July 4, 1967

L. D. PLUNKETT

3,329,178

STRAPPING TOOL

Filed May 24, 1965

5 Sheets-Sheet 1

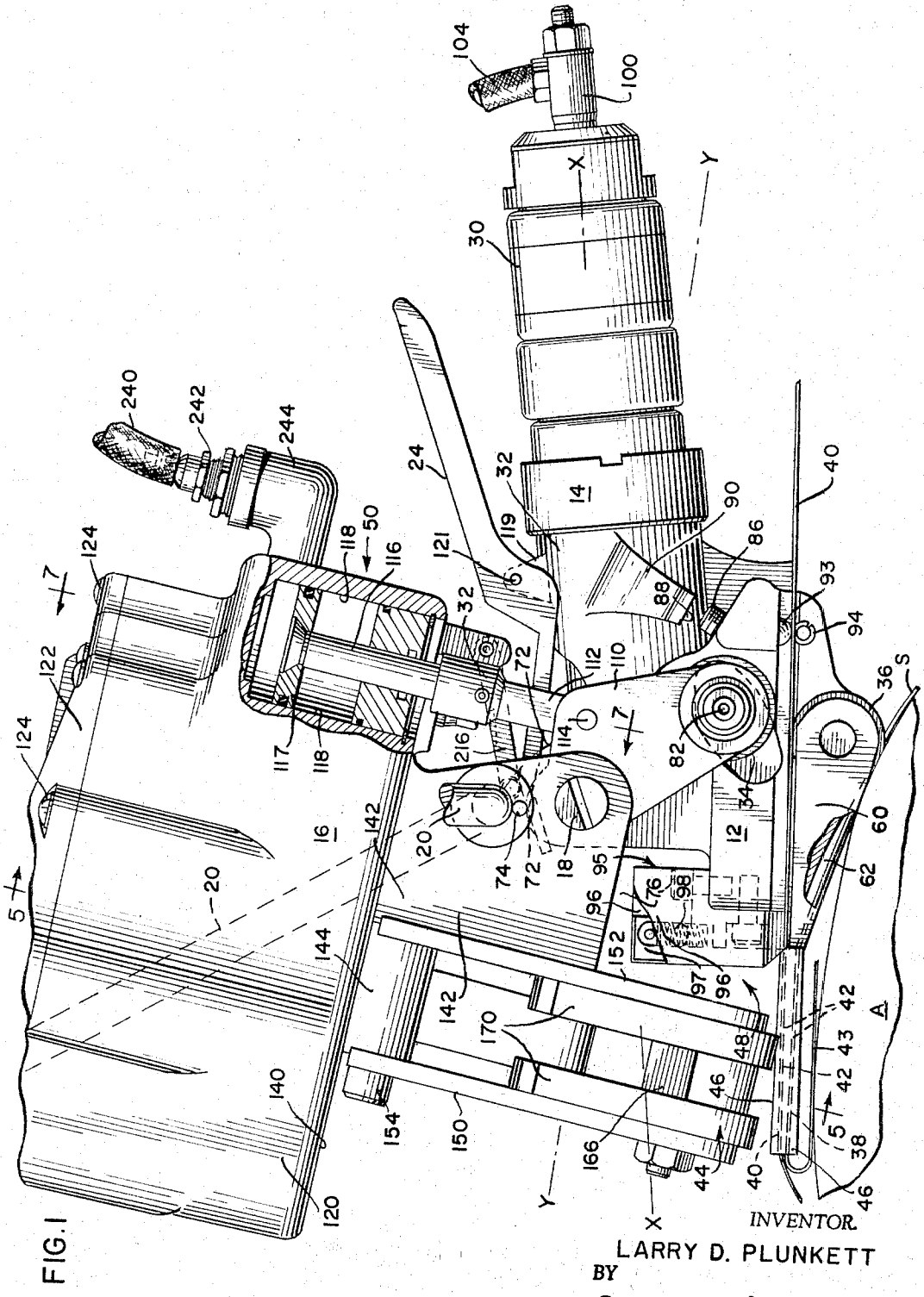

FIG. 1

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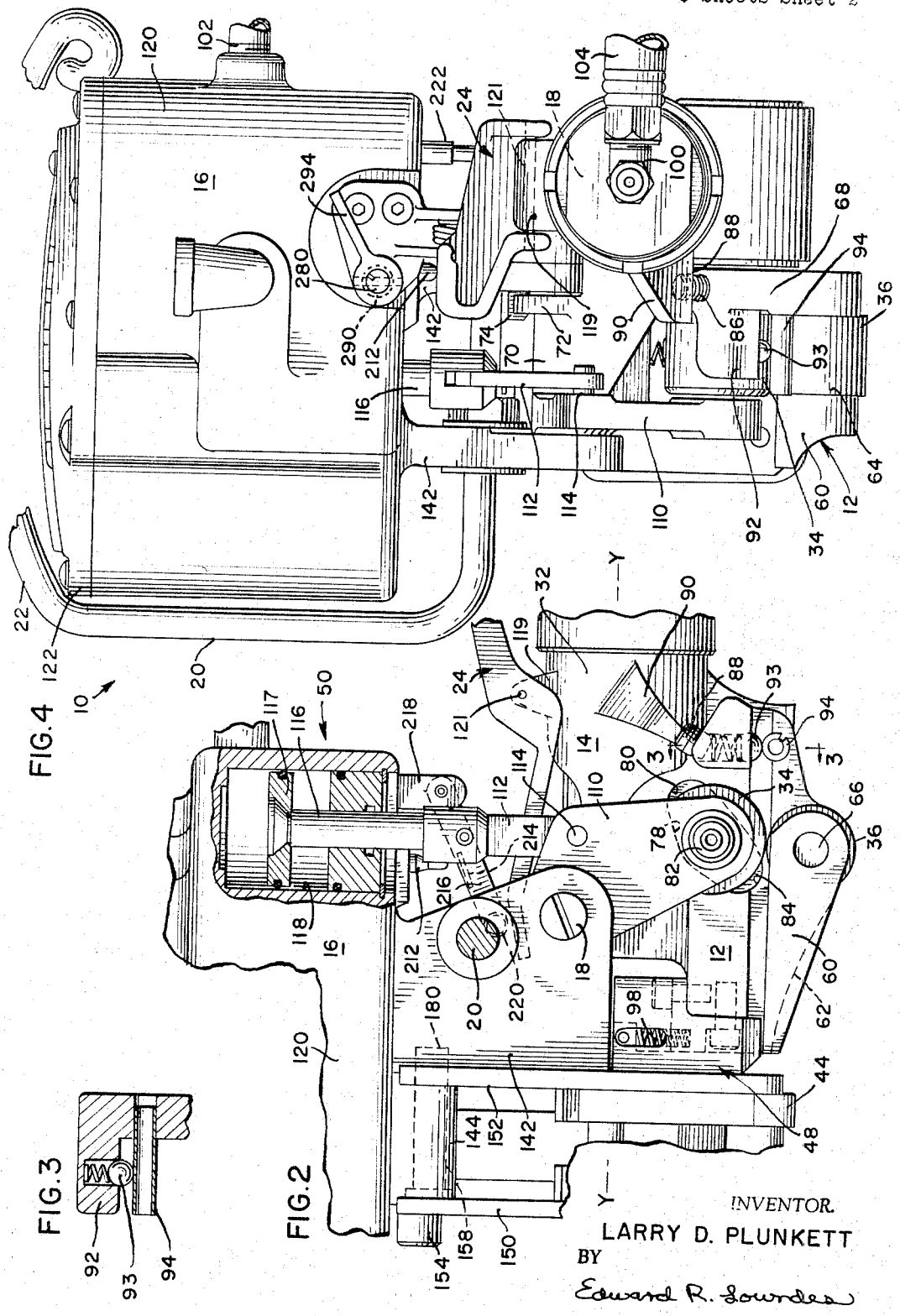
July 4, 1967 L. D. PLUNKETT 3,329,178

