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(54) Title: THRESHING OF HARVESTED GRAIN

(57) Abstract: A threshing apparatus 10 has an inclined threshing zone 16 bounded below by a sieve 24. Harvested grain 40 is transported longitudinally into the zone 16 by means of an auger 22. Beater bars 18.1 perform a threshing action on the grain. A fan 26 moves air longitudinally through the zone 16 at an intensity such that liberated grain of relatively high density falls on the sieve and chaff of relatively low density is expelled via the fan 26. The auger, beater bars and fan are all mounted on and driven by a common shaft 30. Cleaning apparatus, similar in construction and operation, is arranged adjacent to and parallel to the threshing apparatus. The cleaning apparatus cleans the liberated grain of remaining chaff.

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A B S T R A C T

A threshing apparatus 10 has an inclined threshing zone 16 bounded below by a sieve 24. Harvested grain 40 is transported longitudinally into the zone 16 by means of an auger 22. Beater bars 18.1 perform a threshing action on the grain. A fan 26 moves air longitudinally through the zone 16 at an intensity such that liberated grain of relatively high density falls on the sieve and chaff of relatively low density is expelled via the fan 26. The auger, beater bars and fan are all mounted on and driven by a common shaft 30. Cleaning apparatus, similar in construction and operation, is arranged adjacent to and parallel to the threshing apparatus. The cleaning apparatus cleans the liberated grain of remaining chaff.

THIS INVENTION relates to the threshing of harvested grain. It relates more specifically to a method of threshing harvested grain and to harvesting apparatus.

It is envisaged that the invention will find particular application in the field of threshing of grain like maize (corn), wheat, beans, and the like.

In accordance with a first aspect of the invention, there is provided a method of threshing harvested grain in the form of ears, pods, and the like, the method including performing a threshing action on the harvested grain in a threshing zone which is bounded, at least along a lower extremity thereof, by a sieve, and causing an air flow stream of predetermined force or intensity to move through the threshing zone, perforations of the sieve being selected to pass grain liberated during threshing with little clearance, the force or intensity of the air flow stream being predetermined generally such as to carry chaff (of relatively low density) out of the threshing zone and to allow

liberated grain (of relatively high density) to fall onto the sieve.

The method may include arranging the threshing zone at an inclined attitude along a threshing axis, the sieve being correspondingly inclined and concentric to the threshing axis and the air flow stream being directed longitudinally of the threshing axis. The axis may be inclined at at least about 20°, conveniently at at least about 30° and preferably at about 45°.

The method may include transporting the harvested grain into the threshing zone in a direction longitudinally of the threshing axis. Such transporting may be effected by means of a screw conveyor or auger, which is co-axial with the threshing axis.

The threshing action may be performed by means of beater bars mounted for rotation about an axis which is co-axial with the threshing axis.

Similarly, the air flow stream may be generated by means of a fan co-axial with the threshing axis.

Advantageously, the method may then include mounting the screw conveyor or auger, beater bars and fan on a common shaft or axle co-axial with the threshing axis and driving the screw conveyor or auger, beater bars and fan by means of said common shaft or axle.

By way of development, there is provided a composite method of threshing harvested grain in the form of ears, pods, and the like, the composite method including a primary method step as described above, and a secondary method step, performed subsequent to and and in series with the primary method step, the secondary method step including agitating or stirring liberated grain obtained from the primary method step in a cleaning zone which is bounded, at least along a lower extremity thereof, by a sieve, and causing an air flow stream of predetermined force or intensity to move through the cleaning zone, perforations of the sieve being selected to pass cleaned grain with little clearance, the force or intensity of the air flow stream being predetermined generally such as to carry chaff (of relative low density) out of the cleaning zone and to allow cleaned grain (of relatively high density) to fall onto the sieve.

The secondary method step may be performed generally adjacent the primary method step, and in generally similar manner.

Advantageously, liberated grain obtained from the primary method step may be transported under gravity to an inlet of apparatus performing the secondary method step.

