United States Patent

Langas et al.

[15] **3,641,656**

[45] **Feb. 15, 1972**

[54] CLIP APPLYING AND CLINCHING TOOLS

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[22] Filed: **Oct. 21, 1969**

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[52] **U.S. Cl.** **29/243.57**

[51] **Int. Cl.** **B23p 11/00**

[58] **Field of Search** 227/130; 29/243.56, 243.57

[56] **References Cited**

UNITED STATES PATENTS

2,969,545	1/1961	Allen	29/243.56 X
3,237,290	3/1966	Frank	29/243.57
3,526,944	9/1970	Cherup	29/243.57 X

FOREIGN PATENTS OR APPLICATIONS

481,926	3/1952	Canada	29/243.57

Primary Examiner—Andrew R. Juhasz

Assistant Examiner—Leon Gilden

[57] **ABSTRACT**

A portable, pneumatically operable, magazine-fed, trigger-actuated, clip-applying tool for clinching open-ended clips around adjacent wire members and having a fixed anvil jaw and a cooperating movable jaw which is actuated by a novel toggle linkage under the control of a reciprocable piston and cylinder arrangement. The direction of toggle thrust is at a right angle to the direction of jaw movement, thereby eliminating the necessity for employing bellcrank or wedge toggle actuators and the toggle linkage is such that it effects quick travel of the movable jaw for rapid clip feed, terminating in high-pressure application to the clip for final effective clinching purposes. An open-trough, clip-containing magazine feeds the clips directly to the jaw structure, thereby eliminating the usual clip transfer mechanism which places the clips in an intermediate position before they are engaged by the clinching jaws. The magazine further cooperates with the movable clinching jaw in such a manner that a positive shearing of the clips from the remaining ribbon-connected clips in the magazine takes place without the creation of ribbon fragments and consequent jaw clogging. The magazine is curved on a long radius so that the usual clip follower employed thereby tends to keep the string of clips firmly seated in the magazine trough. Convenient tool balance in the hand of the operator is a further novel feature of the tool.

11 Claims, 16 Drawing Figures

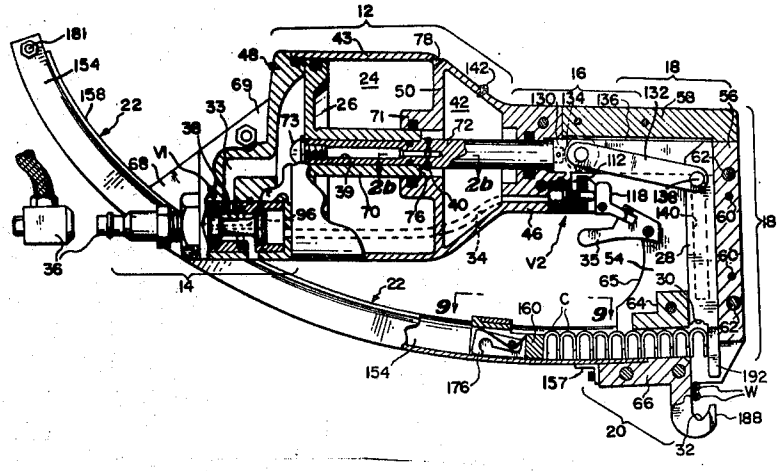
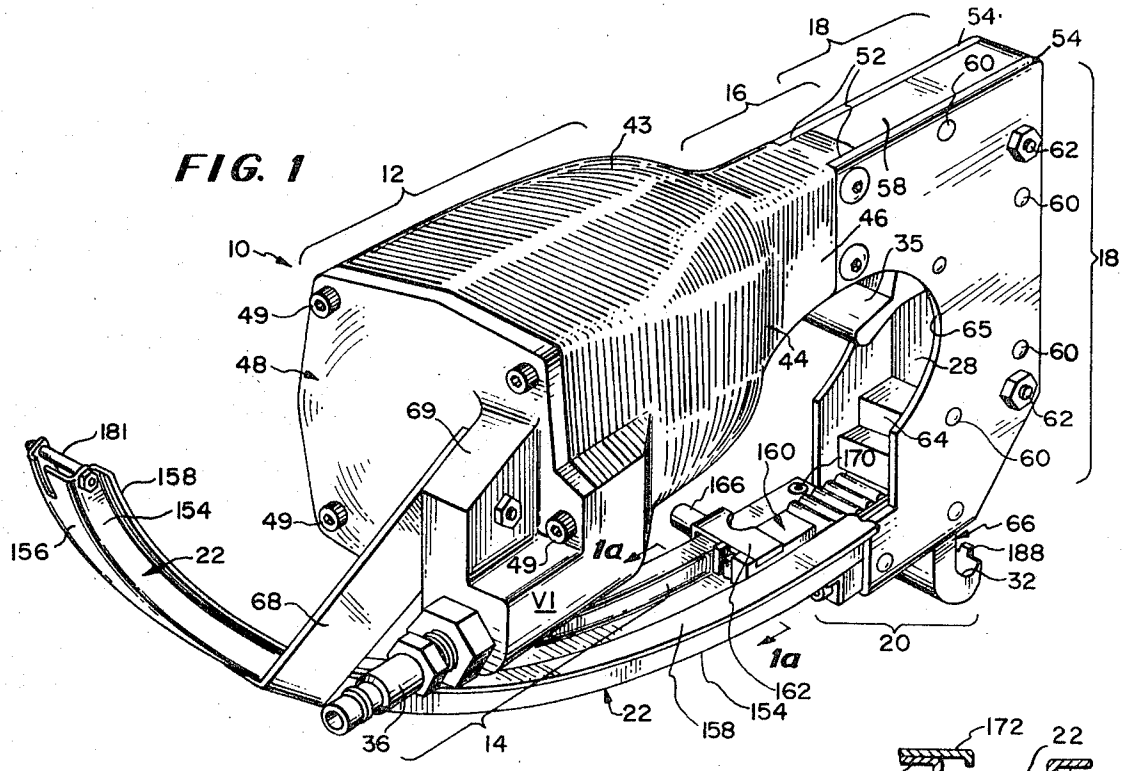


