CLAIMS:

1. Reactor for the continuous production of polymers, in particular synthetic rubbers, comprising at least one essentially tubular reactor housing (4), the reactor housing (4) having a drive shaft (30) which is connected to at least one stirrer (38) arranged so as to be rotatable within the reactor housing (4), the stirrer containing at least one, preferably two, three or four helical mixing elements (24), which are preferably designed close to the wall or in contact with the wall.
2. Reactor according to claim 1, characterized in that the geometric central axis (3) is arranged essentially horizontally or essentially vertically.
3. Reactor according to claim 1 or 2, characterized in that it has an internal displacement body (14) which is arranged essentially along the geometric central axis (3).
4. Reactor according to claims 1 to 3, characterized in that the stirrer (38) has at least one helical mixing element (24) designed close to the wall or in contact with the wall with respect to the reactor housing, and at least one helical mixing element (26) designed close to the wall or in contact with the wall with respect to the surface of the internal displacement body (14).
5. Reactor according to one of claims 3 and 4, characterized in that the internal displacement body (14) is designed in such a way that a temperature control medium can flow through it.
6. Reactor according to one of claims 1 to 5, characterized in that the helical mixing elements are designed such that the distance of the helical mixing elements (24) to the reactor housing (4) and the helical mixing elements (26) to the internal displacement body (14) is 0 or more than 0 to 1% based on the radial diameter of the reactor housing.
7. Reactor according to one of Claims 1 to 5, characterized in that the reactor housing (4) is connected to a conveying device for conveying reactants into the reactor housing (4) and/or for conveying products from the reactor housing (4).

8. Reactor according to one of Claims 1 to 7, characterized in that it has a heat exchanger (10), the heat exchanger (10) in turn having an outer jacket (22) surrounding part of the reactor housing (4) and preferably a spiral partition wall (16) being arranged between the outer jacket (22) and the reactor housing (4) to form a spiral heat exchanger channel (18).
9. Reactor according to one of Claims 1 to 8, characterized in that it a heat exchanger (13), the heat exchanger (13) having an outer jacket (23) surrounding part of the displacement body (14) and a spiral partition wall (15) preferably being arranged between the outer jacket (23) and the displacement body (14) to form a spiral heat exchanger channel (17).
10. Reactor according to claim 8 or 9, characterized in that the heat exchanger (10) is suitable for temperature control with phase change, in particular boiling cooling.
11. Reactor according to claim 9 or 10, characterized in that the heat exchanger (13) is suitable for temperature control with phase change, in particular boiling cooling.
12. Reactor according to one of claims 1 to 11, characterized in that the drive shaft (30) is sealed via a double-acting mechanical seal arranged between the drive shaft (30) and the reactor housing (4), the mechanical seal preferably containing a barrier medium which is inert under the polymerization conditions.
13. Reactor according to one of claims 1 to 12, characterized in that at least one preferably all helical mixing elements (24, 26) contain a groove (37) into which a sealing tape (36) is inserted.
14. Reactor according to one of claims 1 to 13, characterized in that the sealing tape (36) is pressed via a spring mechanism (35) onto the surfaces of the reactor housing (4) or the internal displacement body, so that the sealing tape runs close to the wall or in contact with the wall during operation of the reactor to the surfaces of the reactor housing or the internal displacement body.
15. Reactor according to one of claims 1 to 14, characterized in that the sealing tape (36) is made of polytetrafluoroethylene (PTFE), glass fiber-reinforced PTFE, polyvinylidene fluoride (PVDF), ethylene-

tetrafluoroethylene copolymer (ETFE), polyether-ether ketone (PEEK), polyoxymethylene (POM), polyethylene (PE) or a metallic alloy with non-corrosive properties with respect to steels.

16. Reactor according to one of claims 1 to 15, characterized in that the helical mixing elements (24, 26) of the stirrer (38) are made continuously over the entire reactor length from one part or from several parts which are connected to one another in a form-fitting manner, so that this results in a continuous helix over the entire reactor length.

17. Reactor according to one of claims 1 to 16, characterized in that it contains more than one, preferably two, three or four helical mixing elements which are arranged at a uniform distance from one another in the direction of rotation.

18. Reactor according to one of claims 1 to 17, characterized in that the width of the helical mixing elements (24, 26) perpendicular to the surface of the reactor housing (4) is 10% to 100% of the annular gap width between the reactor housing and displacement body, preferably 15% to 50%, particularly preferably 20% to 40% and very particularly preferably 25% to 35%.

19. Reactor according to one of claims 1 to 18, characterized in that the pitch β of the helical mixing elements (24, 26) in relation to the surface of the reactor housing in the axial direction (slope) is from $\beta = 10^{\circ}$ to $\beta < 90^{\circ}$; preferably from $\beta = 30^{\circ}$ to 60° and particularly preferably from $\beta = 50^{\circ}$ to 40°.

