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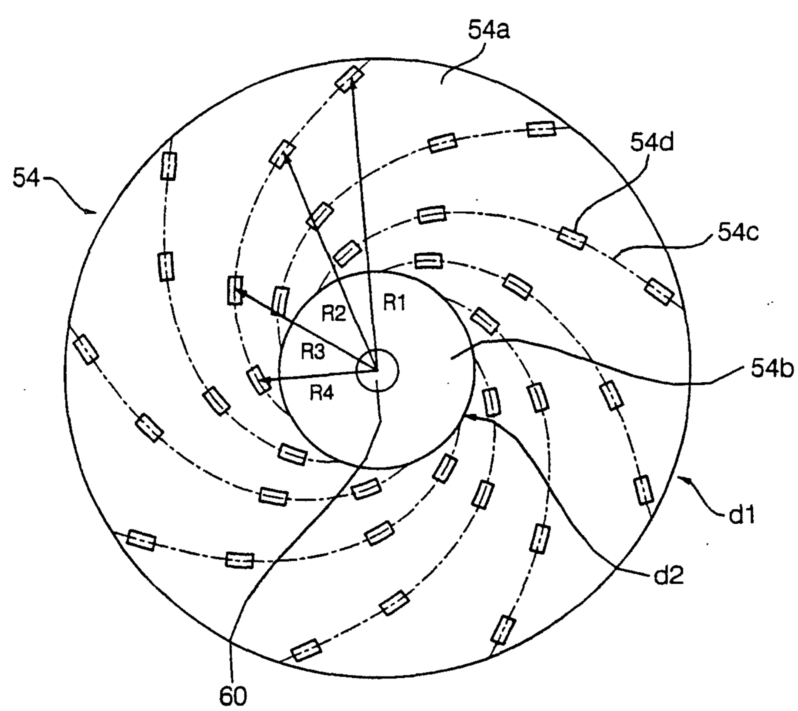
(54) Centifugal blower for vacuum cleaner

(57) Disclosed is an impeller (54) of a centrifugal blower for a vacuum cleaner in which caulking positions (R1 to R4) of each blade (54c) caulked between front and rear covers (54a,54b) are set, taking into consideration design parameters including the length and maximum camber position (MCP) of the blade, so as to disperse the stress concentrated on each caulked portion of the blade (54c), thereby causing a minimum stress to be applied to the caulked portion of the blade (54c), so that the impeller (54) secures a structural stability.

FIG. 3



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an impeller of a centrifugal blower for a vacuum cleaner, and more particularly to an impeller of a centrifugal blower for a vacuum cleaner in which caulking positions of each blade caulked between front and rear covers are set to be optimum, taking into consideration design parameters including the length and maximum camber position of the blade, so as to disperse the stress concentrated on each caulked portion of the blade.

Description of the Related Art

[0002] As well known, a vacuum cleaner is a cleaning appliance adapted to generate a sucking force, thereby removing foreign matters such as dust. Such a vacuum cleaner is equipped with a blower installed in the body of the vacuum cleaner and adapted to generate a sucking force for sucking dust through a suction port, and collecting the sucked dust into a dust bag.

[0003] Fig. 1 is a sectional view illustrating a conventional centrifugal blower for a vacuum cleaner. Fig. 2 is a plan view illustrating an impeller included in the conventional centrifugal blower.

[0004] As shown in Fig. 1, the conventional centrifugal blower for a vacuum cleaner includes an impeller housing 22 provided at a front end thereof with a suction port 22a, an impeller 24 rotatably installed in the impeller housing 22, a motor housing 23 coupled at a front end thereof to a rear end of the impeller housing 22, and provided at a rear end thereof with a plurality of discharge ports 23a, and a motor 30 installed in the motor housing 23, and connected to the impeller 24 via a rotating shaft 29 so as to rotate the impeller 24.

[0005] The impeller 24 includes a pair of spaced covers, that is, a front cover 24a and a rear cover 24b, and a plurality of blades 24c installed between the front and rear covers 24a and 24b while extending to have a circumferentially curved configuration.

[0006] Each blade 24c is fixed to the front and rear covers 24a and 24b at its front and rear ends, respectively. The fixing of each blade 24c to each cover 24a or 24b is achieved in a caulked fashion at four points.

[0007] A disk member 27 is fixedly arranged at the rear of the impeller 24. Diffuser vanes 26 are formed at the front surface of the disk member 27 to feed air discharged from the outlet of the impeller 24 in a pressurized state, whereas guide vanes 28 are formed at the rear surface of the disk member 27 to guide the pressurized air fed by the diffuser vanes 26 to the motor 30.

[0008] However, the impeller of the conventional centrifugal blower for a vacuum cleaner may be structurally instable when it is rotated at high speed, because the caulking positions of each blade 24c fixed to the front and rear covers 24a and 24b are set by simply quartering the length of the blade 24c, so that the stress applied to each caulked portion of the blade 24c during the high speed rotation of the impeller is locally concentrated without being uniformly dispersed.

SUMMARY OF THE INVENTION

[0009] Therefore, the present invention has been made in view of the above mentioned problems involved with the related art, and an object of the invention is to provide an impeller of a centrifugal blower for a vacuum cleaner in which the caulking positions of each blade mounted between front and rear covers are set so that a minimum stress is applied to each caulked portion of the blade during rotation of the impeller, thereby allowing the impeller to be structurally stable.

