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3,359,779

MULTIPLE-STROKE HAND TOOL

Filed June 16, 1965

2 Sheets-Sheet 1

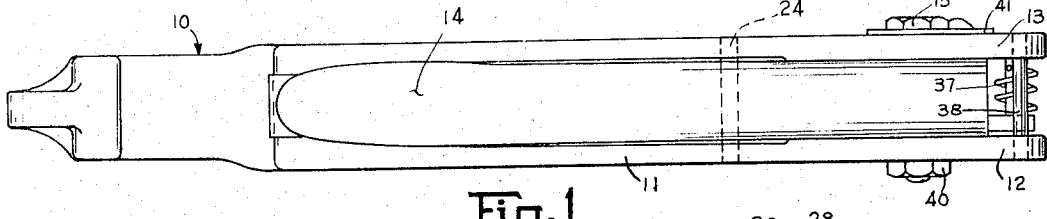


Fig. 1

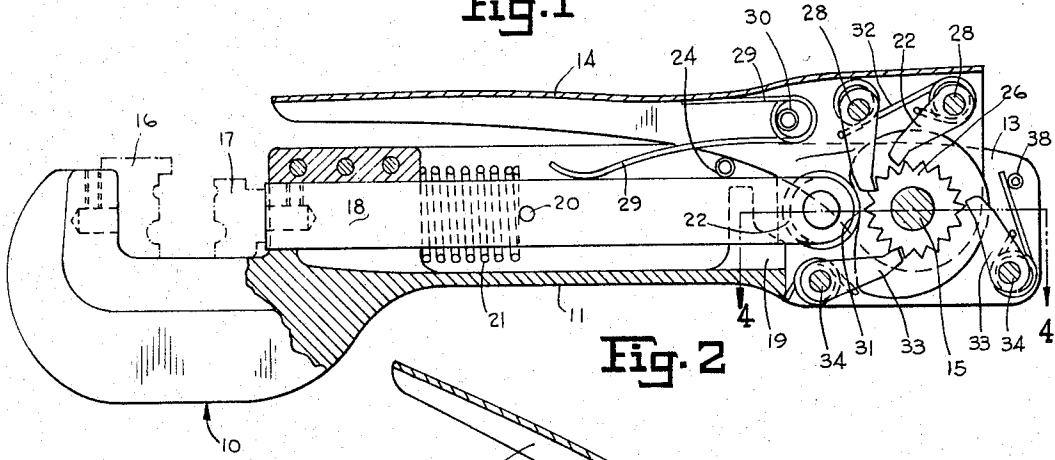


Fig. 2

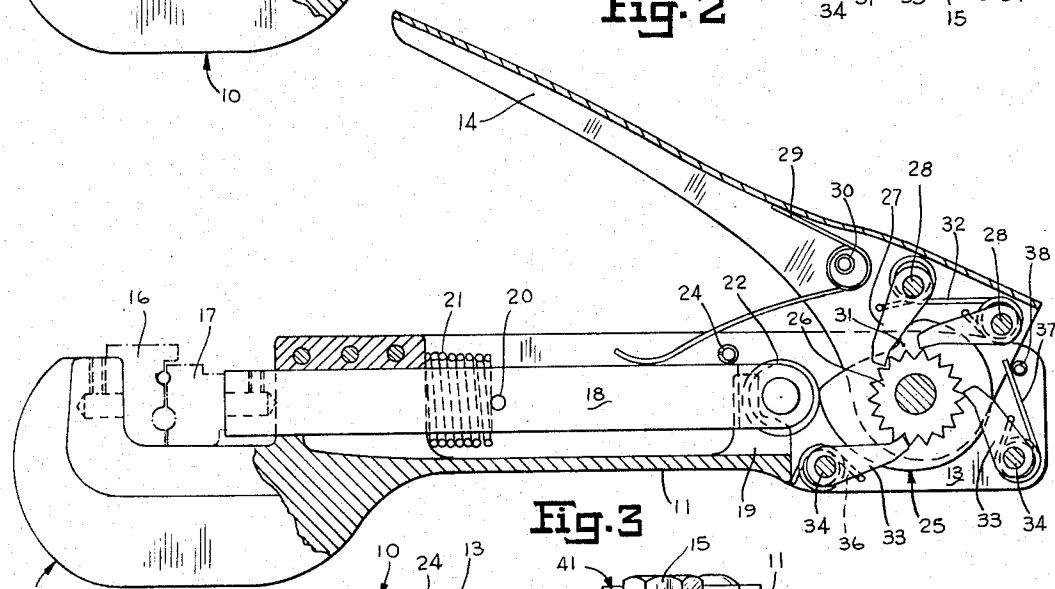


Fig. 3

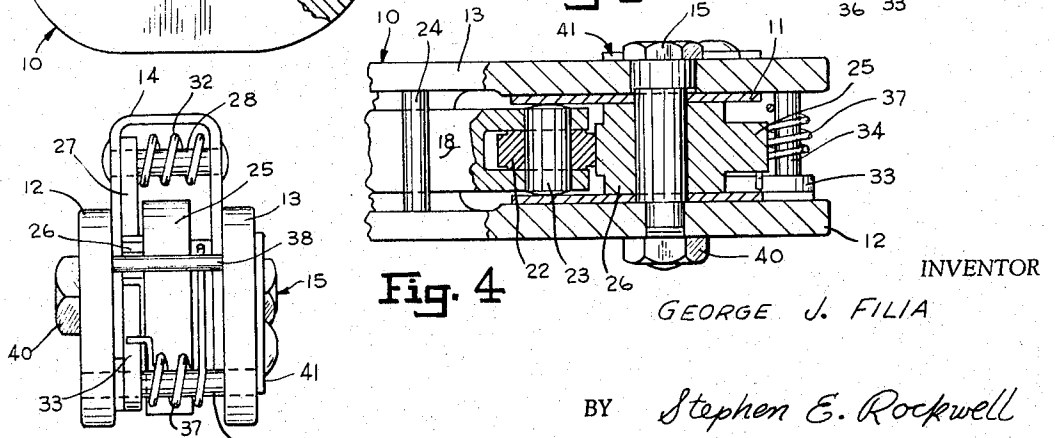


Fig. 4

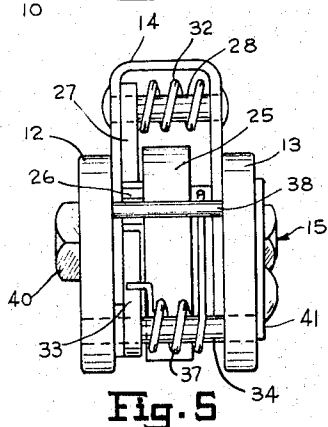


Fig. 5

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2 Sheets-Sheet 2

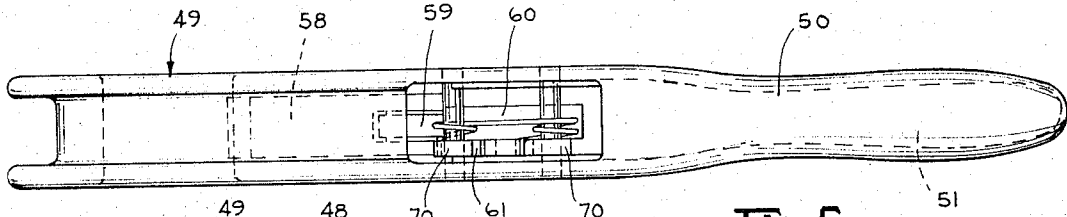


Fig. 6

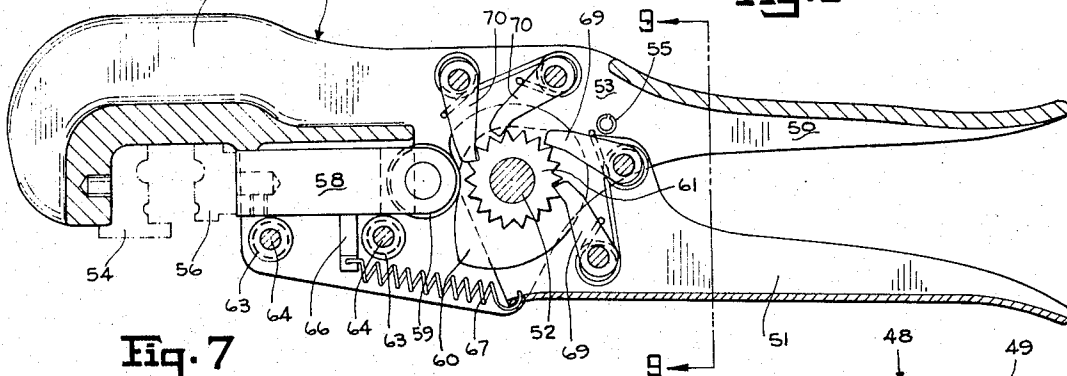


Fig. 7

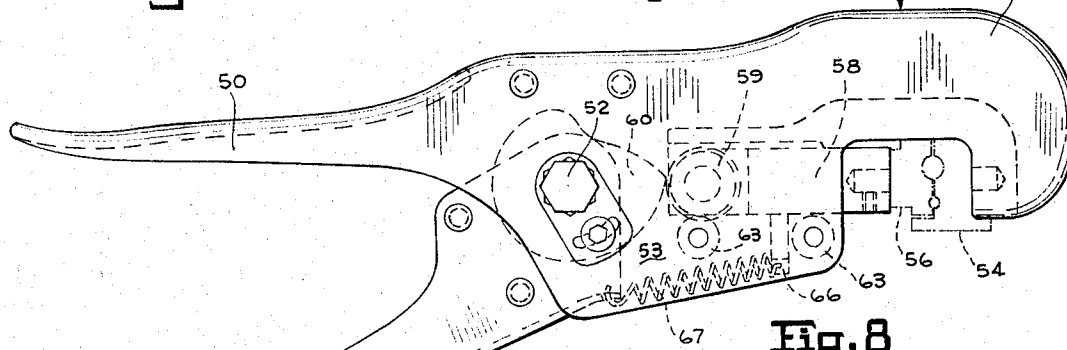


Fig. 8

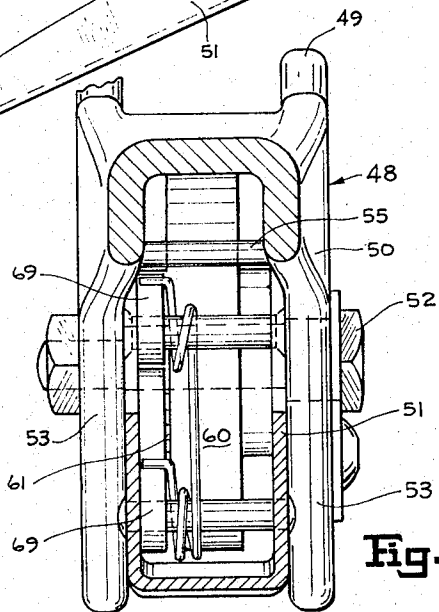


Fig. 9

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**MULTIPLE-STROKE HAND TOOL**

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5 Claims. (Cl. 72-412)

**ABSTRACT OF THE DISCLOSURE**

This disclosure relates to a hand tool having two handles mounted for scissorslike action, one being in fixed relation to a head portion of the tool having a work-engaging and -forming part fixed thereon, the other handle being operable through pawl and ratchet means to rotate a cam driving a ram having a work-engaging and -forming part for cooperation with the first-mentioned such part. The tool is especially useful for crimping workpieces.

This invention relates to a multiple-stroke hand tool provided with two pivotally interconnected handles swingable relatively to one another to move a pair of associated work-engaging or work-performing parts of the tool relatively to one another. The aforementioned work-engaging or work-performing parts may constitute, by way of example, complementary crimping dies movable relatively to one another to perform the function of crimping an electrical terminal on an electrical wire. The dies are moved relatively toward one another to perform such a function, and in a multiple-stroke tool a plurality of cycles of operation of the handles is required to bring the dies together sufficiently to effect a crimp, each cycle being constituted by one relative opening and one closing movement of the handles in a scissorslike action. Known tools of this type have employed togglelike elements operatively interconnecting the handles and the crimping jaws. The toggle movement operating the dies has at least in some instances proven undesirable.

