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(71) Applicant: **Hamilton Sundstrand Corporation**
Charlotte, NC 28277 (US)

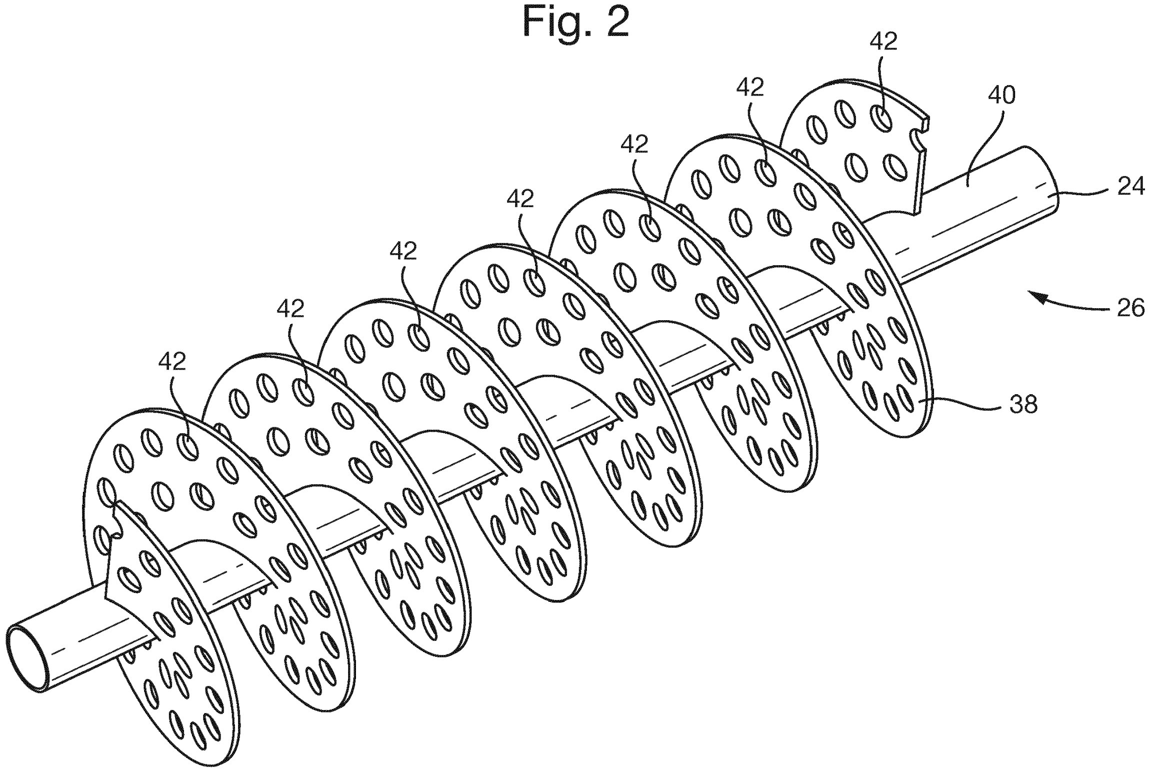
(72) Inventors:
- **MACHA EK, Micha**
  Wroc aw (PL)
- **LEWANDOWSKI, Dawid**
  56-400 Ole nica (PL)
- **HILGER, Artur**
  61-151 Pozna (PL)

(74) Representative: **Leckey, David Herbert**
Dehns
St Bride's House
10 Salisbury Square
London EC4Y 8JD (GB)

(54) HEAT EXCHANGERS

(57) A baffle (26) for a shell and tube heat exchanger (2) comprises a one piece helical flight (38) extending from a central core (24). The helical flight (38) has a plurality of aligned openings (42) for receiving tubes (20) of the heat exchanger (2). The helical flight (38) may be made by machining from a casting or solid block of material, or by an additive manufacturing process.

Fig. 2



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Description

TECHNICAL FIELD

[0001] The present disclosure relates to heat exchangers.