In accordance with a second aspect of the invention, there is provided threshing apparatus suitable for use in threshing harvested grain in the form of ears, pods, or the like, the threshing apparatus comprising

casing means defining a threshing zone;

a sieve bounding at least a lower extremity of the threshing zone;

transport means arranged to transport the harvested grain into the threshing zone;

threshing means arranged to thresh the harvested grain in the threshing zone; and

air flow stream generating means arranged to move air in an air flow stream through the threshing zone,

the arrangement being such that grain, liberated during threshing, falls onto the sieve, perforations of the sieve being selected to pass such liberated grain with little clearance, and such that chaff is carried in the air flow stream out of the threshing zone.

The threshing zone may be generally round cylindrical, having a threshing axis. The threshing axis may be inclined at an angle of at least 20° from the horizontal, advantageously at least about 30°, preferably about 45°. The sieve may be correspondingly arcuate and may be arranged concentrically of the threshing axis.

The threshing means may include beater bars arranged for rotation about a rotation axis which co-incides with the threshing axis.

The transport means may be arranged to transport the harvested grain into the threshing zone in a direction

longitudinal of the threshing axis. The transport means may include a screw conveyor or auger which is arranged co-axially with the threshing axis.

Similarly, the air flow stream generating means may be arranged to cause the air flow stream to move longitudinally of the threshing axis. The air flow stream generating means may be in the form of a fan co-axial with the threshing axis.

Then, advantageously, the beater bars, screw conveyor or auger, and fan may be mounted on a common shaft or axle co-axial with the threshing axis and may be arranged to be driven in use by said common shaft or axle.

By way of development, there is provided composite threshing apparatus comprising primary apparatus as described above, and secondary apparatus in the form of cleaning apparatus comprising

casing means defining a cleaning zone;

a sieve bounding at least a lower extremity of the cleaning zone;

transport means arranged to transport liberated grain obtained from the primary apparatus into the cleaning zone;

agitating or stirring means aranged to agitate or stir the liberated grain in the cleaning zone; and

air flow stream generating means arranged to move air in an air flow stream through the cleaning zone,

the arrangement being such that grain, cleaned during agitating or stirring, falls onto the sieve, perforations of the sieve being selected to pass such cleaned grain with little clearance, and such that chaff is carried in the air flow stream out of the cleaing zone.

The secondary apparatus may be arranged adjacent to and parallel with the primary apparatus.

Advantageously, the transport means of the secondary apparatus may be arranged to transport the liberated grain under gravity.

The invention is now described by way of example with reference to the accompanying diagrammatic drawings. In the drawings

Figure 1 shows, in axial section, threshing apparatus in accordance with the invention; and

Figure 2 shows a section taken at II-II in Figure 1.

With reference to the drawings, threshing apparatus in accordance with the invention is generally indicated by reference numeral 10. The threshing apparatus is composite threshing apparatus comprising first apparatus in the form of threshing apparatus generally indicated by reference numeral 12 and second apparatus in the form of cleaning apparatus generally indicated by reference numeral 112. The first and second apparatus are arranged to perform successive steps in the method of the

invention i.e. in series. The second apparatus is arranged generally below the first apparatus.

The first, threshing, apparatus 12 comprises a generally round cylindrical casing generally indicated by reference numeral 14 and defining a threshing zone generally indicated by reference numeral 16 about a threshing axis 20. The threshing axis 20 is arranged, in this embodiment, at an angle 21 which is between about 30° and about 45° from the horizontal.

The first, threshing, apparatus 12 comprises threshing means 18 operatively provided within the threshing zone 16.

Transport means 22, which is in the form of a screw conveyor or auger is arranged to transport harvested crop in the forms of ears, pods, or the like from a hopper 28 obliquely upwardly into the threshing zone 16. The screw conveyor 22 is conveniently co-axial with the axis 20.

A boundary along a lower extremity of the threshing zone 16 is defined by means of an arcuate, trough-like sieve 24 having perforations 24.1. The sieve 24 is arranged concentrically with the axis 20.