FIG. 1



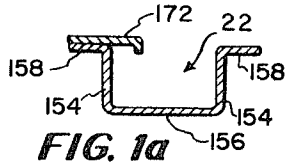


FIG. 1a

FIG. 2

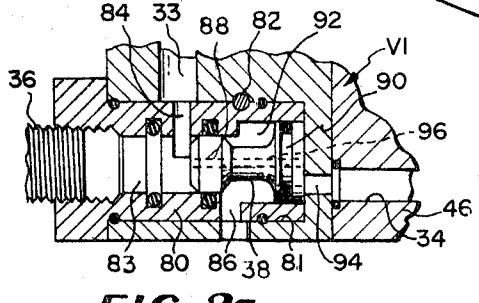


FIG. 2a

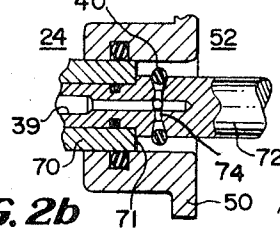


FIG. 2b

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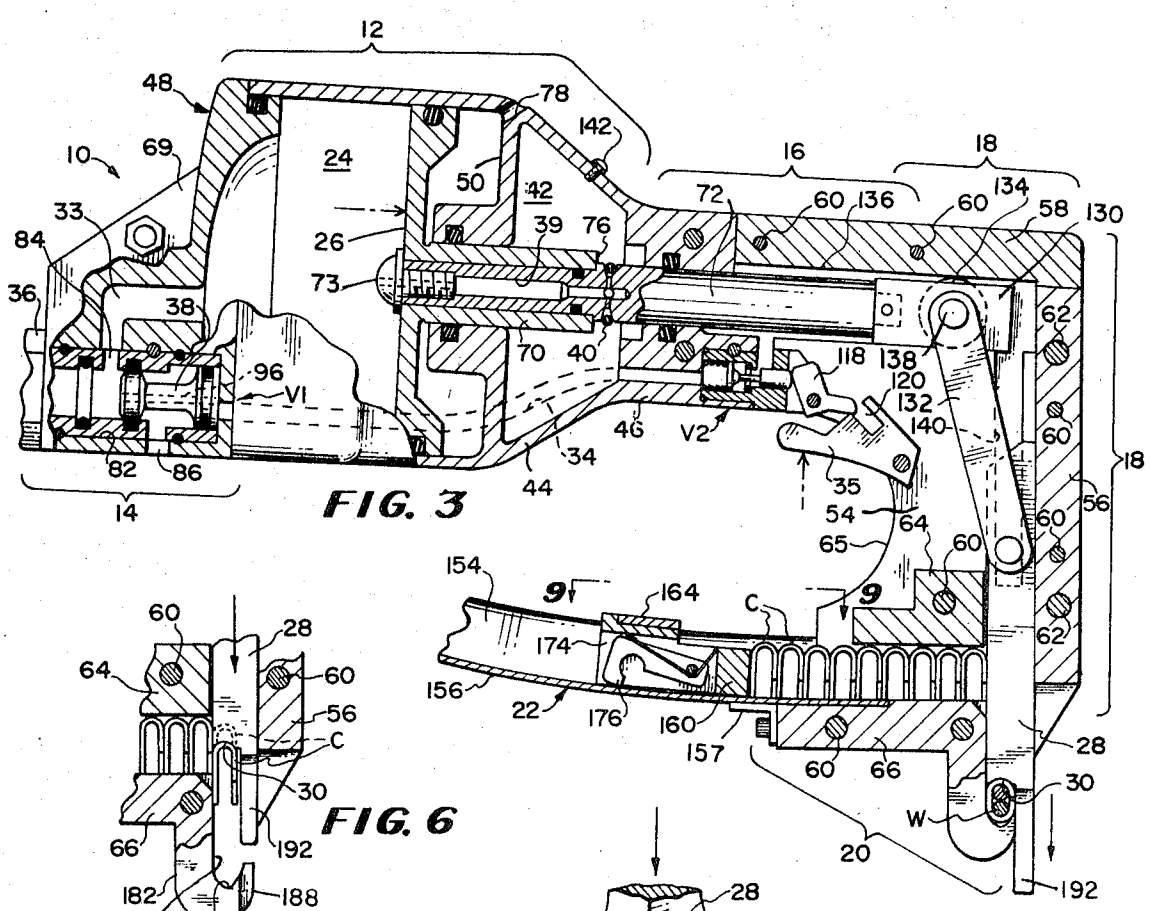

FIG. 3

FIG. 6

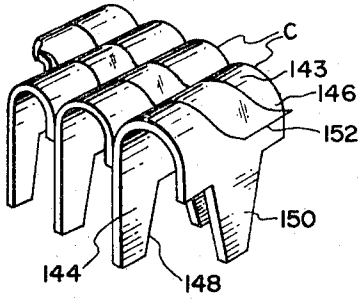

FIG. 4

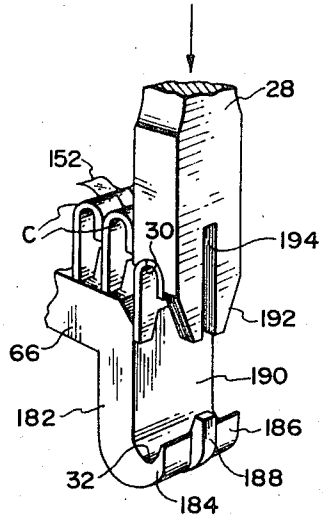

FIG. 7

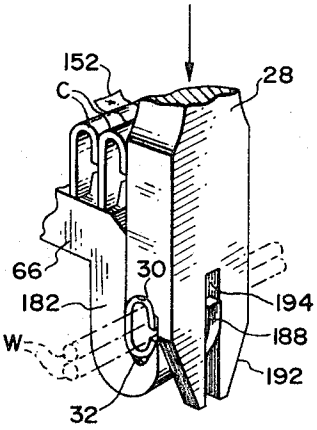

FIG. 8

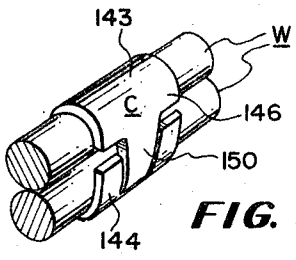

FIG. 5

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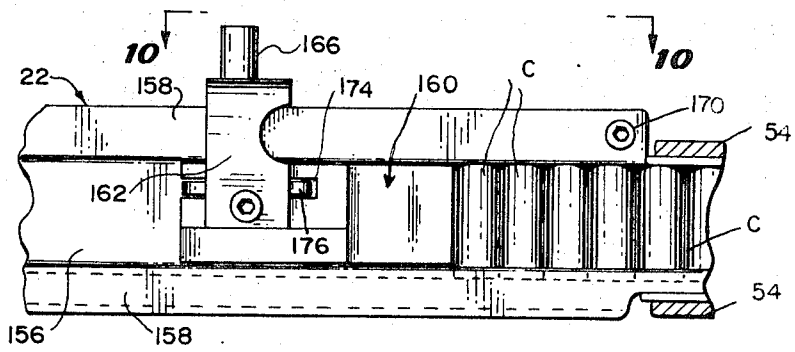


FIG. 9

FIG. 10

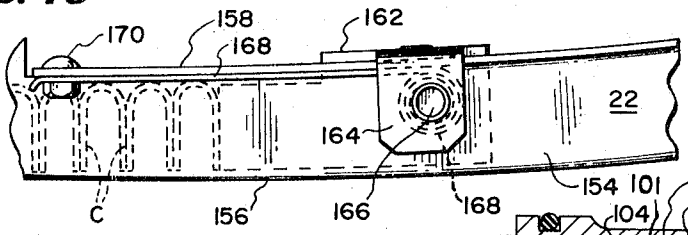
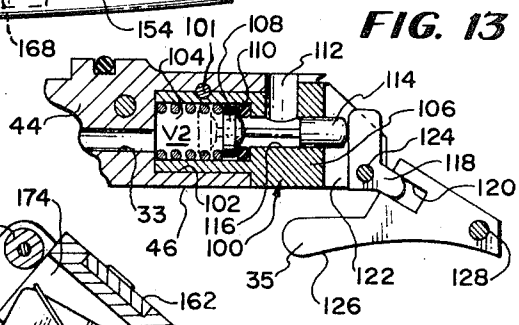


FIG. 13



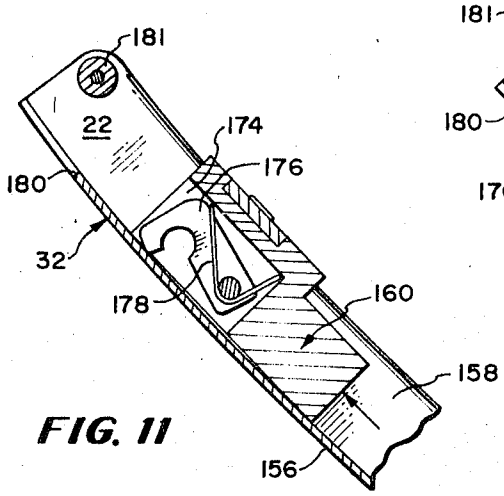


FIG. 11

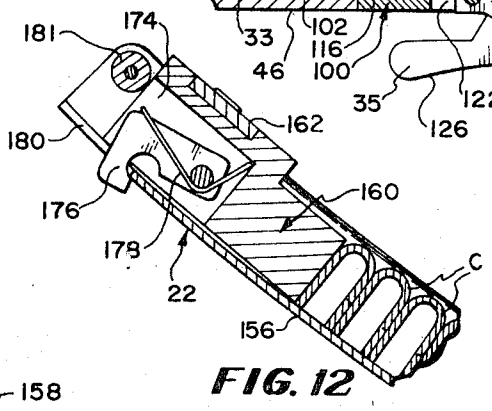


FIG. 12

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CLIP APPLYING AND CLINCHING TOOLS

The improved clip applying and clinching tool comprising the present invention has been designed specifically for use in connection with the application of open U-shaped sheet metal clips to two or more wire members, as for example, in the joining of seat or bedsprings to their associated frame members. The invention is, however, capable of other uses and a tool embodying the principles of the present invention may, if desired, with or without modification as required, be employed for clinching U-shaped clips about a wide variety of adjacent wires, rods or other similar members which are to be joined together. Irrespective however of the particular use to which the invention may be put, the essential features thereof are at all times preserved.