[0010] In accordance with the present invention, this object is accomplished by providing an impeller of a centrifugal blower for a vacuum cleaner including a plurality of blades installed between front and rear covers while being curved, each of the blades being caulked to the front and rear covers at front and rear ends thereof, respectively, wherein

each of the blades is caulked at positions spaced apart from a center of the impeller by respective distances of R1, R2, R3, and R4 expressed as follows:

$$R1 = d1/2 - 2.0 \text{ [mm]}$$

$$R4 = d2/2 + 2.5 \text{ [mm]}$$

$$R2 = \alpha (R1 - R4) + R4 \text{ [mm]}$$

$$R3 = \beta \, (R1 - R4) + R4 \; [mm]$$

where, "d1" represents a diameter of a circle connecting roots of the blades, "d2" represents a diameter of a circle connecting tips of the blades, and "a" and "b" represent constants determined within respective predetermined ranges.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The above objects, and other features and advantages of the present invention will become more apparent after a reading of the following detailed description when taken in conjunction with the drawings, in which:

Fig. 1 is a sectional view illustrating a conventional centrifugal blower for a vacuum cleaner;
Fig. 2 is a plan view illustrating an impeller included in the conventional centrifugal blower;
Fig. 3 is a plan view illustrating an impeller included in a centrifugal blower for a vacuum cleaner in accordance with the present invention;
Fig. 4 is a sectional view illustrating blades included in the impeller of the centrifugal blower according to the present invention;
Fig. 5 is a schematic view illustrating a blade configuration determined by a maximum camber position;
Figs. 6a and 6b are graphs depicting caulking positions and stress distributions when a maximum camber position (MCP) value of a blade according to the present invention is 0.4, respectively;
Figs. 7a and 7b are graphs depicting caulking positions and stress distributions when the MCP value of the blade according to the present invention is 0.5, respectively; and
Figs. 8a and 8b are graphs depicting caulking positions and stress distributions when the MCP value of the blade according to the present invention is 0.6, respectively.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] Now, preferred embodiments of the present invention will be described in detail, with reference to the annexed drawings.

[0013] Fig. 3 is a plan view illustrating an impeller included in a centrifugal blower for a vacuum cleaner in accordance with the present invention. Fig. 4 is a sectional view illustrating blades included in the impeller of the centrifugal blower according to the present invention.

[0014] As shown in Figs. 3 and 4, the impeller of the centrifugal blower according to the present invention includes a plurality of blades 54c mounted between a front cover 54a and a rear cover 54b while extending to have a curved configuration. Each blade 54c is fixed to the front and rear covers 54a and 54b at its front and rear ends, respectively. The fixing of each blade 54c to each cover 54a or 54b is achieved in a caulked fashion. The rear cover 54b is coupled to a motor (not shown) via a rotating shaft 60.

[0015] Fig. 5 is a schematic view illustrating a blade configuration determined by a maximum camber position.

[0016] Typically, a blade configuration is drawn using two arcs because there is a limitation in drawing a blade configuration using a single arc. For example, a two arc method is mainly used, in which a blade configuration is drawn by two arcs having different diameters R1 and R2 in such a fashion that the contact point, at which the arcs are tangent to each other, corresponds a maximum camber position MCP, as shown in Fig. 5.

[0017] In accordance with this two arc method, the blade 54c has a reduced length while having an increased radius of curvature, ρ, at an increased value of the maximum camber position MCP. That is, the blade 54c has a relatively straight configuration while extending radially at the increased MCP value.

[0018] Accordingly, where the blade has a relatively small MCP value, that is, a relatively curved configuration, bending stress is generated when a centrifugal force P is generated in a radial direction of the impeller 54 in accordance with rotation of the impeller 54. On the other hand, where the blade has a relatively large MCP value, that is, a relatively straight configuration, tensile stress is generated by the centrifugal force P. Thus, the stress applied to the blade is reduced as the MCP value is increased.

[0019] Since the stress applied to the blade 54c is varied depending on the maximum camber position MCP, it is required to determine caulking positions for the blade 54c, taking into the consideration the maximum camber position MCP.

[0020] The caulking positions of the blade 54c are set to correspond to positions spaced apart from the rotating shaft 60 by respective straight distances R1, R2, R3, and R4. The straight distances R1, R2, R3, and R4 are expressed as follows:

[Expression 1]

$$R1 = d1/2 - 2.0[mm]$$

$$R4 = d2/2 + 2.5\ [mm]$$

$$R2 = \alpha\ (R1 - R4) + R4\ [mm]$$

$$R3 = \beta\ (R1 - R4) + R4[mm]$$

where, "d1" represents the diameter of a circle connecting the roots of all blades 54c, "d2" represents the diameter of a circle connecting the tips of all blades 54c, and "a" and "b" represent constants determined within respective predetermined ranges.

[0021] In particular, "R2" and "R3" can be varied in accordance with the constants a and b respectively determined within predetermined ranges depending on the maximum camber position MCP of the blade 54c. The constants a and b are determined within respective ranges described in the following Table 1.

Table 1

Maximum Camber Position	a	b
0.4	0.7 to 0.8	0.3 to 0.4
0.5	0.7 to 0.8	0.3 to 0.4
0.6	0.7 to 0.8	0.2 to 0.3

[0022] Once the blade 54c is arranged between the front and rear covers 54a and 54b, the caulking positions R1 and R4 are primarily determined. Thereafter, the caulking positions R2 and R3 are determined in accordance with the values of the caulking positions R1 and R4, and the constants a and b determined depending on the maximum camber position MCP.

[0023] Figs. 6a and 6b are graphs depicting caulking positions and stress distributions when the MCP value of the blade according to the present invention is 0.4, respectively. The optimum caulking position for each of R1 to R4 determined by performing a structural strength analysis several times is obtained under the conditions of a = 0.73, and b = 0.33.

[0024] In this case, the stress applied between the blade 54c, which is made of aluminum, and each of the front and rear covers 54a and 54b, is uniformly dispersed around each of the caulking positions R1 to R4. As shown in Fig. 6b, a maximum stress of 493 MPa is applied to a stress concentration region M1.

