July 19, 1966 O. P. STERNER 3,261,527

APPARATUS FOR FIRING A PLURALITY OF FASTENING TOOLS

Filed Oct. 7, 1964 3 Sheets-Sheet 1

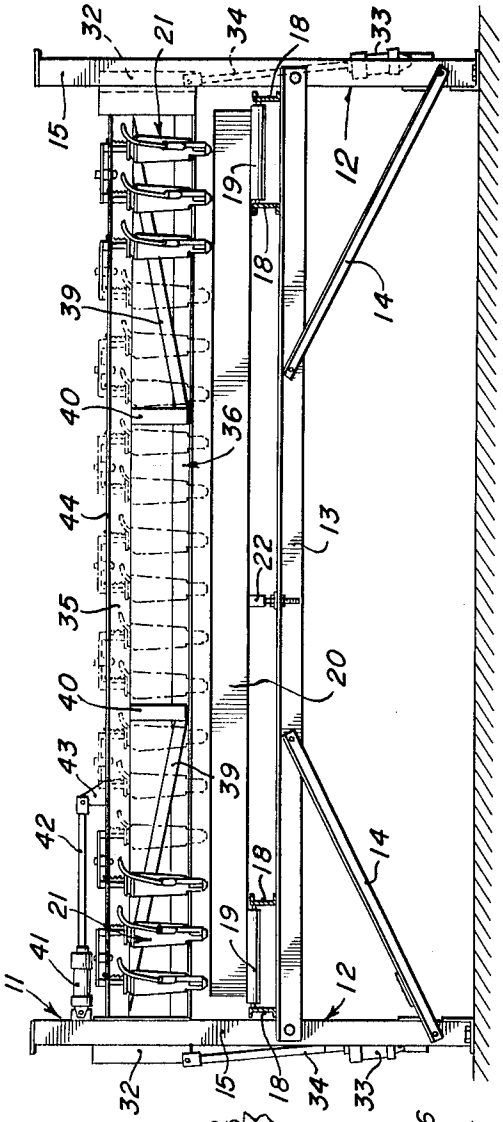


Fig. 2

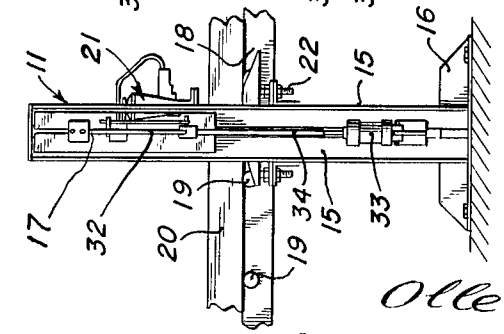


Fig. 1

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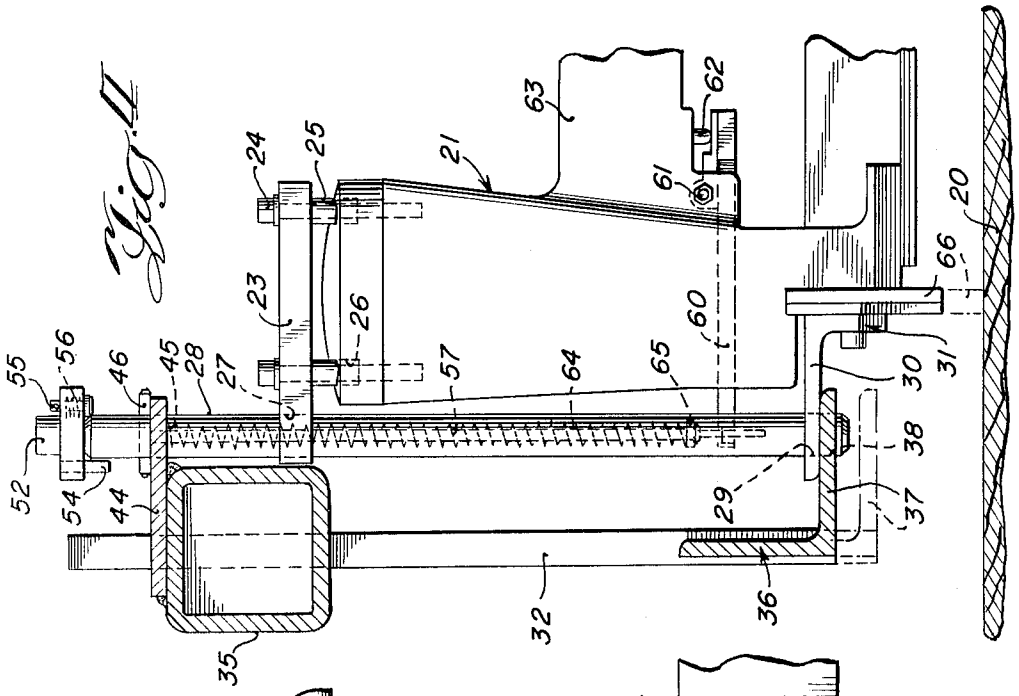