It is an object of the invention to provide in a multiple-stroke hand tool, omitting the toggle elements, a rectilinearly movable ram element for effecting relative opening and closing movements of crimping dies, for example, that is, a tool having a ram action instead of a togglelike action.

A further object is to provide in a hand tool, including a ram element, improved means for driving the ram.

Still another object is to provide in a tool such as characterized above, a construction which is simple, rugged and very efficient in operation.

The novel features of the invention are particularly pointed out and distinctly asserted in the claims appended to and forming part of this specification, and further objects of the invention will be apparent from the following description.

In the drawings:

FIG. 1 is a top plan view of a multiple-stroke hand-operated tool embodying the invention;

FIG. 2 is a side elevational view of the tool, partially in section, illustrating the work-performing elements of the tool in their relatively open or separated positions and illustrating the handles in relatively closed position;

FIG. 3 is a view similar to FIG. 2 illustrating the work-performing parts of the tool in their relatively closed positions and the handles in relatively open positions;

FIG. 4 is a sectional view taken on line 4-4 of FIG. 2;

FIG. 5 is an elevational view of the tool shown in FIG. 1, looking toward the right-hand end thereof as viewed in FIG. 1;

FIG. 6 is a view similar to FIG. 1 but illustrating a modified form of the invention in a hand tool;

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FIG. 7 is a view similar to FIG. 2 further illustrating the modification;

FIG. 8 is a view similar to FIG. 3 also illustrating the modification; and

5 FIG. 9 is an enlarged sectional view taken on line 9-9 of FIG. 7.

In the first illustrated form of the invention the body of the tool is indicated generally at 10. This body is provided with a handle-forming portion 11 of channel shape terminating at its distal end in bifurcations forming side walls 12 and 13. The tool is provided with a companion handle 14 of inverted channel shape having one end thereof pivoted between the side walls 12 and 13 by a bolt 15 extending therethrough, the other end of the last-mentioned handle extending toward the work-performing parts of the tool, as shown in FIG. 2, the last-mentioned parts of the tool being indicated in this view at 16 and 17. Tools having handles arranged relatively to one another in a manner similar to the handles 11 and 14 are commonly known as reverse handle tools.

The work-performing element 16 is suitably secured to the body 10 in a manner to be fixed thereto and may constitute a crimping die by way of example but not by way of limitation. The complementary work-performing part 17 likewise may constitute a crimping die for cooperation with the die 16 and movable toward and away from the latter on one end of a ram 18 slidably mounted in the body and to which ram it is suitably secured. The ram is rectangular in cross section and, as shown in FIG. 2, the dies 16 and 17 extend into a recess or cavity in the body 10.

The ram 18 is mounted for sliding movement in an opening provided by the body and is also guided for this movement by an upstanding part 19 in the bottom of the channel of the handle portion 11, the guide part 19 being U-shaped. A pin 20 extends transversely through the ram, and a compression spring 21 on the ram reacts between the pin 20 and the body 10 as indicated in FIGS. 2 and 3, the spring tending to move the ram in a direction to relatively open or separate the work-performing parts 16 and 17 of the tool.

At its end remote from the die 17 the ram is bifurcated, as best shown in FIG. 4, and receives between the bifurcations a roller 22 supported therebetween by a pin 23 extending through the bifurcations. The pin 23 is maintained captive in the channel formed by the handle portion 11. The roller 22 projects beyond the last-mentioned end of the ram in the manner indicated in FIGS. 3 and 4.

A pin 24 overlies the ram 18, extending transversely thereof between the side walls of the last-mentioned channel, the pin being supported by these walls and serving the dual function of preventing any tendency of the last-mentioned end of the ram to be lifted from the position shown in FIG. 3, and serving as a stop limiting movement of the handle 14 from the position of FIG. 3 in a closing direction, as indicated in FIG. 2.

