Claims

1. Method for separating a homogeneous catalyst from a reaction mixture by means of at least one membrane separation unit in which the reaction mixture which contains the homogeneous catalyst and originates from a reaction zone is applied as feed continuously to the membrane separation unit, in which the homogeneous catalyst is depleted in the permeate of the membrane separation unit and is enriched in the retentate of the membrane separation unit, and in which the retentate of the membrane separation unit is recycled into the reaction zone,

~~characterized in that~~wherein

both the retentate volume flow rate of the membrane separation unit and the retention of the membrane separation unit are kept constant by closed-loop control, and

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~~2. Method according to Claim 1, characterized in that~~wherein the volume flow rate of the reaction mixture discharged from the reaction zone varies.

2~~3~~. Method according to Claim 1~~2~~, ~~characterized in that~~wherein the reaction mixture discharged from the reaction zone is initially charged in a buffer vessel from which, by means of a first conveying unit which is adjustable with respect to its conveying volume, the reaction mixture is supplied as feed to the membrane separation unit, the volume flow rate of the feed being regulated by adjustment of the conveying volume of the first conveying unit as a function of the fill level of the buffer vessel such that the volume flow rate is increased in the case of an elevated fill level and/or with rising fill level and the volume flow rate is reduced in the case of a reduced fill level and/or with falling fill level.

3~~4~~. Method according to any of Claims 1 or~~, 2 or 3~~, ~~characterized in that~~wherein the membrane separation unit comprises an overflow circuit operated by a circulation pump.

4~~5~~. Method according to Claim 3~~4~~, ~~characterized in that~~wherein the closed-loop control of the retention of the membrane separation unit is effected at least partly via the closed-loop control of the temperature of the overflow circuit.

5~~6~~. Method according to Claim 3~~4~~, ~~characterized in that~~wherein the closed-loop control of the retention of the membrane separation unit is effected at least partly via the closed-loop control of the pressure in the overflow circuit.

67. Method according to Claim 56, ~~characterized in that~~wherein the closed-loop control of the pressure in the overflow circuit is effected by reducing an adjustable flow resistance disposed in the permeate of the membrane separation unit in the event of elevated pressure in the overflow circuit.

78. Method according to Claim 56 or 67, ~~characterized in that~~wherein a portion of the permeate of the membrane separation unit is collected in a closed-loop control storage means, and the closed-loop control of the pressure in the overflow circuit is effected by conveying permeate out of the closed-loop control storage means into the overflow circuit or into the buffer vessel in the event of reduced pressure in the overflow circuit.

89. Method according to Claim 78, ~~characterized in that~~wherein the conveying of the permeate out of the closed-loop control storage means into the overflow circuit or into the buffer vessel is effected by means of a second conveying unit adjustable with respect to its conveying volume, in that the pressure differential between the overflow circuit and the permeate of the membrane separation unit is measured, and in that the conveying volume of the second conveying unit is adjusted as a function of the pressure differential.

910. Method according to any of Claims 34 to 89, ~~characterized in that~~wherein the overflow flow rate is kept constant within the overflow circuit of the membrane separation unit.

101. Method according to Claim 910, ~~characterized in that~~wherein the overflow flow rate is kept constant by using a circulation pump adjustable with respect to its conveying volume, by adjusting the conveying volume of the circulation pump as a function of the overflow flow rate.

112. Method according to any of the preceding claims, ~~characterized in that~~wherein the volume flow rate of the retentate of the membrane separation unit is kept constant by means of an adjustable flow resistance disposed in the retentate, the flow resistance of which is adjusted as a function of the volume flow rate of the retentate.

123. Method according to any of the preceding claims, ~~characterized in that~~wherein at least one homogeneously catalysed gas/liquid phase reaction is conducted in the reaction zone, especially selected from the group of the following reactions: oxidations, epoxidations, hydroformylations, hydroaminations, hydroaminomethylations, hydrocyanations, hydrocarboxyalkylation, aminations, ammoxidation, oximations, hydrosilylations, ethoxylations, propoxylations, carbonylations, telomerizations, metatheses, Suzuki couplings or hydrogenations.

134. Method according to Claim 123, ~~characterized in that~~wherein at least one substance having at least one ethylenically unsaturated double bond is hydroformylated in the reaction zone by reaction with carbon monoxide and hydrogen in the presence of an organometallic complex catalyst.

~~15. Apparatus for performance of a method according to any of Claims 1 to 14,~~

~~a) having a reaction zone for preparation of a reaction mixture comprising a homogeneous catalyst;~~

~~b) having at least one membrane separation unit for separation of the homogeneous catalyst from the reaction mixture to obtain a permeate depleted of homogeneous catalyst and a retentate enriched with homogeneous catalyst;~~

~~c) and having a catalyst return system for recycling of the retentate enriched with homogeneous catalyst into the reaction zone;~~

~~characterized by~~

~~d) means for closed-loop control of the retention and the retentate volume flow rate of the membrane separation unit.~~