Fig. 2

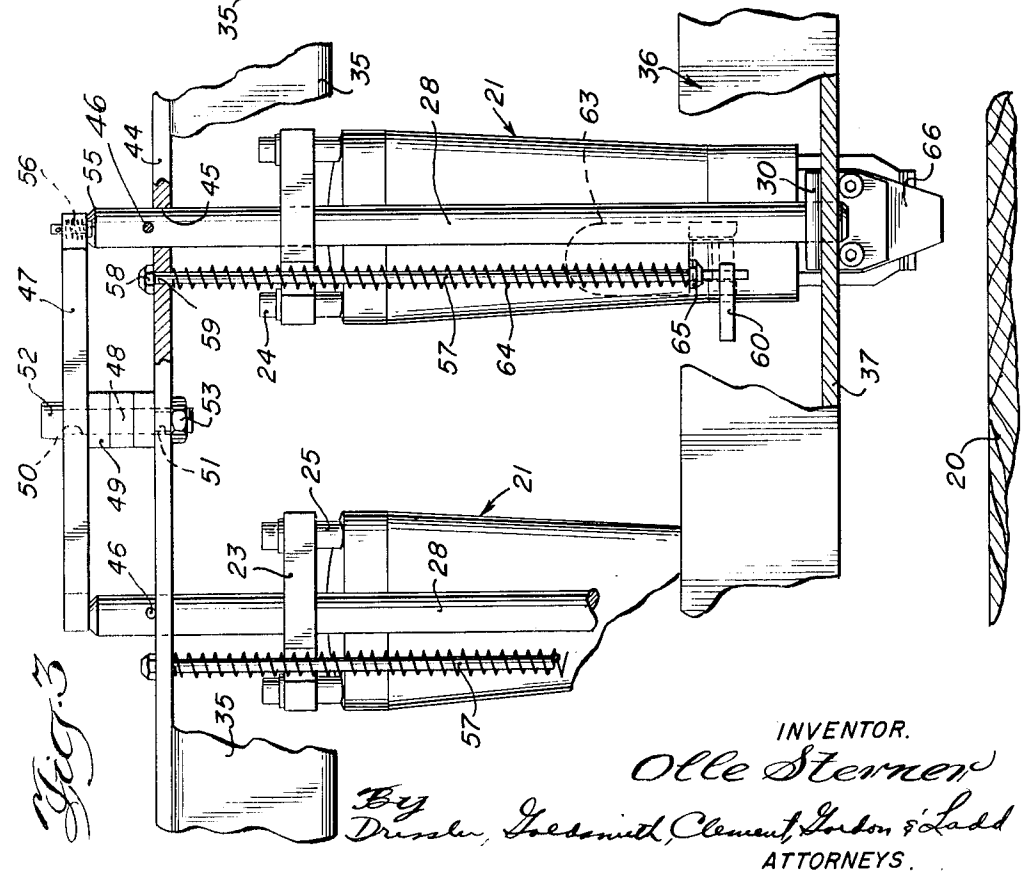


Fig. 3

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Fig. 5

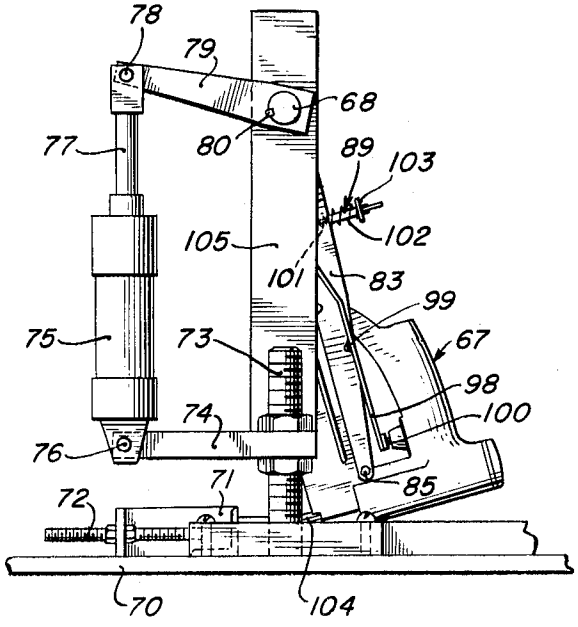


Fig. 6

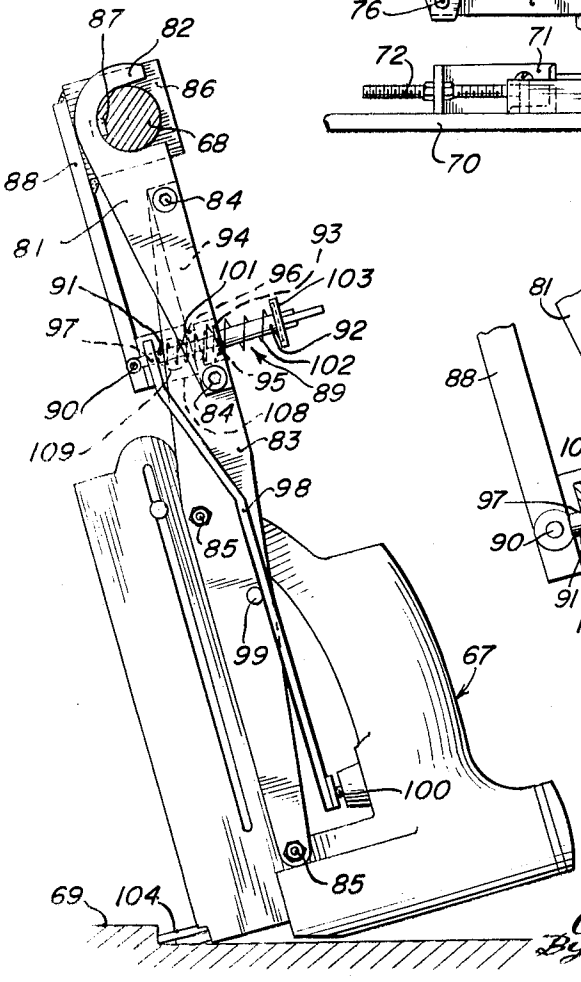
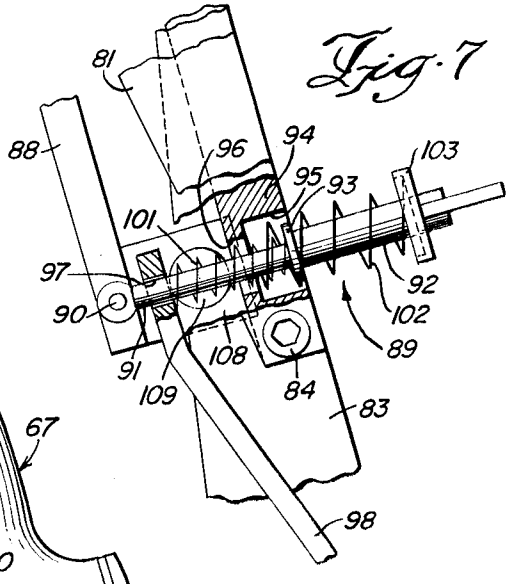


Fig. 7



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APPARATUS FOR FIRING A PLURALITY OF FASTENING TOOLS

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Filed Oct. 7, 1964, Ser. No. 402,284
9 Claims. (Cl. 227—7)

This invention relates to an apparatus for firing a battery of power operated guns of the type adapted to drive staples, nails, or other fasteners into a workpiece and, particularly, with means for controlling the operation of the tool control mechanisms to insure proper firing of each gun.

