United States Patent [19]

Nowikas

[11] **3,910,125**

[45] **Oct. 7, 1975**

[54] **STORED ENERGY EJECTOR MECHANISM**

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[73] Assignee: **Donley, Miller & Nowikas, Inc.**, East Hanover, N.J.

[22] Filed: **July 3, 1974**

[21] Appl. No.: **485,499**

[52] **U.S. Cl.** ..... **74/2;** 83/82; 83/160; 100/218; 214/1 BB

[51] **Int. Cl.²** **G05G 17/00**

[58] **Field of Search** ..... 74/2; 83/82, 160; 214/1 BB; 100/218

[56] **References Cited**

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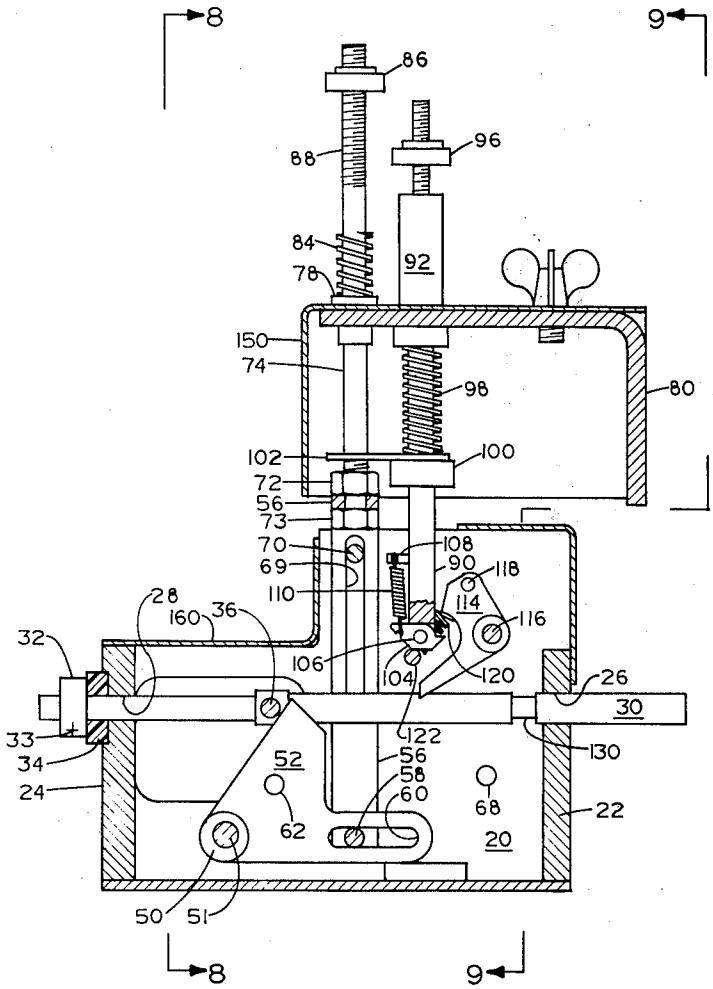
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Primary Examiner—Allan D. Hermann
Attorney, Agent, or Firm—Ralph R. Roberts

[57] **ABSTRACT**

A stored energy ejector mechanism is disclosed and described and includes an ejector plunger member which is propelled by a spring-bias induced by an actuator lever actuated by a stroke of a punch press and the like. The stored energy in these springs is released and the propelling or ejection motion of a plunger member is begun by the actuation of a trigger mechanism whose release time is selectively established and preferably occurs during the same stroke of the press mechanism in which is produced the loading of the springs. Although primarily for use with a punch press to provide a substantially quiet ejector action, this stored energy is equally applicable to other operations such as providing an ejector mechanism for use with a conveying or line inspection system employing linear motion.

