

1 **Patent Application of**

2 **Mark S. Gordon**

3 **for**

4 **GRIPPER FOR MANIPULATING PLANAR WORKPIECE IN TIGHT-FITTING RECEPTACLE**

5  
6 **CROSS REFERENCES TO RELATED APPLICATIONS**

7 This application is a continuation-in-part of application number 14986093.

8 **STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH AND DEVELOPMENT:**

9 Not applicable to this application.

10 **FIELD OF THE INVENTION**

11 The present invention relates to a gripper for manipulating planar workpieces that reside  
12 temporarily during use in a tight-fitting slot or receptacle. This temporary aspect of planar  
13 workpiece use means that they must be installed, manipulated, and/or removed with some  
14 regularity.

15 **BACKGROUND OF THE INVENTION**

16 Planar workpieces whose effective operation requires that they be housed in a tight-fitting  
17 receptacle can be difficult to install in, manipulate in, or remove from such a receptacle. Various  
18 fields of endeavor utilize or can utilize such planar workpieces including but not limited to  
19 technology component or subsystem hardware, medicine, the residential and commercial  
20 building trades, and manufacturing or industrial machinery. These planar workpieces could  
21 include, for example, boards bearing electronic components, medical or surgical objects or  
22 components, filter elements, and machinery components or subsystems.

23 One such application of a planar workpiece in a tight receptacle is the filter utilized in a  
24 commercial or residential forced air heating, ventilating, and air conditioning (HVAC) system. In  
25 this case the filter is an example of a planar workpiece and the slot holding the filter is an  
26 example of a tight-fitting receptacle. These replaceable filters remove particulate objects from  
27 recirculated air during operation. These filters are removed, discarded or cleaned, and then  
28 replaced on a regular basis because they become clogged with particulate matter. Such a filter  
29 is installed in a slot or receptacle that by design: 1) has little or no space or gap between the  
30 filter and the slot, 2) is sized so that when the filter is fully installed the filter top is recessed  
31 below or level with the receptacle frame edge and the frame outer edges and filter outer edges

1 overlap, 1) and 2) together helping to ensure that all recirculated air containing particles to be  
2 removed must pass through the filter and not around it through any gaps at the edges of the  
3 filter. This placement of the filter (planar workpiece) such that its top is recessed below or level  
4 with the receptacle frame edge represents the proper operational location for such a planar  
5 workpiece.

6 These filters are planar in shape, typically square or rectangular, and vary in size from a  
7 minimum of about 9 by 9 inches to over 25 by 25 inches. One commonly used type of HVAC  
8 filter is 1 inch thick. HVAC filters are often manufactured of cardboard or another semi-rigid  
9 material for a frame and of filtration materials including but not limited to fiberglass, paper, foam,  
10 polyester, cloth, etc.

11 While in use HVAC filters often become deformed due to the pressure of air passing through  
12 them. This deformation process may be hastened if a filter is not replaced after it becomes  
13 clogged.

14 The slot or receptacle that holds an HVAC filter is an integral part of an air handling system  
15 comprising ducts typically fabricated from sheet metal at the point holding the filter. These slots  
16 are typically installed manually by an HVAC technician during the HVAC system installation  
17 process. The result is variation in the precise width, depth and thickness of slots that are  
18 ostensibly the same size. In other words some slots designed for a 20X20X1 inch filter will be a  
19 tight fit along the edges for a filter of that size, others will be just right, while others will fit  
20 loosely. In addition, since the depth of the slot may vary, a filter may drop to the bottom of the  
21 filter slot and be below the outer edge of the air handling duct of which the slot is a part, making  
22 access for the purpose of filter removal difficult.

23 As a result, the installation and/or removal of HVAC filters can be difficult for one or more of  
24 the following reasons:

- 25 a. The fit between filter and filter slot may be tight, making it difficult to push the filter  
26 into the slot on installation and pull the filter from the slot on removal.
- 27 b. The outer edge of the filter may, when fully installed in the slot, be below the outer  
28 edge of the duct containing the filter slot, making it impossible to access the edges of  
29 the filter with human fingers during the removal process.
- 30 c. The filter may have become deformed during use, making it impossible to access the  
31 edges of the filter with human fingers during the removal process and/or difficult to  
32 remove due to the deformation.

- 1 d. The gap between the edges of the filter and the edges of the filter slot may be too  
2 small to permit human fingers or a tool such as pliers to grasp the filter during the  
3 removal process.
- 4 e. The space above and/or around the filter slot through which a filter being installed or  
5 removed must pass may be difficult to access with human hands due to its location  
6 or may be partially obstructed by system components such as air ducts and/or gas or  
7 electrical lines.

8 The same difficulties discussed above for the HVAC filter example apply to other  
9 applications that utilize planar workpieces in tight-fitting slots.

#### 10 SUMMARY OF THE INVENTION

11 The present invention relates to hand tools used for the insertion and/or removal of a planar  
12 workpiece from a slot or receptacle in which the planar workpiece fits tightly. A particular  
13 embodiment of the device is a tong-like or clamp-like apparatus with two arms pivoting at a  
14 single point near their longitudinal center, a comfortable, ergonomically-designed handle at one  
15 end of each of the arms, jaws for gripping the planar workpiece at the other end of the arms, a  
16 spring that biases the jaws toward the closed position, and an optional adjustment mechanism  
17 capable of setting the gap between the jaws.

18 The description herein, including the use of HVAC filter elements as an example, is solely  
19 for orientation and ease of understanding and neither this summary nor any of the terms or  
20 phraseology used herein should be construed as limiting. Additional features, advantages and  
21 embodiments of the present invention will be presented hereinafter and will form the basis for  
22 the claims appended hereto. It is to be understood that the present invention is not limited by  
23 the descriptions or drawings of embodiments presented hereinafter.

#### 24 BRIEF DESCRIPTION OF THE DRAWINGS

25 FIG 1. is a top perspective view of one embodiment of the present invention.

26 FIG 2. is a bottom perspective view of one embodiment of the present invention.

27 FIG 3. is a side view of one embodiment of the present invention.

28 FIG 4. is a top view of one embodiment of the present invention.

29 FIG 5. is a bottom view of one embodiment of the present invention.

30 FIG 6. is a side sectional view of one embodiment of the present invention in use.

- 1 FIG 7. is a top perspective view of another embodiment of the present invention.
- 2 FIG 8. is a bottom perspective view of another embodiment of the present invention.
- 3 FIG 9. is a side sectional view of another embodiment of the present invention in use.
- 4 FIG 10. is a top perspective view of a further embodiment of the present invention.
- 5 FIG 11. is a bottom perspective view of a further embodiment of the present invention.
- 6 FIG 12. is a side view of a further embodiment of the present invention.
- 7 FIG 13. is a top view of a further embodiment of the present invention.
- 8 FIG 14. is a side sectional view of a further embodiment of the present invention in use.
- 9 FIG 15. is a top perspective view of a further embodiment of the present invention.
- 10 FIG 16. is a bottom perspective view of a further embodiment of the present invention.
- 11 FIG 17. is a side sectional view of a further embodiment of the present invention in use.

12 DRAWINGS – REFERENCE NUMERALS

<b>Drawing</b>	<b>Reference Numeral</b>	<b>Name</b>
1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	102	first arm
1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	104	second arm
1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	106	first handle end
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	107	second handle end
1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	108	first handle
1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	110	second handle
1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17	111	first linkage extension
1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	112	first middle portion
1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17	113	second middle portion
1, 3, 4, 6, 7, 9, 10, 12, 13, 14, 15, 17	114	first jaw end
2, 3, 5, 6, 9, 11, 12, 14, 17	115	second jaw end
1, 2, 3, 4, 6, 10, 11, 12, 13, 14	116	first jaw
1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17	117	second linkage extension
1, 2, 3, 5, 6, 10, 11, 12, 14	118	second jaw
1, 4, 10, 13	119	first jaw insertion limit line
1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17	120	spring arm
1, 2, 3, 10, 11, 12	121	first jaw leading edge
1, 2, 7, 8, 10, 11, 15, 16	122	spring
1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17	124	pivot pin
1, 3, 4, 6, 7, 9	126	jaw gap adjuster
1, 7	128	adjuster hole
1, 3, 6, 7, 9	130	second threaded sleeve
1, 3, 6, 10, 12, 14	132	second gripping surface
1, 2, 3, 4, 5, 6, 10, 11, 12, 13, 14	134	outer surface
1, 2, 3, 10, 11, 12	136	second jaw leading edge
2, 3, 6, 8, 9	202	first threaded sleeve
2, 5, 11	204	second jaw insertion limit line

<b>Drawing</b>	<b>Reference Numeral</b>	<b>Name</b>
2, 3, 6, 11, 12, 14	206	first gripping surface
6, 9, 14, 17	602	planar workpiece
6, 9, 14, 17	604	receptacle
6, 9, 14, 17	606	receptacle frame
6, 9, 14, 17	608	receptacle frame edge
7, 8, 9, 15, 16, 17	702	first offset jaw
7, 9, 15, 17	704	second offset jaw
7, 8, 15, 16	706	first offset jaw top step
7, 8, 15, 16	708	first offset jaw riser
7, 8, 15, 16	710	first jaw
7, 15	712	first jaw insertion limit line
7, 8, 15, 16	714	second offset jaw top step
7, 8, 15, 16	716	second offset jaw riser
7, 8, 15, 16	718	second jaw
7, 9, 15, 17	720	second gripping surface
7, 15	722	second jaw leading edge
8, 9, 16, 17	802	first gripping surface
8, 16	804	first jaw leading edge
8, 16	806	second jaw insertion limit line

1

1 DETAILED DESCRIPTION OF THE FIRST EMBODIMENT

2 A. Overview of the First Embodiment

3 As depicted in FIGS. 1 through 6, one embodiment of a gripper comprises a first arm **102**  
4 that extends from a first handle end **106** through a first handle **108** and a first middle portion **112**  
5 to a first jaw end **114**. Attached to the first jaw end **114** is a first jaw **116**. A second arm **104**  
6 extends from a second handle end **107** through a second handle **110** and a second middle  
7 portion **113** to a second jaw end **115**. Attached to the second jaw end **115** is a second jaw **118**.  
8 Protruding at approximately a right angle from the underside of the first middle portion **112** is a  
9 first linkage extension **111**. Protruding at approximately a right angle from the underside of the  
10 second middle portion **113** is a second linkage extension **117**. The first linkage extension **111**  
11 and the second linkage extension **117** partially overlap and are attached in this overlap area  
12 using a pivot pin **124** so that the first handle **108** and the second handle **110** can be actuated to  
13 vary the gap between the first jaw **116** and the second jaw **118**, permitting the operator to grasp  
14 and manipulate a planar workpiece **602**.