Specifically, the invention is concerned with a portable, manually operable, magazine-fed, pneumatic tool of the general type wherein a series of open-ended, ribbon-connected sheet metal clips are successively and singly withdrawn from a magazine containing such clips and positioned individually about the wires or other members to be joined together, after which the thus-positioned clip is operated upon by a pair of cooperating jaw members in such a manner as to wrap the clip about such wires and, by a clinching operation, securely tighten the clip against the wires in binding relationship.

Conventional clip applying and clinching tools designed for the same purpose as the tool of the present invention are possessed of certain limitations, principal among which is the difficulty which is associated with transfer of the individual clips from the magazine to the clip-clinching jaw structure. Heretofore it has been considered necessary to utilize a clip-transfer mechanism which engages the leading clip in the magazine and shifts the same from the magazine to an intermediate position in the vicinity of the clinching dies or jaws, after which these latter jaws are caused to engage the clip and clinch the same. A wide variety of such transfer mechanisms are currently employed as constituent parts of present day clinching tools, some of them requiring individual manipulation and others being automatically effective once the tool cycle has been initiated. In either event, the use of such magazine-ejecting and clip-feeding mechanisms materially increases the cost of the tools, as well as entailing relatively complicated moving instrumentalities which constitute a potential source of trouble insofar as the possibility of tool jamming, arising from improper ejection of clips from the magazine or improper positioning of the clips at the clinching region of the tool for subsequent treatment by the clinching jaws or dies, is concerned. Extremely close tolerances must be maintained both in the manufacture of the parts and in the permanent fastening of such parts in their relative positions if cumulative errors in clip handling are to be avoided so that the clips move squarely into their intermediate positions and thereafter move squarely into forming register and cooperation with the clinching dies to effect uniform clinching operations.

The present invention overcomes the above-noted limitation by providing a tool in which the clip-containing magazine is so disposed with respect to the clip-clinching jaws that the leading clip in the magazine is predisposed in the clip-clinching area of the tool, properly oriented for immediate engagement by at least one of the clip-clinching jaws as soon as these jaws are set into operation for clinching purposes. As soon as the jaws have effected their clinching operation upon a given clip and have been restored to their retracted clip-releasing position, the next succeeding clip in the magazine automatically moves into such predisposed and properly oriented position preparatory to effecting the next succeeding cycle of tool operation. By such an arrangement, costly and unreliable clip transfer mechanism is obviated. A further and obvious advantage arising from such direct application of the clips to the clinching area, i.e., the jaw structure of the tool, resides in the fact that with the elimination of intermediate clip transfer instrumentalities, tool size and weight are decreased, thus contributing to compactness of tool design.

Another limitation that is attendant upon the construction and use of conventional clip-clinching tools, particularly pneumatically operable tools, arises from the fact that invariably it has been considered necessary to cause the longitudinal axis of the clip-containing magazine to project laterally in one direction or another from the axis of the piston and cylinder assembly ordinarily associated with such tools for powering the clinching jaws, and sometimes additionally the aforementioned clip transfer mechanism consumes additional lateral space. Since the cylinder casing of such tools ordinarily constitutes the handle portion of the tool by means of which the latter is manipulated or guided for clip application, a fairly wide operating area or space is required for tool manipulation and, frequently, it is difficult to guide the tool in close operating quarters. The present invention also obviates this latter limitation in that it contemplates a novel tool casing design wherein not only is the clip transfer mechanism eliminated but the clip magazine lies in close proximity to the axis of the piston and cylinder assembly and extends in the same general direction so that it does not offer lateral interference with a wide range of tool movements, either in approaching the work to be done or in retreating therefrom. The specific tool casing design of the present invention, in addition to permitting greater freedom of tool movement as set forth above, further enhances the portability of the tool during operation thereof in that it establishes a novel arrangement and disposition of the essential tool instrumentalities which are common to all such tools which are designed for the same purpose and in which, when the tool is supported from the hand of the operator, possesses a degree of stable equilibrium wherein the jaw structure assumes a convenient disposition with respect to a pair of horizontally positioned contiguous wires to be joined so that little or no manual effort on the part of the operator is required to initially align or bring the jaw structure of the tool into operative forming register with such wires. The present tool is thus distinguished from conventional tools in which an initial application of torque by the wrist of the operator is required either to raise or lower the forming jaws into forming register with the members to be joined.

A further and important feature of the present invention resides in the provision of a novel means for translating the power stroke of the piston into jaw-closing movements by means of which the clips are clinched about the wires to be joined. Such means embodies a piston-instituted toggle action which differs from conventional toggle actions employed by certain clinching tools in that the effective toggle thrust is at a relatively step angle with respect to the axis of piston thrust, such an arrangement affording a number of advantages which are not present in connection with piston-activated toggle actions wherein the direction of piston travel is the same as the direction of toggle thrust. Specifically, one such advantage, as incorporated in the present clip-clinching tool, resides in the absorption of the reaction thrust offered by the toggle mechanism and which reaches large proportion near the end of the toggle link movement by the camming action of a stationary surface on the tool casing. Since this reaction thrust is at a steep angle to the piston rod which constitutes the motivating member for the toggle action, and which, at the time of terminal toggle action is substantially fully extended from the piston cylinder, toggle forces which otherwise would bend or rupture the piston rod are assimilated by the tool casing. Another advantage of such angular transmission of power from the piston to the clip-clinching jaw structure resides in the elimination of the necessity for employing a bellcrank mechanism to guide the power input joint of the toggle links which invariably is required when unidirectional toggle input and output motions are employed. A further advantage of such angular power transmission results in a shortening of overall tool length, and also of tool width since, obviously unidirectional transmission of power by a toggle joint from a reciprocable piston to a movable toggle output member entails additive linear space factors, one for piston travel and another for toggle link spreading. Reduction in tool casing

width is a result of the elimination of the offset bellcrank which is necessary to insure linear continuity of piston thrust to the movable jaw element. Finally, the angular transmission of power from the piston to the jaw structure, as embodied in the present tool, makes possible the attainment of the aforementioned tool balance by a compact and convenient disposition of the various tool parts or instrumentalities, all in a manner that will be described in detail subsequently.

An additional novel feature of the present invention resides in the specific construction of the clip-containing magazine by means of which successive clips are fed to the clinching jaw structure. Apart from the closely nested disposition of the magazine with respect to the tool casing which has previously been discussed, the magazine affords functional advantages not present in connection with elongated linearly straight magazines. According to the present invention, the clip-containing magazine is of open troughlike design and is curved on a long radius, the magazine having associated therewith the usual spring-biased clip follower which yieldingly urges the clips in the magazine forwardly toward the clip-clinching jaw structure. By such an arrangement, the entire string or group of clips which are nested within the magazine are caused to seat squarely on the trough bottom against upward displacement under the influence of tool vibration or shock, as well as preventing falling of the clips from the magazine in the event that the tool becomes inverted, either during periods of use or idle time.

The provision of a clip-clinching tool which is relatively simple in its construction and which therefore may be manufactured at a low cost; 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 is capable of ease of assembly and disassembly for purposes of inspection of parts, replacement or repair thereof; one which is smooth and comparatively silent in its operation; 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.

The provision of a clip-clinching tool such as has briefly been described above and possessing the stated advantages constitutes the principal object of the present invention. Numerous other objects and advantages, not at this time enumerated, will readily suggest themselves as the nature of the invention is better understood.

In the accompanying three sheets of drawings forming a part of this specification, one exemplary form of the invention has been shown.

