



(22) Date de dépôt/Filing Date: 2001/11/16

(41) Mise à la disp. pub./Open to Public Insp.: 2003/05/16

(51) Cl.Int.<sup>7</sup>/Int.Cl.<sup>7</sup> E21B 43/12

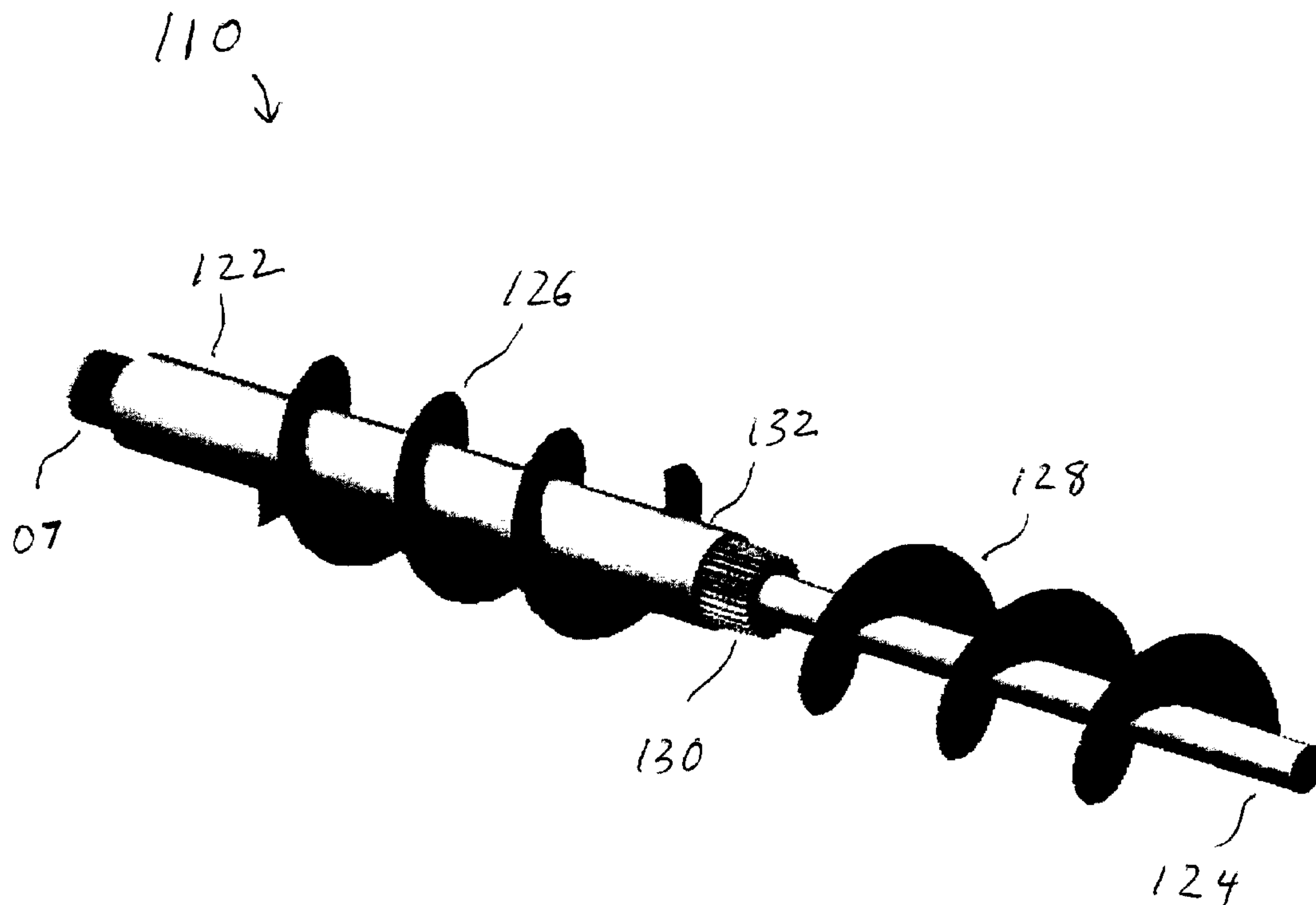
(71) Demandeurs/Applicants:  
MITCHELL, BRUCE, CA;  
ALMOND, DONALD JAMES, CA

