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Giancola

(54) **ADJUSTABLE PROFILE SANDING AND DUST REMOVAL METHOD AND APPARATUS**

(71) Applicant: **Attilio Giancola**, Hamilton (CA)

(72) Inventor: **Attilio Giancola**, Hamilton (CA)

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(57) **ABSTRACT**

The present invention provides a means to increase the efficacy of the sanding of surfaces of contoured or other complex geometries as often found in automotive panels undergoing collision repair. In particular, the present invention provides a means to achieve a flat, convex, or concave sanding surface as required by the site of the work and as adjusted by the operator. Additionally, dust removal facility means are provided for the adjustable profile sander allowing the operator to reduce the release of fine particulates in the immediate work environment. The application of the present invention reduces the occurrence of secondary damage arising from the action of sanding through its surface contour adaptability while also reducing the number of sanding passes required to achieve the level of smoothness desired. Further, the safety of the operator is enhanced through the removal of potentially harmful particulates at the site of the work as generated during the operation of sanding.

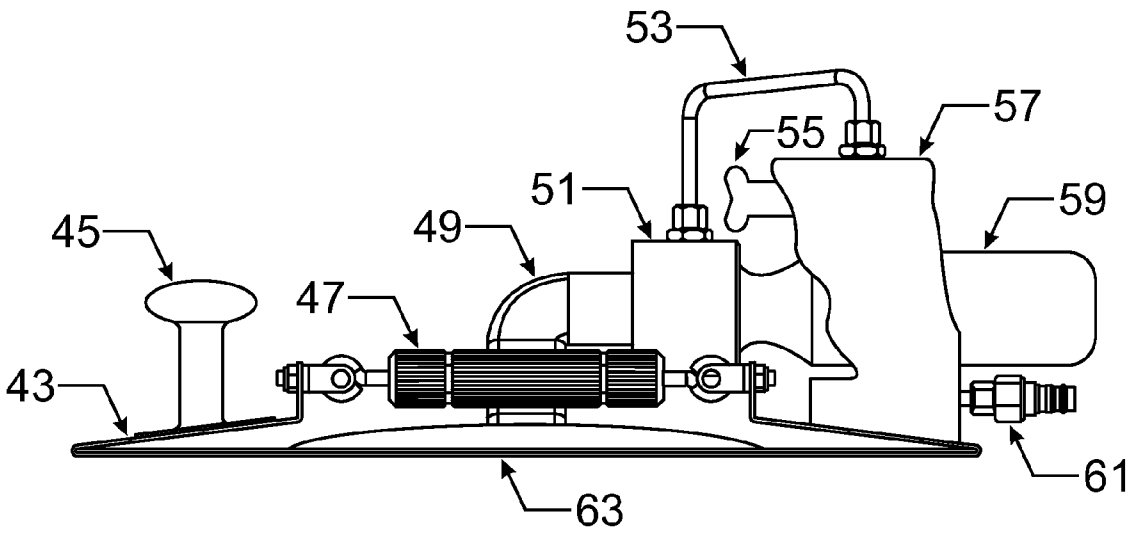


FIGURE 1

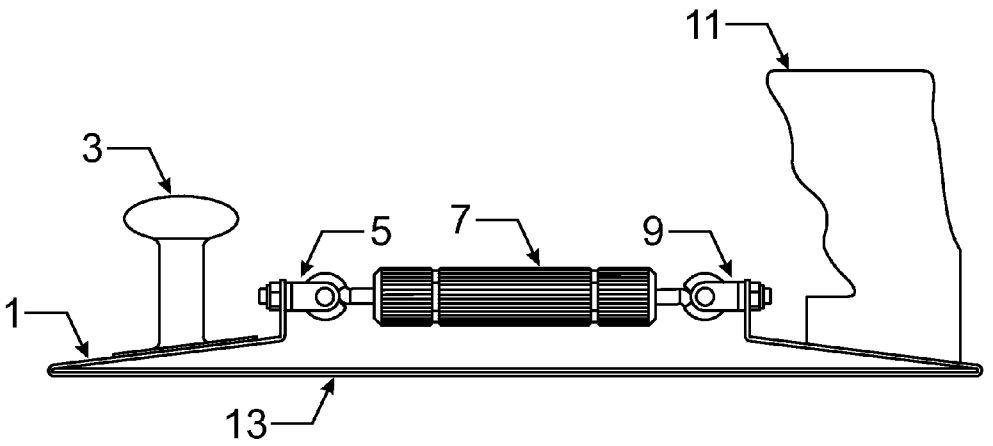


FIGURE 2