STRAPPING TOOL

Filed May 24, 1965 5 Sheets-Sheet 2



July 4, 1967 L. D. PLUNKETT 3,329,178

STRAPPING TOOL

Filed May 24, 1965 5 Sheets-Sheet 3

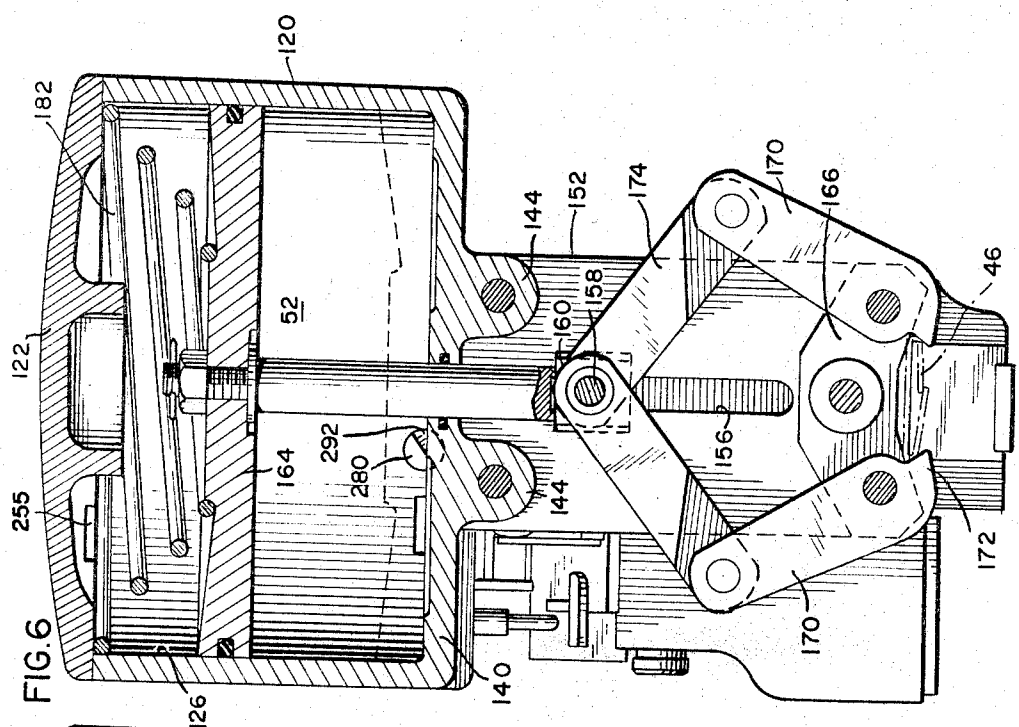


FIG.6

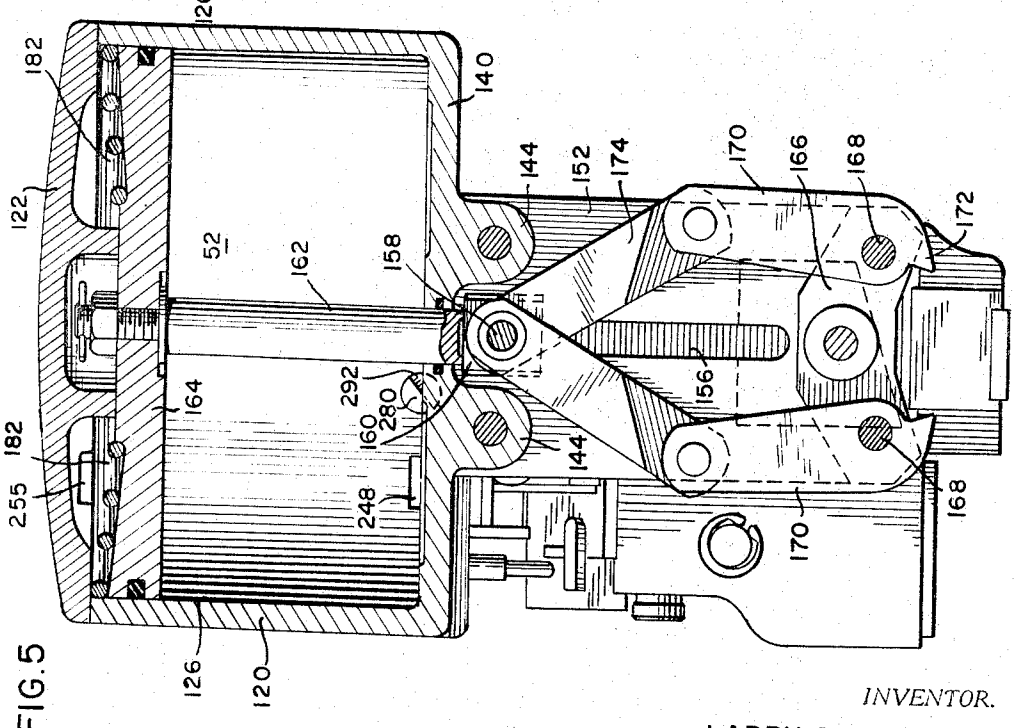


FIG.5

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July 4, 1967 L. D. PLUNKETT 3,329,178

STRAPPING TOOL

Filed May 24, 1965 5 Sheets-Sheet 4

FIG. 7

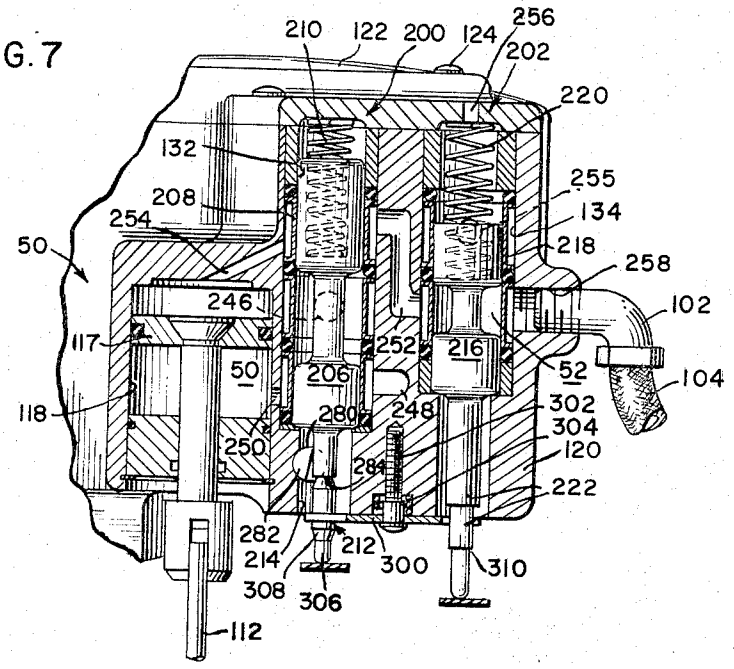
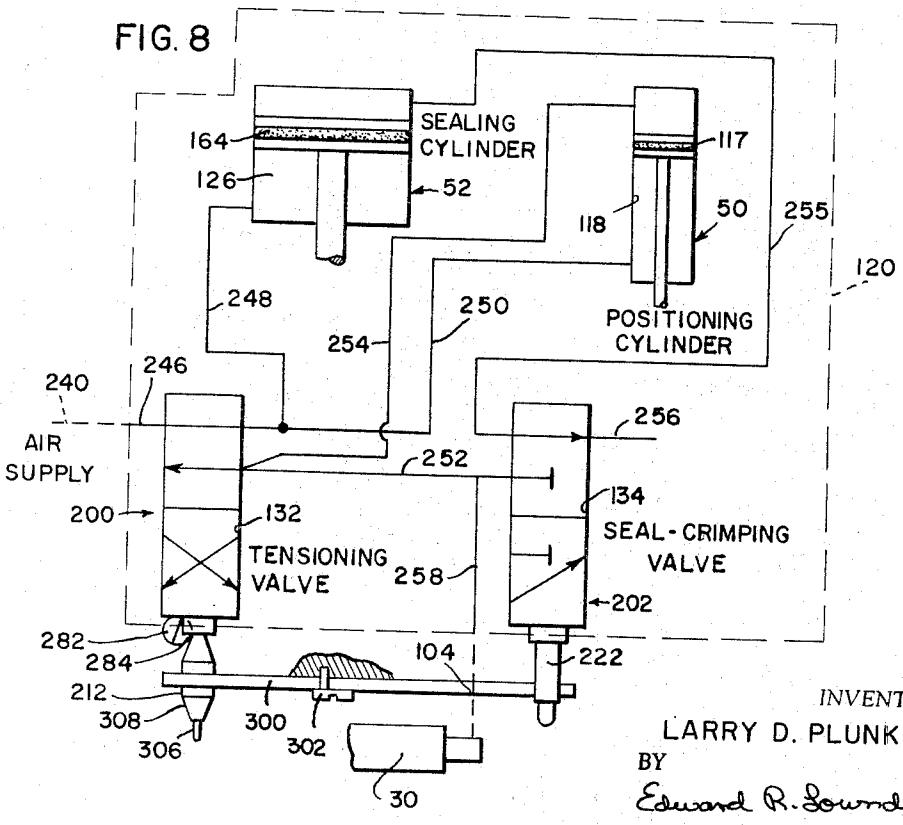


FIG. 8



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July 4, 1967 L. D. PLUNKETT 3,329,178