It has been the practice with some fastening tools to actuate the tools by some device motivated by the engagement of some part of the gun, with the workpiece into which the fastener is to be driven. If the surface of the workpiece is not level, and it is desired to fire a plurality of fasteners with the use of a plurality of guns, it is necessary to make suitable provisions to insure that the individual guns will not fire until they are in actual contact with the workpiece. If this is not done and all the guns are fired simultaneously, some of the fasteners may not be driven the correct amount. Furthermore, if the guns are mounted on a beam that is moved to carry the guns into engagement with one surface of the workpiece, some of the guns may not be fired before the beam starts on its movement away from the workpiece.

In order to compensate for irregularities in the surface of the workpiece, attempts have been made to hold the guns in place by springs or by gravity in such a way that the guns may be lifted from the supporting beam in areas where high points occur in the surface into which the fasteners are to be driven. It has been found, however, that when a gun mounted in this manner is fired, the recoil sometimes bounces the gun off the workpiece, and, when the gun drops back to the workpiece, the trigger may be actuated to fire the gun a second time and drive a second fastener into the workpiece.

The present invention will be described in connection with a battery of power operated guns, which while operated by compressed air may be operated by electric power, inertia devices, or any other suitable medium.

Furthermore, the invention is intended for use with power operated nailing or stapling guns, but its advantages may be utilized in connection with other similar devices. The details of the gun employed do not constitute any part of the invention and therefore will not be described.

In accordance with the present invention, a group of guns are supported by a beam or other support member that may be moved vertically or pivotally toward and from a workpiece into which fasteners are to be driven. As the beam is moved toward the workpiece, the guns are moved in the same direction. Each gun stops moving when it engages a surface of the workpiece, but the beam continues to move in the same direction until each gun is in engagement with the workpiece.

A trigger actuating lever is pivotally mounted on each gun and is controlled by the movement of the main support assembly. As each gun engages the workpiece, its respective lever is subjected to spring pressure until sufficient pressure is built up to move the lever and thereby actuate its associated trigger. Any recoil from the firing of the gun compresses the spring that actuates the lever, thus preventing a second firing. After the guns are fired, the beam member returns the guns to their initial position.

The structure by means of which the above mentioned and other advantages of the invention are attained will be fully described in the following specification, taken in

conjunction with the accompanying drawings showing two preferred illustrative embodiments of the invention, in which:

FIGURE 1 is an end elevational view of the apparatus incorporating the present invention;

FIGURE 2 is a rear elevational view of the apparatus of FIGURE 1;

FIGURE 3 is an enlarged fragmentary rear elevational view of the gang mounting and parts of the trigger actuating mechanism;

FIGURE 4 is an enlarged view, partly in section and partly in elevation, showing the trigger actuating mechanism;

FIGURE 5 is a side elevational view of an apparatus illustrating another embodiment of the invention;

FIGURE 6 is an enlarged side elevational view of the structure of FIGURE 5, with parts removed to facilitate illustration of the trigger actuating mechanism; and

FIGURE 7 is an enlarged view, partly in section and partly in elevation, of the structure shown in the central portion of FIGURE 6.

In FIGURES 1 and 2 of the drawings, there is shown a frame **11** comprising a pair of spaced uprights **12**, a pair of transverse angle irons **13**, and a plurality of braces **14**. Each upright **12** comprises a pair of vertically disposed angle irons **15** having their lower ends secured in spaced relationship to a bracket **16** bolted to the floor. The purpose of the gap or slot **17** between angle irons **15** will be described later. Each transverse member **13** is secured at its ends to one edge of uprights **12** intermediate the height of the vertical uprights. Each brace has one end secured to an upright **12** and to a transverse angle iron **13**. The braces extend diagonally between the uprights **12** and the transverse angle irons. A pair of channel irons **18**, secured to angle irons **13** in spaced relationship adjacent each upright, extend at right angles to angle irons **13**. A roller **19** is rotatably mounted in each pair of channel irons. Each roller **19** is one of a series of parallel rollers (not shown) that cooperate to form a conveyor upon which a workpiece **20** is supported as it is moved under a group of transversely aligned vertically disposed guns **21**. An endless belt of a width sufficient to cover the transversely spaced rollers **19** may extend around all of said rollers, if desired. An adjustable center support **22** secured to one of the angles irons may be provided adjacent the bottom of the workpiece to keep it from sagging.

