeline pig's travel from the central section, the nose having decreasing diameter with increasing distance from the central section.

[0014] The scraping ends 18 of the plurality of fins 16 collectively define a circular scraping surface 20 extending radially outwardly from the central axis A of the central section 14. The circular scraping surface can be seen in Fig. 1 and in the end view shown in Fig. 4. Each of the fins 16 having inward facing pressure bearing surfaces 22 (Fig. 5). There is at least a flow-through passage extending between the fins 16. The flow through passage includes, as shown in Fig. 1, an opening 24 at the front end of the nose 12, the size of which opening is flow limiting. The flow-through passage may be placed anywhere on the nose 12 or the central section 14 as long as fluid is allowed to pass through the pipeline pig. The flow through passage may be made with different flow limiting diameters. In embodiments with a large diameter of the flow through passage, the pipeline pig moves more slowly and allows for a greater flow rate of fluid through the pipeline pig. Conversely, in embodiments with a smaller diameter, the pipeline pig moves more quickly and allows for a lesser volume of fluid flow through. The opening could be made of variable size, but this is not preferred due to weight preferences. For example, all 4 inch pigs (intended for cleaning 4 inch lines) are less than 8 ounces. The use of the nose and selection of the size of the flow limiting opening helps eliminate minor scraping on the tube wall in 180 degree short radius U bends. The opening is decided by fluid speed of each different heater. No heaters have the same feed stock and same heater temperatures. The pig travels in the heater fluid stream, disrupting the precursors of coke that adhere to the tube wall. Tubes are made of CR 5, CR 9 and various

Stainless steels. Depending on flow speed the opening and fin stiffness are designed to touch, not gouge or scrape hard the tube wall. The faster the pig speed the more exerted side wall pressure is required. The opening size and fin stiffness are thus a design choice for the engineer based on experiment and calculations suited to the particular heater being treated.

[0015] In Fig. 1, each of the scraping ends 18 of the plurality of fins 16 further comprise flat scraping ends 26. The nose 12, central section 14 and the plurality of fins 16 may be formed of a unitary piece of metal or alloy.

[0016] In the embodiment shown in Fig. 2, the nose 12 of the pipeline pig 10 has a conical shape. In other embodiments the nose 12 may have different shapes such as parabolic. The nose may have a first section and a second section, the first section being a segment of a cone and the second section having a conical shape, such that both are frusto-conical and the first section tapers more gradually than the second section, with the second section extending most forwardly. The nose may assist in guiding the pipeline pig through bends in the pipe. In one embodiment, the nose assists in guiding the pipeline pig through 90° U-bends. Rivets 28 may be used to connect the central section 14 to the fins 16. The central section 14 may also be connected to the fins 16 by other methods, such as welding. As shown in Fig. 2, each of the plurality of fins 16 are cantilevered from the central section 14.

[0017] As shown in Fig. 4, the nose 12 and central section 14 of the pipeline pig may be hollow. Fluid may flow through the hollow passage within the nose and central section of the pipeline pig.

[0018] As shown in Fig. 5, each of the plurality of fins has a longitudinal section 30 connected to and extending rearwardly from the central section 14 (Fig. 2) and a radial section 32 extending away from and radially outward from the longitudinal section 30 of the fin 16, in which the radial section 32 of the fin 16 further comprises a flat scraping end 26. The radial section 32 of the fin 16 may be formed at various angles from the longitudinal section 30 and may bend, for example, 90 degrees or less, with the radial section having a length for example of ¾ inches or less.

[0019] In the embodiment of Fig. 6, the nose 12 of the pipeline pig has a circular cross-section with a maximal radius denoted by M and in which the central section 14 has a cross-section smaller than the maximal radius M of the cross-section of the nose 12.

[0020] The pipeline pig 10 may be constructed using niconel alloy. The pipeline pig may also be constructed from any oxidation and corrosion resistant materials that is suited for service in extreme environments.

[0021] The plurality of fins 16 may be formed from a sheet of metal or alloy that has been slotted and rolled.