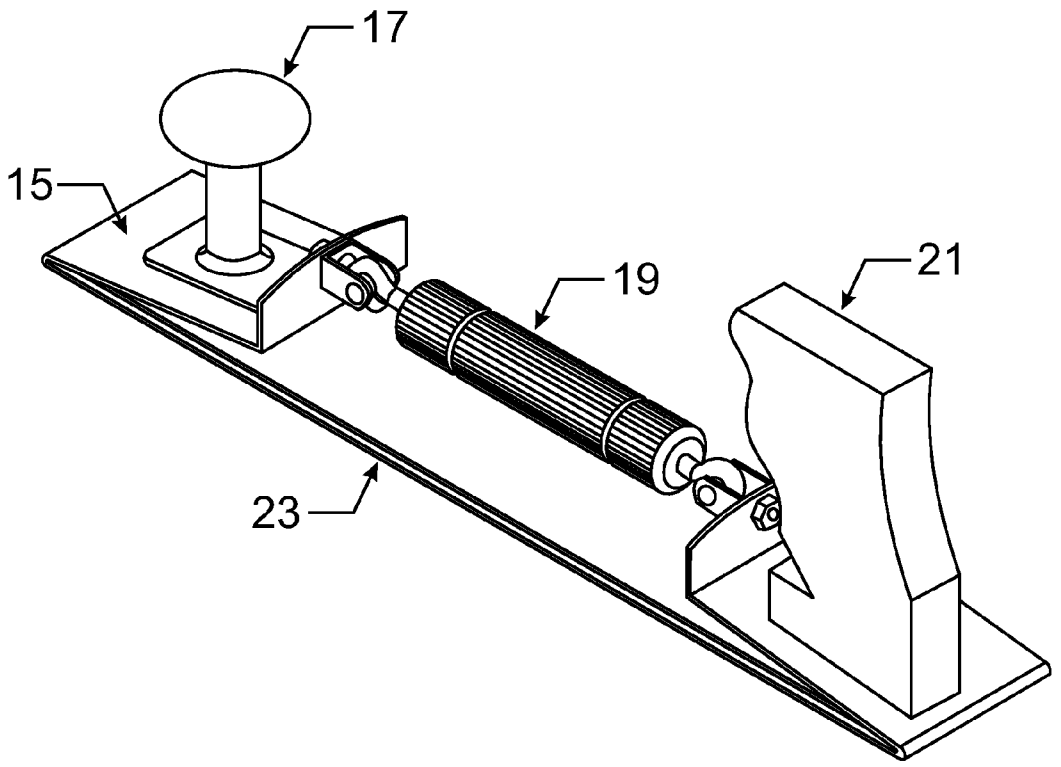


FIGURE 3

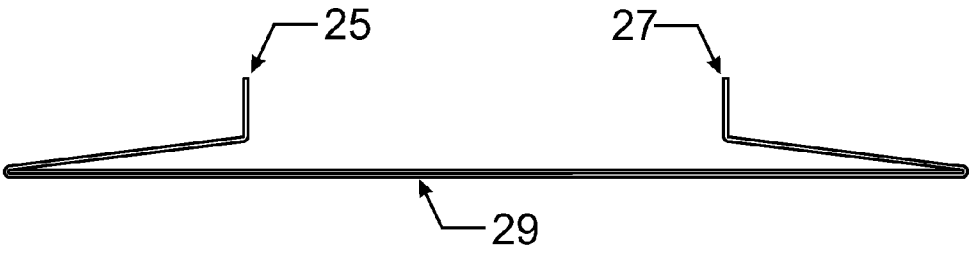


FIGURE 4

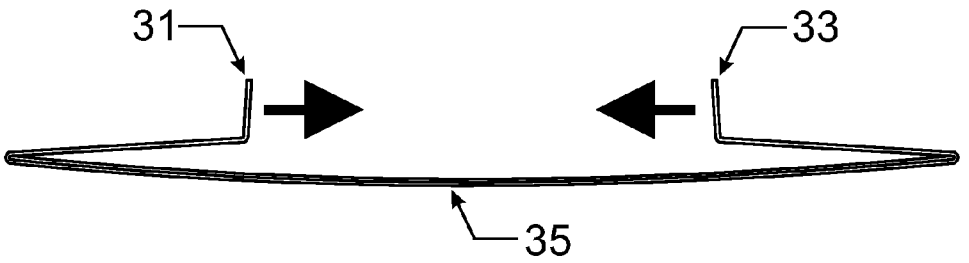


FIGURE 5

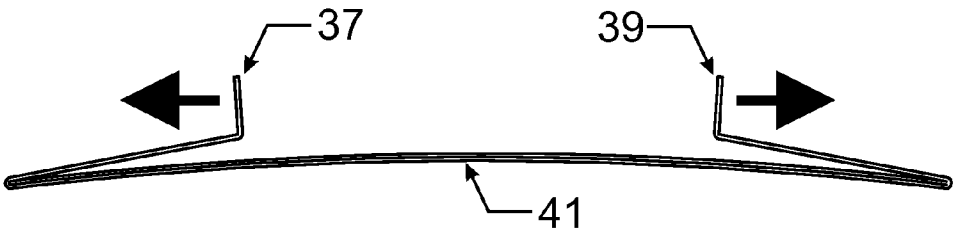


FIGURE 6

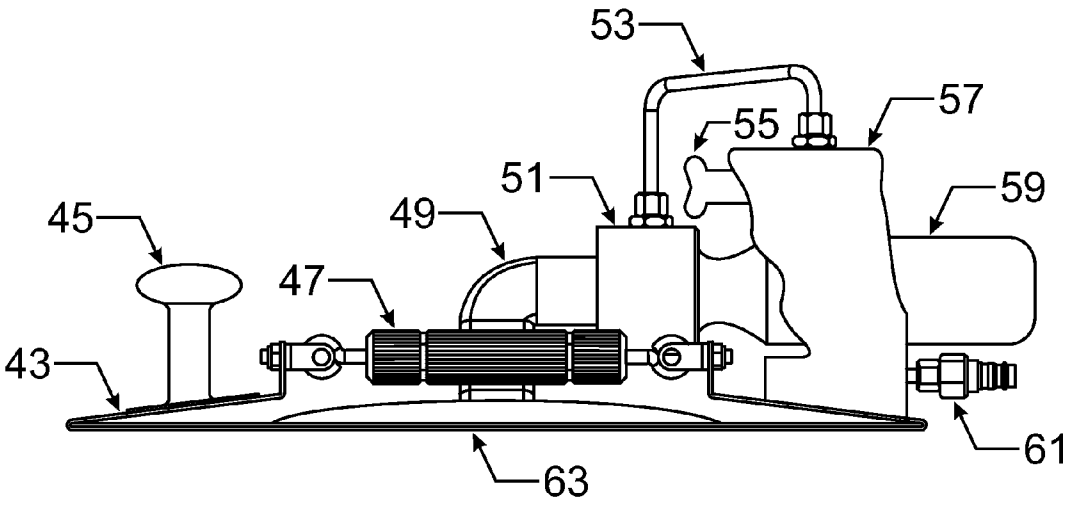


FIGURE 7

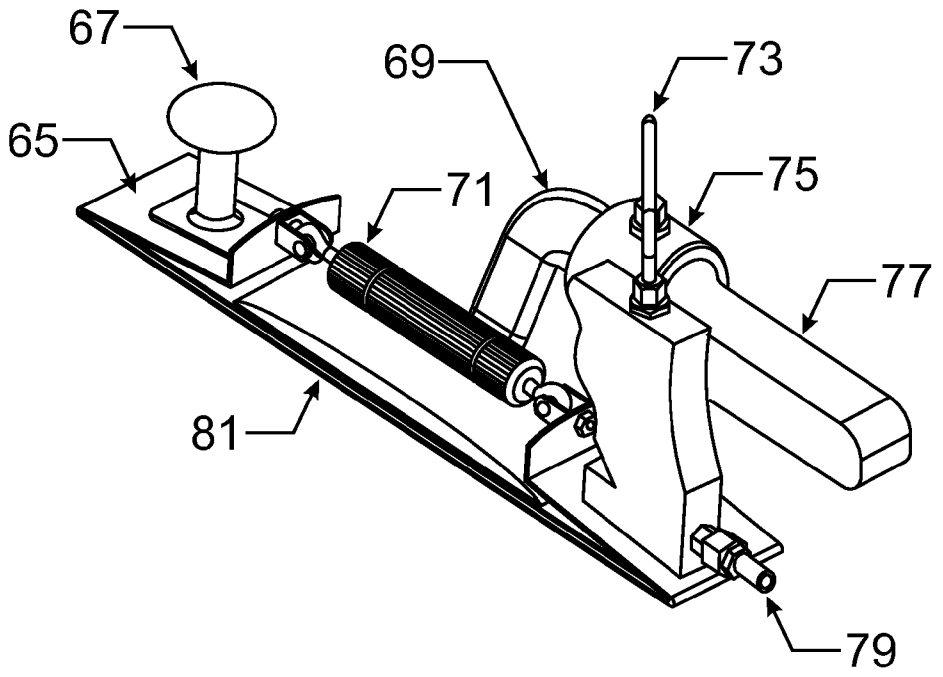
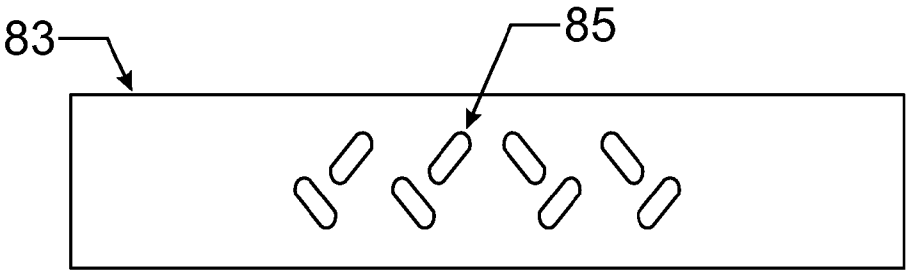


FIGURE 8



ADJUSTABLE PROFILE SANDING AND DUST REMOVAL METHOD AND APPARATUS

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention generally relates to surface smoothing technologies providing sanding means for contoured surfaces. Specifically, the present invention relates to methods and apparatus employed to enhance surface smoothness of contoured automotive panels in preparation for paint application in the automotive collision repair environment. The application of the present invention for surface smoothing is appropriate where the profile of the intended work surface is of contoured geometry. This invention finds particular application in the surface smoothing of the complex contours of modern automobile surfaces where adjustability of the contour of the contact surface of the sanding apparatus is desirable. Additionally, the application of the dust removal facility of the present application is appropriate where the reduction or elimination of fine particulates in the immediate work environment, arising from the action of surface smoothing, is desirable.

