May 30, 1967 G. J. FILIA 3,322,008

TOGGLE-ACTUATED HAND TOOL WITH FULL STROKE-COMPELLING MECHANISM

Filed April 26, 1966 2 Sheets-Sheet 1

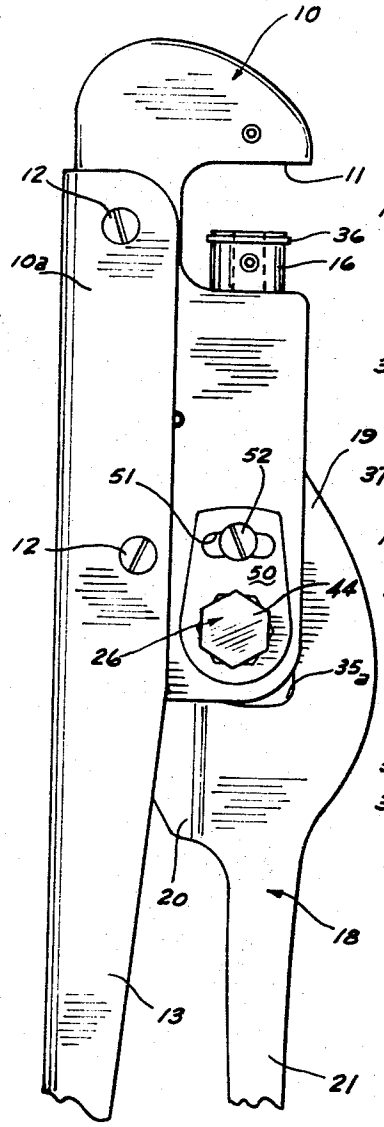


Fig 1

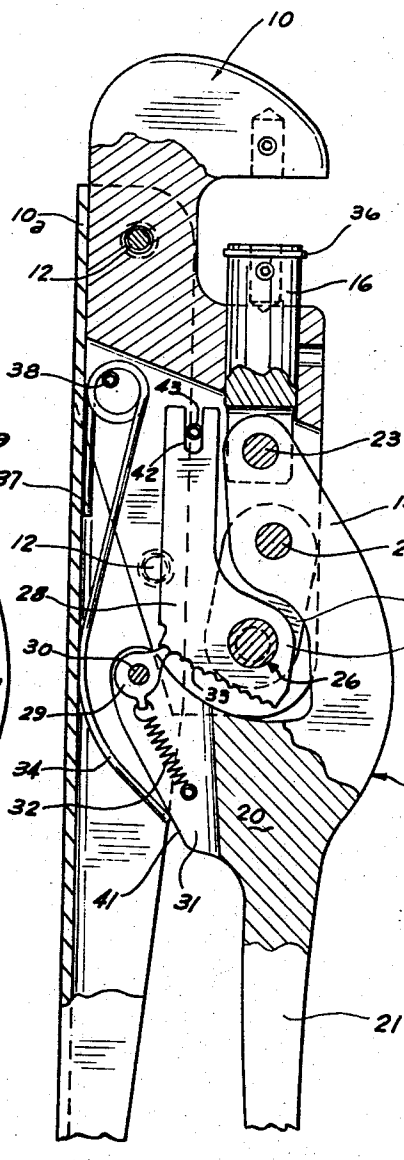


Fig 2

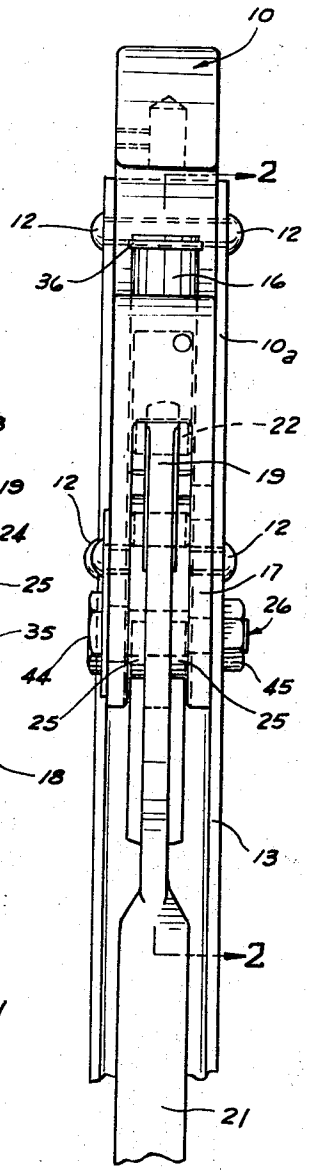


