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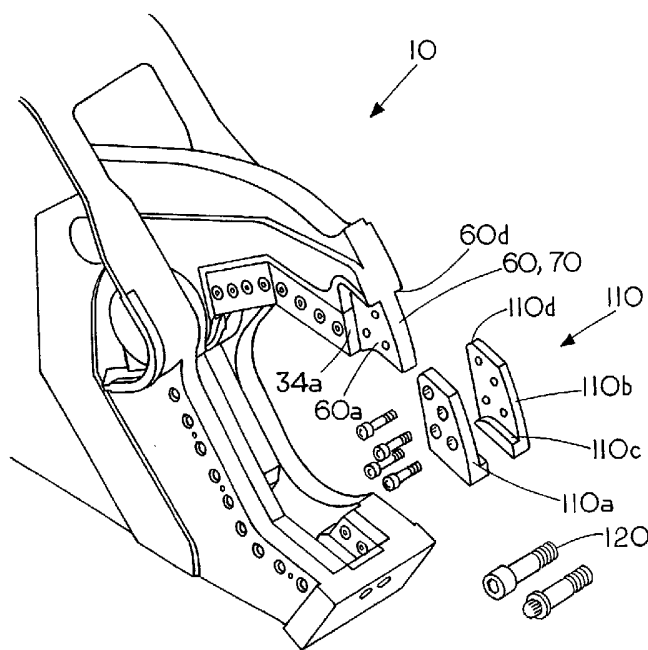
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(54) Title: DEMOLITION SHEAR WITH REPLACEABLE SHEARING TIP



(57) Abstract: A heavy-duty demolition shear (10) with a replaceable shearing tip (110) has a lower jaw (12) and an upper jaw (14) pivotally connected to the lower jaw. The upper jaw (14) has primary and secondary shear blades (33, 34). A replaceable shearing tip (110) is mounted to the upper jaw (14). The replaceable shearing tips (110) has two L-shaped sections (110a, 110b) which engage the upper jaw (14) between them. The replaceable shearing tip (110) engages the upper jaw (14) on at least three seats (60). The replaceable shearing tip (110) is connected to the upper jaw (14) by socket-head cap-screws (120).

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## DEMOLITION SHEAR WITH REPLACEABLE SHEARING TIP

**BACKGROUND OF THE INVENTION**

A fuller understanding of the operation of the demolition apparatus of the present invention may be achieved by studying U.S. Pat. No. 4,519,135, hereby incorporated by  
5 reference. This invention relates to a heavy duty demolition apparatus, especially adapted to be mounted on a rigid boom of a mobile vehicle and particularly adapted to be mounted on the dipper stick of an excavator.

The invention also has a replaceable shearing tip on the movable upper jaw.

Heavy duty shears of the type that are powered by hydraulic cylinders are proving  
10 more and more useful in handling scrap and especially metal scrap of all sorts. Such scrap comes in many different forms, and may be in the form of pipes made of steel or soft iron or cast iron, ranging in sizes from 2 inches or smaller, and up to 8 or 10 inches in diameter or larger; structural beams such as I-beams, channels, angle beams in a large range of sizes, up to 8 or 10 inches across and larger; rods and heavy cables having diameters of 2 to 3 inches  
15 and larger, metal sheets and plates and formed metal of all sorts including wheels and automobile and truck frames, and a myriad of long and short pieces of stock and metal pieces that are cast, rolled, stamped or otherwise formed, both singly and in various types of assembly.

The prior art has included numerous shears such as that illustrated in U.S. Pat. No.  
20 4,198,747; U.S. Pat. No. 4,188,721; U.S. Pat. No. 4,897,921; U.S. Pat. No. 4,543,719; U.S. Pat. No. 4,558,515 and U.S. Pat. No. 4,104,792. Typically, these heavy duty shears mount on the dipper stick of an excavator so that the shears may be controlled fairly well in handling various types of scrap and cutting the scrap into smaller twisted and contorted pieces and lengths as the scrap is drawn into the throat of the shear.

25 Typically, these shears have a fixed lower jaw and a movable upper jaw that pivots on the lower jaw, with shear blades of hardened steel on both the upper jaw and the lower jaw. The workpiece is sheared by closing the upper jaw against the lower jaw under hydraulic pressure, with the shear blades cutting the workpiece. The movable upper jaw may also have a fixed, hardened shearing tip integral with the upper jaw. The tip is not suitable for removal  
30 and replacement due to the high lateral forces exerted on the tip as the movable jaw flexes

laterally. Great tension is also exerted upon the tip, which may be wedged tight with scrap, upon opening the jaws. Direct shear bearing loads are also on the tip when shearing. All these factors will cause a removable tip to readily break off the upper jaw.

There is a need for a heavy duty demolition shear with a replaceable shearing tip

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### **SUMMARY OF THE INVENTION**

A heavy-duty demolition shear with a replaceable shearing tip has a lower jaw and an upper jaw pivotally connected to the lower jaw. The upper jaw has primary and secondary shear blades. A replaceable shearing tip is mounted to the upper jaw. The replaceable shearing tip has two L-shaped sections which engage the upper jaw between them. The  
10 replaceable shearing tip engages the upper jaw on at least three seats. The replaceable shearing tip is connected to the upper jaw by socket-head cap-screws.

A principal object and advantage is that the upper jaw has a replaceable shearing tip.

Another object and advantage is that the replaceable tip is held in place by socket-headed cap-screws which will hold the tip in place despite high direct and lateral forces, as  
15 well as stress shearing forces and tensional forces exerted on the tip when opening the shear with jammed scrap pieces about the tip.

Another object and advantage is that the tip is supported on the upper jaw on at least three seating surfaces, which alleviates stress shearing forces and tensional forces.

Another object and advantage of the present invention is that the tip encapsulates the  
20 upper jaw and prevents the upper jaw from being damaged by forces exerted on the tip.

Other advantages will be understood from reading the Detailed Description of Preferred Embodiments.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

FIG. 1 is a right-side perspective view of the demolition apparatus with the  
25 replaceable shearing tip of the present invention, showing the tip assembled on the apparatus.

FIG. 2 is like Fig. 1, but with the tip exploded off the apparatus (disassembled).

FIG. 3 is similar to Fig. 2, but is a left-side perspective view.

FIG. 4 is similar to Fig. 1, but is a left-side perspective view..

FIG. 5 is a partial right-side elevational view of the upper jaw of the apparatus with the tip mounted thereon, showing various angles.

5 FIG. 6 is a cross-section at approximately the lines 6 of Fig. 5.

FIG. 7 is similar to Fig. 5, showing additional angles.