[0003] 2. Description of the Prior Art

[0004] Prior art embodiments of sanding apparatus provide rigid flat work side surfaces for the action of surface smoothing. Such devices are generally used for the smoothing of a variety of work surface geometries wherein any increase in the complexity of surface geometry significantly reduces the efficacy of application. Due to the limitations of applying a flat surface in the process of smoothing a contoured surface, the operator is often unable to achieve full contact with the work surface thereby increasing the number of passes required to perform the action of surface smoothing. Additionally, the operator is often unable to negotiate concave surfaces with a flat sanding surface thereby leading to secondary damage arising from the action of repair requiring further corrective actions to be undertaken at the site of the work. The high rate of passes in combination with corrective measures generally required to perform contoured surface smoothing using prior art embodiments negatively impacts the overall efficiency of the automotive collision repair process. Additionally, the fine particulates released into the work environment during the action of surface smoothing often threaten the safety and health of the operator.

SUMMARY OF THE INVENTION

[0005] The present invention allows the operator to adjust the surface contour of the smoothing surface of the sanding tool as required by the geometry of the work. In particular, the operator is able to set the concavity or convexity of the sanding surface as desired and the apparatus retains said adjusted surface contour until readjustment is provided by the operator. In setting a concave sanding surface contour, the operator is able to apply the apparatus at the site of convex work surfaces without threat of damage at the contact surface edges. In setting a convex sanding surface contour, the operator is able to apply the apparatus at the site of concave work surfaces thereby greatly increasing the contact area and thus reducing the number of passes required to achieve the action of smoothing. With the use of the dust removal facility of the present invention, the operator is able to significantly reduce the release of potentially dangerous fine particulates into the work environment arising from the action of surface smoothing. The application of the present invention increases efficiency of surface smoothing, particularly for surfaces of complex geometry, while enhancing the safety of the operator thereby providing a method and apparatus generally free of the deficiencies of the prior art.

BRIEF DESCRIPTION OF DRAWINGS

[0006] FIG. **1** is a side view of an embodiment of an adjustable profile sanding apparatus.

[0007] FIG. **2** is an isometric view of an embodiment of an adjustable profile sanding apparatus.

[0008] FIG. **3** is a side view of an embodiment of the body element of an adjustable profile sanding apparatus.

[0009] FIG. **4** is a side view of an embodiment of the body element of an adjustable profile sanding apparatus adjusted for concave work surfaces.

[0010] FIG. **5** is a side view of an embodiment of the body element of an adjustable profile sanding apparatus adjusted for convex work surfaces.

[0011] FIG. **6** is a side view of an embodiment of an adjustable profile sanding apparatus with integrated dust removal facility.

[0012] FIG. **7** is an isometric view of an embodiment of an adjustable profile sanding apparatus with integrated dust removal facility.

[0013] FIG. **8** is bottom view of an embodiment of an adjustable profile sanding apparatus with integrated dust removal facility.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0014] In order to better understand the embodiment of the present invention, an embodiment of the adjustable profile sanding apparatus will be described with reference to FIGS. **1** through **5**. An embodiment of an adjustable profile sanding apparatus is provided as in FIG. **1** comprised of a flexible body element **1**, a first grip handle **3**, a first turnbuckle engagement point **5**, a turnbuckle **7**, a second turnbuckle engagement point **9**, a second grip handle **11**, and a work contact surface **13**. Operation of said turnbuckle **7** provides either expansion or contraction stresses, as adjusted by the operator, at turnbuckle engagement points **5** and **9** thereby causing concave or convex deformation of work contact surface **13** as required by the work. It is understood that the configuration and geometry of grip handles **3** and **11** is variable based on application, size, and ergonomic requirements and that variation of such does not constitute a departure from the spirit of the present invention. Sandpaper is attached to the work contact surface **13** in order to facilitate the action of surface smoothing under operation of the apparatus. The attachment of sandpaper to said work contact surface **13** may be accomplished by a variety of methods such as those provided by mechanical, Velcro, or adhesive means.

