United States Patent [19]

Schweizer

[11] **3,807,407**

[45] **Apr. 30, 1974**

[54] **SUTURE APPLICATOR**

[76] Inventor: **Edward E. Schweizer,** 266 Pelham, New Rochelle, N.Y. 10805

[22] Filed: **Jan. 18, 1973**

[21] Appl. No.: **324,838**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 150,290, June 7, 1971, abandoned.

[52] **U.S. Cl.** ..... **128/334 R,** 128/340

[51] **Int. Cl.** **A61b 17/04**

[58] **Field of Search** ..... 128/334 R, 340, 326, 339

[56] **References Cited**

UNITED STATES PATENTS

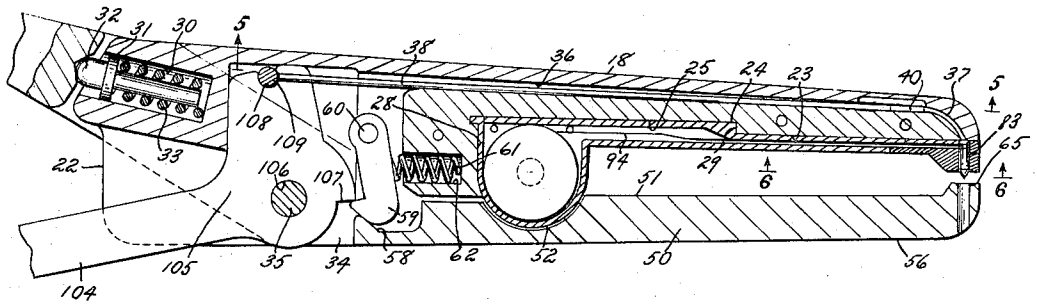
3,470,875	10/1969	Johnson	128/334 R
3,349,772	10/1967	Rygg	128/340
1,449,087	3/1923	Bugbee	128/340
1,464,832	8/1923	Ricardson	128/340