As shown in FIGURES 3 and 4, a flat plate **23** is rigidly secured to the top of each gun **21** by a plurality of bolts **24**. Sleeves **25** mounted on each bolt and fitting into recesses **26** in the top of each gun space the plate **23** above the top of the gun. One edge of the plate **23** extends laterally beyond the edge of the gun and is provided with an aperture **27** through which a vertical pin **28** extends. The lower end of the pin **28** extends through an aperture **29** in the horizontal arm **30** of a bracket **31** secured to the lower portion of the gun and extending laterally therefrom. The pin **28** is slidable vertically relative to the plate **23** and the bracket **31** for reasons hereinafter disclosed.

Two plates **32** at opposite edges of the frame are each mounted in a slot **17** in one of the uprights **12** so that they may be moved vertically or transversely relative to the frame. Two hydraulic cylinders **33** are mounted on the uprights at opposite edges of the frame and each cylinder has a piston rod **34** connected to one plate **32** to move said plates vertically. The plates **32** are secured to opposite ends of a beam **35** extending transversely of the frame. An angle iron **36** extends between the plates **32** and is secured to the lower portion of each of said plates. One leg **37** of the angle iron **36** is provided with

an aperture 38 through which the lower end of the pin 28 extends.

The leg 37 is positioned below the horizontal arm 30 of the bracket 31 and normally supports the weight of the guns 21. Each gun moves downwardly by gravity but is restrained by the engagement of the arm 30 with the leg 37 of angle iron 36. When the beam 35 is raised, the leg 37 engages the arm 30 to raise the gun from which said arm 30 extends. The structure of the gun support assembly is reinforced by diagonal braces 39 and vertical braces 40.

A hydraulic cylinder 41 is secured to one of the uprights and has a piston rod 42 connected to a lug 43 welded to the beam 35 so that it can move the gun assembly transversely of the frame. The hydraulic cylinders 33 are both actuated every time a row of fasteners is to be driven, but the hydraulic cylinder 41 is actuated only at the start of an operation to position the gun assembly laterally with respect to the workpieces into which the fasteners are to be driven.

A flat plate 44 is welded to the top surface of the beam 35 and extends forwardly of said beam. The portion of plate 44 extending forwardly of the beam is provided with a plurality of apertures 45 through each of which the upper end of a pin 28 projects. The interengagement of each pin 28 with a pair of aligned apertures 45 and 38 enables each pin 28 to guide the guns during their vertical movement as the beam 35 is moved vertically by the hydraulic cylinders 33. A pin 46 extends transversely through each pin 28 so as to project on both sides thereof. The pins 46 are positioned above the plate 44 and are engaged by said plate as the plate is moved upwardly. The interengagement of the plate 44 with pins 46 moves each pin 28 upwardly as the plate 44 is moved upwardly.

A bar 47 is pivotally mounted on a bolt 48 located between every pair of pins 28. Each bar 47 is spaced above the plate 35 by a plurality of collars 49 encircling the bolt 48 between the plate 44 and the bar 47. The bolt 48 extends through aligned apertures 50 and 51 in bar 47 and plate 44, respectively, and is held in place by an enlarged head 52 and a nut 63. Each bar 47 engages the tops of two pins 28 to move them downwardly when the plate 44 is moved downwardly.

One end of each bar 47 has a fixed pin 54 depending therefrom to engage one side of the pin 28, and a spring pressed pin 55 normally urged downwardly by its spring 56 to engage the pin 28 at a diametrically opposite point. The pins 54 and 55 are located on opposite sides of pin 28 so that the bar 47 cannot be moved pivotally when the pin 55 is in its down position. If any gun 21 is to be removed from the assembly, it is necessary to remove the pin 28 that extends through the plate 23 and bracket 31 secured to said gun. The pin 55 is moved upward against the action of its spring, and the bar 47 is moved pivotally out of engagement with both pins 28. Either pin 28 may then be pulled upwardly to release its adjacent gun 21.