15 Claims, 15 Drawing Figures



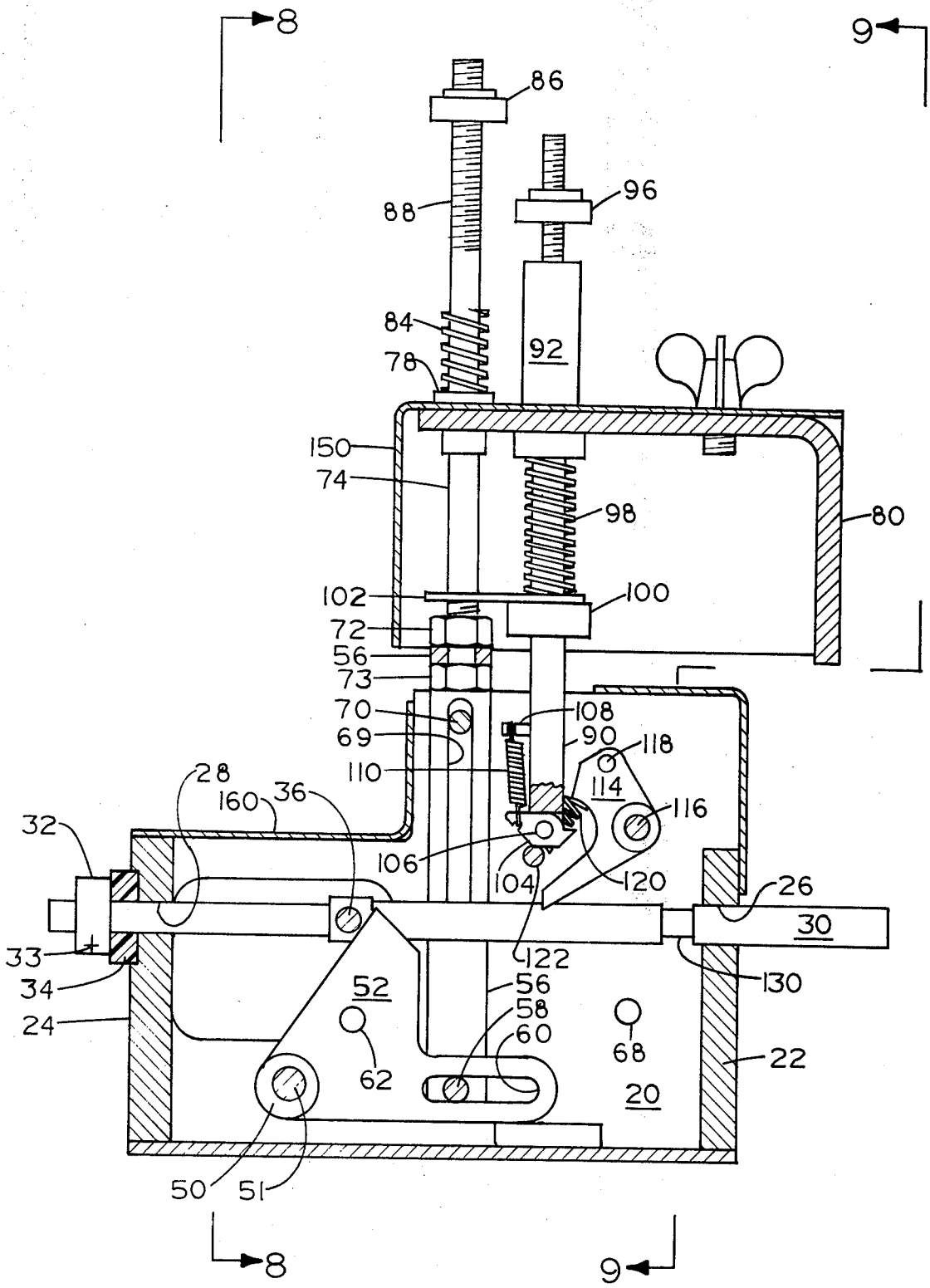

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FIG. 1

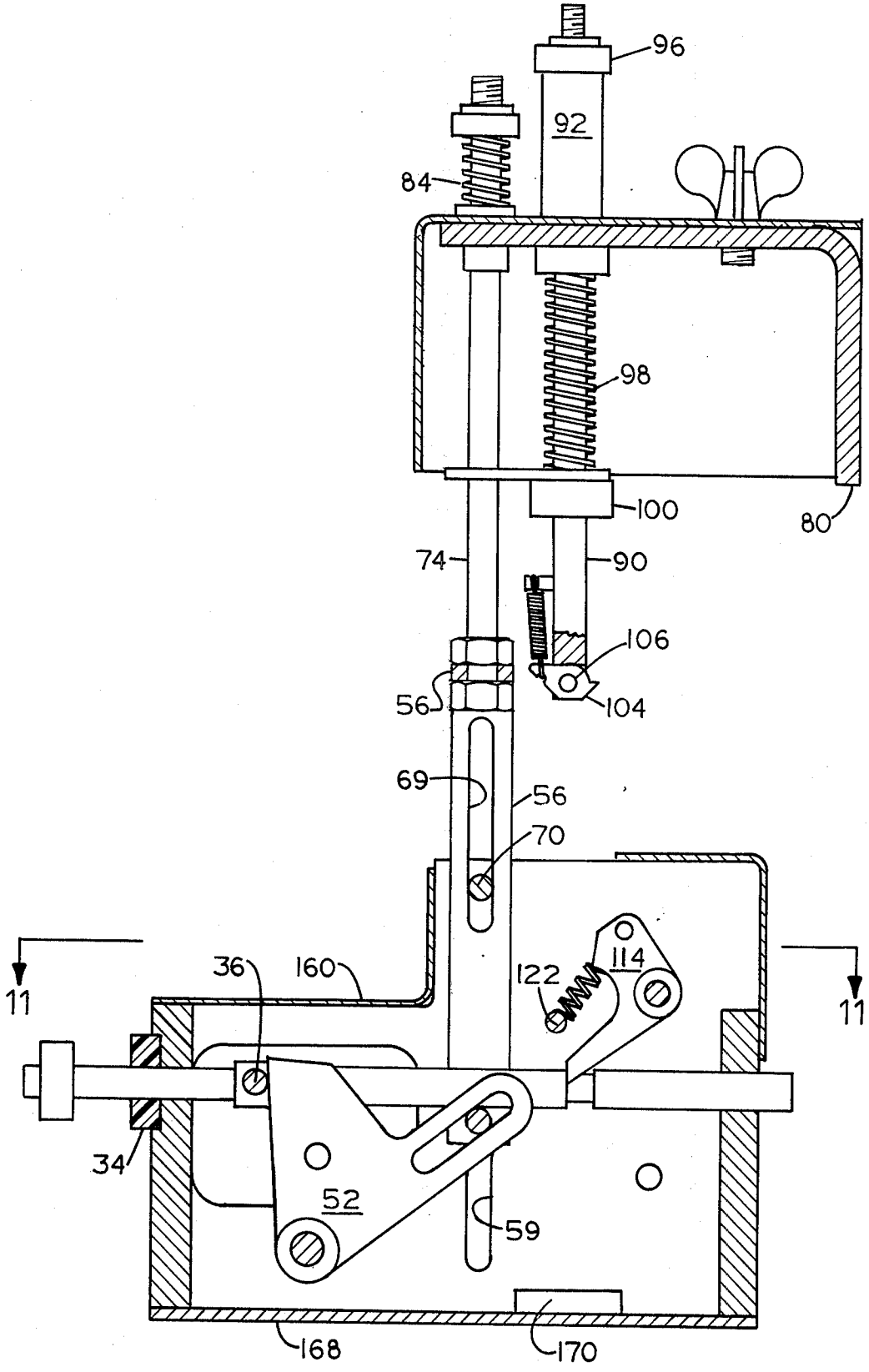

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FIG. 2

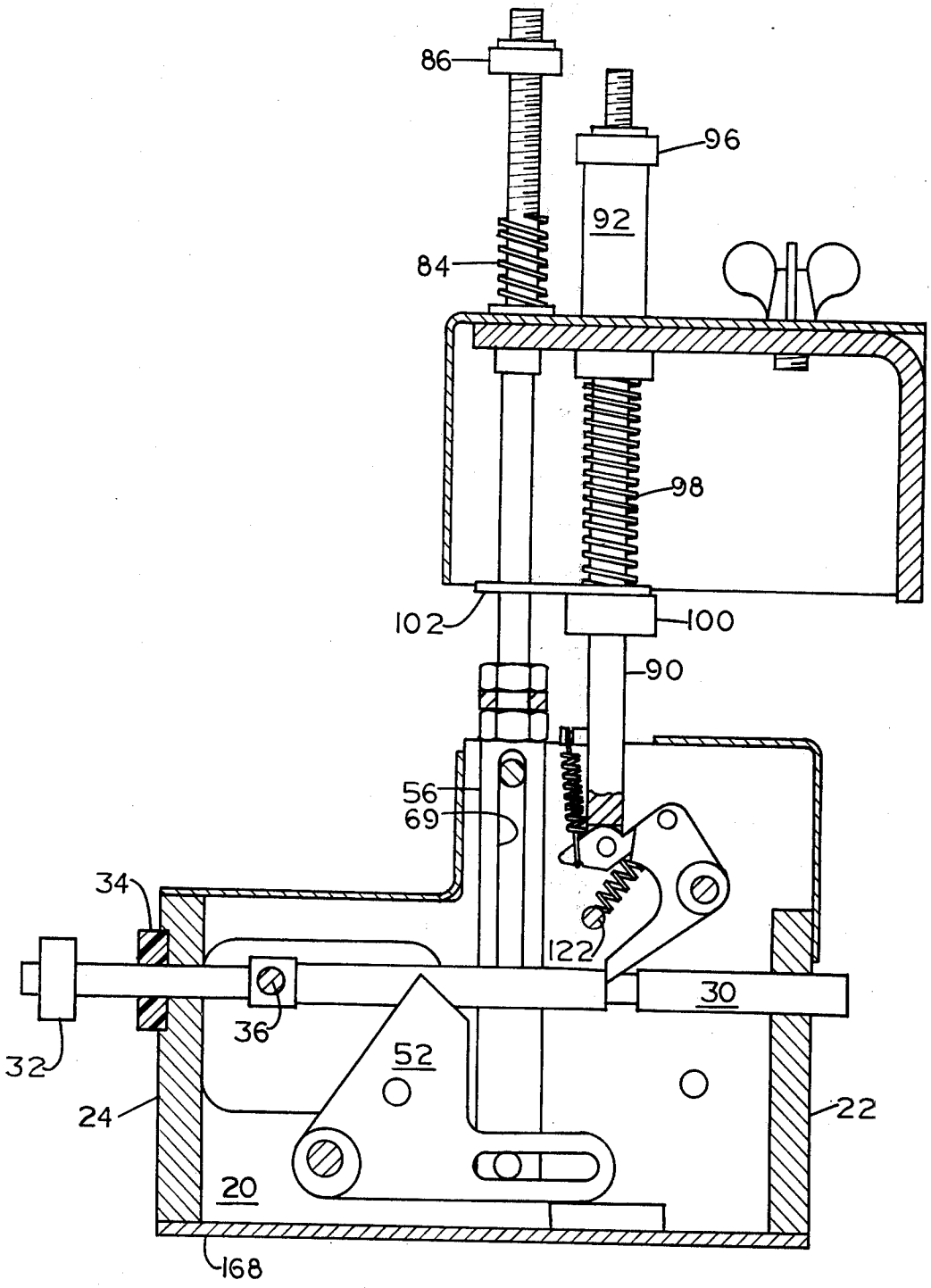


FIG. 3

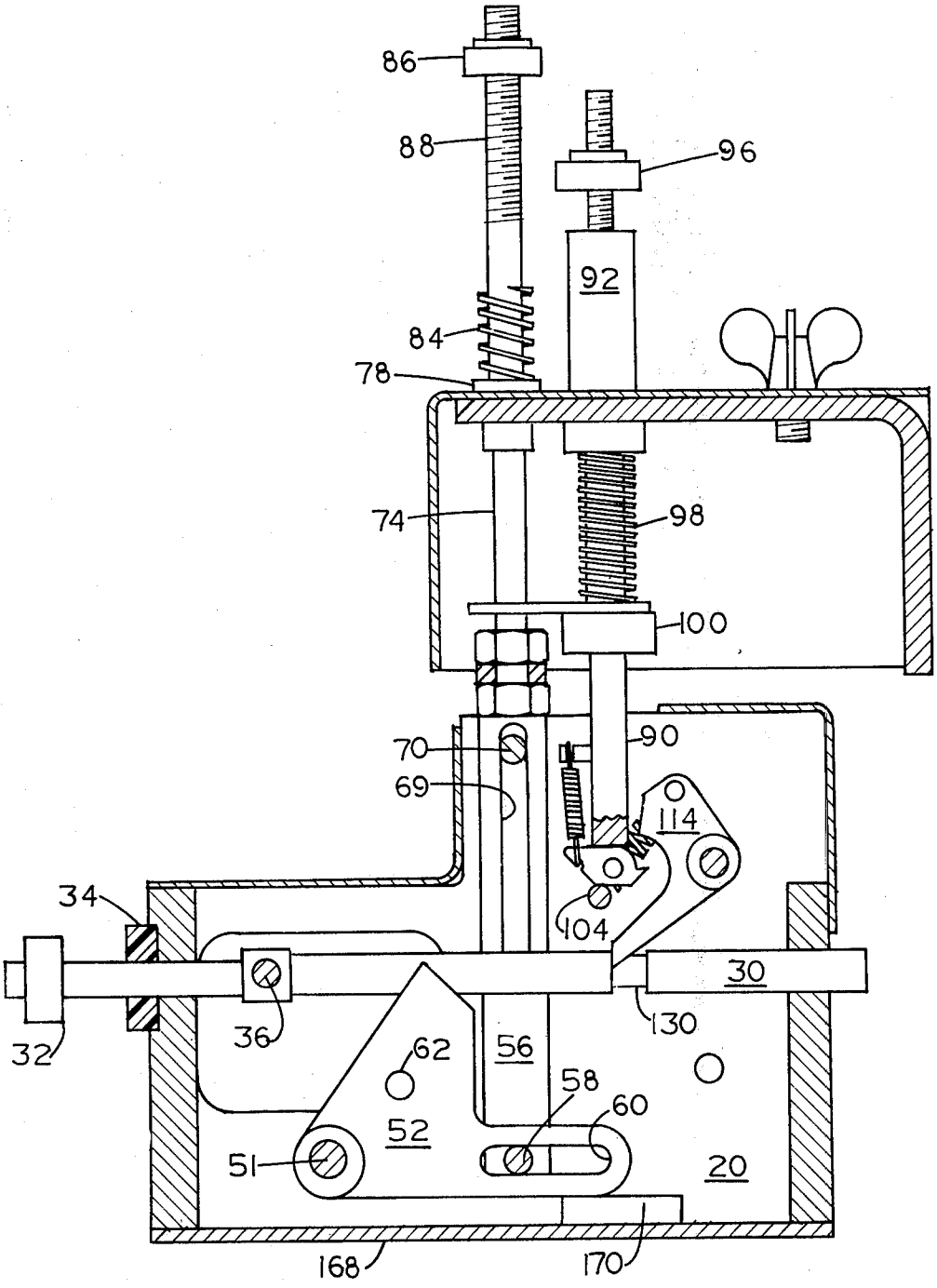

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FIG 4

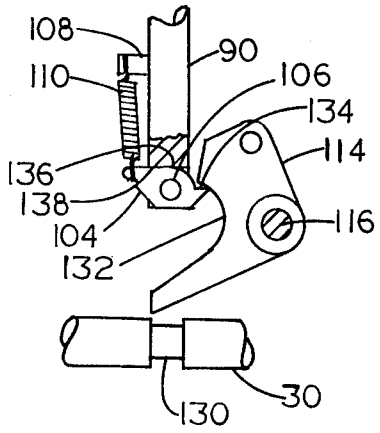


FIG. 5

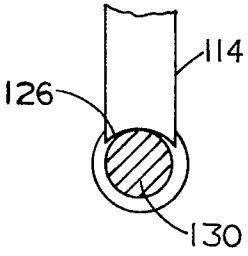


FIG. 6

FIG. 7

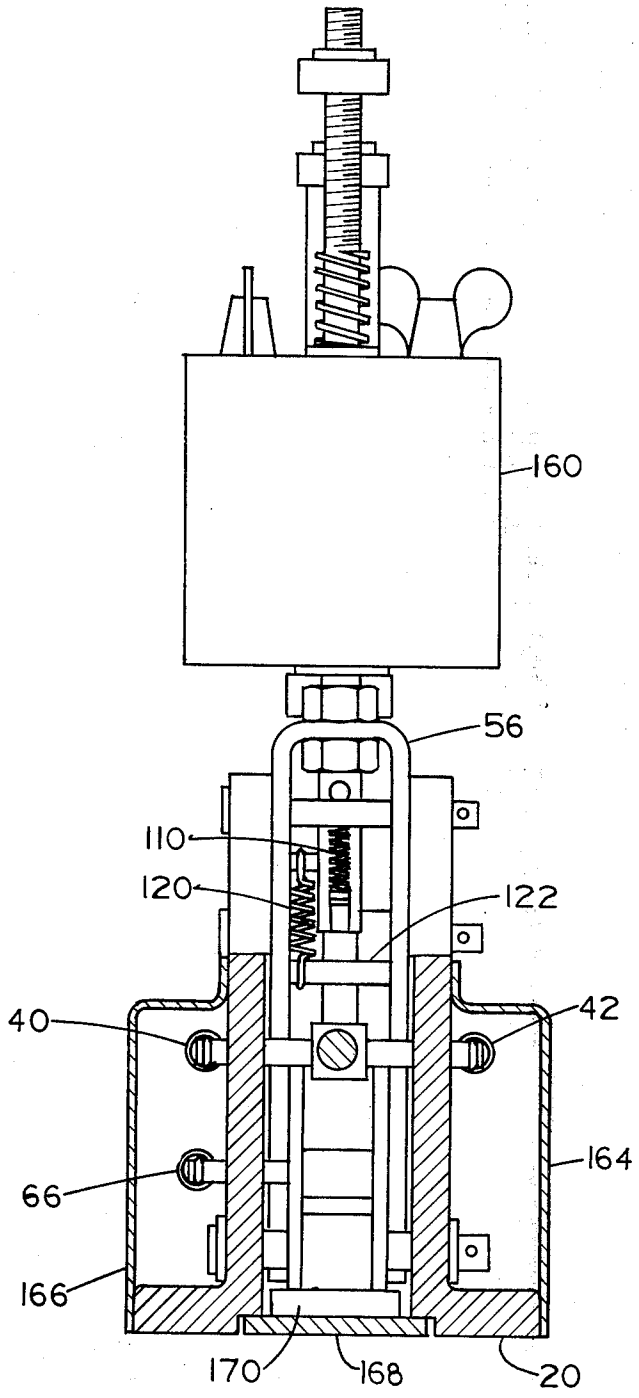


FIG. 8

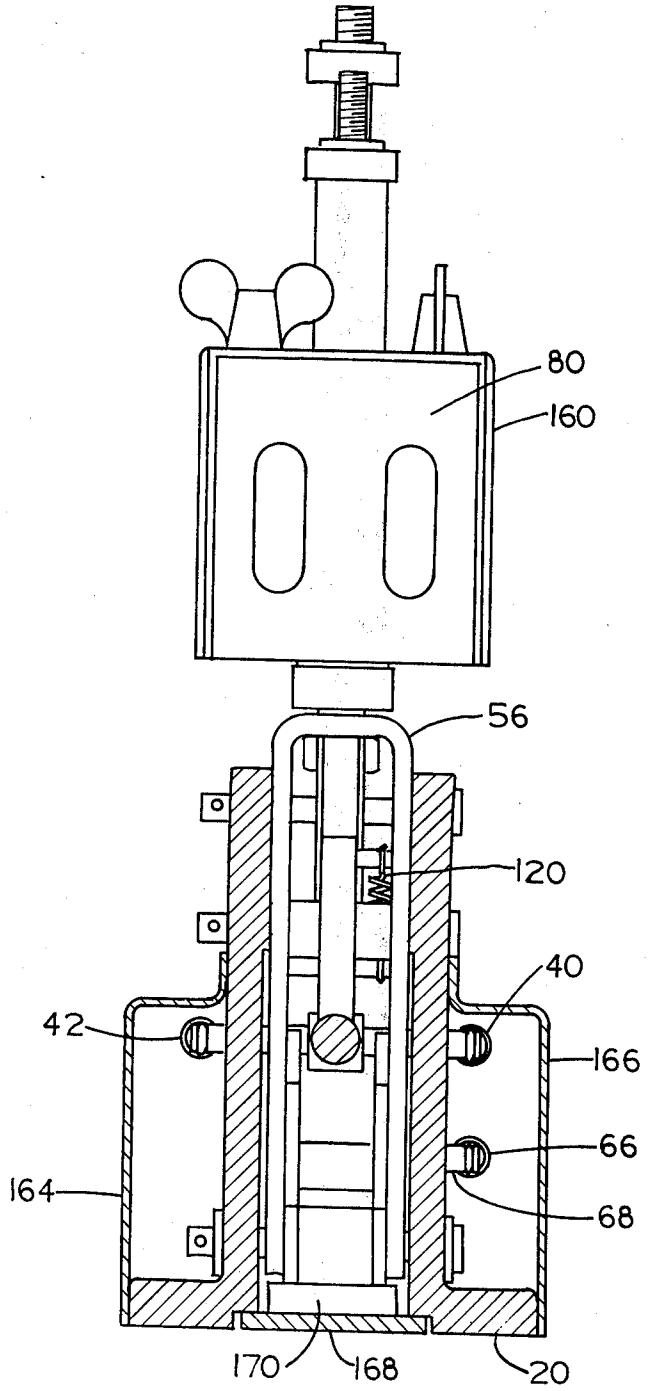


FIG. 9

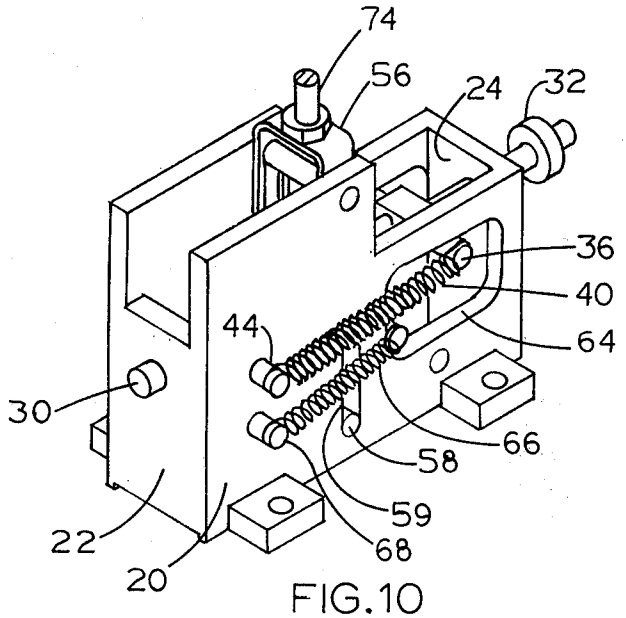

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FIG. 10

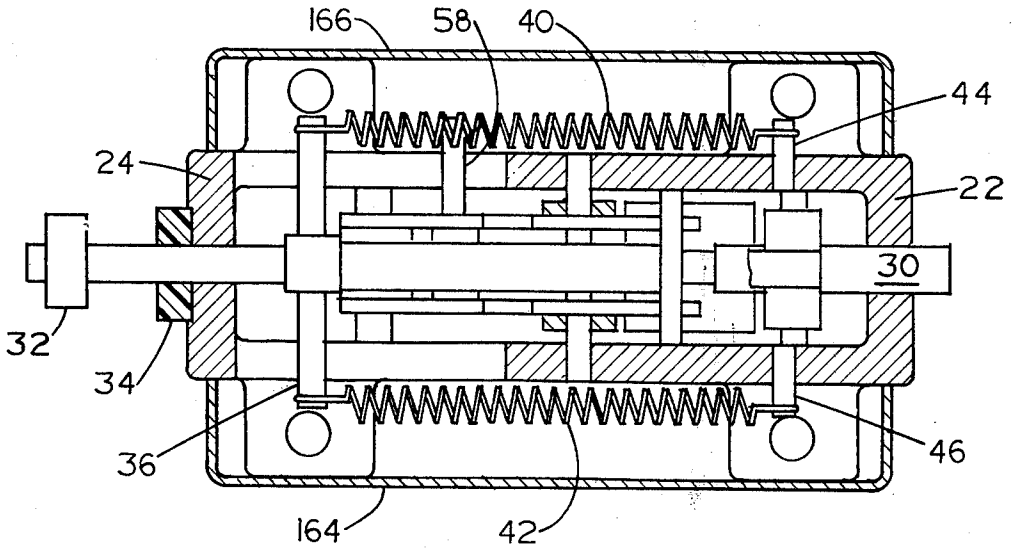

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FIG. 11

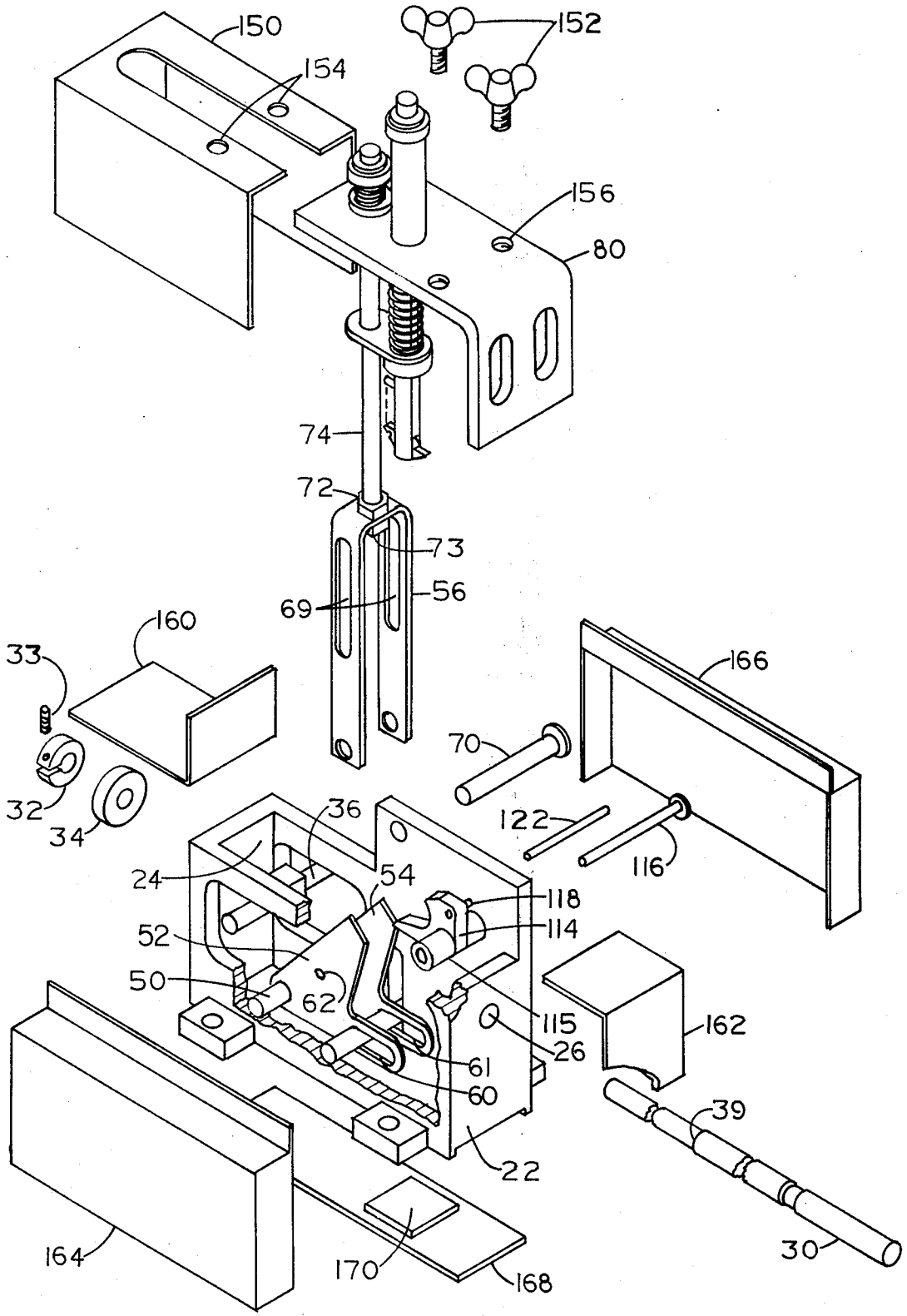

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FIG. 12

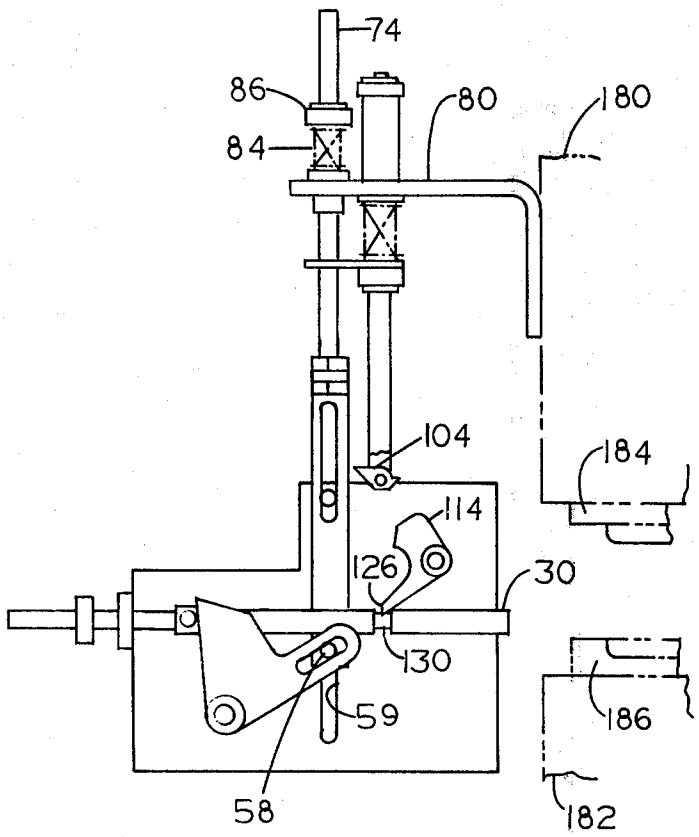

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FIG. 13

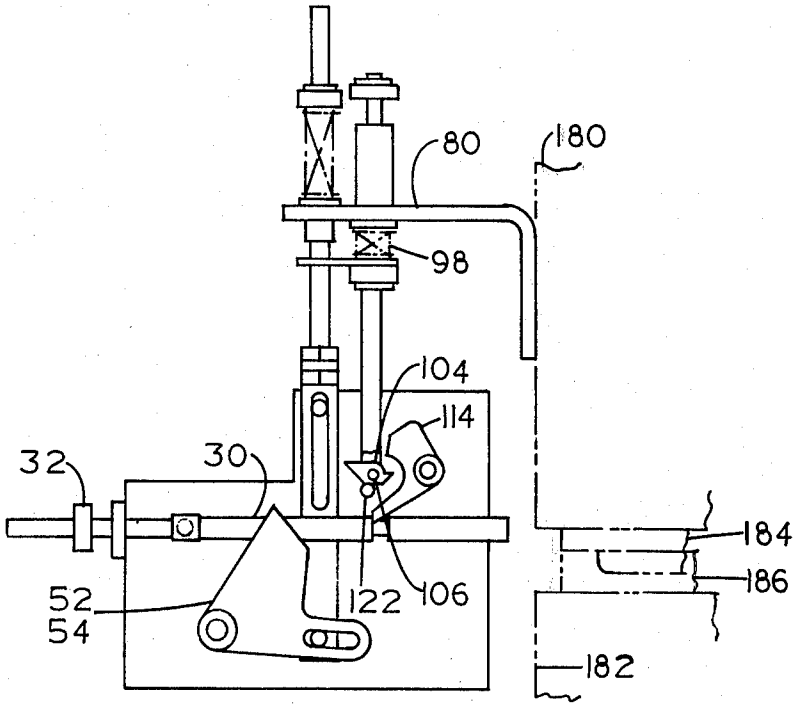

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FIG. 14

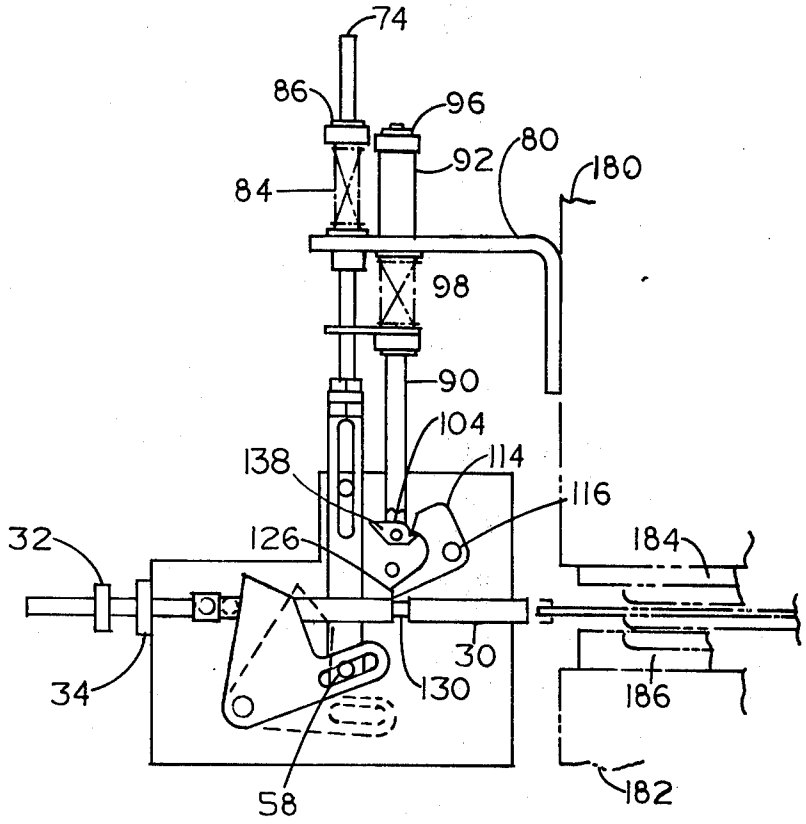

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FIG. 15

STORED ENERGY EJECTOR MECHANISM

BACKGROUND OF THE INVENTION

1. Field of the Invention

With reference to the classification of art as established in the United States Patent Office the present invention pertains to art as found in the general Class entitled, "Material or Article Handling" (Class 214) and the subclass entitled, "transfer devices - reciprocating type" (subclass LBB). Also of note is the art in the general Class entitled, "Cutting" (Class 83) and the subclass entitled, "means to move cooperating cutting member" (subclass 623).

2. Description of the Prior Art

Spring-type ejector pins and levers used with punch presses and mounted dies are well known and are often designed and furnished as a basic component of dies used with and in punch press operations. Hold-downs and step-wise advancing mechanisms are also well known in the punch press industry. In recent years for difficult high speed removal of a product there has been brought into use a controlled jet of air as an ejector means to blow formed, sheared, or compound-formed and sheared members from dies and the like. These jets of air in combination with the removal action of the piece parts are often noisy and in certain circumstances approach, if they do not exceed, the permissible tolerant noise levels now established by Federal law.

The present invention provides apparatus that is relatively silent during ejecting action and during the extending of the tension springs, as well as virtually silent or completely silent during all other phases of operation. The force required to extend the springs is small and is exerted during that part of the press ram movement which occurs during a portion of the travel stroke not immediately used for forming or cutting of the product part. The present invention permits the loading and ejecting cycle to be adjusted to suit the operating cycle. In