20. Reactor according to one of Claims 4 to 19, characterized in that the gradient of the helical mixing elements (24) and the gradient of the helical mixing elements (26) are different.

21. Reactor according to one of claims 1 to 20, characterized in that between the helical mixing elements (26) and the helical mixing elements (24) a support structure comprising, preferably consisting of 2 or more, preferably 4 to 8 support profiles (31) running parallel to the geometric central axis is attached.

22. Reactor according to claim 21, characterized in that the support profiles have a rectangular cross-section and, compared to the radial direction,

have a pitch γ of γ = 0º to 90º, preferably γ = 30º to 60º and particularly preferably γ = 40º to 50º.

23. Reactor according to claim 21, characterized in that the support profiles have a round cross-section and rectangular profiles that are attached to these support profiles have a picth γ with respect to radial direction of γ = 0º to 90º, preferably γ = 30º to 60º and particularly preferably γ = 40º to 50º.

24. Reactor according to one of claims 1 to 23, characterized in that the speed of the drive shaft (30) is selected such that the peripheral speed of the helical mixing elements (24) on the surface of the reactor housing is between 0.05 m/s to 10 m/s, preferably 0.5 m/s to 6 m/s, particularly preferably 1 m/s to 5 m/s and very particularly preferably 1.5 m/s to 3 m/s.

25. Reactor according to one of Claims 1 to 24, characterized in that the ratio of the reactor length L to reactor diameter D (L/D) is 1 to 15, particularly preferably 2 to 8 and very particularly preferably 3 to 6.

26. Reactor according to one of claims 1 to 25, characterized in that the ratio D/d of reactor housing diameter D and displacement body diameter d (D/d) is 1.1 to 3.0, particularly preferably 1.2 to 2.0 and very particularly preferably 1.3 to 1.6.

27. Use of a reactor according to one of claims 1 to 26 for the polymerization of polymerizable monomers.

28. Use according to claim 27, characterized in that the polymers are synthetic rubbers.

29. Process for the continuous production of polymers by polymerization of polymerizable monomers, characterized in that the polymerization is carried out in a reactor according to one of claims 1 to 26.

30. A method according to claim 29, characterized in that in a reactor (1) according to one of claims 1 to 26 essentially a circulating flow or loop flow of the reactants and the products is imposed and during the polymerization any solids or gels that have been deposited on the surfaces of the heat exchangers (32, 33) on the reactor housing (4) and on the displacement body (14) are removed mechanically.

~~31. A method according to claim 20 or 30, characterized in that the mechanical removal is carried out by scraping or wiping.~~

1. A reactor for the continuous production of synthetic rubbers, comprising at least one essentially tubular reactor housing, an internal displacement body arranged essentially along a geometric axis of the reactor and extending essentially a length of the reactor, a reaction space between the housing and the internal displacement body, the reactor housing having a drive shaft connected to an outer stirrer and an inner stirrer which are rotatably arranged inside the reactor housing, the outer stirrer containing at least one helical mixing element, which is close to or in contact with a wall of the reactor housing, and the inner stirrer containing at least one helical mixing element which is close to or in contact with a wall of the internal displacement body; wherein the helical mixing element of the inner stirrer has a conveying direction opposite to a conveying direction of the helical mixing element of the outer stirrer.

2. The reactor according to claim 1, characterized in that the reactor has a geometric center axis arranged essentially horizontally or essentially vertically.

3. The reactor according to claim 1, characterized in that the internal displacement body is designed in such a way that a temperature control medium can flow through it.

4. The reactor according to claim 1, characterized in that the helical mixing elements are designed such that the distance of the helical mixing elements to the reactor housing and the helical mixing elements to the internal displacement body 0 or more than 0 to 1% based on the radial diameter of the reactor housing.

5. The reactor according to one claim 1, characterized in that the reactor housing is connected to a conveying device for conveying starting materials into the reactor housing and/or for conveying products from the reactor housing.

6. The reactor according to claim 1, characterized in that the drive shaft is sealed via a double-acting mechanical seal arranged between the drive shaft and the reactor housing.

7. The reactor according to claim 1, characterized in that the helical mixing elements of the stirrer are made continuously over the entire reactor length from one part or from several parts which are connected to one another in a form-fitting manner, so that results in a continuous helix over the entire reactor length.

8. The reactor according to claim 1, wherein the one or more helical mixing elements of the outer stirrer includes more than one helical mixing elements which are arranged at a uniform distance from one another in the direction of rotation.

9. The reactor according to claim 1, characterized in that a width of the helical mixing elements perpendicular to the surface of the reactor housing 10% to 100% of the annular gap width between the reactor housing and displacement body.

10. The reactor according to claim 1, characterized in that the placement of the helical mixing elements in relation to the surface of the reactor housing in the axial direction (slope) from $\beta=10°$ to $\beta<90°$.