(72) Inventeurs/Inventors:  
MITCHELL, BRUCE, CA;  
ALMOND, DONALD JAMES, CA

(74) Agent: SMART & BIGGAR

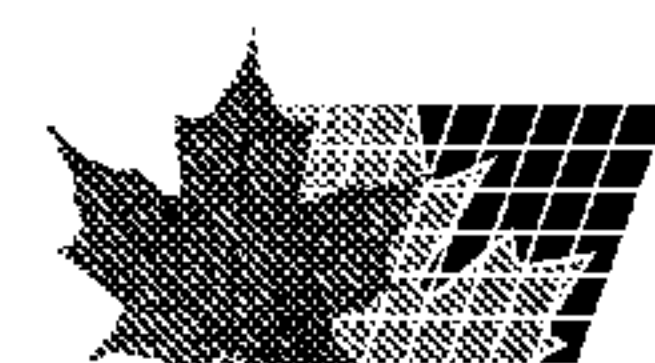
(54) Titre : OUTIL DE PRODUCTION

(54) Title: PRODUCTION TOOL



(57) Abrégé/Abstract:

A production tool for use in heavy oil production is provided. Operating to provide for better inflow of oil and sand to a bottom hole rotating pump, the production tool prevents sand up conditions and keeps the well cellar and the walls of the casing clean to ensure longer periods between workovers. The production tool has a cylindrical member with at least one helical fin extending substantially to the inner radius of the casing, and a gear reducer which drives the cylindrical member at a reduced rotation from input from the rotor of the bottom hole rotating pump. The rotational motion of the cylindrical member in conjunction with the sense of the helical fin cause bore effluence to move to the intake of the rotating pump, effecting constant inflow.



## ABSTRACT

A production tool for use in heavy oil production is provided. Operating to provide for better inflow of oil and sand to a bottom hole rotating pump, the production tool prevents sand up conditions and keeps the well cellar and the walls of the casing clean to ensure longer periods between workovers. The production tool has a cylindrical member with at least one helical fin extending substantially to the inner radius of the casing, and a gear reducer which drives the cylindrical member at a reduced rotation from input from the rotor of the bottom hole rotating pump. The rotational motion of the cylindrical member in conjunction with the sense of the helical fin cause bore effluence to move to the intake of the rotating pump, effecting constant inflow.

**PRODUCTION TOOL****FIELD OF THE INVENTION**

This invention relates to heavy oil well drilling, and more particularly to sand bearing oil production in heavy oil areas.

**BACKGROUND OF THE INVENTION**

In heavy oil well production, a rotating pump within the well bore causes the movement of sand and oil to the surface. Tubing of a smaller diameter than the well bore is used to convey bore effluence to the surface. The rotating pump will generally have a screw like member made of rubber or polyurethane of roughly the same diameter as the tubing, which due to its rotation pushes bore effluence up the tubing. The rotating pump relies on the natural flow of bore effluence in the cellar for the required inflow of effluence to its intake. Rotating pumps will typically work well as long as inflow is always present but if inflow is slowed down or stops because of sand problems or water knocking sand out, the pump can be inhibited or even stop working altogether. Sand up conditions are more likely if sand and well bore effluence are not kept mobile in the well bore, or if a constant intake is not provided to the bottom hole rotating pump. In addition to causing inflow and pump problems, sand up and poor effluence flow problems can cause deposits on the well cellar and walls of the casing, in which case production must be stopped for well maintenance workover operations. Relying on the natural flow of bore effluence to provide inflow to the rotating pump in the well bore does not address these problems which can occur naturally and are very undesirable.

It would be desirable in heavy oil well production for a tool to provide for better inflow of oil and sand to the pump, and provide for a way to keep the well cellar and the walls of the casing clean to ensure longer periods between  
5 workovers.

#### SUMMARY OF THE INVENTION

The present invention provides a production tool to break down sand build up in heavy oil wells and convey the sand and oil to the pump. The invention ensures inflow of oil and  
10 sand to the pump while keeping the well cellar and the walls of the casing clean thereby ensuring smooth production and longer periods between workovers. By providing a constant feed for the pump intake and insuring sand build-up around the pump intake is not occurring, effluent will continue to move into  
15 and through the pump and will not cause the pump to sand up.