15 B. Detailed Description of the First Embodiment

16 As shown in FIG. 1 and FIG. 3, a first arm **102** extends from a first handle end **106** through a  
17 first handle **108** and a first middle portion **112** to a first jaw end **114**. Directly attached to the first  
18 jaw end **114** is a first jaw **116**. Protruding at approximately a right angle from the underside of  
19 the first middle portion **112** is a first linkage extension **111**.

20 As depicted in FIG. 1, the first jaw **116** extends parallel to the longitudinal axis of the first  
21 handle **108** from the first jaw end **114** in a direction opposite from the direction of the first arm  
22 **102** and laterally to either side of the first jaw end **114** so that the first jaw **116** forms a flat plate  
23 of uniform thickness. In this context the phrase “longitudinal axis of the first handle **108**” refers to  
24 a straight line drawn from substantially the lateral center of the first handle end **106** to  
25 substantially the lateral center of the first middle portion **112**, this line running parallel to the  
26 centerline of the first arm **102**, and “uniform” means a thickness variation across the plate  
27 surface of no more than approximately 10%. The edge of the first jaw **116** farthest from the first  
28 jaw end **114** is the first jaw leading edge **121**. The first jaw insertion limit line **119** is the endpoint  
29 for insertion of the first jaw **116** into the receptacle **604**. For the first embodiment the first jaw  
30 insertion limit line **119** is the forward attachment point of the first jaw **116** to the first jaw end  
31 **114**, “forward” meaning in a direction opposite to the first handle **108**. The insertion distance into  
32 the receptacle **604** of the first jaw **116** is the distance from the first jaw leading edge **121** to the

1 first jaw insertion limit line **119**, this insertion distance being represented in FIG. **1** by the letter  
2 **L**.

3 As illustrated in FIG. **2** and FIG. **3**, a second arm **104** extends from a second handle end  
4 **107** through a second handle **110** and a second middle portion **113** to a second jaw end **115**.  
5 Directly attached to the second jaw end **115** is a second jaw **118**. Protruding at approximately a  
6 right angle from the underside of the second middle portion **113** is a second linkage extension  
7 **117**.

8 As depicted in FIG. **2**, the second jaw **118** extends parallel to the longitudinal axis of the  
9 second handle **110** from the second jaw end **115** in a direction opposite from the direction of the  
10 second arm **104** and laterally to either side of the second jaw end **115** so that the second jaw  
11 **118** forms a flat plate of uniform thickness. In this context the phrase “longitudinal axis of the  
12 second handle **110**” refers to a straight line drawn from substantially the lateral center of the  
13 second handle end **107** to substantially the lateral center of the second middle portion **113**, this  
14 line running parallel to the centerline of the second arm **104**, and “uniform” means a thickness  
15 variation across the plate surface of no more than approximately 10%. The edge of the second  
16 jaw **118** farthest from the second jaw end **115** is the second jaw leading edge **136**. For the first  
17 embodiment the second jaw insertion limit line **204** is the forward attachment point of the  
18 second jaw **118** to the second jaw end **115**, “forward” meaning in a direction opposite to the  
19 second handle **110**. The insertion distance into the receptacle **604** of the second jaw **118** is the  
20 distance from the second jaw leading edge **136** to the second jaw insertion limit line **204**, this  
21 insertion distance being represented in FIG. **2** by the letter **L**.

22 First and second arms **102**, **104** may be formed of metal such as aluminum or steel, molded  
23 plastic, carbon fiber, or other materials. First and second arms **102**, **104** length is sufficient to  
24 operate comfortably with one hand, for example in this embodiment approximately six inches.  
25 First and second handles **108**, **110**, as shown in FIGS. **1** through **3**, may be ergonomically  
26 shaped. Other embodiments may use different materials of manufacture and/or different size  
27 and/or different shape configurations.

28 As depicted in FIGS. **1** through **3**, and FIG. **6**, the first linkage extension **111** and the second  
29 linkage extension **117** overlap and are attached in the overlap area by a pivot pin **124**.  
30 Connecting the first arm **102** and the second arm **104** in this manner permits an operator of this  
31 embodiment to alter the gap between the first jaw **116** and the second jaw **118** by actuating the  
32 first handle **108** and the second handle **110** and thereby operate in a tong-like fashion this  
33 apparatus. Though the first arm **102** and the second arm **104** are shown as unitary structures of

1 a particular shape in the referenced figures, they may be shaped differently in other  
2 embodiments and their representation herein should not be considered a limitation. Similarly,  
3 overlap and connection by the pivot pin **124** of the first linkage extension **111** and the second  
4 linkage extension **117** may be arranged differently in other embodiments and their presentation  
5 herein should not be considered a limitation.

6 As shown in FIG. **1** and FIG. **2**, a spring **122** is mounted on the pivot pin **124**. Integral to the  
7 spring **122** are two spring arms **120**, which apply pressure to the first arm **102** and the second  
8 arm **104**, thereby biasing the first jaw **116** and the second jaw **118** toward the closed position.

9 As depicted in FIG. **3**, the first jaw **116** has an outer surface **134** and a first gripping surface  
10 **206**, and the second jaw **118** has an outer surface **134** and a second gripping surface **132**. The  
11 first jaw **116** and the second jaw **118** overlap one another and, in this embodiment, have  
12 coincident edges when viewed from a point six inches along an axis perpendicular to the plane  
13 of the first jaw **116** that extends outward from the first jaw **116** center point. The first jaw **116**  
14 and the second jaw **118** are substantially parallel to one another and, for the HVAC filter  
15 manipulation application discussed earlier, have an adjustable gap of approximately one inch  
16 between the first gripping surface **206** and the second gripping surface **132**. Other embodiments  
17 for different applications may have different jaw dimensions, jaw overlap, and gripping surface  
18 gap.

19 As illustrated in FIGS. **1** through **3**, a first threaded sleeve **202** (not visible in FIG. **1**) is  
20 attached to the underside of the first arm **102** between the first middle portion **112** and the first  
21 jaw end **114**. A second threaded sleeve **130** (not visible in FIG. **2**) is attached to the underside  
22 of the second arm **104** between the second middle portion **113** and the second jaw end **115**. A  
23 jaw gap adjuster **126** passes through an adjuster hole **128** (visible only in FIG. **1**) and the first  
24 threaded sleeve **202** then enters second threaded sleeve **130**. Turning the jaw gap adjuster **126**  
25 clockwise or counterclockwise provides a means for setting or varying the gap or space  
26 between the first gripping surface **206** and the second gripping surface **132**, this adjustment  
27 mechanism being such that the gap or space remains constant when the gripper is at rest  
28 without pressure on the first handle **108** or on the second handle **110**. The description  
29 presented here of a means for setting or varying the gap or space between the first gripping  
30 surface **206** and the second gripping surface **132** represents only one way to set this gap and  
31 this description should not to be considered a limitation; any mechanism known to one skilled in  
32 the art will suffice so long as the gap or space is maintained while the gripper is at rest.

1 The dimensions and material of manufacture for the first jaw **116** and the second jaw **118**  
2 can vary based on gripper application. For the application involving manipulation of HVAC filters  
3 discussed earlier, the width **W** of the first jaw **116**, as shown in FIG. **1**, may be two inches and  
4 the insertion distance **L** may be two inches or more. For the same HVAC filter manipulation  
5 application the width **W** of the second jaw **118**, as shown in FIG. **2**, may be two inches and the  
6 insertion distance **L** may be two inches or more. These first jaw **116** and second jaw **118**  
7 insertion distance and width dimensions will need to be substantially at least 1.25 inches to  
8 ensure sufficient gripping surface and depth of insertion into the receptacle **604**, the term  
9 “substantially at least 1.25 inches” meaning no less than 1.125 inches. One possible first jaw  
10 **116** and second jaw **118** material of manufacture in this HVAC filter manipulation application is  
11 16 gauge cold-rolled steel (0.0598 inches thick). For applications using cold-rolled steel jaws as  
12 a material of manufacture, an anti-corrosion coating such as, but not limited to, zinc or paint  
13 may be applied. Other embodiments for this HVAC filter or different applications may use  
14 stainless steel, plastic, carbon fiber or other materials for jaws.

15 The thickness of the first jaw **116** and the second jaw **118** material must be less than  
16 approximately 0.075 inches, meaning that the thickness cannot exceed 0.080 inches. This  
17 minimal jaw thickness permits use of the gripper when a planar workpiece **602** fits tightly or is  
18 stuck in in its receptacle **604**, “fits tightly”, “stuck in”, and “fit tightly” being defined as one or  
19 more of the following conditions: a) less than approximately 0.25 inches of space between an  
20 outer edge of the planar workpiece **602** and an outer edge of the receptacle **604** on one or both  
21 sides of the planar workpiece **602**; b) a necessity to shake, oscillate, rock side-to-side or  
22 otherwise manipulate with force the planar workpiece **602** in order to free it from the receptacle  
23 **604** on removal or seat it fully into the receptacle **604** on insertion; c) insertion or removal  
24 requires damage or deformation of the planar workpiece **602**, “damage or deformation” being  
25 defined as an increase or decrease of one or more dimensions of the planar workpiece **602** –  
26 dimensions being length, width and thickness – of more than 5% of that dimension and/or the  
27 tearing, detachment or disassociation of planar workpiece **602** components such as, for  
28 example, planar workpiece **602** frame or border from other planar workpiece **602** material.  
29 Planar workpiece **602** as used herein refers to a mechanical object shaped as a rectangular  
30 cuboid.

31 A rigid material is required for the first jaw **116** and the second jaw **118**, “rigid material” being  
32 defined as one that can maintain planarity across its surface to within a deflection from flatness  
33 of no more than one-eighth inch along the unsupported edge when a weight of ten pounds is

1 applied to the unsupported edge of a 4 inch by 4 inch piece of this rigid material secured in a  
2 horizontal position such that a 2 by 4 inch dimension of this piece is cantilevered and thus  
3 unsupported. This measurement can be done by clamping to a flat-topped table one half of a 4  
4 inch by 4 inch piece of the rigid material being tested so that the other half of the test material (a  
5 2 inch by 4 inch section) is off the table top and thus unsupported. Then a ten pound weight is  
6 applied to the unsupported edge of the test material (farthest from the table edge) and the  
7 deflection of the weighted edge is measured with respect to the table edge.

