Claims

1. A cell culture device (1) for use with an optical microscope, comprising
   - a housing (10) that is configured to be placed onto a stage of an optical microscope in front of an objective of the microscope, the housing enclosing an internal space (11) of the housing (10), wherein the housing (10) further comprises a top wall (12) comprising a window (13) and an opposing bottom wall (14),
   - a removable flow chamber (2) enclosing an internal space (20) for accommodating a cell culture (CC) comprising living biological cells, wherein the flow chamber (2) is configured to be inserted into the internal space (11) of the housing (10) and to be removed from the housing (10) for arranging the cell culture in the flow chamber (2), wherein the flow chamber (2) is further configured for guiding a flow of a fluid medium (M) through the internal space (20) of the flow chamber (2) so that the fluid medium (M) can contact the cell culture (CC) and flow along the cell culture (CC), and wherein the flow chamber (2) further comprises a first and a second transparent wall region (21, 22) for observing the cell culture (CC) arranged in the internal space (20) of the flow chamber (2), wherein the transparent wall regions face (21, 22) said window (13) when the flow chamber (2) is inserted into said internal space (11) of said housing (10),
   - a heater (3) arranged in the internal space (11) of the housing (10) for heating said fluid medium (M) to be guided through the flow chamber (2),
   - a first flow path (P1) arranged in the internal space (11) of the housing (10) for guiding said fluid medium (M) towards the flow chamber (2) via said heater (3), and a second flow path (P2) arranged in the internal space (11) of the housing (2) for guiding said fluid medium (M) away from the flow chamber (2), and
   - a pump (4) for pumping said fluid medium (M) through the first flow path (P1) into the internal space (20) of the flow chamber (2) and through the second flow path (P2) out of the internal space (20) of the flow chamber (2) when the flow chamber (2) is inserted into the internal space (11) of the housing (10).

2. The cell culture device according to claim 1, **characterized in that** the cell culture device (1) further comprises a temperature sensor (5) arranged in the internal space (11) of the housing (10) so that the temperature sensor (5) is in thermal

contact with the fluid medium (M) guided through the first flow path (P1) for measuring the temperature of the fluid medium (M).

3. The cell culture device according to claim 1 or 2, **characterized in that** the cell culture device (1) further comprises a control unit (6) that is configured to control the heater (3) such that an actual value of the temperature of the fluid medium (M) measured with the temperature sensor (5) approaches a desired value of the temperature of the fluid medium (M).

4. The cell culture device according to one of the preceding claims, **characterized in that** the cell culture device (1) further comprises a flow sensor (7) for determining a flow rate of the fluid medium (M).

5. The cell culture device according to claim 3 and 4, **characterized in that** the control unit (6) is configured to control said pump (4) such that an actual value of the flow rate of the fluid medium measured with the flow sensor (7) approaches a desired value of the flow rate of the fluid medium (M).

6. The cell culture device according to one of the preceding claims, **characterized in that** the pump (4) is arranged in the internal space (11) of the housing (10) or that the pump (4) is an external pump being arranged outside said internal space (11) of the housing (10).

7. The cell culture device according to one of the preceding claims, **characterized in that** the housing (10) comprises a recess (15) for inserting the flow chamber (2) into the internal space (11) of the housing (10).

8. The cell culture device according to claim 7, **characterized in that** the housing (10) comprises a lateral wall (16) connecting the top wall (12) to the bottom wall (14) of the housing (10), wherein said recess (15) is formed into the bottom wall (14) and the lateral wall (16) of the housing (10).

9. The cell culture device according to one of the preceding claims, **characterized in that** the flow chamber (2) is configured to be slid into the recess (15) for inserting the flow chamber (2) into the internal space (11) of the housing (10), and

configured to be slid out of the recess (15) for removing the flow chamber (2) from the internal space (11) of the housing (10).

10. The cell culture device according to one of the claims 7 to 9, **characterized in that** the flow chamber (2) comprises at least two guide rails (23) which are each configured to engage with an associated groove (17) formed into the housing (10) for guiding the flow chamber (2) upon sliding the flow chamber (2) into and out of said recess (15).

11. The cell culture device according to one of the preceding claims, **characterized in that** the flow chamber (2) comprises a door (24) being hinged to a body (26) of the flow chamber (2), which body (26) comprises a recess (20) formed therein forming the internal space (20) of the flow chamber (2), wherein particularly said door (24) comprises said first transparent wall region (21), and wherein particularly said body (26) of the flow chamber (2) comprises or forms said second transparent wall region (22), and wherein particularly the door (24) is flush with the bottom side (14) of the housing (10) when the flow chamber (2) is inserted into the internal space (11) of the housing (10).

12. The cell culture device according to one of the preceding claims, **characterized in that** the flow chamber (2) comprises an inlet port (200) for injecting said fluid medium (M) into the flow chamber (2) and an outlet port (201) for discharging said fluid medium (M) out of the flow chamber (2).

13. The cell culture device according to one of the preceding claims, **characterized in that** the flow chamber (2) is configured to be slid into said recess (15) with the inlet port (200) and the outlet port (201) ahead so that the inlet port (200) engages with a connector (204) of the first flow path (P1) and the outlet port (201) engages with a connector (205) of the second flow path (P2) and a flow connection between the inlet port (200) and the first flow path (P1) and between the outlet port (201) and the second flow path (P2) is established when the flow chamber (2) is inserted into the internal space (11) of the housing (10).

14. The cell culture device according to one of the preceding claims, **characterized in that** the height (H) of the housing is smaller than 25 mm or equal to 25 mm,

and/or that the breadth (B) is smaller than 160 mm or equal to 160 mm, and/or that the depth (D) is smaller than 110 mm or equal to 110 mm.

15. The cell culture device according to one of the preceding claims, **characterized in that** the cell culture device (1) comprises a gas bubble trap (50) configured for removing bubbles of a gaseous phase from the fluid medium (M).

16. The cell culture device according to claim 15, **characterized in that** the bubble trap (50) comprises a first and a second volume (51, 52), wherein the first and the second volume (51, 52) are separated by a semi-permeable membrane (53) which is impermeable to the fluid medium (M) but permeable for said gaseous phase.

17. The cell culture device of claim 16, **characterized in that** the first volume (51) forms a section of the first flow path (P1).

18. The cell culture device according to claims 13 and 17, **characterized in that** the first volume (51) comprises an inlet (51a) connected to an outlet (34) of the heater (3), and/or that the first volume (51) comprises an outlet (51b) connected to the connector (204).

19. The cell culture device according to one of the claims 16 to 18, **characterized in that** the second volume (52) is smaller than the first volume (51).

20. The cell culture device according to one of the claims 16 to 19, **characterized in that** the second volume (52) comprises a smaller pressure than the first volume (51).

21. The cell culture device according to one of the claims 16 to 19, **characterized in that** the second volume (52) of the bubble trap (50) comprises an outlet (52a) for removing said gaseous phase from the bubble trap (50).

22. Method for observing a cell culture (CC) using a cell culture device (1) according to one of the preceding claims and a microscope (40), wherein a cell culture (CC) is arranged in the flow chamber (2) and the flow chamber (2) is inserted into the internal space (11) of the housing (10) of the cell culture device (1), and wherein

particularly the housing (10) of the cell culture device (1) is arranged on a stage (43) of the microscope (40) in front of an objective (41) of the microscope (40).

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