particular, when used with a forming die the trigger is adjusted so that the ejector release motion occurs only after the die has opened a selected amount. It is to be noted that simple mechanical actions and components are employed so that the service life expectancy of the ejector mechanism and its components is in the millions of cycles. Its adaptability to punch press operations with a minimum of design consideration is also a great assistance to the designer where and when the dies are to be used in the punch press operation, or in a like manner as an ejector mechanism absent the use of pressurized air to remove items from a transport means.

The ejector mechanism utilizes a spring-biased plunger which is energized by a movement of the associated apparatus. A coupled pair of actuator levers is moved to load springs connected to the ejector plunger and the springs and plunger are maintained in the desired loaded or cocked condition until a trigger is actuated to release the ejector plunger which is moved a determined distance under the influence of the released springs. The releasing of the ejector plunger usually occurs in the up stroke portion of the press cycle and after forming and/or cutting. The release of the spring stored energy causes the ejector plunger to engage and dislodge that piece which is to be ejected.

SUMMARY OF THE INVENTION

This invention may be summarized at least in part with respect to its objects.

It is an object of this invention to provide, and it does provide, a stored energy ejection mechanism wherein an ejector plunger is propelled by a spring-biased means which is loaded during an associate stroke of a punch press and the like. A trigger retains the plunger in a cocked condition until the store energy is released by the actuation of the trigger mechanism whose release is selectively timed. This trigger is actuated by a stroke portion of the associated punch press.

It is a further object of this invention to provide a simple, relatively quiet, stored energy ejector mechanism having an ejector plunger which may be positioned at any desired relationship with a product member to be ejected from its placed position. This relatively quiet mechanism conventionally is actuated by the punch press ram during the portion of the press stroke which is non-operative as far as working on the product piece. During this stroke portion a coupled pair of actuator levers is moved to cause a pair of springs to be tensioned. These springs are attached to an ejector plunger. A trigger mechanism holds this ejector plunger in this cocked position until the trigger is actuated also by means of the punch press stroke. The actuated trigger causes a release of the ejector plunger and permits it to move quite rapidly under the influence of the tensioned springs.