FIG. 8 is similar to Fig. 6, showing additional dimensions.

FIG. 9 is similar to Fig. 5, showing additional angles.

FIG. 10 is similar to Fig. 5, showing additional angles.

10 FIG. 11 is similar to Fig. 5, showing additional angles.

FIG. 12 is similar to Fig. 5, showing additional angles.

FIG. 13 is a right-side elevational view of the apparatus of the present invention.

### **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

15 The heavy-duty demolition apparatus of the present invention is generally referred to in the Figures as reference numeral 10.

Referring to FIGS. 1 through 6, the heavy-duty demolition apparatus 10 comprises a lower jaw 12, an upper jaw 14, and pivot means 16 interconnecting the lower jaw 12 and upper jaw 14.

20 The upper jaw 14 has a first side 22, and a second side 24. The lower jaw 12 has a first mounting plate 26 adjacent the first side 22, and a second mounting plate 28 adjacent the second side 24. The first mounting plate 26 and second mounting plate 28 receive the pivot means 16 between them.

The upper jaw 14 has upper shear blades 33 and 34 meeting at apex 35 and the lower jaw 12 has lower shear blades 36 and 37 extending along each other for shearing a workpiece

when the upper shear blades 33 and 34 are closed upon the lower shear blades 36 and 37. Preferably, the shear blades 33, 34, 36 and 37 are replaceable.

Preferably, the apparatus 10 further comprises a guide blade 48 on the lower jaw 12 lying along the lower shear blade 36 and in spaced relation therewith, the outer end 50 of the guide blade and outer end 52 of the shear blade being adjacent each other, and rigid means 54  
5 securing the outer ends 50, 52 together. The rigid means 54 is preferably a tie plate 56.

An open slot 58 preferably exists between the lower shear blade 36 and the adjacent guide blade 48 to receive the upper shear blade 34 therein, the open slot 58 having a width wider than the thickness of the upper shear blade 34 to maintain open space between the  
10 upper shear blade 34 and the guide blade 48 when the upper shear blade 34 is in the open slot 58.

On the first shearing side 22, the upper jaw will receive the upper primary shear blade 31 and the upper secondary shear blade 33. The shear blades 31 and 33 meet at the upper shear blade apex 35 which is the last point wherein the upper jaw 14 shears a workpiece  
15 against lower elongate shear blade 36. On the lower jaw 12, the lower primary shear blade 36 and lower secondary shear blade 37 are received.

To accommodate secure attachment of the replaceable shearing tip 110, the upper, movable jaw 14 is modified to include a tip mounting portion 60, as seen in Figs. 1-4.

The tip mounting portion 60 further comprises a first mounting surface 60a on the  
20 first side 22 of the upper jaw 14, and a second mounting surface 60b on the second side 24. A third mounting surface 60c is located on the bottom side of the upper jaw 14 between the first mounting surface 60a and the second mounting surface 60b. A fourth mounting surface 60d is located above each of the first 60a and second 60b mounting surfaces on the upper jaw 14. Between the first mounting surface 60a and the second mounting surface 60b is narrowed  
25 upper jaw tip portion 70.

The replaceable shearing tip 110 comprises a first half 110a and a second half 110b. The first half 110a mounts to the first mounting surface 60a, while the second half 110b mounts to the second mounting surface 60b. Each of the first half 110a and second half 110b has a ledge or flange 110c that engages the third mounting surface 60c. In overall  
30 configuration, it will be seen that each of the first half 110a and second half 110b is "L"-

shaped in cross-section. In addition, each of the first half 110a and second half 110b has a top edge 110d that engages the fourth mounting surface 60d. The first half 110a and second half 110b each have a rear surface 110e that engages the upper secondary shear blade 34 at forward edge 34a. The first half 110a and second half 110b each have a bottom edge 110f.

5 As best seen in Fig. 6, the replaceable shearing tip 110 is preferably mounted to the tip mounting portion 60 by socket head or spline-head cap-screws 120. Holes 122 are drilled through the first half 110a and the second half 110b to receive the cap-screws 120. The second half 110b is preferably tapped with internal threads that engage external threads on the cap-screw 120. The first half 110a is preferably counter-bored with counter-bores 124 to receive the head 120a of the cap-screw 120. As can be seen, most preferably the thickness of the first half 110a that has the counter-bore 124 is equal to or greater than the thickness of the second half 110b. Also, the thickness of the narrowed upper jaw tip portion 70 is equal to or greater than thickness of either the first half 110a or the second half 110b. Further, as seen best in Fig. 8, the thickness of d1 the material of the first half 110a beneath and supporting the cap-screw head 120a is less than the depth d2 of the cap-screw head counter-bore 124. These structural features provide structural strength to the components.

For stress relief, it is highly preferred that the top edge 110d is radiused where it meets the third mounting surface 60c, which is similarly radiused. Also, the bottom ledge or flange 110c is partially radiused where it meets the third mounting surface 60c. See Fig. 6.

20 As a result of the above structure, as seen in Fig. 7a and 7b, the replaceable shearing tip 110 will seat against the upper movable jaw 14 on at least three separate surfaces or seats: surfaces 60c, 60d, and 34a. This is in addition to the mounting surfaces 60a and 60b on the narrowed upper jaw tip portion 70. This feature greatly relieves stress on the tip 110 and serves to hold the tip 110 firmly in place on the upper jaw 14 as the tip 110 pierces and is later withdrawn from the workpiece.

In addition, the structure of the replaceable shearing tip 110 encapsulates the narrowed upper jaw tip portion 70 and protects it. The tip 110 is more durable than previous replaceable tips and the fastening systems used therewith. Because the tip 110 is constructed of paired halves 110a, 110b, in the event that one of the halves is damaged, it is only necessary to replace that half and not the whole tip.

30

The socket-headed or spline-headed cap-screws 120 allow the tip 110 to be attached to the upper jaw 14 without bolts, improving strength and allowing more material to be used in the upper jaw. Further, an Allen wrench can be used to drive the socket-headed cap-screws 120 into the bores 124, instead of using a box-end wrench or socket wrench on the outside of the screw heads 120a. This requires less material to be removed from the upper jaw 14.

Applicant has found that, for optimum performance and reliability of the replaceable shearing tip 110, a number of important angular relationships between the parts thereof and the upper jaw 14 are highly desirable.

First, as best seen in Figs. 5 and 10, an angle  $\alpha_1$  between the bottom edge 110f of each of the first half 110a and second half 110b and the lower edge 34b of the secondary shear blade 34 should be in the range of  $-10^\circ$  to  $+35^\circ$ . Fig. 10 shows an angle  $\alpha_1$  of  $+10^\circ$ . This optimization tends to prevent the piercing tip 110 from moving outward from the secondary blade 34 as the piercing tip 110 contacts the workpiece.