BACKGROUND

[0002] Heat exchangers are used in a wide range of applications and come in a variety of forms. One form of heat exchanger is a shell and tube heat exchanger. In such a heat exchanger, a plurality of tubes extends through a shell. A first fluid is admitted to and flows through the shell and a second fluid is admitted to the tubes. The first and second fluids are separated from one another by the walls of the tubes and heat transfer from one fluid to the other takes place through those walls. In some constructions, the first fluid is guided through the shell in a prescribed flow path by means of a baffle, for example a helical baffle, in order to increase the length of the flow path and thereby improve heat transfer.

[0003] However, it would be desirable to provide a shell and tube heat exchanger which provides satisfactory heat transfer and which is durable.

SUMMARY

[0004] From a first aspect there is provided baffle for a shell and tube heat exchanger comprising a one piece helical flight extending from a central core, the helical flight having a plurality of openings for forming a plurality of fluid flow passages through the flight.

[0005] From a further aspect of this disclosure, there is provided a shell and tube heat exchanger comprising a shell having an inlet and an outlet for a first fluid; a plurality of tubes extending through the shell and having an inlet and outlet for a second fluid; and a baffle arranged in said shell and having a one-piece helical flight extending from a central core, said helical flight having a plurality of openings through which the tubes extend or are aligned for forming a plurality of fluid flow passages through the flight.

[0006] The helical flight may be integrally formed with the core or may be attached to it by suitable means, for example brazing or welding.

[0007] The core may be a solid core, although in some embodiments, the core may be hollow, for example for conducting a fluid.

[0008] The baffle may further comprise a plurality of tubes mounted through the openings in the flight for conducting fluid therethrough.

[0009] In an alternative embodiment, the baffle may further comprise a plurality of tubes integrally formed with the flight and aligned with the openings in the flight for conducting fluid therethrough.

[0010] The heat exchanger may be a counterflow heat exchanger, in which the first and second fluids flow in opposite directions through the heat exchanger or a parallel flow heat exchanger in which the first and second fluids flow in the same direction through the heat exchanger.

[0011] The disclosure also provides a method of manufacturing a heat exchanger baffle comprising a helical flight extending from a central core, comprising manufacturing the flight as a single continuous piece, and forming a plurality of holes in the flight for forming a fluid flow passage through the flight.

[0012] The helical flight may be integrally formed with the core. Alternatively, the flight may be made separately from the core and attached to the core by suitable means, for example brazing or welding.

[0013] The flight may be made in a number of ways.

[0014] In one embodiment, the flight may be rough cast and then machined to a final shape, the holes being produced by a suitable mechanism, for example drilling. The holes may be formed before or after machining the flight.

[0015] In another embodiment, the flight may be machined from a block of material, for example a cylindrical bar, and the holes being produced in an appropriate manner, e.g. drilling. Again, the holes may be formed before or after machining the flight

[0016] In either of the above arrangements, should the core be integrally formed with the flight, the core may be machined to create a central passage therethrough should that be required.

[0017] In an alternative embodiment, the flight may be made by an additive manufacturing process. Using this approach, the holes in the flight and, optionally, the core may be produced simultaneously with the flight.

[0018] In one embodiment, the method may further include forming a plurality of tubes in alignment with and joining the holes simultaneously with the flight by the additive manufacturing process.

[0019] The disclosure also extends to a method of manufacturing a heat exchanger comprising manufacturing a helical baffle by any of the additive manufacturing processes disclosed above and forming a heat exchanger body around the helical baffle simultaneously with the flight by the additive manufacturing process. A non-limiting embodiment of the disclosure will now be described with reference to the accompanying drawings.

BRIEF DECSRIPTION OF DRAWINGS

[0020]

Figure 1 shows a perspective, cut away view of a shell and tube heat exchanger in accordance with this disclosure

Figure 2 shows a perspective view of a baffle in accordance with the disclosure; and

Figure 3 shows a perspective view of the baffle of Figure 2 with tubes installed.

DETAILED DESCRITION

[0021] With reference to Figure 1, a shell and tube heat exchanger 2 comprises a shell 4 having a tubular body portion 6 having an inlet 8 for a first (for example hot) fluid and an outlet 10 for the first fluid.