The ejector mechanism of this invention is adapted for use with a punch press or a transport mechanism where its energy is stored and released by associating the mechanism with the movement of a ram of the press or a member of the transport mechanism. In a housing attached to a fixed portion of the press is slidably carried an ejector plunger actuated by a pair of tension springs which is attached to the plunger and the housing and urges the plunger to one extreme of travel. A coupled pair of actuator levers is actuated by an energizing shaft moved by and in response to the movement of the ram of the press. During the upward stroke of the press the actuating levers are engaged to stretch further the associated tension springs and move the ejector plunger to its loaded position. A trigger mechanism including a sear member, a stop shoulder on the ejector plunger, and a sear lifter also actuated in response to the upward stroke of the press ram releases the ejector plunger which rapidly moves to its unloaded position. This plunger is positioned to provide the desired ejecting action and the trigger mechanism is adjustable to cause a stroke related release of the ejector plunger.

In addition to the above summary the following disclosure is detailed to insure adequacy and aid in understanding of the invention. This disclosure is intended to cover each new inventive concept no matter how it may later be disguised by variations in form or additions of further improvements. For this reason there has been chosen a specific embodiment of the stored energy ejector mechanism as adopted for use on punch presses and transport mechanisms and showing a preferred means for loading and stroke related releasing of an ejector plunger. This specific embodiment has been chosen for the purposes of illustration and description as shown in the accompanying drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 represents a side view, partly schematic, of the ejector mechanism with the ejector plunger in its unloaded condition and with the actuator levers in condition for the initial loading of the springs by which the ejector plunger is energized;

FIG. 2 represents the mechanism of FIG. 1 with the spring cocking actuator levers moved into their spring loading condition and with the trigger actuation moved into holding position, this occurring when the punch press ram has reached the upward limit of its stroke;

FIG. 3 represents the side view of the mechanism as in FIG. 1 but with the punch press ram in the process of being moved toward the bottom of its stroke and with the sear lifter of the trigger mechanism wiping past the sear member;

FIG. 4 represents a side view of the apparatus as in FIG. 3 but with the press ram and the energizer shaft in the completely bottom position and with the trigger mechanism being brought to a cocked condition prior to the upward motion of the ram of the punch press;

FIG. 5 represents a fragmentary view of the trigger mechanism and showing the sear lifter as it has engaged and rotated the sear to release the energized plunger for rapid movement of the plunger to the right;

FIG. 6 represents a fragmentary sectional view in a slightly enlarged scale of the ejector plunger and the sear while in holding engagement of the plunger, this view taken on the line 6—6 of FIG. 7 and looking in the direction of the arrows;