In these drawings:

FIG. **1** is a rear perspective view of a clip applying and clinching tool embodying the present invention;

FIG. **1***a* is an enlarged sectional view taken substantially on the line **1***a*—**1***a* of FIG. **1**;

FIG. **2** is a side elevational view, largely in longitudinal section, showing the tool operatively positioned with respect to a pair of wires to be joined, preparatory to effecting the clip applying and clinching operations;

FIG. **2***a* is an enlarged fragmentary sectional view taken substantially longitudinally and centrally through an air admission valve employed in connection with the invention;

FIG. **2***b* is an enlarged sectional view taken substantially along the line **2***b* —**2***b* of FIG. **2**;

FIG. **3** is a sectional view, similar to FIG. **2**, showing the tool with the parts thereof in the positions which they assume at the completion of the clip-clinching operation and prior to release of the applied clip;

FIG. **4** is an enlarged perspective view of a string of ribbon-connected clips of the type used in connection with the clip-applying tool of the present invention;

FIG. **5** is a perspective view showing one of the clips of FIG. **4** operatively applied to and crimped about a pair of contiguous wires;

FIG. **6** is an enlarged fragmentary detail sectional view of a portion of the tool, the view being taken in the vicinity of the anvil region of the tool, and the driver or plunger being shown immediately after it has stripped a clip from the magazine-enclosed string of clips;

FIG. **7** is a fragmentary perspective view of the structure shown in FIG. **6**;

FIG. **8** is a perspective view similar to FIG. **7**, showing the driver or plunger in its fully advanced clip-clinching position;

FIG. **9** is an enlarged fragmentary sectional view taken substantially along the line **9**—**9** of FIG. **2**;

FIG. **10** is a fragmentary side elevational view of the structure shown in FIG. **9**, the view looking in the direction and within the confines of the arrows **10**—**10** of FIG. **9**;

FIG. **11** is an enlarged fragmentary sectional view taken longitudinally through the extreme rear region of the clip magazine and illustrating the nature of a clip follower latch mechanism employed in connection with the invention;

FIG. **12** is a sectional view similar to FIG. **11**, showing the latch mechanism in its latched condition; and

FIG. **13** is an enlarged fragmentary sectional view taken substantially centrally and longitudinally through a trigger-actuated bleeder valve employed in connection with the invention.

BRIEF DESCRIPTION

Referring now to the drawings in detail and in particular to FIGS. **1** to **3** inclusive, a portable clip applying and clinching tool constructed according to the present invention has been designated in its entirety at **10** and involves in its general organization a composite tool casing which, for purposes of description herein, is stated to be comprised of a cylinder section **12**, a valve section **14**, a handle section **16**, a power transmission section **18**, and an anvil section **20**. A clip magazine **22** which is adapted to contain an elongated string of wire-fastening clips C communicates at its forward end with the anvil section **18** in a manner and for a purpose that will be made clear presently.

The center of gravity of the tool **10** lies a slight distance below the handle section **16** so that when this section is grasped by the operator of the tool, a condition of balance obtains wherein the tool has a stable degree of equilibrium and tends to remain in the position in which it is shown in FIGS. **1** to **3** inclusive and with the handle section **16** and the longitudinal axis of the cylinder section **12** extending substantially horizontally. The clip magazine **22** is of overall arcuate configuration on a relatively long radius of curvature, its disposition with respect to the tool body being such that when the tool is manually supported in its balanced condition as set forth above, the magazine projects rearwardly and horizontally from the anvil section **20**, extends beneath the handle section **16** and cylinder section **12**, curves gradually upwardly alongside the valve section **14** as clearly shown in FIGS. **1** and **2**, intersects the longitudinal axis of the cylinder section **12**, and terminates at a point which lies a short distance rearwardly of the tool proper and at the uppermost level thereof. In this manually supported balanced condition of the tool, and because the center of gravity of the tool is only slightly below the handle section **16**, the pendulum effect is slight and thus the operator may readily swing or tilt the tool either forwardly or rearwardly, as well as sidewise in either direction if required, in order to align or otherwise bring the anvil section **20** into proper register with two or more wires, rods or other members which are to be secured by the application of one of the clips C thereto. This matter of tool balance when the tool is supported from the handle section **16** constitutes one of the principal features of the present invention.

For convenience and clarity of description, in the remaining portion of this specification and in the appended claims, normal tool orientation will be considered to correspond to the balanced condition of the tool wherein the longitudinal axis of the cylinder section **12** and handle section **16** extends horizontally, although it will be understood that the tool may be ap-

plied to the elements to be joined together in any desired position, even when the handle section **16** extends vertically if necessary, or when this section is inverted from its normal horizontal position.

Briefly, the cylinder section **12** includes a cylinder proper **24** having a reciprocable piston **26** therein which is operatively connected through the handle section **16** to a vertically movable clip-forming driver or plunger **28** disposed within the power transmission section **18**. The arrangement is such that forward horizontal movement of the piston effects downward movement of the plunger **28**. The lower end of the plunger is provided with a movable clip-engaging jaw **30** designed for cooperation with a lower vertically aligned fixed clip-engaging anvil jaw **32** associated with the anvil section **20**, the two jaws, when closed upon a clip C, serving to clinch the latter about the wires W or other elements which are to be joined together. Upon initial descent of the plunger **28** within the toggle link section **18**, the leading clip C is stripped from the string of clips within the magazine **22** and is carried downwardly toward the fixed lower jaw **32**, after which the two jaws **30** and **32** effect the clip-clinching operation, all in a manner that will be described in greater detail subsequently.

The valve section **14** includes an air admission valve V1 which communicates through a passage **33** with the rear end of the cylinder **24**, and also through a passage **34** with a trigger-actuated bleeder valve V2 having a manually operable trigger **35** associated therewith, the valve V2 and trigger **35** being disposed in the handle section **16** of the tool. Air under pressure is applied to the tool through a conventional quick-release fitting **36** which communicates with the valve V1. This latter valve is provided with a movable valve element **38** which normally assumes a position wherein pressurized air is precluded from entering the cylinder **24**, the valve element **38** being normally subjected to equal air pressure on opposite sides thereof. Upon actuation of the bleeder valve V2, air pressure on one side of the valve element **38** of the valve V1 is relieved so that this element shifts its position in such a manner as to admit air to the rear end of the cylinder **24** through the passage **33**, thus driving the piston **26** forwardly so as to effect the power stroke of the plunger **28** and its associated movable jaw **30** for clip-engaging and clinching purposes. A narrow bleeder passage **39** extends through the piston **26** and has a check valve **40** associated therewith, the bleeder passage communicating in all positions of the piston with a variable volume air chamber or reservoir **42** forwardly of the cylinder **24**. Air entrapped in the air reservoir acts on a limited area of the piston and alternately contracts and expands according to the reciprocation of the piston, expansion of such air serving to restore the piston to its retracted position after each clip-clinching operation and after the trigger **35** has been released and the valve V2 has been restored to its normal condition. Restoration of the piston **26** to its retracted position serves to return all of the movable tool elements and instrumentalities to their original or normal positions, thus separating the jaws **30** and **32** and releasing the clinched clip C.

THE TOOL CASING

As previously set forth, the tool casing embodies the aforementioned cylinder section **12**, valve section **14**, handle section **16**, power transmission section **18** and anvil section **20**. The cylinder section **12** and a limited portion of the handle section **16** is established by the provision of a tubular casting in the form of a shell **43** which is generally of rectangular external configuration throughout its longitudinal extent as shown in FIG. **1** and which tapers forwardly as shown at **44** and terminates in a thickened neck portion **46** which projects into the handle section **16** of the casing. The open rear end of the shell is closed by means of closure head **48** which is secured in position by means of screws **49** and which likewise is preferably in the form of a casting. A partition wall **50** extends tranversely across the shell **43** and divides the interior of the shell into a rear cylindrical chamber which constitutes the aforementioned cylinder **24**, and a forward frustoconical chamber which constitutes the aforementioned air reservoir or expansion chamber **42**. This latter chamber is adapted to contain a quantity of pressurized air which is continuously effective against the piston **26** for piston return purposes, all in a manner that will be described in detail subsequently. The closure head **48** establishes the valve section **14** of the tool, the valve V1 being embodied in this section in a manner and for a purpose that also will be set forth subsequently.