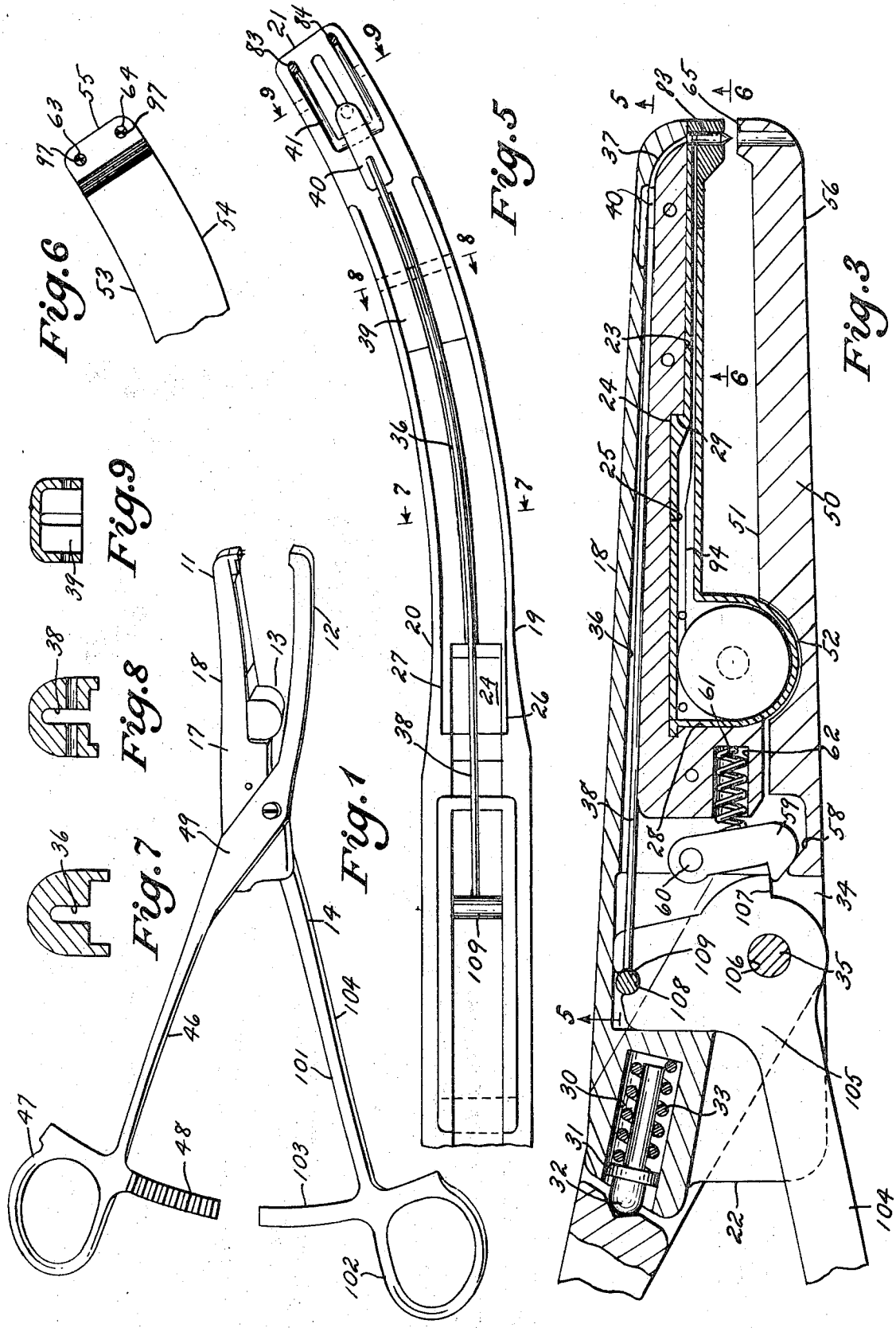
Primary Examiner—Dalton L. Truluck

[57] **ABSTRACT**

A surgical instrument for mechanically suturing an incision or wound comprising first and second pivotally interconnected jaw elements, a replaceable suture magazine containing a single looped suture, the free ends of which are provided with short needles, means on said first jaw for supporting said suture magazine with said needles facing said second jaw, said second jaw including means for receiving and frictionally retaining said needles, whereby upon the positioning of the edge areas of an incision between said jaws, and the closing of the same thereupon, said needles and suture are moved from said magazine to said second jaw to be retained thereon, and after the opening of said jaws to permit manual removal therefrom, and the tying of the suture. One embodiment substitutes metallic staples for the suture and suture needles.