[0025] Figs. 7a and 7b are graphs depicting caulking positions and stress distributions when the MCP value of the blade according to the present invention is 0.5, respectively. The optimum caulking position for each of R1 to R4 determined by performing a structural strength analysis several times is obtained under the conditions of a = 0.72, and b = 0.33.

[0026] In this case, the stress applied between the blade 54c, which is made of aluminum, and each of the front and rear covers 54a and 54b, is uniformly dispersed around each of the caulking positions R1 to R4. As shown in Fig. 7b, a maximum stress of 489 MPa is applied to a stress concentration region M2.

[0027] Figs. 8a and 8b are graphs depicting caulking positions and stress distributions when the MCP value of the blade according to the present invention is 0.6, respectively. The optimum caulking position for each of R1 to R4 determined by performing a structural strength analysis several times is obtained under the conditions of a = 0.75, and b = 0.22.

[0028] In this case, the stress applied between the blade 54c, which is made of aluminum, and each of the front and rear covers 54a and 54b, is uniformly dispersed around each of the caulking positions R1 to R4. As shown in Fig. 8b, a maximum stress of 362 MPa is applied to a stress concentration region M3.

[0029] Although the maximum stress is more than the yield strength of general aluminum corresponding to 140 to 150 MPa, it has no influence on the total yield strength of the blade 54c because its stress concentration region M1, M2 or M3 corresponds to a very small portion of the blade 54c.

[0030] As the configuration of the blade 54c is varied in accordance with the maximum camber position, the optimum caulking position for each of R1 to R4 between the front and rear covers 54a and 54b is also varied.

[0031] As apparent from the above description, the present invention provides an impeller of a centrifugal blower for a vacuum cleaner in which caulking positions of each blade are set in accordance with a specific equation established taking into consideration the length and maximum camber position of the blade, so as to cause a minimum stress to be applied to each caulked portion of the blade during rotation of the impeller, thereby being capable of securing a structural stability.

[0032] Although the preferred embodiments of the invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

Claims

1. An impeller of a centrifugal blower for a vacuum cleaner including a plurality of blades installed between front and rear covers while being curved, each of the blades being caulked to the front and rear covers at front and rear ends thereof, respectively, wherein

   each of the blades is caulked at positions spaced apart from a center of the impeller by respective distances of R1, R2, R3, and R4 expressed as follows:

$$R1 = d1/2 - 2.0\ [mm]$$

$$R4 = d2/2 + 2.5[mm]$$

$$R2 = \alpha\ (R1 - R4) + R4[mm]$$

$$R3 = \beta\ (R1 - R4) + R4[mm]$$

   where, "d1" represents a diameter of a circle connecting roots of the blades, "d2" represents a diameter of a circle connecting tips of the blades, and "a" and "b" represent constants determined within respective predetermined ranges.

2. The impeller according to claim 1, wherein the constants "a" and "b" are determined by a maximum camber position of the blade.

3. The impeller according to claim 1, wherein the constant "a" corresponds to 0.7 to 0.8, and the constant "b" corresponds to 0.3 to 0.4 when the blade has a maximum camber position value of not less than 0.35, but less than 0.45.

4. The impeller according to claim 3, wherein the constant "a" corresponds to 0.73, and the constant "b" corresponds to 0.33 when the blade has a maximum camber position value of 0.4.

5. The impeller according to claim 1, wherein the constant "a" corresponds to 0.7 to 0.8, and the constant "b" corresponds to 0.3 to 0.4 when the blade has a maximum camber position value of not less than 0.45, but less than 0.55.

6. The impeller according to claim 5, wherein the constant "a" corresponds to 0.72, and the constant "b" corresponds to 0.33 when the blade has a maximum camber position value of 0.5.

7. The impeller according to claim 1, wherein the constant "a" corresponds to 0.7 to 0.8, and the constant "b" corresponds to 0.2 to 0.3 when the blade has a maximum camber position value of not less than 0.55, but less than 0.65.

8. The impeller according to claim 7, wherein the constant "a" corresponds to 0.75, and the constant "b" corresponds to 0.22 when the blade has a maximum camber position value of 0.6.

FIG.1(Prior Art)