### 8 C. Operation of the First Embodiment

9 FIG. 6 shows the gripper in operation. The operator first turns the jaw gap adjuster **126** until  
10 the gap between the first jaw **116** and the second jaw **118** is slightly less than the thickness of  
11 the planar workpiece **602** to be manipulated. In the case of planar workpiece **602** removal, the  
12 operator then squeezes the first handle **108** and the second handle **110** together to expand the  
13 gap between the first jaw **116** and the second jaw **118** until it equals the width of the receptacle  
14 **604**. The operator then inserts the first jaw **116** and the second jaw **118** into the receptacle **604**  
15 so that first gripping surface **206** and the second gripping surface **132** overlap the planar  
16 workpiece **602**, then the operator releases the first handle **108** and the second handle **110**. The  
17 resulting tension applied by the spring **122** and the spring arms **120** presses together the first  
18 jaw **116** and the second jaw **118** until the stopping point set with the jaw gap adjuster **126**. This  
19 pressing together of the first jaw **116** and the second jaw **118** causes gripping of the planar  
20 workpiece **602** by the first gripping surface **206** and the second gripping surface **132**. Once  
21 gripped, the planar workpiece **602** can be manipulated as necessary to free its edges from a  
22 receptacle frame **606** present on either side of the planar workpiece **602** and then removed.

23 Planar workpiece **602** insertion is the opposite of removal. The operator first turns the jaw  
24 gap adjuster **126** until the gap between the first jaw **116** and the second jaw **118** is set to be  
25 slightly less than the thickness of the planar workpiece **602** to be manipulated. The operator  
26 then squeezes the first handle **108** and the second handle **110** together to expand the gap  
27 between the first jaw **116** and the second jaw **118** until it exceeds the width of the planar  
28 workpiece **602**. The operator then slides the outer edge of the planar workpiece **602** between  
29 the first gripping surface **206** and the second gripping surface **132** and releases the first handle  
30 **108** and the second handle **110** so that the tension applied by the spring **122** and the spring  
31 arms **120** presses together the first jaw **116** and the second jaw **118** until the stopping point set  
32 with the jaw gap adjuster **126**. The gripper now firmly holds the planar workpiece **602**. The  
33 operator then inserts the planar workpiece **602** into the receptacle **604**. Once partially inserted

1 in the receptacle **604**, the planar workpiece **602** can be manipulated as necessary to slide it fully  
2 into the receptacle **604**. After full insertion of the planar workpiece **602** into the receptacle **604**,  
3 the operator squeezes the first handle **108** and the second handle **110** together to expand the  
4 gap between the first jaw **116** and the second jaw **118** until it exceeds the width of the planar  
5 workpiece **602**, then the operator withdraws the gripper from the receptacle **604**.

6 In FIG. **6** the planar workpiece **602** is shown as recessed below a receptacle frame edge  
7 **608**, which is a common occurrence either because the receptacle **604** is deeper than the  
8 planar workpiece **602** or because the planar workpiece **602** has become deformed during use.  
9 The planar workpiece **602** can be removed from the receptacle **604** in only one direction  
10 because the receptacle frame **606** is closed at the other end of the receptacle **604** (bottom of  
11 receptacle **604** is not shown in FIG. **6**). This placement of the planar workpiece **602** recessed  
12 below (or level with) the receptacle frame edge **608** represents the proper operational location  
13 for such a planar workpiece **602**.

14 The components depicted in FIG. **6** including but not limited to the receptacle **604**, the  
15 receptacle frame **606**, and the receptacle frame edge **608** are an example of a mechanical  
16 system whose operation requires insertion and removal of a planar workpiece **602** that resides  
17 in a receptacle **604** during normal operation. The representation of FIG. **6** is for reference only;  
18 other arrangements are possible that utilize a planar workpiece **602** whose insertion and  
19 removal may require a specialized tool such as the currently described gripper.

20

1 DETAILED DESCRIPTION OF AN ALTERNATIVE EMBODIMENT

2 A. Overview of an Alternative Embodiment

3 A modification of the gripper embodiment depicted in FIGS. 1 through 5 is presented in  
4 FIGS. 7 and 8, wherein the gripper has a first offset jaw 702 and a second offset jaw 704 that  
5 are step-shaped rather than flat. In this alternative embodiment, the first offset jaw 702 adds a  
6 first offset jaw top step 706, and a first offset jaw riser 708, while the second offset jaw 704 of  
7 this alternative embodiment adds a second offset jaw top step 714, and a second offset jaw  
8 riser 716. In addition, for this alternative embodiment the numbering for certain elements  
9 changes as follows:

Element Name	First Embodiment Numeral	Alternative Embodiment Numeral
first jaw	116	710
second jaw	118	718
first gripping surface	206	802
second gripping surface	132	720
first jaw insertion limit line	119	712
first jaw leading edge	121	804
second jaw insertion limit line	204	806
second jaw leading edge	136	722

10 With the exception of these aforesaid jaw and gripping surface elements, the gripper first  
11 embodiment of FIGS. 1 through 5 and the gripper alternative embodiment of FIGS. 7 and 8 are  
12 identical. As such this section will describe only the step-shaped offset jaws of this alternative  
13 embodiment, their orientation, their attachment, and their operation, and the earlier description  
14 of all gripper components other than the jaws and gripping surfaces applies equally to this  
15 alternative embodiment.

16 B. Detailed Description of an Alternative Embodiment

17 As depicted in FIGS. 7 and 8, the first offset jaw 702 comprises three planar surfaces  
18 connected to form the equivalent of two horizontal and parallel but non-overlapping steps that  
19 are attached to one another by a connecting vertical riser. A first offset jaw top step 706 forms  
20 the first such planar surface. The longitudinal axis of the first offset jaw top step 706 is oriented  
21 parallel to the longitudinal axis of the gripper and is attached to the underside of the first jaw end  
22 114. A first offset jaw riser 708 forms the second such planar surface. The first offset jaw riser  
23 708 is attached to the edge of the first offset jaw top step 706 opposite the first jaw end 114 and  
24 is oriented at a right angle to the first offset jaw top step 706 so as to form a downward-oriented  
25 riser component in relation to the first offset jaw top step 706. A first jaw 710 forms the third  
26 such planar surface. The first jaw 710 is attached to the bottom edge of the first offset jaw riser  
27 708 and extends parallel to the longitudinal axis of the first handle 108 from the first offset jaw

1 riser **708** in a direction opposite from the direction of the first arm **102** and laterally to either side  
2 so that the first jaw **710** forms a flat plate of uniform thickness. In this context the phrase  
3 “longitudinal axis of the first handle **108**” refers to a straight line drawn from substantially the  
4 lateral center of the first handle end **106** to substantially the lateral center of the first middle  
5 portion **112**, this line running parallel to the centerline of the first arm **102**, and “uniform” means  
6 a thickness variation across the plate surface of no more than approximately 10%. The edge of  
7 the first jaw **710** farthest from the first offset jaw riser **708** is the first jaw leading edge **804**. The  
8 first jaw insertion limit line **712** is the endpoint for insertion of the first jaw **710** into the receptacle  
9 **604**. For the alternative embodiment the first jaw insertion limit line **712** is the attachment point  
10 of the first jaw **710** to the first offset jaw riser **708**. The insertion distance into the receptacle **604**  
11 of the first jaw **710** is the distance from the first jaw leading edge **804** (visible in FIG. **8** but not in  
12 FIG. **7**) to the first jaw insertion limit line **712**, this insertion distance being represented in FIG. **7**  
13 by the designation **L1**. A first gripping surface **802** (visible in FIG. **8** but not in FIG. **7**) is located  
14 on the underside of the first jaw **710**. The two steps and riser of the first offset jaw **702** may be a  
15 unitary structure.

16 Continuing with FIGS. **7** and **8**, the second offset jaw **704** comprises three planar surfaces  
17 connected to form two horizontal and parallel but non-overlapping steps that are attached to one  
18 another by a connecting vertical riser to form a unitary structure. A second offset jaw top step  
19 **714** forms the first such planar surface. The longitudinal axis of the second offset jaw top step  
20 **714** is oriented parallel to the longitudinal axis of the gripper and is attached to the underside of  
21 the second jaw end **115**. A second offset jaw riser **716** forms the second such planar surface.  
22 The second offset jaw riser **716** is attached to the edge of the second offset jaw top step **714**  
23 opposite the second jaw end **115** and is oriented at a right angle to the second offset jaw top  
24 step **714** so as to form a downward-oriented riser component in relation to the second offset jaw  
25 top step **714**. A second jaw **718** forms the third such planar surface. The second jaw **718** is  
26 attached to the bottom edge of the second offset jaw riser **716** and extends parallel to the  
27 longitudinal axis of the second handle **110** from the second offset jaw riser **716** in a direction  
28 opposite from the direction of the second arm **104** and laterally to either side so that the second  
29 jaw **718** forms a flat plate of uniform thickness. In this context the phrase “longitudinal axis of the  
30 second handle **110**” refers to a straight line drawn from substantially the lateral center of the  
31 second handle end **107** to substantially the lateral center of the second middle portion **113**, this  
32 line running parallel to the centerline of the second arm **104**, and “uniform” means a thickness  
33 variation across the plate surface of no more than approximately 10%. The edge of the second  
34 jaw **718** farthest from the second offset jaw riser **716** is the second jaw leading edge **722**. The

1 second jaw insertion limit line **806** is the endpoint for insertion of the second jaw **718** into the  
2 receptacle **604**. For the alternative embodiment the second jaw insertion limit line **806** is the  
3 attachment point of the second jaw **718** to the second offset jaw riser **716**. The insertion  
4 distance into the receptacle **604** of the second jaw **718** is the distance from the second jaw  
5 leading edge **722** (visible in FIG. **7** but not in FIG. **8**) to the second jaw insertion limit line **806**,  
6 this insertion distance being represented in FIG. **8** by the designation **L1**. A second gripping  
7 surface **720** (visible in FIG. **7** but not in FIG. **8**) is located on the top side of the second jaw **718**.  
8 The two steps and riser of the second offset jaw **704** may be a unitary structure.

9 As depicted in FIGS. **7** and **8**, the first jaw **710** and the second jaw **718** overlap one another.  
10 The first offset jaw **702** has an outer surface **134** and a first gripping surface **802**, and the  
11 second offset jaw **704** has an outer surface **134** and a second gripping surface **720**. The first  
12 gripping surface **802** and the second gripping surface **720** face one another and, in this  
13 embodiment, have coincident edges when viewed from a point six inches along an axis  
14 perpendicular to the plane of the first gripping surface **802** that extends outward from the first  
15 jaw **710** center point. The first gripping surface **802** and the second gripping surface **720** are  
16 substantially parallel to one another and, for the HVAC filter manipulation application discussed  
17 earlier, have an adjustable gap of approximately one inch between the first gripping surface **802**  
18 and the second gripping surface **720**. Other embodiments for different applications may have  
19 different jaw dimensions, jaw overlap, and gripping surface gap.