The roller 22 on the ram cooperates with a cam, indicated generally at 25, arranged vertically and mounted for free rotation on the bolt 15. The cam has associated therewith a ratchet 26 arranged in a coaxial manner and preferably formed integrally with the cam. When the ram is in its retracted position, shown in FIG. 2, under the influence of the compression spring 21, the roller 22 carried by the ram preferably rests, as shown, in an arcuate recess or dwell 31 in the cam, and thereby tends to hold the cam in the position shown in the last-mentioned view. The element forming both the cam 25 and the ratchet 26 is straddled by the handle 14 in the manner indicated in FIGS. 2 and 4, for example.

Cooperating with the ratchet 26 are a plurality of cam-driving pawls 27 spaced apart from one another on respect-

tive pins 28 extending through the side walls of the handle 14. In the illustrated form, the driving pawls 27 are two in number and cooperate with relatively large teeth formed on the ratchet 26, the pawls being spring pressed into engagement with the teeth in a manner to be described hereinafter. The employment of a plurality of pawls to drive the cam through the ratchet tends to insure that at least one pawl is constantly in substantially full engagement with a tooth of the ratchet in a manner to drive the ratchet when the handles are operated. This inhibits slippage between the cam 25 and the handles on relative movement of the latter.

A wire spring 29 is wound intermediate of its ends in a manner to embrace and be supported by a pin 30 extending through the side walls of the handle 14. One end of the spring 29 bottoms on the channel formed by the handle 14 while the other end of the spring 29 is supported on the ram 18, the construction and arrangement being such that the handle 14 is biased to the open position shown in FIG. 3. A single wire spring 32 biases the driving pawls 27 toward the teeth of the ratchet 26, last-mentioned spring being wound intermediate of its ends for support in embracing relation to one of the pins 28 and at a distance therefrom also being wound for support around the other pin 28. The ends of the spring 32 bear against the respective driving pawls 27.

Associated with the body 10, and more particularly the handle portion 11 thereof, are a plurality of cam-holding pawls 33 cooperating with the teeth of the ratchet 26. The last-named pawls are also two in number. These pawls are plural in number for the same reason that the pawls 27 are plural, the pawls 33 being supported in spaced-apart relation on respective pins 34 in turn supported from the side walls 12 and 13 and extending therebetween. One of the pawls 33 is biased toward the teeth of the ratchet 26 by a spring 36 having a portion thereof intermediate its ends wrapped for support around the corresponding pin 34. One end of this spring abuts the handle 11 in the manner shown in FIG. 2, for example, while the other end of the spring abuts the last mentioned pawl. A similar spring 37 reacts between the other pawl 33 and a pin 38 extending between and supported by the side walls 12 and 13, the spring 37 deriving support from the other pin 34. The pin 38 not only serves as an abutment for the spring 37, but serves as a stop to limit movement of the handle 14 in an opening direction from the position of FIG. 2, as shown in FIG. 3.

It will be understood from the foregoing that when the handle 14 is moved relatively to the handle 11 from the position of FIG. 2 toward the position of FIG. 3, the driving pawls 27 are caused to ride over teeth of the ratchet 26 in a manner similar to that indicated in FIG. 3, while the holding pawls 33 prevent clockwise rotation of the cam and ratchet as viewed in FIG. 3. When the handles are moved relatively to one another toward the closed position shown in FIG. 2 from the open position shown in FIG. 3, the driving pawls 27 or one of them drives the ratchet and cam in a counterclockwise direction as viewed in FIG. 2, while the holding pawls 33 ride over the teeth of the ratchet. This counterclockwise movement of the cam 25, by reason of its contour, forces the ram 18 toward an extended position from its retracted position shown in FIG. 2 when the cam and the roller 22 carried by the ram are in the relationship shown in FIG. 2 and the handles 11 and 12 are moved relatively to one another to first open position and then closed position. It will be understood from the foregoing that this movement of the ram effects the initial relative closing movement of the dies 16 and 17.

