

CLAIMS

What is claimed is:

1. A filter holder for liposome extrusion, the filter holder comprising:
a housing including an inlet configured to receive a material to be extruded and an outlet;
a filter support member disposed within the housing between the inlet and the outlet, the filter support member including:
an upstream side having a filter support surface configured to support a membrane filter assembly,
a downstream side opposite the upstream side, and
a plurality of passages extending through the filter support member from the filter support surface to the downstream side; and
an outlet cavity in fluid communication with the outlet,
wherein the filter holder is configured such that the material to be extruded flows through the membrane filter assembly and into the outlet cavity via the plurality of passages before being discharged through the outlet.
2. The filter holder of claim 1, wherein the housing includes an upper housing portion, a lower housing portion, and a middle housing portion between the upper housing portion and the lower housing portion, and wherein the middle housing portion surrounds an outer periphery of the filter support member.
3. The filter holder of claim 2, wherein the downstream side includes a first recess, wherein the lower housing portion includes a second recess, and wherein the first recess and the second recess at least partially define the outlet cavity.
4. The filter holder of claim 2 or 3, wherein the upper housing portion includes a recess, wherein the recess and the filter support surface at least partially define an inlet cavity, and wherein the plurality of passages is in fluid communication with the inlet cavity.
5. The filter holder of any of claims 1 to 4, wherein

- i) at least one of the plurality of passages extends parallel to a longitudinal center axis of the housing; and/or
 - ii) wherein at least one of the plurality of passages extends at a non-zero angle relative to a longitudinal center axis of the housing.
6. The filter holder of any of claims 1 to 5, wherein the filter support member includes a circumferential groove.
7. The filter holder of claim 6, further comprising a temperature regulating assembly configured to circulate a heat transfer fluid through the circumferential groove.
8. The filter holder of any of claims 1 to 7, wherein the membrane filter assembly includes a polycarbonate membrane having a pore size between 10 nanometers and 1 micrometer.
9. The filter holder of any of claims 1 to 8, wherein the downstream side includes a recess with a curved surface, and wherein the recess at least partially defines the outlet cavity.
10. The filter holder of claim 9, wherein the curved surface is hemispherical.
11. The filter holder of any of claims 1 to 10, wherein the filter support member includes a plurality of interconnected channels formed in the downstream side of the filter support member.
12. The filter holder of any of claims 1 to 11, wherein the filter support surface has a maximum width between 5 mm and 600 mm or between 13 mm and 293 mm.
13. A filter holder for liposome extrusion, the filter holder comprising:
a housing defining a longitudinal center axis, the housing including an inlet extending from an inlet cavity and an outlet extending from an outlet cavity; and
a filter support member disposed within the housing between the inlet cavity and the outlet cavity, the filter support member including:

an upstream side adjacent the inlet cavity, the upstream side having a filter support surface configured to support a membrane filter assembly,
a downstream side adjacent the outlet cavity and opposite the upstream side, and
a plurality of passages extending through the filter support member from the upstream side to the downstream side,

wherein the filter holder is configured such that the material to be extruded flows through the membrane filter assembly and into the outlet cavity via the plurality of passages before being discharged through the outlet.

14. The filter holder of claim 13, wherein the housing includes an upper housing portion, a lower housing portion, and a middle housing portion between the upper housing portion and the lower housing portion, and wherein the filter support member is disposed within the middle housing portion.

15. The filter holder of claim 14, wherein the lower housing portion includes a lower recess at least partially defining the outlet cavity, and wherein the upper housing portion includes an upper recess at least partially defining the inlet cavity.

16. The filter holder of claim 14, wherein the lower housing portion includes a lower recess, and wherein the downstream side of the filter support member is flat such that the lower recess defines the outlet cavity.

17. The filter holder of any of claims 13 to 16, wherein at least one of the plurality of passages extends at a non-zero angle relative to the longitudinal center axis.

18. The filter holder of any of claims 13 to 17, wherein the housing includes a recess, wherein the filter support member is received within the recess, and wherein the filter holder further comprises a spacer disposed between the downstream side of the filter support member and an opposing surface of the recess.

19. The filter holder of any of claims 13 to 18, wherein the downstream side of the filter support member includes a concave recess at least partially defining the outlet cavity.
20. An extrusion system comprising:
a supply reservoir containing material to be extruded;
a pressure source configured to pressurize material to be extruded drawn from the reservoir;
a filter holder including
 a housing having an inlet configured to receive the pressurized material to be extruded and an outlet configured to discharge an extrudate,
 a membrane filter assembly disposed between the inlet and the outlet,
 a filter support member disposed within the housing, the filter support member including:
 an upstream side having a filter support surface configured to support the membrane filter assembly,
 a downstream side opposite the upstream side, the downstream side including a first recess, and
 a plurality of passages extending through the filter support member from the filter support surface to the first recess, and
 an outlet cavity at least partially defined by the first recess, the outlet cavity in fluid communication with the outlet; and
a collection reservoir configured to receive the extrudate from the outlet of the filter holder.
21. The extrusion system of claim 20, wherein the filter holder is one of a plurality of identical filter holders fluidly coupled to the supply reservoir and the collection reservoir
i) in parallel; or
ii) in series.
22. The extrusion system of claim 20 or 21, wherein one or more heat exchangers are included between the supply and collection reservoirs.