FIG. 7 represents a sectional side view of the mechanism as in FIG. 4 and with the press ram moved upwardly to cause the sear lifter to be moved into sear disengaging position just prior to a further lift to create the plunger release of FIG. 5;

FIG. 8 represents a sectional view taken on line 8—8 of FIG. 1 and looking in the direction of the arrows;

FIG. 9 represents a sectional view taken on the line 9—9 of FIG. 1 and looking in the direction of the arrows;

FIG. 10 represents a partly diagrammatic isometric view in a reduced scale of the mechanism of FIG. 1 and showing the back side of the apparatus;

FIG. 11 represents a plan view partly in section, this view taken on the line 11—11 of FIG. 2 and looking in the direction of the arrows;

FIG. 12 represents an exploded isometric view of the mechanism with portions of the components broken away to more clearly show the inner construction and relationship of certain components;

FIG. 13 represents a side view in a reduced scale of the ejector mechanism as in FIG. 2, this view is a diagrammatic showing of the mechanism in a typical mounting on a die set and with the die halves in full open condition;

FIG. 14 represents a diagrammatic side view of the mechanism of FIG. 13 with the dies in a fully closed condition, the mechanism in this view is as in FIG. 4, and

FIG. 15 represents a diagrammatic side view of the mechanism of FIG. 13 with the dies in an opening condition at the time of the trigger release to permit the plunger to move on its ejector stroke, this corresponds to the sear mechanism as seen in FIG. 5.

In the following description and in the claims various details will be identified by specific names for convenience; these names, however, are intended to be generic in their application. Corresponding reference characters refer to like members throughout the several figures of the drawings.

The drawings accompanying, and forming part of, this specification disclose specific details of construction for the purpose of explanation of the broader aspects of the invention, but is should be understood that structural details may be modified and that the invention may be incorporated in other structural forms than shown.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As seen in the drawings and in FIGS. 1–15 therein, there is disclosed a preferred embodiment of an ejector mechanism and showing in detail the relationship of the several components and their interaction as they provide the loading, cocking and then the release of an ejector plunger. It is, of course, realized that many different sizes and modifications of the embodiment shown may be made, however, for the purpose of the explanation and relationship of the components it is to be noted that, as depicted, a reduced-to-practice mechanism is shown in FIGS. 1–5, 7–9, 11 and 12 in a substantially three-quarter to full size scale and represents an ejector stroke length of approximately one and one-quarter inches maximum, and one-half inch minimum. Obviously, apparatus larger and smaller may be constructed and the extent of the stroke is only a matter of design selection.