[0022] The pipeline pig may be constructed by making a plurality of slots in a sheet of metal, rolling the slotted sheet of metal to form a plurality of fins and connecting the plurality of fins to a nose and central section of a pipeline pig. The slotted sheet may also be bent to form the scraping ends on the plurality of fins which define the circular scraping surface.

[0023] In operation of the pipeline pig 10, fluid flows through the pipeline pig from the end of the pig having the plurality of fins 16 towards the end of the pig having a nose 12. The pipeline pig is placed within the pipeline to clean the interior surfaces of the pipeline. The pressure of moving fluid pushes against the inward facing pressure bearing surfaces 22 (Fig. 5) of the plurality of fins 16 and causes the pressure responsive scraping ends 18 to scrape against the inner surface of the pipe or pipeline. Although the opening 24 is shown in the center of the nose 12, the opening may be anywhere on the nose 12 or the central section 14 that allows fluid flow through the pipeline pig.

[0024] The opening size and fin stiffness are thus a design choice for the engineer based on experiment and calculations suited to the particular heater being treated. Exemplary flow speeds may be as low as two meters per second for a heavy feed stock and as fast as 70 meters per second in a vacuum heater with large tube size, where the fluid in the tube is a gas, as for example an ethane cracker. Exemplary pig material is Niconel or Inconell. Fin length may be for example 4 inches for a pig that fits in a 4 inch tube. Wall thickness of the pig may be greater in the nose than in the middle section between the nose and fins, and thinnest in the fins. Thus for example, wall thickness may be 0.030 inches in nose, 0.025 inches between the nose and fins, and 0.010 inches or more in the fins. For a 4

inch pig, the opening in the nose may be from 6 mm to 30 mm depending on fluid or gas speed. These measurements give guidance in making an exemplary pig but are not intended to be limiting of all embodiments of the claimed invention. The drawings are schematic. In a practical embodiment, the fins would terminate at the same length and/or the same distance radially outward, the body of the pig would be in section as close to circular as the manufacturing techniques allow and the scraping edges of the fins would form right angles or close to right angles with the side edges of the fins.

[0025] Immaterial modifications may be made to the embodiments described here without departing from what is covered by the claims. In the claims, the word “comprising” is used in its inclusive sense and does not exclude other elements being present. The indefinite article “a” before a claim feature does not exclude more than one of the feature being present. Each one of the individual features described here may be used in one or more embodiments and is not, by virtue only of being described here, to be construed as essential to all embodiments as defined by the claims.