13 Claims, 25 Drawing Figures




Fig. 1
Fig. 3
Fig. 5
Fig. 6
Fig. 7
Fig. 8
Fig. 9

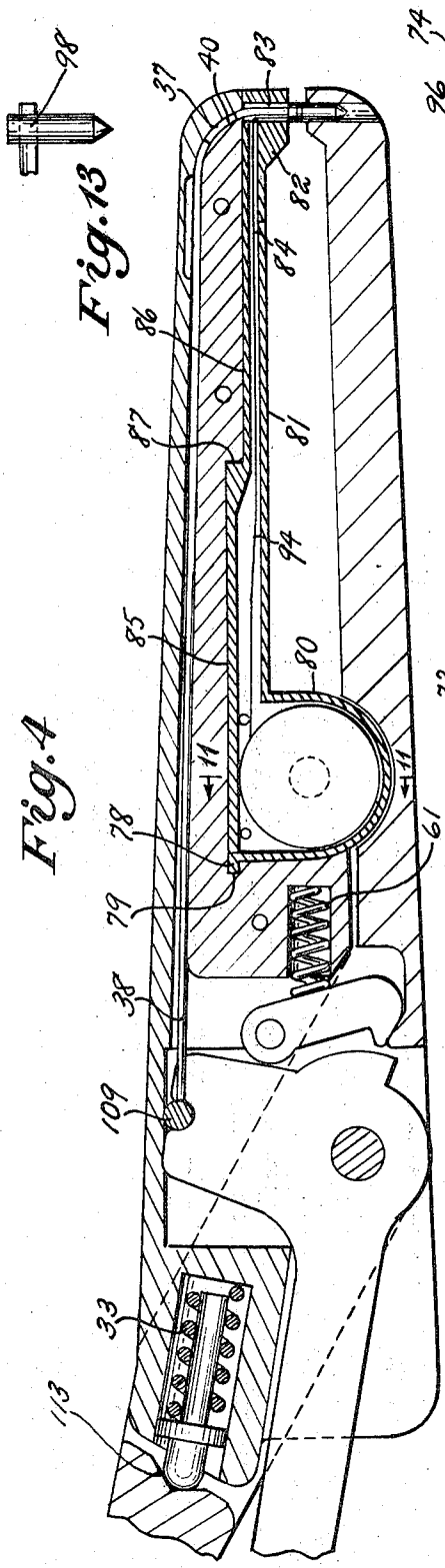


Fig. 13

Fig. 4

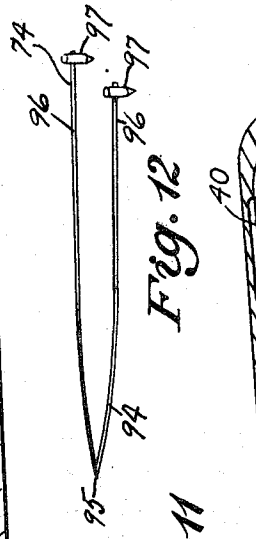


Fig. 12

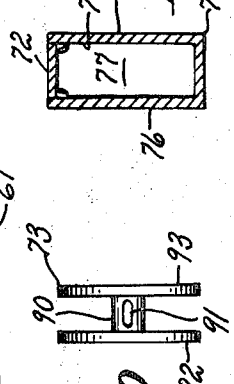


Fig. 11

Fig. 10

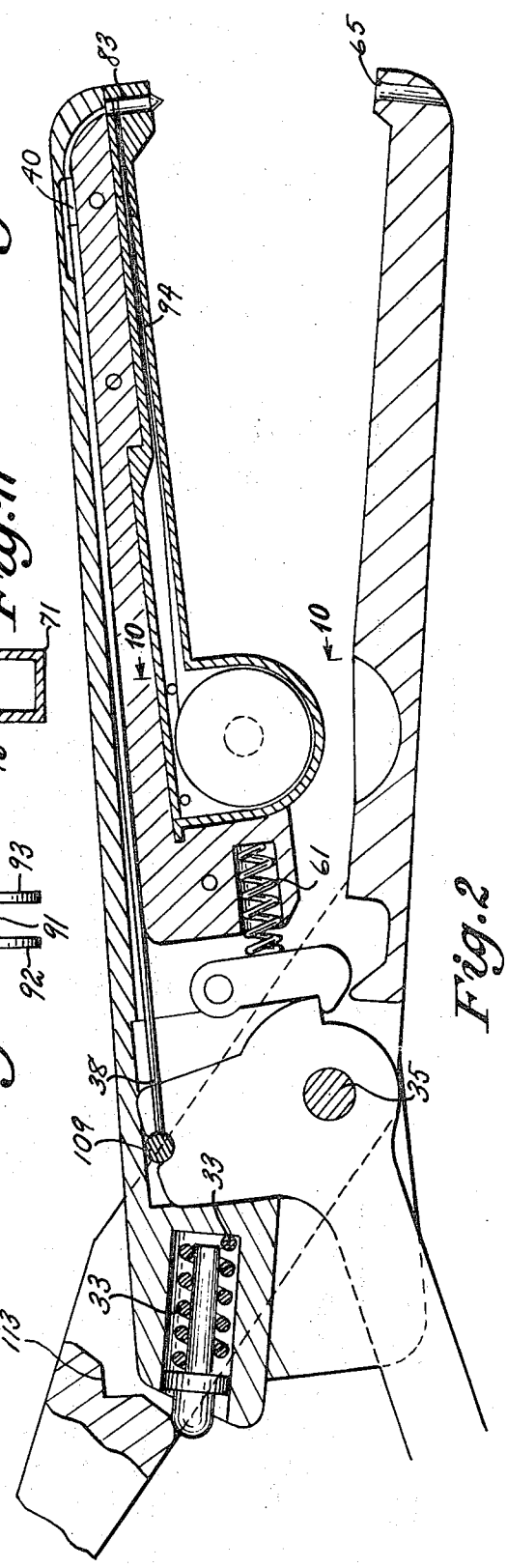


Fig. 2

Fig. 14

Fig. 19

Fig. 18

Fig. 17

Fig. 15

Fig. 16

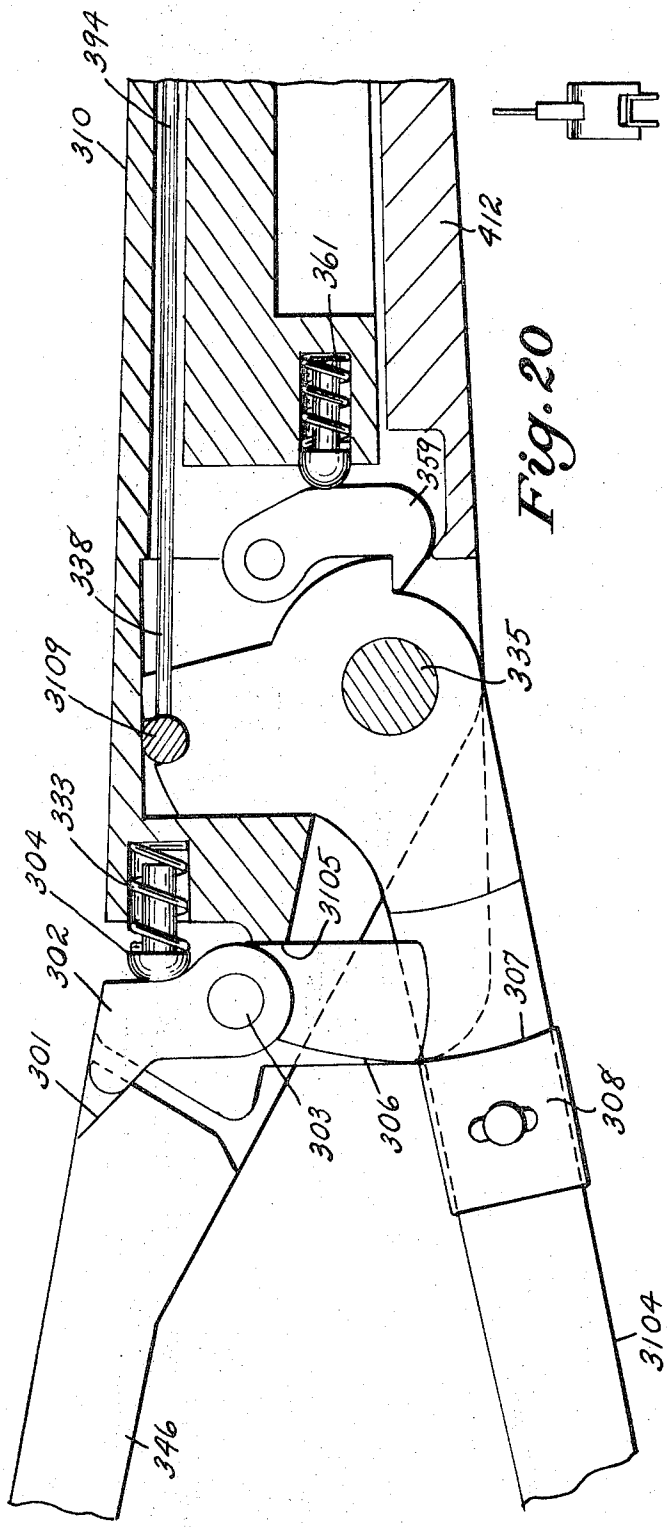


Fig. 20

Fig. 22

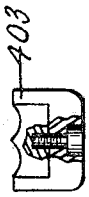


Fig. 23

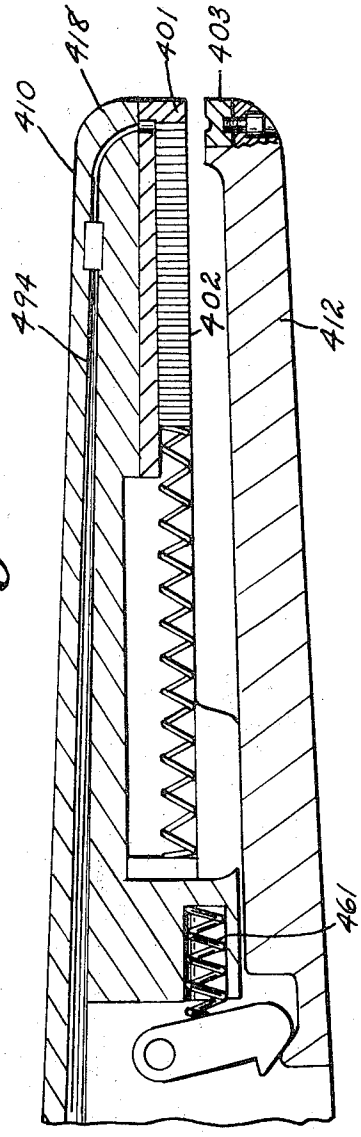


Fig. 21

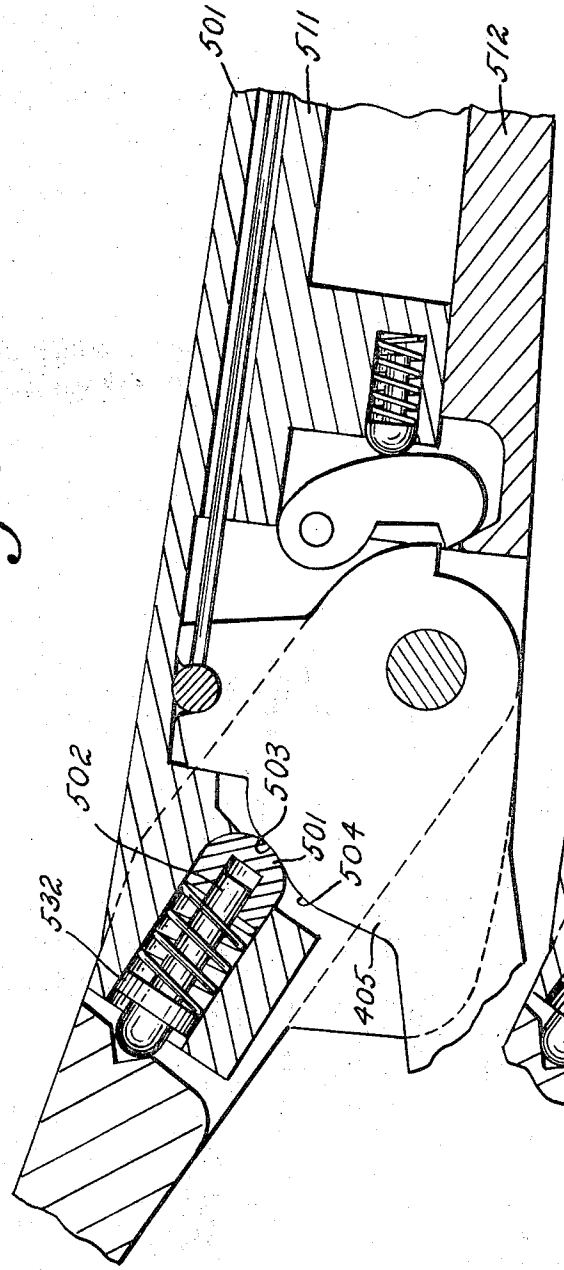


Fig. 24

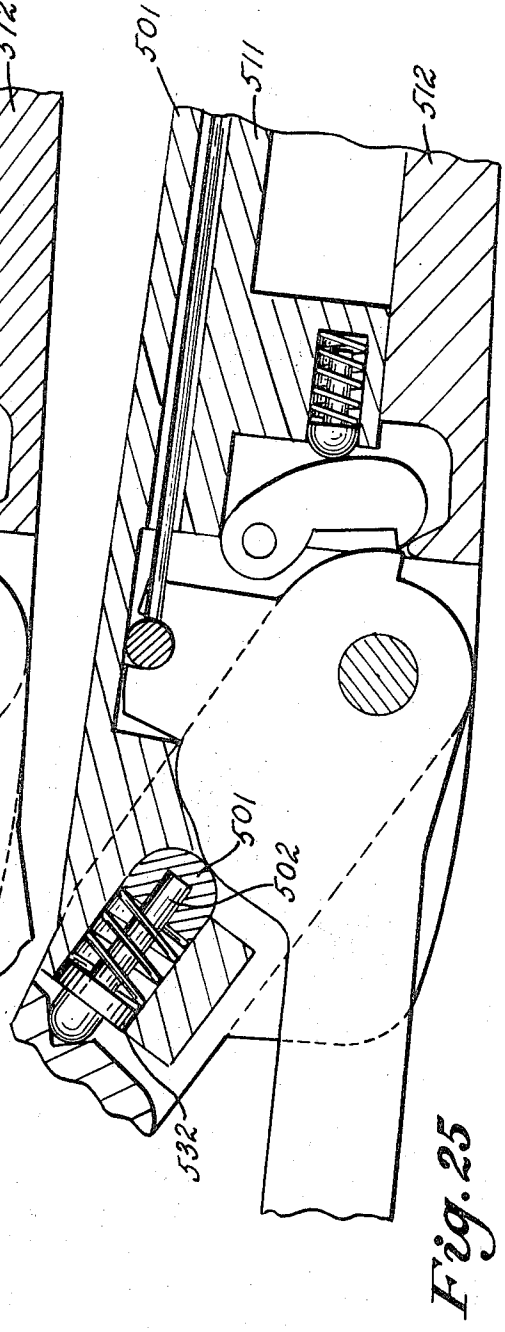


Fig. 25

SUTURE APPLICATOR

This application is a continuation-in-part of my copending application Ser. No. 150,290, filed June 7, 1971 now abandoned under the same title.

This invention relates generally to the field of surgical instrumentation, and more particularly to an improved suture applicator of a type adapted to form a suture closure for a wound or incision by simultaneously forcing through the abutted tissue a pair of needles connected to the opposite free ends of a single looped length of suturing material.

It is among the principal objects of the present invention to provide an improved surgical instrument of the class described which may be conveniently operated by one hand of the surgeon, allowing him to use the remaining hand for whatever additional manipulation may be required at the instant the suturing operation is performed.