As depicted, the apparatus includes a housing 20 which may be a cast unit having end portions 22 and 24 in which are formed guideways 26 and 28 forming and providing bearing means to slidably carry an ejector plunger 30. This plunger, as seen in FIGS. 1–4, and 11, carries on its left end an adjustable split clamp collar 32. A cap screw 33 is preferably used to tighten this collar at the desired position on plunger 30 or, as an alternate means, a threaded arrangement may be provided. An impact absorber 34 which is washer-shaped and of a resilient material absorbs the abrupt stop forward motion when the plunger is released. In addition to absorbing the shock the sound energy is reduced by this absorber which is mounted on the end portion 24 and is disposed between the collar 32 and the housing end 24. Carried on this plunger is a plunger spring anchor 36. A forward shoulder 39 formed by making the rear portion of the plunger a reduced diameter also prevents unwanted forward movement of anchor 36 on the ejector plunger 30. Attached to the outwardly extending rod portions of this anchor 36 and by one end thereof are like extension springs 40 and 42. These are best seen in FIG. 11 wherein also is shown mounted in the side walls of housing 20 like springs retaining pins 44 and 46. On the ends of these pins are mounted the other loop ends of extension springs 40 and 42 which are stretched to provide a determined amount of tension. These springs and plunger, as seen in FIG. 11, show the plunger in the loaded condition.

Actuator lever hub 50 is carried by a clevis pin 51 whose ends are mounted in and extend from the two side walls of the housing 20. Mounted on hub 50 as a matched pair is near and far actuator levers 52 and 54. The forward or rightwardly extending portions of these levers straddle and freely pass a vertically disposed energizer fork 56 which carries a clevis pin 58 in its lower

end. Pin **58** is vertically slidable in slots **59** formed in the side wall of the housing **20.** This clevis pin is slidable in slot **60** formed in the near lever **52** and in a like slot **61** formed in far lever **54.** An actuator lever spring pin **62** is carried in these levers **52** and **54** and extends through cutout **64** in the far wall of the housing **20.** At this extending end the pin is attached to one end of an extension spring **66.** The other end of this spring is attached to a spring anchor post **68** mounted in the far wall of the housing **20.** This spring anchor post can be seen in FIGS. **1** and **9.** The spring **66,** in mounted condition, is in tension and urges lever members **52** and **54** in a clockwise direction as viewed in FIG. **1.**

In the upper portion of energizer fork **56** is a pair of like slots **69** which provides guide means for this fork **56.** A guide pin **70** extends through these slots and by its ends is mounted in holes provided in each side wall. Fork **56** is connected at its upper end by means of upper and lower nuts **72** and **73** to a vertical energizer shaft **74.** The lower end of this shaft is threaded and passes through a hole in the transverse portion of fork **56.** The intermediate portion of this shaft **74** is slidable in a drill jig bushing **78** which provides a guide means when mounted in an actuator mechanism bracket **80.** Above bushing **78** and carried on the vertical shaft **74** is a compression spring **84** which at the upper stroke of the press is adapted to engage an adjusting nut **86** carried on a threaded portion **88** of the shaft **74.** This threaded portion and the nut **86** mounted thereon limits the movement of this shaft and the loading of the spring **84** for a purpose to be hereinafter described.

Also carried in bracket **80** is a sear lifter shaft **90,** which shaft is moved upwardly and downwardly by and with the movement of the bracket **80.** A head liner **92** is carried in and by bracket **80** and acts as a collar stop as well as a guide bearing for shaft **90.**

This bracket **80** is conventionally attached to an upper die carried by the ram of the punch press, not shown, and is reciprocably moved with the ram. If and when this ejector mechanism is to be used with other apparatus such as conveyors, a conventional cyclying mechanism is arranged. For example, arm members on a traveling conveyor might be arranged to engage the bracket **80** and reciprocate this bracket.

The upper portion of the lifter shaft **90** is sized for precise slidable movement in the head liner **92.** The upper portion of shaft **90** is a reduced diameter and is threaded for the adjustable retention of a knurled clamp collar **96** which is adjusted to provide a determined amount of lost motion of shaft **90** in liner guide **92.** Below this head liner **92** there is a compression spring **98** which is slidably carried on shaft **90.** This is a compression spring of a determined length having a determined shut height. This shut height is normally not used since the spring has a determined compression which is calculated to cause a trigger member to pass an actuating engaging point to be hereinafter more fully described.

Secured to the shaft **90** at a selected location on this shaft is a clamp collar **100** which is selectively fixed to the shaft. Above collar **100** is a stabilizer bar **102** which is slidable on shaft **74** and also on shaft **90.** This stabilizer bar **102** is a guide to hold the vertical shaft **90** in a desired oriented position in relation to the trigger mechanism to be hereinafter more fully described. Bar **102** may be fixed to collar **100** to achieve the desired orientation of shaft **90.** An alternate means may be one or two flats formed on shaft **90** and a mating key portion formed in the hold in bar **102** which slides on shaft **90.** Other means, of course, may be used to insure orientation of shaft **90.** The lower end of shaft **90** is formed with a clevis cutout whose upper surface provides a stop shoulder. In this clevis portion is pivotally carried a sear lifter **104** which is rotatably mounted on a sear lifter pin **106** extending through the clevis portion of shaft **90.** Also attached and extending from shaft **90** as it is held in the desired oriented position by bar **102** is a spring support pin **108** which supports and secures the upper end of an extension spring **110** whose other end is mounted in a small notch formed in the sear lifter **104.** This notch is leftward of pin **106** as seen in FIG. **1.**

Referring now in particular to the plunger retaining and release means as depicted in FIGS. **5, 6** and **7,** it is to be noted that as seen in FIGS. **5** and **7,** the sear release lifter **104** is to the left of a sear **114** which has a general C-shape. This sear **114** is spaced from the side walls of housing **20** by sear hubs **115** and is pivotally retained on a shaft **116** which extends between and is retained in holes formed in the near and far side walls of said housing **20.** The upper portion of this sear has a spring anchor **118** which is a short pin mounted in a hole formed in the sear. One end of an extension spring **120** is secured to this anchor **118** and the other end of the spring **120** is mounted on a pin **122** which, as depicted in FIG. **7,** is mounted in the far wall of the housing **20.** Spring **120** urges the sear **114** in a counterclockwise direction around shaft **116.** The lower left portion of the sear **114** has a depending tail portion which contains the means providing the forward stop for the movement of the ejector plunger **30** when and as it is moved to the loaded condition.

It is to be herewith noted that pin **122** as seen in FIG. **1** provides a dual function. It not only secures one end of spring **120** but also insures that if spring **110** breaks or the sear lifter **104** is slow in responding to the urging of the spring **110,** the lifter will be cammed into the engaging position of FIG. **1** with and at the termination of the down stroke.

In certain instances, it may be desirable that spring **110** be eliminated and that the camming action of the sear lifter **104** as it engages pin **122** be used instead. If and where the pin **122** is to be used exclusively to rotate sear lifter **104** to the engaging position of FIG. **1,** a roller may be supplied on pin **122** to reduce wear.

As seen in enlarged detail in FIG. **6,** the depending end of sear **114** is formed with an arcuate cutout **126** which to a large extent is compatible with a reduced diameter portion **130** formed in the plunger **30.** This arcuate portion **126** of the sear is urged by spring **120** into sliding engagement with that larger diameter portion of plunger **30** which is to the left of reduced diameter portion **130.** As the plunger **30** is moved leftwardly from the condition of FIG. **1** to the loaded condition of FIG. **7,** the arcuate portion **126** slides on the upper surface of the plunger **30** until the reduced diameter **130** is brought in way of the arcuate portion **126.** At this point and urged by spring **120** this end of the sear is pulled into reduced diameter **130** and in this position the left shoulder of the reduced diameter portion **130** is engaged by the arcuate portion **126** as the leftward movement of the plunger is stopped. The sear **114,** in the holding condition of FIG. **7,** retains the ejector plunger **30** in the "loaded" condition until the release

action of the sear lifter **104** causes the sear **114** to be disengaged.

The upper left edge of the sear **114**, as seen in FIG. **7**, is formed with an arcuate cam surface **132** whose upper left end provides a shoulder portion in the path of a trigger projection portion **134** of the sear lifter **104**. This lifter is rotatable counterclockwise around sear lifter pin **106** until projection **134** engages the right surface of sear lifter shaft **90**. The clevis formed in the end of this shaft **90** also provides a stop surface **136** which is engaged by a shoulder edge portion **138** of the sear lifter **104**. Extension spring **110** draws the pivoted sear lifter into the lifter engaging condition of FIG. **5** with shoulder edge **138** held against stop surface **136** when and as the projection portion **134** moves upwardly into engagement with the upper portion of cam surface **132**. Also, as noted above, pin **122** insures that the lifter has been moved to the position now seen in FIG. **7**.

Also depicted in the drawings is actuator mechanism cover **150** which is a guard member secured to bracket **80** by wing screws **152** passing through holes **154** into threaded holes **156** formed in bracket **80**. As seen in FIG. **12**, an energizer fork cover **160** is mounted on the upper left surfaces of housing **20**. A sear cover **162** is also secured to the sides of the housing **20** to cover the front opening above the plunger guideway **26**. Near and far side covers **164** and **166** are secured to the sides of housing **20** to guard the moving parts in the housing from damage and/or to prevent tampering with the enclosed parts. A bottom cover **168** carries an impact absorber pad **170** which engages the bottom sides of levers **52** and **54** to limit the turning of these levers around clevis pin **51**.

