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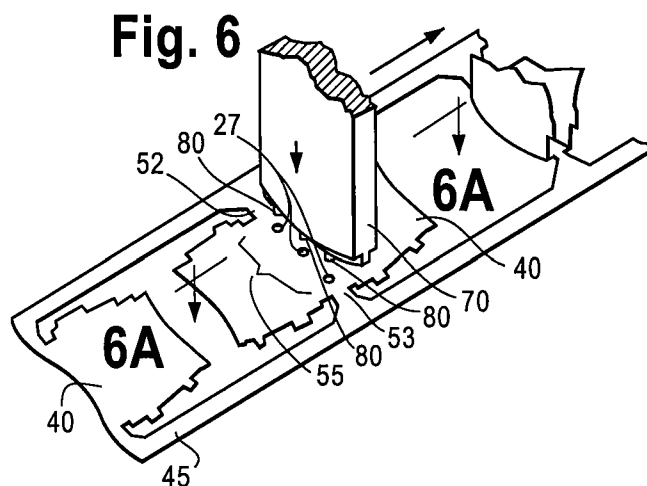
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(54) Title: ARCUATE MAGAZINE FOR A FIREARM AND A METHOD FOR MAKING THE SAME



(57) Abstract: An arcuate magazine for a firearm, such as a rifle or carbine, which has a keyway and follower assembly for delivering rounds of ammunition one at a time to the firing area of the firearm and which may be fabricated from a single piece of metal and have a smooth interior free of welds and rough spots. The invention also includes a method of making such a magazine which includes the steps of deep drawing and wiping the magazine body under substantial pressure using a progressive die having numerous stations.

**ARCUATE MAGAZINE FOR A FIREARM AND
A METHOD FOR MAKING THE SAME**

Priority Claim

[1] This application claims priority from U.S. Provisional Patent Application SN 60/ 922,104 filed 06 April 2007, entitled METHOD TO DRAW AND FORM A CURVED FIREARM CARTRIDGE MAGAZINE BODY WITH A KEYWAY.

Background and Summary of the Invention

[2] This invention relates to a cartridge magazine for a firearm and a method for making such a magazine, and is more particularly related to such a magazine and method wherein the magazine is arcuate in shape and has a body preferably formed from a single piece of metal.

[3] Such a magazine is used to contain ammunition, such as a series of cartridges, which are fed one at a time by spring means into a firing chamber of a weapon. The spring means maintains pressure on the ammunition to force each cartridge in to the firing chamber, and when spent to deliver the next round into firing position.

[4] An example of a firearm using a magazine is the M16 rifle or carbine, which has become a standard rifle in the United States weapons arsenal and in other western countries. There are several variations of the M16 weapon family, such as the M16/A1, A2, A3 and A4, which are the primary infantry rifles used by the U.S. military and 15 NATO countries since the early 1960s. These weapons use a magazine of the type disclosed in this application embodying the present invention.

[5] Preferably, such a magazine is arcuately shaped, and has a substantially rectangular cross section with parallel opposed longer sides defined by the height of the cartridge arranged

between parallel opposed shorter sides defined by the width of the cartridge. One end of the magazine is closed with a removable base plate, and the other end is open to permit a cartridge in juxtaposition to the firing chamber of the weapon to be placed in firing position. Preferably, such a magazine is fabricated from steel rather than plastic or aluminum, as the magazine is subject to heat and substantial stress when it is used in the field.

[6] Usually, as in the case of the M16 carbine series, such a magazine is loaded with about 30 shells, weighting about 18 ounces when filled. Such a magazine must fit into the receiver lower, which is on lower side of the weapon, and, so as not to interfere with the operation of the weapon, the magazine is preferably curved toward the barrel relative to the point of insertion into the firing chamber. Preferably, the magazine has a keyway formed in one of its thinner sides to train and direct the cartridge in a proper firing position for entry into the firing chamber of the weapon. Conventionally, the magazine is formed by appropriately bending multiple pieces of metal and spot welding the pieces together. These operations were crucial, because breaking, bending or malformation of the welds or misalignment of the parts could cause the cartridges to become canted or in extreme cases to fall from the magazine, making the use of the weapon ineffective or dangerous in the field. Correct formation of the keyway is critical: a magazine with a misshaped keyway could make the magazine unuseable as the magazine could not be installed in the receiver lower.

[7] The prior art disclosed a number of magazine structures, such as

[8] Alzamora et al US Pat. 7,117,626, which covers a feed lips gauge for a magazine;

[9] Ciener US Pat. 5,461,811, which discloses a machined magazine body;

[10] Sniezak et al US Pat. 5,438,783, which teaches a handgun magazine having a slidable

butt plate;

[11] Baldus et al US Pat. 4,862,619, which defines a cast or molded encircling element for a handgun magazine;

[12] Chesnut US Pat. 4,586,281, for a magazine adapted for use with various styles of weapons.

[13] Farrar et al US Pat. 4,514,922, which shows a magazine having a special latching mechanism;

[14] Weed US Pat. 1,400,252, which illustrates a primitive releasing structure for a magazine. These references cover a long period of development of various magazines and features for magazines, but they do not teach the novel construction and methods for fabricating a magazine embodying the present invention which may be used without significant failures and which is most dependable in the field. Many references in the prior art deal with magazines for handguns, and these magazines are not typical of magazines for rifles or carbines, which are subject to great field stress and situations where the very life of the user depends upon the effectiveness of the weapon.

[15] Prior art studies of magazines for such rifles and carbines show significant failure rates of prior art magazines, sometimes as high as 50% or more, but studies of magazines embodying the present invention demonstrate almost no failures.

[16] The arcuate magazine device embodying the present invention is strong and fabricated from steel to withstand field stress and has a smooth keyway and interior permitting free travel of a round from the magazine to the firing chamber of the weapon. These features are accomplished by using fabrication means which eliminate wrinkles and rough surfaces in the

magazine, as well as selecting welding points which do not interfere with movement of the shell by the magazine follower mechanism.

