May 18, 1943. J. E. DUGGAN 2,319,727

SUCTION CUP STRUCTURE

Filed March 23, 1942

FIG.2.

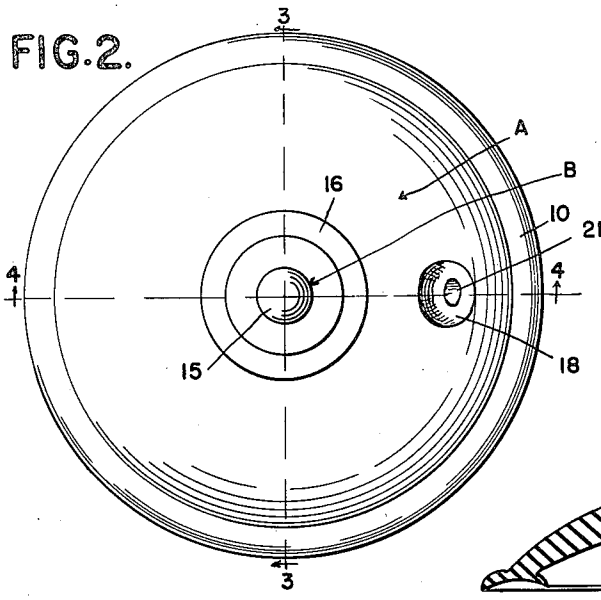


FIG.3.

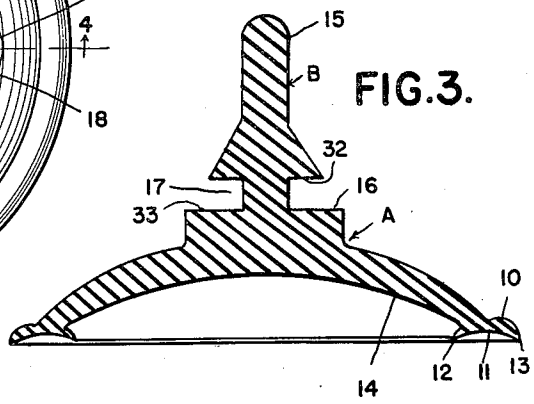


FIG.4.

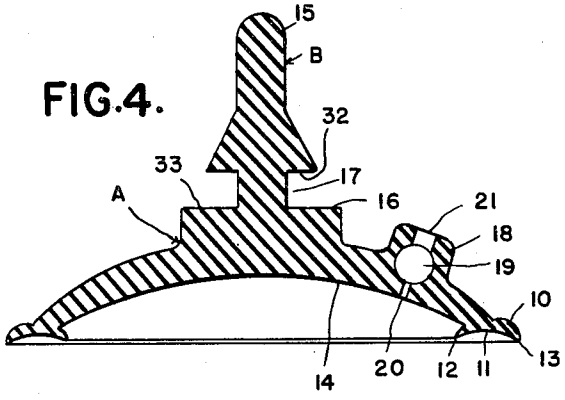


FIG.5.

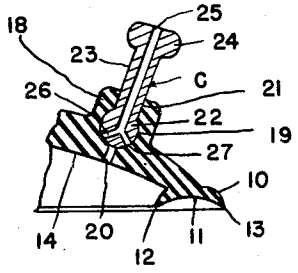


FIG.1.

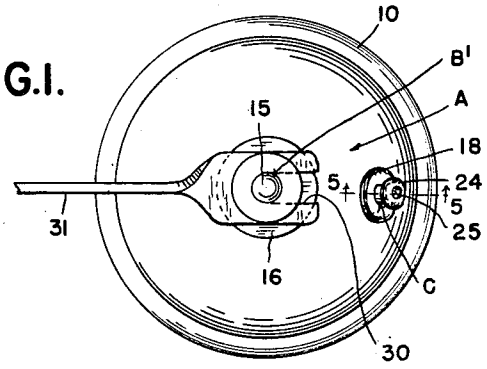
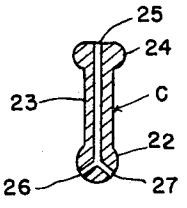


FIG.6.



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SUCTION CUP STRUCTURE

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6 Claims. (Cl. 248—206)

This invention relates generally to suction cup structures and consists of certain improvements, combinations and arrangements of parts that will be hereinafter more fully described and particularly pointed out in the appended claims.