According to a first broad aspect, the invention provides for a production tool to provide constant intake to a bottom hole rotating pump, the production tool having at least one cylindrical member, the cylindrical member having at least  
20 one helical fin wound about its outer surface, the production tool having a gear reducer, in which the gear reducer is connected to the cylindrical member and is adapted to be connected to a rotor of a rotating pump, the gear reducer is adapted to output a reduced rotation to the cylindrical member  
25 from a rotational input from the rotating pump.

In some embodiments of the invention, the cylindrical member has a bore adapted to accommodate passage of the rotor of the rotating pump therethrough for access to the gear reducer, and the cylindrical member has a pump intake adapted

to allow passage of material from the outside of the production tool to the intake of the rotating pump.

According to a second broad aspect, the invention provides for a production tool to provide constant intake to a  
5 bottom hole rotating pump, the production tool having an upper cylinder, the upper cylinder having at least one helical fin wound about its outer surface in a first winding direction, the production tool having a lower cylinder, the lower cylinder having at least one helical fin wound about its outer surface  
10 in a second winding direction in a sense opposite to the first winding direction, the production tool having a gear reducer, in which the gear reducer is connected to the upper cylinder and the lower cylinder and is adapted to be connected to a rotor of a rotating pump, and in which the gear reducer is  
15 adapted to output a reduced rotation to the upper cylinder and the lower cylinder from a rotational input from the rotating pump, and in which the upper cylinder comprises a bore adapted to accommodate passage of a rotor of the rotating pump therethrough for access to the gear reducer, and in which the  
20 upper cylinder comprises a pump intake adapted to allow passage of material from the outside of the production tool to the intake of the rotating pump.

Other aspects and features of the present invention will become apparent to those of ordinary skill in the art upon  
25 review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in greater detail with reference to the accompanying diagrams, in which:

FIG. 1 is a cross-sectional schematic diagram of downhole equipment in a heavy oil well, the downhole equipment including a production tool constructed according to the invention;

5           FIG. 2 is an isometric view of an embodiment of the production tool; and

FIG. 3 is an isometric view of the production tool of FIG. 2 in operation inside the casing.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

10           Referring to FIG. 1, typical downhole equipment for heavy oil well production in which an embodiment of the invention would be used is described. A hollow tube-like metal cylinder called a casing **102** extends from the wellhead **100** to the cellar **112**, defining a depth called the PBTD (Plug Back  
15 Total Depth). The cellar **112** is defined as the region of the well which extends from the bottom of the perforations to the PBTD of the well which has been drilled. Concentric with the casing **102** is metal tubing **104** which extends down into the well to a pump **106**. Along the axis of the casing are rods **108** which  
20 extend from the well head **100** to the pump **106**. Typically the rods **108** drive the rotating pump **106**; however the tubing **104** itself may be used for this purpose. The oil and sand material to be extracted from the well is pumped up the tubing **104** by the operation of the pump **106**. Typically a rotating pump **106**  
25 comprises a screw like member made of rubber or polyurethane of roughly the same diameter as the tubing **104** and is driven typically at 75-200 rotations per minute (RPM). A production tool **110** constructed according to the invention is attached to the pump **106**.

Referring now to FIG. 2, a preferred embodiment of the production tool is described. The production tool **110** consists of a hollow upper cylinder **122** and a lower cylinder **124**. A rotor **107** of the rotary pump **106** passes through a bore in the upper cylinder **122** and is connected to a gear reducer **130** located midway along the height of the production tool **110**. The gear reducer **130** has an output gear connected to both the upper cylinder **122** and the lower cylinder **124**. The upper cylinder **122** has an upper helical fin **126** wound about its outer surface. The lower cylinder **124** has a lower helical fin **128** wound about its outer surface. Both the upper helical fin **126**, and the lower helical fin **128** extend radially to a radius equal to or less than an inner radius of the casing **102**. In an exemplary embodiment of the production tool **110**, the upper and lower helical fins extend to a radius substantially equal to the inner radius of the casing **102** to within operating mechanical tolerances. In the preferred embodiment of the production tool **110**, the upper helical fin **126** is wound about the upper cylinder **122** in a sense opposite to the sense of the winding of the lower helical fin **128** about the lower cylinder **124**. In general the upper cylinder **122** and the lower cylinder **124** may have differing diameters, due in part from the absence of a need for a bore in the lower cylinder.