At one end, which is an upper end in use, of the threshing zone 16, there is provided a fan 26, co-axially with the threshing axis 20, to generate an air flow stream from the hopper 28, through the threshing zone, and to exhaust it via

outlet conduiting 32. The fan 26 is of the centrifugal type and its inlet is thus on axis.

A common shaft or axle 30 acts as a tubular shaft over which flighting of the auger 22 is provided, and in series with the flighting, beater bars 18.1 of the threshing means are mounted on the shaft 30 to extend radially and longitudinally. Also the fan 26 is mounted on the shaft 30.

Underneath the sieve 24, and concentrically with the axis 20, there is provided a trough 34 which is, at its lower end, open as indicated at 36. The open end 36 corresponds to the hopper 28 and leads into transport means of the second threshing apparatus 112.

Air inlet openings 35, which are out of the plane of the section of Figure 1 and which can be perceived from Figure 2, allow air to be drawn via the trough 34 as shown at 37 into the fan 26. The inlet opening of the fan 26 is sufficiently large to have an influence outside the threshing zone 16. A volute for the fan 26 is formed partially by a baffle 27 at an upper end of the trough 34.

It is to be appreciated that, because the sieve 24 is merely arcuate and not circular, the air flow stream 37 moves in a relatively narrow channel, thus making it more effective, alternatively requiring less air to be moved.

In use, harvested crops in the form of ears, pods, or the like fall under gravity into the hopper 28 to be transported obliquely upwardly as indicated at 44 into the threshing zone 16 by means of the transport means 22. In the threshing zone 16, the ears, pods or the like are threshed to liberate grain from chaff.

The chaff in the threshing zone 16 is carried by the flow stream through the fan 26 to be exhausted via the conduiting 32 as indicated at 48.

The grain falls under gravity and under centrifugal force through the air flow stream onto the sieve 24. The apertures 24.1 are selected to pass liberated grain with clearance. Thus, liberated grain, with an amount of relatively small pieces of chaff, fall into the trough 34 as indicated by reference numeral 46.

The small pieces of chaff are carried by the flow stream 37 via the fan 26 into the outlet 32.

The liberated grain 46 slides along the trough 34 via the open end 36 onto the transport means 122 of the second, cleaning apparatus 112.

The second, cleaning, apparatus 112 is similar to the first, threshing, apparatus 12 and is not again described. Like reference numerals refer to like components or features.

Reference numeral 118 indicates stirring bars or agitating bars in place of the beater bars 18.1.

Cleaned grain 146 is discharged from the threshing apparatus 10 via an outlet 136 where it is collected. Chaff is exhausted via the conduiting 32 and 132.

The Applicant believes that, in many applications, threshing by means of the first, threshing, apparatus 12 will provide adequately cleaned grain and that a second step, which will merely be a cleaning step, will not be required. Thus, in those applications, grain will be collected from the open end 36.

It is a first advantage that grain and chaff are separated already in the threshing zone 16. This is conducive to simplicity of design and effectiveness in operation. Transport of the liberated grain and chaff is facilitated and the threshing apparatus can be provided less expensively than comparable threshing apparatus of which the Applicant is aware.

It is further an advantage that the sieve 24 is stationary as it is operated by means of gravity and centrifugal forces, operating on the liberated grain.

It is a further advantage that the sieve through which the liberated grain is passed is merely arcuate and not fully cylindrical. Provision of an arcuate or, in this case, semi-cylindrical sieve is adequate and allows a saving in cost.