[17] In the disclosed method the magazine blank is deep drawn from high carbon steel, preferably having a Rockwell hardness of 34-38 RC, so that the piece will not bend too easily, but not so hard as to make the material brittle. The magazine blank is designed so that only a single seam is necessary to form it, and so that the keyway is free of welds or wrinkling or similar encroachments. This fabrication requires a metal pressing operation which draws and forms the magazine including the keyway in a single operation, preferably using a 600 ton press (but a lesser press could possibly be used) with an upper pressure pad having a male form arbor, and top male form block and bottom female form block. The top male form arbor presses down on the magazine blank pinched between the upper pressure pad and the lower pressure pad with about 5500 lbs. PSI of pressure while the female form arbor resists the downward draw movement with about 9000 lbs. PSI and thereby forming the keyway and one of the short sides in the bridge of the magazine. Two lower pressure pads also serve as the curved surface across which the blank is formed as the blank is drawn down between the lower pressure pads. If inadequate pressure is applied, the keyway fails to form. If excess pressure is applied, the metal tears.

[18] Preferably, the male arbor has pilots for locating the watch holes in the curved side of the magazine blank. These pilot holes preferably perform the function of keeping the blank in place during the draw and form operation and the wiping operation. Preferably, the edges of the form opposed to the keyway are used to weld close the magazine body by means of one or more additive welds, but the position of the weld could be elsewhere, so long as it doesn't interfere

with the keyway and it does not adversely cause wrinkles or rough surfaces on the interior of the magazine when formed. This draw and form operation creates a magazine body oriented in the shape of a "U", with the keyway forming the base of the "U". Ribs may be added to the body to remove any wrinkling of the interior of the magazine and these ribs also add strength to the magazine and support the shell as it moves through the magazine. During the wiping operation, an inner flap is formed and an outer flap is formed running substantially parallel to the keyway enclosing the magazine and in position for welding.

[19] A robotic welder may be used to make the weld on the edges of the blank remote from the keyway, and this weld must follow the curvature of the magazine. After the blank is fully formed and welded into a single piece, a spring and follower is inserted into the closed magazine, and the base plate is applied to close the lower edge of the magazine.

Objects and Advantages of the Invention

[20] It is the object of the invention to provide an arcuate magazine for a rifle or carbine of the character described.

[21] Another object is to provide an arcuate magazine which is fabricated in one piece.

[22] Another object is to provide a body for an arcuate magazine which is closed by additive welds.

[23] Another object is to provide an arcuate magazine for a weapon which may be heat treated with nitride or the like to provide a hardened finish.

[24] Another object is to provide an arcuate magazine which has a substantially smooth interior substantially free of wrinkles and rough surfaces, particularly in its keyway.

[25] Another object is to provide an arcuate magazine which is welded closed on an edge

remote from its keyway.

[26] Another object is to provide a method for fabricating an arcuate magazine which is drawn and formed into a blank having a central keyway, sides depending from the keyway and edges remote from the keyway for welding the blank closed.

[27] Another object is to provide a method for fabricating a blank for an arcuate magazine having a keyway which is formed and drawn by means of high pressure applied to both sides of the blank.

[28] These and other objects and advantages will become more apparent as this description proceeds, taking in conjunction with the accompanying drawings.

Brief Description of the Drawings

[29] In the drawings:

[30] Figure 1 is a perspective view of a part of a M16 weapon having a magazine inserted, with parts broken away to show the interior firing zone.

[31] Figure 2 is a sectional view of the magazine taken on line 2 - 2 of Figure 1 and showing the follower mechanism in the center of the magazine.

[32] Figure 2A is a detailed sectional view of the magazine which shows an alternative way for closing the magazine body by welding an edge for the short side opposed to the keyway over the lower edge of a long side.

[33] Figure 3 is an elevation view of one short side of the magazine showing the watch or pilot holes.

[34] Figure 4 is a sectional view of the magazine taken on line 4 - 4 of Figure 3, showing rounds, the follower assembly, the spring, follower housing and ribs.

- [35] Figure 5 is an elevational view of one short side opposed to the keyway side shown in Figure 3, showing the additive welds closing the magazine body.
- [36] Figure 6 is a schematic view illustrating the stamped blanks being drawn at the draw station. Figure 6A is a magazine blank not yet drawn but punched from the sheet metal and then trimmed.
- [37] Figure 7 is a schematic view showing the forming of the drawn blanks.
- [38] Figure 7A is a sectional view taken on line 7A - 7A, showing the forming of the keyway, taken through a pilot hole.
- [39] Figure 8 is a sectional view showing the cam press putting the ribs and wiping the edge section in the magazine body.
- [40] Figure 9 is a sectional view similar to Figure 8 showing the cam press putting the ribs and wiping the edge section on the other side of the magazine body.
- [41] Figure 10 is a schematic view showing the installation of the follower, spring and spring base into the magazine, and the installation of the base plate.
- [42] Figure 11 is a front view of the draw and form station with the die closed.
- [43] Figure 12 is a side view of the draw and form station with the die open.
- [44] Figure 13 is a front view of the wipe station with the die open.
- [45] Figure 14 is a side view of the wipe station with the die closed.

Description of the Preferred Embodiments

(I) The Magazine

- [46] With reference to Figure 1 - 5, a magazine 10 embodying the present invention is installed in a rifle or carbine weapon W, in position for a round of ammunition to enter the firing

area C of the weapon. The ammunition is delivered to the firing area C by means of a spring loaded follower 11 which travels through the magazine 10 as each round is placed in firing position.

[47] The magazine 10 is secured in the weapon W in a receiver R and the magazine comprises spaced apart short walls 12 and 13, bridged by space apart long walls 14 and 15. One of the short walls 12 has arranged therein a keyway 16, and the other short wall 13 comprised of edge sections 17 and 18 which overlap one another and are secured by welds. A plurality of ribs 19 and 20 are arranged opposed and in line with one another in the long walls 14 and 15, and on set of aligned ribs 21 and 22 may be larger and deeper than the other sets of ribs. Within the interior of the walls 12 - 15, the follower 11 is positioned with a head 23, sides 24 and tail 25 slidably engaged in the keyway 16. Preferably, the magazine body is formed in one piece and closed by the additive weld or welds.

[48] As shown in Figure 3 - 5, the magazine 10 has an arcuate shape 26 and on its short walls 12, 13 with side 12 having the keyway 16. Keyway 16 has a series of watch or pilot holes 27 permitting a view of the cartridges within the magazine. At the end of the magazine 10 remote from the follower 11 the magazine is closed by a base or floor plate 28. Within the interior of the magazine 10, there is a spring 29 secured at one end to a spring base 30 which rests on the base plate 28 and at its other end to the follower 11 such that the follower is urged by the spring 29 to lift the cartridges toward to weapon firing position C. The additive welds 31 extend along the length of the short wall 13 but leave the interior of the short wall 12 free of flux and additive material. The interior of walls 12-15 and the keyway 16 are substantially smooth and substantially without rough spots so that ammunition rounds may be slidably moved by the

follower 11 through the magazine 10 to the firing position C. Alternatively, as shown in Figure 2A, the short wall 13a may be lengthened and a long wall 14a may be shortened and stepped inward to permit the edge section 17a of the short wall 13a to be folded over the end of the long wall 14a and welded in place for closing the magazine 10. Figure 4 shows the follower 11 partially retracted in magazine 10 with rounds of ammunition being pushed by the follower 11 toward the top of the magazine 10.