Referring now to FIG. 3, the operation of the production tool **110** inside the casing **102** is described. The cylinders **122** and **124** of the production tool **110** are driven using the rotation supplied by the rotor **107** of the rotary pump **106** to the gear reducer **130**. Typically, the rotor **107** of the rotary pump **106** rotates at a speed of approximately 75-200 RPM, and the gear reducer **130** acts to reduce this rotational speed which is imparted to the upper cylinder **122** and the lower cylinder **124**, to approximately 20 RPM. This reduction in

rotational speed is made to ensure that the cylinders of the production tool **110** rotate at a speed within mechanical tolerances, and to reduce wear and tear on the production tool.

The rotation of the production tool **110** will generally be chosen to be in a sense which, in conjunction with the sense of the upper helical fin **126** and the lower helical fin **128**, causes the movement of bore effluence toward the area between the upper cylinder **122** and the lower cylinder **124**. Specifically, the bore effluence in the region surrounding the upper cylinder **122** will move in a downward direction in response to the rotation of the upper helical fin **126**, while the bore effluence in the region surrounding the lower cylinder **124** will move in an upward direction in response to the rotation of the lower helical fin **128**. In the area of the gear reducer **130**, in the lower portion of the upper cylinder **122**, is a pump intake **132** which comprises openings or slots (not shown in the drawing) in the upper cylinder **122**. The pump intake **132** allows the passage of desired material exterior to the production tool **110** into the upper cylinder **122** from which it passes to the rotary pump **106**. Although not shown in the figures, the rotation imparted to the rotor of the rotary pump, may originate from the rotational motion of the tubing **104** instead of from the rods **108**. In the most general arrangement the production tool **110** may comprise only one of the upper or the lower cylinder. In the case that only the upper cylinder **122** is present, its rotational motion and the sense of the windings of the upper helical fin **126** are such that bore effluence moves in a downward direction to the pump intake **132**. In the case that only the lower cylinder **124** is present, its rotational motion and the sense of the windings of the lower helical fin **128** are such that bore effluence moves in an upward direction to the pump intake **132**. In this arrangement, the

upper cylinder may be replaced with a similar hollow cylinder which would be similarly attached to the gear reducer **130**, similarly comprise a pump intake **132**, and similarly provide passage of bore effluence to the rotary pump **106**, however, this  
5 cylinder would not comprise a helical fin, and typically could be shorter than the upper cylinder **122** of the preferred embodiment. This arrangement may alternatively not require the presence of any sort of upper cylinder. Due to the operation of the production tool **110**, specifically its ability to move  
10 bore effluence in an upward, downward or in a downward and upward direction, constant intake to the bottom hole rotating pump is provided, helping to prevent sand problems or water knocking sand out, to ensure operation of the pump. Through the use of fins extending substantially toward the inner radius  
15 of the casing **102** and directing bore effluence towards the pump intake, sand up conditions and poor effluence flow are avoided, and deposits on the well cellar and the walls of the casing are prevented for smooth production.

What has been described is merely illustrative of the  
20 application of the principles of the invention. Other arrangements and methods can be implemented by those skilled in the art without departing from the spirit and scope of the present invention. For example, instead of the production tool of the preferred embodiment comprising two cylinders attached  
25 to the gear reducer, the production tool may comprise a single cylindrical member with an upper portion and a lower portion configured and functioning like the upper and lower cylinders respectively as described above.

We claim:

1. A production tool to provide constant intake to a bottom hole rotating pump comprising:

at least one cylindrical member having at least one  
5 helical fin wound about its outer surface; and

a gear reducer,

wherein the gear reducer is connected to the  
cylindrical member and is adapted to be connected to a rotor of  
a rotating pump, and wherein the gear reducer is adapted to  
10 output a reduced rotation to the cylindrical member from a  
rotational input from the rotating pump.

2. The production tool of claim 1 wherein the  
cylindrical member has a bore adapted to accommodate passage of  
the rotor of the rotating pump therethrough for access to the  
15 gear reducer, and wherein the cylindrical member has a pump  
intake adapted to allow passage of material from the outside of  
the production tool to the intake of the rotating pump.