Second, as best seen in Figs. 5 and 9, an angle  $\alpha_2$  between the fourth mounting surface 110d and the top edge 34c of the secondary shear blade 34 should be in the range of  $-20^\circ$  to  $+25^\circ$ . Fig. 9 shows an angle  $\alpha_2$  of  $+10^\circ$ . This optimization helps to hold the tip 110 in place on the upper jaw 14 from a force trying to push the tip 110 forward from the forward edge 34a of the secondary shear blade 34.

Third, as best seen in Figs. 5 and 11, an angle  $\alpha_3$  between the front surface 110g of either the first half 110a or the second half 110b, and the lower edge 34b of the secondary shear blade 34 should be in the range of  $55^\circ$  to  $75^\circ$ . In the embodiment shown in the phantom line L in Fig. 12, the angle  $\alpha_3$  is measured between the lower edge 34b and a line L from the top corner 110g1 to the bottom corner 110g2 of the front surface 110g.

Fourth, as best seen in Fig. 12, an angle  $\alpha_4$  between the bottom edge 110f of the replaceable shearing tip 110 and the ledge or flange 110c should be in the range of  $-15^\circ$  to  $+15^\circ$ .

Fig. 14 shows the sequence of positions that the tip 110 will take within the lower jaw 12 as the upper jaw 14 closes on the lower jaw 12. It will be seen that force directed against the tip 110 by the workpiece will result in force being applied to the secondary shearing blade

34 at a variety of angles as the tip successively encounters and the penetrates the workpiece (not shown). The structure of the tip 110 serves to keep the tip 110 firmly in contact with the secondary shear blade 34 with minimum stress.

5 The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and it is therefore desired that the present embodiment be considered in all respects as illustrative and not restrictive reference being made to the appended claims rather than to the foregoing description to indicate the scope of the invention.



**WHAT IS CLAIMED:**

1. A heavy-duty demolition shear with a replaceable shearing tip, the apparatus having a lower jaw and an upper jaw pivotally connected to the lower jaw, the upper jaw having a primary shearing blade and a secondary shearing blade, comprising:

- 5 (a) a tip mounting portion on the upper jaw; and
- (b) a replaceable shearing tip mountable to the tip mounting portion, wherein the replaceable shearing tip further comprises two sections encompassing the tip mounting portion there-between.

2. The apparatus of claim 1, wherein the two sections are substantially L-shaped.

10 3. The apparatus of claim 1, wherein the tip mounting portion is narrower than the remainder of the upper jaw.

4. The apparatus of claim 1, wherein the two sections are connected to the tip mounting portion by fasteners which lie entirely within the two sections.

15 5. The apparatus of claim 4, wherein the fasteners are screws with a socket head accepting an Allen wrench-type tool.

6. The apparatus of claim 5, wherein one of the sections is counter-bored to accept the socket head and the other section is tapped to accept the other end of the screw.

7. The apparatus of claim 1, wherein the upper jaw further comprises at least three seats for engaging the replaceable shearing tip.

20 8. The apparatus of claim 7, wherein one of the at least three seats is a forward edge of the secondary shear blade, and wherein the replaceable shearing tip abuts firmly against the forward edge without a gap.

9. The apparatus of claim 7, wherein the two sections of the replaceable shearing tip are L-shaped, and wherein one of the at least three seats engages the long arm of the L.

25 10. The apparatus of claim 9, wherein the seat engaging the long-arm of the L is radiused.

11. The apparatus of claim 9, wherein one of the at least three seats engages the short arm of the L.

12. The apparatus of claim 11, wherein the seat engaging the short arm of the L is radiused.

5 13. The apparatus of claim 1, wherein each section has a bottom edge and the secondary shear blade has a lower edge, and wherein an angle between the section bottom edge and the secondary shear blade lower edge is in the range of  $-10^{\circ}$  to  $+35^{\circ}$ .

14. The apparatus of claim 9, wherein the secondary shear blade has a top edge, and wherein an angle between the seat engaging the long arm of the L and the top edge of the  
10 secondary shear blade is in the range of  $-20^{\circ}$  to  $+25^{\circ}$ .

15. The apparatus of claim 1, wherein each section has a front surface and the secondary shear blade has a lower edge, and wherein an angle between the front surface and the secondary shear blade lower edge is in the range of  $55^{\circ}$  to  $75^{\circ}$ .

16. The apparatus of claim 11, wherein each section has a bottom edge and the  
15 short arm of the L has a ledge engaging the seat, and wherein an angle between the bottom edge and the ledge is in the range of  $-15^{\circ}$  to  $+15^{\circ}$ .

17. The apparatus of claim 6, wherein the section that is counter-bored has a thickness equal to or greater than the thickness of the section that is tapped.

18. The apparatus of claim 1, wherein the thickness of the tip mounting portion is  
20 equal to or greater than the thicknesses of the sections.

19. The apparatus of claim 17, wherein the thickness of the section that is counter-bored under the counter-bore supporting the screw head is less than the depth of the counter-bore.

20. A heavy-duty demolition shear with a replaceable shearing tip, the apparatus having a lower jaw and an upper jaw pivotally connected to the lower jaw, the upper jaw having a primary shearing blade and a secondary shearing blade, comprising:

- (a) a tip mounting portion on the upper jaw; and
- 5 (b) a replaceable shearing tip mountable to the tip mounting portion, wherein the replaceable shearing tip further comprises two sections encompassing the tip mounting portion there-between, wherein the two sections are substantially L-shaped,
- (c) wherein the upper jaw further comprises at least three seats for  
10 engaging the replaceable shearing tip, one of the three seats engaging the long arm of the L-shaped section; and
- (d) wherein the secondary shearing blade has a top edge, and an angle between a seat engaging the long arm of the L-shaped section and the top edge of the shearing blade is in the range of  $-20^{\circ}$  to  $+25^{\circ}$ .