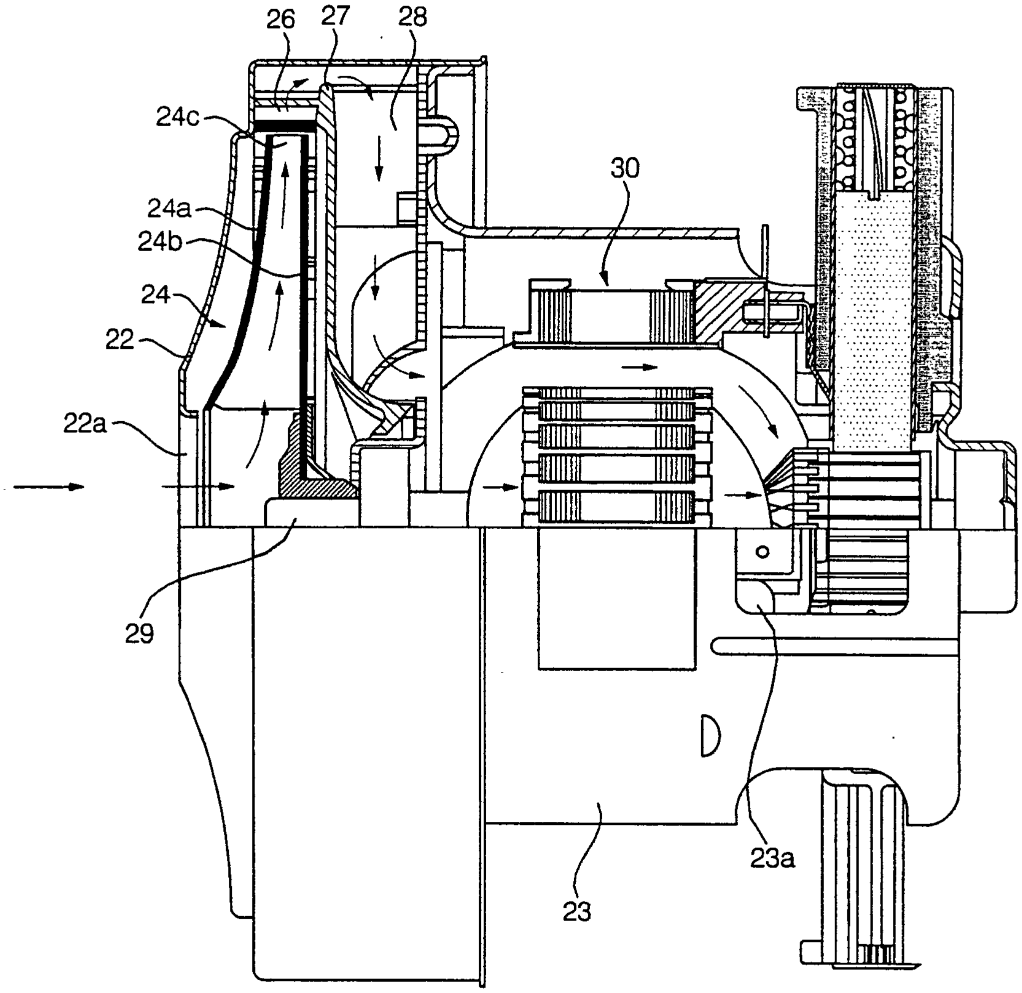


FIG. 2(Prior Art)