Fig 3

INVENTOR
GEORGE J. FILIA

BY Stephen E. Rockwell

ATTORNEY

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TOGGLE-ACTUATED HAND TOOL WITH FULL STROKE-COMPELLING MECHANISM

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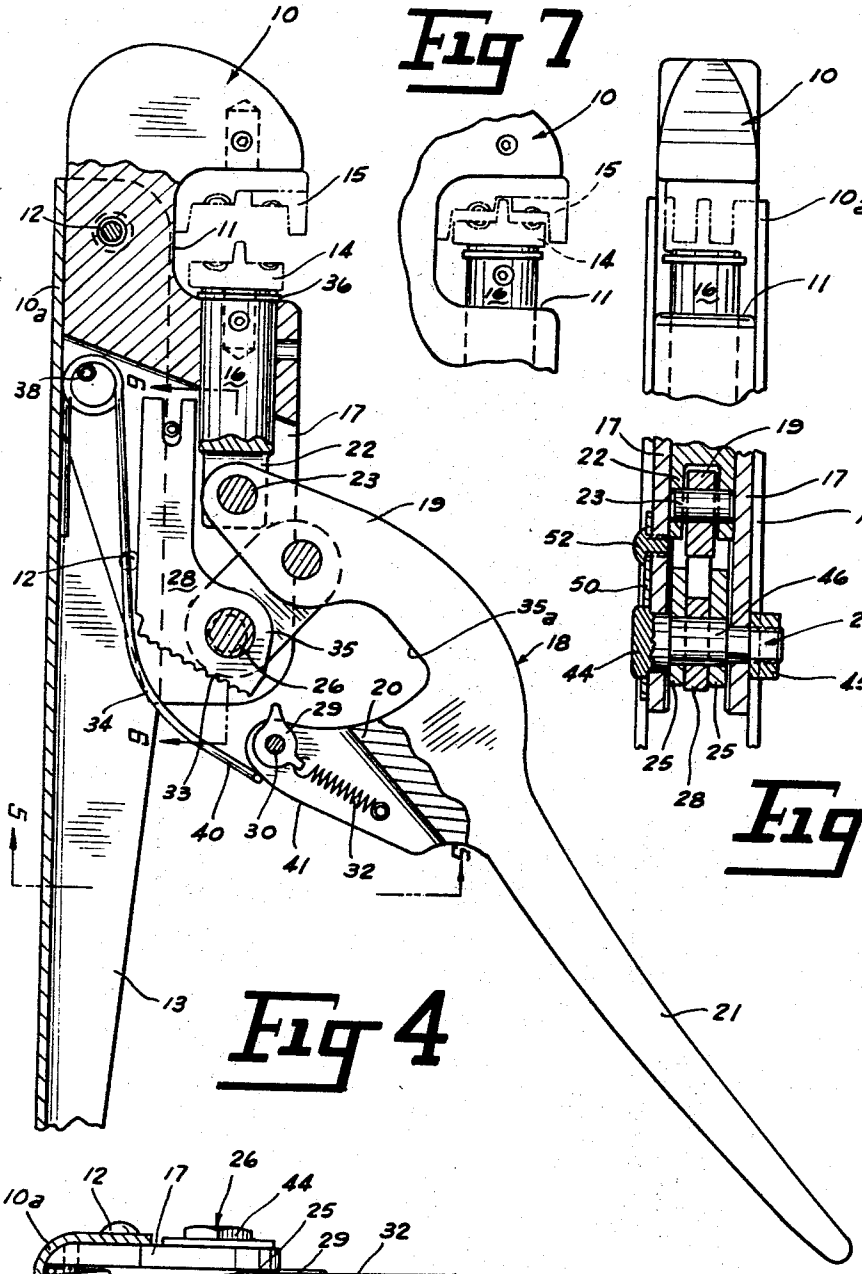