A rod 57 having an enlarged end 58 extends downwardly through an aperture 59 in the plate 44 adjacent every gun. The lower end of the rod 57 extends through an aperture in one end of a lever 60 pivoted intermediate its length to the gun 21, as indicated at 61. The other end of the lever 60 is positioned below a button or trigger 62 depending from the handle 63 of the gun 21. When the trigger 62 is pressed inwardly toward the handle of the gun, the gun is actuated to drive a fastener into the workpiece supported on the conveyor under the gun 21.

A compression spring 64, coiled around rod 57, has one end bearing against the underside of the plate 44 and its other end bearing against a nut 65 fixed to the rod 57 adjacent its lower end but spaced above the lever 60. When the beam 35 is moved downwardly, the plate 44 compresses the spring 64, but, as long as the gun is moving downwardly with the beam 35, the spaced relationship between the nut 65 and the lever 60 remains fixed. As soon as the bottom of the gun projection 66, through which the fastener is discharged, engages the workpiece 20, the downward movement of the gun stops, while the beam 35 and plate 44 continue their downward movement. The stroke of cylinders 33, which controls the downward movement of the beam 35, is long enough to cause every gun to engage the workpiece before the downward stroke of cylinders 33 is completed.

Continued downward movement of the beam 35 after the projection 66 is in engagement with the workpiece causes the plate 44 to compress the spring 64 to move the nut 65 into engagement with the lever 60. The vertical position of the pivot 61 is fixed at the time the downward movement of the gun is stopped. As the compression of the spring 64 is increased by the downward movement of plate 44, pressure of the nut 65 against the lever 60 is increased until it forces the lever to move about its pivot 61. The pivotal movement of the lever 60 presses the trigger 62 upwardly to fire the gun and thereby drive the fastener into the workpiece.

It will be noted that the gun is not fired until sometime after its discharge member is in engagement with the workpiece, thereby making it impossible for the gun to fire prematurely. Guns that are fired by contact with the workpiece may fire prematurely if the workpiece is not level and one part of the discharge member hits a high spot on the surface of the workpiece. Each gun is fired individually, but all of them are fired before the guns start moving upwardly with the upward stroke of the piston rod 34. Often, when a gun is fired, the recoil of the firing mechanism causes the gun to jump away from the workpiece. If the firing mechanism is actuated by contact with the workpiece, it may be actuated a second time when the gun moves back to the workpiece after the force of the recoil moves it away.

An accidental second firing of the gun, such as described above, is not possible with the trigger actuating mechanism of the present invention. As shown best in FIGURE 4, the lever 60, which moves pivotally to press the trigger 62 upwardly to actuate the firing mechanism, is moved pivotally in the required direction by the downwardly exerted force of the spring 64. The downward pressure of the spring 64 will hold the lever 60 with its shorter end pressed upwardly in contact with the trigger 62 until the cylinders 33 start their upward stroke and thus release the spring 64 from compression. If the recoil of the firing mechanism makes the gun bounce upwardly from the workpiece, the lever 60 will move upwardly with the gun, and will retain the spring 64 under compression, thus preventing a second firing.

In FIGURES 5 and 6, there is shown another embodiment of the invention in which a group of power operated guns 67 mounted between a pair of uprights 105 (only one of which is shown) are pivotally moved about a shaft 68 to bring each of them into engagement with a workpiece 69 into which fasteners are to be driven at an angle. In this embodiment, the workpiece is placed on a stationary table 70 or other suitable surface, and is positioned relative to the gun by a guide 71 having a screw adjustment mechanism 72. A vertical adjusting screw mechanism 73 regulates the vertical position of a support bar 74 having an air cylinder 75 secured to its outer end, as indicated at 76.

A piston rod 77 projecting from one end of the cylinder 75 is pivotally connected, as indicated at 78, to one end of an arm 79. The arm 79 is keyed to the shaft 68, as indicated at 80. Accordingly, the piston rod rotates the shaft 68 in clockwise direction, as viewed in FIGURES 5 and 6, during its outward stroke, and in counterclockwise direction during its inward stroke.