CLAIMS

1. A method of threshing harvested grain (40) in the form of ears, pods, and the like, the method including performing a threshing action on the harvested grain (40) in a threshing zone (16) which is bounded, at least along a lower extremity thereof, by a sieve (24), and inducing by means of a fan (26) a main air flow stream of predetermined force or intensity to move through the threshing zone (16), perforations (24.1) of the sieve (24) being selected to pass grain (46) liberated during threshing with little clearance, the force or intensity of the air flow stream being predetermined generally such as to carry chaff (48) (of relatively low density) out of the threshing zone (16) and to allow liberated grain (46) (of relatively high density) to fall onto the sieve (24),

characterized by

receiving liberated grain (46) in a volume defined by a trough (34) below the sieve (24);

subjecting such liberated grain (46) and any chaff which has passed through the sieve (24) to an auxiliary air flow stream (37) induced by said fan (26) to flow alongside said main air flow stream through said volume, the auxiliary air flow stream being at predetermined force or intensity such as to carry the chaff (of relatively low density) out of said volume, and such as not to carry the liberated grain (46) out of said volume.

2. A method as claimed in Claim 1 which includes arranging the threshing zone at an inclined attitude along a threshing axis, the sieve being correspondingly inclined and concentric to

the threshing axis and the air flow stream being directed longitudinally of the threshing axis.

3. A method as claimed in Claim 2 which includes transporting the harvested grain into the threshing zone in a direction longitudinally of the threshing axis.

4. A method as claimed in Claim 3 in which such transporting is effected by means of a screw conveyor or auger, which is co-axial with the threshing axis.

5. A method as claimed in Claim 4 in which the threshing action is performed by means of beater bars mounted for rotation about an axis which is co-axial with the threshing axis.

6. A method as claimed in Claim 5 in which said fan (26) is co-axial with the threshing axis (20).

7. A method as claimed in Claim 6 which includes mounting the screw conveyor or auger, beater bars and fan on a common shaft or axle co-axial with the threshing axis and driving the screw conveyor or auger, beater bars and fan by means of said common shaft or axle.

8. A method as claimed in any one of the preceding claims, in which said volume is in communication with an inlet of said fan and in which said auxiliary air flow stream is generated by means of said fan.

9. A method as claimed in Claim 8 characterized in that communication between said volume and said inlet of the fan (26) is via a communication opening at one end of the trough (34) above a baffle (27) at the end of the trough (34).

10. A composite method of threshing harvested grain in the form of ears, pods, and the like, the composite method including a primary method step as claimed in any one of Claim 1 to Claim 7 inclusive, and a secondary method step, performed subsequent to and in series with the primary method step, the secondary method step including agitating or stirring liberated grain obtained from the primary method step in a cleaning zone which is bounded, at least along a lower extremity thereof, by a sieve, and causing an air flow stream of predetermined force or intensity to move through the cleaning zone, perforations of the sieve being selected to pass cleaned grain with little clearance, the force or intensity of the air flow stream being predetermined generally such as to carry chaff (of relatively low density) out of the cleaning zone and to allow cleaned grain (of relatively high density) to fall onto the sieve.

11. A composite method as claimed in Claim 10 in which the secondary method step is performed generally adjacent the primary method step.

12. A composite method as claimed in Claim 11 in which liberated grain obtained from the primary method step is

transported under gravity to an inlet of apparatus performing the secondary method step.

13. Threshing apparatus suitable for use in threshing harvested grain in the form of ears, pods, or the like, the threshing apparatus comprising

casing means defining a threshing zone;

a sieve bounding at least a lower extremity of the threshing zone;

transport means arranged to transport the harvested grain into the threshing zone;

threshing means arranged to thresh the harvested grain in the threshing zone; and

air flow stream generating means arranged to move air in an air flow stream through the threshing zone,

the arrangement being such that grain, liberated during threshing, falls onto the sieve, perforations of the sieve being selected to pass such liberated grain with little clearance, and such that chaff is carried in the air flow stream out of the threshing zone.

14. Threshing apparatus as claimed in Claim 13 in which the threshing zone is generally round cylindrical, having a threshing axis.

15. Threshing apparatus as claimed in Claim 14 in which the threshing axis is inclined at an angle of at least 20° from the horizontal.

16. Threshing apparatus as claimed in Claim 15 in which the sieve is correspondingly arcuate and is arranged concentrically of the threshing axis.