Fig 4

Fig 6

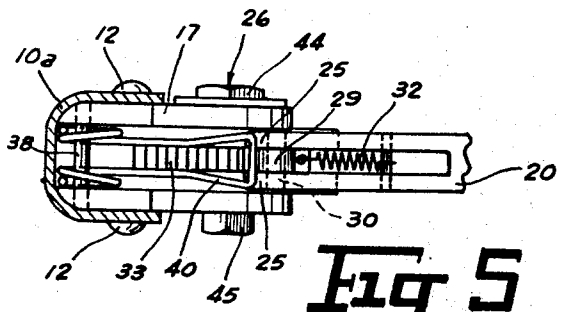


Fig 5

INVENTOR

GEORGE J. FILIA

BY Stephen E. Rockwell

ATTORNEY

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TOGGLE-ACTUATED HAND TOOL WITH FULL STROKE-COMPELLING MECHANISM

George J. Filia, Shelton, Conn., assignor to Sargent & Company, New Haven, Conn., a corporation of Connecticut

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12 Claims. (Cl. 81—313)

This invention relates to a toggle-actuated hand tool having plierlike operating handles pivotally interconnected, which tool incorporates a pair of cooperating, relatively shiftable parts each carrying a work-performing element such as one of a pair of cooperating crimping dies, for example, which tool includes a mechanism for compelling motion of one of the aforementioned cooperating parts toward the other to effect a full stroke of the tool. The tool further comprises a ram or plunger carrying one work-performing element for cooperation with the other work-performing element, the latter being provided with a stationary support from the tool. Generally speaking, the tool is of the type illustrated and described in U.S. Patent No. 3,080,779, issued Mar. 12, 1963. However, the tool of the present invention differs in a number of respects, perhaps the most important of which is the provision, in accordance with the invention, of means to simultaneously adjust the stroke of the shiftable work-performing element and the degree to which the stroke is compelled.

In accordance with the invention, adjustment of the stroke effects the required degree of self-compensating adjustment of the motion-compelling mechanism. The tools of U.S. Patent 3,204,445, issued Sept. 7, 1965, and application for U.S. Letters Patent, Ser. No. 386,594, filed July 31, 1964, now Patent No. 3,262,342, also have some features in common with the tool of the present invention but lack the last-mentioned feature thereof.

As previously indicated, the invention may be embodied in a hand tool of the type which may have two pivotally interconnected handle elements which may be swung relatively to one another to move one work-performing part of the tool relatively to a cooperating work-performing part. The work-performing parts of the tool may comprise crimping dies for crimping a terminal on an electrical conductor. In crimping tools of this type it is often highly desirable to control very exactly the distance of travel of one crimping die toward its companion and moreover to provide an adjustable control of this travel.

Moreover, in a crimping tool of this type it is also often helpful to provide a force-multiplying means such as a toggle connection between at least one operating handle and a shiftable die element, and it has also been found advantageous in at least some instances to associate this toggle with a rectilinearly movable part such as a ram or plunger provided for the purpose of carrying a shiftable die. In hand tools of this type attempts have been made heretofore to control not only the distance of travel of the shiftable die, but the distance of travel which may be compelled by a motion-compelling mechanism incorporated in a tool to assure that, in the operation of the tool, the dies are moved relatively toward one another a sufficient distance to satisfactorily perform the work before the dies may be separated.

In this connection it is well known that in crimping terminals to electrical conductors it is necessary to achieve both a good electrical connection between each conductor and terminal and a strong physical connection between these parts. Attempts have been made to achieve such results by providing tools having parts made to very fine tolerances or by providing in such tools a plurality of adjustment means, the adjustment of one of which means requires compensating adjustment of another. Such tools

commonly comprise a relatively large number of parts and often are undesirably large and/or heavy. Moreover, it will be obvious that such tools are by reason of their nature expensive to produce.

One object of the present invention is to provide in a tool such as characterized above means of adjustment of the stroke which effects the required degree of self-compensating adjustment of the motion-compelling mechanism.

A further object is to employ a self-adjusting part of the motion-compelling mechanism as a stop to act directly on one of the handles of the tool to limit relative swinging movement of the handles in a die-closing direction.