[0015] Another view of an embodiment of an adjustable profile sanding apparatus is provided as in FIG. **2**. A flexible body element **15** is provided with a work contact surface **23**. Grip handles **17** and **21** are rigidly connected to upper surfaces of said flexible body element **15**, provided for ease of handling by the operator of the apparatus. A turnbuckle **19** is provided to deliver expansion or contraction facility, as adjusted by the operator, in order to provide convex or concave deformity of said work contact surface **23** as required by the work.

[0016] An embodiment of the flexible body element of an adjustable profile sanding apparatus is provided as in FIG. **3**. Said flexible body element is provided with static force delivery edges **25** and **27** to be engaged by a static force delivery mechanism such as that provided by the turnbuckle described in FIGS. **1** and **2**. Said flexible body element is shown in an unstressed condition wherein the work contact surface **29** remains flat.

[0017] An embodiment of the flexible body element of an adjustable profile sanding apparatus is provided as in FIG. **4**. Said flexible body element is provided with static force delivery edges **31** and **33** to be engaged by a static force delivery mechanism such as that provided by the turnbuckle described in FIGS. **1** and **2**. Said flexible body element is shown in contraction stress condition, as indicated by the arrows, wherein the work contact surface **35** takes on a convex aspect.

[0018] An embodiment of the flexible body element of an adjustable profile sanding apparatus is provided as in FIG. **5**. Said flexible body element is provided with static force delivery edges **37** and **39** to be engaged by a static force delivery mechanism such as that provided by the turnbuckle described in FIGS. **1** and **2**. Said flexible body element is shown in expansion stress condition, as indicated by the arrows, wherein the work contact surface **41** takes on a concave aspect.

[0019] An embodiment of an adjustable profile sanding apparatus with integrated dust removal facility is provided as in FIG. **6**. Said apparatus is comprised of a flexible body element **43**, a first grip handle **45**, a turnbuckle **47**, a second grip handle **57**, and a work contact surface **63** similar to the embodiment of FIG. **1**. Said apparatus is further provided with a vacuum channel **49**, a vacuum chamber **51**, air delivery duct **53**, vacuum trigger **55**, air inlet **61**, and dust bag **59** providing dust removal facility to said apparatus. The dust removal path follows the removal of dust at the work contact surface **63** through vacuum channel **49** and through vacuum chamber **51** to be collected in dust bag **59**. Air intake is provided at air inlet **61** following a path via air duct through second grip handle **57** and through air delivery duct **53** and directed through vacuum chamber **51** and further returned to the environment through pores in said dust bag **59**. Said air inlet **61** is configured to engage air compressor fittings as commonly available in the shop of the technician. A vacuum is created at the work contact surface **63** by the rapid flow of air through the path as described above. The engagement of the dust removal facility is controlled by vacuum trigger **55**.

[0020] Another view of an embodiment of an adjustable profile sanding apparatus with integrated dust removal facility is provided as in FIG. **7**. Said apparatus is comprised of a flexible body element **65**, a grip handle **67**, a turnbuckle **71**, and a work contact surface **81** as in FIG. **6**. Said apparatus is further provided with a vacuum channel **69**, a vacuum chamber **75**, air delivery duct **73**, air inlet **79**, and dust bag **77** illustrating the relative position of dust removal components for ease of operation of the composite assembly.

[0021] A bottom view of an embodiment of an adjustable profile sanding apparatus with integrated dust removal facility is provided as in FIG. **8**. A work contact surface **83** is illustrated with perforations such as perforation **85** in order to provide a dust removal path at work contact surface **83**. It is understood that any sandpaper attached to work contact surface **83** would be of similar configuration in order to allow the movement of dust away from the site of the work. It is also understood that the pattern of perforations may vary considerably without departing from the spirit of the present invention.

I claim as my invention:

1. An adjustable profile sanding apparatus comprising:
(a) a flexible body element;
(b) handle components;
(c) an adjustable expansion and contraction component.