21. A heavy-duty demolition shear with a replaceable shearing tip, the apparatus having a lower jaw and an upper jaw pivotally connected to the lower jaw, the upper jaw having a primary shearing blade and a secondary shearing blade, comprising:

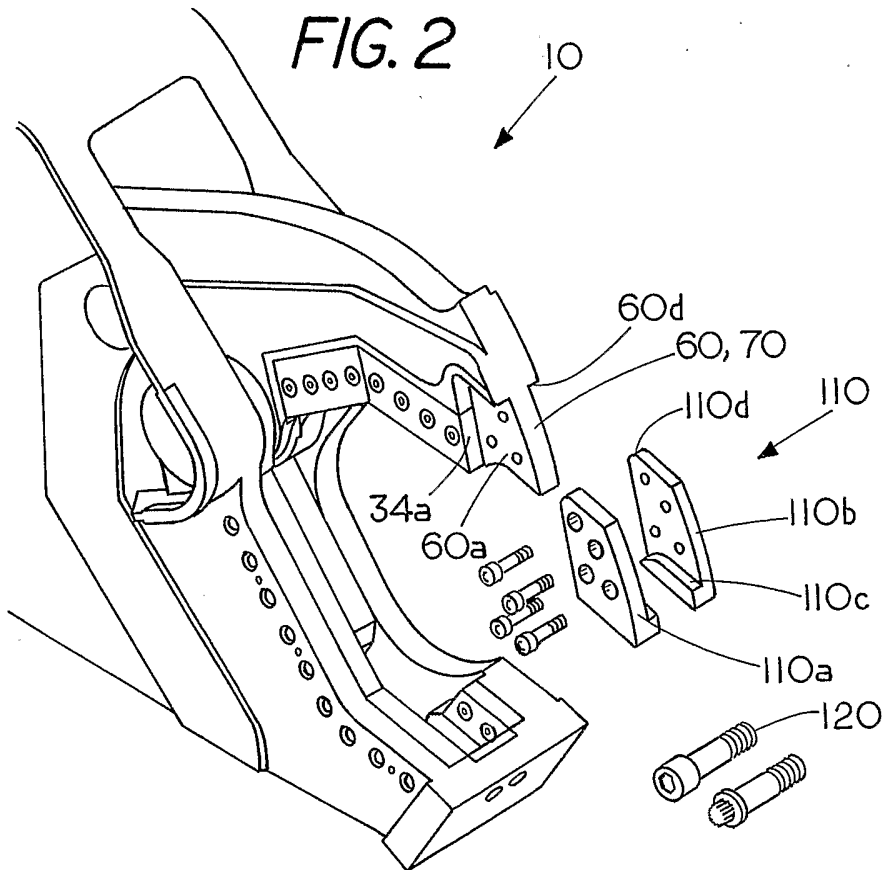
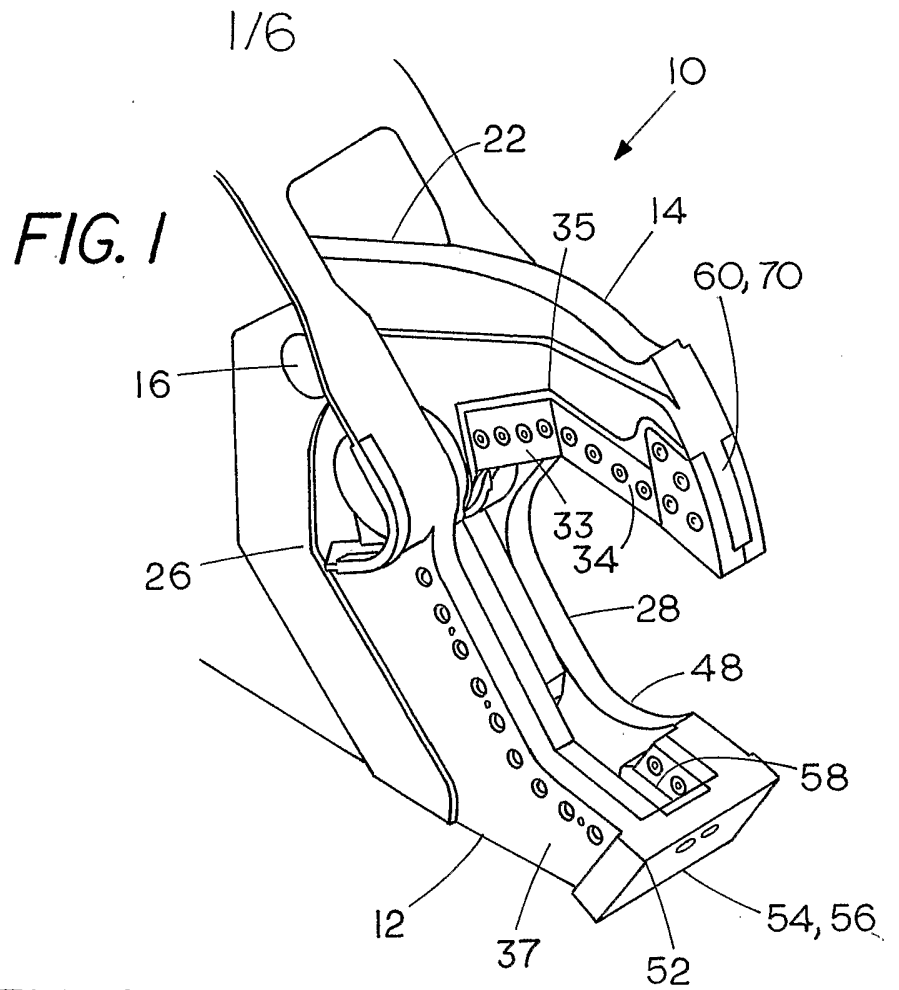
- (a) a tip mounting portion on the upper jaw; and
- 5 (b) a replaceable shearing tip mountable to the tip mounting portion, wherein the replaceable shearing tip further comprises two sections encompassing the tip mounting portion there-between, each section having a bottom edge, and
- 10 (c) wherein the secondary shearing blade has a lower edge, and wherein an angle between the section bottom edge and secondary shearing blade lower edge is in the range of  $-10^{\circ}$  to  $+35^{\circ}$ .

22. A heavy-duty demolition shear with a replaceable shearing tip, the apparatus having a lower jaw and an upper jaw pivotally connected to the lower jaw, the upper jaw having a primary shearing blade and a secondary shearing blade, comprising:

- (a) a tip mounting portion on the upper jaw; and
- 5 (b) a replaceable shearing tip mountable to the tip mounting portion, wherein the replaceable shearing tip further comprises two sections encompassing the tip mounting portion there-between, wherein the two sections are substantially L-shaped, each section having a front surface and
- 10 (c) wherein the secondary shearing blade has a lower edge, and an angle between the front surface and the secondary shearing blade lower edge is in the range of 55° to 75°.