In the illustrated form being described the cam is given such a contour that it will effect relative closing movement of the dies and reopen them on a single revolution of the cam. However, if desired, the cam might be contoured to provide a plurality of both opening and closing movements of the dies during a single revolution of the

cam. It may be noted that in the illustrated form the cam is contoured in such a manner that the greatest mechanical leverage is exerted by the cam on the ram at the end portion of the ram's travel in a die-closing direction. Moreover, in the form being described, fifteen opening and closing movements of the handles may be required for a crimping operation, that is, to close the dies relatively to one another on the workpiece and then reopen them.

The action of the cam on the ram provides a very effective force on the movable die 17 through the multi-stroke driving means for the cam. To insure that the dies close properly upon one another, the pivot on which the cam and ratchet rotate is adjustable in the manner fully described in my copending U.S. patent application, Ser. No. 273,407, filed Mar. 16, 1963, now Patent No. 3,204,445. It is sufficient here to explain that the pivot on which the aforementioned parts are revoluble is adjustable in a direction toward and away from the die 16 by being formed as an eccentric portion 39 of the bolt 15, angularly adjustable in the side walls 12 and 13, which is shown in FIG. 4. Also as indicated in this view, the bolt may be tightened in an angularly adjusted position by a nut 40. A further locking device, indicated generally at 41, for the bolt which also serves as an adjusting member for the bolt, such as shown and described in the aforementioned pending patent application, is preferably employed but need not be described here.

In the modification of the hand tool embodying the invention shown in FIGS. 6 through 9 by way of example, the body of the tool is indicated generally at 48. It comprises a head portion 49 and a handle portion 50 of tapered form and generally of inverted channel shape throughout the greater portion of its length. The head portion 49 provides a die-receiving opening and may be of the configuration shown to advantage in FIGS. 6, 7 and 8. A handle 51, also of tapered form and generally of channel shape through the greater portion of its length, is pivoted to the body 48 as at 52 by a bolt similar to the bolt 15 previously described, the bolt extending through the side walls of the channel formed by the handle 51 and through complementary side walls 53 of the body, the former being received within the latter.

To the head 49 of the body there is secured in fixed relation a die 54 similar to the die 16 previously described, and for cooperation with the die 54 there is provided a die 56 similar to the previously-described die 17. The die 56 is fixed to one end of a ram 58 slidably mounted in the body 48 for rectilinear motion in a direction to carry the die 56 toward and away from its companion 54. At the other end of the ram, in similar fashion to the previously-described ram 18, there is provided a roller 59 supported in like manner to the roller 22, previously described, for cooperation with a cam 60, similar to the cam 25, and angularly rigid with the ratchet 61, similar to the ratchet 26. The cam 60 and the ratchet 61 are mounted on the pivot 52 in similar fashion and, as will be fully apparent hereinafter, the cam 60 actuates the ram 58 in much the same manner that the cam and ratchet of the first-described form actuates the associated ram.

To provide partial support for the ram 58 in the body 48, a plurality of rollers 63 is provided, two being shown, each mounted on the body in spaced-apart relation along the length of the ram 58 by pins 64 supported in the side walls 53 and extending therebetween transversely of the ram in a manner such that the rollers bear against the underside of the ram as viewed in FIG. 7. Suspended from the underside of the ram 58 as seen in the last-mentioned view is a pin 66, to the lower end of which is attached one end of a tension spring 67 having its other end attached to the handle 51 as shown in FIG. 7. The spring 67 serves a dual purpose. It tends to retract the ram 58, or in other words move the dies 54 and 56 in a relative opening direction, and it also tends to maintain the handle 51 in the open position shown in FIG. 8.