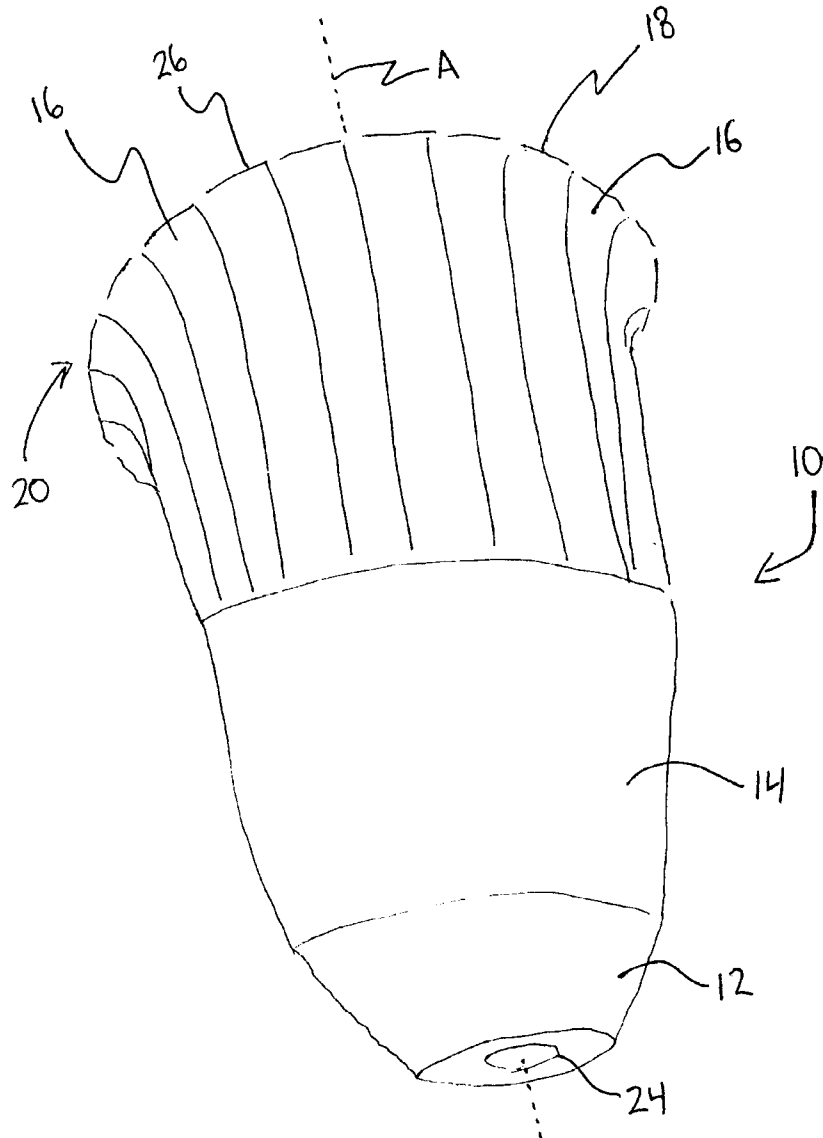
THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A pipeline pig, comprising:
a nose, a central section having a central axis, a plurality of fins extending rearwardly from the central section, each of the plurality of fins having a pressure responsive scraping end; the scraping ends of the plurality of fins collectively define a circular scraping surface extending radially outwardly from the central axis of the central section; each of the fins having inward facing pressure bearing surfaces; and at least a flow-through passage extending between the fins and through the central section.
2. The pipeline pig of claim 1 in which the at least a flow-through passage extending between the fins and through the central section comprises an opening at the front end of the nose.
3. The pipeline pig of claim 1 or 2 in which each of the scraping ends of the plurality of fins further comprise flat scraping ends.
4. The pipeline pig of claim 1, 2 or 3 in which the nose comprises one or more conical portions.
5. The pipeline pig of claim 4 in which the one or more conical portions comprise a first section and a second section and the first section tapers more gradually than the second section.
6. The pipeline pig of any one of claims 1-5 in which the nose has a circular cross-section with a maximum radius and in which the central section has a cross-section with a radius smaller than the maximum radius of the cross-section of the nose.
7. The pipeline pig of any one of claims 1-6 in which the nose and the plurality of fins are formed of a unitary piece.

8. The pipeline pig of any one of claims 1-7 in which each of the plurality of fins comprises a cantilever.
9. The pipeline pig of claim 8 in which each of the plurality of fins further comprises:
a longitudinal section connected to and extending rearwardly from the central section;
and
a radial section extending away from and radially outward from the longitudinal section of the fin; and
in which the radial section of the fin further comprises a flat scraping end.
10. The pipeline pig of any one of claims 1-9 in which the pipeline pig is formed of a niconel alloy.
11. The pipeline pig of any one of claims 1-10 in which the nose and central section are hollow.
12. The pipeline pig of any one of claims 1-11 in which the plurality of fins are formed from a sheet of metal or alloy that has been slotted and rolled.
13. A method of constructing the pipeline pig of any one of claims 1-12, comprising:
making a plurality of slots in a sheet of metal or alloy;
rolling the slotted sheet of metal or alloy to form a plurality of fins; and
connecting the plurality of fins to a nose and central section of a pipeline pig.
14. The method of claim 13 further comprising:
bending the slotted sheet of metal or alloy to form scraping ends on the plurality of fins which define a circular scraping surface.
15. A method of cleaning a pipe, the method comprising the step of placing the pipeline pig of any one of claims 1-12 in the pipe and running the pipeline pig through the pipe to scrape

coke precursors from the pipe, in which the pressure responsive scraping ends scrape against an inner surface of the pipe.