23. A heavy-duty demolition shear with a replaceable shearing tip, the apparatus having a lower jaw and an upper jaw pivotally connected to the lower jaw, the upper jaw having a primary shearing blade and a secondary shearing blade, comprising:

- (a) a tip mounting portion on the upper jaw; and
- 5 (b) a replaceable shearing tip mountable to the tip mounting portion, wherein the replaceable shearing tip further comprises two sections encompassing the tip mounting portion there-between, wherein the two sections are L-shaped, each having a bottom edge and the short arm of the L-shaped section has a ledge thereon for mounting to the tip  
10 mounting portion, and
- (c) wherein an angle between the bottom edge and the ledge is in the range of  $-15^{\circ}$  to  $+15^{\circ}$ .





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FIG. 3

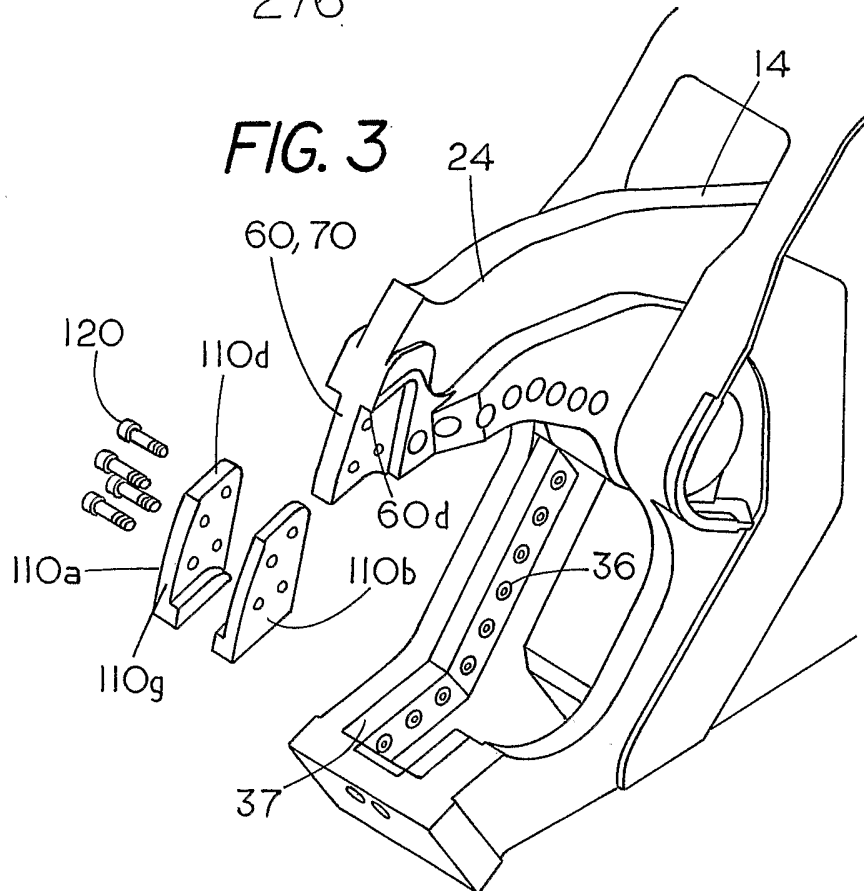
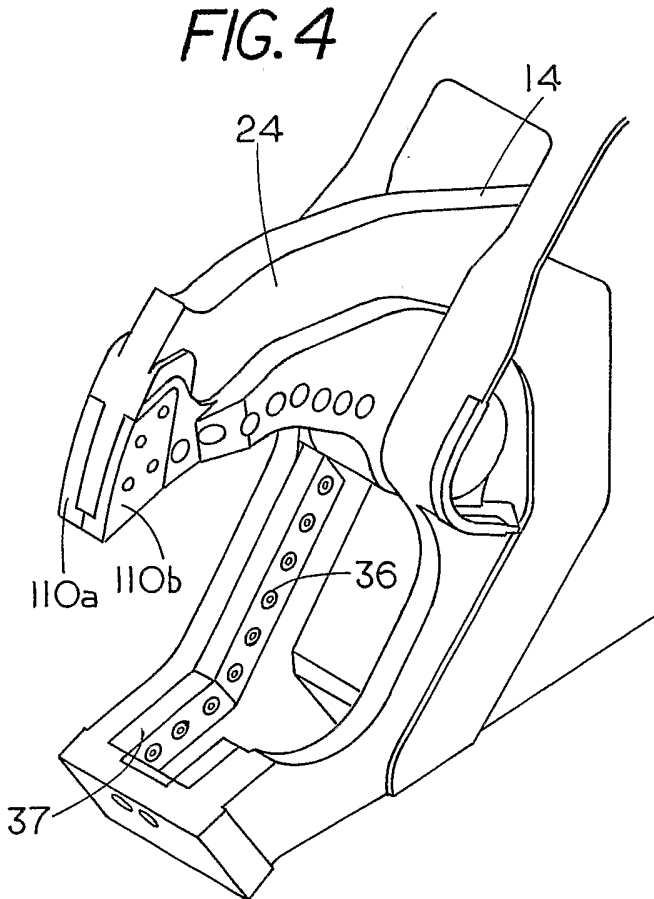