17. Threshing apparatus as claimed in Claim 16 in which the threshing means includes beater bars arranged for rotation about a rotation axis which co-incides with the threshing axis.

18. Threshing apparatus as claimed in Claim 17 in which the transport means is arranged to transport the harvested grain into the threshing zone in a direction longitudinal of the threshing axis.

19. Threshing apparatus as claimed in Claim 18 in which the transport means includes a screw conveyor or auger which is arranged co-axially with the threshing axis.

20. Threshing apparatus as claimed in Claim 19 in which the air flow stream generating means is arranged to cause the air flow stream to move longitudinally of the threshing axis.

21. Threshing apparatus as claimed in Claim 20 in which the air flow stream generating means is in the form of a fan, co-axial with the threshing axis.

22. Threshing apparatus as claimed in Claim 21 in which the beater bars, screw conveyor or auger, and fan are mounted on a

common shaft or axle co-axial with the threshing axis and are arranged to be driven in use by said common shaft or axle.

23. Threshing apparatus as claimed in any one of Claim 13 to Claim 22 inclusive, which includes a volume outside of said sieve and auxiliary air flow stream generating means arranged to move air in an auxiliary air flow stream through said volume, the force or intensity of the auxiliary air flow stream behing such as to carry chaff which may have passed through the sieve with the liberated grain out of the volume and not to carry liberated grain away.

24. Threshing apparatus as claimed in Claim 23 insofar as it is dependant from Claim 21 and Claim 22, in which the auxiliary air flow generating means is said fan, co-axial with the threshing axis.

25. Composite threshing apparatus comprising primary apparatus as claimed in any one of Claim 13 to Claim 24 inclusive, and secondary apparatus in the form of cleaning apparatus comprising

casing means defining a cleaning zone;

a sieve bounding at least a lower extremity of the cleaning zone;

transport means arranged to transport liberated grain obtained from the primary apparatus into the cleaning zone;

agitating or stirring means aranged to agitate or stir the liberated grain in the cleaning zone; and

air flow stream generating means arranged to move air in an air flow stream through the cleaning zone,

the arrangement being such that grain, cleaned during agitating or stirring, falls onto the sieve, perforations of the sieve being selected to pass such cleaned grain with little clearance, and such that chaff is carried in the air flow stream out of the cleaing zone.

26. Composite threshing apparatus as claimed in Claim 25 in which the secondary apparatus is arranged adjacent to and parallel with the primary apparatus.

27. Composite threshing apparatus as claimed in Claim 26 or Claim 22 in which the transport means of the secondary apparatus is arranged to transport the liberated grain under gravity.