STRAPPING TOOL

Filed May 24, 1965 5 Sheets-Sheet 5

FIG. 9

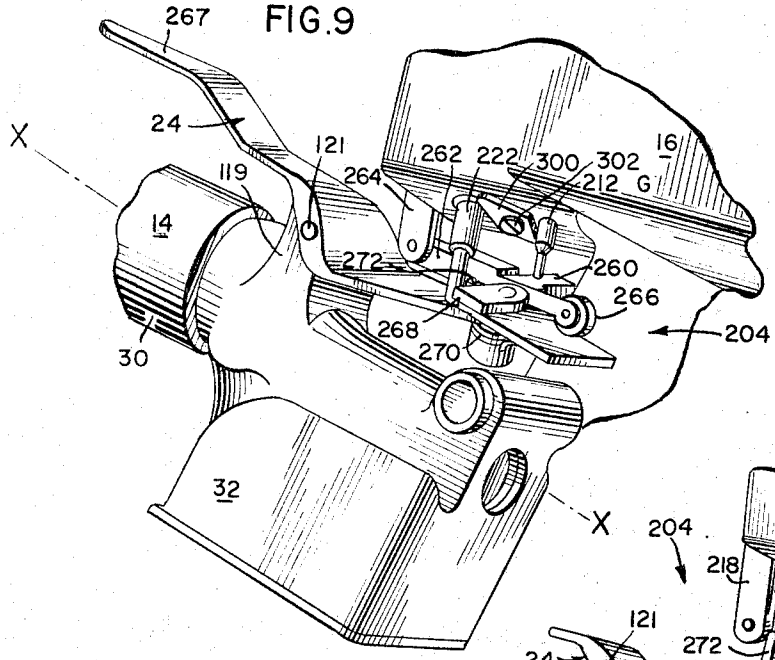


FIG. 10

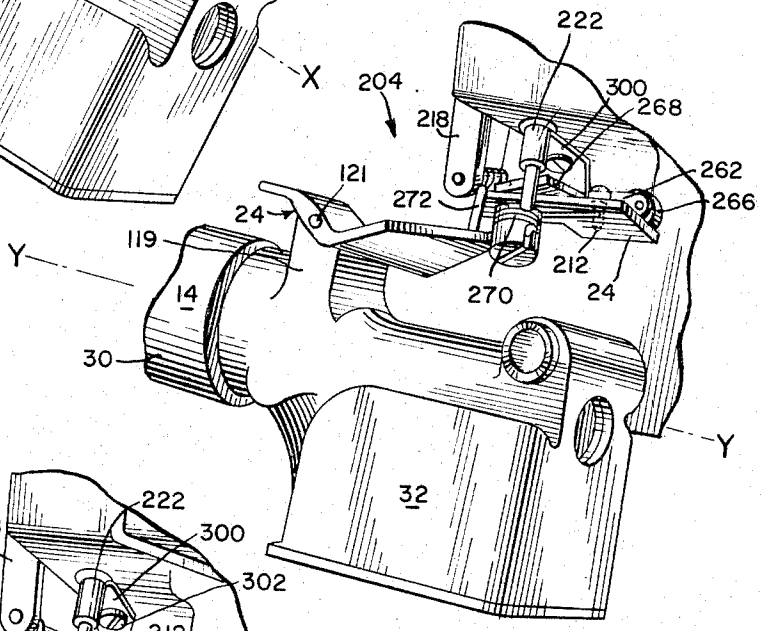
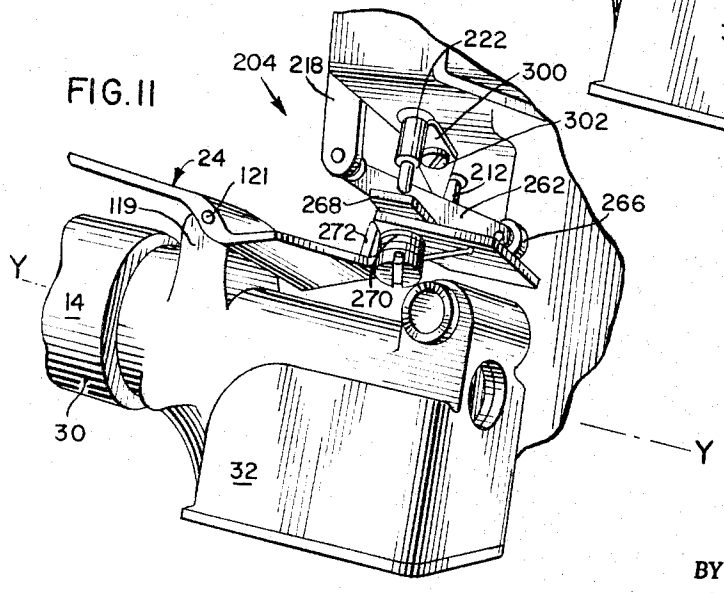


FIG. 11



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STRAPPING TOOL

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Filed May 24, 1965, Ser. No. 458,087
15 Claims. (Cl. 140—93.4)

ABSTRACT OF THE DISCLOSURE

A pneumatically operable heavy duty strapping tool for tensioning a loop of steel strapping about an object, applying a seal to the overlapping portions of the strapping, crimping the seal to unite such portions, and severing the loop from the source of strapping. Upon initial depression of a single control lever, the tool body which carries a tensioning wheel shifts to a position wherein the wheel engages the strapping. At the same time a pair of seal-crimping jaws lightly engage the seal to hold it in position without crimping it while the tensioning wheel tightens the strapping loop. Upon a second depression of the lever, the jaws positively close upon the seal to crimp it, after which a shear blade severs the thus tensioned and sealed loop from the strapping source.

The present invention relates to package binding tools, commonly referred to as strapping tools, and by means of which a loop of flexible metal strapping which has been caused to encircle an article, or series of articles, is tensioned and thereafter a seal which has been positioned about the overlapping end regions of the loop is crimped or otherwise deformed to provide a seal joint, after which the feed end region of the strapping is severed to free the tensioned loop and article encircled thereby from the source of strapping.

The tool of the present invention will find particular application in applying tension to heavy duty steel strapping, i.e. strapping having a width of three-quarters of an inch or greater, and a thickness between .031 and .050 inch. Basically, the present strapping tool embodies many of the features of existing strapping tools which are designed to operate upon heavy duty strapping. For example, because of the fact that the use to which such strapping is put requires a greater degree of tensioning that may conveniently be applied by manual force, pneumatic power is employed to initiate the tensioning operation. Pneumatic power also is employed for effecting the seal crimping operation and this power is applied through opposed crimping jaws in a manner similar to that employed in connection with certain prior strapping tools. An effective pneumatically operable strap-severing method and mechanism, heretofore employed in connection with existing strapping tools, and wherein the strapping is severed in the immediate vicinity of the seal and by displacement of the seal bodily with respect to a shearing edge associated with the tool, also constitutes an adopted feature of the present strapping tool.

Apart from the adoption of the above-outlined previously used features of strapping tool operations and the employment of a more or less basic or standard strapping tool design which, in outward appearance at least, renders the present strapping tool similar to other known strapping tools, the present tool is possessed of numerous features of novelty which contribute toward increased efficiency of operation, both functionally and in ease of operation, as well as extending the usefulness of the tool. For example, in certain similar tools designed for the same purpose as that of the present strapping tool, the tensioning wheel which engages the feed end portion of the strapping loop for strap feeding purposes is brought into effective engagement with the strapping by the force of gravity

acting upon the entire tensioning assembly of which the tensioning wheel forms a part, and including the tensioning motor. Such an expedient necessarily limits the use of a strapping tool to horizontal positioning of the tool over the package undergoing strapping and it requires the use of manual lifting force to withdraw the tensioning wheel from the strapping for purposes of strapping release. On the other hand, the strapping tool of the present invention employs pneumatically operable means for positively shifting the tensioning assembly toward and away from the strapping to bring the tensioning wheel into effective binding engagement with the latter and to withdraw the wheel therefrom. Moreover, it maintains the tensioning wheel in such binding engagement with the strapping during the tensioning operation under pneumatic pressure. The tool thus may be used in positions other than horizontal and it may be said to be capable of universal positioning during the strapping operation, even to the point of operating in an inverted position if the occasion arises.

Specifically, the strapping tool of the present invention embodies a novel control system by means of which the strap tensioning, sealing and severing operations are caused to be initiated successively, and in the order named, in a more expeditious manner than has heretofore been possible with conventional strapping tools designed to accomplish the same over-all functions. For example, the present strapping tool employs a single manually operable control lever which is finger-operated, as distinguished from the plural hand-operated control levers ordinarily required by similar power actuated tools, and which lever, upon an initial depression thereof, brings the tensioning assembly to an operative tensioning position with respect to the strapping and also initiates the tensioning operation and causes it to be carried out to completion. Then, upon a second depression of the same lever, the seal-crimping operation is initiated and completed and the strapping tool parts all are restored automatically to their original positions preparatory to a successive strapping operation. Apart from the initial loading of the strapping tool, two successive finger-depressions of the control lever are all that are required of the operator to complete a given strapping operation. The semi-automatic tool is therefore more nearly fully automatic than are conventional tools designed for the same purpose.

An important feature of the present invention resides in the manner in which the seal-crimping jaws are caused to close upon the seal under light spring pressure after the initial depression of the control lever to thus hold the seal in accurate register with the tensioning wheel yet without deforming the seal. This "prewrapping" of the crimping jaws about the seal is maintained effective during the tensioning operation. As soon as the tensioning operation is complete and the operator has depressed the control lever for the second time, the spring pressure is augmented by pneumatic pressure and the crimping jaws close still further to perform the seal-crimping operation.

Another feature of the present strapping tool resides in a novel means for holding the feed end region of the strapping loop in position against indiscriminate displacement during the tensioning operation, and also holding or capturing the loose end of the strapping stock which is freed from the tool as soon as the severing operation has been completed so that it will be readily accessible to the operator for subsequent loading of the tool.

Several features of novelty are associated with the previously mentioned control system for effecting semi-automatic sequential operation of the strapping tool from the initial loading thereof to the final strap severing and strapping release operations. Certain of these features are embodied in a novel pneumatic control system embodying

two piston and cylinder assemblies and two valve assemblies, together with porting arrangements therefor.

Other features of novelty are embodied in certain interrelated latching means whereby the valve stems associated with the two valve assemblies are latched to hold the valve assemblies in predetermined positions until after certain tool operations have been completed, after which they are automatically released, their release being effected under the control of the terminal movement of an element at the completion of such operations. The strapping tool is thus cyclic in its operation, portions of the tool cycle being dependent upon and being initiated by completion of the next preceding portion of the tool cycle.

Still another feature of the present strapping tool resides in a novel interlock which is provided between the valve stems of the two valve assemblies to correlate their movements, the operation of such interlock being dependent upon and controlled by the operation of the aforementioned latching means.

Finally, a further feature of novelty of the present strapping tool resides in the provision of a manually operable lever and latching system by means of which the aforementioned single manually operable control lever is caused, upon successive depression thereof, to effect different valve control operations, each to the exclusion of the other. This latter lever and latching system constitutes one of the principle features of the present invention.

The provision of a strapping tool of the character briefly outlined above constitutes the principal object of the present invention.

The provision of a heavy duty power-actuated strapping tool which, despite the many functions performed by it during each tool cycle, is of relatively simple design and construction as compared to similar tools which are intended for the same purpose; one which is comprised of a minimum number of parts, particularly moving parts, and which therefore is unlikely to get out of order; one which is rugged and durable and which therefore will withstand rough usage; one which may be manufactured at a low cost; one which is capable of ease of assembly and disassembly for purposes of inspection of parts, replacement or repair; one which is simple in its operation and which therefore does not require the use of skilled labor; one which is attractive in its appearance and pleasing in its design; and one which, otherwise, is well adapted to perform the services required of it, are further desirable features which have been borne in mind in the production and development of the present invention.

Other objects and advantages of the invention, not at this time enumerated, will readily suggest themselves as the nature of the invention is better understood.

In the accompanying five sheets of drawings forming a part of this specification, one illustrative embodiment of the invention has been shown.