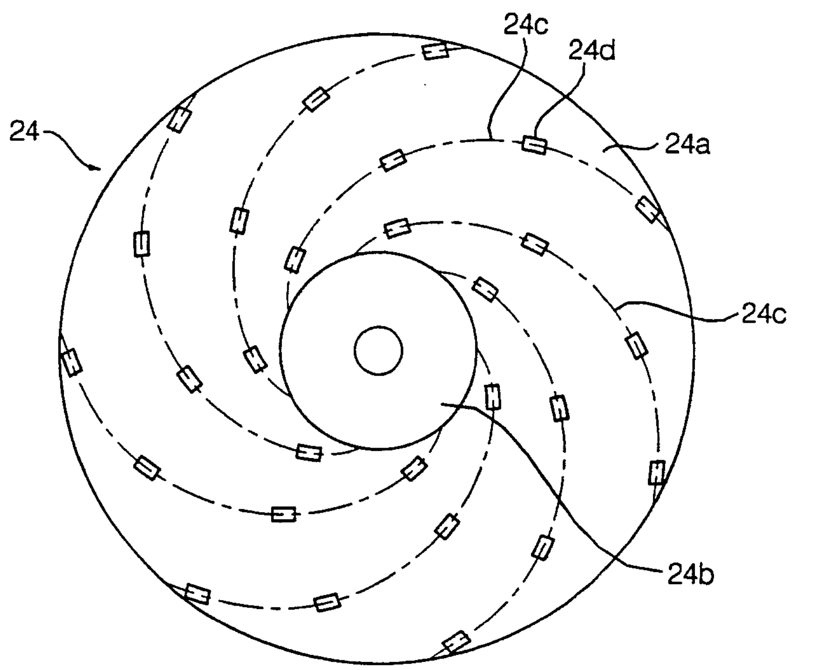


FIG. 3

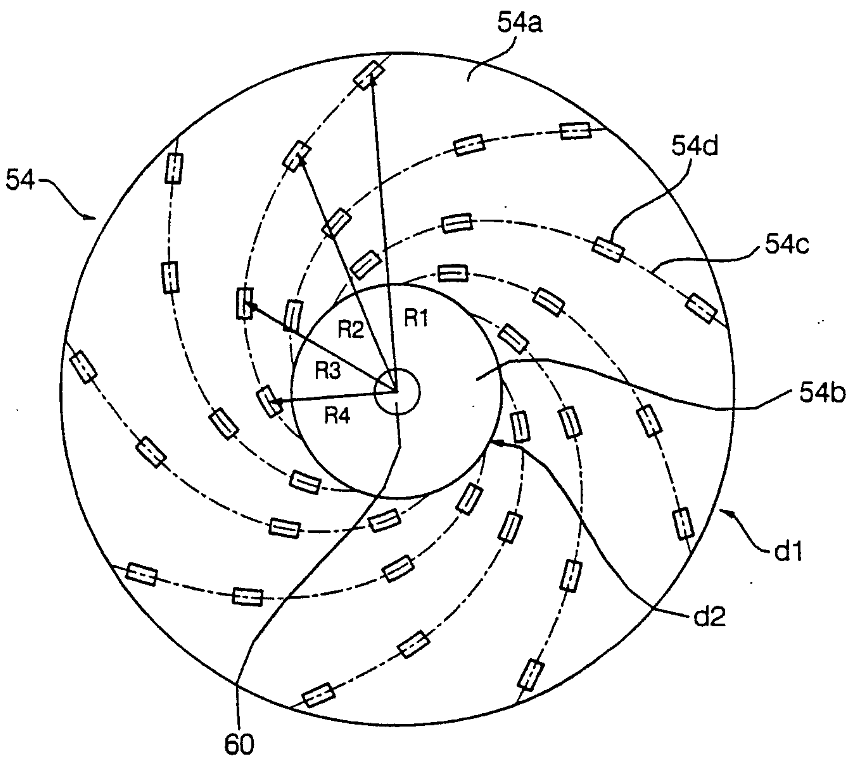


FIG. 4

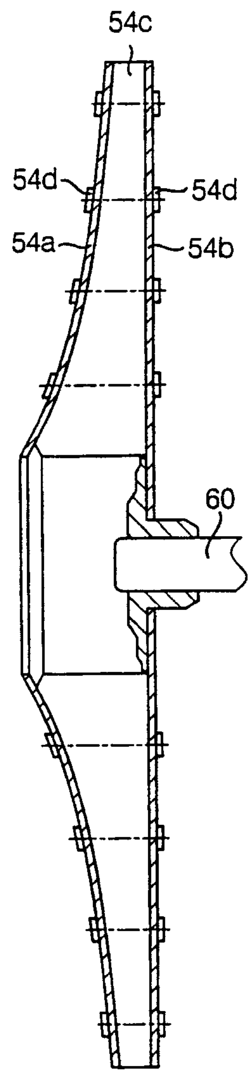


FIG. 5

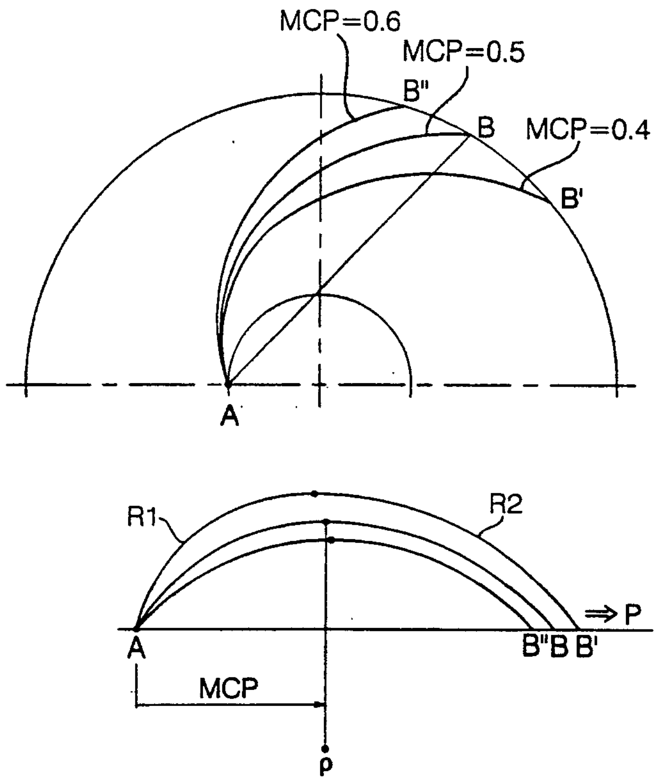
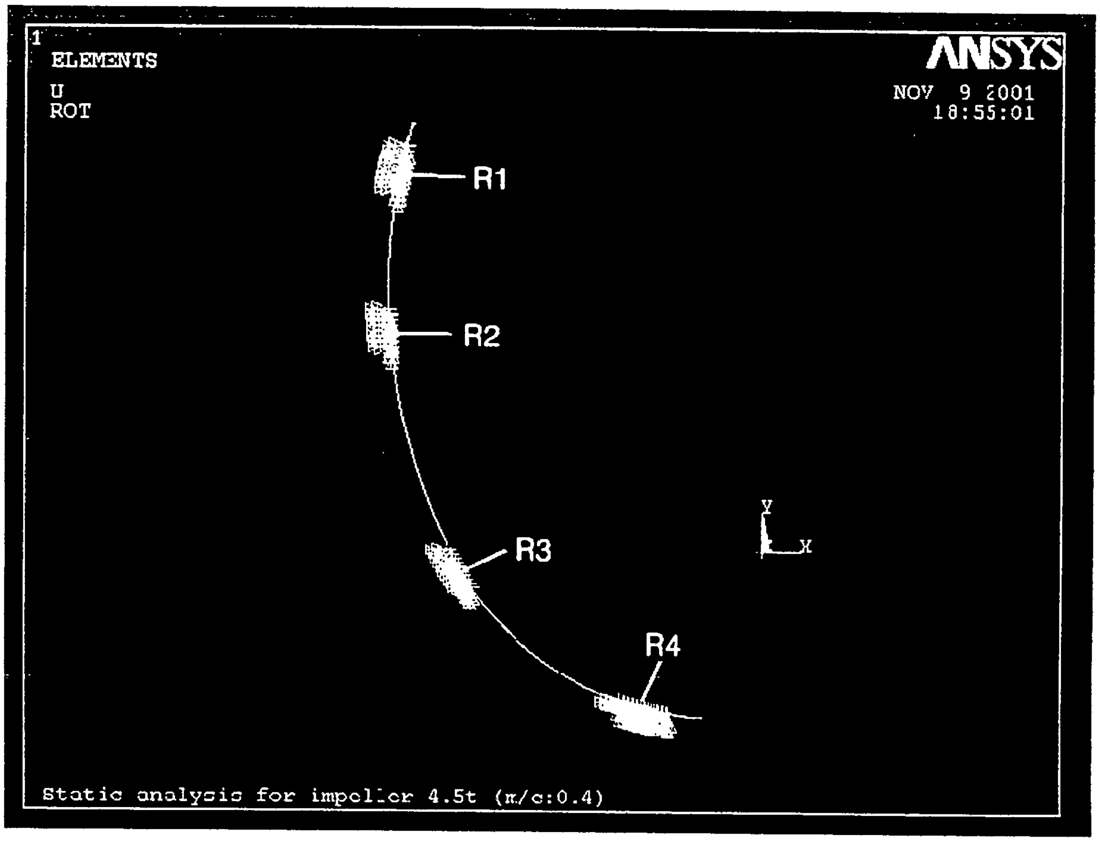