Another object is to provide a tool of the type characterized above which may be of simplified construction which may be of an unobjectionable size and weight.

Other objects of the invention will be apparent from the following detailed description referring to the accompanying drawings illustrating a tool embodying the invention.

In the drawings:

FIG. 1 is a fragmentary elevational view of a toggle-actuated hand tool provided with a full stroke-compelling mechanism, incorporating the invention;

FIG. 2 is a sectional view taken on line 2—2 of FIG. 3;

FIG. 3 is a fragmentary plan view of the tool;

FIG. 4 is a view similar to FIG. 2 illustrating parts of the tool in different positions from those shown in FIG. 2;

FIG. 5 is a sectional view taken on line 5—5 of FIG. 4;

FIG. 6 is a sectional view taken on line 6—6 of FIG. 4; and

FIG. 7 is a fragmentary view illustrating in both side elevation and top plan the fully extended, adjusted position of the ram or plunger of the tool.

In the drawings the body, indicated generally at **10**, of the tool may be formed as a metal casting having a relatively deep and wide recess in one side thereof in what may be termed the head of the body, the recess being indicated at **11** and being shown to advantage in FIGS. 1 and 2 of the drawings. To the body there is affixed as by suitable screws **12** a channel-shaped member **10a** which may be formed of sheet metal, having an extension beyond the body portion forming a handle **13**.

As best shown in FIGS. 4 and 7, work-performing elements such as cooperating crimping die elements **14** and **15** are disposed in the recess **11** in the body. The die **15** is provided with a suitable mounting so that it is in fixed relation to the body **10** while the die **14** is suitably secured to a ram or plunger **16** providing a support for the die **14** by which the latter may be reciprocated in a manner to approach and move away from the die **15**. The plunger **16** is mounted for reciprocating motion in a suitable bore in the body communicating in a direction opposite that of the recess **11**, with a bifurcation **17** of the body.

There is provided in the tool a lever, indicated generally at **18**, having arms **19**, **20** and **21**. The distal end portion of arm **19** is received in a bifurcation **22** of the trailing end portion of the plunger **16** and pivoted to this bifurcation by a pin **23** having its axis located on the longitudinal axis of the plunger. A distance rearwardly of the pivot pin **23** the arm **19** is pivoted by a pin **24** to a pair of links **25**, one at either side of the arm **19**, the connection being made to one end portion of each link **25**, as viewed in FIG. 2. The other ends of the links **25** are pivoted to the body **10** by a member, indicated generally at **26**, passing through the links and received in the aforementioned bifurcation of the body. The member **26** will be described in detail hereinafter.

The arm **21** constitutes a handle which, when swung relatively to the handle **13** in a manner to approach the latter, effects extension of the plunger **16** through the

aforementioned pivotal connection of the lever **18** to the plunger, as at **23**, and the pivotal connection to the body, including the pivots **24**, **26** and the links **25** providing a toggle mechanism. When the handle **21** is swung in the opposite direction, retraction of the plunger is effected through the aforementioned toggle mechanism.

As previously indicated, the tool includes a motion-compelling mechanism including a ratchet member, indicated generally at **28**, between the links **25** supported from the body **10** and a pawl **29** carried by the lever **18** for cooperation with the teeth of the ratchet member. As shown in FIG. 2, for example, the pawl is pivoted at **30** within a bifurcation **31** of the arm **20** of the last-mentioned lever. The pawl **29** is biased by a spring **32** secured to the lever **18** to an angular position shown in FIG. 4. As shown in the last-mentioned view, a pawl projects from the bifurcation of the arm **20**. The teeth **33** of the ratchet member are formed on a pitch line or radius from the axis of the pivotal connection of the lever **18** to the plunger **16**, taking into account the movement of this axis during swinging movement of the lever **18** as by operation of the handle **21**. As previously indicated, the last-mentioned pivotal axis lies in the longitudinal median plane of the plunger **16**.