[49] Preferably, after the magazine body is fully fabricated, it is heat treated with nitrides. This heat treatment hardens the surfaces of the metal.

(II) The Method of Making the Magazine

[50] With reference to Figures 6 - 10, in a rolled metal sheet 45, a somewhat rectangular magazine blank 40 is formed in the metal sheet 45 by punching and removing a U-like piece of metal from the metal sheet 45. Prior to the drawing station, pilot or watch holes 27 are formed in the sheet so that they run along the center line of the magazine blank 40 perpendicular to the path of travel of the metal sheet 45. The center line from one edge of the metal sheet 45 across the magazine blank 40 including the section with the pilot or watch holes 27 to the other edge of the metal sheet 45 approximating a bridge 55. The magazine blank 40 is connected to the metal sheet 45 by the bridge 55. The pilot or watch holes 27 are in line with the bridge 55. Each magazine blank 40 form has two long edges 50, 51 parallel to the bridge 55 and four short sides 60 roughly perpendicular to long sides 50, 51. At the draw station, there is a male form arbor 70. The male form arbor 70 is fitted with pilot pins 80. The pilot pins 80 are set to correspond to the watch or pilot holes 27. When the male form arbor 70 is pressed in a downward direction during the draw operation the pilot pins 80 go through the magazine blank 40 helping to hold the

magazine blank 40 in proper position. During the drawing operation, each short side 60 is angularly bent upwardly. The magazine blank 40 is held in place by an upper pressure pad 90 and lower pressure pad 100. The male form arbor 70 presses downwardly while the female form arbor 110 presses upwardly drawing and forming the magazine blank 40. After the drawing and forming operation, the magazine blank 40 has a the keyway 16 with the watch or pilot holes 27 running up the middle of the keyway 16. The remaining metal bridge 55 connects the magazine blank 40 to the sheet or strip of metal 45 at spans 52, 53.

[51] As shown in Figure 8, a first pair of short sides 60 are pressed between forming blocks 75, 76 so as to add ribs 19, 21 and to wipe over the interior flap 17. As shown in Figure 9, a second pair of short sides 60 magazine blank 40 is then pressed by another set for forming blocks 85, 86 so as to add ribs 20, 22 to the other side of the magazine blank 40 and to wipe over exterior flap 18. The action of the press as shown in Figures 8 and 9 is bending the long edges 50, 51 at about 90 degrees and forming the ribs 19-21 smooths wrinkles which may have been formed in the magazine blank 40 and puts the magazine blank in the final shape of magazine 10. With reference to Figure 10, the long side edges 50 and 51 are then welded from the exterior of the magazine blank 40 to close the magazine 10. The follower 11 with its head 23, sides 24, spring 29, tail 25, spring base 30 are then fitted into the interior of the magazine 10. Finally, base plate 28 is set in place adjacent to spring base 30 to prevent exit of follower 11 and to complete the formation of the magazine 10.

[52] During the drawing and forming operation and the wiping operations, the magazine blank 40 attention is paid to prevent rough surfaces and to insure that the rounds will travel smoothly through the magazine 10.

[53] The magazine 10 in the preferred embodiment is fabricated in a progressive die with a series of stations. Preferably, the operations are as follows:

1. Pierce the pilot holes 27 into the magazine blank 40. One would use pressure sufficient to hold the magazine blank 40 and to strip the magazine blank 40 off the punch, that pressure being known as stripping pressure.
2. Notch the center of the magazine blank 40 using stripping pressure.
3. Trim the ends of the magazine blank 40 using stripping pressure.
4. Draw and form the magazine blank 40 to create the long sides 50, 51 and the short sides 60 using about 5500 lbs. PSI from above and about 9000 lbs. PSI from below as further explained below.
5. Form the ribs 19-22 and side wipe the top edge of the magazine blank 40 using sufficient pressure to hold the magazine blank 40 flat and wiping the edges 50, 51 with minimum pressure of about 2000 lbs. PSI. The rib forming operation and wiping operation could be done separately.
6. Re-strike the magazine blank 40. The re-strike sets the form in its finished geometry where male and female form blocks strike the long and short sides of magazine blank 40 into magazine 10. Little pressure is required.
8. Cut off scrap material.

Wrinkling of the interior of the magazine 10 is also taken out during the formation of the ribs 19-22, to assure that there are not rough spots within the magazine body.

[54] The draw and form station used in the method is shown in Figures 11-12, using multiple nitrogen cylinders 130 on top and multiple nitrogen cylinders 140 on the bottom. The magazine

blank 40 is placed the between the upper pressure pad 90 and the lower pressure pad 100 with the male form arbor 70 above and the female form arbor 110 below. At the moment of the pressing operation, the male form arbor 70 descends and pushes the female form arbor 110 into a pocket. It is the pocket that wipes the sides. The male form arbor is set in the die. When the die is closing, the upper pressure pad 90 exerts about 5500 lbs. PSI on bottom side form blocks 100. The female form arbor 110 descends and resists that descent with about 9000 lbs. PSI. Different nitrogen cylinders may be used such that they achieve the required pressures. Pressure may be achieved by a number of means including spring pressure or urethane pressure. Attention should be paid to the travel distance of the cylinders given the needs of particular travel distances to do the draw and form operation to the magazine blank 40. In the preferred embodiment, on top four Moeller HR2400-125 nitrogen cylinders are used to create about 5500 lbs. PSI and on bottom three Moeller HR1500-100 are used to create about 9000 lbs. PSI. As depicted in Figures 13-14, at the wiping station, the top nitrogen cylinders 150 are HR 2400-125 and the bottom nitrogen cylinders 160a are Moeller HR1000-100 and 160b Moeller HR300-100 to wipe long side edges 50 and 51. When the die closes, the long side edges of 50 and 51 are formed over the two form arbors 200. In Fig. 14 the wiping station is shown with the die in the open position. The cam pushers 210 force the male form arbors toward the center of the die with the edges 50 and 51 formed over the male form arbors 200, The pressure creating devices at this station in the preferred embodiment are cylinders that that achieve about 2000 lbs. PSI. Parts 170a and 170b are spacers. The magazine is held in the magazine holder 220.