[0022] The tubular body portion 6 is formed with end walls 12, 14 which close the shell 4 to form a shell cavity 16. One or both of the end walls 12,14 may be initially separate from the tubular body 6 and attached thereto during assembly of the heat exchanger. The end walls 12, 14 have holes 18 for receiving, in a plurality tubes 20 which extend through the shell cavity 16 and a central opening 22 for receiving the core 24 of a helical baffle 26. The helical baffle 26 creates a helical flow path for the first fluid through the shell cavity 16.

[0023] The tubes 20 extend from an inlet plenum 28 for a second (for example cold) fluid provided at one end of the tubular body portion 6 to an outlet plenum 30 provided at the opposite end of the tubular body portion 6. In this embodiment, the inlet and outlet plenums 28, 30 are formed as closed caps mounted to the end walls 12, 14 and having respective base walls 32, 34 with openings 36 aligned with the holes 18, 20 in the end walls 12, 14 for receiving the tubes 20 and central core 24 in a sealed manner. In this embodiment, respective o-ring seals may be provided around the tubes 20 and core 24, although other suitable sealing mechanisms may be used. Also, it will be appreciated that the plenums may be provided in any suitable fashion, for example as open caps or by suitable partitioning of the tubular body portion 6.

[0024] Turning now to Figures 2 and 3, the helical baffle 26 will be described in greater detail.

[0025] The helical baffle 26 comprises core 24 from which extends a one-piece helical flight 38. In this embodiment, the core 24 is hollow and has open ends and may allow for passage of the second fluid from the inlet plenum 28 to the outlet plenum 30. However, in other embodiments, the ends of the core 24 may be closed to prevent passage of fluid therealong, or the core 24 may be solid.

[0026] The helical flight 38 extends from the radially outer surface 40 of the core 24. In this embodiment, the core 24 is formed integrally with the flight 38, but in other embodiments, the flight 38 may be manufactured in one piece separately from the core 24 and subsequently attached to the core 24, for example by brazing.

[0027] The flight 38 comprises an array of aligned holes 42 for receiving the tubes 20, as illustrated in Figure 3, so as to form a plurality of fluid passages through the flight 38. By aligned is simply meant that the openings 42 are positioned to receive the tubes 20. In this embodiment, the openings 42 and the tubes 20 are aligned parallel to the axis of the core 24 in this embodiment, although this is not essential. For example the openings 42 and the tubes 20 may extend at an angle to the axis of the core. The tubes 20 may be located in the holes 42 in any suitable manner, for example brazing.

[0028] The helical flight 38 at least is made in a single piece. This may provide a number of advantages. Firstly, it may provide a smoother flow path for the first fluid through the shell cavity 16, leading to a lower pressure drop in the first fluid. Secondly, the flight may be more durable than a multi-piece baffle which will, by necessity, have multiple joints, leading to possible weaknesses, particularly when being subjected to high pressure flow.

[0029] The advantages may be even more pronounced in embodiments where the helical flight 38 and the core 24 are formed in one piece, as it avoids possible weaknesses at the joint between the flight 38 and the core 24.

[0030] The flight 38 (with, optionally, the core 24) may be made in one piece by any suitable method.

[0031] In a first embodiment, the flight 38 (and core 24 where present) may first be rough cast, for example to a near-net shape, and then machined to a final shape. The holes 42 may then be produced in the flights by a suitable process. For example the holes 42 may be drilled, formed by EDM (electro-discharge machining) or any other suitable process. It is not essential that the holes 42 be created after the flight 38 has been machined. Thus, in another embodiment, the holes 42 may be produced in the rough cast flight prior to final machining of the flight 38. Rough holes may be rough cast into the rough casting to facilitate subsequent machining of the holes 42.

[0032] In another embodiment, the flight 38 (and core 24 where present) may be machined to a final shape from a block of material, for example a cylindrical bar. The holes 42 may then be formed as above. Thus, the holes 42 may be machined either in the machined flight 38 or in the precursor block of material.

[0033] In either of the above arrangements, should the core 24 be integrally formed with the flight 38, the core 24 may also be machined to create a central passage therethrough should that be required. Again this may be done either before or after machining of the flight 38.