The forward end of the neck portion **46** is provided with a pair of oppositely disposed flat relief areas **52** (FIG. **1**) to which there are bolted a pair of spaced-apart sideplates **54** of irregular outline and which, in combination with a backplate **56** and a top plate **58**, establish the power transmission section **18**. Locating pins **60** project through the various plates **54**, **56** and **58** while through-bolt assemblies **62** hold the plates together. An L-shaped guide block **64** for the plunger **28** is interposed between the sideplates **54** in the bottom regions thereof and is held in position by additional locating pins **60**. This guide block in addition to performing its guiding function, also reinforces or rigidifies the tool casing in the transmission section **18** thereof. Arcuate relief or clearance areas **65** are provided in the rear edges of the sideplates **54** to expose the trigger **35** and facilitate trigger actuation when the tool is manually supported. The anvil section **20** of the tool is established by the provision of a generally L-shaped blocklike anvil member **66** to which the forward end of the magazine **22** is secured, the member cooperating with the guide block **64** to provide an entrance throat for passage of the clips C to the jaw structure of the tool for successive cooperation with the jaws **30** and **32** in a manner that will be set forth in detail when the operation of the jaw structure is set forth. The anvil member **66** is held in position between the sideplate **54** by locating pins **60**. A tool casing adjunct in the form of a strap **68** is attached at one end to the rear region of the clip magazine **22** and at its other end to a rearwardly projecting web **69** provided on the closure head **48**.

THE PISTON AND CYLINDER ASSEMBLY

As previously stated, the cylinder proper **24** and the air return or expansion chamber **42** are disposed within the casting shell **43** and are separated by the partition wall **50**. The piston **26** is of circular configuration, is slidingly sealed to the wall of the cylinder **24**, and is provided with a forwardly extending tubular stem **70** which projects through a tubular boss **71** provided centrally on the partition wall **50** and is slidingly sealed thereto. The piston **26** is further provided with a piston rod **72** which has its rear end region projecting into the stem **70** and its forward end region projecting into and through the thickened neck portion **46** of the shell **43** and is slidably sealed therein. A fastening screw **73** holds the piston rod **72** in position within the stem **70**. The aforementioned bleeder passage **39** extends longitudinally through the piston rod **72** and fastening screw **73** and communicates with the interior of the cylinder **24** at its rear end and with the air expansion chamber **42** through a series of four radial passages **74** (FIG. **2***b*) which normally are closed by a resilient elastomeric O-ring which surrounds the piston rod **72** and constitutes the aforementioned check valve **40**. The O-ring functions to close the passages **74** when air pressure in the expansion chamber **42** exceeds the air pressure in the cylinder **24**, and to permit air to flow through these passages when the air pressure in the cylinder **24** exceeds that in the expansion chamber **52**. Thus, when air at full line pressure is admitted to the cylinder **24** through the passage **33** by the valve V1 due to bleeding of the passage **34** by actuation of the bleeder valve V2, the piston will be driven forwardly until it reaches the end of its power stroke as shown in FIG. **3**, after which air will bleed through the passage **39** in the piston and thus pressurize the chamber **42** to such an extent that when the bleeding effect of the valve V2 is terminated by release of the trigger **35** and the valve V1 is restored to its normal position, the air pressure developed in

the chamber 42 will act on the narrow annulus 76 established by the extreme forward rim of the tubular piston stem 70 and restore the piston to its retracted position as shown in FIG. 2. An air vent 78 in the forward region of the cylinder 24 allows escape of air during the pressure stroke of the piston 26, as well as admitting air to the cylinder during the return stroke.

PNEUMATIC CONTROL MECHANISM

The pneumatic control mechanism for actuating the piston 26 embodies the aforementioned air admission valve V1, the bleeder valve V2, and the trigger 35.

(The Air Admission Valve)

The air admission valve V1 is best illustrated in FIGS. 2, 2*a* and 3 and includes a fixed valve casing 80 disposed in a socket 81 formed in the closure head 48 and held therein by a roll pin 82 (FIG. 2*a*). The valve casing 80 is provided with an inlet port 83 which communicates with the quick-release fitting 36, a second port 84 which communicates with the passage 33 leading to the cylinder 24, and a third port 86 communicating with the atmosphere. The valve element 38, in the illustrated form of the invention, is a free-floating element although it is within the purview of the invention to spring bias the same in a rearward direction. This element is of spoollike design and has a first spool flange 88 which is movable bodily with the element between the retracted position shown in FIG. 2 wherein air is prevented from passing from the quick-release fitting 36 to the passage 33, and the advanced position shown in FIG. 3 wherein the fitting and passage are in communication with each other. The valve element 38 is provided with a second piston flange 90 which is slidable in a chamber 92 having communication through a passage 94 with the bleeder passage 34, the latter passage being formed in the wall of the shell 43 and also projecting through the reduced neck portion 46 in the handle section 16 of the tool. A narrow bleeder passage 96 extends axially through the spoollike valve element 38 for the purpose of normally equalizing the pressure on opposite sides of the element, in which case the greater area of the piston flange 90 as compared to the area of the spool flange 88 will maintain the valve element in its rearward retracted position. At such time as the pressure of air on the forward side of the valve element 38 is relieved incident to manipulation of the bleeder valve V2, the valve element 38 will move to its advanced position, thus uncovering the passage 33 and allowing air at line pressure to be conducted to the rear end of the cylinder 24 to initiate the power stroke of the piston 26.

(The Bleeder Valve)

The trigger-actuated bleeder valve V2 is shown in detail in FIG. 13 and it includes a valve casing 100 which is sealingly secured by a roll pin 101 in a socket 102 provided in the forward end face of the reduced neck portion 46 of the cylinder shell 43. The valve casing 100 is generally of cup-shape configuration and defines an internal valve chamber 104 having a relatively thick front wall 106 and within which there is disposed a reciprocable valve element 108 designed for sealing engagement with an O-ring 110 which bears against the front wall 106. The forward end of the valve chamber 104 communicates through an L-shaped passage 112 with the atmosphere in the vicinity of the handle section 16 of the tool. The valve element 108 is provided with a stem 114 which is guided in a bore 116 formed in the valve body 100, the forward end of the stem being engageable with one leg of an actuator 118 in the form of a bellcrank, the other leg of the actuator projecting into a slot 120 provided in the trigger 35. The forward end of the valve casing 100 is bifurcated as indicated at 122 for reception of the trigger actuator 118, the latter being pivoted on a pin 124. The trigger 35 has a fingerpiece 126 (FIGS. 1, 2 and 3) pivoted on a pin 128 which extends between the sideplates 54 of the power transmission section 18, the fingerpiece projecting forwardly of the clearance areas 65 of these sideplates where it is conveniently accessible for manipulation when the tool is supported by the handle section 16.

From the above description it will be apparent that when the trigger 35 is depressed the consequent rearward movement of the valve element 108 will lift the same from its seating engagement with the O-ring 110 (FIG. 13) so that air which is disposed in the bleeder passage 34 will be bled through the valve V2 and its associated passage 112 to the atmosphere, thus relieving the pressure on the forward side of the piston flange 90 of the valve element 38 of the air admission valve V1 and shifting the spool flange 88 of the valve body 38 to its forward position under the influence of live air issuing from the quick-release fitting 36 and allowing such air to be admitted to the rear end of the cylinder 24 to effect the power stroke of the piston 26. After the power stroke of the piston 26 and prior to the time that the trigger 35 is released, live air is bled through the passage 39 in the piston rod 72 past the O-ring check valve 40 and fills the air return expansion chamber 42 for piston return purposes in the manner previously set forth.