[55] While many changes and modifications can be made in the structure of the magazine and in the method of making it within the spirit of the invention, it is not intended that the invention should be limited to the exact structure and steps shown and described.

Claims

1. An arcuate magazine for delivering rounds of ammunition one round at a time to the firing chamber of a firearm such as a rifle or carbine, said magazine having a keyway and follower assembly therein for moving said round to said firing chamber, said magazine having a one piece body with opposed side walls, said keyway being arranged on one of said side walls, and welded closure means for said body on another wall remote from said keyway.
2. The arcuate magazine recited in Claim 1, wherein said body has a smooth interior substantially free of wrinkles and rough spots.
3. The arcuate magazine recited in Claim 1, wherein said body is fabricated from metal.
4. The arcuate magazine recited in Claim 2, wherein said body is formed from a single sheet of metal.
5. The arcuate magazine recited in Claim 1, wherein said body comprises opposed short sides and opposed longer sides and said keyway is arranged in one of said short sides.
6. The arcuate magazine recited in Claim 1, wherein the short side of said body opposed to the side having said keyway has overlapping edges welded together for closing said body.
7. The arcuate magazine recited in Claim 5, wherein a short side of said body opposed to said keyway overlays an edge welded to one of said longer sides.
- 8.. The arcuate magazine recited in Claim 5, wherein one of said long side has rib means impressed therein and said follower is trained to move through said body directed toward said firing area within the confines of said ribs and keyway.
9. The arcuate magazine recited in Claim 1, wherein said welded closure means comprise additive welds.

10. The arcuate magazine recited in Claim 1, wherein said keyway has spaced apart pilot holes along and extending through its surface.
11. The arcuate magazine recited in Claim 3, wherein the surfaces of said body are hardened.
12. A method for making a one piece body of an arcuate magazine for delivering rounds of ammunition one round at a time to the firing chamber of a firearm such as a rifle or carbine, said magazine having a follower assembly therein for smoothly moving said round to said firing chamber, said method comprising the steps of
 - (i) forming a blank by removing opposed inverted spaced apart U-like shaped pieces from a strip of metal;
 - (ii) bending the central portion of the strip between the legs of said removed U-like shaped pieces toward one another;
 - (iii) drawing a keyway into the bridge between said U-like shaped pieces;
 - (iv) wiping said legs at substantially a 90 degree angle from said keyway bridge and bending an edge on at least one of said legs toward the other of said legs, said edge being remote from said bridge; and
 - (v) welding said edge to the other of said legs to form a magazine body containing opposed shorter sections and opposed longer sections for containing said keyway and follower assembly.
14. The method recited in Claim 12, wherein said bridge has spaced apart pilot holes, and the method includes the additional step of placing members for holding said blank in a selected position by means of said pilot holes.

15. The method recited in Claim 12, wherein edges of both of said legs are wiped at said 90 degree angle toward one another, so that the edge of one leg overlaps the edge of the other leg.
16. The method recited in Claim 12, wherein said keyway is impressed on its upper and lower surfaces.
17. The method recited in Claim 12, wherein ribs are formed during said wiping, and said wiping removes wrinkles from said blank.
18. The method recited in Claim 12, with the additional step of filling said formed magazine body with a follower assembly comprising a spring, follower member and base plate for urging rounds into said firing chamber.
19. The method recited in Claim 12, with the additional step of heat treating said magazine body to harden its surfaces.
20. The method recited in Claim 12, wherein said welding step includes adding metallic material during said welding..