[0034] In an alternative embodiment, the flight 38 with, optionally, the core 24 (with or without a central passage) may be made by an additive manufacturing process. Examples of such processes include, but are not limited to, Direct Metal Laser Sintering (DMLS), Electron Beam Sintering (EBS), Electron Beam Melting (EBM), Laser Engineered Net Shaping (LENS), Laser Net Shape Manufacturing (LNSM), Direct Metal Deposition (DMD), Laser Powder Bed Fusion (LPBF), Selective Laser Sintering (SLS) and Selective Laser Melting (SLM).

[0035] An advantage of this technique is that it is potentially less wasteful of material. Also, it will allow the holes 42, and where present the central passage of the core 24, to be formed at the same time as the flight 38, avoiding the need to perform a separate drilling or other process to create the holes 42 or core passage. After the baffle 26 has been manufactured and the tubes 20 mounted thereto, it may be mounted in the shell cavity 16 in any suitable manner, for example through an open end of the tubular body portion 6 prior to attachment of the end wall(s) 12, 14.

[0036] In another embodiment, however, when using an additive manufacturing technique, the tubes 20 may be formed integrally with the baffle 26, avoiding the need for a separate process for assembling the tubes 20 in the holes 42 in the flight 38.

[0037] In a yet further embodiment, not only may the tubes 20 be formed integrally with the baffle 26, but also the heat exchanger body 6 could also be formed simultaneously with the baffle 26, avoiding the need for separate mounting of the baffle 26 in the heat exchanger body 6.

[0038] It should be noted that the above is non-limiting a description of an embodiment of the disclosure and that modifications may be made thereto within the scope of the disclosure. For example while in this embodiment, the heat exchanger 2 is shown as a counterflow heat exchanger (the flows of the first and second fluids being in opposite directions), the heat exchanger could also be a parallel flow heat exchanger.

Claims

1. A baffle (26) for a shell and tube heat exchanger (2) comprising a one piece helical flight (38) extending from a central core (24), the helical flight (38) having a plurality of openings (42) therethrough for forming a plurality of fluid flow passages through the flight (38).

2. A baffle as claimed in claim 1, wherein the core (24) is a hollow core, or is a solid core.

3. A baffle as claimed in any claim 1 or 2, wherein the helical flight (38) is integrally formed with the core (24), or is formed separately from and attached to the core (24).

4. A baffle as claimed in any preceding claim further comprising a plurality of tubes (20) mounted through the openings (42) in the flight (38) for conducting fluid therethrough.

5. A baffle as claimed in any of claims 1 to 3, further comprising a plurality of tubes (20) integrally formed with the flight (38) and aligned with the openings (42) in the flight (38) for conducting fluid therethrough.

6. A shell and tube heat exchanger (2) comprising a shell (4) having an inlet (8) and an outlet (10) for a first fluid; a plurality of tubes (20) extending through the shell (4) and having an inlet (28) and outlet (30) for a second fluid; and a baffle (26) as claimed in any preceding claim arranged in said shell (4) said tubes (20) extending through or aligning with the plurality of openings (42) in the helical flight (38).

7. A method of manufacturing a heat exchanger baffle (26) comprising a helical flight (38) extending from a central core (24), comprising forming the helical flight (38) as a single continuous piece, and forming a plurality of holes (42) in the flight (38) for forming a fluid flow passage through the flight (38)..

8. A method as claimed in claim 7, wherein the helical flight (38) is integrally formed with the core (24).

9. A method as claimed in claim 7 or 8, comprising providing a rough casting of the helical flight (38), machining the rough casting to a final shape, and forming the holes (42) in the flight (38) either before or after machining the flight (38).

10. A method as claimed in claim 7 or 8, comprising providing a block of material, for example a cylindrical block, machining the block to produce a flight (38) having a final shape, and forming the holes (42) in the flight (38) either before or after machining the flight (38).