In the drawings:

FIG. 1 is a side elevational view, partly in section, of a pneumatic strapping tool embodying the principles of the present invention, the tool being illustrated with the operative parts thereof in the positions which they assume when air is first supplied to the tool and the latter is in condition for immediate use;

FIG. 2 is a fragmentary detail side elevational view of a portion of the structure shown in FIG. 1, the view being taken in the vicinity of the tensioning mechanism and showing the parts in the positions which they assume during the strapping tensioning operation;

FIG. 3 is a sectional view taken substantially along the line 3—3 of FIG. 2 and showing a strapping-retaining detent mechanism employed in connection with the invention;

FIG. 4 is a rear elevational view of the strapping tool with the parts being shown in the positions which they assume during the strapping tensioning operation;

FIG. 5 is a sectional view taken substantially along the line 5—5 of FIG. 1;

FIG. 6 is a sectional view similar to FIG. 5 but showing the parts in the positions which they assume during the strapping tensioning operation;

FIG. 7 is a sectional view taken substantially along the line 7—7 of FIG. 1;

FIG. 8 is a pneumatic diagram, entirely schematic in its representation, showing the pneumatic control mechanism by means of which the strapping tool is operated;

FIG. 9 is a fragmentary perspective view showing certain manually operable valve control mechanism employed in connection with the present invention, the parts being shown in the position which they assume in FIG. 1; and

FIG. 10 is a fragmentary perspective view similar to FIG. 9, showing the position of the valve control mechanism upon initial depression of a certain control lever and immediately prior to initiation of the tensioning operation; and

FIG. 11 is a fragmentary perspective view similar to FIGS. 9 and 10, showing the position of the valve control mechanism upon release of the control lever and during the strapping tensioning operation.

BRIEF DESCRIPTION

Referring now to the drawings in detail and in particular to FIGS. 1, 2 and 4, a pneumatic strapping tool constructed in accordance with the principles of the present invention has been designated in its entirety at **10**. Briefly, the strapping tool **10** involves in its general organization three relatively movable carriage or frame assemblies including a main frame or foot assembly **12**, a strapping tensioning assembly **14**, and a sealing assembly **16**. These three assemblies are pivoted for limited relative swinging movement about a common horizontal axis represented by the pivot pin or shaft **18**. A suspension rod **20** pivoted to the sealing assembly **16** extends upwardly along one side of the tool and has an arched portion (FIG. 4) shown at **22** which is adapted to overlie the tool for supporting the same bodily from a suitable overhead hoist or support when the tool is not in operation. The rod **20** also serves as a carrying handle for the tool. When the tool is thus supported, the rod **20** extends substantially vertically as shown in full lines in FIG. 1 and, since the point of pivotal support of the tool on the rod coincides substantially with the center of gravity of the tool, the latter possesses a degree of stable equilibrium in any suspended position of the tool. When the tool is lowered upon an article undergoing strapping, the tool is supported upon the foot assembly **12** in a manner and for a purpose that will be described presently and, at this time, the supporting rod **20** may be swung to an inclined out-of-the-way position as indicated in dotted lines in FIG. 1 and in full lines in FIG. 4. Alternatively, the rod **20** may be left in its full line vertical position to the end that the overhead hoist may continue to counterbalance a major portion of the weight of the tool during the strapping operation, thus minimizing the possibility of crushing or otherwise damaging the article undergoing strapping. The tool **10** is capable of being used in positions other than the vertical position in which it is illustrated and the supporting rod **20** is designed so that it may be suspended to support the tool in any desired position of inclination, such universal positioning of the tool being particularly useful in enabling the tool to be applied to irregular shaped articles or bundles.

When the tool is suspended from the rod **20** as shown in FIG. 1 and is in its free state, i.e. before it is connected to a source of air, the three assemblies **12**, **14** and **16** assume relative positions which, in the normal operation of the tool, do not occur. As soon as the tool is supplied with air, certain valve-controlled piston movements are set into operation which results in movement of the parts to the positions in which they are shown in

FIG. 1. Thereafter, operation of the tool for article-strapping purposes under the control of a manually operable lever **24** and in a manner that will be described in detail presently, effects other positional relationships of the parts whereby strap clamping, strap tensioning, seal positioning, seal crimping, strap severing and strap releasing operations automatically and progressively in the order named. Since these abnormal positions of the three assemblies **12**, **14** and **16**, as well as of the operative piston and valve control devices and other instrumentalities associated therewith, do not occur in the operation of the tool and otherwise perform no useful functions, they will not be described herein and reference will be made only to the operative positions of the parts.

The strapping tensioning assembly **14** has associated therewith a pneumatically operable motor **30** which is operatively connected through a gear reduction device **32** to a rotatable strap tensioning or feed wheel **34**. This wheel is designed for cooperation with a freely rotatable anvil or back-up roller **36** carried by the foot assembly **12** to clamp the feed end portion of the strapping therebetween and draw the strap taut about the article undergoing strapping. In FIGS. 1 and 2 the manner in which the strapping S is applied to an article A and caused to pass between the tensioning wheel **34** and anvil roller **36** has been clearly illustrated. The tool **10** is lowered into the vicinity of the article and the strapping S is then passed around the article A with its free end region **38** underlying the sealing assembly **16** and so that the feed end region **40** of the strapping overlaps the free end region as indicated at **42** and then passes rearwardly between the tensioning wheel **34** and anvil roller **36**. The extreme end portion of the free end region **38** is turned rearwardly as at **43** so that it underlies the seal **46**. The sealing assembly **16** has associated therewith a seal-retaining and seal crimping unit **44** which is effective during the tensioning operation to engage and retain a previously applied seal **46** (FIGS. 1 and 6) in encircling relationship about the overlapping portions **42** of the strapping. Subsequently, and after a predetermined degree of tension has been attained in the strapping, the unit **44** is effective to crimp the seal **46** about the overlapping portions **42**. Thereafter a strap-shearing unit **48** carried by the foot assembly **12** is effective to shear the strapping S in the immediate vicinity of the seal **46**, after which the strapping S is released by the tensioning wheel **34** and anvil roller **36**.

As will become more readily apparent as the nature of the invention is better understood, after the tool has been supplied with air under operating pressure, the strapping tensioning assembly **14** will assume a raised position wherein its longitudinal axis is coincident with the line *x*—*x* of FIG. 1. At this time the tensioning wheel **34** will assume a retracted position remote from the anvil roller **36** so that when the tool is lowered to bring the foot assembly into contact with the article A, the feed end portion **40** may be introduced sidewise between the tensioning wheel and anvil roller. Upon an initial or first depression of the lever **24**, actuation of a piston and cylinder unit **50** associated with the assembly **16** will be effective to move the tensioning assembly **14** bodily as a unit to a lowered position wherein its longitudinal axis is coincident with the line *y*—*y* of FIGS. 1 and 2 to engage the strappjing between the tensioning wheel **34** and anvil roller **36**, and at the same time move the foot assembly **12** including the strap-shearing unit **48** to the position wherein it is shown in FIG. 2 and wherein the shearing unit **48** is in close proximity to and in register with the seal crimping unit **44**. As soon as the two assemblies **14** and **12** have thus moved to the positions wherein they are shown in FIG. 2, the tensioning or feed wheel becomes effective to tension the strapping about the article. When the strapping has attained a predetermined degree of tension, the lever **24** is again depressed and actuation of a piston and cylinder unit **52** (FIGS. 5 and 6) is initiated to effect the seal crimping operation and such operation is followed automatically by actuation of the shearing unit **48** to sever the strapping S in the immediate vicinity of the crimped seal **46**. As soon as the severing operation has been completed, the tool is automatically operable to restore the assemblies **12**, **14** and **16** to their original positions as shown in FIG. 1, the unit **44** serving to release the seal **46**, and the tensioning wheel **34** and anvil roller **36** serving to release the strapping S, thus freeing the tool.

THE FOOT ASSEMBLY

The foot assembly **12**, although of appreciably smaller proportions than the assemblies **14** and **16**, may for facility of description be regarded as the main frame of the tool **10** inasmuch as during the actual strapping operation it seats squarely upon the article undergoing strapping and affords reaction for the movements of the two other assemblies. This assembly **12** is comprised of a casting which is generally L-shape in transverse cross section and which provides a laterally extending horizontal foot proper **60**, the underneath surface of which is formed with a shallow channel **62** (FIGS. 1 and 2) which guides or centers the strapping S during the tensioning operation. The rear end of the foot casting is bifurcated as shown at **64** in FIG. 4 and the previously mentioned anvil roller **36** is rotatably supported upon a transverse shaft **66** which extends across the bifurcations. The foot casting further includes a vertically extending wall **68** the upper region of which is formed with a lateral boss **70** through which the pivot pin or shaft **18** extends. A raised shoulder-forming rib **72** (FIGS. 1 and 4) on the wall **68** is designed for engagement with a pin **74** carried by the sealing assembly and limits the extent of swinging movement of the sealing assembly in one direction with respect to the foot casting. The shearing unit **48** is removably mounted by means of clamping bolts **76** on the forward region of the foot casting and the front side of this unit is engageable with the rear side of the seal retaining and crimping unit to limit the extent of swinging movement of the latter unit with respect to the foot casting in the other direction.

Swinging movements of the tensioning assembly **14** in opposite directions with respect to the foot casting **12** is limited by the provision of an elongated clearance slot **78** (FIG. 2) formed in the vertical wall **68**, one end **80** of the slot being engageable with a tensioning wheel supporting shaft **82** associated with the assembly **14** to limit the raised inoperative position of the assembly.

An adjustable set screw **86** opposes a downwardly facing shoulder **88** provided on a radially disposed protuberance **90** formed on the gear reduction device **32** and is designed for engagement with the shoulder to prevent direct engagement between the tensioning wheel **34** and the anvil roller **36** when there is no strapping in the tool.

The strap-retaining detent device

A lateral shelf portion **92** formed on the vertical wall **68** carries a spring pressed detent ball **93** which is in register with a laterally projecting pin **94** immediately below the ball, the ball and pin constituting a friction grip arrangement for the strapping S as it emerges from between the tensioning wheel **34** and anvil roller **36** during the tensioning operation, the arrangement being provided principally to capture the feed end portion of the strapping at the time of strap severing and retain it so that it is readily accessible to the operator at the time that the severing operation transforms it into the free end portion of the next length of strapping to be applied to a subsequent article to be strapped. The detent arrangement also constitutes a safety feature to prevent the hazard of loose spring tensioned or spring flexed strapping in the vicinity of tool operations.

The shearing unit

The previously mentioned shearing unit **48** is of conventional construction and is comprised of a generally H-shaped bracket **95** secured by means of the bolts **76** to the foot casting and having slotted side walls **96** which slidably retain therebetween a shear blade or cutter **97**. The cutter **97** is yieldingly biased by a spring **98** to a raised retracted position and is adapted to be forced downwardly in the performance of its strap-severing stroke by engagement with a moving element associated with the seal retaining and crimping unit **44** after the crimping operation has been completed, all in a manner that will be set forth subsequently.