An arm 81, having a hook 82 at one end fitting over shaft 68, is rigidly fixed to a flat plate 83 by screws 84. The gun 67 is secured to the plate 83 by screws 85. A block 86, keyed to the shaft 68 at 87, has a plate 88 welded to one surface thereof. The block 86 and plate 88 move pivotally with the shaft 68 as the shaft is rotated

in either direction by the piston rod **77**. A rod **89** is pivotally secured at one end to the plate **88**, as indicated at **90**. The inner section **91** of the rod, adjacent pivot **90**, is smaller in diameter than the outer section **92**. A washer **93** is impaled on section **91** of the rod and is adapted to butt against the shoulder at the inner end of section **92**.

A strip **94**, fixed to one side of the plate **83** by the screws **84** has a recess **95** in one surface thereof. The section **91** of the rod extends through the recess **95**, through an aperture **96** in the bottom of the recess, and through an aperture **97** in one end of a lever **98** that is pivotally secured to the plate **83**, as indicated at **99**. The other end of the lever **98** is engageable with a button or trigger **100** adapted to actuate the firing mechanism of the gun. A compression spring **101** encircles section **91** of rod **89** between the lever **98** and the washer **93**. Another compression spring **102**, large enough to fit over the washer **93**, encircles section **92**. One end of the spring **102** is seated in the recess **95** and is biased against the bottom of said recess. The outer end of the spring **102** is biased against an anuular collar **103** secured to section **92** at its outer end in any suitable manner.

As the piston rod **77** moves outwardly of its cylinder **75**, it moves arm **79** to rotate shaft **68**, thus moving plate **88** around shaft **68** as a pivot. As viewed in FIGURE 6, this movement is toward the left, thereby tending to compress the springs **101** and **102**. The spring **101** is shorter than the distance between the washer **93** and the lever **98**. Therefore the washer **93** must move toward the lever before the spring **101** can be compressed. The spring **102**, however, extends from the collar **103** to the bottom of the recess **95** and is compressed as soon as the rod **89** is moved toward the left. The compression of spring **102** moves the gun pivotally to the left until the nose of the gun engages the workpiece.

The pivotal movement of the gun to the left is stopped by the engagement of the nose **104** with the workpiece, but, as in the embodiment of FIGURES 1 to 4, the gun is not fired by the engagement with the workpiece, and the piston rod **77** continues its outward stroke. The continued rotation of the shaft **68** moves the rod **89** to the left, and, since the spring **102** cannot move the strip **94** to the left, the washer **93** is moved into the recess **95** and compresses the spring **101**. The spring **101** is so dimensioned that it exerts sufficient pressure against the adjacent end of lever **98** to move it about its pivot **99** to actuate the trigger **100** and fire the gun before the piston completes its outward stroke. As described above in connection with the embodiment of FIGURES 1 to 4, the delay in firing the guns **67** until the spring **101** builds up pressure against the lever **98** prevents premature firing of the gun, and the spring arrangement prevents accidental second firing if the gun falls back into engagement with the workpiece after being forced away from it by the recoil force of the first firing.

After all of the guns **67** are fired, the piston rod **77** completes its outward stroke and starts moving inwardly relative to its cylinder **75**. The inward movement of the piston rod reverses the direction of rotation of the shaft **68** and moves the plate **88** pivotally toward the right, as viewed in FIGURE 6. A block **108**, fixed to one edge of plate **88**, has a stud **109** projecting therefrom. As the plate **88** moves to the right, the stud **109** engages the rear surface of the strip **94** to move the gun **67** pivotally to the right to return it to its initial position.

Although I have described two preferred embodiments of the invention in considerable detail, it will be understood that the description thereof is intended to be illustrative, rather than restrictive, as many details of structure may be modified or changed without departing from the spirit or scope of the invention. Accordingly, I do not desire to be restricted to the exact structure described.

I claim:

1. An apparatus for controlling the firing of a plurality of fastening guns including a support member supporting said guns in spaced relationship to a workpiece, means for moving said support member to position said guns in engagement with the workpiece, means to operate said guns and lost motion means held by said support member and being operable after said guns are in engagement with said workpiece to actuate said gun operating means.