20 As illustrated in FIGS. **7** and **9**, a first threaded sleeve **202** (not visible in FIG. **7**) is attached  
21 to the underside of the first arm **102** between the first middle portion **112** and the first jaw end  
22 **114**. A second threaded sleeve **130** is attached to the underside of the second arm **104**  
23 between the second middle portion **113** and the second jaw end **115**. A jaw gap adjuster **126**  
24 passes through an adjuster hole **128** (visible only in FIG. **7**) and the first threaded sleeve **202**  
25 then enters second threaded sleeve **130**. Turning the jaw gap adjuster **126** clockwise or  
26 counterclockwise provides a means for setting or varying the gap or space between the first  
27 gripping surface **802** and the second gripping surface **720**, this adjustment mechanism being  
28 such that the gap or space remains constant when the gripper is at rest without pressure on the  
29 first handle **108** or second handle **110**. The description presented here of a means for setting or  
30 varying the gap or space between the first gripping surface **802** and the second gripping surface  
31 **720** represents only one way to set this gap and this description should not to be considered a  
32 limitation; any mechanism known to one skilled in the art will suffice so long as the gap or space  
33 is maintained while the gripper is at rest.

1 The dimensions and material of manufacture for the first offset jaw **702** and the second  
2 offset jaw **704** can vary based on gripper application. For the application involving manipulation  
3 of HVAC filters discussed earlier, the width **W1** of the first jaw **710**, shown in FIGS. **7** and **8**, may  
4 be two inches and the insertion distance **L1** may be two inches or more. For the same HVAC  
5 filter manipulation application the width **W1** of the second jaw **718**, as illustrated in FIGS. **7** and  
6 **8**, may be two inches and the insertion distance **L1** may be two inches or more. These first jaw  
7 **710** and second jaw **718** insertion distance and width dimensions will need to be substantially at  
8 least 1.25 inches to ensure sufficient gripping surface and depth of insertion into the receptacle  
9 **604**, the term “substantially at least 1.25 inches” meaning no less than 1.125 inches. One  
10 possible first offset jaw **702** and second offset jaw **704** material of manufacture in this HVAC  
11 filter manipulation application is 16 gauge cold-rolled steel (0.0598 inches thick). For  
12 applications using cold-rolled steel jaws as a material of manufacture, an anti-corrosion coating  
13 such as, but not limited to, zinc or paint may be applied. Other embodiments for this HVAC filter  
14 or different applications may use stainless steel, plastic, carbon fiber or other materials for jaws.

15 As illustrated in FIG. **9**, this alternative embodiment of the gripper is used when the  
16 receptacle frame **606** on one side of the receptacle **604** extends in the direction of insertion and  
17 removal of the planar workpiece **602** such that insertion of the gripper with flat jaws (FIGS. **1**  
18 through **5**) into the receptacle **604** is difficult or not possible.

19 Though the first offset jaw top step **706**, the first offset jaw riser **708**, and the first jaw **710**  
20 are shown as unitary structures in the referenced figures, they may be shaped or attached to  
21 one another and the first jaw end **114** differently in other embodiments and their representation  
22 herein should not be considered a limitation. Similarly, though second offset jaw top step **714**,  
23 the second offset jaw riser **716**, and the second jaw **718** are shown as unitary structures in the  
24 referenced figures, they may be shaped or attached to one another and the second jaw end **115**  
25 differently in other embodiments and their representation herein should not be considered a  
26 limitation.

27 The thickness of the first jaw **710** and the second jaw **718** material must be less than  
28 approximately 0.075 inches, meaning that the thickness cannot exceed 0.080 inches. This  
29 minimal jaw thickness permits use of the gripper when planar workpiece **602** fits tightly or is  
30 stuck in in its receptacle **604**, “fits tightly”, “stuck in”, and “fit tightly” being defined as one or  
31 more of the following conditions: a) less than approximately 0.25 inches of space between an  
32 outer edge of the planar workpiece **602** and an outer edge of the receptacle **604** on one or both  
33 sides of the planar workpiece **602**; b) a necessity to shake, oscillate, rock side-to-side or

1 otherwise manipulate with force the planar workpiece **602** in order to free it from the receptacle  
2 **604** on removal or seat it fully into the receptacle **604** on insertion; c) insertion or removal  
3 requires damage or deformation of the planar workpiece **602**, “damage or deformation” being  
4 defined as an increase or decrease of one or more dimensions of the planar workpiece **602** –  
5 dimensions being length, width and depth – of more than 5% of that dimension and/or the  
6 tearing, detachment or disassociation of planar workpiece **602** components such as, for  
7 example, planar workpiece **602** frame or border from other planar workpiece **602** material.  
8 Planar workpiece **602** as used herein refers to a mechanical object shaped as a rectangular  
9 cuboid.

10 A rigid material is required for the first jaw **710** and the second jaw **718**, “rigid material” being  
11 defined as one that can maintain planarity across its surface to within a deflection from flatness  
12 of no more than one-eighth inch along the unsupported edge when a weight of ten pounds is  
13 applied to the unsupported edge of a 4 inch by 4 inch piece of this rigid material secured in a  
14 horizontal position such that a 2 by 4 inch dimension of this piece is cantilevered and thus  
15 unsupported. This measurement can be done by clamping to a flat-topped table one half of a 4  
16 inch by 4 inch piece of the rigid material being tested so that the other half of the test material (a  
17 2 inch by 4 inch section) is off the table top and thus unsupported. Then a ten pound weight is  
18 applied to the unsupported edge of the test material (farthest from the table edge) and the  
19 deflection of the weighted edge is measured with respect to the table edge.

#### 20 C. Operation of an Alternative Embodiment

21 The alternative embodiment of the gripper presented in FIG. **9** operates similarly to the flat  
22 jaw gripper of FIGS. **1** through **5**. The operator first turns the jaw gap adjuster **126** until the gap  
23 between the first offset jaw **702** and the second offset jaw **704** is slightly less than the thickness  
24 of the planar workpiece **602** to be manipulated. In the case of planar workpiece **602** removal,  
25 the operator then squeezes the first handle **108** and the second handle **110** together to expand  
26 the gap between the first jaw **710** and the second jaw **718** until it equals the width of the  
27 receptacle **604**. The operator then inserts the first jaw **710** and the second jaw **718** into the  
28 receptacle **604** so that the first gripping surface **802** and the second gripping surface **720**  
29 overlap the planar workpiece **602**, then the operator releases the first handle **108** and the  
30 second handle **110**. The resulting tension applied by the spring **122** and the spring arms **120**  
31 presses together the first jaw **710** and the second jaw **718** until the stopping point set with the  
32 jaw gap adjuster **126**. This pressing together of the first jaw **710** and the second jaw **718** causes  
33 gripping of the planar workpiece **602** by the first gripping surface **802** and the second gripping

1 surface **720**. Once gripped, the planar workpiece **602** can be manipulated as necessary to free  
2 its edges from a receptacle frame **606** present on either side of the planar workpiece **602** and  
3 then removed.

4 Planar workpiece **602** insertion using the offset jaw embodiment of the gripper as depicted  
5 in FIG. **9** is the opposite of removal. The operator first turns the jaw gap adjuster **126** until the  
6 gap between the first jaw **710** and the second jaw **718** is set to be slightly less than the  
7 thickness of the planar workpiece **602** to be manipulated. The operator then squeezes the first  
8 handle **108** and the second handle **110** together to expand the gap between the first jaw **710**  
9 and the second jaw **718** until it exceeds the width of the planar workpiece **602**. The operator  
10 then slides the outer edge of the planar workpiece **602** between the first gripping surface **802**  
11 and the second gripping surface **720** and releases the first handle **108** and the second handle  
12 **110** so that the tension applied by the spring **122** and the spring arms **120** presses together the  
13 first jaw **710** and the second jaw **718** until the stopping point set with the jaw gap adjuster **126**.  
14 The gripper now firmly holds the planar workpiece **602**. The operator then inserts the planar  
15 workpiece **602** into the receptacle **604**. Once partially inserted in the receptacle **604**, the planar  
16 workpiece **602** can be manipulated as necessary to slide it fully into the receptacle **604**. After full  
17 insertion of the planar workpiece **602** into the receptacle **604**, the operator squeezes the first  
18 handle **108** and the second handle **110** together to expand the gap between the first jaw **710**  
19 and the second jaw **718** until it exceeds the width of the planar workpiece **602**, then the operator  
20 withdraws the gripper from the receptacle **604** leaving the planar workpiece **602** in place.

21 In FIG. **9** the planar workpiece **602** is shown as recessed below a receptacle frame edge  
22 **608**, which is a common occurrence either because the receptacle **604** is deeper than the  
23 planar workpiece **602** or because the planar workpiece **602** has become deformed during use.  
24 The planar workpiece **602** can be removed from the receptacle **604** in only one direction  
25 because the receptacle frame **606** is closed at the other end of the receptacle **604** (bottom of  
26 receptacle **604** is not shown in FIG. **9**). This placement of the planar workpiece recessed below  
27 (or level with) the receptacle frame edge represents the proper operational location for such a  
28 planar workpiece.

29 The components depicted in FIG. **9** including but not limited to the receptacle **604**, the  
30 receptacle frame **606**, and the receptacle frame edge **608** are an example of a mechanical  
31 system whose operation requires insertion and removal of a planar workpiece **602** that resides  
32 in a receptacle **604** during normal operation. The representation of FIG. **9** is for reference only;

1 other arrangements are possible that utilize a planar workpiece **602** whose insertion and  
2 removal may require a specialized tool such as the currently described gripper.

3

4

1 DETAILED DESCRIPTION OF FURTHER EMBODIMENTS

2 Further embodiments of the gripper described in this application are identical to the first  
3 embodiment and the alternative embodiment described earlier in this specification with the  
4 exception that these further embodiments do not have an adjustment mechanism capable of  
5 setting the gap between the jaws.

6 A. Overview of the First Further Embodiment

7 As depicted in FIGS. **10** through **14**, a first further embodiment of a gripper comprises a first  
8 arm **102** that extends from a first handle end **106** through a first handle **108** and a first middle  
9 portion **112** to a first jaw end **114**. Attached to the first jaw end **114** is a first jaw **116**. A second  
10 arm **104** extends from a second handle end **107** through a second handle **110** and a second  
11 middle portion **113** to a second jaw end **115**. Attached to the second jaw end **115** is a second  
12 jaw **118**. Protruding at approximately a right angle from the underside of the first middle portion  
13 **112** is a first linkage extension **111**. Protruding at approximately a right angle from the underside  
14 of the second middle portion **113** is a second linkage extension **117**. The first linkage extension  
15 **111** and the second linkage extension **117** partially overlap and are attached in this overlap area  
16 using a pivot pin **124** so that the first handle **108** and the second handle **110** can be actuated to  
17 vary the gap between the first jaw **116** and the second jaw **118**, permitting the operator to grasp  
18 and manipulate a planar workpiece **602**.