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Fig. 1

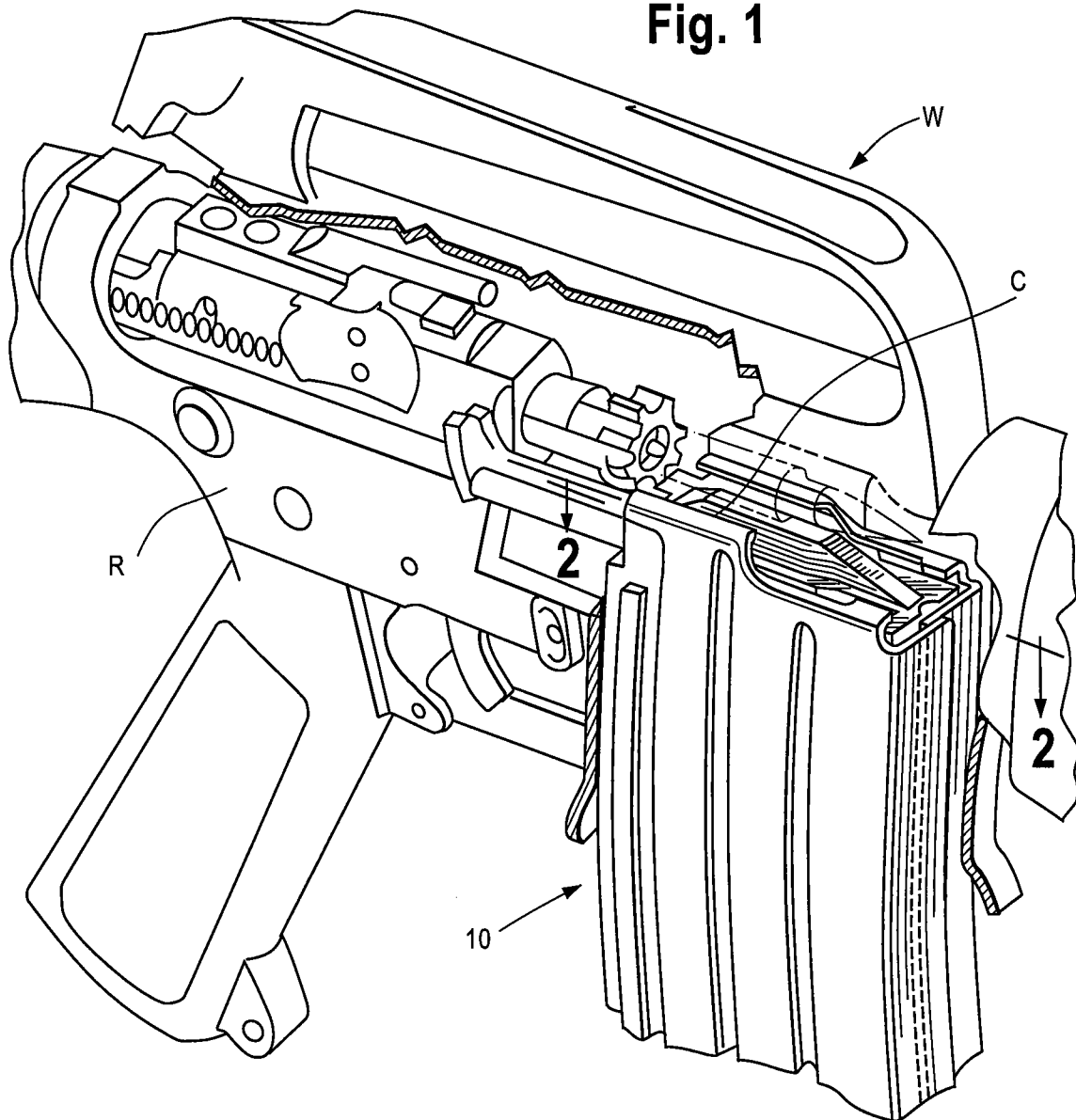


Fig. 2A

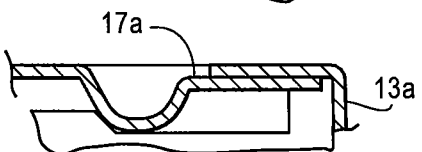


Fig. 2

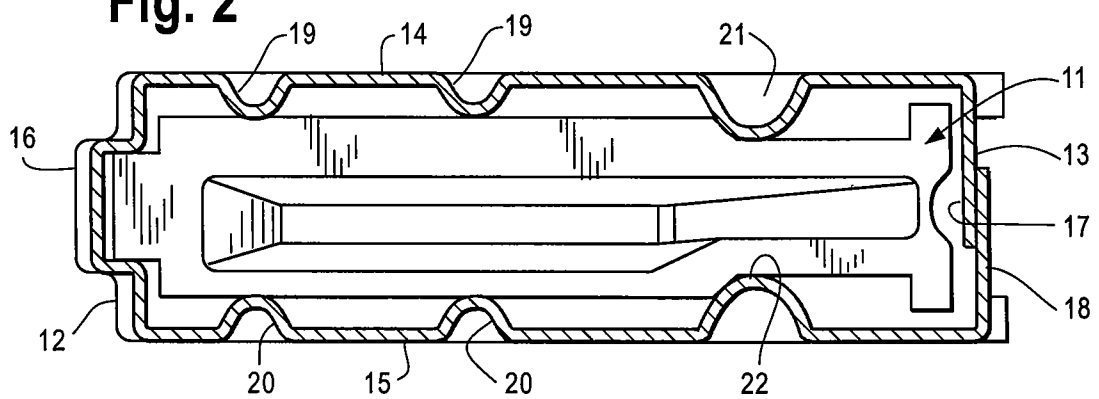


Fig. 3