11. A method as claimed in claim 9 or 10, wherein the holes (42) are formed by drilling.

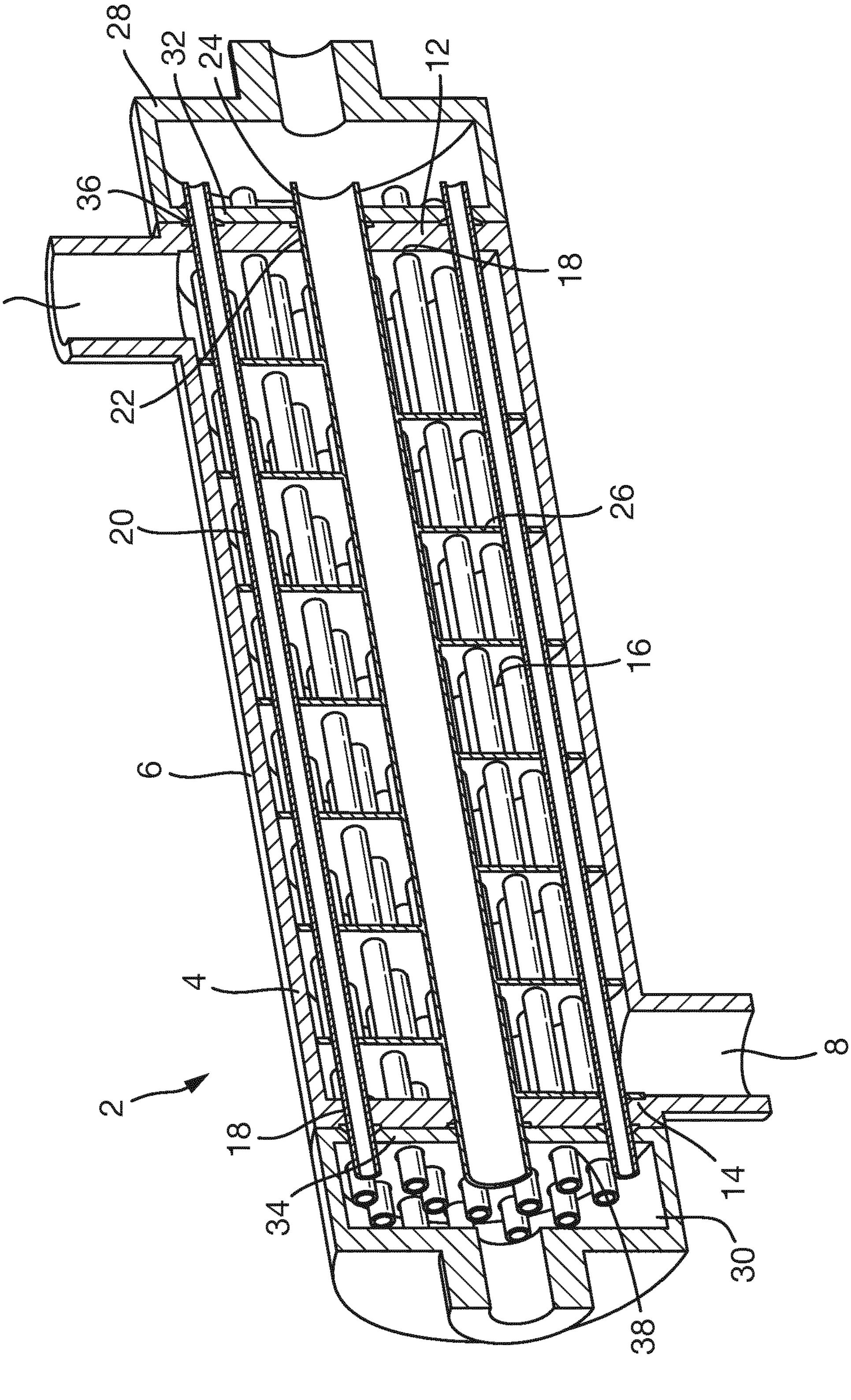
12. A method as claimed in claim 7 or 8, comprising manufacturing the helical flight (38) by an additive manufacturing process.

13. A method as claimed in claim 12, comprising forming the holes (42) simultaneously with the flight (38) by the additive manufacturing process.

14. A method as claimed in claims 13 or 14, further comprising forming a plurality of tubes (20) in alignment with and joining the holes (42) simultaneously with the flight (38) by the additive manufacturing process.