Another object of the invention lies in the provision of an improved suturing instrument capable of retaining a detachable suture magazine, each magazine having a single suture therein in predetermined position for application, whereby a series of suturing applications may be performed in rapid sequence.

Yet another object of the invention lies in the provision of an improved suturing device including a detachable magazine, in which both device and magazine may be conveniently placed in sterile condition, as by treatment within a surgical autoclave, without deleterious effect.

A further object of the invention lies in the provision of an improved suturing device of the class described, in which the suturing operation, including the clamping of tissue to be sutured, and the subsequent insertion of the suture may be performed sequentially by progressive squeezing of the handle of the device.

Still another object of the invention lies in the provision of an improved suturing applicator, in which the cost of fabrication may be of a reasonably low order, thereby permitting consequent wide sale, distribution and use.

These objects, as well as other incidental ends and advantages, will more fully appear in the course of the following disclosure, and be pointed out in the appended claims.

In the drawings, to which reference will be made in the specification, similar reference characters have been employed to designate corresponding parts throughout the several views.

FIG. 1 is a view in perspective of an embodiment of the invention.

FIG. 2 is a fragmentary enlarged longitudinal sectional view showing the jaw elements comprising the device in relatively open condition, and prior to the commencement of a suturing application.

FIG. 3 is a similar fragmentary enlarged longitudinal sectional view showing the device with the jaw elements in relatively closed position, and prior to the insertion of a suture through clamped tissue.

FIG. 4 is a similar fragmentary longitudinal sectional view showing the insertion of the suture while the jaw elements are in relatively locked condition.

FIG. 5 is a horizontal fragmentary sectional view as seen from the plane 5—5 in FIG. 3.

FIG. 6 is a fragmentary sectional view as seen from the plane 6—6 in FIG. 3.

FIGS. 7, 8 and 9 are transverse sectional views as seen from the planes 7—7, 8—8, and 9—9 in FIG. 5.

FIG. 10 is a view in elevation of a spool forming part of a magazine element retaining individual sutures.

FIG. 11 is a transverse sectional view of the magazine element as seen from the plane 11—11 in FIG. 4.

FIG. 12 is a view in perspective showing an individual looped suture.

FIG. 13 is an enlarged fragmentary view of a suture element corresponding to the upper right hand portion of FIG. 12.

FIG. 14 is a fragmentary longitudinal sectional view, corresponding in most respects to that seen in FIG. 4, but showing a modified form of the embodiment.

FIG. 15 is a longitudinal enlarged sectional view of the magazine employed in the modified form shown in FIG. 14.

FIG. 16 is a bottom plan view as seen from the lower portion of FIG. 15.