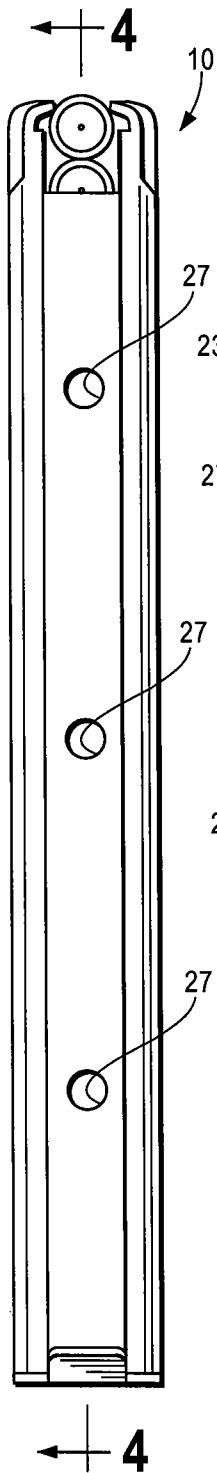


Fig. 4

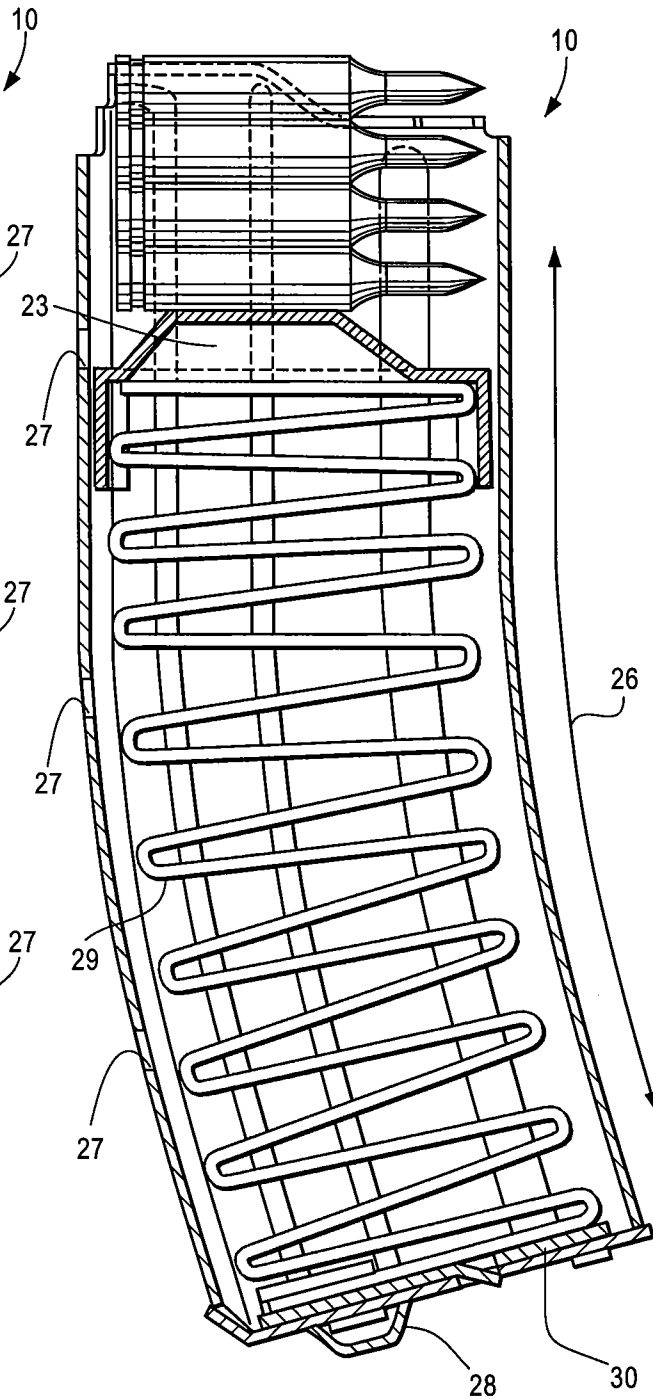
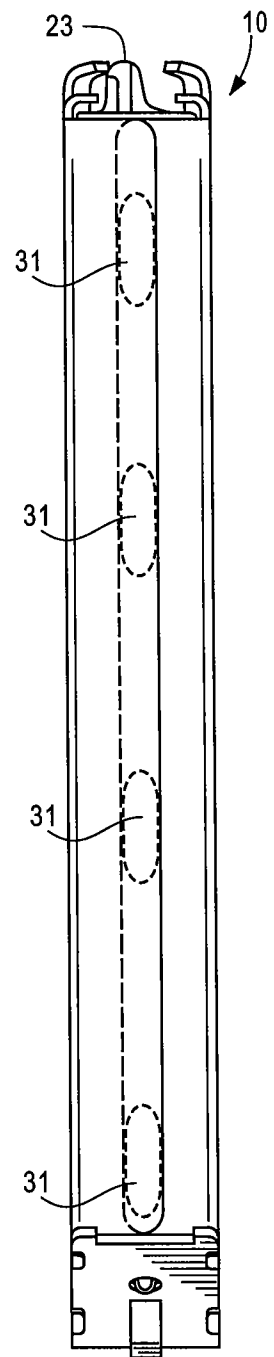
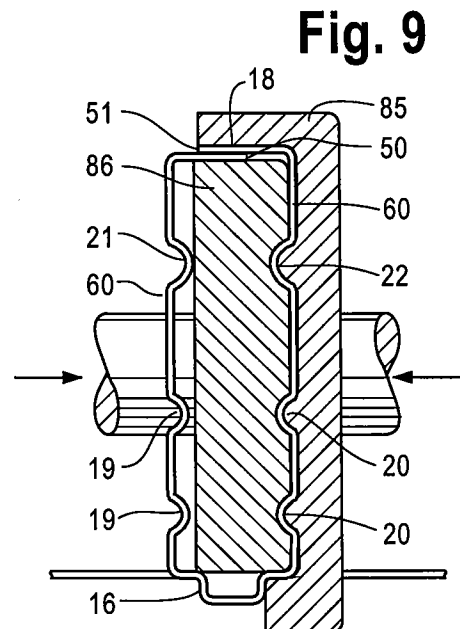
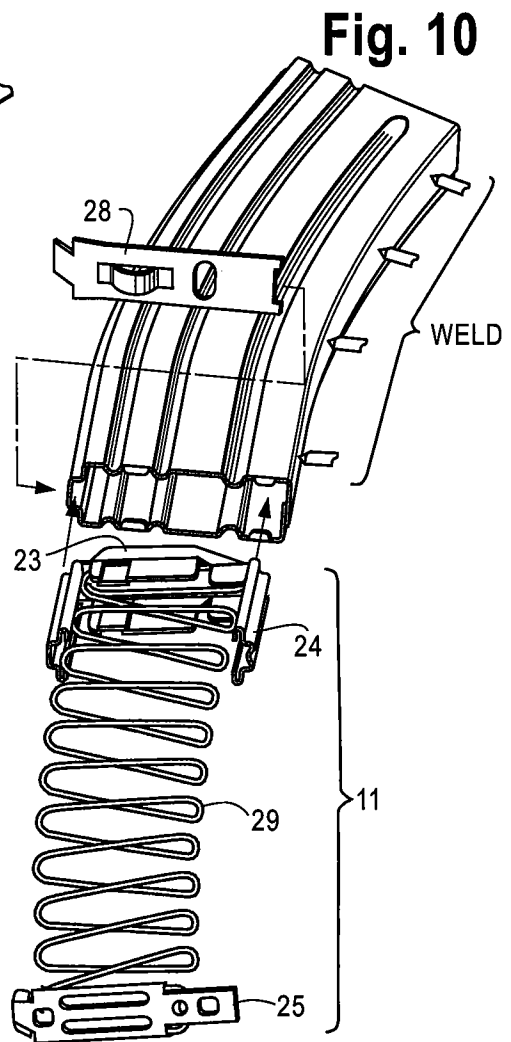
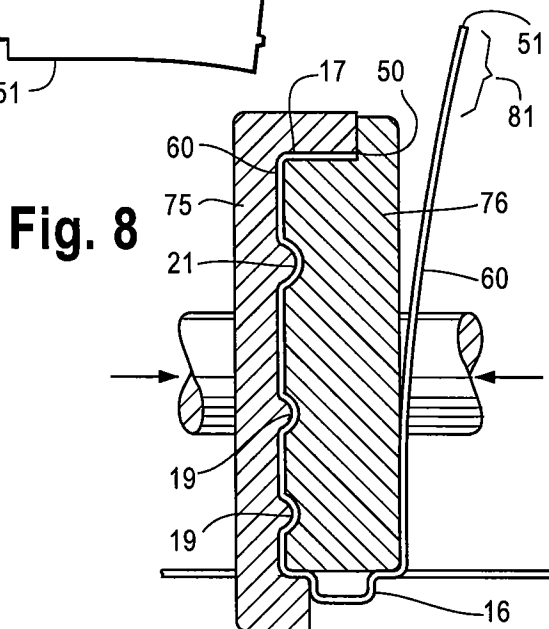