THE POWER TRANSMISSION TOGGLE MECHANISM

Forward motion of the piston 26 and its associated piston rod 72 is translated into downward movement of the jaw-carrying driver or plunger 28 by means of a toggle mechanism of the elbow joint type and which is disposed between the two sideplates 54, this toggle mechanism being disposed partly in the transmission section 18 of the tool and partly in the handle section 16 thereof. As clearly shown in FIGS. 2 and 3, the forward end of the piston rod 72 is pivotally connected by a bifurcated yoke and pin connection 130 to the rear end of a composite dual toggle link 132, which constitutes the driving link of the elbow joint, the pin carrying a roller 134 which travels in a shallow guideway 136 formed in the top plate 58. The forward end of the link 132 is pivoted by a pin 138 to the upper end of the plunger or slide member 28 which constitutes the driver link of the elbow joint. The opposite ends of the pin 138 travel in vertical grooves 140 which are formed in the sideplates 54. The lower end of the plunger 28 projects between the guide block 64 and backplate 56 so that the plunger is at all times constrained to maintain its vertical position within the confines of the sideplates 54 and backplate 56. The width of the grooves 140 is slightly greater than the diameter of the pivot pin and the disposition of the grooves is such that during the forward movement of the piston 26, the toggle link 132 is maintained under compression and the upper region of the forward edge of the plunger 28 makes frictional engagement with the rear face of the backplate 56. During the return stroke of the piston under the influence of the air which is entrapped within the expansion chamber 42, the link 132 is maintained under tension and, at this time, the ends of the pivot pin 138 ride against the rear sides of the grooves 140 and prevent the plunger 28 from pulling away appreciably from the backplate 56.

It is to be noted at this point that the normal position of the plunger is the raised position in which it is shown in FIG. 2, such position being a positive one wherein an appreciable amount of tension is retained in the toggle link 132 under the influence of the air pressure which is maintained within the expansion chamber 42. This air pressure is for all intents and purposes permanently maintained in the expansion chamber 42 by reason of the efficient sealing action of the elastomeric O-ring seals between the piston stem and the boss 71 and between the piston rod 72 and the neck portion 46. With a new tool, or with a tool that has remained idle for a long period of time, the initial on-rush of live air at full line pressure into the rear end of the cylinder 24 commences immediately to flow forwardly through the passage 39 in the piston rod 72 and past the O-ring check valve 40 (FIG. 2*b*) into the expansion chamber 42 for piston return purposes. During the time which elapses from the time the piston reaches the forward end of its stroke until the operator has released the trigger 35,

an adequate supply of pressurized air will be introduced into the chamber **42** for piston return purposes. If this air does not reach full line pressure during the first application of a clip C, the next succeeding operation of the tool will supply additional air to the chamber **42** and, more often than not, the second use of the tool in applying a clip will suffice to bring the pressure of air in the chamber **42** to substantial full-rated line pressure. Thereafter, this accumulated or stored air will serve for piston return purposes substantially indefinitely, even after a prolonged period of shelf life of the tool, measured in weeks, for example. Even in an instance where the sealing means which exists between the piston rod **72** and the neck portion **46** of the cylinder shell has become worn due to continued use of the tool, a small amount of leakage of air from the expansion chamber **42** past the piston rod may be tolerated inasmuch as each admission of air to the cylinder **24** for piston driving purposes will serve to replenish any air which may have escaped during a preceding cycle of tool operation.

THE MAGAZINE AND CLIPS THEREFOR

The details of the clip magazine **22** are best illustrated in FIGS. **1** to **3** inclusive and **9** to **12** inclusive, while the nature of the clips which are capable of being loaded into the magazine is shown in FIGS. **4** and **5**.

(The Magazine Contained Clips)

The individual clips C disclosed herein for exemplary purposes are purely conventional and no claim is made herein to any novelty associated with the same. Briefly, each clip C formed from a flat blank of sheet metal which has been bent to U-shape form so as to provide a semicylindrical crown portion **143** (FIG. **4**) with substantially planar depending legs **144** and **146**. When a given clip is disposed in the magazine **22**, the planes of the legs **144** and **146** extend transversely of the magazine so that the leg **146** may be considered to be the forward or leading leg while the leg **144** constitutes the rear or trailing leg with respect to the direction of motion of the clip as it is fed forwardly toward the jaw structure of the tool. The rear leg **144** is formed with a central generally V-shaped recess **148** therein, while the front leg is formed with a conformably shaped tongue **150**. When the clip is clinched about a pair of wires such as have been designated at W in FIG. **5**, a wrapping operation takes place wherein the crown portion **142** of the clip seats on the upper wire, while the leg **144** becomes wrapped about the lower wire, and the recess **148** therein partially or fully receives therein the tongue **150** of the leg **146**, the latter becoming partially wrapped about such lower wire. Depending upon the approach angle of the tool when applied to the wires W, the circumferential disposition of the clinched or wrapped clip C around the wires may become shifted in one direction or the other from the precise illustrated position of FIG. **5**.

The magazine-loaded clips C, collectively, are connected together in substantially contiguous side-by-side relationship by means of an elongated ribbon **152** which may be in the form of a length of pressure-sensitized tape or which may otherwise be adhered to the crown portions **142** so as to produce an elongated "string" of the clips. The specific nature of the interconnected string of clips and the manner in which the string is formed constitutes the subject matter of our copending application, Ser. No. 854,037, filed Aug. 29, 1969, now U.S. Pat. No. 3,613,878 entitled "U-CLIP ASSEMBLY," and reference may be had to such application for a full understanding of several forms of interconnected clips which are capable of being used in the magazine **22** of the present tool.

(The Clip Magazine)

The magazine **22** is in the form of an elongated arcuate length of heavy-gauge sheet metal stock which is fashioned so as to present a troughlike configuration in transverse cross section and having trough sides **154** and a trough bottom **156**. The front end of the magazine is secured to the anvil member **66** by a bolt and bracket assembly **157**. The upper edges of the trough sides **154** are provided with lateral flanges **158** throughout substantially their entire length. As previously stated, the forward open end of the troughlike structure projects between the anvil member **66** and the guide block **64** while the remainder of the magazine underlies the handle section **16** and cylinder section **12** of the tool and arches upwardly so that the rear region thereof extends alongside the valve section **14** of the tool and is supported by the strap **68**.

A clip follower **160** is slidable in the magazine trough and carries a plate **162** which overlies one longitudinal edge of the trough. The outer edge of the plate **162** is provided with a downwardly extending flange **164** (FIG. **10**) which is spaced from the adjacent trough side **154** and which carries an outwardly projecting manipulating fingerpiece **166** (FIGS. **9** and **10**). The fingerpiece projects inwardly through the ear **164** and constitutes the central axial support for an involuntarily wound constant-tension spring coil **168**, the inner end of which is suit ably secured to the central support and the free end of which is anchored by an anchor bolt **170** (FIGS. **1** and **9**) to the forward end of the adjacent lateral flange **158**. The spring **168** serves to yieldingly urge the clip follower **160** forwardly in the magazine trough to feed successive clips C to the jaw structure of the tool, the extreme forward position of the follower being limited by the presence of the anchor bolt **170** which is adapted to be engaged by the forward edge of the lateral overhanging plate **162** on the follower **160**. An elongated retention strip **172** in the form of an anglepiece (FIG. **1***a*) is welded or otherwise secured to one of the flanges **158** of the magazine as shown in FIGS. **1** and **1***a* and serves to capture the follower within the magazine trough against upward displacement.

The rear end of the follower **160** is bifurcated as indicated at **174** in FIGS. **9**, **11** and **12**, the bifurcation carrying a pivoted latch member **176** which is biased by a spring **178** in a counterclockwise direction as viewed in FIG. **11**. A slot **180** in the bottom wall **156** is adapted to receive the latch member **176** when the follower is in its extreme rearward position. The latch member **176** is provided for the purpose of holding the follower in its fully retracted position during clip-loading operations as shown in FIG. **12**. An abutment **181** at the rear end of the magazine trough limits the extent of rearward movement of the follower **160**.

THE CLIP-CLINCHING JAW STRUCTURE

Referring now to FIGS. **2** and **3**, and additionally to FIGS. **6**, **7** and **8**, the anvil member **66** is of unitary construction and is provided with a depending leg **182**, the lower end of which is formed with a forwardly extending hook portion **184** presenting a flat vertical front face **186** which is interrupted by a medially disposed, forwardly projecting tongue **188** which extends above the level of the face **186**. The front face **190** of the leg **182** is smooth and planar and the lower region thereof merges on a curved bias with the upper troughlike surface of the hook portion **184** to provide the aforementioned lower fixed jaw **32**. The front face **190** constitutes a dropoff portion which is designed for sliding engagement with the rear or trailing leg **144** of the leading clip C in the magazine **22**, the jaw **30** normally overlying the clip C prior to descent of the plunger **28** as shown in dotted lines in FIG. **6**. The effective clip-engaging surfaces of the anvil member **66** thus assume the form of an upright "J."