19 B. Detailed Description of the First Further Embodiment

20 As shown in FIG. **10** and FIG. **12**, a first arm **102** extends from a first handle end **106**  
21 through a first handle **108** and a first middle portion **112** to a first jaw end **114**. Directly attached  
22 to the first jaw end **114** is a first jaw **116**. Protruding at approximately a right angle from the  
23 underside of the first middle portion **112** is a first linkage extension **111**.

24 As depicted in FIG. **10**, the first jaw **116** extends parallel to the longitudinal axis of the first  
25 handle **108** from the first jaw end **114** in a direction opposite from the direction of the first arm  
26 **102** and laterally to either side of the first jaw end **114** so that the first jaw **116** forms a flat plate  
27 of uniform thickness. In this context the phrase “longitudinal axis of the first handle **108**” refers to  
28 a straight line drawn from substantially the lateral center of the first handle end **106** to  
29 substantially the lateral center of the first middle portion **112**, this line running parallel to the  
30 centerline of the first arm **102**, and “uniform” means a thickness variation across the plate  
31 surface of no more than approximately 10%. The edge of the first jaw **116** farthest from the first  
32 jaw end **114** is the first jaw leading edge **121**. The first jaw insertion limit line **119** is the endpoint  
33 for insertion of the first jaw **116** into the receptacle **604**. For the first further embodiment the first

1 jaw insertion limit line **119** is the forward attachment point of the first jaw **116** to the first jaw end  
2 **114**, “forward” meaning in a direction opposite to the first handle **108**. The insertion distance into  
3 the receptacle **604** of the first jaw **116** is the distance from the first jaw leading edge **121** to the  
4 first jaw insertion limit line **119**, this insertion distance being represented in FIG. **10** by the letter  
5 **L**.

6 As illustrated in FIG. **11** and FIG. **12**, a second arm **104** extends from a second handle end  
7 **107** through a second handle **110** and a second middle portion **113** to a second jaw end **115**.  
8 Directly attached to the second jaw end **115** is a second jaw **118**. Protruding at approximately a  
9 right angle from the underside of the second middle portion **113** is a second linkage extension  
10 **117**.

11 As depicted in FIG. **11**, the second jaw **118** extends parallel to the longitudinal axis of the  
12 second handle **110** from the second jaw end **115** in a direction opposite from the direction of the  
13 second arm **104** and laterally to either side of the second jaw end **115** so that the second jaw  
14 **118** forms a flat plate of uniform thickness. In this context the phrase “longitudinal axis of the  
15 second handle **110**” refers to a straight line drawn from substantially the lateral center of the  
16 second handle end **107** to substantially the lateral center of the second middle portion **113**, this  
17 line running parallel to the centerline of the second arm **104**, and “uniform” means a thickness  
18 variation across the plate surface of no more than approximately 10%. The edge of the second  
19 jaw **118** farthest from the second jaw end **115** is the second jaw leading edge **136**. For the first  
20 further embodiment the second jaw insertion limit line **204** is the forward attachment point of the  
21 second jaw **118** to the second jaw end **115**, “forward” meaning in a direction opposite to the  
22 second handle **110**. The insertion distance into the receptacle **604** of the second jaw **118** is the  
23 distance from the second jaw leading edge **136** to the second jaw insertion limit line **204**, this  
24 insertion distance being represented in FIG. **11** by the letter **L**.

25 First and second arms **102**, **104** may be formed of metal such as aluminum or steel, molded  
26 plastic, carbon fiber, or other materials. First and second arms **102**, **104** length is sufficient to  
27 operate comfortably with one hand, for example in this embodiment approximately six inches.  
28 First and second handles **108**, **110**, as shown in FIGS. **10** through **12**, may be ergonomically  
29 shaped. Other embodiments may use different materials of manufacture and/or different size  
30 and/or different shape configurations.

31 As depicted in FIGS. **10** through **12**, and FIG. **14**, the first linkage extension **111** and the  
32 second linkage extension **117** overlap and are attached in the overlap area by a pivot pin **124**.  
33 Connecting the first arm **102** and the second arm **104** in this manner permits an operator of this

1 embodiment to alter the gap between the first jaw **116** and the second jaw **118** by actuating the  
2 first handle **108** and the second handle **110** and thereby operate in a tong-like fashion this  
3 apparatus. Though the first arm **102** and the second arm **104** are shown as unitary structures of  
4 a particular shape in the referenced figures, they may be shaped differently in other  
5 embodiments and their representation herein should not be considered a limitation. Similarly,  
6 overlap and connection by the pivot pin **124** of the first linkage extension **111** and the second  
7 linkage extension **117** may be arranged differently in other embodiments and their presentation  
8 herein should not be considered a limitation.

9 As shown in FIG. **10** and FIG. **11**, a spring **122** is mounted on the pivot pin **124**. Integral to  
10 the spring **122** are two spring arms **120**, which apply pressure to the first arm **102** and the  
11 second arm **104**, thereby biasing the first jaw **116** and the second jaw **118** toward the closed  
12 position.

13 As depicted in FIG. **12**, the first jaw **116** has an outer surface **134** and a first gripping surface  
14 **206**, and the second jaw **118** has an outer surface **134** and a second gripping surface **132**. The  
15 first jaw **116** and the second jaw **118** overlap one another and, in this embodiment, have  
16 coincident edges when viewed from a point six inches along an axis perpendicular to the plane  
17 of the first jaw **116** that extends outward from the first jaw **116** center point. The first jaw **116**  
18 and the second jaw **118** are substantially parallel to one another and, for the HVAC filter  
19 manipulation application discussed earlier, have an adjustable gap of approximately one inch  
20 between the first gripping surface **206** and the second gripping surface **132**. Other embodiments  
21 for different applications may have different jaw dimensions, jaw overlap, and gripping surface  
22 gap.

23 The dimensions and material of manufacture for the first jaw **116** and the second jaw **118**  
24 can vary based on gripper application. For the application involving manipulation of HVAC filters  
25 discussed earlier, the width **W** of the first jaw **116**, as shown in FIG. **10**, may be two inches and  
26 the insertion distance **L** may be two inches or more. For the same HVAC filter manipulation  
27 application the width **W** of the second jaw **118**, as shown in FIG. **11**, may be two inches and the  
28 insertion distance **L** may be two inches or more. These first jaw **116** and second jaw **118**  
29 insertion distance and width dimensions will need to be substantially at least 1.25 inches to  
30 ensure sufficient gripping surface and depth of insertion into the receptacle **604**, the term  
31 “substantially at least 1.25 inches” meaning no less than 1.125 inches. One possible first jaw  
32 **116** and second jaw **118** material of manufacture in this HVAC filter manipulation application is  
33 16 gauge cold-rolled steel (0.0598 inches thick). For applications using cold-rolled steel jaws as

1 a material of manufacture, an anti-corrosion coating such as, but not limited to, zinc or paint  
2 may be applied. Other embodiments for this HVAC filter or different applications may use  
3 stainless steel, plastic, carbon fiber or other materials for jaws.

4 The thickness of the first jaw **116** and the second jaw **118** material must be less than  
5 approximately 0.075 inches, meaning that the thickness cannot exceed 0.080 inches. This  
6 minimal jaw thickness permits use of the gripper when a planar workpiece **602** fits tightly or is  
7 stuck in in its receptacle **604**, “fits tightly”, “stuck in”, and “fit tightly” being defined as one or  
8 more of the following conditions: a) less than approximately 0.25 inches of space between an  
9 outer edge of the planar workpiece **602** and an outer edge of the receptacle **604** on one or both  
10 sides of the planar workpiece **602**; b) a necessity to shake, oscillate, rock side-to-side or  
11 otherwise manipulate with force the planar workpiece **602** in order to free it from the receptacle  
12 **604** on removal or seat it fully into the receptacle **604** on insertion; c) insertion or removal  
13 requires damage or deformation of the planar workpiece **602**, “damage or deformation” being  
14 defined as an increase or decrease of one or more dimensions of the planar workpiece **602** –  
15 dimensions being length, width and thickness – of more than 5% of that dimension and/or the  
16 tearing, detachment or disassociation of planar workpiece **602** components such as, for  
17 example, planar workpiece **602** frame or border from other planar workpiece **602** material.  
18 Planar workpiece **602** as used herein refers to a mechanical object shaped as a rectangular  
19 cuboid.

20 A rigid material is required for the first jaw **116** and the second jaw **118**, “rigid material” being  
21 defined as one that can maintain planarity across its surface to within a deflection from flatness  
22 of no more than one-eighth inch along the unsupported edge when a weight of ten pounds is  
23 applied to the unsupported edge of a 4 inch by 4 inch piece of this rigid material secured in a  
24 horizontal position such that a 2 by 4 inch dimension of this piece is cantilevered and thus  
25 unsupported. This measurement can be done by clamping to a flat-topped table one half of a 4  
26 inch by 4 inch piece of the rigid material being tested so that the other half of the test material (a  
27 2 inch by 4 inch section) is off the table top and thus unsupported. Then a ten pound weight is  
28 applied to the unsupported edge of the test material (farthest from the table edge) and the  
29 deflection of the weighted edge is measured with respect to the table edge.

### 30 C. Operation of the First Further Embodiment

31 FIG. **14** shows the gripper in operation. In the case of planar workpiece **602** removal, the  
32 operator squeezes the first handle **108** and the second handle **110** together to expand the gap  
33 between the first jaw **116** and the second jaw **118** until it equals the width of the receptacle **604**.

1 The operator then inserts the first jaw **116** and the second jaw **118** into the receptacle **604** so  
2 that first gripping surface **206** and the second gripping surface **132** overlap the planar workpiece  
3 **602**, then the operator releases the first handle **108** and the second handle **110**. The resulting  
4 tension applied by the spring **122** and the spring arms **120** presses together the first jaw **116**  
5 and the second jaw **118**. This pressing together of the first jaw **116** and the second jaw **118**  
6 causes gripping of the planar workpiece **602** by the first gripping surface **206** and the second  
7 gripping surface **132**. Once gripped, the planar workpiece **602** can be manipulated as necessary  
8 to free its edges from a receptacle frame **606** present on either side of the planar workpiece **602**  
9 and then removed.