An upper edge portion **35** of the ratchet member provides an abutment limiting swinging movement of the handle **21** toward the handle **13** and, therefore, acts as a positive and direct stop for the handle-provided lever **18** when the lever is swung in a direction to extend the die-carrying plunger **16** into the recess **11** of the body. It should be noted that the lever **18** is recessed, as at **35a**, to receive in edgewise relation the bottoming ratchet member **28** which may be formed of plate stock. Movements of the plunger and the lever **18** in the opposite directions are limited as by a collar **36** provided on the plunger and engageable with the body of the tool in the manner shown in FIG. 4.

The handles **13** and **21** of the tool are urged apart to effect the retracted position of the plunger **16** shown in the last-mentioned view by a wire spring **34** having end portions **37** supported within the channel of the member **10a**, providing the handle **13**, and having an intermediate spiraled portion thereof supported by a transverse pin **38** received in the bifurcation **17** of the body. The spring **36** is provided with a bight portion **40** engageable with surfaces **41** of the bifurcated arm **20** of the lever **18**.

The ratchet member **28**, which may be formed of plate or sheet stock, is generally of L shape, as viewed in FIG. 2, having one leg thereof receiving the aforementioned support member **26** and having in the distal end portion of the other leg thereof a longitudinally elongated recess **42** which receives a transverse pin **43**, the ends of which are supported by the bifurcation **17** of the body. The pin **43** serves as a guide for adjusting movement of the ratchet member **28**, the details of which will appear hereinafter, and also a pivot about which the ratchet member may move angularly as will also appear hereinafter. It should be noted that the location of this pin **43** is not far from pivot pin **23** of the handle. In the interests of providing a tool which is not bulky and overweight, the ratchet member is pivoted to the pin **43** rather than the handle pivot **23** which would otherwise be a preferable arrangement.

The aforementioned member **26** supporting the ratchet member comprises a bolt extending through the bifurcated portion **17** of the body having a polygonal head **44** engageable with one face of the body and threadedly receiving a nut **45** for cooperation with the remote face of the body, the bolt having intermediate of its ends an eccentric cylindrical portion **46** on which are supported (FIG. 6) the aforementioned toggle links **25** and the ratchet member **28**, the links being free to move angularly relatively to the ratchet member during operation of the toggle mechanism, while the ratchet member therebetween remains in fixed relation to the body.

The aforementioned teeth **33** of the ratchet member are formed along one edge portion of the ratchet member, as shown in FIG. 2. As indicated in FIG. 6, the eccentric portion **46** is received in registering holes in the links **25** and the ratchet member **28**. The bolt portion **46** is closely received in the holes but not so closely that the bolt may not be turned when the nut **45** is loosened. Turning movement of the bolt, of course, effects angular movement of the axis of the eccentric portion **46**, which angular movement may be employed for infinite longitudinal adjustment of the plunger **16**, within a limited range, through the lever **18** and the links **25**. It will also be understood that this longitudinal adjustment of the plunger **16** effects a similar degree of movement of the pawl **29** carried by the lever **18**, longitudinally of the plunger.

Moreover, it will be understood that this turning movement of the bolt effects through the eccentric portion thereof movement of the ratchet member **28** generally lengthwise of the plunger **16** on the guide pin **43**, while simultaneously effecting a small degree of angular movement of the ratchet member on the last-mentioned pin. The angular movement of the ratchet member sufficiently changes its relationship to the lever **18** to move the abutment **35**, thereby changing the point at which the handle **21** is stopped by the abutment. However, as the toothed portion of the ratchet member is in fixed relation to the abutment **35** of the ratchet member, movement of one, say, the abument **35**, is compensated in a self-determining manner by movement of the toothed portion of the ratchet member.

Hence it is significant that it is unnecessary to provide in this mechanism separate means for angular compensating movement of the ratchet member on its pivot after longitudinal adjustment of the plunger **16** such as may be required in the tool of the aforementioned Patent 3,204,445. This is avoided in the present tool by pivoting the handle-providing lever **18** directly on the plunger **16** and generating the ratchet teeth from this movable pivot point.

Reference has been made to Patent 3,080,779 by reason of the similarity of the toggle mechanism employed in that tool. However, the toggle mechanism of the patented tool is not adjustable and, while the tool incorporates a motion-compelling mechanism providing a stop for the movable handle element of the toggle mechanism, the motion-compelling mechanism is only adjustable to the extent that the axis of the pawl of the motion-compelling mechanism may be adjusted angularly so that the pawl properly disengages the teeth of the ratchet with which it cooperates when the handle is stopped in the aforesaid manner.

