We claim:

1. A non-contact suction cup device (100) with flow recycling, wherein the device comprises:
   - a suction cup with an outer shell (2);
   - optionally, one or more flow diverter(s) (4);
   - one or more suction means (5);
   - a chamber (51) formed at one side of the suction cup, facing a surface (1) to be sucked by action of fluid flow enabling adherence of the suction cup device (100) onto the surface (1), *and* the other side of the suction cup forms the outer shell (2) of the device;
   - wherein the chamber (51) of the suction cup comprises one or more passage(s) (12) that allow a portion of suction fluid to recirculate within the chamber (51), hence causing a recycling effect on fluid used to create suction;
   - wherein, the passage (12) comprises one or more split point(s) (6) inside the suction cup chamber (51) that acts as fluid inlet of the passage (12), and one or more merge point(s) (8) at outer periphery (52) of the suction cup chamber (51) that acts as fluid outlet of the passage (12);
   - wherein, in operation of the device (100), a main fluid flow (11) from the end of outer periphery (52) enters inside the suction cup chamber (51) and at said split point (6), the main fluid flow (11) splits into parts forming:
     (i) a secondary fluid flow path (11B) that recirculates said portion of suction fluid through said one or more passage(s) (12), and
     (ii) a primary fluid flow path (11A) that flows out other portion of suction fluid outside the device through exhaust (23).

2. The non-contact suction cup device as claimed in claim 1, wherein the said one or more split point(s) (6) of recycle passage(s) (12) within the chamber (51) is/are provided in place(s)/position(s) in between the suction means (5) and the merge point (8).

3. The non-contact suction cup device as claimed in claim 1, wherein the said one or more passage(s) (12) of the suction cup comprises:
   - a single passage, or
   - multiple passages in cascaded system, or
   - multiple separate tubes/ducts.

4. The non-contact suction cup device as claimed in claim 3, wherein the said one or more passage(s) (12) of the suction cup comprises: one or more flow passage gap(s) formed

in between the outer shell (2) and an inner shell (3), wherein the shells (2,3) are sandwiched with a gap in between.

5. The non-contact suction cup device as claimed in claim 3, wherein the said multiple cascaded flow passages (12) of the suction cup comprises flow passages (12.1 and 12.2), wherein an inner shell (3) comprises first inner shell portion (3.1) and second inner shell portion (3.2), and wherein,
   - said first flow passage (12.1) is formed in between first inner shell portion (3.1) and second inner shell portion (3.2), and comprises first fluid recycle inlet at first split point (6.1), and first fluid outlet at first merge point (8.1);
   - said second flow passage (12.2) is formed in between the outer shell (2) and second inner shell portion (3.2), and comprises second fluid recycle inlet at second split point (6.2), and second fluid outlet at second merge point (8.2).

6. The non-contact suction cup device as claimed in claim 3, wherein the said one or more passage(s) (12) of the suction cup comprises separate tubes/ducts (22) used to create the said recycling flow passage (12).

7. The non-contact suction cup device as claimed in claim 1, wherein the device further comprises of an additional exhaust duct (15) which redirects the exhaust from suction means (5) to a location close to the inlet, wherein the suction means is centrifugal style blower or impeller.

8. The non-contact suction cup device as claimed in claim 1, wherein the device further comprises of an additional flexible skirt (16) around the periphery of the suction cup, wherein the skirt (16) collapses around a large obstacle allowing the suction device to go over larger obstacles than the gap between the suction cup and the sucked surface.

9. The non-contact suction cup device as claimed in claim 1, wherein,
   - the said one or more suction means (5) comprises one or more apparatus capable of creating suction when conjugated with the suction cup, and are configured to suck or draw the fluid (11) from the outer periphery (52) of the device (100) into the chamber (51) of suction cup; and
   - the said flow diverter (4) is provided inside the chamber (51) and configured to divert the flow of fluid (11) flowing below an inner shell (3) starting from a region from outer periphery (52) to a region between inner shell (3) and flow diverter (4).

10. A method for non-contact suction using a cup device (100), wherein the method comprises:

- providing one or more passage(s) (12) in chamber (51), that allow a portion of suction fluid to recirculate within the chamber (51), hence causing a recycling effect on fluid used to create suction;
- wherein, when the one or more suction means (5) conjugated with the suction cup is operated and function to create suction, a main fluid flow (11) from the end of outer periphery (52) enters inside the suction cup chamber (51), diverted by the flow diverter (4) and at split point (6), the main fluid flow (11) splits into parts forming:
  (i) a secondary fluid flow path (11B), wherein a portion of fluid enters into the passage (12) via the inlet at split point (6), flowing therethrough exits out from the passage (12) via the outlet at merge point (8) where the said portion of fluid merges, and is mixed with the main fluid flow (11) which continues to flow and thus a portion of main suction fluid flow (11) recirculates through said one or more passage(s) (12); and
  (ii) a primary fluid flow path (11A) that flows out other portion of suction fluid outside the device through exhaust (23) provided at the suction means attachment (13).

11. The method as claimed in claim 10, wherein the said one or more passage(s) (12) of the suction cup comprises:
    - a single passage, or
    - multiple passages in cascaded system, or
    - multiple separate tubes/ducts.

12. The non-contact suction cup device as claimed in any claims 1-10, wherein the device comprises an acceleration zone (9) having a flat under surface and a diffusion zone (10) lacking a flat under surface, wherein the device first reduces pressure in the acceleration zone (9) and then finally increases pressure in the diffusion zone (10).

13. The non-contact suction cup device as claimed in any claims 1-10, wherein the fluid (11) comprises air or liquid or slurries or any mixture thereof capable to create pressure and suction.

14. The non-contact suction cup device as claimed in any claims 1-10, wherein the shape of suction cup is a shape selected from circular, oval or polygonal.

15. The non-contact suction cup device as claimed in any claims 1-10, wherein said one or more suction means (5) is/are apparatus capable of creating suction, selected from fan(s), or jet(s) is conjugated with the suction cup either by:

(a) direct attachment, by attaching suction means (5) with a suction means attachment (13) of the suction cup,
or
(b) indirect attachment, wherein the suction means (5) is provided in a suction pipe or tubular means (14) and then conjugating the suctioning end of pipe or tubular means (14) with the suction means attachment (13);

and wherein the suction means (5) can be placed in any orientation with respect to device (100).

16. The non-contact suction cup device as claimed in any claims 1-10, wherein,
- the recycling fluid flow passage (12) comprises one or more fin like structures (20) within the recycle passage which provide support to an inner shell (3);
- the flow diverter (4) comprises one or more support fin(s) (21) to connect to a suction means attachment (13) or outer shell (2) of the suction cup device (100).

17. The non-contact suction cup device as claimed in any claims 1-10, wherein the said one or more recycled-flow passages (12) are provided with fan(s) and/or jet(s) to add momentum to recycling flow wherein the fans/jets use an external source or comprise holes linking recycle passage to the environment hence using the lower pressure in recycle flow passage to drive the fans/jets.