THE TENSIONING ASSEMBLY

The specific details of the pneumatically operable motor **30** and of the gear reduction device **32** which, in the main, constitute the tensioning assembly **14** have not been illustrated herein inasmuch as they form no part of the present invention. Any suitable type of air-operated motor and associated gear reduction device may be employed. The housings for these two instrumentalities are suitably bolted or otherwise connected together and provide the aforementioned elongated tensioning assembly **14**, the longitudinal axis of which is shiftable between the positions *x*—*x* and *y*—*y* of FIG. 1 as the assembly moves between its raised inoperative and its lowered operative positions. As best seen in FIGS. 1 and 4, the housing for the pneumatic motor **30** is provided with an adjustable air restriction elbow fitting **100** by means of which the motor may be connected to a second elbow fitting **102** associated with the previously mentioned piston and cylinder assembly **52** and forming a part of the sealing assembly **16**. A flexible conduit **104** extends between the two elbow fittings **100** and **102**.

As previously stated, the pivot pin or shaft **18** constitutes the common pivotal support for the three assemblies **12, 14** and **16**. Insofar as the assembly **14** is concerned, the upper forward region of the gear reduction device **32** fixedly receives the shaft **18** so that swinging movements of the assembly **14** is accompanied by rocking movement of the shaft **18**. A link **110** which may be regarded as a part of the tensioning assembly **14** since it moves bodily with this assembly, has its proximate end connected to the shaft **18** and its distal end connected to the shaft **82** which supports the tensioning wheel **34**. The link **110**, in effect, constitutes a crank arm by means of which rocking movements of the assembly **14** on the foot assembly **12** may be effected under the control of a connecting or positioning link **112**. The lower end of the link **112** is connected to a pin **114** provided in the medial regions of the link **110** while the upper end of the link **112** is connected to a plunger **116** carried by a piston **117** mounted for reciprocation in a cylinder assembly **50**. This latter assembly thus serves to effect limited swinging movement of the link **110** to, in turn cause shifting movement of the assembly **14** bodily as a unit all in a manner and for a purpose that will be set forth subsequently. The previously mentioned shoulder-forming protuberance **90** is formed on the housing of the gear reduction device **32**. An upstanding lug **119** (see also FIGS. 9, 10 and 11) also formed on the housing, carries a cross-pin **121** which provides a trunnion support for the operating lever **24**.

THE SEALING ASSEMBLY

Framework

The sealing assembly **16** involves in its general organization a relatively large casting providing an upper cup-shaped housing **120** the upper open rim of which is closed by a closure head or plate **122** secured in position by bolts **124**. The housing **120** is internally compartmented to provide the cylinder **126** of the previously mentioned piston and cylinder unit **52**, as well as to provide the cylinder **118** associated with the previously mentioned

piston and cylinder unit **50** (FIGS. 1 and 7), and also a pair of valve chambers **132** and **134** (FIG. 7).

The housing **120** is provided with a bottom wall **140** from which there extends downwardly a pair of spaced apart ears **142** (FIGS. 1, 2 and 4), the previously mentioned pivot pin or shaft **18** extending transversely between the ears and serving as a pivotal support of the assembly **16** as a whole. The suspension rod **20** also is pivotally supported by the ears **142**. A pair of spaced apart ribs **144** (FIGS. 1, 2, 5 and 6) also depend from the bottom wall **140** and serve as a support for the previously mentioned seal crimping unit **44**.

The seal crimping unit

The seal crimping unit **44** involves in its general organization a pair of plates **150** and **152** (FIG. 2) which are secured to the ribs **144** by means of machine screws **154**. A vertical guide slot **156** (FIG. 5) is formed in the plate **152** and establishes a guideway for the vertical reciprocating movements of a cross pin **158** which is secured in a crosshead **160** fixedly carried at the lower end of a plunger **162** associated with a piston **164** mounted for reciprocation in the cylinder **126**. A notcher block **166** positioned between the plates **150** and **152** is supported on cross pins **168** and dual jaw members **170** having seal-retaining and crimping jaws proper **172** at their lower ends are pivoted on the pins **168** and are pivotally connected at their upper ends to the lower ends of spreader links **174**. The upper ends of the spreader links **174** are pivotally connected to the cross pin **158**.

The specific details of the jaw mechanism associated with the seal crimping unit **44** and including the jaw members **170**, spreader links **174**, crosshead **160**, guide plate **152** and notcher block **166** are more or less of conventional design and no claim is made herein to any novelty associated with the same. A similar jaw mechanism has been shown and described in United States patent to Meier, Patent No. 3,150,694, granted on Sept. 29, 1964, and entitled "Strapping Tool." Reference may be had to the above-mentioned patent for a full understanding of the nature and operation of such a jaw mechanism. For purposes of description herein it is deemed sufficient to point out, briefly, that the crimping operation is effected when the plunger **162** moves downwardly in the cylinder **126**, at which time the spreader links **174** force the upper ends of the jaw members **170** outwardly so that the lower ends of these members including the crimping jaws proper **172** close inwardly upon the seal **46** and force the latter against the notcher block **166**, thus tightening and crimping the seal about the overlapping regions **42** (FIG. 1) of the strapping S in the usual manner.

As is the case in connection with the crimping unit of the aforementioned patent to Meier, the crimping unit **44** and shearing unit **48** cooperate with each other in effecting shearing of the excess strapping along and by the rear edge of the seal **46**. Accordingly, the pin **158** projects completely through the guide slot **156** (FIGS. 2 and 5) as indicated at **180** and this projecting portion is designed for engagement with the shear blade or cutter **97** at such time as the piston **164** is at the bottom of the cylinder **126** and the pin **158** is at the bottom of its stroke. Upon depression of the cutter **97** by the projecting portion **180** of the pin **158**, the cutter is forced downwardly against the yielding action of the spring **98**, thus engaging and depressing the adjacent edge of the seal **46** and causing relative movement between the excess portion of the strap and the relatively sharp forward edge of the foot proper **60** so that the strap is severed along the rear edge of the seal, all in the manner set forth in the above-mentioned patent to Meier.

It is to be noted at this point, however, that while the details of the seal crimping and strap shearing units **44** and **48**, and the manner in which they cooperate with each other are, in general, similar to the corresponding units shown and described in the Meier patent, the con-

trol mechanism by means of which the units **44** and **48** are actuated differs widely from the control mechanism of such patent. As will be pointed out in greater detail presently, the piston **164** is normally and yieldingly biased downwardly in the cylinder **126** by means of a helical involute compression spring **182** (FIGS. 5 and 6) so that when the lower region of the cylinder is in communication with the atmosphere and no air is supplied to the upper region thereof, the piston is forced downwardly solely under the influence of the spring **182**, thus moving the crimping jaws proper **172** into holding engagement with the seal **46** under insufficient pressure to effect the crimping operation. The seal is thus held in a position of register with the tensioning wheel **34** and anvil roller **36** during the strap tensioning operation. The jaws **172** may thus be said to be "prewrapped" about the seal **46** for seal-aligning and holding purposes, this "prewrap" condition constituting one of the principal features of the present invention. Subsequently, at a point later in the tool cycle, air under full line pressure is applied to the upper region of the cylinder **126** to forcibly drive the piston **164** downwardly, thus applying full power to the crimping jaws **172** and effecting the crimping operation.

THE PNEUMATIC CONTROL INSTRUMENTALITIES

The valve mechanism and valve porting

Briefly, the operation of the pneumatic strapping tool **10** is effected under the control of two valve assemblies **200** and **202** which are disposed in the previously mentioned valve chambers **132** and **134** respectively (FIG. 7). Actuation of the two valve assemblies is effected under the control of an external compound lever and latch mechanism which has been designated in its entirety at **204** and illustrated in detail in FIGS. 9, 10 and 11, this latter system including the previously mentioned manually operable lever **24**.

The valve assembly **200** includes a spool-type valve body **206** (FIG. 7) which is vertically slidable in a composite valve cage **208** and normally is urged by means of a spring **210** to the lowered position in which it is shown in FIG. 7. The valve body **206** is formed with a depending valve stem **212** (see also FIGS. 9, 10 and 11) which projects outwardly of the housing **120** through an exhaust port **214** and is designed for engagement with an element of the external lever and latch system **204** as will be described presently.

The valve assembly **202** includes a spool-type valve body **216** which is vertically slidable in a valve cage **218** and is normally urged by means of a spring **220** to the lowered position of FIG. 7. A valve stem **222** projects downwardly from the valve body **216** out of the housing **120** and is designed for engagement with another element of the lever and latch system **204** as also will be described subsequently.

Referring now to FIGS. 1, 7 and 8, air is supplied to the tool **10** through a flexible conduit **240** and quick-release fitting **242** carried by an elbow **244** from whence it is supplied to the valve chamber **132** through an internal passage **246** (FIG. 7) provided in the housing **120**. It is to be noted at this point that in FIG. 8, wherein the pneumatic circuitry for the tool **10** has been shown, dotted lines are employed to designate external air lines while full lines have been employed to designate internal air passages within the housing **120**. A dotted rectangle designated at **120** represents the housing.

An internal passage **248** establishes communication between the valve chamber **132** and the cylinder **126** (see also FIG. 5). A second internal passage **250** establishes communication between the valve chamber **132** and the cylinder **118**. A third internal passage **252** establishes communication between the valve chambers **132** and **134**. A fourth internal passage **254** establishes communication between the valve chamber **132** and the cylinder **118**. A fifth internal passage **255** establishes communication between the valve chamber **134** and the cylinder **126**. An exhaust passage **256** connects the valve chamber **134** to the atmosphere. Finally, the previously mentioned flexible air line **104** is connected through the elbow fitting **102** to an internal passage **258** leading to the valve chamber **134**.