In the illustrated modified form of the hand tool, the handle 51 is provided with a pair of driving pawls 69 similar to the previously-described driving pawls 27 and supported in like manner, for the purpose of driving the ratchet 61 and through the ratchet the cam 60, when the handle 51 is moved from the position of FIG. 8 to the position of FIG. 7, while holding pawls 70 ride over teeth of the ratchet. The holding pawls 70 are similar to the previously-described holding pawls 33 and are mounted in similar fashion in the body 48. Actuation of the handles of the tool in the previously-described manner effects partial rotation of the cam when the ram 58 is in the position of FIG. 7 to move the cam one step toward the position shown in FIG. 8 in which the dies 54 and 56 are relatively closed, one on the other. Movement of the handles from the relatively open position to the relatively closed position is limited by a pin 55 similar to the previously-described pin 38 and supported from the body in like fashion, the pin 55 being engageable by the handle 51. It will be understood from the foregoing that when the handles are opened under the influence of the spring 67, the holding pawls 70 effectively inhibit reverse rotation of the cam 60 while the driving pawls 69 ride over teeth of the ratchet 61. It will be appreciated from the foregoing that the operation of the hand tool shown in FIGS. 6 through 9 is much the same as that of the form of FIGS. 1 through 5.

Some of the differences between the two forms of the tool will be readily apparent. For example, the tool of FIGS. 6 through 9 differs in that it is not a reverse-handle tool and differs also in that the spring which effects retraction of the ram also biases the pivoted handle carrying the driving pawls to a relatively open position.

While only two forms of the hand tool have been illustrated and described, it will be apparent 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 spirit 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 providing a handle portion at one end thereof and having in fixed relation to the other end thereof a head portion having a work-engaging and -forming part, a ram mounted for sliding movement in the body toward and away from said work-engaging and -forming part in a direction lengthwise of the body and having a work-engaging and -forming part for cooperation with the first-mentioned such part, a handle pivoted to the body, ratchet and cam means rotatably supported on the body in coaxial and angularly fixed relation to one another, which on angular movement from one position to another, drives said ram by said cam means to an extended position for cooperation of said work-engaging and -forming parts, a spring connected to said handle and to said ram acting to bias the ram to a retracted position and said handle in one direction relatively to said handle portion, and pawl means carried by said handle for cooperation with said ratchet means, whereby relative motion of said handle and handle portion in the other direction affects

said extension of the ram for effecting an operation on a workpiece disposed between said work-engaging and -forming parts, and permits separation of the last-mentioned parts on retraction of the ram.

2. In a hand tool, the combination of an elongated body providing a handle portion at one end thereof and having in fixed relation to the other end thereof a head portion having a work-engaging and -forming part, a ram mounted for sliding movement in the body toward and away from said work-engaging and -forming part in a direction lengthwise of the body and having a work-engaging and -forming part for cooperation with the first-mentioned such part, a pivot member rotatably supported in the body for angular adjustment thereof and having means to secure the member in the body in angularly adjusted position, the last-mentioned member having an eccentric pin part thereof movable toward and away from the first-mentioned work-engaging and -forming part on angular adjustment of said pivot member, a handle swingably mounted on said pin part, ratchet and cam means rotatable on said pin part in coaxial and angularly fixed relation to one another, which on angular movement from one position to another, drives said ram by the cam means to an extended position for cooperation of said work-engaging and -forming parts, means to retract the ram when permitted by further angular movement of the cam means, and pawl means carried by said handle for cooperation with said ratchet means, whereby relative motion of said handle and handle portion in one direction affects said extension of the ram for effecting an operation on a workpiece disposed between said work-engaging and -forming parts, and permits separation of the last-mentioned parts on retraction of the ram, and said pivot member on angular adjustment thereof being effective to vary the travel of the ram.

3. A hand tool as defined in claim 2 wherein said handle is pivoted to the body at the end portion thereof remote from the head portion and has an end approaching said head portion.

4. A hand tool as defined in claim 2 wherein the handle is pivoted to the body adjacent the end of the handle portion thereof nearest said head portion, and the other end of the handle extends away from the head portion.

5. A hand tool as defined in claim 4 wherein said means to retract the ram comprises a single tension spring having one end thereof in fixed relation to the ram and having the other end thereof fixed to said handle, said spring also serving to bias said handle in a direction opposite said one direction of movement thereof.

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