10 Planar workpiece **602** insertion is the opposite of removal. The operator squeezes the first  
11 handle **108** and the second handle **110** together to expand the gap between the first jaw **116**  
12 and the second jaw **118** until it exceeds the width of the planar workpiece **602**. The operator  
13 then slides the outer edge of the planar workpiece **602** between the first gripping surface **206**  
14 and the second gripping surface **132** and releases the first handle **108** and the second handle  
15 **110** so that the tension applied by the spring **122** and the spring arms **120** presses together the  
16 first jaw **116** and the second jaw **118**. The gripper now firmly holds the planar workpiece **602**.  
17 The operator then inserts the planar workpiece **602** into the receptacle **604**. Once partially  
18 inserted in the receptacle **604**, the planar workpiece **602** can be manipulated as necessary to  
19 slide it fully into the receptacle **604**. After full insertion of the planar workpiece **602** into the  
20 receptacle **604**, the operator squeezes the first handle **108** and the second handle **110** together  
21 to expand the gap between the first jaw **116** and the second jaw **118** until it exceeds the width of  
22 the planar workpiece **602**, then the operator withdraws the gripper from the receptacle **604**.

23 In FIG. **14** the planar workpiece **602** is shown as recessed below a receptacle frame edge  
24 **608**, which is a common occurrence either because the receptacle **604** is deeper than the  
25 planar workpiece **602** or because the planar workpiece **602** has become deformed during use.  
26 The planar workpiece **602** can be removed from the receptacle **604** in only one direction  
27 because the receptacle frame **606** is closed at the other end of the receptacle **604** (bottom of  
28 receptacle **604** is not shown in FIG. **14**). This placement of the planar workpiece **602** recessed  
29 below (or level with) the receptacle frame edge **608** represents the proper operational location  
30 for such a planar workpiece **602**.

31 The components depicted in FIG. **14** including but not limited to the receptacle **604**, the  
32 receptacle frame **606**, and the receptacle frame edge **608** are an example of a mechanical  
33 system whose operation requires insertion and removal of a planar workpiece **602** that resides

1 in a receptacle **604** during normal operation. The representation of FIG. **14** is for reference only;  
 2 other arrangements are possible that utilize a planar workpiece **602** whose insertion and  
 3 removal may require a specialized tool such as the currently described gripper.

4 D. Overview of the Second Further Embodiment

5 A modification of the gripper first further embodiment depicted in FIGS. **10** through **13** is  
 6 presented in FIGS. **15** and **16**, wherein the gripper has a first offset jaw **702** and a second offset  
 7 jaw **704** that are step-shaped rather than flat. In this second further embodiment, the first offset  
 8 jaw **702** adds a first offset jaw top step **706**, and a first offset jaw riser **708**, while the second  
 9 offset jaw **704** of this second further embodiment adds a second offset jaw top step **714**, and a  
 10 second offset jaw riser **716**. In addition, for this second further embodiment the numbering for  
 11 certain elements changes as follows:

Element Name	First Further Embodiment Numeral	Second Further Embodiment Numeral
first jaw	116	710
second jaw	118	718
first gripping surface	206	802
second gripping surface	132	720
first jaw insertion limit line	119	712
first jaw leading edge	121	804
second jaw insertion limit line	204	806
second jaw leading edge	136	722

12 With the exception of these aforesaid jaw and gripping surface elements, the gripper first  
 13 further embodiment of FIGS. **10** through **13** and the gripper second further embodiment of  
 14 FIGS. **15** and **16** are identical. As such this section will describe only the step-shaped offset  
 15 jaws of this second further embodiment, their orientation, their attachment, and their operation,  
 16 and the earlier description of all gripper components other than the jaws and gripping surfaces  
 17 applies equally to this second further embodiment.

18 E. Detailed Description of a Second Further Embodiment

19 As depicted in FIGS. **15** and **16**, the first offset jaw **702** comprises three planar surfaces  
 20 connected to form the equivalent of two horizontal and parallel but non-overlapping steps that  
 21 are attached to one another by a connecting vertical riser. A first offset jaw top step **706** forms  
 22 the first such planar surface. The longitudinal axis of the first offset jaw top step **706** is oriented  
 23 parallel to the longitudinal axis of the gripper and is attached to the underside of the first jaw end  
 24 **114**. A first offset jaw riser **708** forms the second such planar surface. The first offset jaw riser  
 25 **708** is attached to the edge of the first offset jaw top step **706** opposite the first jaw end **114** and  
 26 is oriented at a right angle to the first offset jaw top step **706** so as to form a downward-oriented  
 27 riser component in relation to the first offset jaw top step **706**. A first jaw **710** forms the third

1 such planar surface. The first jaw **710** is attached to the bottom edge of the first offset jaw riser  
2 **708** and extends parallel to the longitudinal axis of the first handle **108** from the first offset jaw  
3 riser **708** in a direction opposite from the direction of the first arm **102** and laterally to either side  
4 so that the first jaw **710** forms a flat plate of uniform thickness. In this context the phrase  
5 “longitudinal axis of the first handle **108**” refers to a straight line drawn from substantially the  
6 lateral center of the first handle end **106** to substantially the lateral center of the first middle  
7 portion **112**, this line running parallel to the centerline of the first arm **102**, and “uniform” means  
8 a thickness variation across the plate surface of no more than approximately 10%. The edge of  
9 the first jaw **710** farthest from the first offset jaw riser **708** is the first jaw leading edge **804**. The  
10 first jaw insertion limit line **712** is the endpoint for insertion of the first jaw **710** into the receptacle  
11 **604**. For the second further embodiment the first jaw insertion limit line **712** is the attachment  
12 point of the first jaw **710** to the first offset jaw riser **708**. The insertion distance into the  
13 receptacle **604** of the first jaw **710** is the distance from the first jaw leading edge **804** (visible in  
14 FIG. **16** but not in FIG. **15**) to the first jaw insertion limit line **712**, this insertion distance being  
15 represented in FIG. **15** by the designation **L1**. A first gripping surface **802** (visible in FIG. **16** but  
16 not in FIG. **15**) is located on the underside of the first jaw **710**. The two steps and riser of the  
17 first offset jaw **702** may be a unitary structure.

18 Continuing with FIGS. **15** and **16**, the second offset jaw **704** comprises three planar surfaces  
19 connected to form two horizontal and parallel but non-overlapping steps that are attached to one  
20 another by a connecting vertical riser to form a unitary structure. A second offset jaw top step  
21 **714** forms the first such planar surface. The longitudinal axis of the second offset jaw top step  
22 **714** is oriented parallel to the longitudinal axis of the gripper and is attached to the underside of  
23 the second jaw end **115**. A second offset jaw riser **716** forms the second such planar surface.  
24 The second offset jaw riser **716** is attached to the edge of the second offset jaw top step **714**  
25 opposite the second jaw end **115** and is oriented at a right angle to the second offset jaw top  
26 step **714** so as to form a downward-oriented riser component in relation to the second offset jaw  
27 top step **714**. A second jaw **718** forms the third such planar surface. The second jaw **718** is  
28 attached to the bottom edge of the second offset jaw riser **716** and extends parallel to the  
29 longitudinal axis of the second handle **110** from the second offset jaw riser **716** in a direction  
30 opposite from the direction of the second arm **104** and laterally to either side so that the second  
31 jaw **718** forms a flat plate of uniform thickness. In this context the phrase “longitudinal axis of the  
32 second handle **110**” refers to a straight line drawn from substantially the lateral center of the  
33 second handle end **107** to substantially the lateral center of the second middle portion **113**, this  
34 line running parallel to the centerline of the second arm **104**, and “uniform” means a thickness

1 variation across the plate surface of no more than approximately 10%. The edge of the second  
2 jaw **718** farthest from the second offset jaw riser **716** is the second jaw leading edge **722**. The  
3 second jaw insertion limit line **806** is the endpoint for insertion of the second jaw **718** into the  
4 receptacle **604**. For the second further embodiment the second jaw insertion limit line **806** is the  
5 attachment point of the second jaw **718** to the second offset jaw riser **716**. The insertion  
6 distance into the receptacle **604** of the second jaw **718** is the distance from the second jaw  
7 leading edge **722** (visible in FIG. **15** but not in FIG. **16**) to the second jaw insertion limit line **806**,  
8 this insertion distance being represented in FIG. **16** by the designation **L1**. A second gripping  
9 surface **720** (visible in FIG. **15** but not in FIG. **16**) is located on the top side of the second jaw  
10 **718**. The two steps and riser of the second offset jaw **704** may be a unitary structure.

11 As depicted in FIGS. **15** and **16**, the first jaw **710** and the second jaw **718** overlap one  
12 another. The first offset jaw **702** has an outer surface **134** and a first gripping surface **802**, and  
13 the second offset jaw **704** has an outer surface **134** and a second gripping surface **720**. The first  
14 gripping surface **802** and the second gripping surface **720** face one another and, in this  
15 embodiment, have coincident edges when viewed from a point six inches along an axis  
16 perpendicular to the plane of the first gripping surface **802** that extends outward from the first  
17 jaw **710** center point. The first gripping surface **802** and the second gripping surface **720** are  
18 substantially parallel to one another and, for the HVAC filter manipulation application discussed  
19 earlier, have an adjustable gap of approximately one inch between the first gripping surface **802**  
20 and the second gripping surface **720**. Other embodiments for different applications may have  
21 different jaw dimensions, jaw overlap, and gripping surface gap.

22 The dimensions and material of manufacture for the first offset jaw **702** and the second  
23 offset jaw **704** can vary based on gripper application. For the application involving manipulation  
24 of HVAC filters discussed earlier, the width **W1** of the first jaw **710**, shown in FIGS. **15** and **16**,  
25 may be two inches and the insertion distance **L1** may be two inches or more. For the same  
26 HVAC filter manipulation application the width **W1** of the second jaw **718**, as illustrated in FIGS.  
27 **15** and **16**, may be two inches and the insertion distance **L1** may be two inches or more. These  
28 first jaw **710** and second jaw **718** insertion distance and width dimensions will need to be  
29 substantially at least 1.25 inches to ensure sufficient gripping surface and depth of insertion into  
30 the receptacle **604**, the term “substantially at least 1.25 inches” meaning no less than 1.125  
31 inches. One possible first offset jaw **702** and second offset jaw **704** material of manufacture in  
32 this HVAC filter manipulation application is 16 gauge cold-rolled steel (0.0598 inches thick). For  
33 applications using cold-rolled steel jaws as a material of manufacture, an anti-corrosion coating

1 such as, but not limited to, zinc or paint may be applied. Other embodiments for this HVAC filter  
2 or different applications may use stainless steel, plastic, carbon fiber or other materials for jaws.