FIG. 17 is an enlarged fragmentary view in perspective of the tip of a lower jaw member, corresponding to the lower right hand portion of FIG. 14.

FIG. 18 is a side elevational view of a bobbin forming part of the magazine illustrated in FIG. 15.

FIG. 19 is a transverse sectional view as seen from the plane 19—19 in FIG. 15.

FIG. 20 is a fragmentary sectional view corresponding to that seen in FIG. 3 and showing a second embodiment of the invention.

FIG. 21 is a fragmentary sectional view corresponding to that seen in FIG. 3, and showing a third embodiment of the invention.

FIGS. 22 and 23 are end elevational views of the third embodiment as seen from the right hand portion of FIG. 21.

FIG. 24 is a fragmentary sectional view corresponding to FIG. 3 and showing a fourth embodiment of the invention.

FIG. 25 is a fragmentary sectional view of the fourth embodiment showing certain of the component parts in altered relative condition.

In accordance with the first embodiment of the invention, the device, generally indicated by reference character 10, comprises broadly: a first jaw element 11, a second jaw element 12, a replaceable suture magazine element 13, and manually engageable operating means 14. Elements 11, 12 and 14 are preferably formed as precision castings from stainless steel or other suitable material. The magazine element 13 may also be formed of such materials, but in the interest of low cost of manufacture, where the magazines are not to be reloaded, they are preferably formed as moldings from synthetic resinous materials capable of withstanding heat of sterilization, and effects of the sterilizing liquids.

The first jaw element 11 includes a main body 17, bounded by an outer surface 18, side surfaces 19 and 20, a forward end surface 21, a rearward end surface 22 and an inner surface 23. Extending into the surface 23 is a magazine-engaging recess 24, bounded by a bottom surface 25, side surfaces 26 and 27, a rearward end surface 28 and a forward end surface 29. A rearwardly facing cylindrical bore 30 supports a resilient detent member 31 which includes an outer end projection 32 moved leftwardly as seen in FIG. 3 under the action of a coil spring 33.

A large, irregularly-shaped recess **34** is penetrated by a main pintle **35**. A longitudinally extending bore **36** communicates with the recess **34** as does a forwardly extending bore **37** which encloses a motion transmitting cable **38**. The cable passes through an open area **39** (see FIGS. **5** and **9**), and communicates through a link **40** to a bifurcated needle actuator **41** in the bore **37**.

The second jaw element **12** is of symmetrical configuration with respect to the first jaw element, and is interconnected thereto by the pintle **35**. It includes an integral handle member **46**, having a finger engaging loop **47** and a locking rachet member **48** of a type well known in the surgical instrument field. A bifurcated member **49** surrounds the main body **17** of the element **11**, and supports a jaw body **50** having an inner surface **51**. A recess **52** extends into the surface **51** to accommodate the magazine element **13** when the jaws are in closed position (see FIG. **3**). As best seen in FIG. **6**, the jaw **50** is bounded by side surfaces **53** and **54**, an end surface **55**, and an outer surface **56**. An inwardly-extending recess forms a camming surface **58** which acts upon a latch member **59** arranged for pivotal movement on a pin **60** in the first jaw element **11**, and normally urged leftwardly as seen in FIG. **3** by a spring **61** positioned in the recess **62**.

The free end adjacent the surface **55** includes a pair of needle receiving bores **63** and **64** having flanged ends **65**.

The surface magazine element **13** will be best understood from a consideration of FIGS. **10** to **13**, inclusive, and includes a molded synthetic resinous main body member **71**, a detachable cover member **72**, a freely rotating bobbin **73**, and a single length of looped suture **74**.

The main body member **71** includes a bobbin holder **75** comprising side walls **76**, a rear wall **77**, a projection **78** engaging a corresponding recess **79** in the element **11**, a forward wall **80**. A forwardly extending tongue member **81** includes a thickened tip **82** having a pair of transversely extending bores **83** which communicate with axially extending bores **84**. The cover member **72** includes first and second walls **85** and **86**, interconnected by a ledge forming member **87** which, in connection with the projection **78** permit the magazine to be resiliently snapped into place with respect to the upper jaw element **11**.

The bobbin **73** includes a core **90** having a suture-engaging eye **91** and a pair of side flanges **92** and **93**. A length of suture material **94** (FIG. **12**) may be of any well known suturing material, and includes a looped end **95** engageable within the eye **91**, and a pair of free ends **96**, each provided with a short needle **97**, the eye **98** of which is squeezed against the end of the suturing material to retain the same in position.

The means **14** includes a handle member **101** also carried by the pintel **35**. The member **101** includes a corresponding finger engaging loop **102** and ratchet **103**, and an elongated shank **104** having an end enlargement **105**. A transversely extending bore **106** provides a bearing for the pintle **35**. The enlargement includes a projection **107** selectively engageable with the latch member **59**, and a recess **108** which engages a transversely extending enlargement **109** on the end **110** of the cable **38**.