16. The method of claim 15 in which the pipe is a pipe in a heater.

Fig. 1

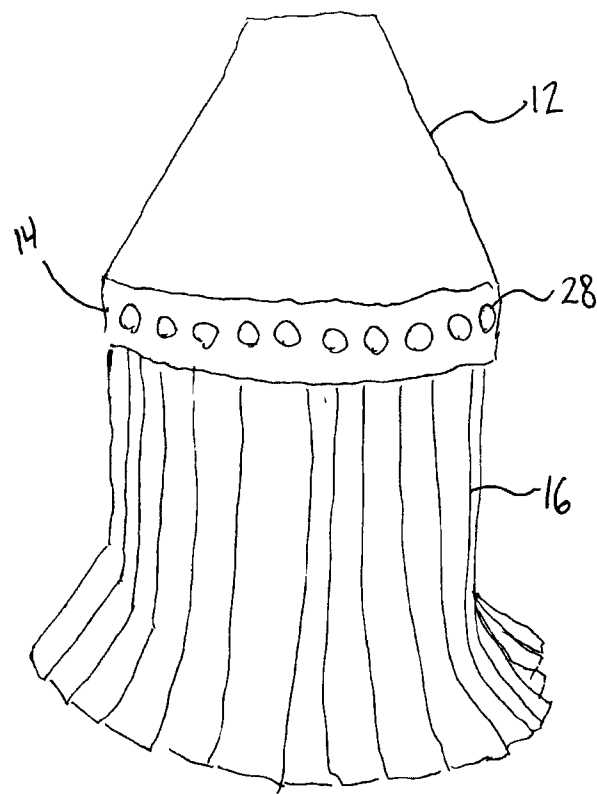


Fig. 2

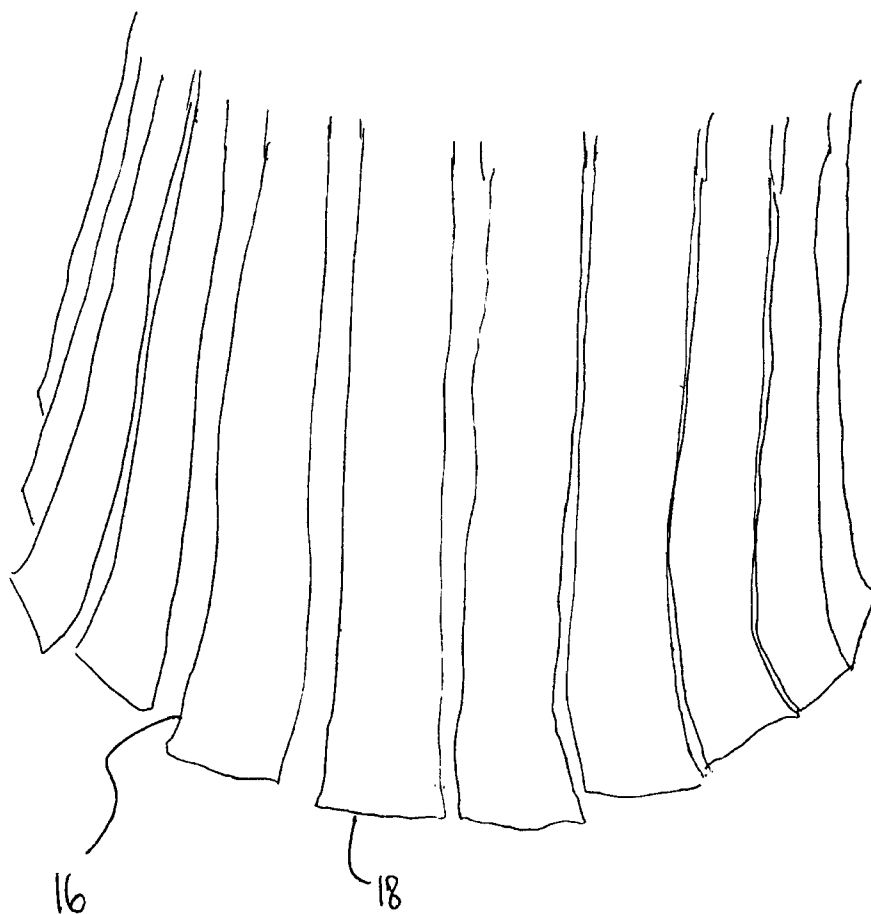


Fig. 3

