CLAIMS

1. A robotic device for handling catalyst material in an interior of a reactor, characterized in that the robotic device comprises:

a body configured to engage a flange of the reactor, wherein an inner edge of the flange defines an opening in the reactor; and

a handling arm connected to the body and having a free end, the handling arm comprising at least one segment which is telescopically extendible/retractable relative to the body, wherein at least a part of the handling arm including the free end is configured to extend through the opening in the reactor into the interior of the reactor, and wherein the handling arm is configured to receive or connect to a vacuum line to form a cleaning arm for removing catalyst material from the interior of the reactor such that the free end of the handling arm and an inlet end of the vacuum line are proximate each other,

wherein the body includes a base plate which is configured to engage the flange of the reactor and a head which is articulated to the base plate for rotation relative to the base plate about a rotation axis; wherein the handling arm is in the form of a multistage telescopic handling arm which comprises a frame assembly which defines a central passageway along its length which is configured to receive or connect to the vacuum line to form the cleaning arm, and wherein the head of the body defines a longitudinally extending receiving channel therein, the handling arm being connected to the head of the body and being longitudinally displaceable relative to the head of the body within the receiving channel.

2. The robotic device according to claim 1, wherein the handling arm is longitudinally displaceable relative to the body in an operational upward or downward direction by way of multiple motor-driven rack and pinion arrangements.

3. The robotic device according to claim 1 or 2, wherein the base plate of the body is provided with a plurality of holes therethrough, positioning of the holes corresponding with or being in register with holes provided through the flange of the reactor such that the base plate of the body can be secured to the flange by means of fasteners; and wherein the head of the body is configured to rotate about the rotation axis passing through the body, whereby the rotation of the head of the body propels

the handling arm connected to the head to rotate in a horizontal plane about the generally vertical rotation axis.

4. The robotic device according to any one of claims 1 to 3, wherein the handling arm takes the form of a multi-segmented, articulated cleaning arm which includes a first, multistage telescopic segment which is displaceably connected to the head of the body and which is removably connected by way of a pivot joint to a second segment which, in turn, is removably connected by way of another pivot joint to a third segment.

5. The robotic device as claimed in any one of claims 1 to 4, wherein the head of the body is connected to the base plate by way of a swivel joint such that the head is angularly displaceable relative to the base plate about the rotation axis.

6. The robotic device as claimed in claim 1, wherein the multistage telescopic handling arm includes a segment which comprises a plurality of interconnected extensions which are telescopically extendable/retractable relative to one another.

7. The robotic device as claimed in claim 6, wherein telescopic displacement of the multistage telescopic handling arm is achieved by means of a winch system, wherein a winch cable is secured to an innermost telescopic extension of the segment such that telescopic extension of the extensions is achieved by winding down or out the winch cable, which allows the extensions to be lowered into the interior of the reactor under the pull of gravity, and telescopic retraction is achieved by raising the innermost telescopic extension by winding up the winch cable.

8. The robotic device according to any one of claims 1 to 3, 6 or 7, wherein the handling arm is configured as a loading arm by connecting a telescopically extendable/retractable loading sleeve to individual telescopic extensions of the telescopic segment of the handling arm to form the loading arm for loading catalyst material into the interior of the reactor, the free end of the handling arm and an outlet of the loading sleeve being proximate each other.

9. The robotic device according to claim 8, wherein the loading sleeve includes telescopically extendable/retractable sections each of which is internally secured to an individual corresponding extension of the segment of the loading arm such that the loading sleeve is concentrically received within the segment of the loading arm, and such that the loading sleeve is telescopically displaceable, in inside out fashion relative to the segment, in unison within the segment of the loading arm; and wherein a revolving material distributor is secured to the free end of the loading arm, in fluid flow communication with a lowermost section of the loading sleeve.

10. The robotic device as claimed in claim 9, wherein an operatively upper end of each respective section of the loading sleeve is secured to the corresponding extension of the segment of the loading arm, the loading sleeve therefore forming an internal passageway for conveying the catalyst material from an inlet to the revolving material distributor.

11. The robotic device according to claim 10, wherein an operatively lower end of each section of the loading sleeve includes a flow restriction which serves to impede the flow of catalyst material through the internal passageway such that the loading sleeve has multistage internal flow restriction along the internal passageway between the inlet and the revolving material distributor.

12. The robotic device as claimed in claim 11, wherein the flow restrictions are conical and alternate between a depending cone and an inverted or upwardly orientated cone.

13. The robotic device according to any of the preceding claims, wherein it is remotely controlled by an operator from a remote control station and includes at least one camera which is mounted to the handling arm for feeding video footage to the remote control station.

14. A method for removing catalyst material from an interior of a reactor using the robotic device according to any one of claims 1 to 7, wherein the method comprises:

connecting the vacuum line to the handling arm of the robotic device to form the cleaning arm;

connecting a second and a third segment to the cleaning arm such that the second segment articulates with the at least one segment and the third segment articulates with the second segment;

positioning the robotic device on the flange of the reactor such that at least part of the cleaning arm including the free end extend through the opening in the reactor into the interior of the reactor;

securing the body of the robotic device to the flange of the reactor by means of fasteners such that stabilizing arms, to grip an inner surface of the reactor during use of the robotic device, are not necessary; and

removing the catalyst material by vacuum from the interior of the reactor by telescopically extending the cleaning arm of the robotic device by way of remote control.

15. A method for loading catalyst material to an interior of a reactor using the robotic device according to any one of claims 8 to 12, wherein the method comprises:

connecting the loading sleeve to the segment of the handling arm of the robotic device to form the loading arm;

connecting a revolving material distributor to the free end of the loading arm;

positioning the robotic device on the flange of the reactor such that at least part of the loading arm including the revolving material distributor extends through the opening in the reactor into the interior of the reactor;

securing the body of the robotic device to the flange of the reactor by means of fasteners such that stabilizing arms, to grip an inner surface of the reactor during use of the robotic device, are not necessary; and

loading the catalyst material using the robotic device by directing flow of catalyst material through the loading sleeve and progressively telescopically retracting the loading arm as a level of catalyst inside the reactor rises.