ACTUATING OF EJECTOR MECHANISM AS SEEN IN FIGS. 13, 14 AND 15

Referring next and finally to FIGS. **13**, **14** and **15** there is shown the ejector mechanism of this invention and mounted in an operating condition on or in association with upper and lower die plates as seen in phantom outline and identified as **180** and **182**. A representation of an upper die portion **184** is shown attached to this upper die plate. A representation of a lower die is also shown as a forming die and is identified as **186**. This lower die is attached to the lower die plate **182**. As depicted in FIG. **13**, the ejector mechanism is shown with the dies in a fully opened condition and with the plunger **30** in an energized or cocked condition. The sear **114** has dropped into a plunger retaining condition with the end having cutout **126** laying in reduced diameter portion **130**. The sear **114** is in the trigger retaining condition for holding the plunger **30** against rightward movement while the sear lifter **104** is in its uppermost position as carried by the bracket **80**.

As illustrated, the bracket **80** is affixed to the upper die plate **180** by means such as cap screws. The upward movement of the bracket **80** and upper die plate **180** causes the energizer shaft **74** to travel to its upper limit. The clevis pin **58** has been moved to the upper limit established by guide slots **59** formed in the side wall of the housing **20**. The upper spring **84** on the shaft **74** may be slightly compressed with the upper travel of the bracket **80**. This occurs when the upward stroke travel of the shaft **74**, which is a fixed distance, is less than the lifting stroke of the press. This requires the adjusting nut **86** and the energized shaft spring **84** to be adjusted as to the extent of compression. The adjusting of the upper limit as established by the nut occurs after the mounting of the bracket **80** on the upper die **184**. The top "dead center" position of the press ram is shown in FIG. **13**.

Referring next to FIG. **14**, the mechanism and die plates **180** and **182** are shown at the bottom limit of the downward stroke of the punch press. The upper and lower dies **184** and **186** are fully closed to perform whatever operation is to be done upon the workpiece, not shown. The sear lifter compression spring **98** is in a compressed condition and the sear lifter **104** has passed by the sear **114** on its way down. The rotation of the sear lifter **104** is about sixty or seventy degrees as it engages and passes by the sloped part of the sear and is counterclockwise around the pin **106**. As and after the sear lifter has been moved to its lower limit, as established by the stop pin **122**, the spring **98** is compressed to provide the desired amount of lost motion which occurs on the upward movement of the bracket **80**. This determined lost motion occurs as the bracket **80** initially begins its upward travel. It is to be noted that the actuator levers **52** and **54** are in the lowermost position and the ejector plunger **30** is in "cocked" condition. The stop collar **32** is secured on plunger **30** at a determined distance which is established to limit the extent of the rightward travel of the ejector plunger.

Referring next and finally to FIG. **15**, the bracket **80** has been carried upwardly by the upper die plate **180** until the sear lifter **104** is in engagement with the sear **114** to the extent the sear has been rotated clockwise to the point of release of the ejector plunger **30**. The compression spring **98** has expanded to its normal position at which the top of the head liner **92** is in engagement with the adjusted clamp collar **96** on the sear lifter shaft **90**. The sear lifter **104** in its engagement with the sear **114** has moved upwardly about one-quarter inch to cause the sear to be rotated clockwise around pin **116**. A slight amount of the clockwise movement of the sear is necessary to cause the engaging portion containing the arcuate U-shape cutout portion **126** to slide up the shoulder **138** and when free the plunger **30** is released to move rightwardly until the collar **32** engages the impact absorber **34**. Collar **32** limits the movement of the plunger to its rightward position. This travel and limit extent of the ejector plunger **30** may be from one-half inch to one and one-quarter inches.

In a typical sequence of a reduced-to-practice use there is provided an ejector mechanism in a punch press having a die stroke of one and one-half inches. A die requiring a forming depth of one-quarter inch between the upper and lower dies requires that the upper and lower dies **184** and **186** be open for a distance of five-eighths of an inch before the ejector plunger is released. During this upward stroke of five-eighths of an inch, the sear lifter **104** remains in its fully down position for the first three-eighths of an inch. The expansion of the compressed spring **98** provides the desired lost motion travel. The next quarter of an inch of travel of the sear lifter shaft **90** brings the sear lifter **104** into releasing engagement with the sear **114** to cause the release of the ejector plunger **30**. A minimum travel of the ejector plunger might be three-eighths of an inch while the maximum plunger travel might be as much as one and one-quarter inches with this amount dependent upon the size of the apparatus.

USE AND OPERATION

As particularly seen in FIGS. **13, 14** and **15,** it is anticipated that the ejector mechanism of this invention will, in many instances, be used with and will be attached to upper and lower die plate portions as used with and in a punch press. As an alternative to a punch press installation, a conveyor system may have an ejector mechanism associated therewith and arranged so that the ejector is used to reject certain workpieces that do not meet the desired standard and are rejected by an inspection method of some known means. Assuming, for example, that this apparatus is used in a punch press with forming dies, as in FIGS. **13, 14** and **15,** the ejector mechanism itself is fastened to the base plate of the press or to a lower die plate **182.** The ejector pin **30** in its adjusted extended condition is arranged so that the end contacts and moves the formed workpiece after the workpiece has been formed, cut or a combination thereof. A sufficient stroke of the ejector plunger is provided so that when actuated it strikes the workpiece to move the workpiece from its position in the die to an accumulating bin. In order to mount and apply the ejector mechanism to a conventional die it is necessary that the designer establish the following data: (a) The working stroke of the die set. This, of course, is usually the stroke of the punch press. Alternately the die set may be moved only a determined amount which is less than the press stroke. This may be accomplished when the upper die set is pushed to its limited open condition by means of die springs and the ram acts as a striking hammer. (B) Orientation of the ejector mechanism. This requires the plunger to be located as to the orientation of the ejector plunger for both the amount of displacement impact and the direction of the ejector stroke on the workpiece. (C) The time of ejection. This time of ejection is established in relation to the opening of the dies after the bottom dead center of the press stroke has been accomplished. (D) Establish the ejector plunger path of travel. It is also necessary to determine the length of stroke necessary for the ejecting plunger to move the workpiece and return the plunger to a cocked condition free of the dies. (E) Determine the feed stroke in relation to the ram motion. In many instances it is necessary to keep in mind the feeding of strip stock into and between the dies. Usually the stock feed takes place while and with the plunger in its cocked position.

After determining the above parameters to establish a desired operating procedure it is necessary then to adjust the ejector mechanism as to its plunger stroke. This is accomplished by first removing the side covers **164** to expose the inside of the mechanism. The split clamp collar **32** is loosened and with the plunger in the fully retracted or cocked condition the clamp collar **32** is loosened by loosening the clamp screw **33** to permit the collar to be slid on the ejector plunger **30** to a calculated stroke distance. This length of the calculated stroke is set as the distance from the innerface of the clamp collar **32** to the outer face of the impact absorber ring **34.** This is the desired stroke of the ejector plunger and establishes the parameter of the motion of the plunger **30.** The crank head of the punch press is moved to determine where the start of the stock feed apparatus is to begin. With the ejector plunger positioned as to its stroke and direction the bracket **80** is located on the upper die plate **180.** It is to be noted that in positioning bracket **80** on the upper die plate the actuator levers **52** and **54** need to make contact with the plunger spring anchor **36.** As a practical matter and to reduce wear to a minimum, the energizer shaft **74** is preferably arranged so that its axis is parallel to the axis of die posts used with the die sets. Minimal wear occurs when this parallelism is maintained within about one sixty-fourth of an inch total indicator error.

With the ejector mechanism mounted on the press or lower die plate **182** adjustment of the mechanism is begun. The adjusting nut **86** on the energizer shaft **74** is screwed down to compress spring **84** so that levers **52** and **54** are moved to cause plunger **30** to be moved to derive approximately one-sixteenth of an inch additional spacing between the clamp collar **32** and the impact absorber **34.** This establishes the position of the actuator mechanism bracket **80** on the upper die plate. After this indication has been made the press ram is jogged to bottom dead center and the bracket **80** is mounted on the desired or assigned position upon the side of the upper die plate **180.** It is essential that the stablizer bar **102** does not bear upon the upper hexagon nut **72** carried on shaft **74.** When the stablizer bar **102** closely approaches or engages the hexagon nut **72,** the collar **100** is loosened and is moved upwardly on the sear actuator shaft **90** until there is an established clearance.

The firing of the plunger is now adjusted and with the press ram at bottom dead center as in FIG. **14,** the sear lifter **104** is moved so as to touch the stop pin **122.** From this lower position approximately one-quarter of an inch movement is to take place before sear lifter **104** causes the sear **114** to release the plunger from its cocked position. It is to be noted that if the release of the ejector plunger is to be retarded from the above suggested setting a greater separation of the upper and lower die plates **180** and **182** is required. Again the ram of the press is brought to the bottom dead center with the sear lifter **104** in contact with the sear lifter stop pin **122.** The clamp collar **96** on the upper end of the sear lifter shaft **90** is loosened and is rotated to move upwardly on the shaft to provide a greater distance above the head liner **92** carried in the bracket **80.** This increases the amount of lost motion of sear lifter shaft **90** and the relationship of the upward motion of bracket **80** to the sear lifter shaft **90** and provides a desired increase and separation of the upper and lower die plates **180** and **181.** With the adjustment of the upper collar **96** it is necessary to insure that the spring **98** carried on the sear lifter shaft **90** is sufficiently, initially compressed to provide a sufficient downward force to cause the sear lifter **104** to pass by the left shoulder face of the sear **114.** If the compression force in the spring **98** is not sufficient to cause the sear lifter to pass by the sear, the collar **100** is loosened and both collar **100** and stablizer bar **102** are raised upward until a sufficient compression is put into the spring **98** to cause the sear lifter **104** to pass the sear on the down stroke of shaft **90** as the bracket **80** is moved to its downward position.