3. A production tool to provide constant intake to a  
bottom hole rotating pump comprising:

20 an upper cylinder having at least one helical fin  
wound about its outer surface in a first winding direction;

a lower cylinder having at least one helical fin  
wound about its outer surface in a second winding direction in  
a sense opposite to the first winding direction; and

25 a gear reducer,

wherein the gear reducer is connected to the upper  
cylinder and the lower cylinder and is adapted to be connected

to a rotor of a rotating pump, and wherein the gear reducer is adapted to output a reduced rotation to the upper cylinder and the lower cylinder from a rotational input from the rotating pump, and wherein the upper cylinder comprises a bore adapted  
5 to accommodate passage of a rotor of the rotating pump therethrough for access to the gear reducer, and wherein the upper cylinder comprises a pump intake adapted to allow passage of material from the outside of the production tool to the intake of the rotating pump.

Smart & Biggar  
Ottawa, Canada  
Patent Agents

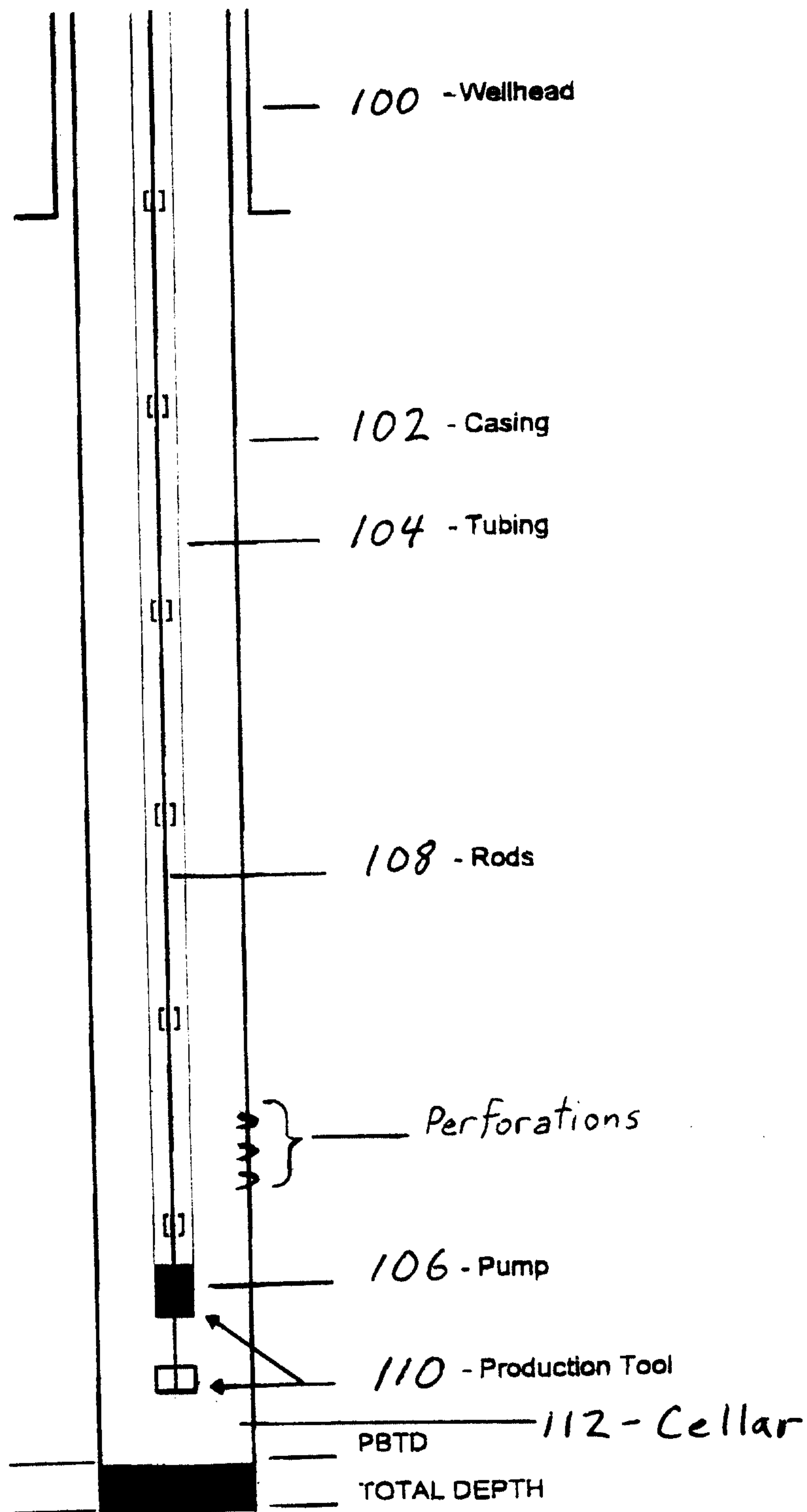


FIG. 1

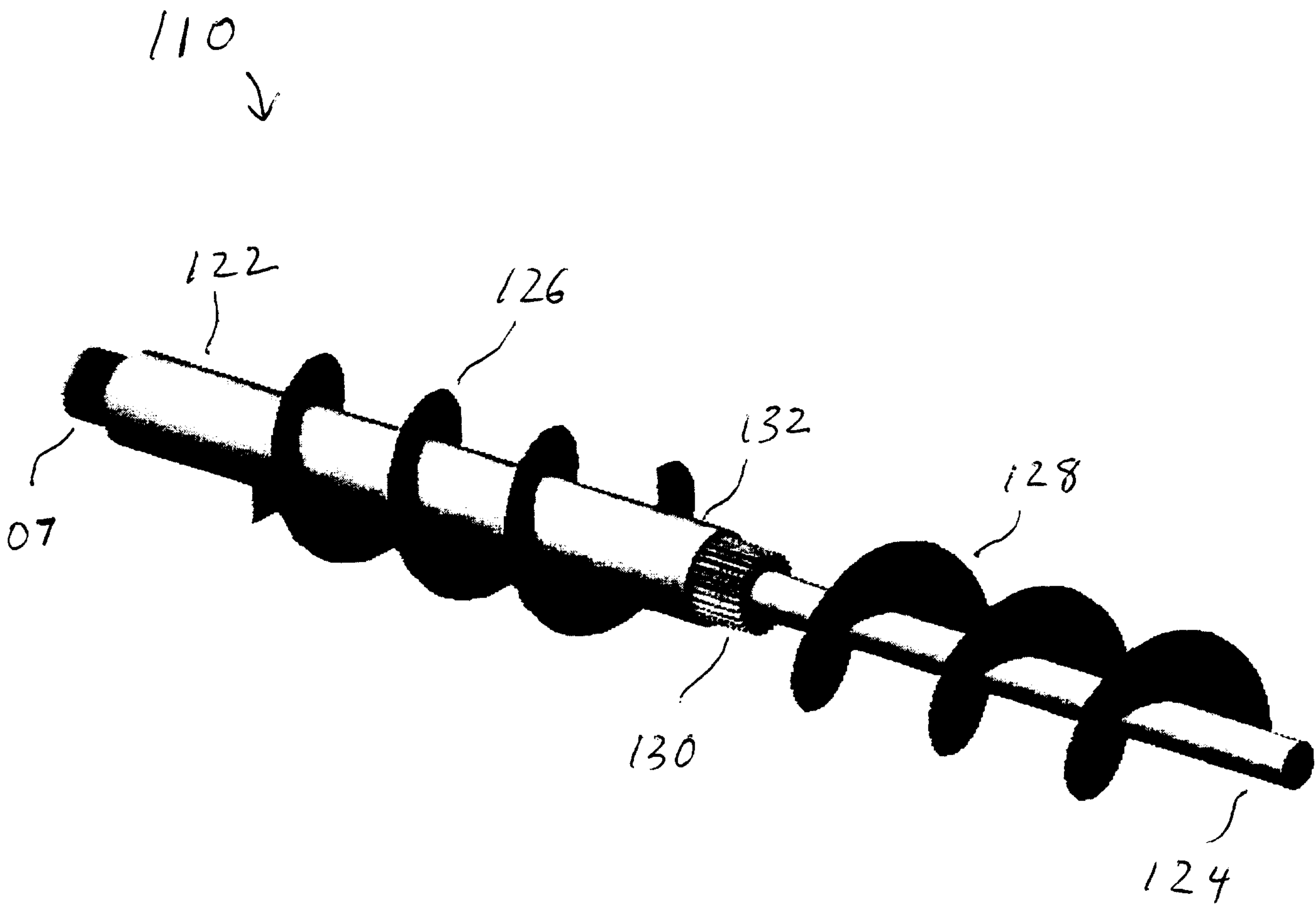


FIG. 2

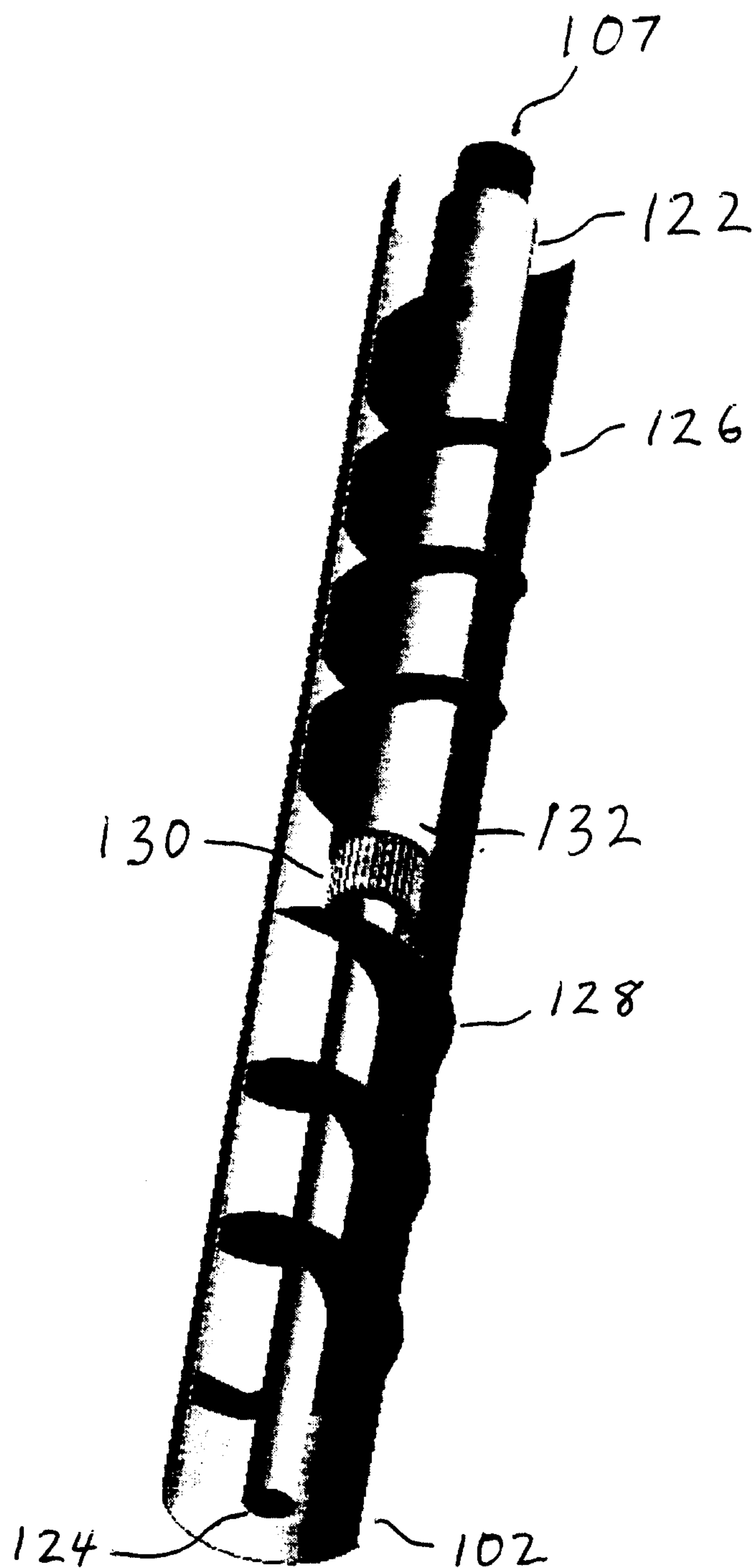


FIG. 3

110  
↓

122

126

132

128

07

130

124