Operation of the device will be understood by a successive consideration of FIGS. **2**, **3** and **4**. While in the condition shown in FIG. **2**, a loaded magazine element is snapped into the position shown by first engaging the projection **78** in the recess **79**, and swinging the magazine such that the ledge-forming member **87** engages the corresponding notch **112** in the inner surface **23**. This operation will position the needles **97** as shown in FIG. **2**, to be subsequently actuated by the cable **38**.

At the commencement of a suturing operation, the flesh to be sutured is inserted between the jaw elements, and the means **14** and handle member **46** are squeezed together between the thumb and fingers by the surgeon. During the period in which the projection **107** and latch member **59** are engaged as shown in FIG. **2**, the jaw elements will be moved to a closed position as shown in FIG. **3**. As the position shown in FIG. **3** is approached, the latch is cammed out of engagement with the projection **107**, but as complete disengagement occurs, the detent member **31** will engage a corresponding recess **113** in the handle member **46** to prevent the jaws from opening until required.

With the disengagement of the latch member **59**, relative movement between the enlargement **105** and the first jaw element **11** is possible, and motion is transmitted through the enlargement **109** to the cable **38** which moves the bifurcated needle actuator **41** against the rear ends of the needles **97**, and forces them through the flesh and into engagement with the bores **63–64**, to be frictionally retained thereby as the end of the suture becomes wedged within the bores. The ratchet member **48** may then be disengaged from the ratchet member **103**, and the device returned to the position shown in FIG. **2**, following which the suture needles **97** may be disengaged, and the suture tied by the surgeon. After the knot (not shown) has been formed, the remaining length of suture may be conveniently cut.

During this return movment, the cable **38** is automatically withdrawn by the opening of the ratchet members, and when the leftward vertical surface of member **105** engages the leftward vertical surface of the recess **34**, the detent member **32** is pulled out of its corresponding recess **113**, the movement imparted to the finger engaging portions **47** and **102** providing an automatic resetting of the device.

In normal practice, where a large number of suturing operations are to be performed, it is desirable to have a plurality of devices which may be conveniently handed to the surgeon as required. Each device, after use, may be again readied for reuse, by the removal of the magazine element **13**, and its replacement by a fresh magazine.

Turning now to the alternate form of the embodiment illustrated in FIGS. **14** to **18**, inclusive, parts corresponding to those of the principal form have been designated by similar reference characters with the addition "2".

The alternate form, generally indicated by reference character **120** differs from the principal form in a number of respects. A follower **121** is provided for the spring **261**, and the member **259** is altered to angular configuration for superior transmission of resilient pressure thereupon.

The magazine element **213** is modified by elimination of the cover member thereof, and the bobbin **273** is provided with a radially-extending tab **123** in lieu of the eye **91**.

The tip **124** of the lower jaw **256** is provided with a shaped recess **125** accommodating a synthetic resinous

plug 126 secured in position by a threaded means 131. The plug 126 has extensions 127 which extend to communicate with the bores 263 and 264, and thereby provide a yieldable resilient frictional means for retaining the needles 297 when the jaws are opened.

Turning now to the second embodiment of the invention illustrated in FIG. 20, and generally indicated by reference character 310, parts corresponding to those of the first embodiment have been designated by corresponding reference characters with the additional prefix "3".

To provide a more positive maintenance for the jaws in relatively closed condition, the third embodiment includes a recess 301 selectively engaged by a lock latch 302 pivotally mounted at 303 and urged clockwise as seen in FIG. 20 by a spring plunger 304.

As the actuator lever 3104 is released by the pawl 359, it moves toward the lower jaw lever 346, and a radial locking surface 306 moves into position in front of a corresponding radial surface 307 on an adjustable member 308, thus locking the tip of the lock latch into the recess 301.

The lower jaw and the upper jaw are now positively locked into a one piece unit resisting all possible opening forces on the lever tips when the needles are being driven.

As the levers are retracted and opened, the actuator lever resets itself to its initial position. The locking latch is now free to pivot and release the upper jaw from the lower jaw lever. The stop surface 3105 limits the travel of the lock latch when it is disengaged from the lower jaw. When the levers are fully opened, they are, of course, freely moveable.

Turning now to the third embodiment of the invention, generally indicated by reference character 310, and illustrated in FIG. 21, parts corresponding to those of the first embodiment have been designated by similar reference characters with the additional prefix "4".

This embodiment differs from the first embodiment in the provision of a staple magazine 401 having a plurality of serially advanced staples 402 fed to the end of the jaw 418. Staple closing means 403 replaces the opening 65 in the principal embodiment, whereby the device may serve as a hand-held stapler for both surgical and non-medical use.

Turning now to the fourth embodiment of the invention, as illustrated in FIGS. 24 and 25, and designated by reference character 501, parts corresponding to those with the principal embodiment have been designated by similar reference characters with the initial prefix "5".

This embodiment features a resilient plunger 532 including a hollow cam follower 501 riding on a shaft portion 502. The enlargement 405 includes a cam having a first surface 503 and a second surface 504 which presses the follower toward the shaft to form a solid column when the jaws 511 and 512 are in relatively closed condition, and the surface 504 is engaged. In this condition, the detent structure holding the jaws in relatively closed condition is no longer resilient, but is completely positive until the jaws are moved to opened condition.