The manually operable lever and latching mechanism

The previously mentioned lever and latch mechanism **204** of FIGS. 9, 10 and 11 includes the manually depressible lever **24** and this mechanism is so designed that upon an initial depression and release of the lever **24** the valve stem **212** will become elevated and latched in its raised position, at which time the tensioning assembly **14** will shift from its raised position represented by the axis *x*—*x* to its lowered position represented by the axis *y*—*y* while at the same time the tensioning motor **30** will be energized. Then, upon a subsequent depression of the lever **24**, the valve stem **222** will become elevated and latched in its raised position, at which time the seal crimping unit **44** will become effective to crimp the prepositioned seal **46** about the overlapping portions of the strapping S and the shearing unit **48** will severe the strapping in the immediate vicinity of the seal **46**. As soon as the strap-severing operation has been completed, means automatically become effective to release the latching devices for both valve stems **212** and **222** to the end that all the strapping tool parts will be restored to their initial position preparatory to the performance of a subsequent strapping operation.

Accordingly, the valve stem is designed for engagement with a lateral projection **260** on a secondary lever **262** which is pivoted at one end to a depending lug **264** and which carries a roller **266** at its distal end. The lever **24** is pivoted medially of its ends on the pin **121** and the rear end **267** of the lever **24** constitutes a finger pad which is designed to be depressed for lever-actuating purposes. The roller **266** overlies the forward end of the lever **24** and rides thereon so that upon depression of the rear end of the lever **24**, the roller **266**, and consequently the secondary lever **262**, is moved to an elevated position wherein the lateral projection **260** engages and raises the valve stem **212** and consequently the valve body **206**, at a predetermined time in the tool cycle as will also be described presently.

The valve stem **222** is designed for engagement with a spring-pressed dog **268** pivotally mounted on the lever **24**. The dog **268** is yieldingly biased by a spring **270** against a pin **272** to a normal position wherein it projects laterally of the lever **24** and underlies the valve stem **222** as shown in FIG. 11 when the tensioning assembly **14** is in its lowered position coincident with the axis *y*—*y*. Thus, when the assembly **14** is in such lowered position and the rear end **267** of the lever **24** is manually depressed, the dog **268** will engage the valve stem **222** and raise the same, thus elevating the valve body **216**. When the tensioning assembly **14** is in its elevated position coincident with the axis *x*—*x* as shown in FIG. 9, the dog **268** will be out of register with the valve stem **222** and actuation of the lever **24** will cause raising of the valve stem **212** as previously described but will fail to cause raising of the valve stem **222**.

The valve stem latching device

As best seen in FIGS. 7 and 8, means are provided for latching the valve stem **212** in its elevated position after initial raising of this stem by the laternal projection **260** on the lever **24**. This means comprises a latch shaft **280** having a first half-moon extension **282** designed for latching engagement with a shoulder **284** provided on the valve stem **212**, such engagement taking place when the valve stem is initially moved to its raised position. The latch shaft **280** projects outwardly of the housing **120** as shown in FIG. 4, and is yieldingly biased by a spring **290** into

latching position. A second half-moon extension **292** (FIGS. 5 and 6) is provided on the latch shaft **280** and normally assumes a position adjacent the bottom wall **140** of the housing **120** and in the path of movement of the piston **164** so that at such time as the piston has fully descended in the cylinder **126**, this latter extension **292** will be engaged by the underneath side of the piston and the latch shaft rocked against the action of the spring **290** to valve stem-releasing position. A manually operable trip finger **294** (FIG. 4) is provided on the outwardly projecting portion of the latch shaft **280** and may be employed to release the latched valve stem **212** at such time as a jam or other malfunctioning of the strapping tool **10** takes place as will be described subsequently.

The valve stem interlock

Still referring to FIGS. 7 and 8, an interlock connection between the valve stems **212** and **222** is provided whereby upon movement of the valve stem **222** to its raised position the same will become effectively latched in such position and will remain thus latched until such time as the previously raised valve stem **212** is released by half-moon extension **282** on the latch shaft **280**. Accordingly, a latch arm **300** (FIGS. 7 and 9) is pivoted for swinging movement in a horizontal plane about the vertical axis of a retaining bolt **302** and is disposed substantially midway between the valve stems **212** and **222**, the arm underlying the housing **120**. A spring **304** biases the arm into cooperating engagement with the valve stem **212**, the effective diameter of the latter stem at its point of contact with the latch arm determining the position of the arm. The valve stem **212** is formed with a reduced section **306** at its extreme lower end and this reduced section is connected to the main body portion of the valve stem by a frusto-conical section **308**. When the valve stem **212** is in its fully lowered position, the adjacent end region of the latch arm **300** bears against the main body portion of the valve stem **212** while the opposite end region is maintained clear of the valve stem **222**. When the valve stem **212** is in its raised position, the adjacent end of the latch arm **300** moves inwardly toward the reduced section **306** and the opposite end region of the arm is biased against the valve stem **222** under the influence of the spring **304**. This condition permits the latch arm **300** to move beneath a downwardly facing annular shoulder **310** on the valve stem **222** and thus latch the latter stem in its raised position. At such time as the valve stem **212** is released by the latching extension **282** of the latch shaft **280** as previously described, the adjacent end of the latching lever **300** will ride outwardly on the frusto-conical section **308** of the valve stem **212** during descent of the latter and return to its position on the main body portion of the valve stem, thus causing the opposite end of the lever **300** to move away from the valve stem **222** and release the latter for downward movement under the influence of the spring **220**.

OPERATION OF THE STRAPPING TOOL

Before describing the operation of the strapping tool **10** in detail, it is deemed pertinent in the interests of clarity to ascribe functional designations to two valve assemblies **132** and **134** and to the two piston and cylinder assemblies **50** and **52**. These functional designations have been applied in the form of labelling in FIG. 8. Inasmuch as descent of the piston **164**, either under the influence of the spring **182** or of pneumatic pressure, serves to effect closure of the jaws proper **172** against the seal **46**, the piston and cylinder assembly **52** has been designated as the sealing cylinder. Inasmuch as movement of the piston **117** serves to position the tensioning assembly **14** with respect to the sealing assembly **16**, the piston and cylinder assembly **50** has been designated as the positioning cylinder. The valve assembly **132** has been designated as the tensioning valve inasmuch as its operation controls the operation of the tensioning motor **30**. Finally, the valve assembly **134** has been designated as the crimping valve inasmuch as its operation controls the application of pneumatic pressure to the upper end of the cylinder **126** for the purpose of forcibly driving the piston **164** downwardly to effect the seal crimping operation.

In the operation of the strapping tool **10**, the tool may be suspended from an overhead hoist or adjustable tool balancing support by means of the suspension rod **20**, the rod being designed to maintain the tool at various universal inclinations other than the vertical position in which it is shown in the drawings. An appreciable amount of the total weight of the tool is thus supported to the end that the danger of damaging the article A undergoing strapping will be minimized. The tool is then manipulated to bring the foot proper **60** to a position wherein its underneath surface bears against the article A as shown in FIG. 1. Prior to such manipulation of the tool **10**, the strapping S is passed around the article A and fed through a seal **46** in such a manner that the feed end region **40** overlies the free end region **38** as it passes through the seal. The extreme free end portion **43** of the free end region is turned rearwardly and underlies the seal **46** so that this portion of the strapping is anchored in position between the seal and article A during the tensioning operation. When the tool is brought into position against the article A, the guide channel **62** in the foot proper **60** becomes centered over the strapping. The feed end portion of the strapping is caused to pass over the foot proper **60** and enter between the detent ball **93** and pin **94** as previously described and from thence the strapping S passes to a suitable source of strapping such as a strapping coil or the like. Manual tensioning may be resorted to until all looseness in the encircling strap has been taken up and the strap assumes its approximate final position with respect to the article.

It will be understood that prior to application of the strapping tool **10** to the article A, the flexible conduit **240** will have been applied to the quick-release fitting **242** so that the strapping tool will be supplied with air, the air entering the valve chamber **132** through the passage **246** (FIG. 7) and flowing through the valve cage **208** to the passage **248** from whence it enters the cylinder **126** (FIG. 5) in the lower regions thereof and maintains the piston **164** in its uppermost position against the action of the spring **182**. With the piston **164** thus elevated, the seal crimping unit **44** assumes the position in which it is shown in FIG. 1 with the crimping jaws proper **172** in their fully open position. At the same time, air leaves the valve chamber **132** through the passage **250** and enters the cylinder **118** below the piston **117**, thus elevating the piston and causing the tensioning assembly **14** to assume the position wherein it is shown in FIG. 1 with its axis coincident with the line *x*—*x*. At this time the tensioning or feed wheel **34** will be out of effective engagement with the anvil or back-up roller **36** to facilitate loading of the tool in the manner previously described.

After the strapping tool **10** has been loaded with the strapping S, the lever **24** is initially depressed, at which time the pivoted dog **268** (FIG. 9) will be out of register with the lower end of the valve stem **222** so that raising of the forward end of the lever **24** will fail to effect engagement of this valve stem by the dog **268**. However, the lateral projection **260** on the secondary lever **262** which, at this time is in register with the valve stem **212**, will engage this valve stem and raise the same as the roller **266** is forced upwardly by the forward end of the lever **24**. This movement of the valve stem **212** causes the valve body **206** (FIG. 7) to become elevated and the half-moon extension **282** of the latch shaft **280** will engage the shoulder **284** on the valve stem **212** and maintain the valve body **206** in its raised position. As the valve stem **212** thus moves upwardly, the adjacent end of the latch arm **300** will ride inwardly on the frusto-conical section **308** of the valve stem and the opposite

end of the arm will engage the valve stem **222** and yieldingly bear thereagainst under the influence of the spring **304** (FIG. 7).

With the valve body **206** thus raised, the passages **248** and **250** will exhaust to the atmosphere through the exhaust port **214**. At the same time air will feed through the passage **254** and enter the cylinder **118** above the piston **117** to force the latter downwardly and cause shifting of the tensioning unit **14** bodily as a unit so that its axis will coincide with the line *y*—*y* of FIGS. 1 and 11, thus bringing the tensioning wheel **34** into cooperation with the anvil or back-up roller **36** for strapping engaging purposes. Air also will at this time pass through the passage **252**, enter the valve chamber **134**, and be conducted through the passage **258**, elbow fitting **102** and flexible line **104** to the tensioning motor **30** which will thus be energized to cause rotation of the tensioning wheel in a tensioning direction to draw the strapping S about the article A in the usual manner of strap tensioning.