FIG. 4





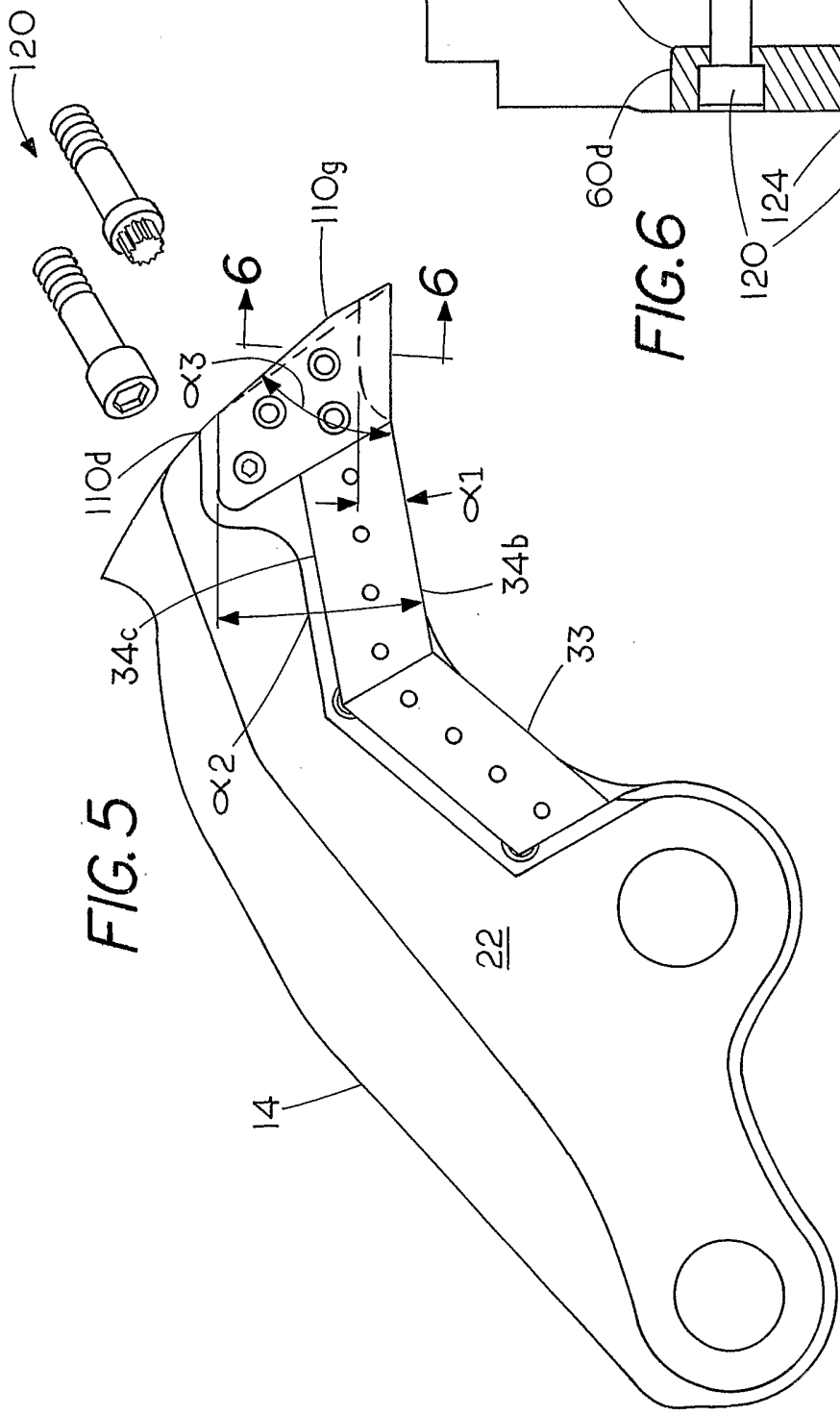


FIG. 5

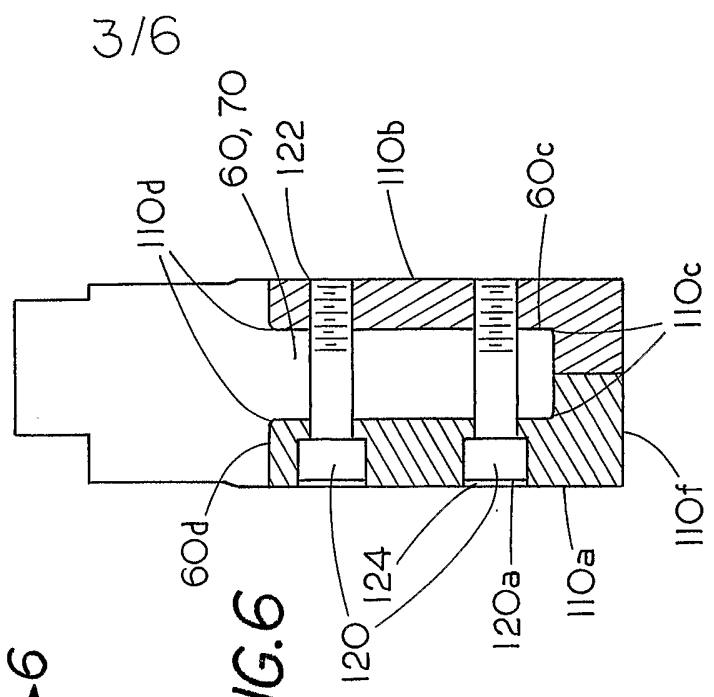
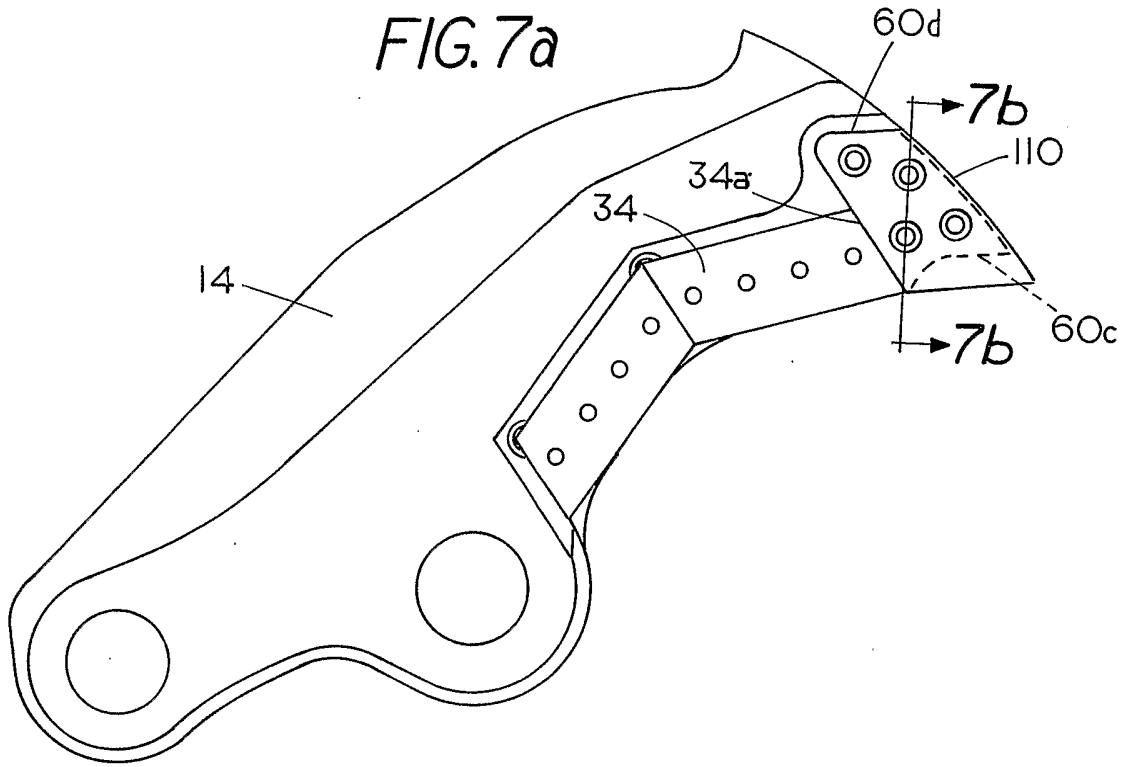
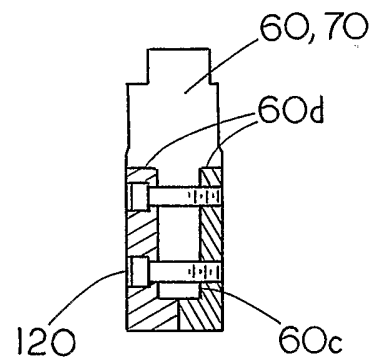