3 As illustrated in FIG. 17, this second further embodiment of the gripper is used when the  
4 receptacle frame **606** on one side of the receptacle **604** extends in the direction of insertion and  
5 removal of the planar workpiece **602** such that insertion of the gripper with flat jaws (FIGS. **10**  
6 through **13**) into the receptacle **604** is difficult or not possible.

7 Though the first offset jaw top step **706**, the first offset jaw riser **708**, and the first jaw **710**  
8 are shown as unitary structures in the referenced figures, they may be shaped or attached to  
9 one another and the first jaw end **114** differently in other embodiments and their representation  
10 herein should not be considered a limitation. Similarly, though second offset jaw top step **714**,  
11 the second offset jaw riser **716**, and the second jaw **718** are shown as unitary structures in the  
12 referenced figures, they may be shaped or attached to one another and the second jaw end **115**  
13 differently in other embodiments and their representation herein should not be considered a  
14 limitation.

15 The thickness of the first jaw **710** and the second jaw **718** material must be less than  
16 approximately 0.075 inches, meaning that the thickness cannot exceed 0.080 inches. This  
17 minimal jaw thickness permits use of the gripper when planar workpiece **602** fits tightly or is  
18 stuck in in its receptacle **604**, “fits tightly”, “stuck in”, and “fit tightly” being defined as one or  
19 more of the following conditions: a) less than approximately 0.25 inches of space between an  
20 outer edge of the planar workpiece **602** and an outer edge of the receptacle **604** on one or both  
21 sides of the planar workpiece **602**; b) a necessity to shake, oscillate, rock side-to-side or  
22 otherwise manipulate with force the planar workpiece **602** in order to free it from the receptacle  
23 **604** on removal or seat it fully into the receptacle **604** on insertion; c) insertion or removal  
24 requires damage or deformation of the planar workpiece **602**, “damage or deformation” being  
25 defined as an increase or decrease of one or more dimensions of the planar workpiece **602** –  
26 dimensions being length, width and depth – of more than 5% of that dimension and/or the  
27 tearing, detachment or disassociation of planar workpiece **602** components such as, for  
28 example, planar workpiece **602** frame or border from other planar workpiece **602** material.  
29 Planar workpiece **602** as used herein refers to a mechanical object shaped as a rectangular  
30 cuboid.

31 A rigid material is required for the first jaw **710** and the second jaw **718**, “rigid material” being  
32 defined as one that can maintain planarity across its surface to within a deflection from flatness  
33 of no more than one-eighth inch along the unsupported edge when a weight of ten pounds is

1 applied to the unsupported edge of a 4 inch by 4 inch piece of this rigid material secured in a  
2 horizontal position such that a 2 by 4 inch dimension of this piece is cantilevered and thus  
3 unsupported. This measurement can be done by clamping to a flat-topped table one half of a 4  
4 inch by 4 inch piece of the rigid material being tested so that the other half of the test material (a  
5 2 inch by 4 inch section) is off the table top and thus unsupported. Then a ten pound weight is  
6 applied to the unsupported edge of the test material (farthest from the table edge) and the  
7 deflection of the weighted edge is measured with respect to the table edge.

#### 8 F. Operation of a Second Further Embodiment

9 The second further embodiment of the gripper presented in FIG. 17 operates similarly to the  
10 flat jaw gripper of FIGS. 10 through 13. In the case of planar workpiece 602 removal, the  
11 operator squeezes the first handle 108 and the second handle 110 together to expand the gap  
12 between the first jaw 710 and the second jaw 718 until it equals the width of the receptacle 604.  
13 The operator then inserts the first jaw 710 and the second jaw 718 into the receptacle 604 so  
14 that the first gripping surface 802 and the second gripping surface 720 overlap the planar  
15 workpiece 602, then the operator releases the first handle 108 and the second handle 110. The  
16 resulting tension applied by the spring 122 and the spring arms 120 presses together the first  
17 jaw 710 and the second jaw 718. This pressing together of the first jaw 710 and the second jaw  
18 718 causes gripping of the planar workpiece 602 by the first gripping surface 802 and the  
19 second gripping surface 720. Once gripped, the planar workpiece 602 can be manipulated as  
20 necessary to free its edges from a receptacle frame 606 present on either side of the planar  
21 workpiece 602 and then removed.

22 Planar workpiece 602 insertion using the offset jaw embodiment of the gripper as depicted  
23 in FIG. 17 is the opposite of removal. The operator squeezes the first handle 108 and the  
24 second handle 110 together to expand the gap between the first jaw 710 and the second jaw  
25 718 until it exceeds the width of the planar workpiece 602. The operator then slides the outer  
26 edge of the planar workpiece 602 between the first gripping surface 802 and the second  
27 gripping surface 720 and releases the first handle 108 and the second handle 110 so that the  
28 tension applied by the spring 122 and the spring arms 120 presses together the first jaw 710  
29 and the second jaw 718. The gripper now firmly holds the planar workpiece 602. The operator  
30 then inserts the planar workpiece 602 into the receptacle 604. Once partially inserted in the  
31 receptacle 604, the planar workpiece 602 can be manipulated as necessary to slide it fully into  
32 the receptacle 604. After full insertion of the planar workpiece 602 into the receptacle 604, the  
33 operator squeezes the first handle 108 and the second handle 110 together to expand the gap

1 between the first jaw **710** and the second jaw **718** until it exceeds the width of the planar  
2 workpiece **602**, then the operator withdraws the gripper from the receptacle **604** leaving the  
3 planar workpiece **602** in place.

4 In FIG. **17** the planar workpiece **602** is shown as recessed below a receptacle frame edge  
5 **608**, which is a common occurrence either because the receptacle **604** is deeper than the  
6 planar workpiece **602** or because the planar workpiece **602** has become deformed during use.  
7 The planar workpiece **602** can be removed from the receptacle **604** in only one direction  
8 because the receptacle frame **606** is closed at the other end of the receptacle **604** (bottom of  
9 receptacle **604** is not shown in FIG. **17**). This placement of the planar workpiece recessed  
10 below (or level with) the receptacle frame edge represents the proper operational location for  
11 such a planar workpiece.

12 The components depicted in FIG. **17** including but not limited to the receptacle **604**, the  
13 receptacle frame **606**, and the receptacle frame edge **608** are an example of a mechanical  
14 system whose operation requires insertion and removal of a planar workpiece **602** that resides  
15 in a receptacle **604** during normal operation. The representation of FIG. **17** is for reference only;  
16 other arrangements are possible that utilize a planar workpiece **602** whose insertion and  
17 removal may require a specialized tool such as the currently described gripper.

18  
19

1 CLAIMS:

2 The invention claimed is:

3 1. A gripper for manipulating a planar workpiece (602) in a receptacle (604), the gripper  
4 comprising:

5 (a) a first arm (102) having a first handle (108), and a second arm (104) having a second  
6 handle (110), said arms (102), (104) being connected pivotally such that they  
7 operate in a tong-like fashion when the first handle (108) and the second handle  
8 (110) are actuated;

9 (b) a first jaw (116, 710) of rigid material and predetermined uniform thickness that  
10 attaches to a first jaw end (114) of said first arm (102) located opposite said first  
11 handle (108), said first jaw (116, 710) extending longitudinally as a flat surface from a  
12 first jaw leading edge (121) located opposite said first jaw end (114) in a direction  
13 toward said first jaw end (114) to a first jaw insertion limit line (119) at which said first  
14 jaw (116, 710) attaches to said first jaw end (114), and said first jaw (116, 710)  
15 extending as a flat surface laterally a width that is substantially at least 1.25 inches;

16 (c) a second jaw (118, 718) of rigid material and predetermined uniform thickness that  
17 attaches to a second jaw end (115) of said second arm (104) located opposite said  
18 second handle (110), said second jaw (118, 718) extending longitudinally as a flat  
19 surface from a second jaw leading edge (136) located opposite said second jaw end  
20 (115) in a direction toward said second jaw end (115) to a second jaw insertion limit  
21 line (204) at which said second jaw (118, 718) attaches to said second jaw end  
22 (115), and said second jaw (118, 718) extending as a flat surface laterally a width  
23 that is substantially at least 1.25 inches;

24 (d) a spring (122) and spring arms (120) that bias said gripper to the normally closed  
25 position as the result of said spring arms (120) exerting pressure on said first arm  
26 (102) and said second arm (104);

27 (e) a first gripping surface (206, 802) comprising that surface of said first jaw (116)  
28 located opposite said first jaw's (116) attachment point to said first jaw end (114),  
29 and a second gripping surface (132, 720) comprising that surface of said second jaw  
30 (118) located opposite said second jaw's (118) attachment point to said second jaw  
31 end (115), said first gripping surface (206, 802) and said second gripping surface  
32 (132, 720) together acting to grip said planar workpiece (602) when pressed against

1           said planar workpiece (602) by said spring (122) exerting pressure on said first arm  
2           (102) and said second arm (104);

3           (f) an arrangement of said first gripping surface (206, 802) and said second gripping  
4           surface (132, 720) such that these surfaces face one another directly and are  
5           substantially parallel to one another when separated by a gap approximately equal to  
6           the thickness of said planar workpiece (602);

7           whereby said first jaw (116, 710) and said second jaw (118, 718) can be inserted into said  
8           receptacle (604) with one jaw on each side of said planar workpiece (602), the insertion  
9           distance into said receptacle (604) being substantially parallel to the longitudinal axis of  
10          said first handle (108) and said second handle (110), and extending from each jaw's  
11          leading edge to each jaw's jaw insertion limit line.

12          2. The gripper of claim 1, wherein:

13           (a) said first jaw (116) is less than approximately 0.075 inches thick and attaches directly  
14           to and extends longitudinally from said first jaw end (114) in a direction away from  
15           said first handle (108) a distance that is substantially at least 1.25 inches;

16           (b) said second jaw (118) is less than approximately 0.075 inches thick and attaches  
17           directly to and extends longitudinally from said second jaw end (115) in a direction  
18           away from said second handle (110) a distance that is substantially at least 1.25  
19           inches;

20           (c) said first jaw (116) and said second jaw (118) are arranged so that both jaws can be  
21           inserted into a receptacle (604) a distance that is substantially at least 1.25 inches  
22           with one jaw on each side of said planar workpiece (602);

23           (d) said planar workpiece (602) is substantially at least 0.50 inches thick;

24          whereby said gripper enables insertion or removal of said planar workpiece (602) without  
25          damage or deformation when the proper operational location for said planar workpiece  
26          (602) is recessed below or level with a receptacle frame edge (608) of said receptacle  
27          (604), and said planar workpiece (602) may fit tightly or be stuck in said receptacle  
28          (604).