As previously stated, the lower end of the plunger of slide member **28** establishes the movable upper jaw **30**, this jaw being in the form of a downwardly facing troughlike recess which is best seen in FIGS. **7** and **8**. This jaw is slightly offset rearwardly from the midplane of the plunger and, immediately forwardly of the jaw **30**, the plunger is formed with a downwardly extending slotted extension **192** having a centrally disposed vertical slot **194** therein which extends upwardly into the body portion of the plunger a slight distance

above the level of the jaw **30**. This slot **194** is disposed in vertical register with the tongue **188** on the anvil member **66** and is adapted to receive the tongue therein when the plunger is in its lowermost position as shown in FIG. **8**. The effective clip-engaging surfaces of the plunger or slide member **28** thus assume the form of an inverted "J."

In the operation of the above-described jaw structure, upon initial descent of the plunger **28**, the upper jaw **30**, which normally is maintained a slight distance above the level of the crown portion **143** of the leading clip in the magazine **22**, engages the tape-covered crown portion as shown in dotted lines in FIG. **6** and strips the leading clip from the flexible string of clips remaining in the magazine as shown in full lines in this view and also in FIG. **7**. Thereafter, the jaw **30** carries the dislodged clip downwardly and during the downward movement thereof the clip is confined between the vertical front face **190** and the slotted extension **192** of the plunger **28**. It is to be noted at this point that because the upper jaw cavity **30** assumes the form of an inverted "J" while the lower jaw cavity **32** assumes the form of an upright "J" as previously stated, and because the two "J's" slide vertically relative to each other and are disposed in tandem face-to-face relationship, one leg of the clip C slides on the surface **190** which constitutes the "stem" of the upright "J," while the other leg of the clip moves bodily downwardly with the extension **192** which constitutes the "stem" of the inverted "J" until such time as the two opposed troughs of the "J's" curl the legs of the clip about the articles undergoing joining. Thus, during actual clip-clinching operations, the clip is completely enclosed by a substantially solid wall or cocoon of metal and is thereby maintained steady for accurate precision clinching. The above-described clip-clinching jaw structure constitutes one of the principal features of the present clip-clinching tool.

As the clip approaches the lower fixed jaw **32**, the rear leg **144** thereof is caused to curl forwardly as shown in FIG. **7**, while the slotted extension **192** moves downwardly alongside the front face **186** of the hook portion **184**, thus causing the depending tongue **150** (FIG. **7**) of the clip C to curve inwardly on the troughlike lower jaw **32** and enter the recess **148** which is provided in the rear leg **144** of the clip. The net result of such clip deformation or clinching is shown in FIG. **5** wherein the clip becomes securely wrapped or clinched about the wires or other members which are to be joined together.

It is to be noted at this point that during the initial descent of the plunger **28**, the downward effective initial pressure which is exerted upon the leading clip in the magazine **22** is transmitted through the flexible ribbon **152** which overlies the clip, the downwardly facing upper jaw seating squarely upon such ribbon and pressing the same against the crown portion **143** of the clip with impact force. As the plunger and jaw continue to descend, the relatively sharp rear edge of the troughlike jaw **30** effects a shearing action on the ribbon, thus severing the same along a transverse line without disturbing the position of the next preceding clip in the magazine **22**. The severed portion of the ribbon **152** is carried downwardly with the clip and, at the time the high-pressure clinching operation takes place, the severed fragment of ribbon is further pressed tightly against the crown portion **143** of the clip where it remains after the upper jaw **30** has been retracted and the clinched clip freed from the tool. By such an arrangement, no ribbon fragments are scattered in the jaw region of the tool and, as a consequence, there is little danger of tool clogging, either by reason of such fragments or by clip misalignment. It should be further noted that the slotted extension **192** on the plunger **28** normally projects downwardly below the level of the discharge mouth of the magazine **22** so that when the plunger is in its fully raised position the clip follower **160** urges the string of clips forwardly and causes the leading clip C to bear against the rear side of the extension **192** which thus constitutes a backstop for the leading clip and maintains it in an intermediate position from which it is dislodged by the jaw **30** during the initial descent thereof. Continued downward movement of such jaw conducts the clip downwardly and into forming engagement with the lower jaw **32**. Additional advantages of the present jaw structure will be set forth when the operation of the tool **10** as a whole is described.

OPERATION OF THE TOOL

Having thus described the structural aspects of the present invention, it is believed that the mode of operation of many of the functional tool instrumentalities are apparent from the preceding description. However, the following brief summary of the overall tool operation in applying a clip to a pair of wires or other elements to be joined together will lead to a full understanding of the invention.

Considering the tool **10** with the various movable parts thereof in their normal positions and after the quick-release fitting **36** has been connected to a source of air under pressure, the operator will initially cause the tool to be supported by the handle section **16** and the anvil member **66** brought to bear against the wires W in the manner shown in FIG. **2**. Thereafter the trigger **35** will be depressed, thus rocking the bellcrank actuator **118** and shifting the valve element of the bleeder valve V2 rearwardly from its seat on the O-ring seal **110** and bleeding the passage **34** so as to reduce the pressure of air in the valve chamber **92** of the air admission valve V1. Such pressure reduction allows the full line pressure of air acting on the spool flange **88** of the valve element **34** to move the valve element forwardly and uncover the port **84** so that air may flow through the air passage **33** and cylinder **24** so as to force the piston **26** forwardly and effect the power stroke thereof. Such forward movement of the piston causes forward axial shifting of the piston rod **72** which, in turn, thrusts the upper end of the dual toggle link **132** forwardly and places the latter under compression while at the same time the pivot pins **138** slide downwardly in the slots **140** provided in the sideplates **54**. This downward movement of the pin **138** forces the plunger or slide member **28** downwardly, thus moving the upper clip-engaging jaw **30** toward the lower fixed anvil jaw **32**.

The operation of the jaw structure embodying the two jaws **30** and **32** has been fully set forth previously but it should particularly be noted at this point that prior to engagement of the leading clip C in the magazine **22** the compressional forces acting on the toggle link **132** are relatively small due to the absence of a load upon the upper jaw **30** and despite the fact that the angle of divergence existing between the backplate **56** and the toggle link **132** is relatively steep and on the order of 15° as shown in FIG. **2**. For this reason, little resistance to downward motion of the plunger **28** is encountered. However, the downward component of thrust upon the plunger is adequate to effect stripping of the leading clip C from the remaining string of clips in the magazine, the shearing action on the ribbon or tape **152** being a clean one with no loose ribbon fragments being present to clog the jaw structure.

It should also be noted at this point that as the piston approaches the end of its forward stroke, the toggle link **132** tends to progressively "straighten out" which is to say that it gradually approaches a vertical position of alignment with the plunger and, in so doing, the toggle effect produces a progressively increasing potential downward thrust by the lower jaw **32**, the magnitude of this thrust amounting to many times the magnitude of the thrust exerted by the piston. Such increasing thrust is applied to the clip by the upper jaw **30** during the clinching operation and is made possible by reason of the reaction force which is provided by the top plate **58** of the tool casing against the roller **134** which travels tractionally forwardly along the underneath surface of the top plate **58** as previously described and with increasing pressure thereagainst. In the absence of such reaction force, the piston rod which, at the time of maximum plunger thrust, becomes substantially fully projected from the reduced neck portion **46**, would be unable to exert the necessary downward thrust on the toggle link for proper clip clinching without bending or becoming otherwise damaged.

Finally, in connection with the feeding of the clips to the jaw structure, it should be observed that the magazine **22** delivers the clips successively directly to the jaw structure or, in other words, presents each succeeding leading or foremost clip directly to the upper jaw **30** by projecting the clip sidewise and forwardly against the rear inside face of the bifurcated downward extension **192** where it remains properly oriented for engagement by the upper jaw **30** for shearing and clinching purposes as previously described. By such an arrangement, the use of intermediate transfer devices which are currently used for shifting the leading clip from the magazine to a position of operative register with the clinching jaws is eliminated.