When the handle **21** is in the open position of FIG. 4 and is thereafter swung toward the handle **13** or in a direction to close the handles, the spring-biased pawl is engaged with the ratchet member and deflected in a clockwise direction from that shown in FIG. 4 until it engages the teeth **33** of the ratchet member and is moved thereover by continued closing movement of the handle **21**, under the influence of spring **32**. Once the teeth of the ratchet member have been engaged in this manner, the handle **21** may not be reopened until the pawl has traversed every tooth of the ratchet member and disengaged the teeth. Motion of the plunger **16** is compelled in this manner.

The construction and arrangement of the handle-providing lever **18** and the ratchet member are such that movement of the lever is stopped by the abutment provided by the ratchet member when the pawl has disengaged the ratchet teeth in the aforementioned manner. When the handle **21** is thereafter swung in the opposite direction, the pawl is deflected in a counterclockwise direction, as viewed in FIG. 4, and reengaged with the ratchet teeth in a manner to prevent reverse movement of the handle until the pawl has once again left the

toothed portion of the ratchet member, but this time moving in the opposite direction.

Reference has been made to application, Ser. No. 386,594, filed July 31, 1964. This application also illustrates and describes a tool wherein there is provided a motion-compelling mechanism including an adjustable ratchet member carried by one handle, and a cooperating pawl carried by another handle of the tool and wherein the ratchet member or a part carried thereby provides a stop for the handle member carrying the pawl. However, there is no toggle mechanism in this tool comparable to the toggle mechanism of the tool of the instant invention, no plunger or ram and, of course, no means to adjust a ram or plunger.

To facilitate the turning of the bolt providing the eccentric pivot **46** which, as previously indicated, is in effect a pin angularly movable about the axis of the bolt to adjust the stroke of the plunger and effect a self-compensating movement of the ratchet of the motion-compelling mechanism, there is provided a socket wrench **50** (FIG. 1) of platelike form receiving the polygonal head **44** of the bolt and having one face thereof engageable with the corresponding face of the body **10**, the wrench having at a point removed from the socket an arcuate slot **51** receiving a screw **52** provided with a suitable head to clamp the wrench against the body **10** in the desired angularly adjusted position. The wrench and its cooperation with the bolt head for adjustment of the bolt is fully described in the aforementioned Patent 3,204,445 and need not be further described here.

As will be noted from the foregoing, the tool of the present invention may be employed for such operations as crimping, cutting or punching, employs a force-multiplying toggle mechanism and is of a construction such that it may be very accurately adjusted, that is, with reference of the work-engaging parts to one another, at the factory and, if necessary, in the field to compensate for parts made to relatively low tolerances, which parts are not as expensive as they would be if made to fine tolerances. The means for adjustment of the work-engaging parts of the tool also compensate, of course, for wear and overstress of the parts and may, in fact, permit accommodation of a series of dies, for example, within a certain size range.

While only one form of the tool has been illustrated and described, it will be obvious to those versed in the art that the invention may take other forms and is susceptible of various changes in details without departing from the principles of the invention and the scope of the appended claims.

What is claimed is:

1. In a hand tool, the combination of an elongated body including at one end thereof a handle element and having in fixed relation to the other end thereof a head provided with a work-engaging part fixed thereto, a plunger mounted for sliding movement in the body toward and away from said work-engaging part in a direction lengthwise of the body and having a work-engaging part for cooperation with the first-mentioned work-engaging part, a toggle mechanism including a second handle element swingable relatively to the first-mentioned handle element and operably connected through pivotal connections to the plunger and to the body for advancing and retracting the plunger, and coacting motion-compelling means on said body and the second handle element, for said handle elements controlling relative movements therebetween and comprising an abutment-providing member engageable by one handle element to limit relative swinging movement of the handle elements in a direction to advance the plunger, and said pivotal connection between the toggle mechanism and the body including an elongated pivot-providing member, having a longitudinal axis, carried by the body, having a cylindrical portion thereon eccentric to said axis, which provides said pivotal connection, said pivot-providing member being angularly adjustable on its axis to thereby adjust the extent of movement by which the plunger may be advanced, said abutment-providing member of the motion-compelling mechanism also being mounted on said eccentric portion of the pivot-providing member for self-adjustment of the handle abutment on angular adjusting movement of the pivot-providing member.