2. An adjustable profile sanding apparatus as in claim **1**, wherein said flexible body element is equipped with a work contact surface.

3. An adjustable profile sanding apparatus as in claim **1**, wherein said flexible body element has handle components on its upper surface for ease of handling during the operation of sanding.

4. An adjustable profile sanding apparatus as in claim **1**, wherein said flexible body element is equipped to engage said adjustable expansion and contraction component.

5. An adjustable profile sanding apparatus as in claim **2**, wherein said work contact surface is configured for the attachment of sandpaper for the operation of sanding.

6. An adjustable profile sanding apparatus as in claim **4**, wherein said engaged adjustable expansion and contraction component may be expanded or extended to achieve a concave aspect of the work contact surface of said flexible body element as required by the contours of the work.

7. An adjustable profile sanding apparatus as in claim **4**, wherein said engaged adjustable expansion and contraction component may be contracted to achieve a convex aspect of the work contact surface of said flexible body element as required by the contours of the work.

8. An adjustable profile sanding apparatus with integrated dust removal facility comprising:
(a) a flexible body element;
(b) handle components;
(c) an adjustable expansion and contraction component;
(d) a vacuum chamber;
(e) a vacuum path;
(f) an air intake;
(g) an airflow path;
(h) a dust bag;
(i) an operation trigger.

9. An adjustable profile sanding apparatus with integrated dust removal facility as in claim **8**, wherein said flexible body element is equipped with a work contact surface which has openings to permit the passage of dust through the system.

10. An adjustable profile sanding apparatus with integrated dust removal facility as in claim **8**, wherein said flexible body element has handle components on its upper surface for ease of handling during the operation of sanding.

11. An adjustable profile sanding apparatus with integrated dust removal facility as in claim **8**, wherein said flexible body element is equipped to engage said adjustable expansion and contraction component.

12. An adjustable profile sanding apparatus with integrated dust removal facility as in claim **9**, wherein said work contact surface is configured for the attachment of sandpaper for the operation of sanding and wherein said sandpaper has openings similar to those on said work contact surface to permit the passage of dust through the system.

13. An adjustable profile sanding apparatus with integrated dust removal facility as in claim **11**, wherein said engaged adjustable expansion and contraction component may be

expanded or extended to achieve a concave aspect of the work contact surface of said flexible body element as required by the contours of the work.

14. An adjustable profile sanding apparatus with integrated dust removal facility as in claim **11**, wherein said engaged adjustable expansion and contraction component may be contracted to achieve a convex aspect of the work contact surface of said flexible body element as required by the contours of the work.

15. An adjustable profile sanding apparatus with integrated dust removal facility as in claim **8**, wherein said vacuum path removes dust from the work contact surface of the flexible body element and passes through the vacuum chamber for delivery of collected dust in the dust bag.

16. An adjustable profile sanding apparatus with integrated dust removal facility as in claim **8**, wherein said air flow path provides flow of air from said air inlet through said vacuum chamber and out through pores in said dust bag thereby creating the flow required to produce the vacuum as desired at the work contact surface of said flexible body element and as controlled by said operation trigger.

17. An adjustable profile sanding apparatus with integrated dust removal facility as in claim **8**, wherein said air inlet is configured to accept compressed air sources such as those generally available to the technician in an automotive collision repair environment.

18. An adjustable profile sanding method comprising:

(a) an adjustable profile sanding apparatus;

(b) an adjustable profile sanding apparatus with integrated dust removal facility.

19. An adjustable profile sanding method as in claim **18**, wherein said adjustable profile sanding apparatus may be adjusted such that its work contact surface is flat, concave, or convex as required by the geometry of the site of the work.

20. An adjustable profile sanding method as in claim **18**, wherein said adjustable profile sanding apparatus with integrated dust removal facility may be adjusted such that its work contact surface is flat, concave, or convex as required by the geometry of the site of the work and where the dust removal facility may be engaged as deemed necessary by the operator due to the generation of particulates under sanding operation.

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