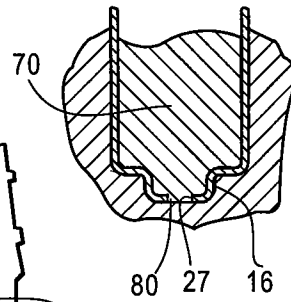
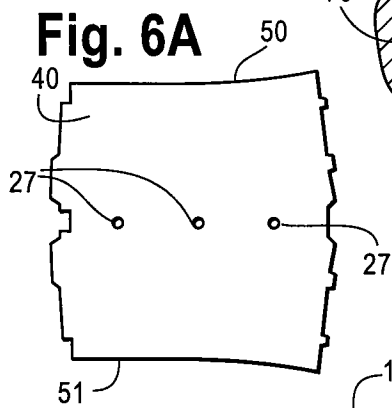
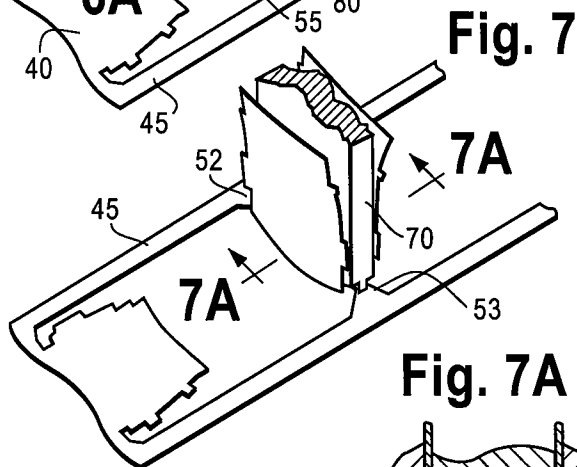
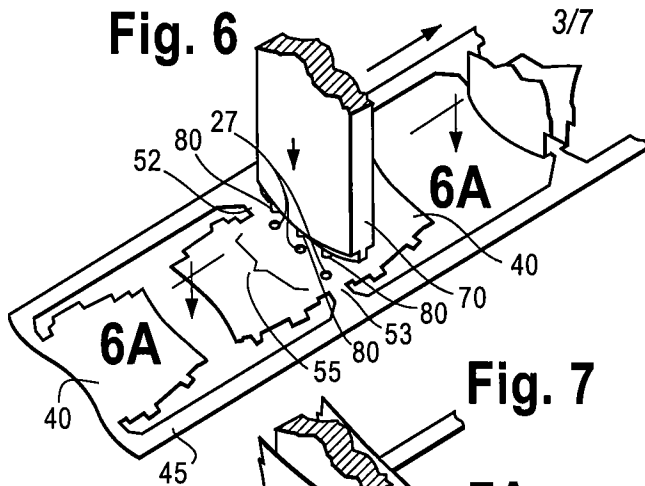
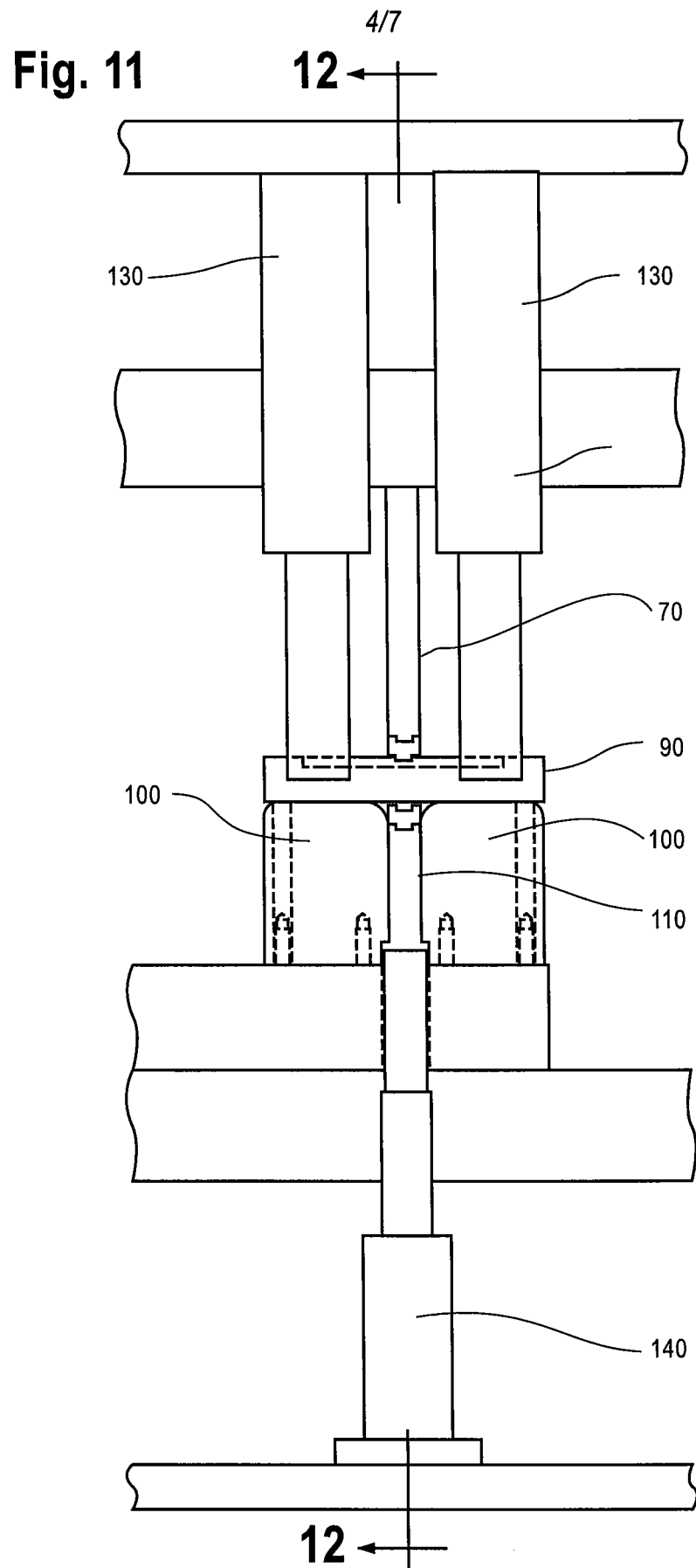