2. A hand tool as defined in claim **1** wherein said second handle element is pivoted directly to the plunger.

3. A hand tool as defined in claim **2** wherein said adjustment-providing member is of plate form having ratchet teeth along an edge portion thereof cooperating with a biased pivotally mounted toothed member of the motion-compelling means on said one of the handle elements.

4. A hand tool as defined in claim **3** wherein said abutment-providing member is generally of L shape having a leg thereof supported on said eccentric portion of the pivot-providing member and having an opening in the other leg receiving a body-supported member for guiding movement of the abutment-providing member on adjustment of said pivot-providing member, the pitch radius of the ratchet teeth emanating from the movable swinging axis of the second handle element.

5. A hand tool as defined in claim **4** wherein said second handle element is provided by a lever having a recess formed therein receiving said handle abutment which bottoms in the means defining said recess.

6. A hand tool as defined in claim **5** wherein the tail end of the plunger extends into a bifurcation in the tail end of the body and is itself bifurcated to receive the pivotal connection of the second handle element to the plunger, and wherein said toggle mechanism further comprises a pair of links, one on either side of said lever and having the greater part thereof within the body bifurcation, pivotally interconnecting the lever and said eccentric portion of the pivot-providing member.

7. In a hand tool, the combination of an elongated body including at one end thereof a handle element and having in fixed relation to the other end thereof a head provided with a work-engaging part fixed thereto, a plunger mounted for sliding movement in the body toward and away from said work-engaging part in a direction lengthwise of the body and having a work-engaging part for cooperation with the first-mentioned work-engaging part, a toggle mechanism including a second handle element swingable relatively to the first-mentioned handle element and operably connected through pivotal connections to the plunger and to the body for advancing and retracting the plunger, and coacting motion-compelling means on said body and the second handle element, for said handle elements controlling relative movements therebetween, and said pivotal connection between the toggle mechanism and the body including an elongated pivot-providing member, having a longitudinal axis, carried by the body, having a cylindrical portion thereon eccentric to said axis, which provides said pivotal connection, and pivot-providing member being angularly adjustable on its axis to thereby adjust the extent of movement by which the plunger may be advanced, said second handle element being pivoted directly to said plunger, said motion-compelling mechanism comprising a member on said eccentric portion of the pivot-providing member and self-adjustable on angular adjustment of the latter, said member of the motion-compelling means coacting with a member on said second handle element.

8. A hand tool as defined in claim **7** wherein one of said members of the motion-compelling means is of plate form having ratchet teeth along an edge portion thereof cooperating with said other member of the last-mentioned means, the last-mentioned member comprising a biased pivotally mounted toothed member.

9. A hand tool as defined in claim **8** wherein said member having ratchet teeth thereon is generally of L

shape having a leg thereof supported on said eccentric portion of the pivot-providing member and having an opening in the other leg receiving a body-supported member for guiding movement of the last-mentioned member of the motion-compelling means on adjustment of said pivot-providing member, the pitch radius of the ratchet teeth emanating from the movable swinging axis of the second handle element.

10. A hand tool as defined in claim **9** wherein said handle element is provided by a lever having a recess formed therein receiving the greater part of the first-mentioned leg having ratchet teeth thereon.

11. A hand tool as defined in claim **10** wherein said first leg is provided with an edge portion providing an abutment limiting relative swinging of the handle elements to advance the plunger, the last-mentioned edge portion bottoming in the means defining the recess in said lever.

12. A hand tool as defined in claim **11** wherein the

tail end of the plunger extends into a bifurcation in the tail end of the body and is itself bifurcated to receive the pivotal connection of the second handle element to the plunger, and wherein said toggle mechanism further comprises a pair of links, one on each side of said lever and having the greater part thereof within the body bifurcation, pivotally interconnecting the lever and said eccentric portion of the pivot-providing member.

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WILLIAM FELDMAN, *Primary Examiner.*

MILTON S. MEHR, *Examiner.*