Inasmuch as at this time the passage **248** (FIGS. 5 and 7) as in communication with the atmosphere through the exhaust port **214**, the spring **182** will force the piston **164** downwardly in the cylinder **126** to close the crimping jaws **172** about the seal **46** which has been previously positioned about the overlapping portions of the strapping, as shown in FIG. 6. The force of the spring **182** is insufficient to crush or crimp the seal **46** and is sufficient merely to preposition the seal and hold it in register with the shearing unit **48** which has now moved into operative register and cooperation with the sealing unit **44** as previously described and as shown in FIG. 2. This seal-engaging or "prewrap" condition is maintained during the entire tensioning operation and until such time as the lever **24** is again depressed for seal crimping purposes as will now be fully described.

It is to be noted at this point that during movement of the tensioning assembly **14** from its raised to its lowered position as previously described, the pivoted dog **268** will engage and slide upon the valve stem **222** and finally move beneath this latter valve stem at such time as the tensioning assembly **14** attains its lowermost position coincident with the line *y*—*y*. At such time as the tensioning operation has been completed, and as evidenced by stalling of the tensioning motor **30**, the operator will again depress the lever **24**. The pivoted dog **268** will at this time engage the valve stem **222** and raise the same, thus raising the valve body **216** within the valve chamber **134** (FIG. 7). At this time the adjacent end of the latch arm **300** will move beneath the shoulder **310** on the valve stem **222** and latch the stem and valve body in an elevated position against the action of the spring **220**.

With the valve body **216** thus raised, air issuing from the passage **252** will flow through the passage **255** (FIGS. 5 and 7) and enter the cylinder **126** above the piston **164**, thus driving the latter downwardly and effecting the seal crimping operation as the crimping jaws proper **172** forcibly close upon the seal **46**. This downward power stroke of the piston **164** not only effects the seal crimping operation but it also effects operation of the shearing unit **48** due to the fact that the extension **180** of the cross pin **158** engages the shear blade or cutter **97** at the bottom of its stroke and depresses the seal **46** so that the strapping S is sheared against the forward edge of the foot proper **60** in the manner previously set forth and as fully described in the above-mentioned patent to Meier No. 3,150,694.

At such time as the piston **164** reaches the bottom of its power stroke, the underneath side of the piston engages the half-moon extension **292** (FIG. 5) on the latch shaft **280**, thus rotating the shaft **280** and causing the half-moon extension **282** (FIGS. 7 and 8) to release the shoulder **284** on the valve stem **212** and allowing the valve body **206** and stem **212** to move downwardly under the influence of the spring **210**. Such downward movement of the stem **212** causes the adjacent end of the latch arm **300** to ride outwardly on the frusto-conical section **308** of the valve stem **212**, thus withdrawing the opposite end of the latch arm **300** from the valve stem **222** and allowing this latter stem, together with its associated valve body, to move downwardly.

With both valve bodies **206** and **216** now in their lowered positions in the valve chambers **132** and **134** respectively, air is exhausted from the passage **255** (FIGS. 5 and 7) to the atmosphere through the valve chamber **134** and from thence through the exhaust passage **256**. At the same time air is exhausted from the upper end of the cylinder **118**, through the internal passage **254**, valve chamber **132**, passage **252**, valve chamber **134**, passage **258**, elbow fitting **102** and flexible conduit **104** to the tensioning motor **30**, from whence it escapes through the usual exhaust ports (not shown) associated with the motor. At this time, air under full line pressure is restored to the cylinder **126** below the piston **164** from the port **248** as previously described, thus forcing the piston **164** upwardly against the action of the spring **182**. Also, air under full line pressure is applied to the cylinder **118** below the piston **117** from the port **250** as also previously described, thus causing the tensioning assembly **14** to return to its position wherein its longitudinal axis is coincident with the line *x*—*x*. The various strapping tool instrumentalities are thus restored to their original position as shown in FIG. 1 preparatory to the next strapping operation.

The invention is not to be limited to the exact arrangement of parts shown in the accompanying drawings or described in this specification as various changes in the details of construction may be resorted to without departing from the spirit of the invention. Therefore, only insofar as the invention has particularly been pointed out in the accompanying claims is the same to be limited.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. In a pneumatically operable strapping tool for tensioning a loop of strapping about an article, said loop having overlapping free end and feed end portions threaded through a seal, and for thereafter crimping the seal about said overlapping portions, a frame adapted to rest upon the article, a strap tensioning member supported on the frame, a sealing assembly supported on the frame and including a pair of seal-positioning and seal-crimping jaws movable from an open seal-releasing position through an intermediate seal-retaining position to a fully closed seal-crimping position and vice versa, a cylinder supported on the sealing assembly, a piston slidable in said cylinder and operatively connected to said sealing jaws, said piston being movable between a retracted position wherein said jaws are in their seal-releasing position and a fully advanced position wherein the jaws are in their seal-crimping position, spring means yieldingly biasing said piston toward its fully advanced position to cause said jaws to engage the seal under pressure sufficient only to engage and maintain the seal positioned with respect to the tensioning member but insufficient to crimp the seal, and manually operable valve means for supplying air to said cylinder to augment the action of said spring biasing means and force the piston to its fully advanced position.

2. In a pneumatically operable strapping tool for tensioning a loop of strapping about an article, said loop having overlapping free end and feed end portions threaded through a seal, and for thereafter crimping the seal about said overlapping portions, a frame adapted to rest upon the article, a strap tensioning wheel supported on the frame, a sealing assembly supported on the frame and including a pair of seal-positioning and seal-crimping jaws movable from an open seal-releasing position through an intermediate seal-retaining position to a fully closed seal-crimping position and vice versa, a cylinder

supported on the sealing assembly, a piston slidable in said cylinder and operatively connected to said sealing jaws, said piston being movable between a retracted position wherein said jaws are in their seal-releasing position and a fully advanced position wherein the jaws are in their seal-crimping position, spring means yieldingly biasing said piston toward its fully advanced position to cause said jaws to engage the seal under pressure sufficient only to engage and maintain the seal positioned with respect to the tensioning wheel but insufficient to crimp the seal, and manually operable valve means for selectively supplying air to the opposite ends of said cylinder to maintain the piston in its retracted position against the action of said spring biasing means and to augment the action of said spring biasing means and force the piston to its fully advanced position respectively.

3. In a pneumatically operable strapping tool for tensioning a loop of strapping about an article, said loop having overlapping free end and feed end portions threaded through a seal, and for thereafter crimping the seal about said overlapping portions, a frame adapted to rest upon the article, a strap tensioning member supported on the frame, a sealing assembly supported on the frame and including a pair of seal-positioning and seal-crimping jaws movable from an open seal-releasing position through an intermediate seal-retaining position to a fully closed seal-crimping position and vice versa, a cylinder supported on the sealing assembly, a piston slidable in said cylinder and operatively connected to said sealing jaws, said piston being movable between a retracted position wherein said jaws are in their seal-releasing position and a fully advanced position wherein the jaws are in their seal-crimping position, spring means yieldingly biasing said piston toward its fully advanced position to cause said jaws to engage the seal under pressure sufficient only to engage and maintain the seal positioned with respect to the tensioning member but insufficient to crimp the seal, a manually operable control valve including a valve body effective in a first position to supply air to one end of said cylinder to maintain the piston in its retracted position against the action of said spring means and effective in a second position to supply air to the other end of the cylinder to augment the action of said spring means and force the piston to its fully advanced position, spring means yieldingly urging said valve body to its first position, latch means automatically effective upon movement of the valve body to its second position to latch the same in such position, and means automatically operable upon movement of the piston to its fully advanced position to release said latch means for return of the valve body to its first position under the influence of said spring means.

4. In a pneumatically operable strapping tool for tensioning a loop of strapping about an article, said loop having overlapping free end and feed end portions threaded through a seal, and for thereafter crimping said seal about the overlapping portions, a main frame adapted to rest upon the article, a strap-tensioning member supported on the main frame, a sealing assembly pivotally supported on the main frame and including a pair of seal-retaining and seal-crimping jaws movable from an open seal-releasing position, through an intermediate position wherein the jaws straddle and engage the seal in holding relationship, to a fully closed seal-crimping position and vice versa, said sealing assembly being movable between a retracted position wherein said jaws are out of register with the seal and an advanced position wherein the jaws are in register with the seal, a first piston and cylinder unit effective between the sealing assembly and main frame to move the sealing assembly between its retracted and advanced positions, a second piston and cylinder unit carried by the sealing assembly and effective to actuate said jaws, spring means normally biasing said second piston and cylinder assembly to move said jaws toward their intermediate position, and manually operable valve means effective in a first position to supply air to said first and second piston and cylinder assemblies to maintain said sealing assembly in its retracted position and to maintain the jaws in their open position against the action of said spring means, effective in a second position to relieve said second piston and cylinder assembly of air and cause said jaws to move to their intermediate seal-retaining position, and effective in a third position to supply air to said second piston and cylinder assembly to move said jaws to their fully closed seal-crimping position.