2. An apparatus for controlling the firing of a plurality of fastening guns including a support member adapted to support the guns in spaced relationship to a workpiece, a plate fixed to said support member and projecting therefrom, means for moving said support member to position said guns against a workpiece, a trigger control for each of said guns, a lever pivoted intermediate its ends to each of said guns with one end of each lever disposed adjacent a trigger, a spring confined between the oppoiste end of each of said levers and said plate, each of said springs being moved into engagement with said opposite end of its respective lever and pressed thereagainst by movement of said support member to pivot said lever to press a trigger and fire a gun, and lost motion means preventing movement of said springs into engagement with its lever until after its associated gun is in engagement with said workpiece.

3. An apparatus for controlling the firing of a plurality of fastening guns each having a trigger, a lever pivotally secured intermediate its ends to each of said guns with one end adjacent a trigger, a compression spring engageable with the opposite end of said lever, means engageable with said spring to compress it against said lever, whereby said lever is pivoted to operate said trigger, and means for supporting and moving each of said guns into engagement with a workpiece and to move said first mentioned means into compressing engagement with said spring after the gun engages the workpiece, whereby the guns will be in positive engagement with the workpiece before they are fired.

4. An apparatus for controlling the firing of a battery of fastening tools including a support member for supporting said tools, a trigger projecting from each of said tools for effecting firing of same, each of said tools having a lever engageable with the trigger of said tool, and lost motion means between said support member and lever whereby each of said tools will be moved into engagement with a workpiece prior to the engagement of its lever with its trigger.

5. An apparatus for controlling the firing of a battery of fastening guns including a support member for supporting said guns in spaced relationship to a workpiece, a trigger projecting from each of said guns, a lever pivotally secured intermediate its ends to each of said guns with one end thereof positioned to engage a trigger, a compression spring adapted to engage the opposite end of each of said levers, means projecting from said support member in alignment wtih each of said springs and movable into engagement therewith to compress it against the adjacent end of one of said levers to pivot same and bias its respective trigger into gun actuating position, means to move in sequence each of said guns into engagement with said workpiece and said first mentioned means into engagement with each of said springs to insure engagement of a gun with said workpiece prior to the gun being fired.

6. An apparatus for controlling the firing of a battery of fastening guns including a support member for pivotally supporting said guns in arcuately spaced relationship to a workpiece, means for pivotally moving said support member to position said guns in engagement with a workpiece, means to operate said guns, and lost motion means to insure engagement of each gun with said workpiece prior to actuation of said gun operating means.

7. An apparatus for controlling the firing of a battery of fastening guns including a pair of spaced uprights, a shaft rotatably mounted in said uprights for pivotally supporting said guns in arcuately spaced relationship to a workpiece, separate means for firing each of said guns,

means for rotating said shaft, two springs actuated sequentially by rotation of said shaft to pivotally move each of said guns into engagement with said workpiece and to actuate said separate means with respect to any one of said guns after it is moved into engagement with said workpiece.

8. An apparatus for controlling the firing of a battery of fastening guns comprising a rotatable shaft for pivotally supporting said guns in spaced relationship to a workpiece, a plate rigidly secured to each of said guns and projecting therefrom, means to rotate said shaft, a rod operatively connected to said shaft, rotational movement of said shaft being effective to move said rod axially, a compression spring engaging said rod and said plate, said rod compressing said spring as it is moved axially to position said gun in engagement with said workpiece, a trigger for actuating said gun, a lever engageable with said trigger, and a second compression spring engaging said rod, said rod compressing said second spring as said rod is moved axially after said gun is in engagement with said workpiece to move the lever to actuate the trigger.

9. An apparatus for controlling the firing of a battery of fastening guns including a support member for supporting said guns in spaced relationship to a workpiece,

a plate fixed to said support member and projecting therefrom, means for moving said support member to position said guns in engagement with said workpiece, a trigger projecting from each of said guns, a lever pivoted intermediate its length to each of said guns with one end adjacent one of said triggers, spring means confined between the opposite end of each lever and said plate, each of said spring means being positioned to be pressed against the opposite end of one of said levers by movement of said support member after said gun is in engagement with said workpiece to pivot said one lever to move the adjacent trigger into gun actuating position, each of said spring means being pressed against said plate by its related lever upon application of any recoil force of sufficient strength to move the related gun away from said workpiece to prevent second firing of said gun upon its return to said workpiece after any recoil.

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