One of the essential objects of the invention is to provide a suction cup structure having two cooperating suction faces for engagement with a given surface.

Another object is to provide a suction cup structure having improved valve means for controlling the suction or vacuum between the body of the cup and the surface engaged thereby.

Another object is to provide a suction cup structure having a body provided with an improved edge formation for obtaining a better vacuum between the body and the surface engaged thereby.

Another object is to provide a suction cup structure having a stem by which it may be manipulated and provided with means for receiving and holding portions of brackets or other devices of structures or apparatus with which such cups are employed, so that the cups may be attached without separate or additional fastening means to said structures or apparatus.

Another object is to provide a suction cup structure that is simple in construction, economical to manufacture, efficient in operation and that can be easily and quickly applied to and removed from a surface without marring the same.

In the accompanying drawing:

Figure 1 is a top plan view of a suction cup structure embodying my invention, and showing a portion of a bracket attached thereto;

Figure 2 is a top plan view of the suction cup structure illustrated in Figure 1, with the bracket and valve element removed;

Figure 3 is a vertical sectional view taken on the line 3—3 of Figure 2;

Figure 4 is a vertical sectional view taken on the line 4—4 of Figure 2;

Figure 5 is a sectional view taken on the line 5—5 of Figure 1;

Figure 6 is a vertical sectional view through the valve element.

Referring now to the drawing, A is the body, B is the stem, and C is the valve element of a suction cup structure embodying my invention.

As shown, the body A is formed of resilient material such as rubber or rubber composition and is substantially concavo-convex in configuration. The marginal or edge portion 10 of the body is relatively wide and has a concave suction face 11 for engagement with a suitable surface of an article to which the cup structure is to be attached. Preferably the inner edge or rim 12 of this suction face 11 is shallower than the outer edge or rim 13 so that a double seal between the body and surface to be engaged may be effectively obtained. However, upon manipulation of the stem B or when communication between the atmosphere and the central concave suction face 14 of the body is established by the valve element C, as hereinafter described, then communication may also be established between the marginal concave suction face 13 and the central concave suction face 14.

Stem B is integral with the body and is located at approximately the center thereof. Preferably this stem has a cylindrical end portion 15 that serves as a finger piece and is provided between said end portion and the body with an enlarged portion 16 having an annular laterally opening slot 17 therein.

Located in an enlargement 18 of the body between the stem B and edge portion 10 thereof is a spherical hole 19, while at substantially diametrically opposite sides of this hole are aligned cylindrical openings 20 and 21, respectively. The opening 20 is relatively small and extends inwardly through the central concave suction face 14 of the body while the opening 21 is larger and extends outwardly through the outer face of the enlargement 18.

Located within the spherical hole 19 and outwardly extending opening 21 in the body are spherical and stem portions 22 and 23, respectively, of the valve element C for controlling the flow of air to and from the concave suction face 14 of the body. Preferably the valve element C has a knob or finger piece at its outer end and is provided with a longitudinally extending passage 25 and branch passages 26 and 27, respectively. As shown, the longitudinal passage 25 extends inwardly from the outer end of the knob 24 to a point substantially at the center of the spherical portion 22 of the valve element, while the branch passages 26 and 27 are disposed at approximately a 90° angle to each other and extend inwardly from the inner end of the passage 25 through the spherical portion 22 of the valve element C so as to be normally closed by the walls of the hole 19 upon opposite sides of the inwardly extending passage 20 in the body.

The lateral slot 17 in the stem B of the suction cup may receive a slotted portion 30 of a bracket rigid with a frame such as 31 or may receive any other suitable device to which the cup is to be attached. Preferably the depth of the slot 17 in the stem of the cup is less than the thickness of the bracket 30 or other device mentioned so that it is necessary to stretch the rubber of the enlargement by exerting a pull in opposite directions upon the stem B and body A to separate the walls 32 and 33, respectively, of the slot sufficiently to permit the insertion therebetween of the portion 30 of the bracket. Such walls 32 and 33 will grip the portion 30 of the bracket when

the parts A and B are released and will effectively maintain the proper connection between the suction cup and bracket.