15. A method of manufacturing a heat exchanger comprising manufacturing a helical baffle (26) by a method as claimed in claim 12, 13 or 14, and forming a heat exchanger body (6) around the helical baffle (26) simultaneously with the flight (38) by the additive manufacturing process.

Fig. 1



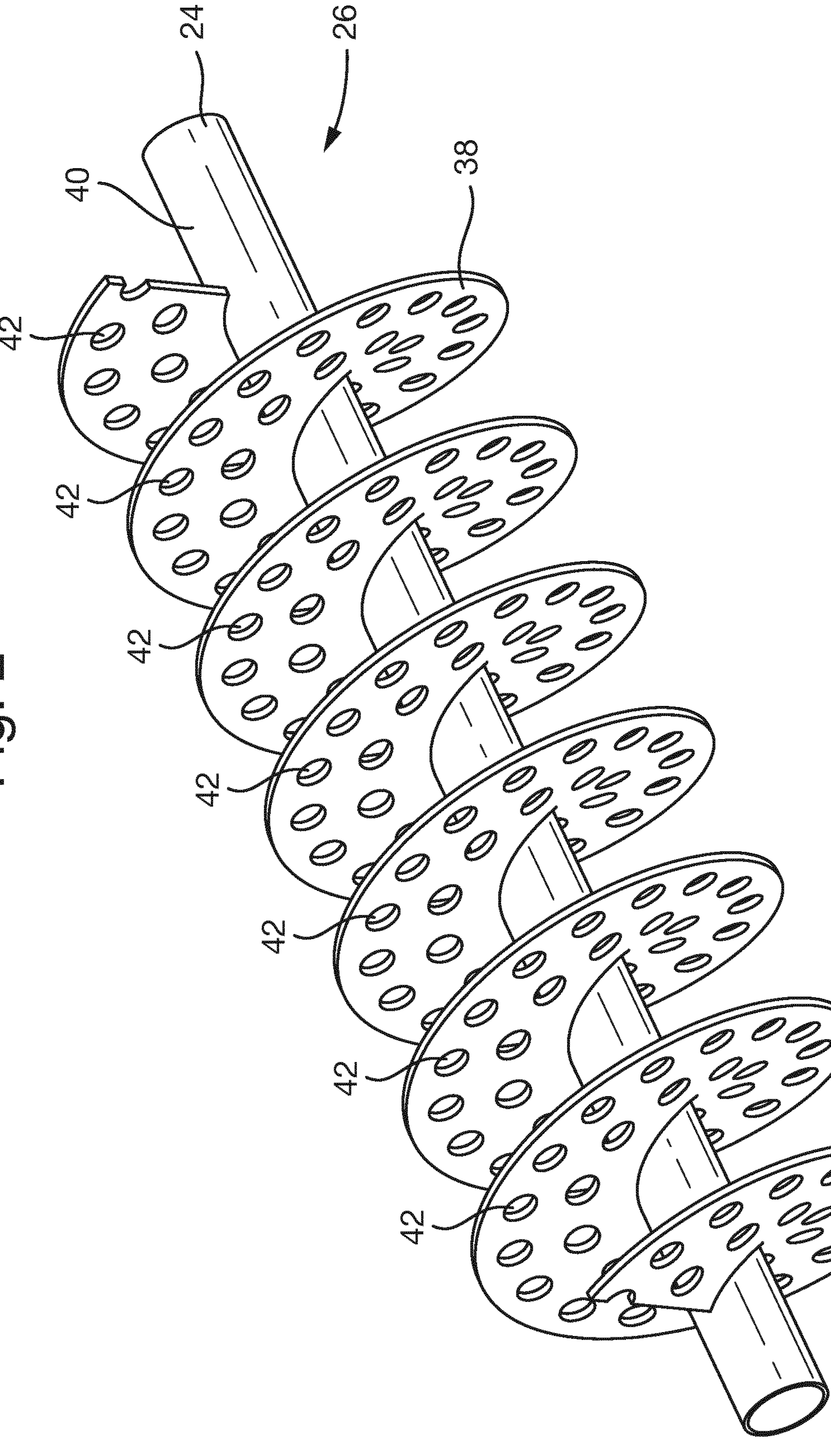