FIG. 6a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R2
R3
R4
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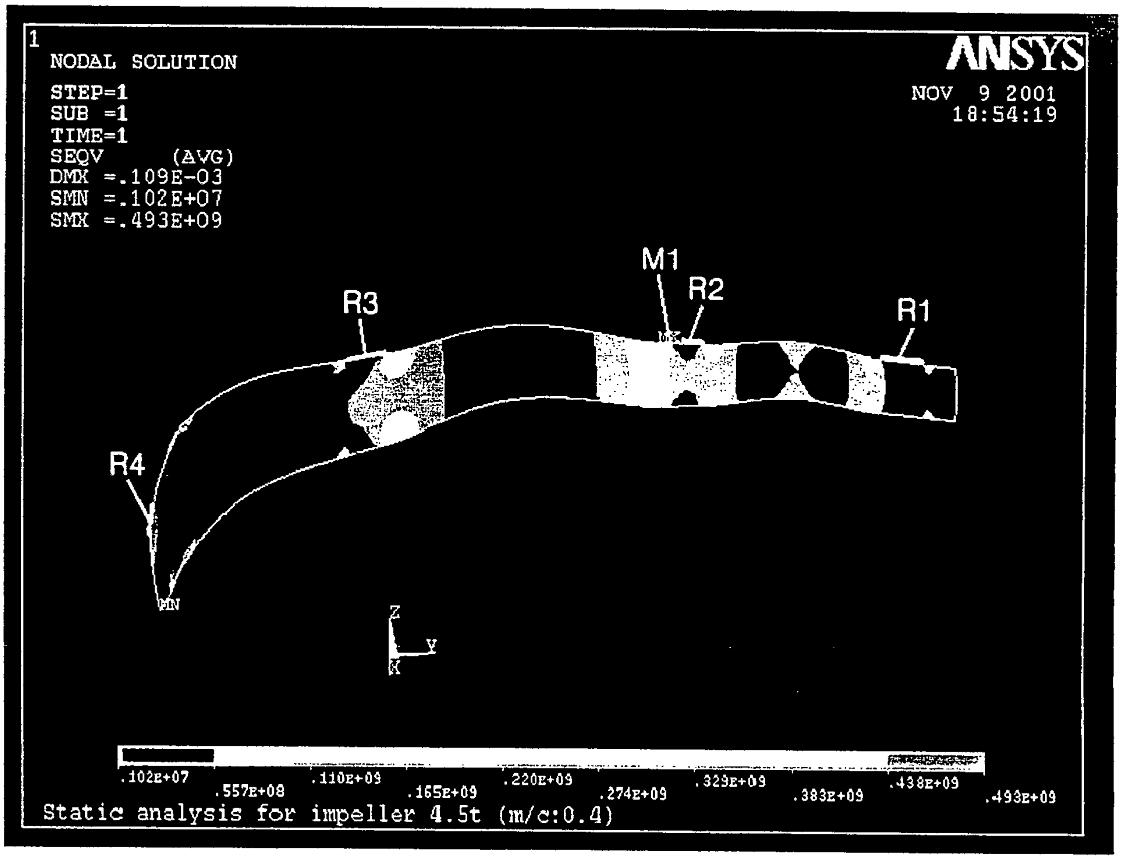
FIG. 6b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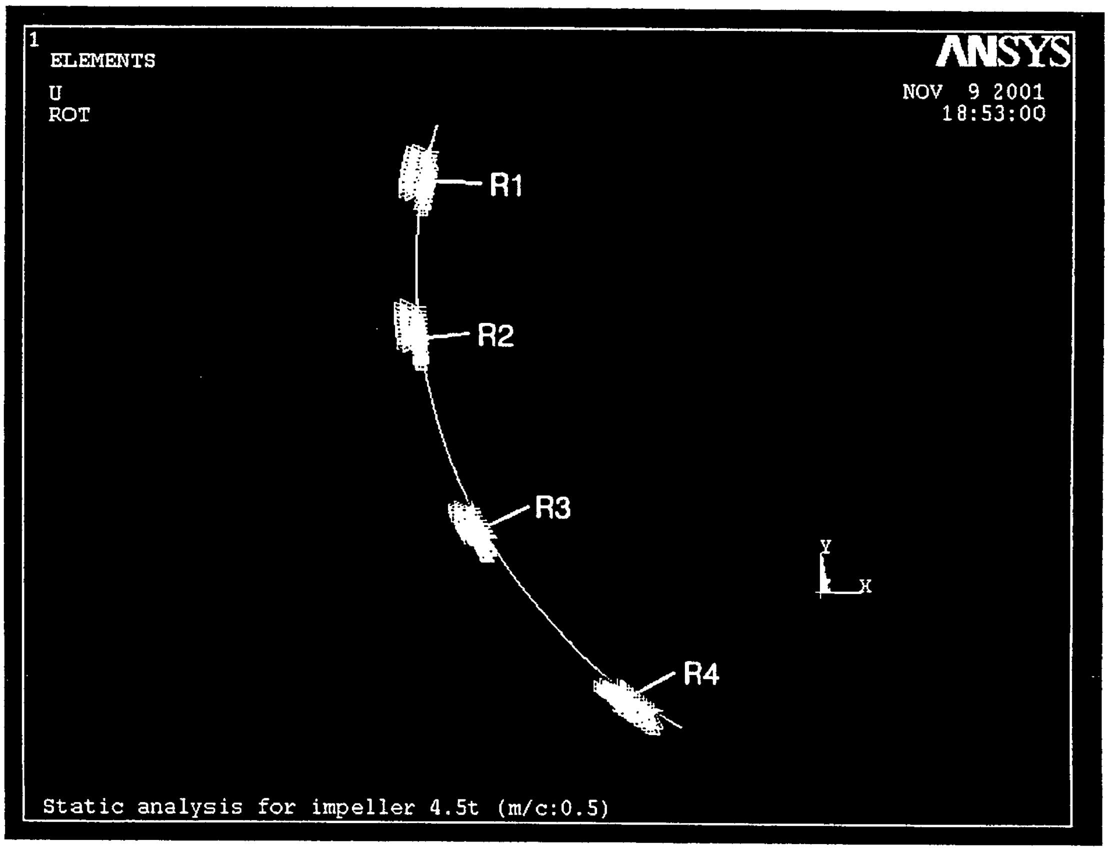
Static analysis for impeller 4.5t (m/c:0.4)