In use when it is desired to apply the suction cup structure to a given surface such, for example, as the surface of an airplane wing, the body A of the cup is pressed in the usual manner against said surface to establish a double vacuum between the said body and said surface, one between the central concave face 14 and said surface and the other between the marginal concave suction face 11 and said surface. In the present instance, the concave edge formation 11 of the body will materially aid in obtaining this double suction effect to insure firm attachment of the cup to the surface mentioned. Normally the spherical portion 22 of the valve element C fits snugly against the walls of the spherical hole 19 in the body of the cup and therefore serves as a valve head and closes the inner opening 20 in said body. Hence, when the suction cup is pressed in the usual manner against the airplane wing or other surface, the proper vacuum is obtained and the cup will be anchored firmly in place.

When it is desired to remove the cup structure from the airplane wing, the valve element C in the body of the cup is pulled upward a predetermined distance so that the rubber forming the walls of the spherical hole 19 in said body will be distorted or deformed sufficiently to provide in said hole 19 a space for air between and in communication with the branch passages 26 and 27 in the spherical portion 22 of the valve element and the small opening 20 in the valve body. Thus, air from the atmosphere may enter the body A of the suction cup to destroy the vacuum between said body and airplane wing surface and permit the resiliency of the rubber forming said body and more particularly the concavo-convex portion thereof to free the cup from the wing surface.

Thus, from the foregoing it will be apparent that I have provided a suction cup structure that may be easily and quickly applied to or removed from a given surface without marring the same.

What I claim as my invention is:

1. A suction cup structure having a body of resilient material provided with a suction face, said body containing a spherical hole having substantially cylindrical openings at substantially diametrically opposite sides of said hole, one opening extending outwardly through the body to the exterior thereof, and the other extending inwardly through the body to the suction face thereof, and valve means within the spherical hole and outwardly extending opening and normally closing the inwardly extending opening, the resiliency of the material forming the body permitting distortion of the walls of the hole by the valve means to establish communication between the inwardly extending opening and the exterior of said body, the valve means being provided upon the exterior of the body with a finger piece by which the valve means may be manipulated.

2. A suction cup structure having a body of resilient material provided with a suction face, said body containing a spherical hole and having openings at diametrically opposite sides of said hole, one extending outwardly through the body to the exterior thereof, the other extending inwardly through the body to the suction face thereof, and valve means engaging said hole and outward opening for controlling the flow of air through the inward opening, said valve means having an air passage adapted to communicate with the inward opening but normally closed by a wall of the hole, said valve means being accessible outside the body and adapted upon being subjected to an outward pull to distort the resilient walls of the hole to establish communication between the air passage in the valve means and said inward opening.

3. A suction cup structure having a body of resilient material provided with a suction face, said body containing a spherical hole and provided at substantially diametrically opposite sides of said hole with substantially cylindrical openings, one leading outwardly from the hole to the outside of the body and the other leading inwardly from the hole to the suction face of the body, and a valve element having a spherical portion fitting the hole snugly and having a stem extending through the outwardly extending opening to the outside of the body, said stem being provided outside the body with a knob or finger piece, said valve element having a passage for air extending lengthwise thereof from the outer end thereof to a point substantially at the center of the spherical portion thereof and having branch passages extending from the inner end of the passage aforesaid through the spherical portion of the valve element to the walls of the hole upon opposite sides of the inwardly extending opening aforesaid, the construction and arrangement of the parts being such that the branch passages are normally closed by the walls of said hole but may be opened so as to be in communication with said inwardly extending opening upon distortion of the resilient walls of the hole by an outward pull upon the knob or finger piece of said valve element.

4. A suction cup structure having a body of resilient material provided with a suction face, said body containing a spherical hole and provided at substantially diametrically opposite sides of said hole with openings, one leading outward from the hole to the outside of the body and the other leading inward from the hole to the suction face of the body, and valve means engaging the hole and outward opening for controlling the flow of air through the inward opening.

5. A suction cup structure having a body of resilient material provided with a suction face, and a valve element extending into the body from the exterior thereof and terminating short of said suction face, said body having a passage for air extending through the suction face thereof to the valve element, the valve element having a passage for air adapted to communicate with the passage in the body but normally closed therefrom by resilient material of the body, the valve element being adapted to distort resilient material of the body to establish communication between the passage in said element and the passage in said body.

6. A suction cup structure having a body provided with a suction face, and a valve element extending into the body from the exterior thereof and terminating short of said suction face, said body having a passage for air extending through the suction face thereof to the valve element, the valve element having a passage for air adapted to communicate with the passage in the body but normally closed therefrom by a portion of the body, the valve element being movable relative to the body to establish communication between the passage in said element and the passage in said body.

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