29          3. The gripper of claim 1, wherein:

30           (a) said first jaw (710) attaches at a right angle to a first offset jaw riser (708) at said first  
31           jaw insertion limit line (712) and extends longitudinally from said first jaw leading  
32           edge (804) to said first jaw insertion limit line (712) a distance that is substantially at

- 1 least 1.25 inches, and said first jaw (710) extends laterally to either side of said first  
2 arm (102);
- 3 (b) said first offset jaw riser (708) attaches at a right angle to a first offset jaw top step  
4 (706);
- 5 (c) said first offset jaw top step (706) attaches directly to said first jaw end (114) of said  
6 first arm (102);
- 7 (d) said first jaw (710), said first offset jaw riser (708), and said first offset jaw top step  
8 (706) together form a first offset jaw (702), said first offset jaw being a unitary  
9 element having three flat surfaces with the plane of said first offset jaw top step (706)  
10 being parallel to the plane of said first jaw (710);
- 11 (e) said first jaw (710) is less than approximately 0.075 inches thick;
- 12 (f) said second jaw (718) attaches at a right angle to a second offset jaw riser (716) at  
13 said second jaw insertion limit line (806) and extends longitudinally from said second  
14 jaw leading edge (722) to said second jaw insertion limit line (806) a distance that is  
15 substantially at least 1.25 inches, and said second jaw (718) extends laterally to  
16 either side of said second arm (104);
- 17 (g) said second offset jaw riser (716) attaches at a right angle to a second offset jaw top  
18 step (714);
- 19 (h) said second offset jaw top step (714) attaches directly to said second jaw end (115)  
20 of said second arm (104);
- 21 (i) said second jaw (718), said second offset jaw riser (716), and said second offset jaw  
22 top step (714) together form a second offset jaw (704), said second offset jaw (702)  
23 being a unitary element having three flat surfaces with the plane of said second  
24 offset jaw top step (714) being parallel to the plane of said second jaw (718);
- 25 (j) said second jaw (718) is less than approximately 0.075 inches thick;
- 26 (k) said first jaw (710) and said second jaw (718) are arranged so that both jaws can be  
27 inserted into a receptacle (604) a distance that is substantially at least 1.25 inches  
28 with one jaw on each side of said planar workpiece (602);
- 29 (l) said planar workpiece (602) is substantially at least 0.50 inches thick;
- 30 whereby said gripper enables insertion or removal of said planar workpiece (602) without  
31 damage or deformation when the proper operational location for said planar workpiece  
32 (602) is recessed below or level with a receptacle frame edge (608) of said receptacle

1 (604), and said planar workpiece (602) may fit tightly or be stuck in said receptacle  
2 (604).

3 4. A planar workpiece manipulation system comprising:

4 (a) a planar workpiece (602) that resides in a receptacle (604) when in operation, and  
5 whose use requires installation and removal by a human;

6 (b) a mechanical system containing said receptacle (604) populated by said planar  
7 workpiece (602);

8 (c) a gripper comprising a first arm (102) having a first handle (108), a second arm (104)  
9 having a second handle (110), said arms (102), (104) being connected pivotally such  
10 that they operate in a tong-like fashion when the first handle (108) and the second  
11 handle (110) are actuated;

12 (d) said gripper having a first jaw (116, 710) of rigid material and predetermined uniform  
13 thickness that attaches to a first jaw end (114) of said first arm (102) located opposite  
14 said first handle (108), said first jaw (116, 710) extending longitudinally as a flat  
15 surface from a first jaw leading edge (121) located opposite said first jaw end (114) in  
16 a direction toward said first jaw end (114) to a first jaw insertion limit line (119) at  
17 which said first jaw (116) attaches to said first jaw end (114), and said first jaw (116,  
18 710) extending as a flat surface laterally a width that is substantially at least 1.25  
19 inches;

20 (e) said gripper having a second jaw (118, 718) of rigid material and predetermined  
21 uniform thickness that attaches to a second jaw end (115) of said second arm (104)  
22 located opposite said second handle (110), said second jaw (118, 718) extending  
23 longitudinally as a flat surface from a second jaw leading edge (136) located  
24 opposite said second jaw end (115) in a direction toward said second jaw end (115)  
25 to a second jaw insertion limit line (204) at which said second jaw (118, 718)  
26 attaches to said second jaw end (115), and said second jaw (118, 718) extending as  
27 a flat surface laterally a width that is substantially at least 1.25 inches;

28 (f) said gripper having a spring (122) and spring arms (120) that bias said gripper to the  
29 normally closed position as the result of said spring arms (120) exerting pressure on  
30 said first arm (102) and said second arm (104);

31 (g) said gripper having a first gripping surface (206, 802) comprising that surface of said  
32 first jaw (116) located opposite said first jaw's (116) attachment point to said first jaw  
33 end (114), and a second gripping surface (132, 720) comprising that surface of said

1 second jaw (118) located opposite said second jaw's (118) attachment point to said  
2 second jaw end (115), said first gripping surface (206, 802) and said second gripping  
3 surface (132, 720) together acting to grip a planar workpiece (602) when pressed  
4 against said planar workpiece (602) by said spring (122) exerting pressure on said  
5 first arm (102) and said second arm (104);

6 (h) said gripper having an arrangement of said first gripping surface (206, 802) and said  
7 second gripping surface (132, 720) such that these surfaces face one another  
8 directly and are substantially parallel to one another when separated by a gap  
9 approximately equal to the thickness of the planar workpiece (602);

10 whereby said gripper's first jaw (116) and second jaw (118) can be inserted into said  
11 receptacle (604) with one jaw on each side of said planar workpiece (602), the insertion  
12 distance into said receptacle (604) being substantially parallel to the longitudinal axis of  
13 said first handle (108) and said second handle (110), and extending from each jaw's  
14 leading edge to each jaw's jaw insertion limit line.

15 5. The planar workpiece manipulation system of claim 4, wherein:

16 (a) said first jaw (116) is less than approximately 0.075 inches thick and attaches directly  
17 to and extends longitudinally from said first jaw end (114) in a direction away from  
18 said first handle (108) a distance that is substantially at least 1.25 inches;

19 (b) said second jaw (118) is less than approximately 0.075 inches thick and attaches  
20 directly to and extends longitudinally from said second jaw end (115) in a direction  
21 away from said second handle (110) a distance that is substantially at least 1.25  
22 inches;

23 (c) said first jaw (116) and said second jaw (118) are arranged so that both jaws can be  
24 inserted into a receptacle (604) a distance that is substantially at least 1.25 inches  
25 with one jaw on each side of said planar workpiece (602);

26 (d) said planar workpiece (602) is substantially at least 0.50 inches thick;

27 whereby said planar workpiece manipulation system enables insertion or removal of said  
28 planar workpiece (602) without damage or deformation when the proper operational  
29 location for said planar workpiece (602) is recessed below or level with a receptacle  
30 frame edge (608) of said receptacle (604), and said planar workpiece (602) may fit  
31 tightly or be stuck in said receptacle (604).

- 1       6. The planar workpiece manipulation system of claim 4, wherein:
- 2           (a) said first jaw (710) attaches at a right angle to a first offset jaw riser (708) at said first
- 3                 jaw insertion limit line (712) and extends longitudinally from said first jaw leading
- 4                 edge (804) to said first jaw insertion limit line (712) a distance that is substantially at
- 5                 least 1.25 inches, and said first jaw (710) extends laterally to either side of said first
- 6                 arm (102);
- 7           (b) said first offset jaw riser (708) attaches at a right angle to a first offset jaw top step
- 8                 (706);
- 9           (c) said first offset jaw top step (706) attaches directly to said first jaw end (114) of said
- 10                 first arm (102);
- 11           (d) said first jaw (710), said first offset jaw riser (708), and said first offset jaw top step
- 12                 (706) together form a first offset jaw (702), said first offset jaw being a unitary
- 13                 element having three flat surfaces with the plane of said first offset jaw top step (706)
- 14                 being parallel to the plane of said first jaw (710);
- 15           (e) said first jaw (710) is less than approximately 0.075 inches thick;
- 16           (f) said second jaw (718) attaches at a right angle to a second offset jaw riser (716) at
- 17                 said second jaw insertion limit line (806) and extends longitudinally from said second
- 18                 jaw leading edge (722) to said second jaw insertion limit line (806) a distance that is
- 19                 substantially at least 1.25 inches, and said second jaw (718) extends laterally to
- 20                 either side of said second arm (104);
- 21           (g) said second offset jaw riser (716) attaches at a right angle to a second offset jaw top
- 22                 step (714);
- 23           (h) said second offset jaw top step (714) attaches directly to said second jaw end (115)
- 24                 of said second arm (104);
- 25           (i) said second jaw (718), said second offset jaw riser (716), and said second offset jaw
- 26                 top step (714) together form a second offset jaw (704), said second offset jaw (702)
- 27                 being a unitary element having three flat surfaces with the plane of said second
- 28                 offset jaw top step (714) being parallel to the plane of said second jaw (718);
- 29           (j) said second jaw (718) is less than approximately 0.075 inches thick;
- 30           (k) said first jaw (710) and said second jaw (718) are arranged so that both jaws can be
- 31                 inserted into a receptacle (604) a distance that is substantially at least 1.25 inches
- 32                 with one jaw on each side of said planar workpiece (602)

1 (l) said planar workpiece (602) is substantially at least 0.50 inches thick;  
2 whereby said planar workpiece manipulation system enables insertion or removal of said  
3 planar workpiece (602) without damage or deformation when the proper operational  
4 location for said planar workpiece (602) is recessed below or level with a receptacle  
5 frame edge (608) of said receptacle (604), and said planar workpiece (602) may fit  
6 tightly or be stuck in said receptacle (604).

7

8

1 ABSTRACT:

2 This apparatus supports gripping, manipulation and/or insertion or removal of a planar  
3 workpiece from a receptacle into which it fits tightly. The apparatus has two substantially  
4 identical rigid arms attached to one another at a single pivot point near their longitudinal center.  
5 One end of each arm forms a handle; pressing or releasing these two handles actuates the  
6 gripper. The other end of each arm has attached on its inside surface a rigid plate. Together  
7 these two substantially parallel plates form jaws to grip the planar workpiece. A spring attached  
8 to the two handles biases the jaws toward the closed position. An optional adjustable stop  
9 mechanism supports setting the gap between jaws when the apparatus is in the closed position.  
10 An alternative embodiment utilizes step-shaped jaws for applications where flat jaws are difficult  
11 to utilize.  
12