With the mechanism as now adjusted a slow try of the punch press is made. The stock for the workpiece is fit into the dies for the initial operation. During the up stroke of the press ram prior to the feeding of the first piece into the die, the upward movement of te energizer fork **56** causes te fork to lift the pin **58.** The upward movement of this pin causes the levers **52** and **54** to be rotated counterclockwise and to move the spring

anchor **36** leftwardly. The ejector plunger is moved leftwardly with the spring anchor **36** to its cocked condition. The energizer shaft **74** is lifted upwardly by the bracket **80** until the upper die plate **180** reaches its top dead center position as in FIG. **13,** at which point the ejector plunger has been brought slightly past its normally cocked condition. The lower end of the sear **114** is urged into the notch provided by the groove **130.**

As the ram and the die start to move downwardly the sear lifter shaft **90** is also carried downwardly as is the energizer shaft **74.** The attached fork **56** carries the clevis pin **58** downwardly to bring the levers **52** and **54** to the condition as seen in FIG. **14.** During this downward travel the sear lifter **104** is caused to pass by the sear in a wiping action as seen in FIG. **3** and is brought to the full down position as seen in FIG. **1** and FIG. **14.** At the bottom of the stroke the stock between the dies **184** and **186** is acted upon as to cutting, forming, or a combination of both. The upward motion of the ram then begins and as the die halves start to separate with the upper die moving upwardly the spring **98** starts to expand while retaining the sear lifter **104** in its down position. Before the dies have reached their desired separation and approximately one-quarter of an inch before the desired striking action of the ejector plunger, the upward movement of bracket **80** causes the collar **96** to engage the head liner **92** and lift the sear lifter **104** into the releasing action as seen in FIG. **15.** The release of the sear **114** from in way of the groove **130** causes the biased plunger to move from the solid outline position as seen in FIG. **15** to the dashed outline position which is the forward limit of travel. At or just prior to this position the ejector plunger strikes the workpiece to be ejected and moves it from the dies. The further continued upward lifting of the shaft **74** causes the pin **58** to rotate the levers **52** and **54** to again cam the ejector plunger **30** to its cocked condition of FIG. **13** which is achieved when the dies are in fully opened condition and with the punch press ram at the top of its stroke.

The above discussion is more-or-less directed toward apparatus in which both the sear release action and the cocking of the ejector plunger is accomplished on the up stroke of the press ram with which the ejector mechanism is used. This, of course, is the logical time to achieve these operations which is as soon as the dies are sufficiently opened to allow the piece to be removed from the open dies. This allows the maximum amount of time for the feed in of new stock between the time of ejecting of the piece and the closing of the dies on the advanced stock.

Where the time of the release of the ejector plunger or the cocking of the ejector plunger is to be on the down stroke of the press ram, a lever linkage or a rack and pinion drive may be employed. Bracket **80** may be eliminated, if desired, and the energizer shaft **74** and the sear lifter shaft **90** may be separately carried and actuated. Where the ejector mechanism is to be used with conveyors, separate control means may provide the best design. Each application, except where used with a press stroke mechanism, lends itself to specialized design but within the parameters provided by the above-description.

Terms such as "left," "right," "up," "down," "bottom," "top," "front," "back," "in," "out," "clockwise," "counterclockwise" and the like are applicable to the embodiment shown and described in conjunction with the drawings. These terms are merely for the purposes of description and do not necessarily apply to the position in which the stored energy ejector mechanism may be constructed or used.

While a particular embodiment of this mechanism has been shown and described it is to be understood that modifications may be made within the scope of the accompanying claims and protection is sought to the broadest extent the prior art allows.

What is claimed is:

1. A stored energy ejector mechanism adapted for mounting on a punch press, a conveyor support and like apparatus wherein workpieces are to be selectively removed at selected times in the operation thereof, said ejector mechanism including: (a) a housing; (b) an ejector plunger reciprocably carried in guideways provided in said housing; (c) biasing means associated with the ejector plunger and adapted to move the plunger in one direction; (d) means for limiting the extent of movement of the plunger in said one direction; (e) at least one actuator lever movable so as to engage the plunger and move the plunger counterflow to the bias urged direction and to a "loaded" biased position; (f) an energizer shaft operatively connected to the actuator lever, said energizer shaft operatively moved by the apparatus on which the ejector mechanism is mounted; (g) trigger means in association with the ejector plunger and adapted to engage and retain said ejector plunger in a "cocked" condition as and after the actuator lever has moved the plunger to its biased loaded condition, and (h) trigger release means associated with and moved by the apparatus to and on which the ejector mechanism is mounted, said trigger release means when actuated removing the retaining engagement of the trigger and permitting the released plunger under the influence of the bias means to move rapidly to its limited extent of movement.

2. A stored energy ejector mechanism as in claim **1** in which the biasing means associated with the ejector plunger includes a plunger spring anchor carried by and secured to the ejector plunger and at least one tension spring which is attached at one end to the plunger spring anchor and with the other end of the tension spring secured to the housing and sufficiently extended to supply an initial tension which is increased as the ejector plunger is moved to its cocked condition.

3. A stored energy ejector mechanism as in claim **2** in which the spring anchor is disposed to carry a pair of like tension springs which are arranged so that the springs are disposed on opposite sides of the ejector plunger, each spring of the pair of springs providing approximately one-half of the bias used for propulsion of the ejector plunger.

4. A stored energy ejector mechanism as in claim **1** in which the moving of the ejector plunger from its "at rest" condition to its cocked condition is by a coupled pair of actuator levers pivotally carried by a pin mounted in the housing, the movement of the actuator levers being in response to one portion of a reciprocal stroke of an energizer shaft moved by the associated workpiece production apparatus.

5. A stored energy mechanism as in claim **4** in which the actuator levers are formed with like slot guideways in which a clevis pin is slidable, this clevis pin being reciprocably moved by a fork carried by the energizer shaft.

6. A stored energy ejector mechanism as in claim 5 in which there is provided a biasing means associated with the actuator levers, said biasing means disposed to urge the levers to their at rest position during the time the levers are not being moved to bring the ejector plunger to its cocked condition.

7. A stored energy ejector mechanism as in claim 1 in which the trigger mechanism includes a sear pivotally mounted on a shaft carried by the housing, said sear having a depending portion with a face adapted to engage a shoulder edge carried by the ejector plunger, the sear urged toward and into engagement with the ejector plunger by a bias means and when the shoulder edge in the ejector plunger is engaged providing a stop of the biased plunger in its cocked condition, and a sear lifter carried by a reciprocably moved sear lifter shaft, the sear lifter adapted to pass by an engaging shoulder portion of the sear during one stroke of the lifter shaft and during a portion of the other stroke of said shaft the sear lifter is brought into engagement with the engaging shoulder portion of the sear to cause the sear to rotate on its support shaft sufficiently to disengage the depending face of the sear from in way of the shoulder edge of the plunger to release the plunger from its cocked condition.

8. A stored energy ejector mechanism as in claim 7 in which the shoulder edge of the ejector plunger is an undercut in the ejector plunger and in which the sear lifter is pivotally carried on a clevis pin mounted in the depending end of the lifter shaft, the sear lifter having stop means for limiting a rotary motion of the sear lifter around the pin in one direction while being formed so as to rotate at least sixty degrees around the pin in the other direction during the passing of the sear lifter by the engaging shoulder of the sear.

9. A stored energy ejector mechanism as in claim 8 in which the stroke, during which the sear lifter is moved past the sear, is positively limited in its travel by a stop pin in way of the path of the sear lifter.

10. A stored energy ejector mechanism as in claim 9 in which both the energizer shaft and sear lifter shaft are carried by an actuator mechanism bracket adapted for attachment to a movable portion of the associated apparatus from which the ejector mechanism is disposed to move produced workpieces.

11. A stored energy ejector mechanism as in claim 10 in which lost motion is provided with both the energizer shaft and sear lifter shaft and the actuator mechanism bracket, the lost motion, in part, including a compression spring which is compressed to a determined extent to insure that the lost motion positively occurs during the desired time period of movement of the bracket.

12. A stored energy ejector mechanism as in claim 1 in which the means for limiting the extent of movement of the ejector plunger includes an adjustable collar which is selectively locked in a determined position on the ejector plunger and an impact absorber which is positioned and retained by the housing to provide the determined stop of the ejector stroke when the collar carried by the ejector plunger is moved from the cocked condition to the forward at rest position.

13. A stored energy ejector mechanism as in claim 12 in which the ejector mechanism when associated with a punch press has both the cocking action and the trigger release action occurring during the same stroke cycle of the press.

14. A stored energy ejector mechanism as in claim 13 in which the press stroke cycle is the upward stroke and in which the trigger means includes a sear lifter shaft, and in which the energizer shaft and sear lifter shaft are both slidably carried in a bracket secured to a member moved by the ram of the punch press.

15. A stored energy ejector mechanism as in claim 14 in which both the triggering action of the sear lifter shaft and the loading action of the energizer shaft are both adjustable as to their actuation with respect to a position in the cycle which occurs after the bottom dead center of the punch press stroke has been achieved.

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