Fig. 5







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Fig. 12

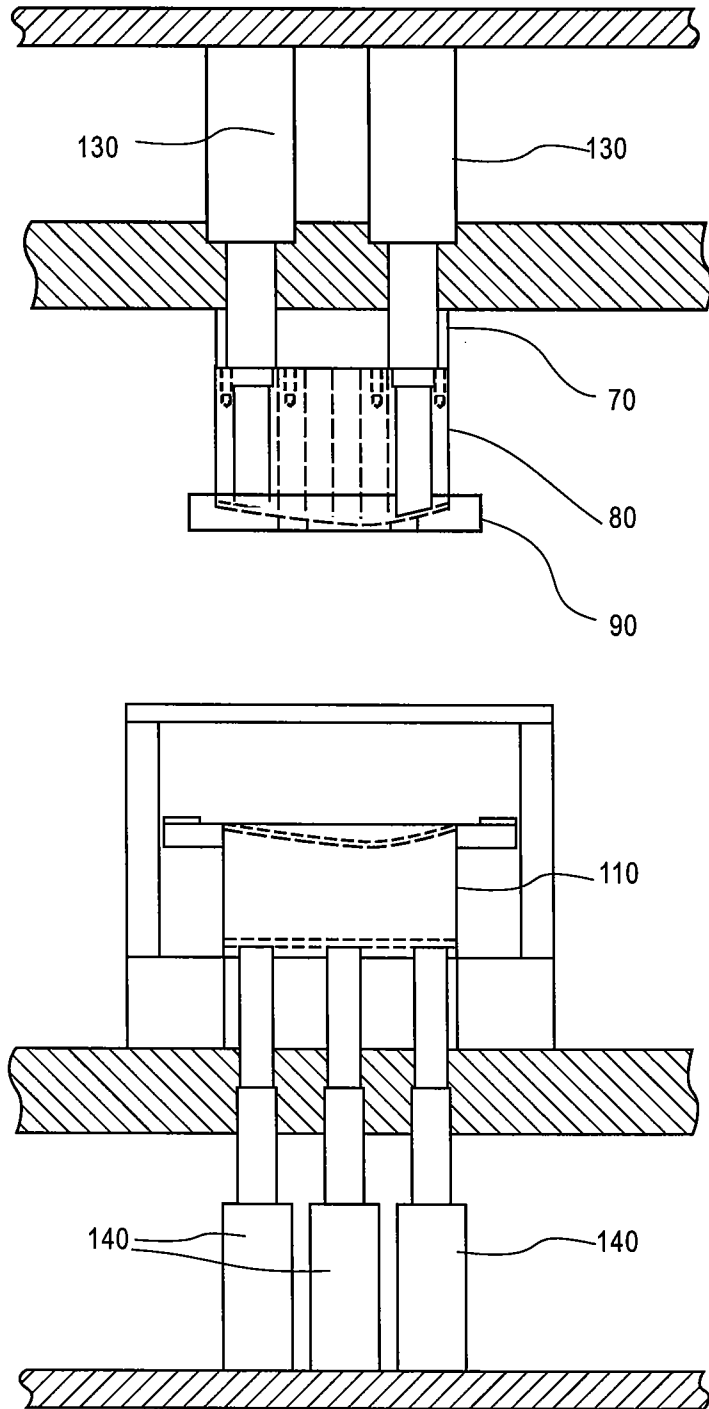
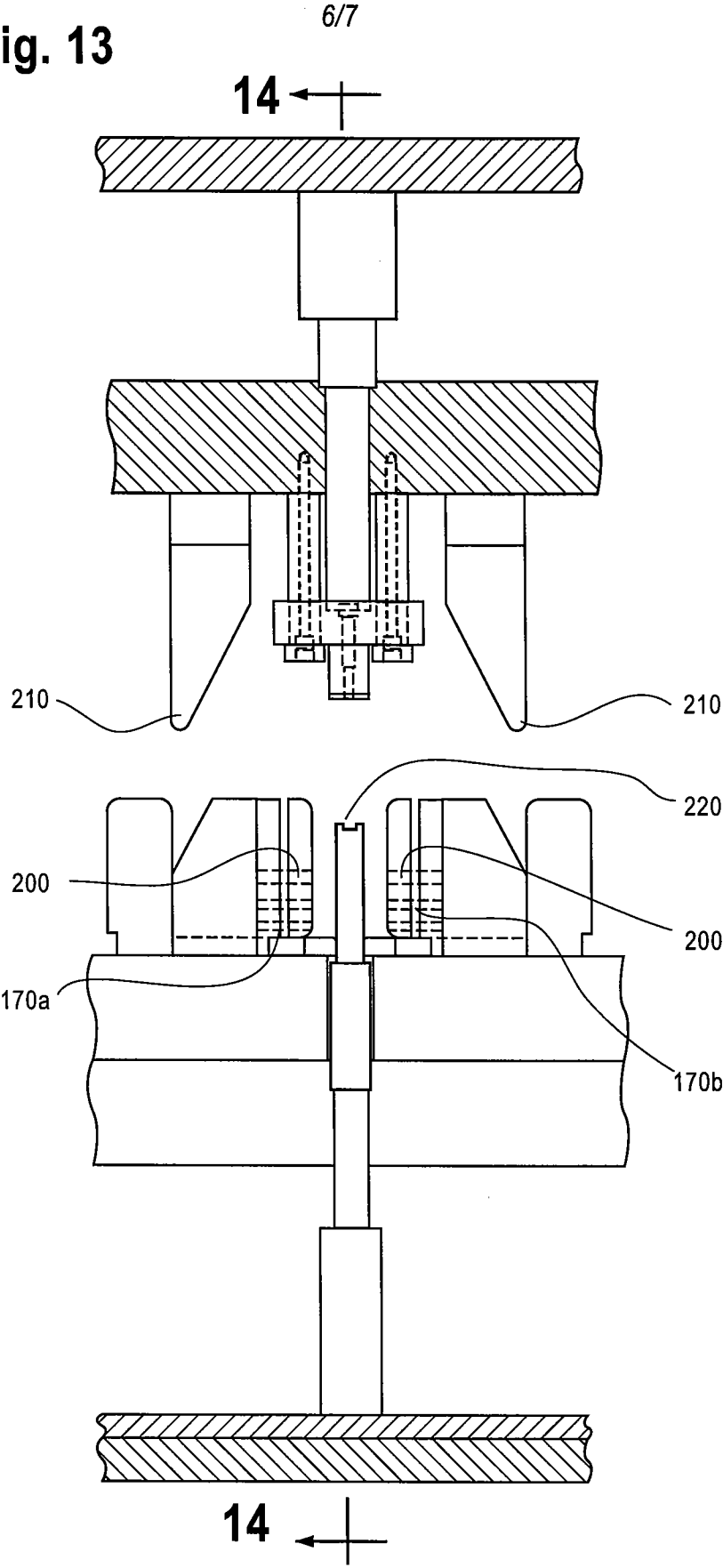


Fig. 13



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Fig. 14