It may thus be seen that I have invented a simple conveniently used suturing applicator which permits the use of tissue absorbable suturing materials without resort to laborious hand suturing operations. Each loop stitch formed is of the same size, and the speed of application is materially reduced. The device may be durably constructed at a cost permitting the availability of many such devices at a single location, so that a relatively complicated suturing procedure involving many individual suturing applications may be performed rapidly and conveniently. One embodiment discloses the inventive structure in a form suitable for feeding and closing staples both for medical and non-medical use.

It is to be understood that it is not considered that the invention lies in the specific details of structure shown and set forth in this specification, for obvious modifications will occur to those skilled in the art to which the invention pertains.

What is claimed is:

1. A surgical suture applicator comprising: a first lever including a first jaw arm thereon; a second jaw arm; a pivotal connection between said first lever including said first jaw arm and said second jaw arm; an actuator lever also pivotally mounted on said connection; a latch member carried on said second jaw arm; means on said actuator lever engaging said latch member to transmit pivotal movement to said second jaw arm through a predetermined angle toward said first jaw arm to a relatively closed condition; means on said second jaw arm operable to disengage said latch member, and means located on surfaces of said second jaw arm and said first lever operable to interlock said second jaw arm and said first lever when said first and second jaw arms move into said relatively closed condition; and means on said actuator lever for operating suturing means when said first lever and second jaw arms are interlocked.

2. The surgical suture applicator defined by claim 1 wherein said latch member disengaging means comprises: a cam member on said first lever engageable by said latch member as said first and second jaw arms move toward said relatively closed condition.

3. The surgical suture applicator defined by claim 1 including: a protuberance on said actuator member; a surface on said protuberance which is perfectly flat and on a center line of said pivotal connection; a surface on said latch member which is flat and in face-to-face engagement with said protuberance surface; and said latch member being pivotally carried on said second jaw arm.

4. The surgical suture applicator defined by claim 1 wherein said interlocking means comprises: a spring detent on one of said first lever and said second jaw arm; and a recess on the other of said first lever and said second jaw arm.

5. The surgical suture applicator defined by claim 4 wherein: said spring detent is disposed on said second jaw arm on a side of said pivotal connection to bias said second jaw arm relative to said first lever toward said relatively closed condition.

6. The surgical suture applicator defined by claim 1 wherein said interlocking means comprises: a plunger on said second jaw arm; a recess on said first lever opposing said plunger when said jaws are in said relatively closed condition; a cam follower behind said plunger; spring means interposed between said plunger and said cam follower; high and low cam dwell surfaces on said actuator lever engaging said cam follower; said high dwell surface being operable to force said cam follower to overcome said sprng means and engage against said

plunger forming a solid column between said actuator lever and said first lever after said actuator lever is released by said latch member.

7. The surgical suture applicator defined by claim 1 including: means on said actuator lever and said second jaw arm for disengaging said interlocking means upon moving said actuator lever in a reverse direction to move said jaw arms to relatively open condition.

8. The surgical suture applicator defined by claim 6 wherein said means comprises: opposing push surfaces on said actuator lever and said second jaw arm engageable during said reverse movement to overcome said interlocking means and pivot said second jaw arms with said actuator lever.

9. The surgical suture applicator defined by claim 1 including: a pair of opposing stop surfaces on said first and second jaw arms engageable when said arms are in said relatively closed position.

10. The surgical suture applicator defined by claim 1 wherein said suture operating means comprises: means on said second jaw arm for carrying a needle and suture; a receptacle on said first jaw arm to receive a needle driven from said second jaw arm; and an elongated pusher member on said second jaw arm connected to said actuator lever to drive said needle.

11. The surgical suture applicator defined by claim 1 wherein said suture operating means comprises: an elongated pusher member on said second jaw arm adapted to drive a needle and suture; a pusher arm on said actuator lever disposed to pivot about said pivotal connection through an arc generally tangent to the longitudinal axis of said pusher member; and means attaching said elongated pusher member to said pusher arm.

12. Structure in accordance with claim 1, wherein said interlocking means comprises: a pivotally mounted latch on one of said jaw arms and having an arcuate surface, a corresponding locking surface on an oppositely disposed lever, an arcuate surface on said actuating arm selectively engageable with said arcuate surface on said latch, movement of said jaws to a relatively closed condition serving to engage said arcuate surfaces and positively lock said latch against said locking surface.

13. Structure in accordance with claim 1, including suturing means in the form of a staple-holding magazine removably retained on said second jaw arm.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

Certificate

Patent No. 3,807,407 Patented April 30, 1974

Edward E. Schweizer

Application having been made by Edward E. Schweizer, the inventor named in the patent above identified, for the issuance of a certificate under the provisions of Title 35, Section 256, of the United States Code, adding the name of Arthur Zimmet as a joint inventor, and a showing and proof of facts satisfying the requirements of the said section having been submitted, it is this 28th day of February 1978, certified that the name of the said Arthur Zimmet is hereby added to the said patent as a joint inventor with the said Edward E. Schweizer.

FRED W. SHERLING,
Associate Solicitor.