5. In a pneumatically operable strapping tool for tensioning a loop of strapping about an article, said loop having overlapping free end and feed end portions threaded through a seal, and for thereafter crimping the seal about said overlapping portions, a foot assembly including a foot proper adapted to rest upon the article and having an anvil member adapted to underlie said feed end portion, a tensioning assembly including a rotatable strap-tensioning wheel and a drive motor operatively connected thereto, a seal-crimping sealing assembly including a housing and a crimping unit carried thereby, said crimping unit including seal-retaining and seal-crimping jaws movable from an open seal-releasing position through an intermediate seal-retaining position to a fully closed seal-crimping position and vice versa, a pivot shaft common to said assemblies and on which the assemblies are pivotally mounted for independent swinging movements of the tensioning and sealing assemblies bodily relative to the foot assembly, said tensioning assembly being movable bodily between advanced and retracted positions to bring the tensioning wheel into and out of strap-engaging position respectively, said sealing assembly being movable bodily between advanced and retracted positions to bring the seal-positioning and seal-crimping jaws into and out of seal-engaging position respectively, a first piston and cylinder unit carried by said housing and operatively connected to the tensioning assembly, a second piston and cylinder unit carried by said housing and operatively connected to the crimping unit, spring means yielding biasing said second piston and cylinder assembly to maintain said jaws in seal-retaining position, first and second valve assemblies carried by said housing and each including a valve body movable between first and second positions, spring means yieldingly biasing said valve bodies toward their first positions respectively, said first valve assembly being operatively connected to said first and second piston and cylinder assemblies, said valve assemblies being effective when the valve bodies thereof are both in their first positions to supply air to the first piston and cylinder assembly to maintain the tensioning and sealing assemblies in their retracted positions and also to supply air to the second piston and cylinder assembly to maintain said jaws in their open seal-releasing position, said valve assemblies being effective when the valve body of the first valve assembly is in its second position and the valve body of the second valve assembly is in its first position to supply air to the first piston and cylinder assembly to maintain the tensioning and sealing assemblies in their advanced positions, to supply air to the drive motor, and to exhaust air from the second piston and cylinder assembly to maintain said jaws in seal-retaining position under the influence of the biasing spring means associated therewith, said valve assemblies being effective when both valve bodies are in their second positions to supply air to the second piston and cylinder assembly to move said jaws to their fully closed seal-crimping position, and manually operable means for selectively moving said valve assemblies between their first and second positions respectively.

6. In a pneumatically operable strapping tool for tensioning a loop of strapping about an article, said loop having overlapping free end and feed end portions threaded through a seal, and for thereafter crimping the seal

about said overlapping portions, a foot assembly including a foot proper adapted to rest upon the article and having an anvil member adapted to underlie said feed end portion, a tensioning assembly including a rotatable strap-tensioning wheel and a drive motor operatively connected thereto, a seal-crimping sealing assembly including a housing and a crimping unit carried thereby, said crimping unit including seal-retaining and seal-crimping jaws movable from an open seal-releasing position through an intermediate seal-retaining position to a fully closed seal-crimping position and vice versa, a pivot shaft common to said assemblies and on which the assemblies are pivotally mounted for independent swinging movements of the tensioning and sealing assemblies bodily relative to the foot assembly, said tensioning assembly being movable bodily between advanced and retracted positions to bring the tensioning wheel into and out of strap-engaging position respectively, said sealing assembly being movable bodily between advanced and retracted positions to bring the seal-positioning and seal-crimping jaws into and out of seal-engaging position respectively, a first piston and cylinder unit carried by said housing and operatively connected to the tensioning assembly, a second piston and cylinder unit carried by said housing and operatively connected to the crimping unit, spring means yieldingly biasing said second piston and cylinder assembly to maintain said jaws in seal-retaining position, and manually operable valve means effective in a first position to supply air to the first piston and cylinder assembly to maintain the tensioning and sealing assemblies in their retracted positions and also to supply air to the second piston and cylinder assembly to maintain said jaws in their open seal-releasing position, said valve means being effective in a second position to supply air to the first piston and cylinder assembly to maintain the tensioning and sealing assemblies in their advanced positions to supply air to the tensioning wheel and also to the drive motor, as well as to exhaust air from the second piston and cylinder assembly to maintain said jaws in seal-retaining position under the influence of the biasing spring means associated therewith, said valve means being effective in a third position to supply air to the second piston and cylinder assembly to move said jaws to their fully closed seal-crimping position.

7. In a pneumatically operable strapping tool for tensioning a loop of strapping about an article, said loop having overlapping free end and feed end portions threaded through a seal, and for thereafter crimping the seal about said overlapping portions, a frame adapted to rest upon the article, a pivot shaft on said frame, a tensioning assembly including a pneumatic drive motor, a gear housing and a tensioning member secured together and pivotally mounted on said shaft for rocking movement with respect to the frame between advanced strap-tensioning and retracted strap-releasing positions, a sealing assembly including a housing and a crimping unit, including movable seal-crimping jaws, secured together and pivotally mounted on said shaft for rocking movement independent of the rocking movement of the tensioning assembly and with respect to the frame between a retracted position wherein the crimping jaws are out of register with the seal and an advanced position wherein said jaws are in register with the seal, interengaging limit stop means on said frame and tensioning assembly establishing the retracted and advanced positions of the tensioning assembly, interengaging limit stop means on said frame and sealing assembly establishing the retracted and advanced positions of the sealing assembly, said housing being provided with an internal cylinder, a piston slidable in said housing, a plunger connecting said piston to the tensioning assembly, and control valve means for selectively applying air to the opposite ends of the cylinder to actuate said piston and thus simultaneously rock the tensioning and sealing assemblies toward and away from each other between their advanced and their retracted positions respectively.

8. In a pneumatically operable strapping tool for tensioning a loop of strapping about an article, said loop having overlapping free end and feed end portions threaded through a seal, and for thereafter crimping the seal about said overlapping portions, a foot assembly including a foot proper adapted to rest upon the article and having an anvil member adapted to underlie said feed end portion, a pivot shaft on said foot assembly, a tensioning assembly including a pneumatic drive motor, a gear housing and a tensioning feed wheel secured together and pivotally mounted for rocking movement on said shaft toward and away from said foot assembly to bring the feed wheel into and out of strap-engaging position respectively, a sealing assembly including a housing and a crimping unit carried thereby, said crimping unit including seal-crimping jaws movable between open seal-releasing and closed seal-crimping positions, said sealing assembly being pivotally mounted for rocking movement on said shaft independently of the tensioning assembly to move the crimping unit into and out of register with the seal, said housing being provided with an internal cylinder, a piston slidable in said housing, a plunger connecting said piston to the tensioning assembly, and control valve means for selectively applying air to the opposite ends of the cylinder to actuate said piston and thus simultaneously rock the tensioning and sealing assemblies toward and away from each other between their advanced and their retracted positions respectively.

9. In a pneumatically operable strapping tool for tensioning a loop of strapping about an article, said loop having overlapping free end and feed end portions threaded through a seal, and for thereafter crimping the seal about said overlapping portions, in combination, a foot assembly adapted to rest upon the article and including an anvil member, a tensioning assembly pivoted to the foot assembly and including a tensioning member designed for cooperation with said anvil member, and a drive motor for the tensioning wheel, a sealing assembly pivoted to the foot assembly and including a housing and a crimping unit having seal-crimping jaws capable of opening and closing movements about said seal, said tensioning assembly and sealing assembly being independently movable toward and away from pre-selected operating positions with respect to the frame, said housing being formed with first and second internal cylinders therein and with first and second valve chambers therein, a piston in said first cylinder, operatively connected to said tensioning assembly and effective to cause simultaneous movement of the tensioning and sealing assemblies toward and away from their respective operating positions, a piston in the second cylinder and operatively connected to said sealing jaws and effective to actuate the latter, a valve body in each of said valve chambers and movable between first and second operating positions therein, spring means yieldingly biasing said valve bodies to their first positions, said valve bodies being effective when in their first positions to supply air to both cylinders to maintain the tensioning and sealing assemblies away from their operating positions and to maintain said jaws in their open positions, said valve bodies being effective when the valve body of the first valve chamber is in its second position and the valve body of the second valve chamber is in its first position to supply air to the first cylinder to maintain the tensioning and sealing assemblies in their operating positions, and to supply air to said drive motor, said valve bodies being effective when both valve bodies are in their second positions to supply air to the second cylinder to effect closing of said crimping jaws, and manually operable control means for selectively moving said valve bodies from their first positions to their second positions against the yielding action of said spring means.

10. In a pneumatically operable strapping tool, the combination set forth in claim 9, wherein said manually operable control means comprises a valve stem on each of

said valve bodies and projecting outwardly of the housing, a control lever pivoted to one of said assemblies and effective upon an initial depression thereof to effectively engage the valve stem of the valve body of the first valve chamber to the exclusion of the other valve stem, and effective upon a subsequent depression thereof to effectively engage said other valve stem.

11. In a pneumatically operable strapping tool, the combination set forth in claim **10**, wherein said lever is pivoted to the tensioning assembly and is shiftable bodily therewith.

12. In a pneumatically operable strapping tool, the combination set forth in claim **10**, wherein said lever is pivoted to the tensioning assembly and is shiftable bodily therewith, the combination further including a stem-engaging dog carried by said lever, said dog being positioned out of register with the valve stem of the valve body of the second valve chamber when the tensioning assembly is away from its operating position, and being movable bodily with the lever and tensioning assembly into such register when the tensioning assembly is in its operating position.

13. In a pneumatically operable strapping tool, the combination set forth in claim **12**, wherein said stem-engaging dog is pivoted to the lever, is spring-biased to a terminal position, and is slidingly engageable with the valve stem of the valve body of the second valve chamber during movement of the tensioning assembly toward its operating position to prevent binding of the dog against said latter valve stem.

14. In a pneumatically operable strapping tool, the combination set forth in claim **12** and including, additionally, a secondary lever pivoted to the housing and having a portion thereof in register and engageable with the valve stem of the valve body of the first valve chamber, said secondary lever being engageable by the control lever upon initial depression of the latter and constituting the media whereby the control lever is effectively engageable with said latter valve body.

15. In a pneumatically operable strapping tool, the combination set forth in claim **12**, wherein said stem-engaging dog is pivoted to the lever, is spring-biased to a terminal position, and is slidingly engageable with the valve stem of the valve body of the second valve chamber during movement of the tensioning assembly toward its operating position to prevent binding of the dog against said latter valve stem, and including, additionally, a secondary lever pivoted to the housing and having a portion thereof in register and engageable with the valve stem of the valve body of the first valve chamber, said secondary lever being engageable by the control lever upon initial depression of the control lever and constituting the media whereby the control lever is effectively engageable with said latter valve body.

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