FIG. 7a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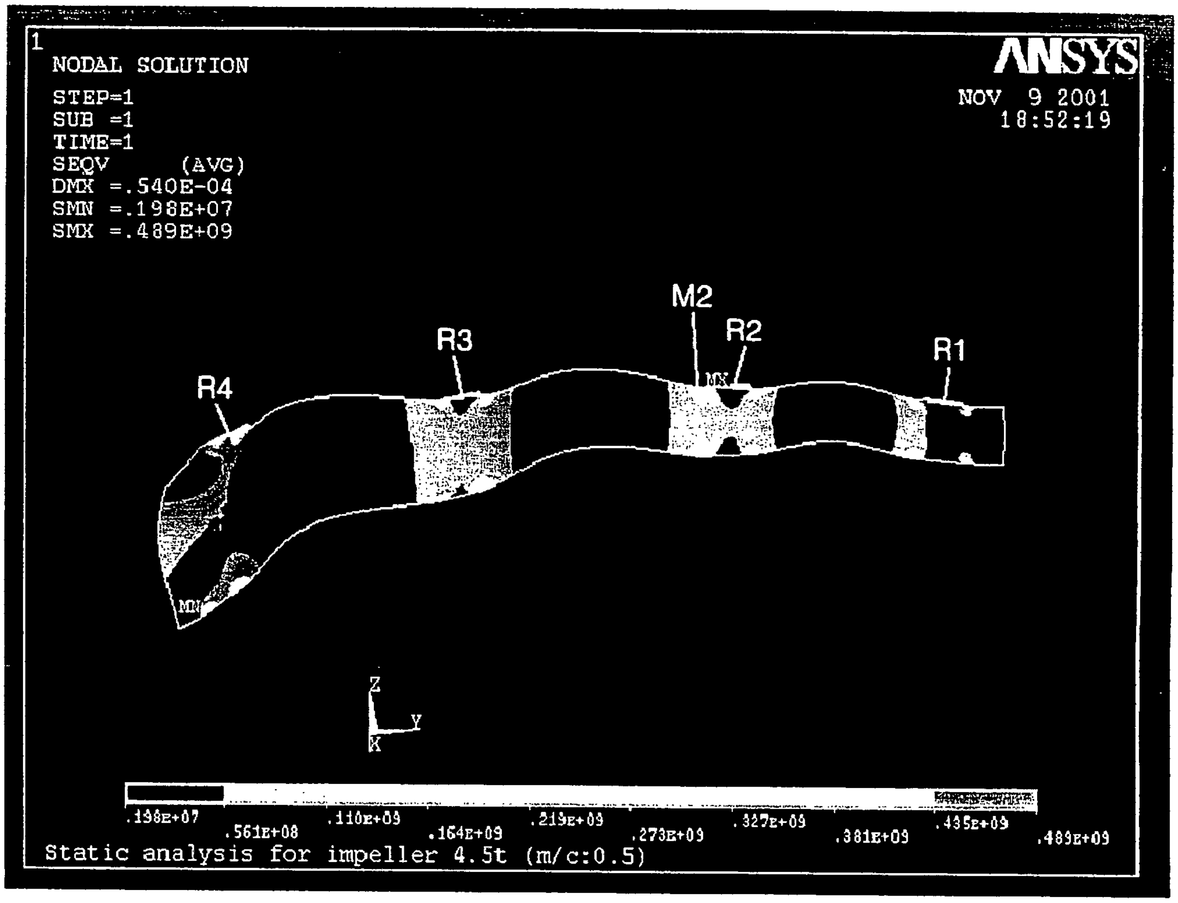
Static analysis for impeller 4.5t (m/c:0.5)