Insofar as the clip-containing magazine **22** is concerned, the arcuate nature of this magazine, in combination with the spring-biased clip follower **160** tends to keep the entire string of clips seated on the bottom wall **154** of the magazine against dislodgment due to normal piston shock, as well as accidental shock incident to handling of the tool. Maintenance of the magazine within the relatively narrow lateral confines of the casing, as distinguished from tools in which the clip magazine projects laterally from the casing, conserves an appreciable amount of space and greatly facilitates use of the tool in small working areas, while the arching of the magazine in an upward direction from one end of the tool casing to the other and beneath the handle and cylinder sections **16** and **18** respectively, further contributes toward tool compactness, while at the same time contributing toward the aforementioned tool balance.

With reference to the previously described pneumatically operable automatic piston return system, since the initial introduction of live air at full line pressure into the air return chamber or reservoir **42** takes place incident to any given depression of the trigger **35** and remains effective over a long period of time for piston return purposes, an appreciable saving in consumption of live air is effected over conventional air return systems which depend for their operation upon a fresh supply of live air for each piston retraction. Furthermore, since the volume of the air reservoir **42** need not be large to produce a powerful rearward thrust upon the piston **26**, the size of the cylinder casting, and consequently of the overall tool casing may be kept to relatively small proportions.

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. For example, although the transmission section **18** of the tool has been illustrated and described as effecting a right-angle transmission of power from the piston **26** to the plunger **28**, it is within the scope of the invention to cause the effective axis of the cylinder section to extend at an obtuse angle with respect to the axis of the plunger **28** since angles which deviate from a right angle by as much as 15° have resulted in satisfactory tool operation. Therefore, only insofar as the invention has particularly been pointed out in the accompanying claims is the same to be limited.

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

1. In a clip-clinching tool, in combination, a rigid casing defining a forward transmission section, a rear cylinder section, and an anvil section adjacent the lower end of the transmission system, said transmission section including a pair of parallel sideplates, a vertical backplate and a horizontal top plate, said plates defining a rearwardly and downwardly opening enclosure, said cylinder section including a cylinder, a piston slidable substantially horizontally in said cylinder and a piston rod connected to the piston and movable with the piston between a retracted position and an extended position wherein it projects into the enclosure between said sideplates, said anvil section including an anvil block defining an upwardly facing lower jaw, a vertically disposed elongated plunger the lower end of which defines a downwardly facing upper jaw designed for clinching cooperation with said lower jaw, guide means on said side plates constraining said plunger to move in a vertical path between an upper position wherein said upper jaw is remote from the lower jaw, and a lower position wherein said jaws are in close clip-clinching proximity to each other, a thrust link for translating the horizontal movements of said piston rod into vertical movements of the plunger, means pivotally connecting one end of the thrust link to the forward end of the piston rod, and means pivotally connecting the other end of the thrust link to the upper end of the plunger, the effective lengths of said thrust link and plunger being such that when the piston and stem are in their retracted position, the thrust link extends at a relatively small angle to the axis of the piston rod, and when the piston and stem are in their extended position, the thrust link closely approaches a position of vertical alignment with the plunger and the jaws assuming positions of close clip-clinching proximity to each other.

2. In a clip-clinching tool, the combination set forth in claim **1**, wherein said sideplates are provided with a pair of parallel slots therein, and the means pivotally connecting said other end of the thrust link to the upper end of the plunger comprises a transversely extending pivot pin the opposite ends of which project into and are guided by said slots.

3. In a clip-clinching tool, the combination set forth in claim **2**, wherein means pivotally connecting said one end of the thrust link to the forward end of the piston rod comprises a transversely extending pivot pin, the piston rod closely underlies said top plate, and said latter pivot pin carries a roller thereon which makes tractional engagement with the underneath side of said top plate during forward movement of the piston rod to the end that said top plate assimilates the upward reaction thrust of the thrust link during clip-clinching operations.

4. In a clip-clinching tool, the combination set forth in claim **3**, wherein said top plate is provided with a shallow groove therein within which said roller is confined.

5. In a clip-clinching tool, the combination set forth in claim **4**, wherein the disposition and width of said vertical slots in the sideplates, and the width of the plunger are such that the latter makes sliding contact with the rear face of said backplate during downward movement of the plunger under the influence of the forward thrust of the piston rod thereon.

6. In a clip-clinching tool, the combination set forth in claim **1** including, additionally, an elongated clip-storing magazine for a string of ribbon-connected clips underlying said rear cylinder section and having its forward end in communication with the open rear side of said enclosure, a clip follower yieldingly biasing the stored clips forwardly to project the leading clip from the magazine into said enclosure and into the path of downward movement of said downwardly facing jaw when the plunger is in its upper position whereby, upon downward movement of the plunger, the thus projected clip will initially be engaged by said latter jaw and carried downwardly for subsequent clinching between said jaws, and limit stop means disposed within said enclosure constituting a backstop for limiting the extent of projection of the leading clip from the forward end of the magazine.

7. In a clip-clinching tool, the combination set forth in claim **6**, wherein said limit stop means is carries by and movable with the plunger.

8. In a clip-clinching tool, the combination set forth in in claim **6**, wherein said magazine is channel shape in transverse cross section, opens upwardly, and is arcuate in longitudinal extent whereby the compressional forces exerted by said follower and said backstop and acting upon the leading and the trailing clip in the string of clips disposed in the magazine respectively serve to maintain all of the clips seated in the magazine trough against upward dislodgment.

9. In a pneumatically operable clip-clinching tool, in combination, a pair of clip-clinching jaws which are relatively movable between closed clip-clinching and open clip-releasing positions, a piston and cylinder assembly for actuating said jaws and including a tubular casing defining an internal enclosure provided with front and rear closure walls, a transverse

partition wall extending across the enclosure and dividing the same into a rear cylinder proper and a forward air reservoir, a piston slidable axially in said cylinder between a forward advanced position and a rear retracted position and having a piston rod projecting completely through said air reservoir and slidably sealed in respective openings in said partition wall and front closure wall, control means effective at will to admit live air to said cylinder rearwardly of the piston, means operatively connecting the forward end of the piston rod to said pair of jaws for translating movement of the piston rod into jaw-opening and jaw-closing movements, the effective area of the opening for the piston rod in said front closure wall being less than the effective area for the piston rod in said partition wall, whereby when the pressure of air in said air reservoir exceeds that in said cylinder rearwardly of the piston, differential air pressure acting on the latter will urge the same toward its retracted position, there being a bleeder passage in said piston and piston rod establishing communication between said cylinder rearwardly of the piston and said air reservoir in all positions of the piston for admitting live air from said cylinder into the air reservoir, and check valve means associated with said passage for preventing return flow of air from the air reservoir to said cylinder, said cylinder being provided with a bleeder opening forwardly of the piston and rearwardly of the partition wall.

10. In a pneumatically operable clip-clinching tool, the combination set forth in claim **8**, wherein said bleeder passage in the piston rod includes a series of generally coplanar radial passages which open into said air reservoir and a resilient O-ring encircling the piston rod and yieldably sealing the outer ends of said radial passages.

11. In a clip-clinching tool for clinching an inverted U-shaped metal clip having an arched crown and depending parallel side legs about a pair of contiguous wire members, in combination, a fixed lower jaw member and an upper movable jaw member, each member being generally of J-shape configuration and presenting a vertical side face which terminates in an arcuate jaw trough, said members being disposed in tandem face-to-face relationship with the jaw troughs opposing each other and with the side faces being spaced apart a distance substantially equal to jaw trough width, said upper member being movable vertically between a lower position wherein said jaw troughs are in close proximity to each other in clip-clinching relationship and the regions of the side faces which are disposed in the vicinity of the jaw troughs directly oppose each other in clip-confining relationship, and an upper clip-releasing position, the side face of the movable jaw member being formed with a vertical relief area and the fixed jaw member being formed with a tongue which projects laterally beyond the associated jaw trough and is adapted to project into said relief area when the upper jaw member is in its lower position.

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