11. The reactor according to claim 1, characterized in that the at least one helical mixing element designed close to the wall or in contact with the reactor housing has a gradient and the at least one helical mixing element designed close to the wall or in contact with the wall of the internal displacement body has a different gradient.

12. The reactor according to claim 1, characterized in that a speed of the drive shaft is selected such that the peripheral speed of the helical mixing elements on the surface of the reactor housing is between 0.05 m/s to 10 m/s.

13. The reactor according to claim 1, characterized in that a ratio of the reactor length L to reactor diameter D (L/D) is 1 to 15.

14. The reactor of claim 1, wherein the reactor includes a first heat exchanger for controlling a temperature of a first surface of the housing in contact with the reactor space and a second heat exchanger for controlling a temperature of a second surface of the internal displacement body in contact with the reactor space, wherein a ratio of a volume of the reactor space to the total surface area of the first and second surfaces is from 1 m^2/m^3 to 60 m^2/m^3.

15. A reactor for the continuous production of synthetic rubbers, comprising at least one essentially tubular reactor housing, the reactor housing having a drive shaft connected to at least one stirrer which is rotatably arranged inside the reactor housing, the stirrer containing at least one helical mixing element, which are close to or in contact with a wall of the reactor housing;

wherein the reactor has a heat exchanger, the heat exchanger in turn having an outer jacket surrounding part of the reactor housing, and the heat exchanger includes a spiral partition between the outer jacket and the reactor arranged to form a spiral heat exchanger channel.

16. The reactor according to claim 15, wherein the reactor includes an internal displacement body and a heat exchanger having an outer casing, the heat exchanger surrounding part of the internal displacement body, wherein the heat exchanger includes a spiral partition between the outer casing and the displacement body forming a spiral heat exchanger channel.

17. The reactor according to claim 16, characterized in that the heat exchanger is suitable for temperature control with phase change.

18. The reactor according to claim 15, characterized in that the heat exchanger is suitable for temperature control with phase change.

19. The reactor according to claim 15, characterized in that the stirrer has at least one helical mixing element designed close to the wall or in contact with the reactor housing, and at least one helical mixing element designed close to the wall or in contact with a wall of the internal displacement body.

20. A reactor for the continuous production of synthetic rubbers, comprising at least one essentially tubular reactor housing, an internal displacement body arranged essentially along a geometric axis of the reactor, the reactor housing having a drive shaft connected to an outer stirrer and an inner stirrer which are rotatably arranged inside the reactor housing, the outer stirrer containing at least one helical mixing element, which is close to or in contact with a wall of the reactor housing, and the inner stirrer containing at least one helical mixing element which is close to or in contact with a wall of the internal displacement body;

wherein the reactor includes a support structure between the helical mixing elements of the inner stirrer and the helical mixing elements of the outer stirrer, wherein the support structure includes 2 or more support profiles running parallel to the geometric central axis.

21. The reactor according to claim 20, characterized in that the support profiles have a rectangular cross-section and, compared to the radial direction, an adjustment γ of γ =0° to 90°.

22. The reactor according to claim 20, characterized in that the support profiles have a round cross-section and rectangular profiles are attached to these support profiles, which have an angle γ of γ =0° to 90°.

23. The reactor according to claim 20, characterized in that a ratio D/d of a diameter, D, of the reactor housing and a diameter, d, of the internal displacement is 1.1 to 3.0.

24. The reactor according to claim 20, characterized in that at least one of the helical mixing elements contains a groove into which a sealing tape is inserted.

25. The reactor according to claim 24, characterized in that the sealing tape is pressed via a spring mechanism onto the surfaces of the reactor housing or the internal displacement body, so that the sealing tape is close to the wall or in contact with the wall during operation of the reactor to the surfaces of the reactor housing or the internal displacement body.

26. The reactor according to claim 24, characterized in that the sealing tape is made of polytetrafluoroethylene (PTFE), glass fiber reinforced PTFE, polyvinylidene fluoride (PVDF), ethylene tetrafluoroethylene copolymer (ETFE), polyether-ether ketone (PEEK), polyoxymethylene (POM), polyethylene (PE) or a metallic alloy with non-eating properties compared to steel.

27. A method for the continuous production of polymers by polymerization of polymerizable monomers, characterized in that the polymerization is carried out in a reactor according to claim 1.

28. The method according to claim 27, wherein the reactor includes an internal displacement body arranged essentially along a geometric central axis of the reactor, characterized in that in the reactor has a circulating flow or loop flow of starting materials and during the polymerization, a product is impressed on a surface of a heat exchanger on the reactor housing and on a surface of a heat exchanger on the internal displacement body, wherein the solids or gels that have deposited on the surfaces of the heat exchangers are removed mechanically.

29. The method according to claim 28, characterized in that the mechanical removal is carried out by scraping or wiping.