FIG. 6

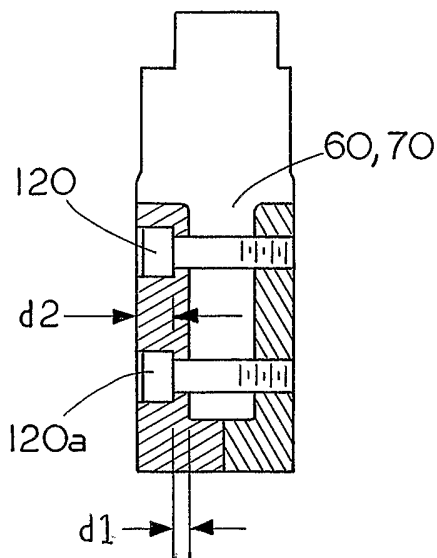




**FIG. 7b**

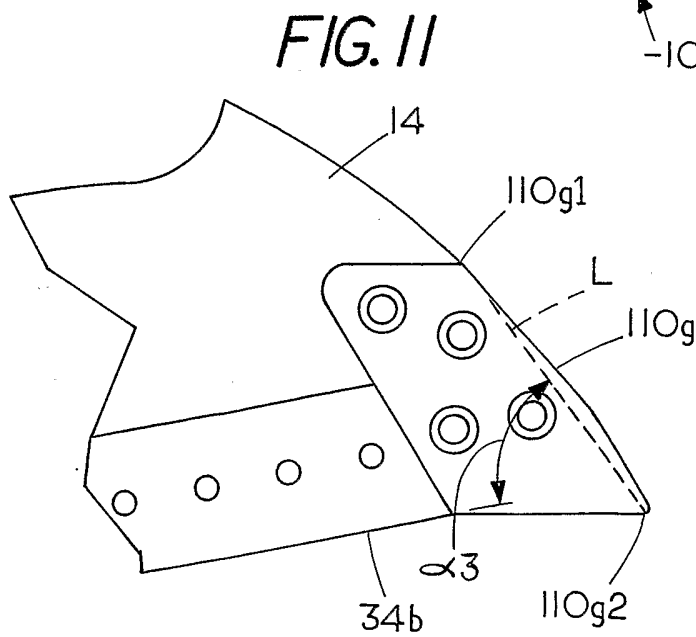
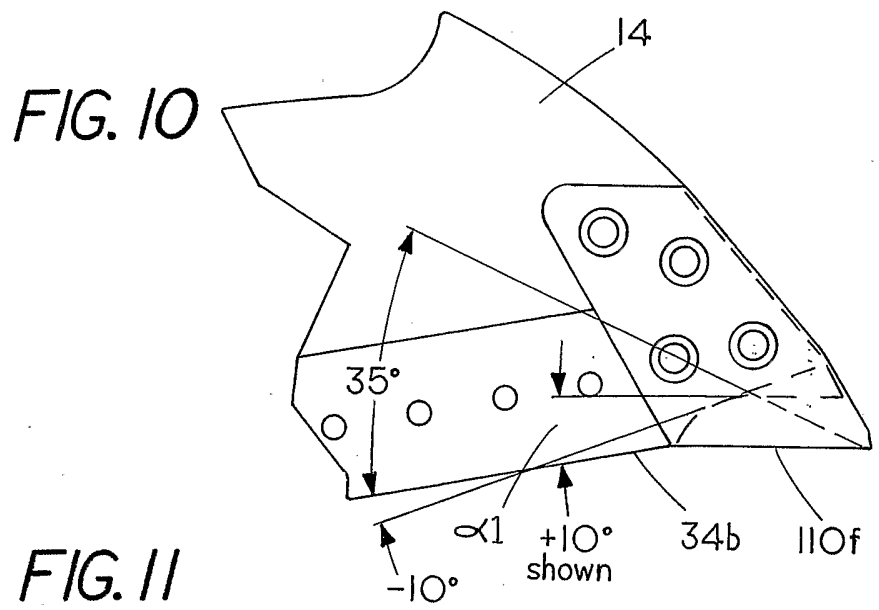
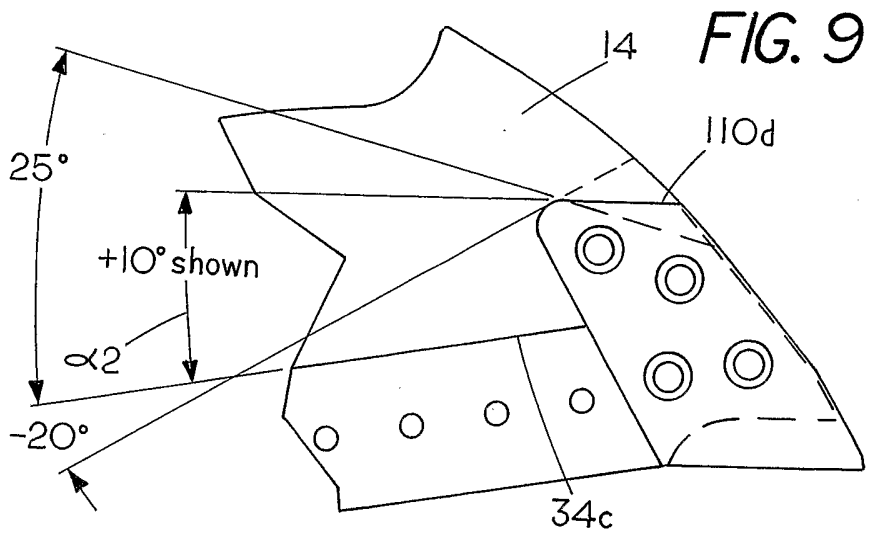