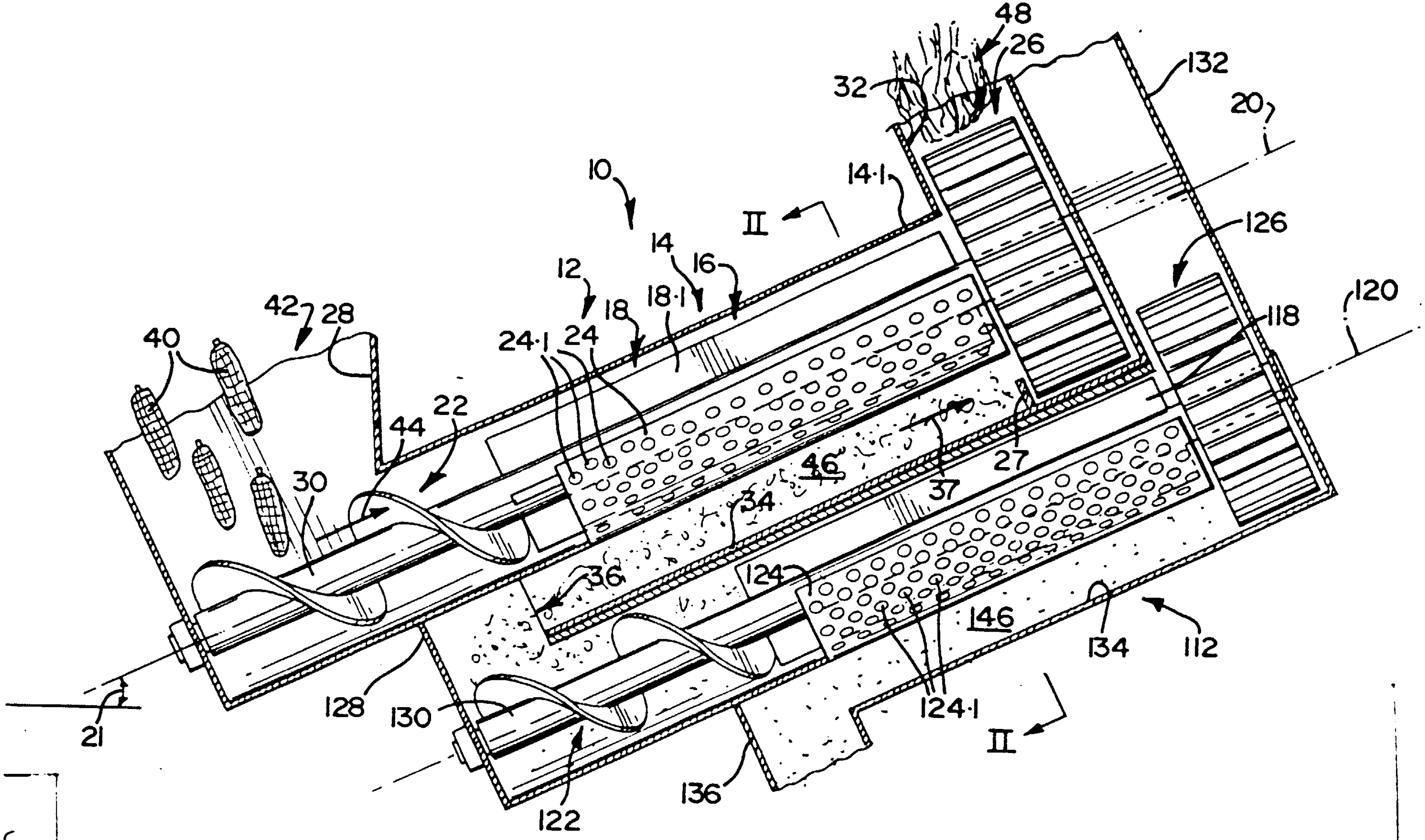

FIG 1

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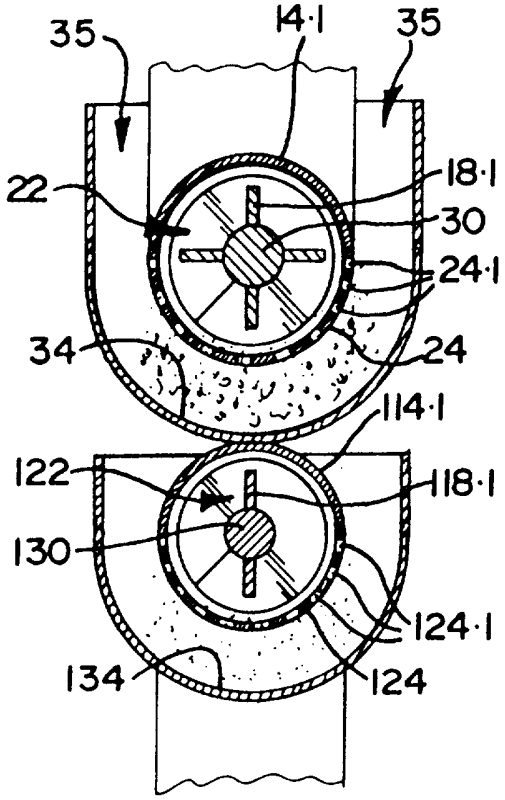

FIG 2