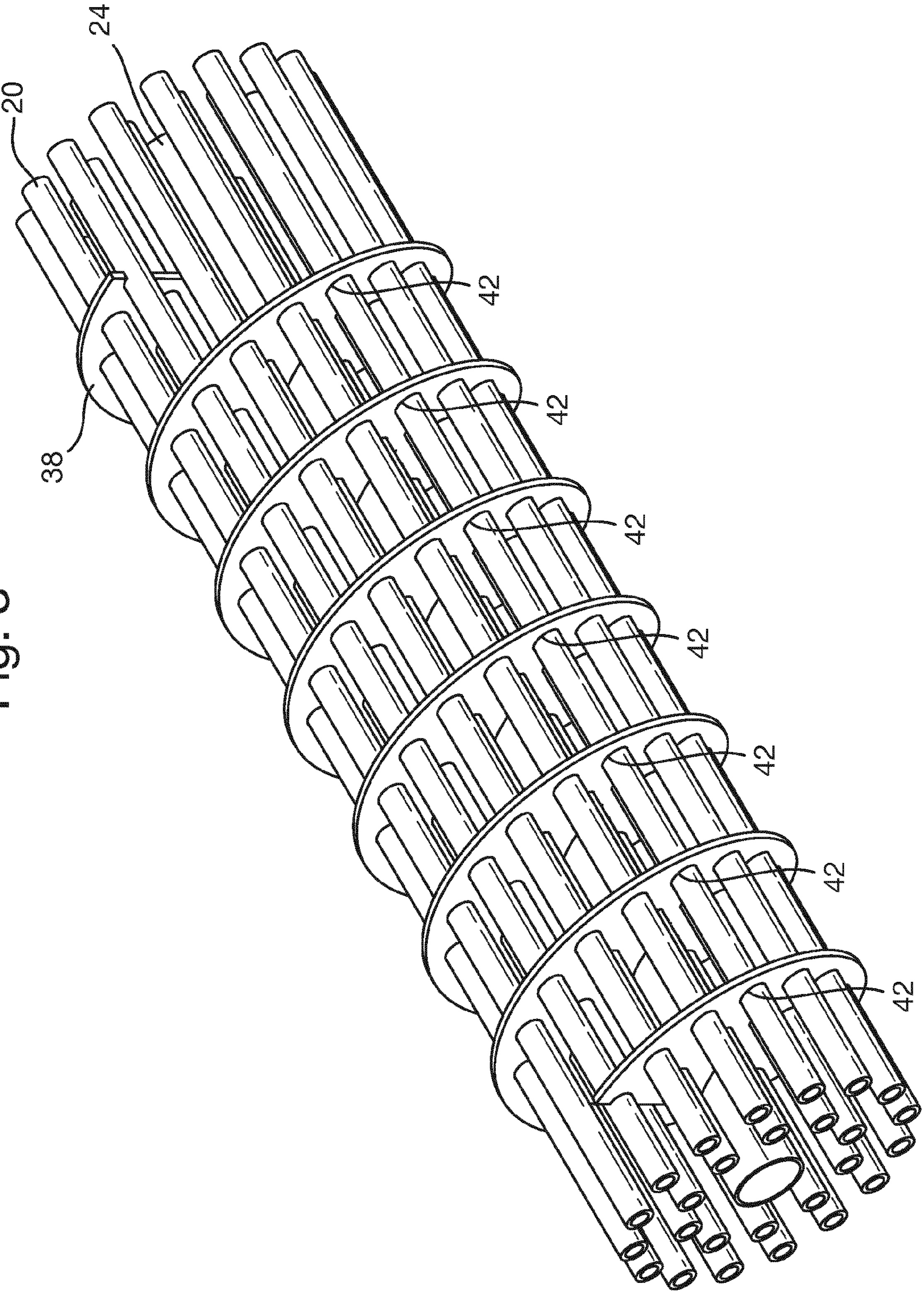


Fig. 2

Fig. 3



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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	31 March 2016	Louchet, Nicolas

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EUROPEAN SEARCH REPORT

Application Number
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