**FIG. 8**



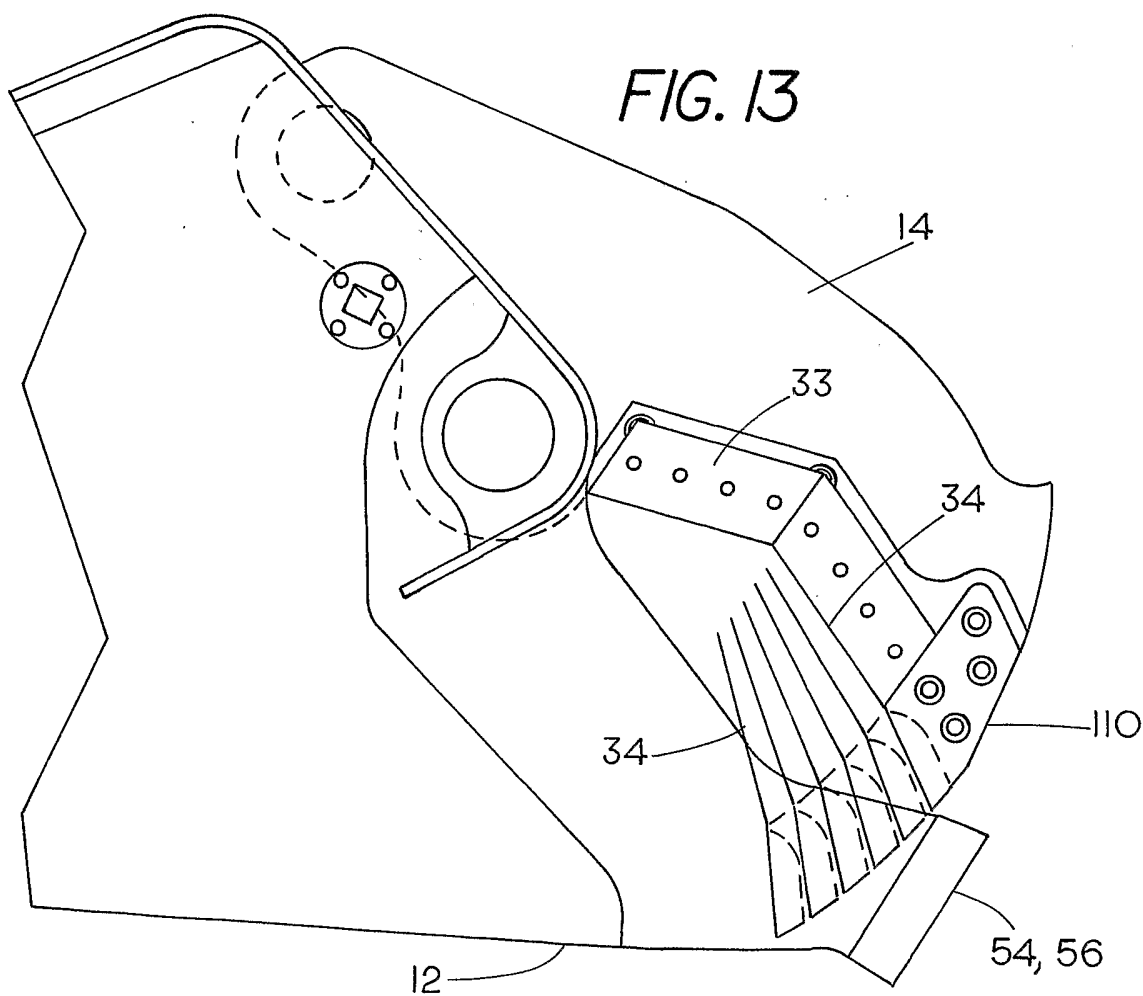
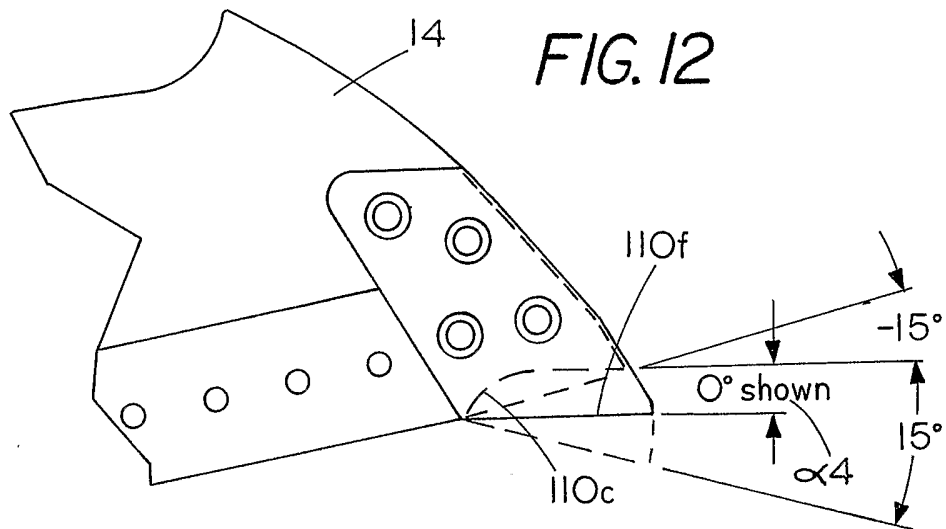


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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 03/36817

A. CLASSIFICATION OF SUBJECT MATTER  
 IPC 7 B23D17/00 B23D35/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B23D E04G E02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

PAJ, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages  | Relevant to claim No.             |
|------------|---|-----------------------------------|
| X          | PATENT ABSTRACTS OF JAPAN<br>vol. 1997, no. 11,<br>28 November 1997 (1997-11-28)<br>-& JP 09 195528 A (NIPPON PNEUMATIC MFG CO<br>LTD), 29 July 1997 (1997-07-29) | 1-4,<br>7-11,<br>13-16,<br>18, 20 |
| Y          | abstract  | 5, 6, 12,<br>17, 19               |
| Y          | EP 0 768 137 A (OYODO DIESEL KK)<br>16 April 1997 (1997-04-16)<br>figure 9A   | 5, 6, 17,<br>19                   |
| Y          | US 5 992 023 A (SEDERBERG CLAYTON ET AL)<br>30 November 1999 (1999-11-30)<br>figures 8-10   | 12                                |
| A          | EP 0 666 131 A (WACK HELMUT)<br>9 August 1995 (1995-08-09)  |                                   |
|            | -/--  |                                   |



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Patent family members are listed in annex.

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Date of the actual completion of the international search

29 March 2004

Date of mailing of the international search report

02/04/2004

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## INTERNATIONAL SEARCH REPORT

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| C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT |   |                       |
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| Category °   | Citation of document, with indication, where appropriate, of the relevant passages                      | Relevant to claim No. |
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