FIG. 7b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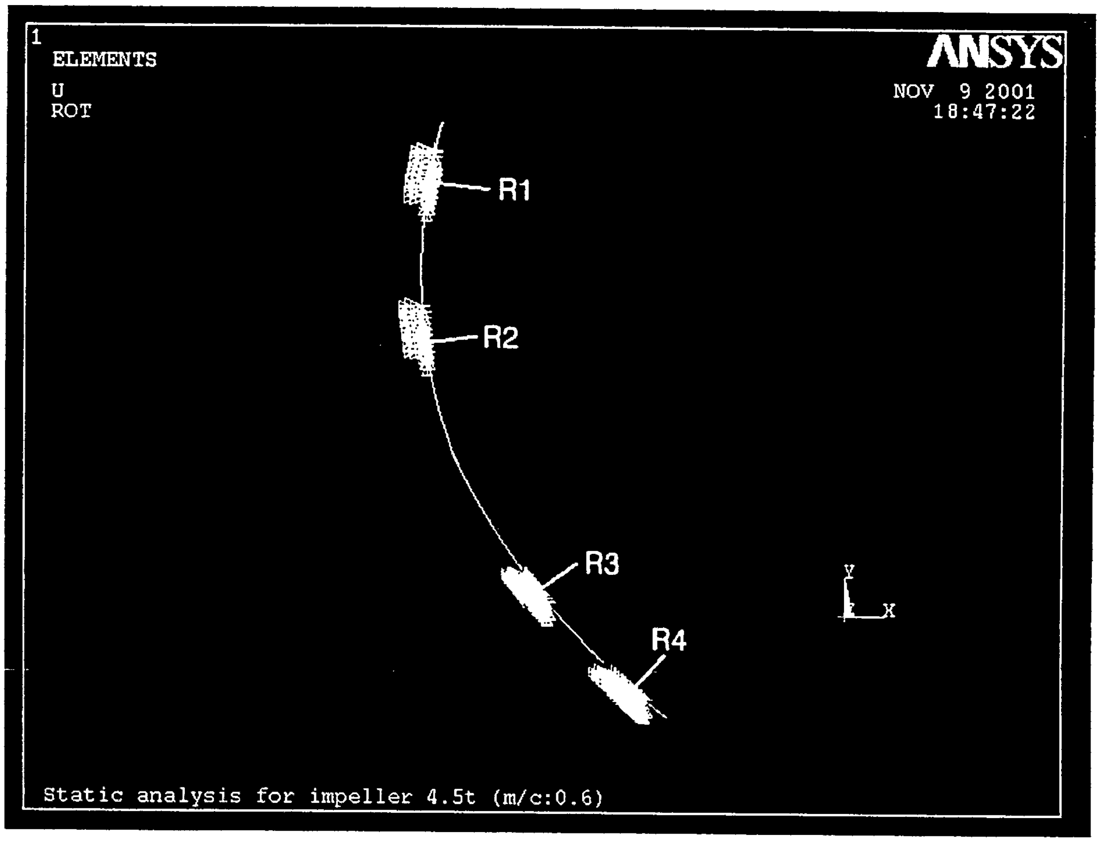
Static analysis for impeller 4.5t (m/c:0.5)

FIG. 8a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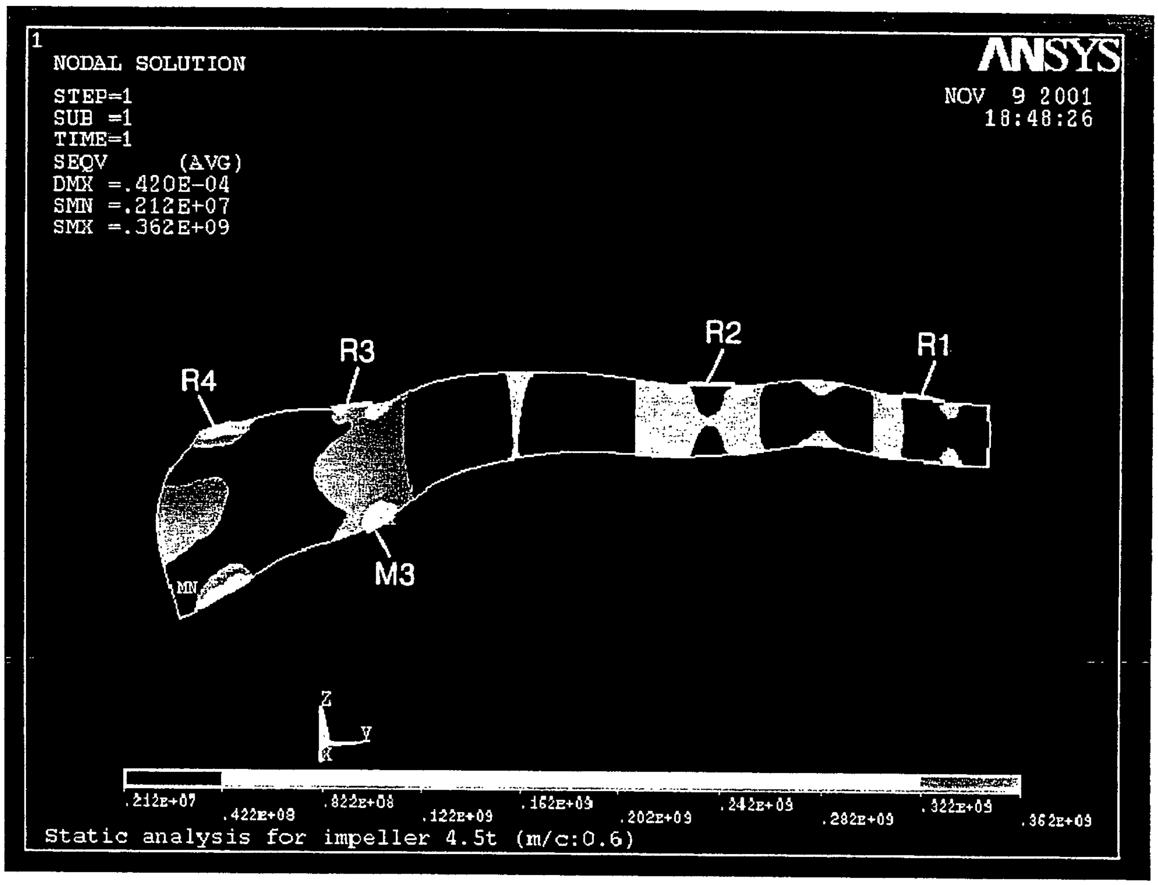
Static analysis for impeller 4.5t (m/c:0.6)

FIG. 8b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Static analysis for impeller 4.5t (m/c:0.6)